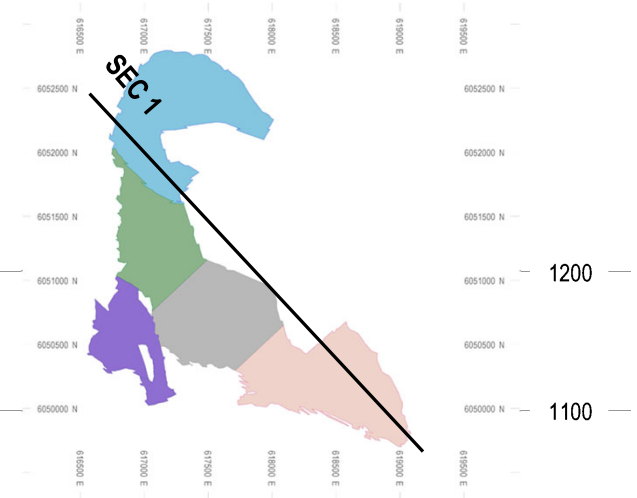
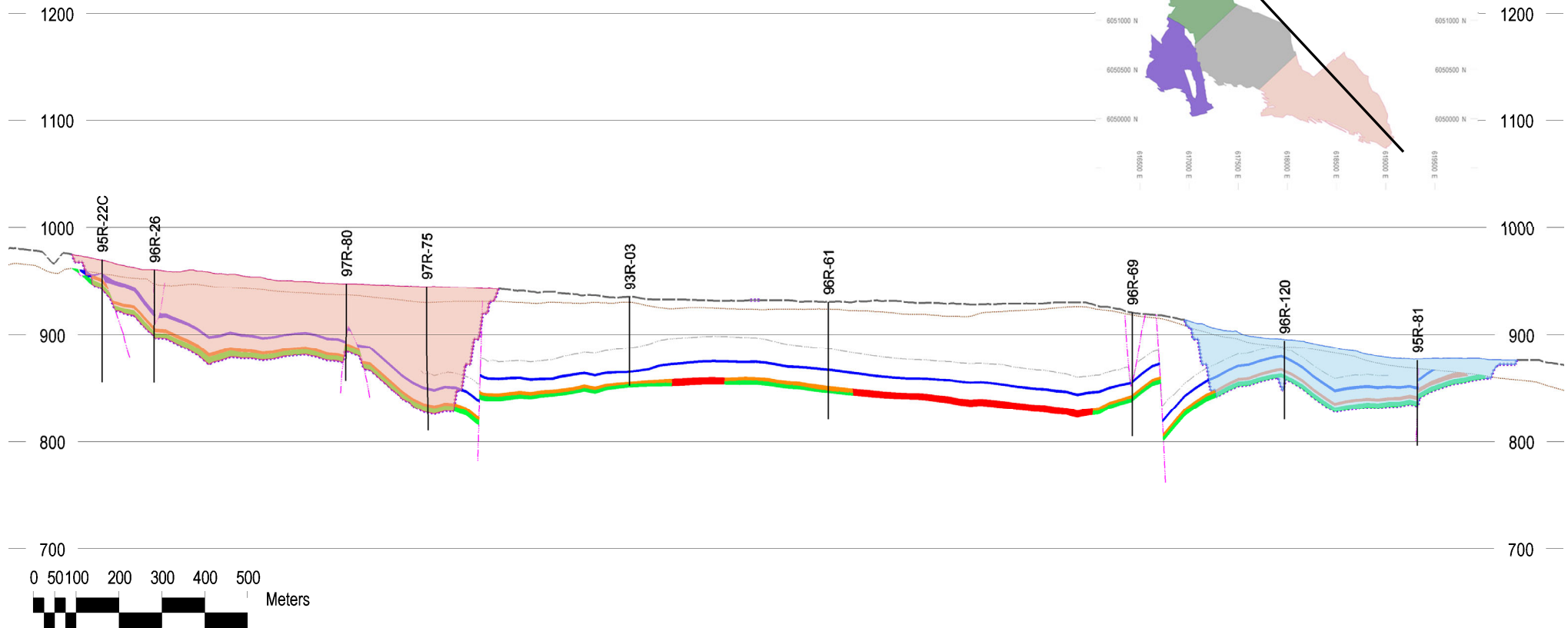


SEC 1

STRIKE: 317.00
DIP: 90.00



Legend

- | | | |
|---|--|--|
|  Central North Phase |  Coal Seam 1 |  Drill Hole |
|  Central South Phase |  Coal Seam 1L |  Fault |
|  North Phase |  Coal Seam 1U |  Overburden Contact |
|  South Phase |  Coal Seam C |  PAG Rock Contact |
|  Start Phase | |  Surface Topography |

Tenas Project

Open Pit longitudinal section 1

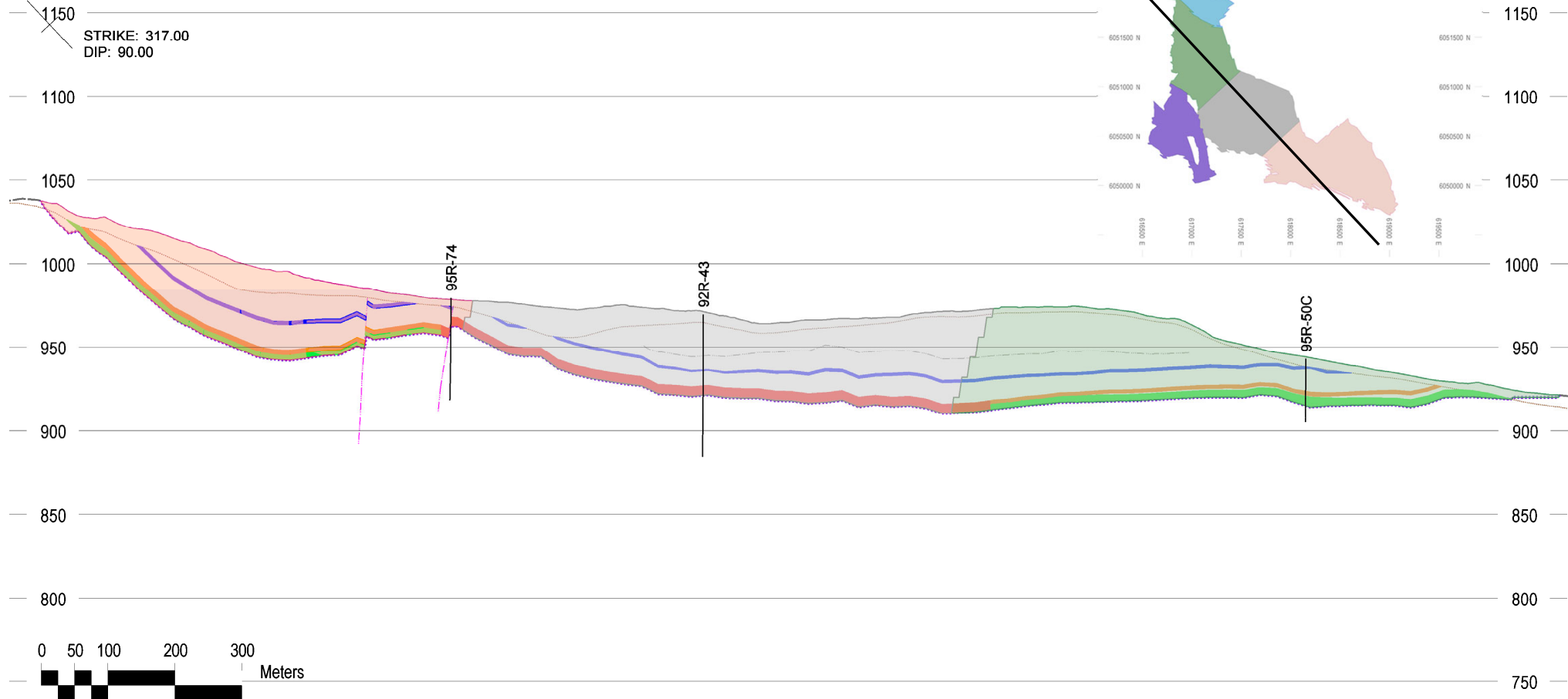
Vertical Exaggeration 2.5 Vertical to 1.0 Horizontal

Figure 1.11-16

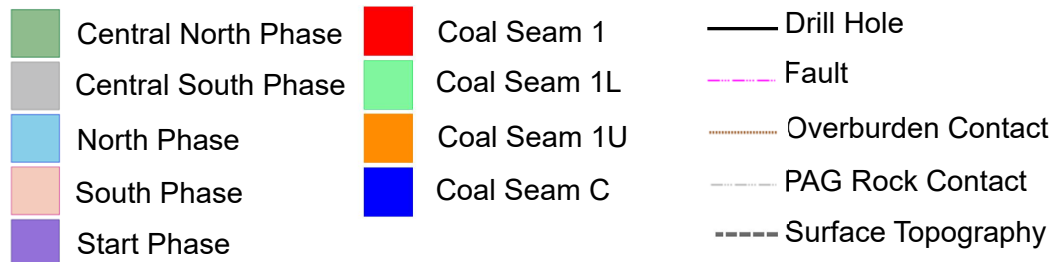


SEC 2

STRIKE: 317.00
DIP: 90.00



Legend



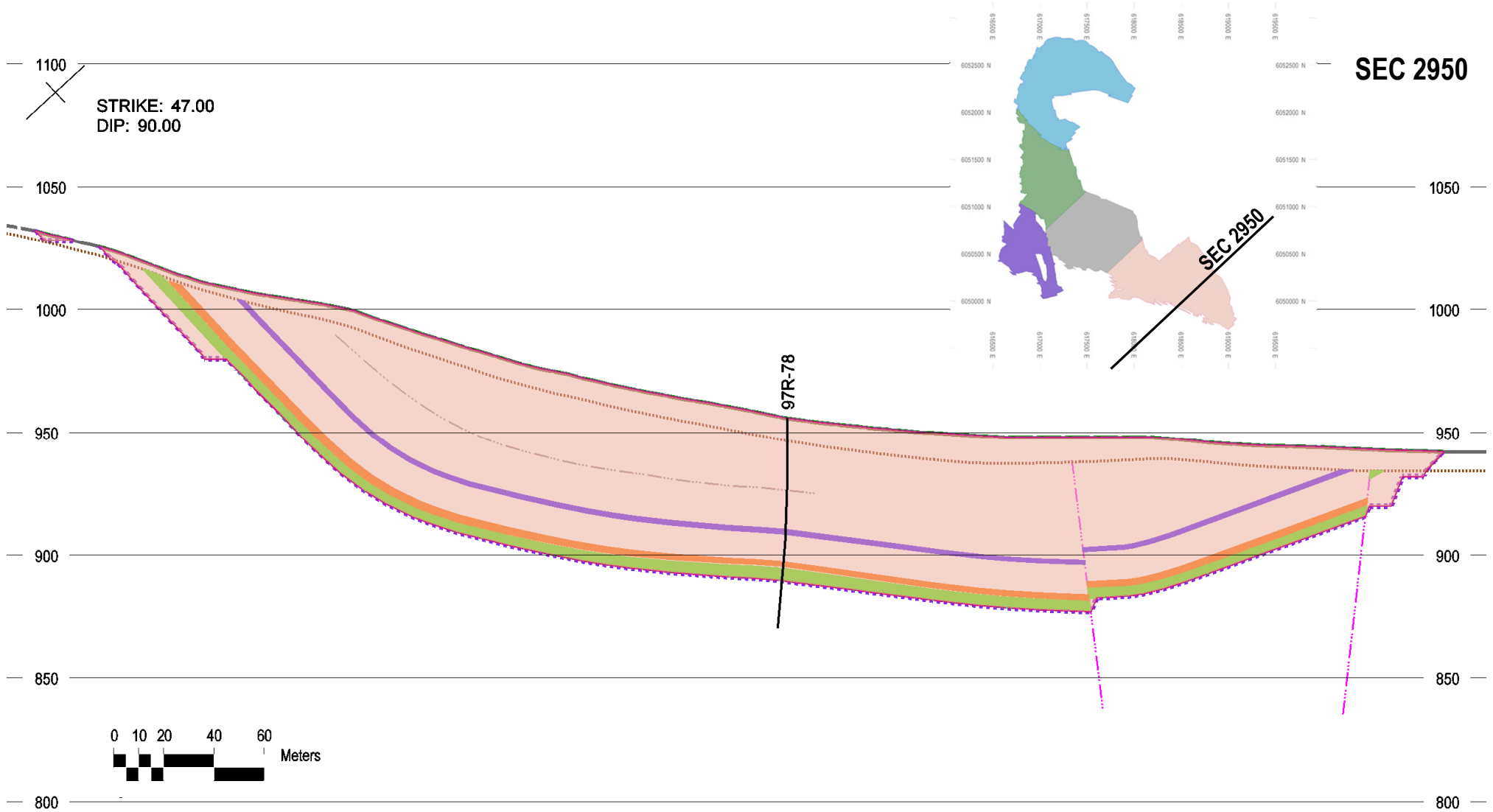
Tenas Project

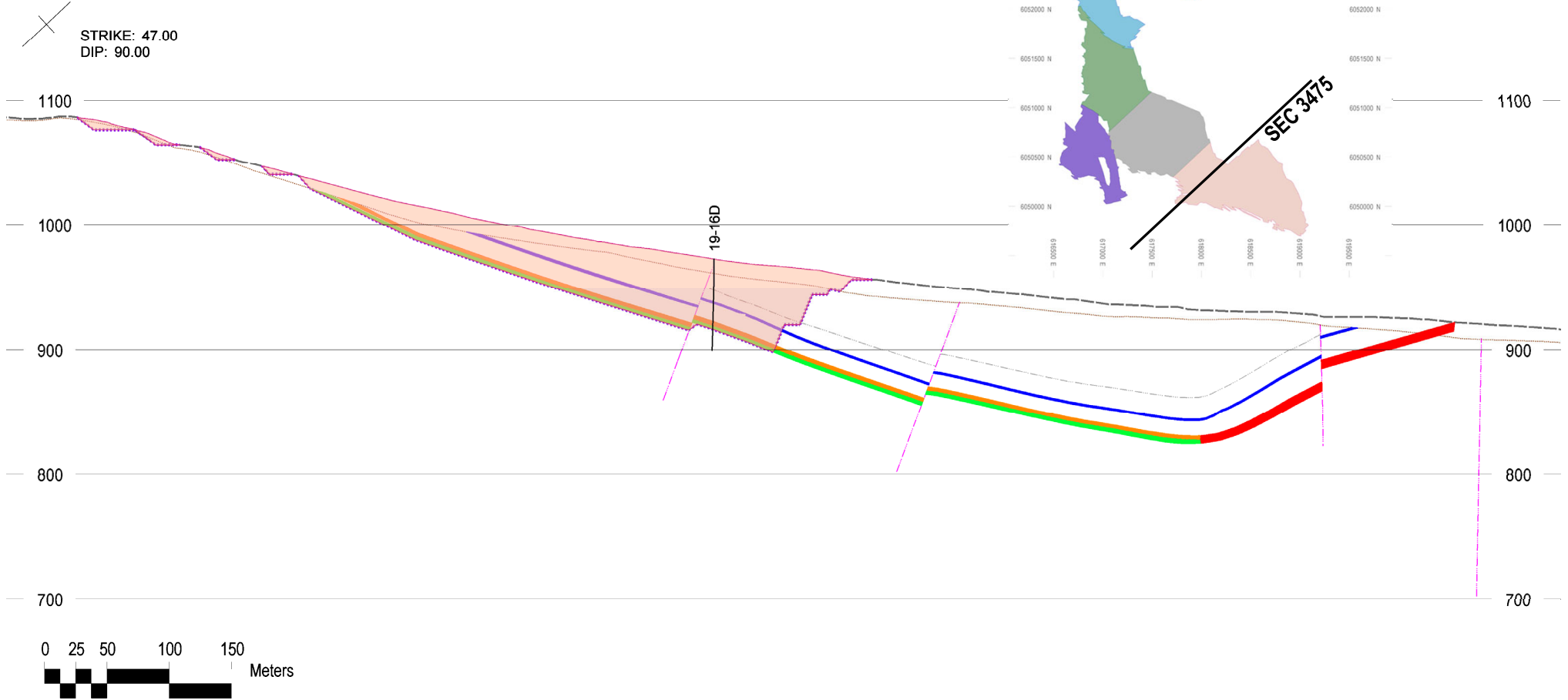
Open Pit longitudinal section 2

Vertical Exaggeration 2.5 Vertical to 1.0 Horizontal

Figure 1.11-17







Legend

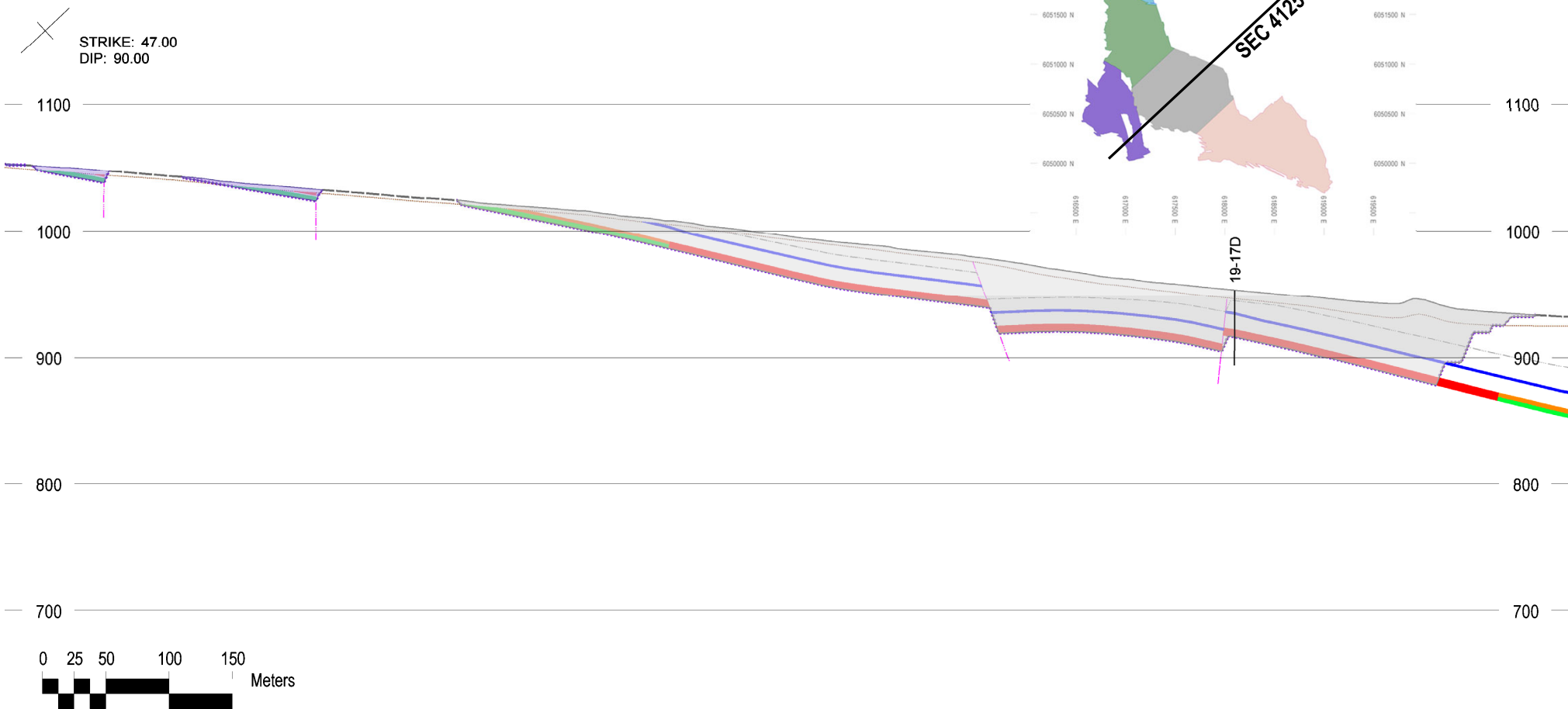
	Central North Phase		Coal Seam 1		Drill Hole
	Central South Phase		Coal Seam 1L		Fault
	North Phase		Coal Seam 1U		Overburden Contact
	South Phase		Coal Seam C		PAG Rock Contact
	Start Phase				Surface Topography

Tenas Project

Open pit cross section 3475

Figure 1.11-19





Legend

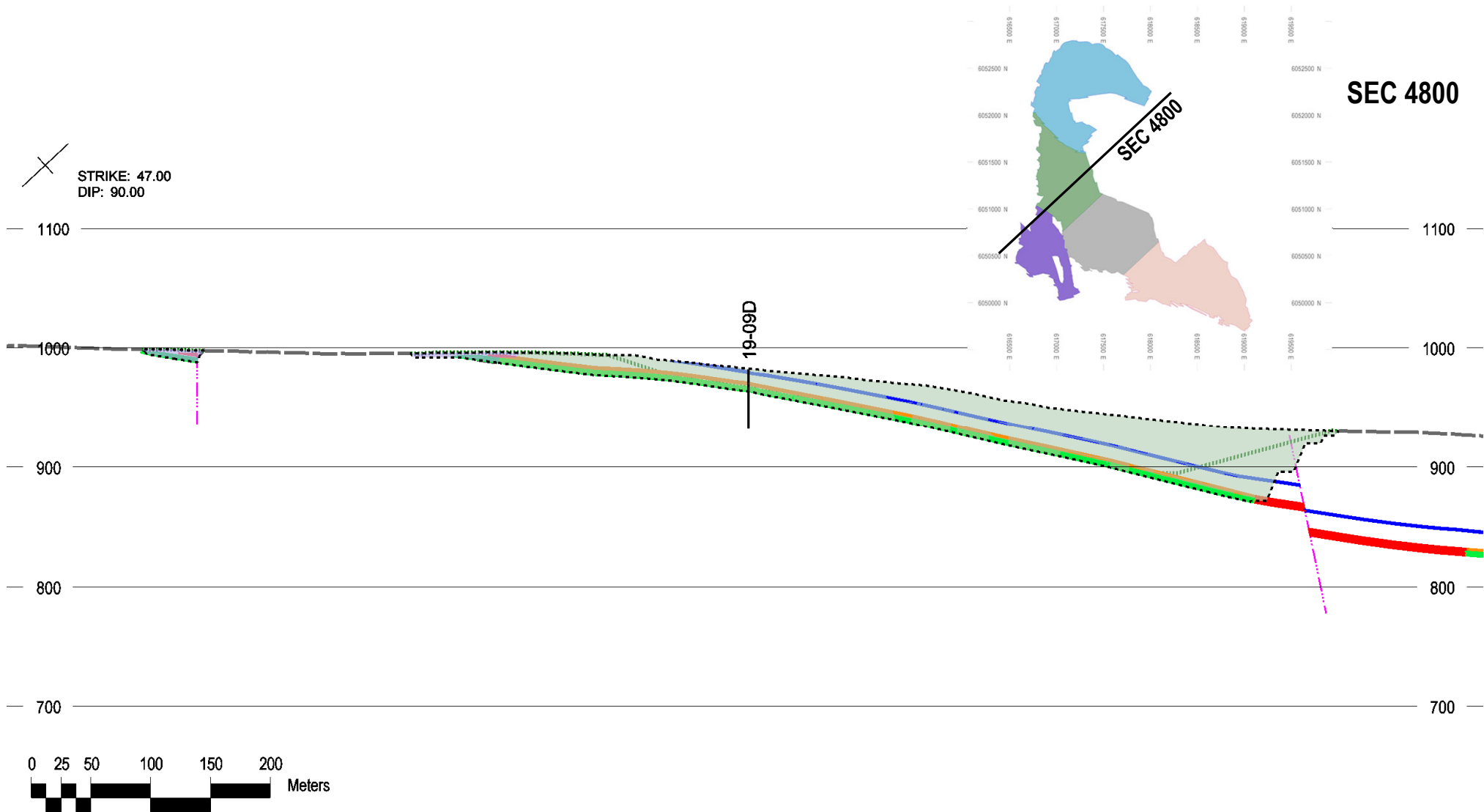
	Central North Phase		Coal Seam 1		Drill Hole
	Central South Phase		Coal Seam 1L		Fault
	North Phase		Coal Seam 1U		Overburden Contact
	South Phase		Coal Seam C		PAG Rock Contact
	Start Phase				Surface Topography

Tenas Project

Open pit cross section 4125

Figure 1.11-20





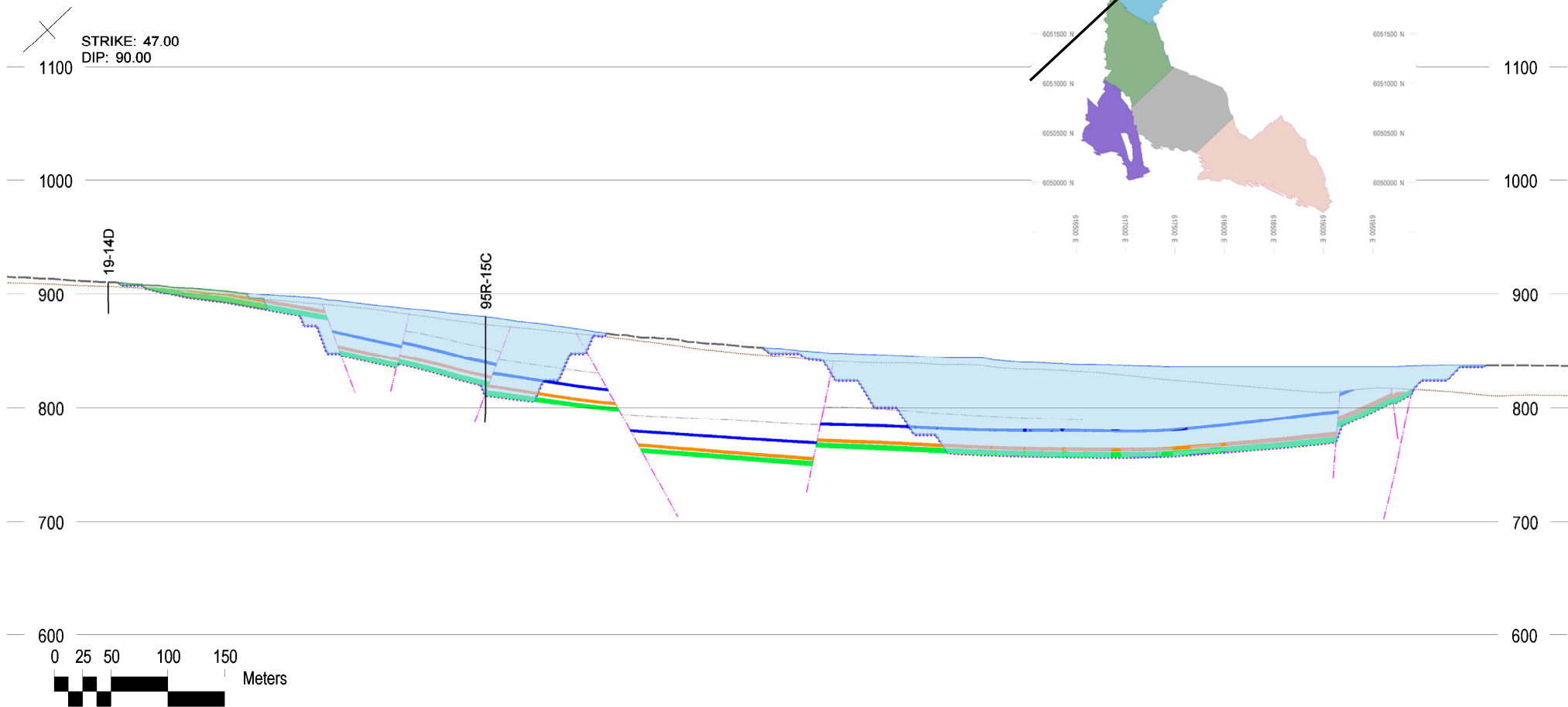
Legend

	Central North Phase		Coal Seam 1		Drill Hole
	Central South Phase		Coal Seam 1L		Fault
	North Phase		Coal Seam 1U		Overburden Contact
	South Phase		Coal Seam C		PAG Rock Contact
	Start Phase				Surface Topography

Tenas Project

Open pit cross section 4800

Figure 1.11-21



Legend

Central North Phase	Coal Seam 1	Drill Hole
Central South Phase	Coal Seam 1L	Fault
North Phase	Coal Seam 1U	Overburden Contact
South Phase	Coal Seam C	PAG Rock Contact
Start Phase		Surface Topography

Tenas Project

Open pit cross section 5400

Figure 1.11-22

1.11.4.1 *Open Pit Phase Definition*

For the selecting open pit phases, the following parameters are used to determine the optimum phase sequence:

- ▶ strip ratio;
- ▶ coal seam dip;
- ▶ material management; and
- ▶ related mining conditions (as provided below).

The mining conditions are as follows:

- ▶ For seam dips less than or equal to 9 degrees; cuts (5 m seam drop) can be double-lane width;
- ▶ For seam dips between 9 degrees and 13 degrees, only single lane access in 5 m cuts are possible;
- ▶ For seam dips between 13 degrees and 22 degrees, single lane cuts can mine a cut representing a 12 m drop in coal seam elevation; and
- ▶ For seam dips greater than 22 degrees, the "bottom-up" method no longer applies and more conventional "top-down" bench mining is adopted.

These differences in seam dips are used to define phases, whereby a given phase consists of a prevalent range of seam dips as illustrated by **Figure 1.11-23**. Based on this information about seam dips, the main open pit phases were determined. They are illustrated by **Figure 1.11-24**.

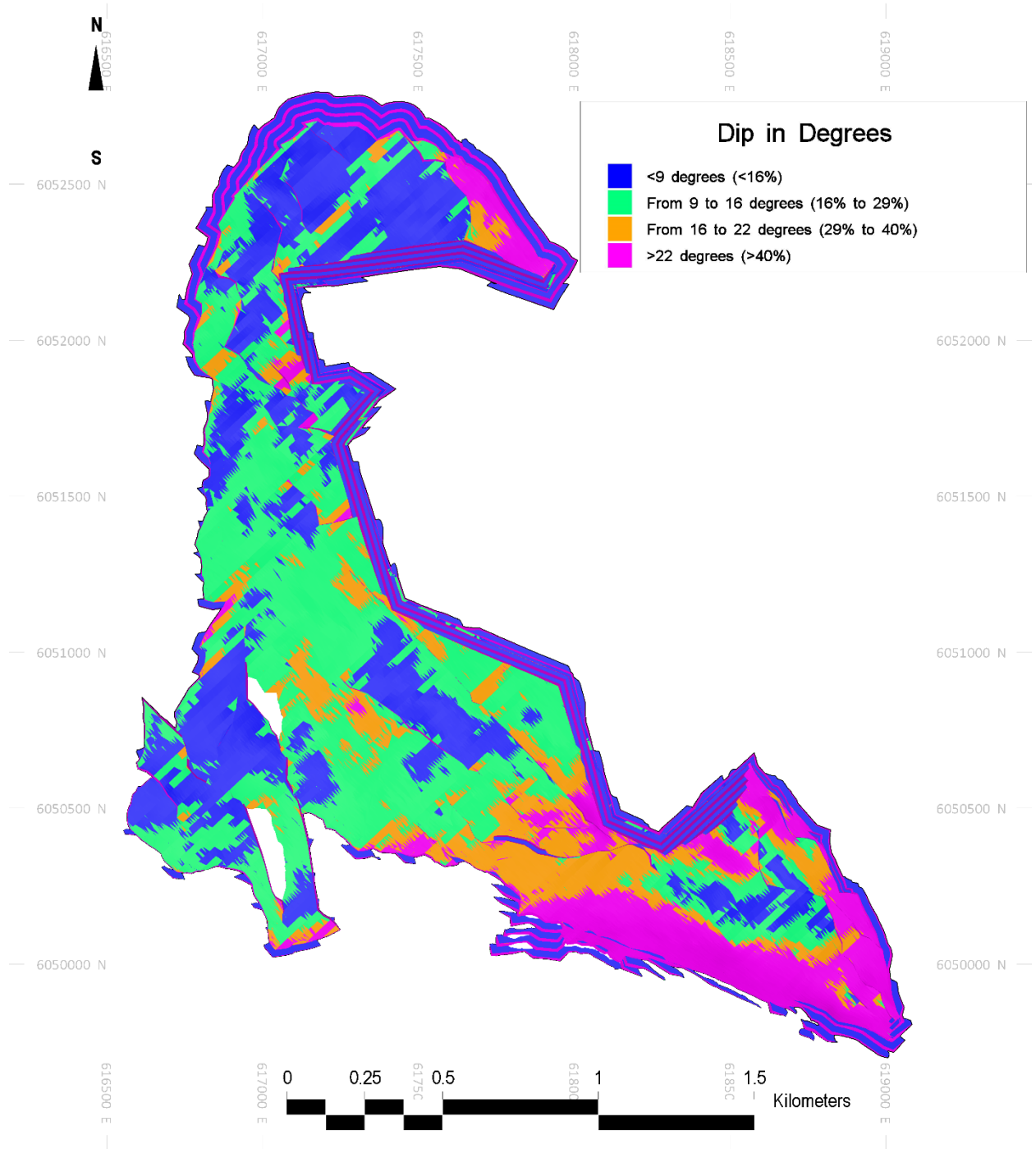


Figure 1.11-23: Deepest coal seam dips within the environmental assessment (EA) open pit

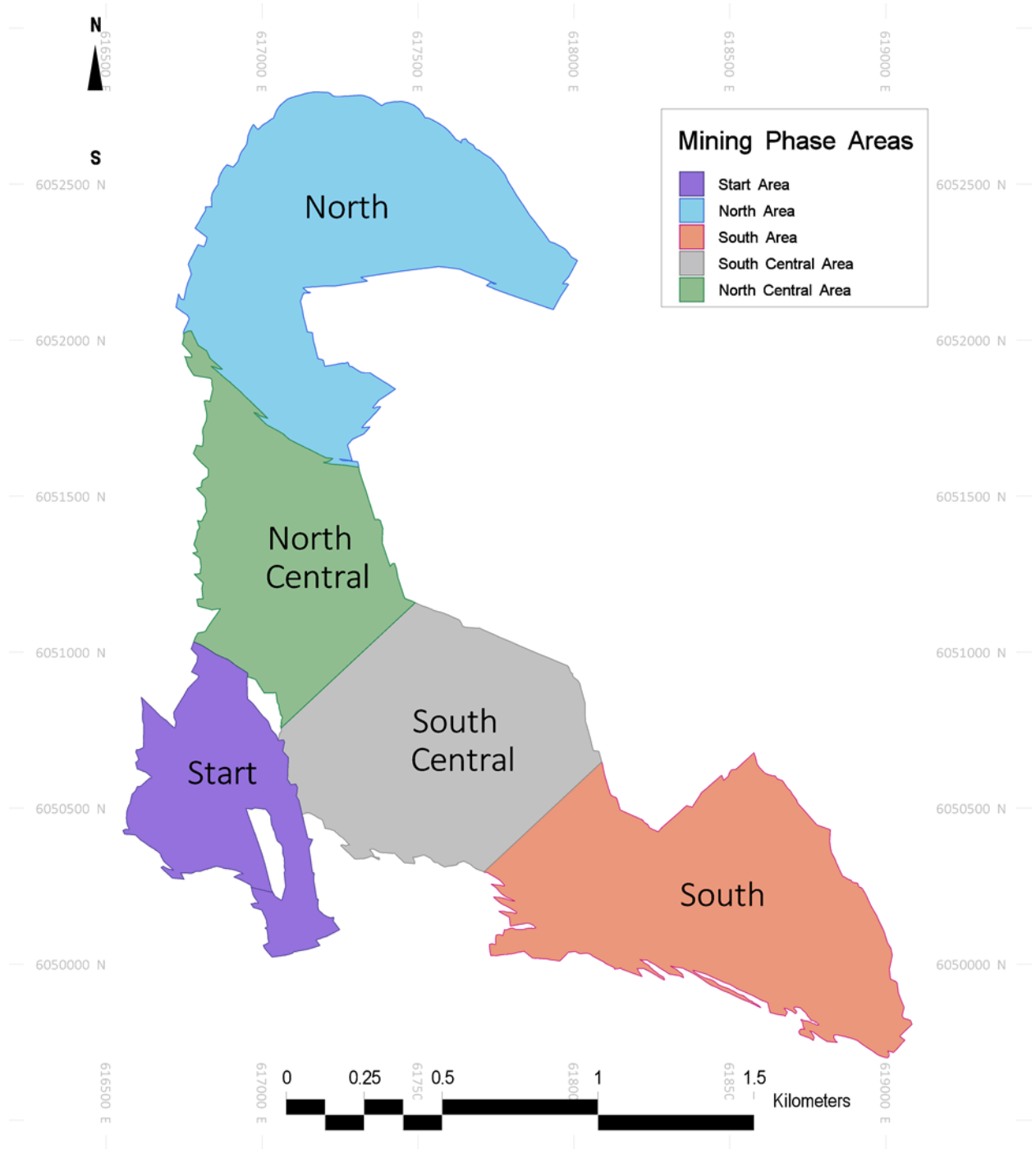


Figure 1.11-24: Environmental assessment (EA) open pit phases

1.11.4.2 *Cut Definition for Open Pit Phases*

In the bottom-up or conventional top-down mining method, cuts are defined by the strike and dip of the coal seams. For an orderly development of the reserve, a consistent bench interval is selected on which to base cuts. After analysis of seam dips, mining widths, and excavator digging depth and reach, it was judged that a 4-m bench interval would work best. This works well in all the above seam dip ranges for "bottom-up" and "top-down" mining. With the steeper dips however, it is necessary to undercut the material wedge to reach coal.

Another consideration for cut definition is the juxtaposition of Seam C mining and Seam 1U and/or 1L and/or 1 mining. It has been established that these coal seam horizons should be mined separately as different cuts, and that the separation of these cuts is dependent on the local seam dip within the cut. In scheduling though, these coal horizons are mined as close together as possible. In other words, Seam C mining does not advance more than the required cuts adjacent to the Seam 1 mining. **Figure 1.11-25** illustrates the proposed mining cuts for the Project.

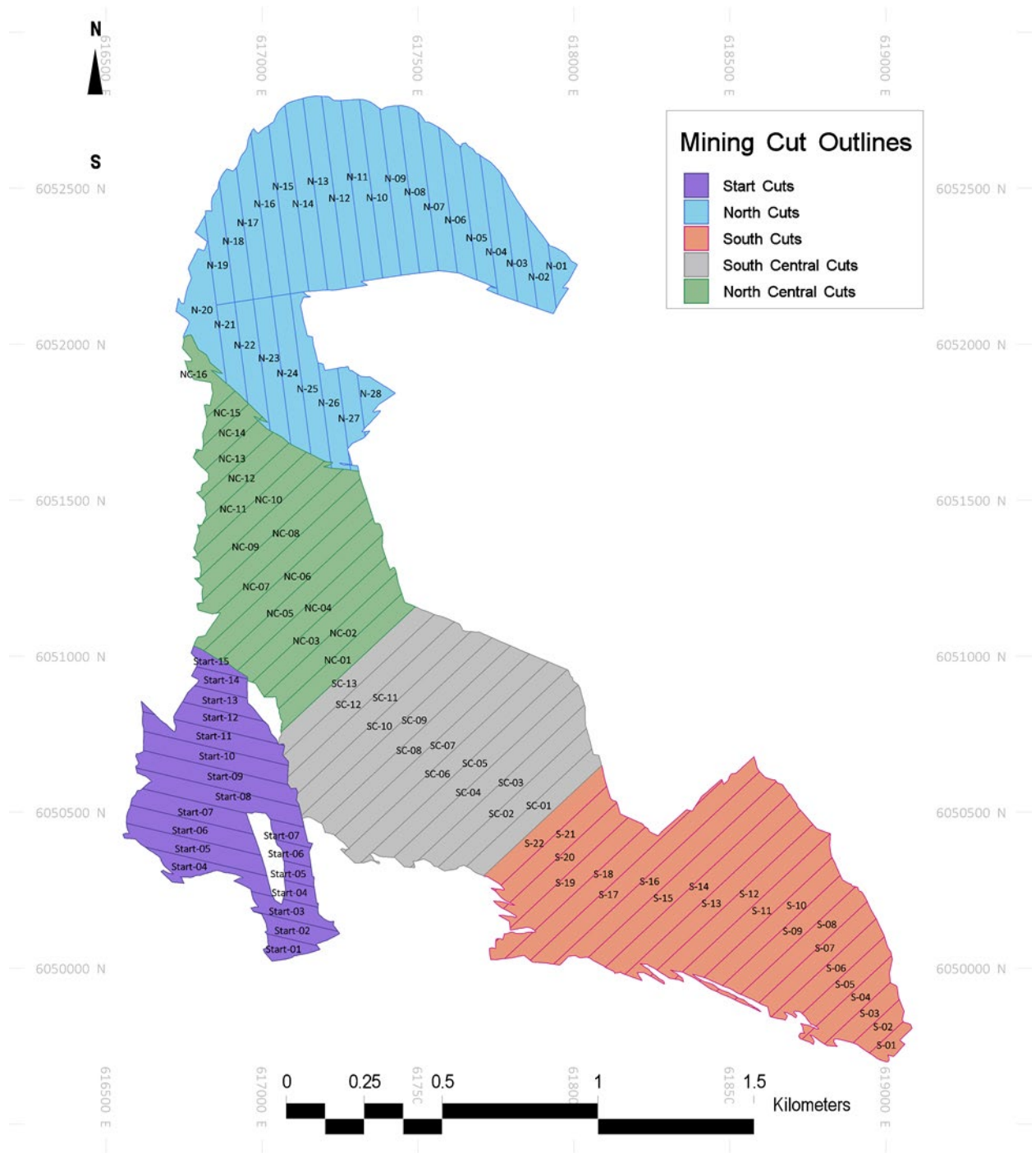


Figure 1.11-25: Environmental assessment (EA) open pit showing mining cuts for phases

1.11.4.3 *Open Pit Water Management*

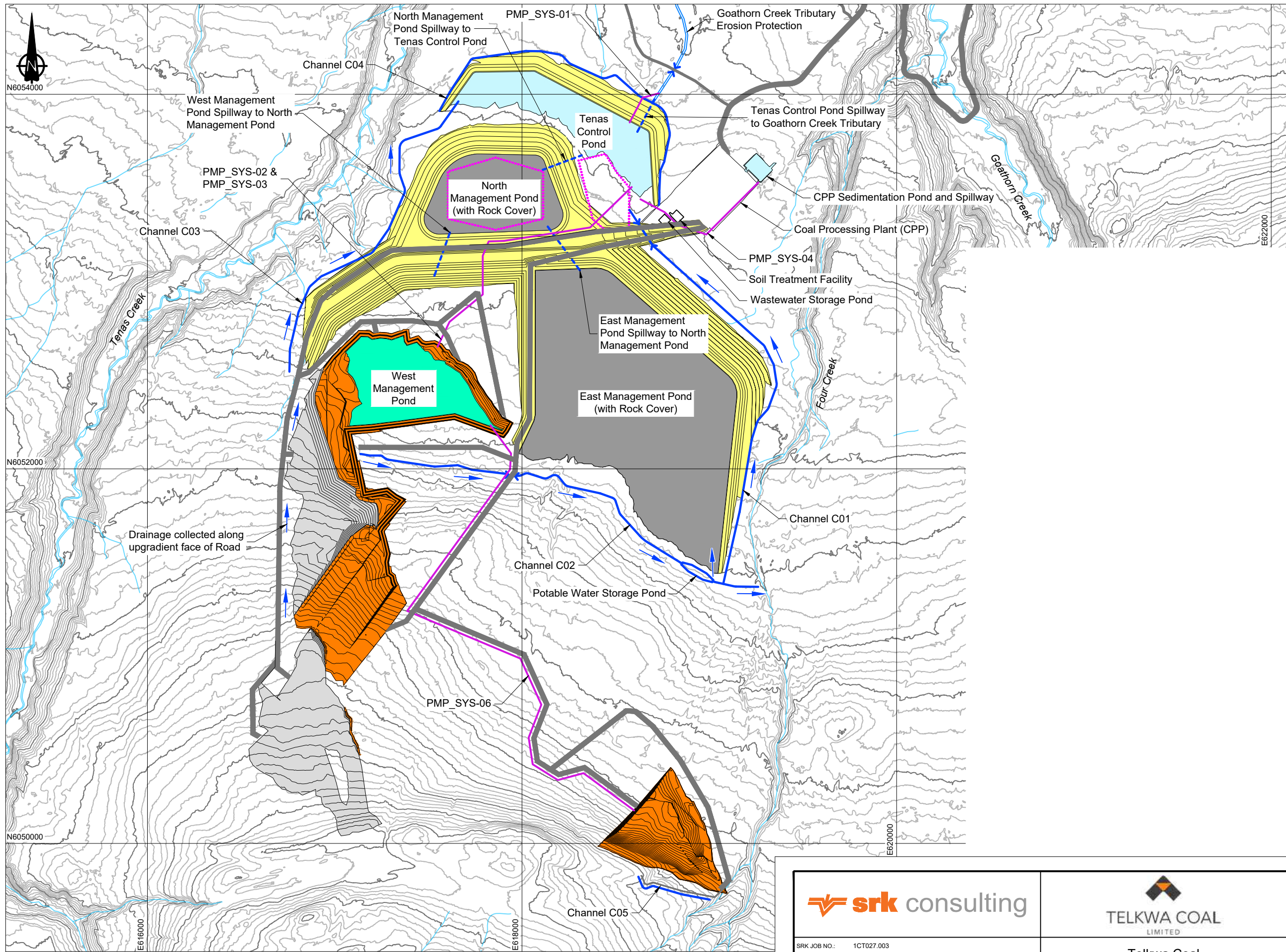
Section 1.17 Water Management provides an overall description of surface water management for the entire Project while this subsection only focusses on the open pit component.

1.11.4.3.1 *Surface Water*

There is a diversion channel in the very south end of the open pit that diverts a tributary of Four Creek around the south end of the open pit thereby preventing this non-contact water from getting affected by mining which is identified as C05. There is another diversion channel south of the northern end of the open pit to intercept the non-contact water that would otherwise go into this region of the open pit which is identified as C02.

Figure 1.11-26 illustrates the location of these surface water diversion channels. The open pit will require a mobile diesel pump system and pipe network to deal with expected surface water flows from direct precipitation and snow within the area of the open pit. This system has been designed to deal with a 1 in 2-year event or approximately 10,900 m³ per day, with any larger events required open pit operations to move to higher areas in the open pit to allow the lower portions to temporarily flood. Supplemental pumps will be available onsite to install to assist with up to 1 in 5-year rainfall events up to 17,500 m³ per day if required.

\\ark-adf\share\env\Projects\01_SIT\SIT\Telkwa Coal\040_AutoCAD\Water Management\Mine Plan Progression\1CT027.003 EOY 10.dwg



LEGEND

- Water Management Feature
- Water Flow Direction
- Spillway
- Culvert
- Existing Watercourse
- Pipeline
- Proposed Road
- Dam and Butress
- Pit Excavation
- Sedimentation and Control Pond
- Active Management Pond
- Backfill / NAG Pile
- Rock Cover
- Topsoil Stockpile

NOTES

- Contours shown at 5.0m intervals.
- All dimensions shown in meters unless otherwise stated.
- West Management Pond is active and encompasses the northern extents of the open pit. All PAG rock and processed rock to be placed in West Management Pond.
- Non-PAG rock and overburden cover placed across final PAG rock surface in East Management Pond. Final surface is vegetated and spillway upgraded to closure design.
- Non-PAG rock placed as backfill in open pit.
- All runoff collected in open pit areas pumped to West Management Pond.
- Channel C05 is constructed prior to open pit mining in southeastern region of Project footprint.
- PMP_SYS-05 to be installed at Explosive Magazine, Explosive Facility and Rail Infrastructure Sedimentation Pond to discharge nominal flows up to 1 in 10-year event to downstream environment.

REFERENCE

NAD83 UTM Zone 9.



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SRK JOB NO.: 1CT027.003
FILE NAME: 1CT027.003 EOY 10.dwg

TELKWA COAL
LIMITED

Telkwa Coal

Environmental Assessment

Surface water diversion channels
C05 and C02

DATE:
2021/07/16

APPROVED:
SAB

FIGURE:
1.11-26

1.11.4.3.2 *Groundwater*

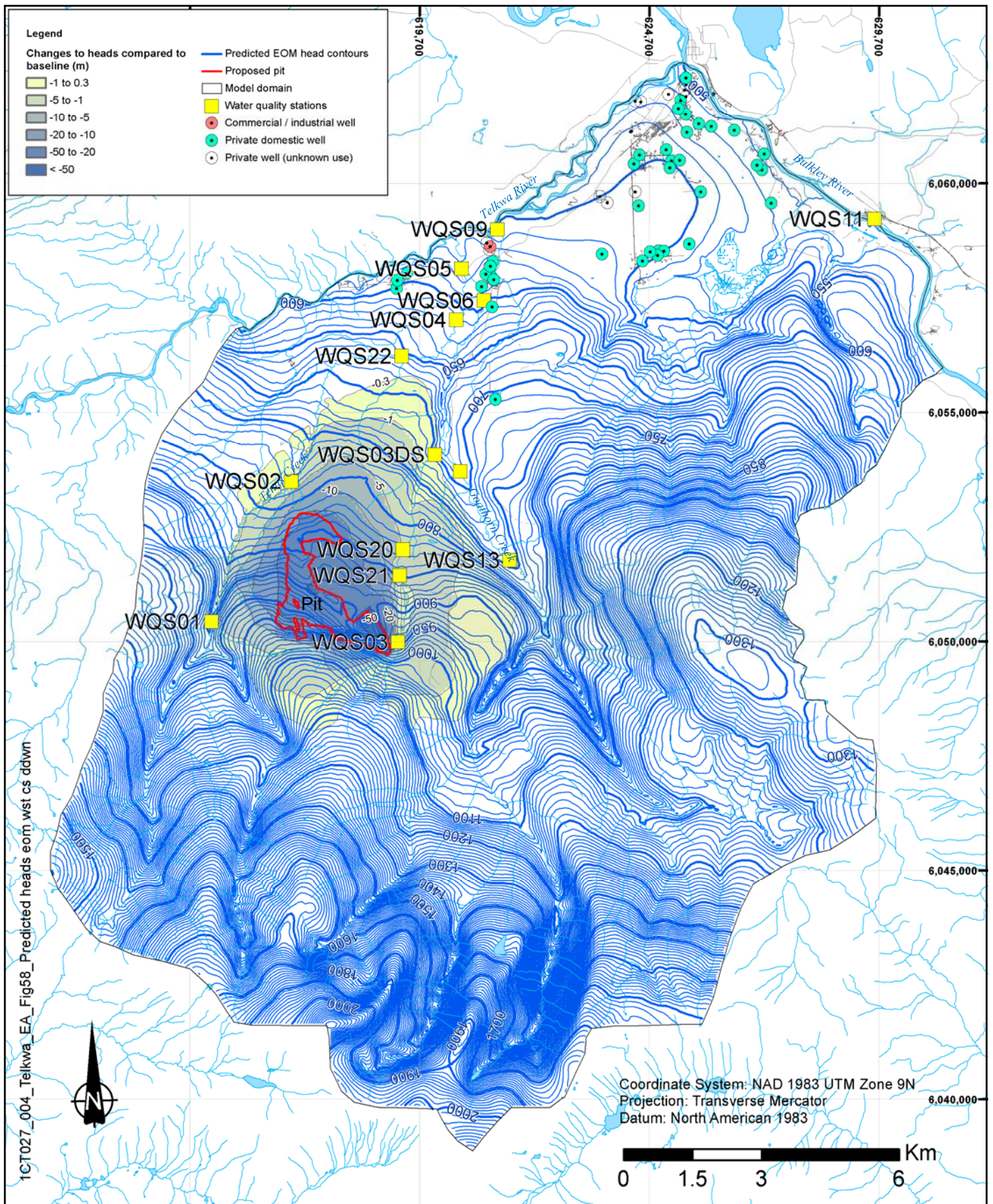
Based on the hydrogeologic investigations conducted, dewatering wells are not required for the open pit as it is relatively shallow, and the groundwater system will not result in unmanageable water quantities faced in the open pit by mining operations. The mobile diesel pump system specified for handling surface water inflows is sufficient to deal with anticipated groundwater inflows. Mining will require sumps to be constructed for subsequent bench elevations to pre-drain future benches.

The predicted maximum drawdown zone from open pit development is provided by **Figure 1.11-27**.

At this time, no slope depressurization wells are planned to be installed in the open pit walls to meet stability requirements.

The volume of groundwater to be dewatered on an annual basis at the maximum open pit shell extents and depth is estimated 550 m³.

The pumped water from the open pit will be discharged directly into the North Management Pond and/or East Management Pond and/or West Management Pond depending on which is active at the time of open pit dewatering. Effects to the Surface Water VC and Groundwater VC and related effects to aquatic and terrestrial receptors is discussed in **S4.0-C3 and S4.0-C4** of this **EAC Application**.



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TELKWA COAL
LIMITED

**Maximum groundwater drawdown
zone from environmental assessment
(EA) open pit development**

Job No: 1CT027.004

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Tenas Project

Date:
Dec 2020

Approved:
GF

Figure:
1.11-27

1.11.4.4 Open Pit Reserves

The inputs and/or modifying factors to convert Project resources to reserves include:

- ▶ topography;
- ▶ geological block model;
- ▶ coal reserve classification (proven or probable);
- ▶ coal type definition;
- ▶ coal loss and dilution assumptions and extraction assumptions;
- ▶ raw coal ash and density;
- ▶ ROM coal moisture; and
- ▶ rehandle and outside of the open pit mining material factors.

A summary of Reserves is provided in **1.11.4.4.3** below.

1.11.4.4.1 Topography

The topography file, 2019 topo surface.dxf was generated by James Henderson who is TCL's Senior Mine Engineer. It was based on the Lidar (Light Detection and Ranging) flyover conducted in 2018 for the Project and was used as the basis of the geological model and mine planning. The accuracy of this topography is +/- 0.10 m in the vertical direction and +/- 0.05 m in the northing and easting directions.

1.11.4.4.2 Geological Block Model

The multi-ore percent coal geological block model file, tn15v2.dat, generated by Ron Parent, P.Geo., who is TCL's Chief Geologist, was used for mine design. The geological model was developed on a sectional basis with blocks oriented along strike to match the sectional volumes and has x, y, z dimensions of 25 x 5 x 5 m. See **Figure 1.11-28** which shows probable reserves and proven resources over the Tenas Deposit.

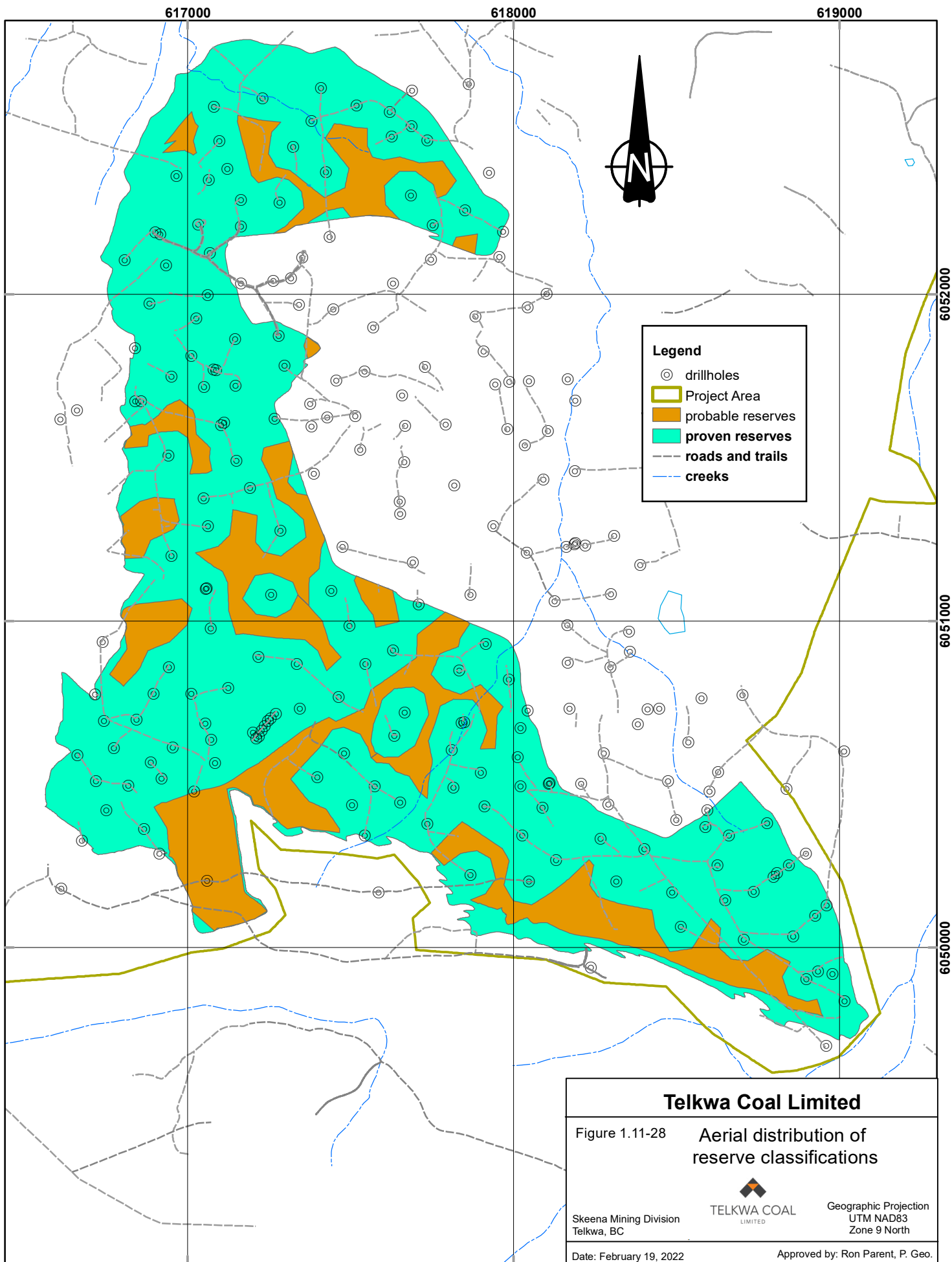
1.11.4.4.3 Coal Reserve Classification

To classify the Reserves, the following parameters (which are the same as the Resource definition criteria) in **Table 1.11-8** below were applied.

Table 1.11-8: Tenas Project Reserve Classification Parameters

Reserves		
Spacing Between	Structural	Quality
Data Points (m)	Data Point	Data Point
Proven	<75 m	<150 m
Probable	<150 m	<300 m
Unclassified	>150 m	>150 m

Note: >=greater than; <=less than; m=metre



1.11.4.4.4 Coal Type Definition

At the Project, there are two (2) distinct types of insitu and/or ROM coal defined by the coal's FSI:

- ▶ oxidized metallurgical coal is defined as coal that has an FSI <1; and
- ▶ metallurgical coal is defined as coal with an FSI >1.

These FSI values were equated to depths below surface based on an oxidization study done during the exploration program. **Table 1.11-9** below illustrates the depths used for the various coal types.

Table 1.11-9: Coal Type Definition for the Tenas Project

Coal Type	Oxidized Metallurgical Coal	Metallurgical Coal
Coal Seam	Depth Below Bedrock (m)	Depth Below Bedrock (m)
c	< 2.5	> 2.5
1U	< 2.5	> 2.5
1L	< 2.5	> 2.5
1	< 2.5	> 2.5

Notes: >=greater than; <=less than; m=metre

Currently the oxidized metallurgical coal tonnages have not been included into the recoverable tonnage values for the reserves of the open pit but have been added to the PAG rock volumes for the open pit. There is approximately 0.746 million m³ of oxidized metallurgical coal or 1.164 Mt that might be able to be recovered during the Operation Phase depending on market requirements and actual bench scale oxidation measurements.

1.11.4.4.5 Coal Loss and Dilution Assumptions, Extraction Assumptions

A key input to determining reserves at the Project is to determine coal losses and dilution associated with each coal seam. Coal losses are due to the actual efficiency of mining equipment at recovering the individual coal seam. Dilution gains are due to the unintended mixing of hanging and/or footwall rock with the coal seam. These parameters vary with the size of equipment utilized to recover the individual coal seam, the dip of the coal seam, the competency of the hanging and footwall rock, the competency of the coal seam, whether through seam blasting, will be practiced and the sharpness of the contact between the clastic roof and floor and the coal seam. For the Project these parameters are:

- ▶ The equipment size for recovering coal will be medium, i.e., a 12 m³ bucket excavator will be used for handling coal;
- ▶ The seam dip ranges between 0 and 45 degrees;
- ▶ The hanging wall is competent for all coal seams, and the footwall is also competent for all coal seams. Coal seams in general are reasonable competent;
- ▶ Through-seam blasting will not be generally practiced at the Project except for the c Seam where it has a dip greater than 13 degrees but less than 40 degrees;
- ▶ The contact between the hanging wall (roof) and the coal seams is sharp on all coal seams; and
- ▶ The contact between the footwall (floor) and coal seams is sharp on all coal seams.

Based on the above information the following loss and dilution values will be used at the Project as summarized by **Table 1.11-10** below.

Table 1.11-10: Dilution and Loss Parameters

Item	Assumption
Dilution	0.20 m per seam - non blasted 0.40 m per seam - blasting
Coal Loss	0.20 m per seam - non blasted 0.40 m per seam - blasting
c Seam through Seam Blasting	When seam dip is greater than 13 degrees but less than 40 degrees
Separable Rock Parting	≥ 0.20 m in thickness
Dilution Ash	80.0% (db)
Dilution Bulk Density	2.50 tonnes / m ³ (db)

Notes: ==equal; >=greater than; <=less than; %=percent; db=dried basis; m=metre; m³=cubic metres

The Project has not begun operations, however BMPs will be used for coal recovery and an extraction factor of 100% is currently assumed. Once the mine is in operation this factor may need to be modified based on coal tonnage reconciliations completed by the operation.

1.11.4.4.6 Run-of-mine (ROM) Coal Ash and Density

ROM ash values are calculated based on the insitu ash values provided previously and are summarized in **Tables 1.11-11** and **1.11-12** below for each coal seam. The calculation of ROM ash is based on the following methodology:

$$\text{ROM Ash} = \frac{(\text{insitu coal thickness} - \text{coal loss}) * \text{insitu coal density based on insitu ash} * \text{coal insitu ash} + \text{dilution} * \text{dilution density} * \text{dilution ash}}{(\text{insitu coal thickness} - \text{coal loss}) * \text{insitu coal density based on insitu ash} + \text{dilution} * \text{dilution density}}$$

Using the following values for coal:

- ▶ coal thickness = 2.0 m; and
- ▶ insitu ash = 15.0%.

The equation becomes:

$$\begin{aligned} &= (2-0.1) * 1.4 * 15 + 0.1 * 2.5 * 80 / ((2-0.1) * 1.4 + 0.1 * 2.5) \\ &= 39.9+20 / (2.66+0.25) \\ &= 20.58\% \end{aligned}$$

ROM ash values are calculated based on the insitu ash values previously provided in **1.8.3 Project Resources** and are summarized for each coal seam in **Tables 1.11-11** and **1.11-12** below.

Table 1.11-11: Run-of-mine (ROM) Ash Values (Air Dried Basis [adb]) for Coal Seams for the Project Open Pit

Coal Seam	Rom Ash (adb)
c	32.3%
1U	24.1%
1L	22.6%
1	17.9%

Notes: %=percent; adb=air dried basis

Table 1.11-12: Run-of-mine (ROM) Ash Values (air dried basis [adb]) for Coal Seams for the Environmental Assessment (EA) Open Pit Phases

Coal Seam	Center South ROM Ash (adb)	Start ROM Ash (adb)	North ROM Ash (adb)	Center North Rom Ash (adb)	South Rom Ash (adb)
c	34.5%	29.2%	30.2%	33.1%	35.6%
1U	23.5%	24.1%	24.1%	23.7%	23.5%
1L	20.0%	24.8%	21.4%	23.8%	22.8%
1	18.6%	N/A	N/A	10.6%	15.2%

Notes: %=percent; adb=air dried basis

While the raw density was not actually used for ROM coal tonnage calculations, it can be calculated using the same relationship that was used for insitu bulk density calculations for resources.

ROM coal tonnage was calculated using the following equation:

$$\text{ROM coal tonnage} = \text{insitu coal tonnage} - \text{coal loss tonnage} + \text{dilution tonnage}$$

1.11.4.4.7 Run-of-mine (ROM) Coal Losses, Dilution, Extraction Factor, Moisture

A value of 5.0% has been assumed for ROM moisture which is inline with moisture values measured at other western Canadian metallurgical coal operations.

Once the Project is in the Operation Phase, sampling of actual moisture values for ROM coal will be completed, and this factor may need to be modified in the future.

Table 1.11-13 below summarizes the key assumptions and results for each coal seam for the overall open pit to allow for the calculation of reserves.

Table 1.11-13: Run-of-mine (ROM) Coal Dilution, Coal Losses, Extraction Factors, and Moisture

Seam	Insitu Moisture (adb) (%)	Dilution (m)	Coal Loss (m)	Extraction Factor (%)	ROM Moisture (%)
C (not blasted < 13 degrees)	0.85	0.20	0.20	100	5.0
C (blasted > 13 degrees)	0.85	0.40	0.40	100	5.0
1U	1.06	0.20	0.20	100	5.0
1L	0.89	0.20	0.20	100	5.0
1	0.95	0.20	0.20	100	5.0

Notes: < is less than; > is greater than; %=percent; adb=air dried basis; m=metre

1.11.4.4.8 Material Rehandle and Mining Material outside of the Open Pit Factors

In all open pit operations, there is some material that is unaccounted for in the design process that is involved with in-pit access ramps resulting in material rehandle and new bench access points resulting in ex-pit mining volumes. The more rigorous the design process the lower these volumes are, with 0.5% considered best practices. A value of 1.0% has been assumed at the Project as there is no history of mining operations onsite. No amount of additional material outside of the open pit has been included as the open pit design volumes has included all material for ramp and access development that is outside of the open pit design. The amount included for roads and ramp accesses is approximately 550,000 BCM.

1.11.4.4.9 Summary of Reserves

The following **Table 1.11-14** summarizes the available Proven and Probable Reserves at the Project as of December 31, 2021.

Table 1.11-14: Tenas Project Reserves as of December 31, 2021, with Coal Reserves Being NI 43-101 and JORC Compliant

Parameter	Units	Value
Reclamation materials (surface soils) within the Open Pit	BCM	886,910
Reclamation materials (surface soils) within the remainder of Project Area	BCM	1,376,965
Overburden excluding reclamation materials (surface soils)	BCM	21,409,301
Non-PAG rock not including rehandle	BCM	28,705,846
PAG rock	BCM	31,828,593
Road Construction (Overburden)	BCM	551,000
Rehandle (non-PAG rock)	BCM	815,726
Proven ROM Coal @ 5.0% moisture	tonnes	17,112,387
Probable ROM Coal @ 5.0% moisture	tonnes	4,903,218
Proven and Probable Processed Coal @ 10.0% moisture	tonnes	16,274,569

Parameter	Units	Value
CPP Yield	%	73.9%
ROM Coal Ratio	BCM: ROM tonnes	3.75
Processed Coal Ratio	BCM: Processed coal tonnes	5.07

Notes: @=at; %=percent; BCM=bank cubic metre; CPP=Coal Processing Plant; m³=cubic metres; non-PAG=non potentially acid generating; PAG=potentially acid generating; ROM=run-of-mine

1.11.5 Geohazards for Open Pit

The open pit for the Project is located on a shallow sloping plateau located between the Tenas and Goathorn creeks and is not subject to any geohazards due to adverse terrain. Furthermore, there are no large watercourses at the upslope end of the open pit that would cause mudflows and/or debris flows. Lastly with the shallow slope present the open pit area is not at risk from avalanches. Snow avalanches are addressed in the **Mine Emergency Response Plan (S13.0-C9) (MERP)** by a Hazard Assessment performed by a QP, as required by the the Health, Safety and Reclamation Code in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021) (Code). The conclusion is that the expected snow avalanches are of smaller magnitude than the guidelines provided in CAA (2016) indicating that an avalanche safety program is not required for the study area, given the current terrain and vegetation cover. The only hazards the open pit faces are the ones induced by excavating the open pit which are addressed through the geotechnical analysis conducted by SRK.

1.12 Haul Roads and Service Roads Within the Minesite

This subsection only covers the roads being constructed for mine equipment and the service roads to the Explosive Facility and the Explosive Magazine and around the MIC and accessing water management infrastructure. Please refer to **1.20** for a description of the TAC and it's associated details.

1.12.1 Haul Road Running Widths

Where two (2)-way or double-lane traffic is required, a running width of three (3) times the width of the largest truck will be used, while for one (1)-way or single lane traffic a width of two (2) times the width of the largest truck will be used. **Table 1.12-1** summarizes the running widths calculated for the Project.

Table 1.12-1: Haul Road Running Width Requirements

Haul Truck	Measured Width (m)	2 times truck width (m)	3 times truck width (m)	4 times truck width (m)	BC Code Requirement		TCL Standard Running Surface Widths		
					Single Width (m)	Double Width (m)	Single Width (m)	Double Width (m)	Corner Width (m)
777	6.7	13.4	20.1	26.8	13.4	20.1	15	20	22.5

Notes: BC=British Columbia; Code=Health, Safety and Reclamation Code in British Columbia (British Columbia Ministry of Energy, Mines and Low Carbon Innovation [BC MEMLI] 2021)); m=metre; TCL=Telkwa Coal Limited

1.12.2 Haul Road Corners and Switchbacks

All corners greater than 90 degrees in radius and switchbacks will have a 2% super elevation towards the inside of the corner to promote safe vehicle travel. The minimum radius of a switchback radii is defined by the turning radius of the 777-haul truck which is 10.0 m.

1.12.3 Haul Road Edge and Pile Berms

Haul road edge berms are to be located and maintained along the edge of the haul road wherever a drop-off greater than three (3) m exists and need to be $\frac{3}{4}$ the height of the largest tire on any vehicle using the haul road. For the Project this gives a haul road berm height of approximately 2.0 m.

A “pile berm” means a barrier or ridge of materials other than snow or mud, acting as a guide that will indicate the limit of travel of a vehicle from which material is to be placed when dumping material from a platform (lift) that is greater than three (3) m above the previous lift and/or the existing ground. The height of this pile berm shall not be less than $\frac{1}{2}$ the height of the tire of the largest vehicle from which material is being dumped. For this Project this gives a pile berm height of approximately 1.35 m.

1.12.4 Channels

In most instances, water collection channels will be incorporated within the haul road design. The channels will be designed using a 1 H:1V slopes and an approximate depth of 1.0 m.

1.12.5 Overall Haul Road Design Widths

Using the information from the above subsections, **Table 1.12-2** was generated. The table provides the designed overall road widths to be used for the Project.

Table 1.12-2: Haul Road Design Guidelines for the Tenas Project

Location of Haul Road	Double Lane Running Width (m)	Channel Yes/No	Berm Yes/No	Channel and Berm Width (m)	Design Width (m)	Cut Wall Angle for Cuts <10 m	Cut Wall Angle for Cuts >10 m
Inpit	20	Yes, 1	Yes, 1	6	26	Use open pit wall design guidelines	Use open pit wall design guidelines
Expit on ground	20	Yes, 2	No	4	25	n/a	n/a
Expit elevated both sides	20	No	Yes, 2	12	28	Use pile design guidelines	Use pile design guidelines
Expit, cut	20	Yes, 2	No	4	25	30 degrees in overburden 65 degrees in rock	2.25 to 1 in overburden 50 degrees in rock
Expit elevated one side	20	Yes, 1	Yes, 1	6	26	30 degrees for cut in overburden 65 degrees in rock 35 degrees for fill	2.25 to 1 in overburden 50 degrees in rock 35 degrees for fill

Notes: >greater than; <less than; m=metre; n/a=not applicable

To simplify the haul road design requirements for the Project, a 30 m width was used for the design of all double lane haul roads and 20 m for single lane haul roads.

1.12.6 Open Pit Ramps/Development

Ramps and minimum mining widths abide by the widths described in 1.12.6. Open pit access is generally outside the open pit limits from topography, mining straight into the deposit at 4m bench intervals. Where necessary, in deeper portions of the open pit, -10% ramps are to be used to access the lower levels of cuts. +10% ramps are used to access the embankments for the management ponds and backfills going back into the open pit for the placement of non-PAG material and overburden. For the very open pit bottom benches a ramp grade up to 15% maybe used and truck payloads will need to be reduced to 75% of maximum to allow this to occur. Runaway ramps have been established for extended downhill hauls to the CPP and management ponds. For the determination of haul speeds, a rolling resistance of 3% has been considered in addition to the grade of the ramp.

1.12.7 Runaway Lanes

For TCL haul roads where the grade exceeds 5% the roads shall have installed and maintained runaway lanes or retardation barriers at periodic intervals only where conditions/risk warrants. Runaway lanes will be for a single lane traffic and will not have any channels but will have berms. Runaway lanes will be designed at close to 25% in grade. Please see **Appendix 1.0-J Norwest, Runaway Ramp Report**, attached for further details on runaway lane design that will be utilized for this Project.

1.12.8 Service Roads Within the Project

The service roads for the Project will follow the same requirements as the haul roads except for channels which will only be 0.25 m deep. These access roads will only see light vehicle access such as super B-train trucks delivering explosive products. The access roads to these two (2) facilities will be designed a single lane access with radio control procedures for vehicles to use these access roads as the number of vehicles is very minimal that need to use these access roads. **Table 1.12-3** below summarizes the mine access design guidelines for the Project.

Table 1.12-3: Service Road Design Guidelines for the Tenas Project

Location of Mine Service Road	Double Lane Running Width (m)	Channel Yes/No	Berm Yes/No	Channel and Berm Width (m)	Design Width (m)
Expit on existing ground elevation	8	Yes, 2	No	2	10

Note: m=metre

1.12.9 Haul Road and Service Road Geotechnical Stability

Most of the haul roads and all the service roads are surface cut and fill roads with cut and fill depths being less than 3 m and as such do not require a stability assessment. There is only one (1) haul road that has a cut depth greater than 5 m and SRK has conducted a stability assessment on this haul road which is provided in **Appendix 1.0-K SRK, Geotechnical Foundation Assessment for Mine Infrastructure, Tenas Project**. In summary the proposed haul road design cut slopes are stable. All other haul roads are integrated into the buttress and/or embankment portions of the management ponds and/or into backfills filling the open pit. The stability of these roads will be addressed by the overall stability assessment of these structures carried out by SRK for the management and control pond embankments in **Appendix**

1.0-L SRK, Tenas Project Management and Control Pond Stability Assessment and by the stability assessment carried out by SRK for the backfills which is provided in **Appendix 1-I.0 SRK, Tenas Project Pit Backfill Stability Report**.

1.12.9.1 Geohazards for Haul Roads and Service Roads

The haul roads and service roads within the Minesite for the Project are located on a shallow sloping plateau located between the Tenas and Goathorn creeks and are not subject to any hazards due to adverse terrain. Furthermore, there are no large watercourses at the upslope end of the haul roads and access roads within the Minesite that would cause mudflows and/or debris flows. Lastly with the shallow slope present the area is not at risk from avalanches. The only hazards haul roads face are the ones induced by excavating the open pit and the construction of the management, control and sedimentation ponds which are addressed through the geotechnical analysis conducted by SRK. The road used to access the Project is identified as the TAC which is discussed in **1.20**.

1.13 Material Storage Piles and Backfills

The Project does not have any designated external and/or expit permanent material storage piles required for the permanent storage of PAG material, non-PAG material, processed rock, reclamation materials (surface soils), and/or overburden material. All material will be placed either as backfill within the open pit footprint, and/or the critical backfill portion and/or the buttress portion of the embankments needed to be constructed for the management ponds. Design guidelines will be provided for specific external and/or expit pile structures if they do become necessary sometime in the future.

The term “pile” refers to the storage of natural and processed earth materials. If external overburden storage piles become a requirement, they will be constructed using a series of lifts as shown in **Figure 1.13-1**. External rock piles will be built with a combination of bottom-up (i.e., dump and push) and top-down (i.e., end dumping) construction methods. The foundation is prepared by clearing of vegetation and removal of soft materials prior to material placement into external piles.

Inpit (or backfill) piles will be firstly constructed with non-PAG rock using a combination of end-dumping methods and bottom up construction onto the final excavated footwalls and/or hanging walls. Any inpit placement of overburden will be placed over the non-PAG rock, or directly placed on footwall and/or hanging wall rock.

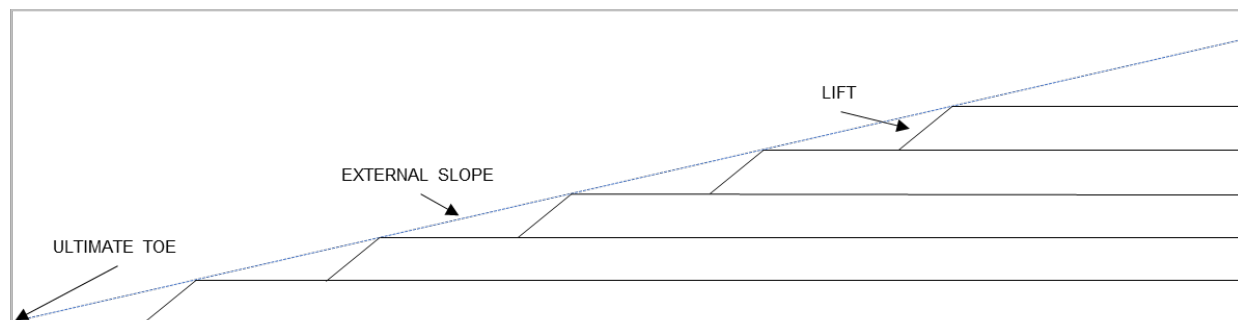


Figure 1.13-1: External and/or backfill pile geometry definitions

The backfilling of the open pit will be in lifts using a "bottom-up" approach where practical and an overall slope of 2.5 to 1 (H:V), with non-PAG rock being targeted for the base of these piles to promote improved stability. Material destined for the dams around the management ponds will follow the specific procedures for construction of these structures. Generally, overburden will be destined for the water side of the dam while non-PAG rock will be destined for the downstream side of the dam to act as buttressing material. In both instances the material will be placed in lifts with the upstream side being compacted to limit water ingress into the structure.

1.13.1 Material Characteristics

SRK has completed an extensive characterisation of the materials in support of this Project in the late 1990's and again augmented this characterisation based on further drilling in 2018 which is provided in **Appendix 1.0-M SRK, Tenas Project Supplemental Geochemical Characterization**. Project overburden and interburden materials are grouped into a series of zones which are geochemically classified as either non-PAG or PAG based on neutralization potential ratio (NPR) values and sample locations stratigraphically. An NPR value of 1.2 has been used to classify materials with all material with an $\text{NPR} \leq 1.2$ being PAG and other materials > 1.2 being non-PAG (please see **Appendix 1.0-M**). TCL used a cut off NPR of ≤ 2 to 1 for all mine planning requirements to ensure storage facilities are designed with excess capacity.

An important driver of mine planning for the Project is the geochemical (ARD) characteristics of the material within the open pit design. The following ABA zones have been identified for the Project and where it is necessary to know the acid-generating nature (non-PAG or PAG) of the material, a geochemical NPR cut-off of 1.2 is used ($\text{NPR} \geq 1.2$ is non-PAG; $\text{NPR} < 1.2$ is PAG for rock) while a cut-off of 2 to 1 was used for mine planning:

- ▶ OVB/Till – overburden/till is considered non-acid-generating (non-PAG) material;
- ▶ Zone 1 – sits atop marker seam, “e”. This unit is pervasively non-PAG throughout the entire deposit;
- ▶ Zone 1a – the bottom 5-8 m of Zone 1 consists of a very low NPR material, making it PAG. Segregating it improves the NPR of Zone 1, reducing risks of pockets of Zone 1 generating acid;
- ▶ Zone 2 – sits atop marker Seam “c-upr”. This unit is pervasively PAG throughout the deposit;
- ▶ Zone 3 – sits atop the Seam c. This unit also is pervasively PAG throughout the deposit. Zones 2 and 3 are always to be mined together with Zone 1a as the deposit’s primary source of PAG rock;
- ▶ Zone 4 – sits atop marker Seam “b”. This zone varies from non-PAG to PAG across the deposit. Where it is non-PAG, it will be dozer-pushed to the mined-out footwall and where it is PAG, it will be hauled to the management ponds;
- ▶ Zone 5 – sits atop Seam 1U (or Seam 1 where only this exists). This unit is generally PAG throughout the deposit;
- ▶ Zone 55 – lies between 1U and 1L. It only exists in the west and east areas of the deposit. It can be both non-PAG and PAG, but for the purposes of mine planning at the Project due to high likelihood of this zone getting insitu coal mixed into it, it is considered PAG;
- ▶ Zone 6 – sits below Seam 1L or 1 and forms the footwall of most of the open pit, it has been classified as PAG anytime where footwall benching requires this material to be excavated;

- ▶ Zone 7 – sits between two (2) rider Seams 1Lb and 1Lc and is pervasively non-PAG throughout the deposit; and
- ▶ Zone 8 – sits between two (2) rider Seams 1Lc and 1Le and is pervasively non-PAG throughout the deposit.

Other materials that are excavated and/or generated from the Project have also been characterised as PAG or non-PAG material based on testing completed to date:

- ▶ Insitu coal, ROM coal, processed coal and processed rock are all classified as PAG;
- ▶ All material within gravel and rock quarries and material procured from the surrounding area for ballast, sub ballast and aggregate requirements have all been classified as non-PAG; and
- ▶ All construction material required for the Explosive Facility, Explosive Magazine, MIC pads, and the TAC have all been classified as non-PAG.

All material will have verification testing during the Construction Phase to augment the data collected to date as specified in the **Metal Leaching (ML)/ARD Management Plan (S13.0-C12) (ML/ARDMP)**.

So, in summary, all material has been classified a PAG material for material segregation for mine planning within the open pit design except for overburden, Zones 1, 7, 8, and a portion of Zone 4 which were clearly always non-PAG material. All material used for construction, gravel, and rock materials outside open pit to allow construction of the TAC and various pads has been classified as non-PAG.

All PAG material will be placed into engineered management ponds for permanent storage underwater. All non-PAG material from the various zones will be placed either into dams and associated buttresses for the management ponds and/or backfilled into the open pit throughout the Operation Phase. The PAG and non-PAG zones based on geochemical properties and mining considerations are summarized in **Table 1.13-1** below. Average weighted NPR for each zone is calculated from length-weighted neutralizing potential (NP) divided by length-weighted acidification potential (AP).

Table 1.13-1: Geochemistry and Mine Planning Material Zones

Material Zone Name	Geochemical Assignment based on NPR of 1.20	ARD Assignment in Mine Plan based on 25% of Material of the Zone Being Below an NPR of 1.20.	Stratigraphic Location	Average Zone Weighted NPR
Zone 0	non-PAG	non-PAG	Till and overburden – topography to bedrock surface	17.5
Zone 1	non-PAG	non-PAG	Bedrock surface to top of Seam e (minus Zone 1a)	3.5
Zone 1a	PAG	PAG	Select area above Seam e to bottom of Seam e	0.8
Zone 2 & 3	PAG	PAG	Bottom of Seam e to bottom of Seam c	0.9
Zone 4	non-PAG	non-PAG ⁽¹⁾	Bottom of Seam c to top of Seam b	2.7

Material Zone Name	Geochemical Assignment based on NPR of 1.20	ARD Assignment in Mine Plan based on 25% of Material of the Zone Being Below an NPR of 1.20.	Stratigraphic Location	Average Zone Weighted NPR
Zone 5	non-PAG	PAG	Top of Seam b to top of Seam 1U	1.4
Zone 55	non-PAG	PAG due to blending with ROM coal cleaning	Top of Seam 1U to bottom of Seam 1L	2.3
Zone 6	non-PAG	PAG due to footwall coal cleaning being blended with material	Bottom of Seam 1L to bottom of Seam 1Lc	1.4
Zone 7**	non-PAG	PAG	Below Seam 1Lc to the bottom of Seam 1Ld	1.7
Zone 8**	non-PAG	non-PAG	Below Seam 1Ld	5.5

Notes: %=percent; ARD=acid rock drainage; EA=environmental assessment; NPR=neutralization potential ratio; PAG=potentially acid generating

⁽¹⁾Zone 4 is spatially segregated as non-PAG and PAG, with the larger portion of the zone (75%) being non-PAG,

^{**}these two (2) zones are currently not being excavated by the EA Open Pit

A stratigraphic column showing the material zone (PAG, non-PAG) based ARD assignment in mine planning for the Project is shown by **Figure 1.13-2** below.

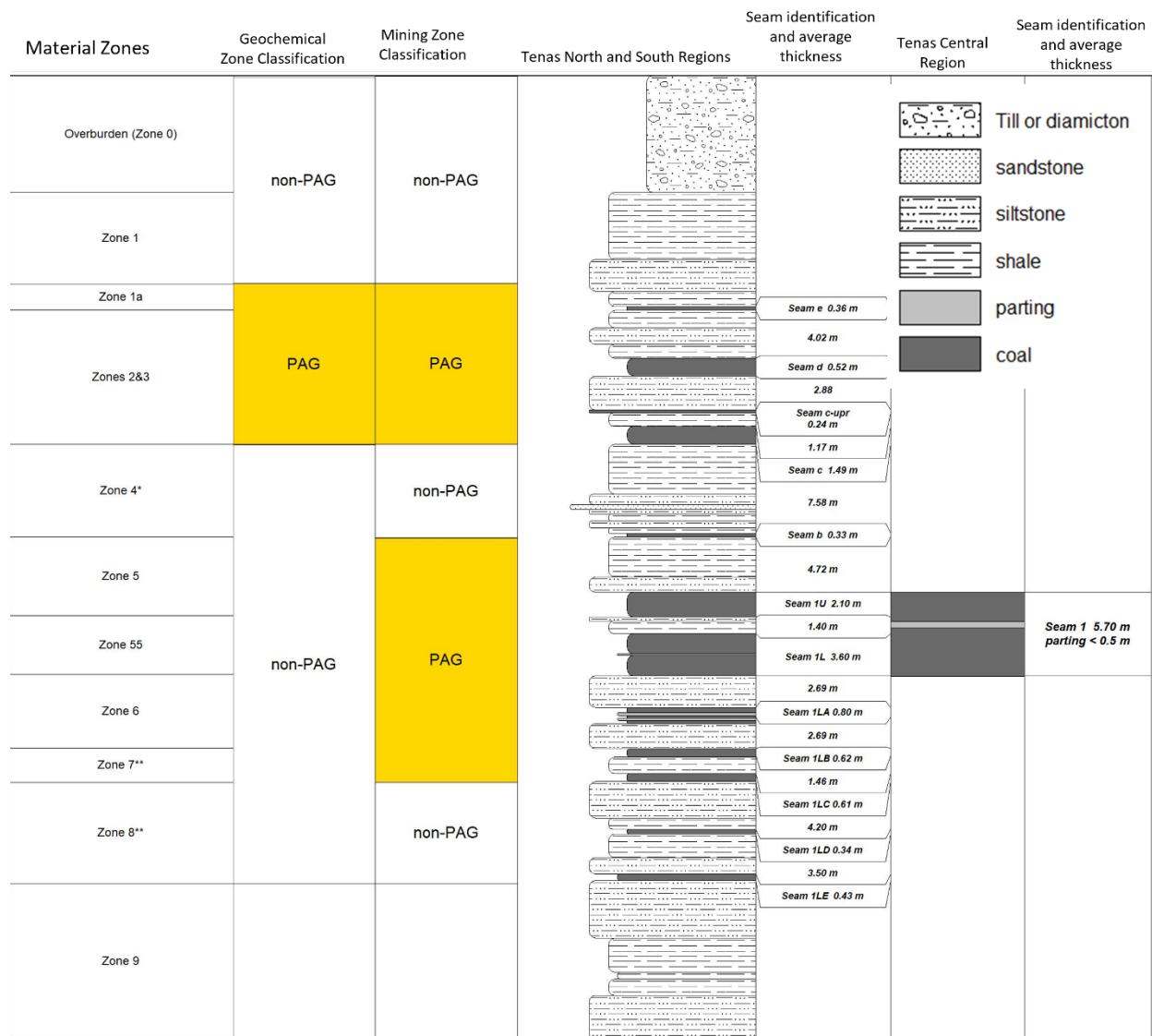
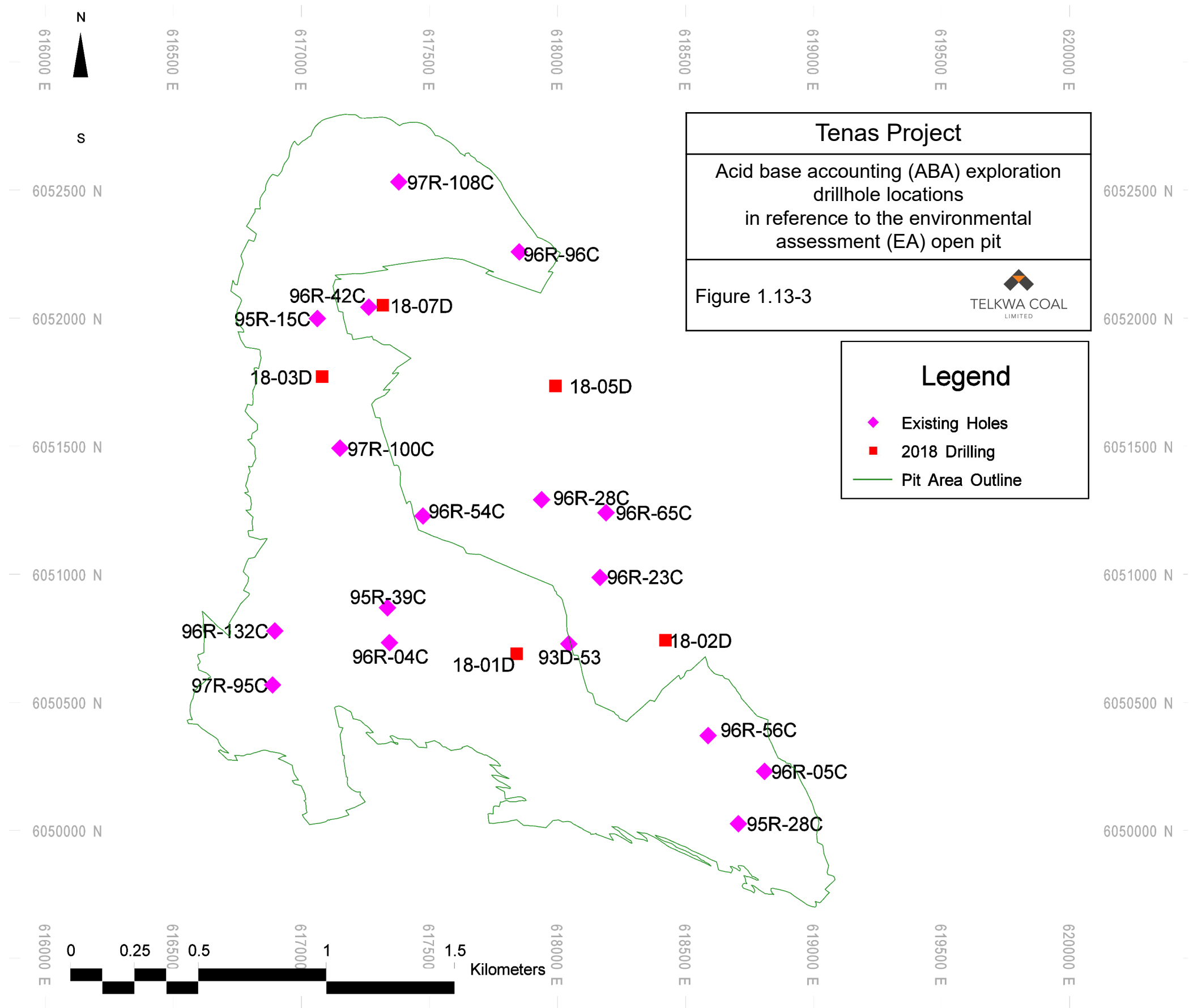


Figure 1.13-2: Stratigraphic column with material zones classified as non-PAG or PAG based on geochemical and mining classifications

Twenty-two (22) holes have been used in geochemical characterisation of the materials with the open pit as shown by **Figure 1.13-3** below. Several holes are within the Project's ultimate open pit footprint; however, it is planned to complete an additional exploration hole drilled west of 97R-100C and one (1) hole drilled south of 93D-53 to fill in these two (2) areas. These exploration holes are currently planned to occur in the proposed winter exploration program of 2023 and/or 2024 for the Project. Furthermore during mining, verification of all material will be conducted based on the analysis drill cuttings from blast holes as described in the **ML/ARDMP**.



1.13.2 Material Management Strategy

The method of ARD mitigation for the Project is placing any material classified as PAG underwater in management ponds to prevent ARD from occurring by preventing the oxidization process. This is also known as a source control method. In the DFS, a combined excavated and dam structure was proposed to contain water for this purpose. However, after additional review a dam structure only was viewed as the preferred method for constructing a structure to hold water for subsequent PAG submersion.

1.13.2.1 *Identification of Potentially Acid Generating (PAG) Material*

As mentioned previously, PAG material has been identified based on the exploration program and TCL has taken the approach of being conservative about material classification to ensure there is sufficient storage for PAG material within the management ponds. As such most of the rock materials within the open pit were classified as 100% PAG even though there are portions of these zones that would be classified as non-PAG. During the Operation Phase, additional testing of both drill cuttings and small diameter core holes will be sampled and tested for sulfur and total inorganic carbon levels to augment the exploration database and verify what material is non-PAG. As a rule, material in most zones besides Zones 1, 4, 7, 8, and overburden are treated as PAG unless the blasthole drilling clearly indicates that material can be classified as non-PAG. A comprehensive **ML/ARDMP** provides additional information about management of this material.

1.13.2.2 *Potentially Acid Generating (PAG) Rock Handling*

Approximately 31.83 million bank cubic metres (MBCM) of PAG rock will be generated from the Project. PAG rock is planned to be excavated in 4 to 6-m lifts in the open pit and placed in 1 to 10-m-high lifts within the management ponds. PAG lifts in the North and East Management Ponds will be placed in lifts between 1 and 3 m to ensure the liner is protected from rock being placed too far above the liner. The West Management Pond is different as there is no liner planned for the bedrock portion of this pond and PAG material can be placed in thicker lifts above the bedrock as there is no concern with damaging the liner. Sometimes this will involve placing PAG material into water that could be deeper than 10 m so water levels will have to be controlled so that the placed lifts do not get too thick to undergo settlement in the Decommissioning and Reclamation Phase. Once the height PAG material reaches the bedrock/overburden contact, the liner will be in place which again limits the PAG lifts in this region to between 1 and 3 m. PAG lifts will be constructed prior to water being allowed to raise above the active elevation of the lift until the lift is completed. Then water will be pumped in until it is 1 meter above the completed lift prior to the next lift commencing.

1.13.2.3 *Non-potentially Acid Generating (non-PAG) Rock Handling*

Approximately 29.52 MBCM of non-PAG rock is generated from the Project open pit which includes rehandled volumes. Non-PAG rock is planned to be excavated and placed in 1 to 15 m high lifts within the embankments (either in the main embankment portions and/or buttresses) of the management and control ponds. Any excess non-PAG material not required for the management and control ponds will be backfilled into the open pit, in the lower portions of the backfilled areas to provide stable foundations for subsequent backfill. Both the backfill and the embankments will be constructed utilizing a bottom up methodology in lifts no greater than 12 meters to reduce differential settlement in Post-closure. Approximately 1.5 MBCM of non-PAG material is expected to be immersed underwater in the management ponds to cap the PAG material to allow dry land reclamation by placing a subsequent lift of overburden and reclamation materials (surface soils). The non-PAG rock is placed into the management pond in roughly a 1.5 m lift once the PAG material reaches its final design elevation and the water level is lowered to within 1 meter of the PAG material. As the non-PAG material is placed the water level needs

to be controlled to stay within approximately 1 m above the PAG material. Then overburden is placed in a 1 to 3 m thick lift with water level being kept at the elevation of the non-PAG rock. Approximately 14.5 MBCM of non-PAG material (roughly 50%) that was placed as backfill within the open pit during the Operation Phase is then flooded by water that is contained by the open pit in the Decommissioning and Reclamation, and Post-closure phases of the Project.

1.13.2.4 Overburden Handling

There is an abundance of overburden (estimated at 21.96 MBCM including road excavation volumes but excluding reclamation materials(surface soils)) to be managed within the open pit. Overburden is to be disposed on top of non-PAG rock where practical and otherwise disposed on its own within the embankment structure as critical backfill and/or buttress material and/or backfilled in the open pit and/or placed as cover material within the management ponds.

Overburden handling has additional material handling considerations. For instance, the mine plan does not allow for the excavation of overburden during spring freshet (from April to May) nor the placement of overburden in critical compaction zones of the embankment between mid-December and March. This minimizes having to handle and drive on wet clay-rich overburden materials or trying to place materials during the most extreme winter conditions on site. As well, the construction of the embankments relies on overburden to be placed in shallower lifts to promote consolidation and trafficability.

1.13.2.5 Dozer Pushing

As previously mentioned, Zone 4 is often non-PAG in the Project. This allows it to be dozer-pushed to the adjacent exposed Seam 1 footwall when the Seam 1 package has been mined. However, when doing this dozer push, there are rehandle considerations that were added to the schedule to expose the Seam 1 coal and to establish a coal access road along the backfill. The dozer rehandle amount is estimated at 45% of any Zone 4 material that is dozer pushed. Approximately 3.39 MBCM of non-PAG material that is currently identified for dozer pushing of Zone 4 onto the exposed Zone 6 footwall during the Operation Phase.

1.13.2.6 Processed Rock Handling (Tailings)

During processing, rock is separated from coal via gravity methods to produce a processed coal with less than 10% rock material by mass. The excess rock, which TCL has identified as processed rock, has been classified as PAG based on the test work carried out to date. The coarse and fine processed rock will be dewatered using a centrifuge so that their individual water contents will be approximately 6% and 30% respectively. The coarse and fine processed rock will be combined within the CPP prior to temporally placing this material into a temporary stockpile at the CPP. After combining the two (2) streams in the CPP the resulting material will have a low enough water content to allow it to be stacked, stored, and loaded using a FEL, and trucked using the same haul trucks used for mining material in the open pit. From this stockpile, FEL will load the same rigid frame haul trucks bringing ROM coal to the CPP and these trucks will then haul this material to the active management pond to be comingled with PAG rock being hauled from the open pit for long term storage underwater. There is approximately 5.74 Mt of processed rock or 3.28 million cubic metres (m³) using a density of 1.75 t/m³ for the processed rock material.

1.13.2.7 Reclamation Materials (Surface Soils) Handling

Prior to mining activities commencing, and after logging and other vegetation clearing activities have been completed, reclamation materials (surface soils) will be salvaged from mining areas using dozers,

excavators, and trucks. If areas are available for reclamation material (surface soil) placement, reclamation materials (surface soils) will be directly placed on these areas to assist with reclamation activities. Otherwise, reclamation materials (surface soils) will be placed into temporary stockpiles for storage until suitable reclamation areas are available for reclamation material (surface soil) placement. Reclamation materials (surface soils) will be placed on reclaimed areas using the “rough mounded” technique to avoid compaction of this material and equipment will not be permitted on areas that have had reclamation materials (surface soils) placed on them. Vegetation planting will occur for temporary stockpiles and areas that has had reclamation materials (surface soils) placed on them as soon as practical to limit any possible erosion and resulting sediment generation due to precipitation. For much of the Project, reclamation material (surface soil) thicknesses average approximately 0.30 m across the Project Area with some localized thickening and thinning and will result in approximately 2.26 MBCM of reclamation materials (surface soils) being salvaged over the mine life.

1.13.2.8 *Run-of-mine (ROM) Coal Handling*

Once sufficient material has been removed, the coal seams can be exposed and recovered for delivery to the CPP. At the CPP, ROM coal will be placed into two (2) to three (3) stockpiles with a total capacity of approximately 40,000 tonnes. There is approximately 22.02 Mt of ROM coal to be recovered within the Project open pit design. In general, the following rules will be followed for insitu coal cleaning and recovery:

- ▶ For coal seam dips < 9 degrees (15%), a backhoe and/or dozer will be used for both coal cleaning and recovery and the coal will be excavated directly by an excavator, if possible, into haul trucks that are running on the footwall of the coal seam;
- ▶ For coal seams with dips between 9 and 25 degrees, bulldozers will be used to push rock off the coal seam for cleaning and then bulldozers will again be used to push the coal down off the footwall into windrows for loading out using a backhoe and/or FEL; and
- ▶ For coal seam dips >25 degrees, backhoes will be used to pull the rock off the coal seam into a windrow to be loaded out with a loader and/or excavator. Once the coal seam is cleaned, a backhoe again will be used to pull down the coal into a windrow for loading out into a mine truck.

This process above will create ROM coal consisting of additional moisture and suffering coal losses and dilution rock gains. All ROM coal will then be hauled to the CPP and placed into stockpiles for eventual feeding into the CPP feed hopper for eventual processing within the CPP.

FELs will be used to reclaim coal from the ROM stockpiles into the CPP. This will allow for coals to be blended if required to optimize plant operations, coal quality specifications, and plant yields.

1.13.2.9 *Processed Coal Handling*

There is approximately 16.27 Mt of processed coal recovered from the CPP over the Operation Phase. The CPP will stack the processed coal using a radial stacker into a circular shaped stockpile that has a volume of approximately 10,000 tonnes. The processed coal stockpile will be divided into two (2) sections, with high sulfur coal on one (1) end of the stockpile and lower sulfur coal on the other end of the stockpile. A FEL will be used to reclaim processed coal from the stockpile into super B-train trucks for transport via the TAC to the Rail Infrastructure for stockpiling and loading into unit trains for delivery to the port. At the Rail Infrastructure, two (2) 15,000-tonne stockpiles will be constructed, with both piles being the same quality.

1.13.2.10 Material Management Decision Matrix

The foregoing discussions on material management strategy can be distilled into a decision matrix as illustrated below in **Figure 1.13-4**. As presented, any surplus overburden and/or non-PAG material will be placed within the buttress area of the management and control pond embankments or backfilled into the open pit.

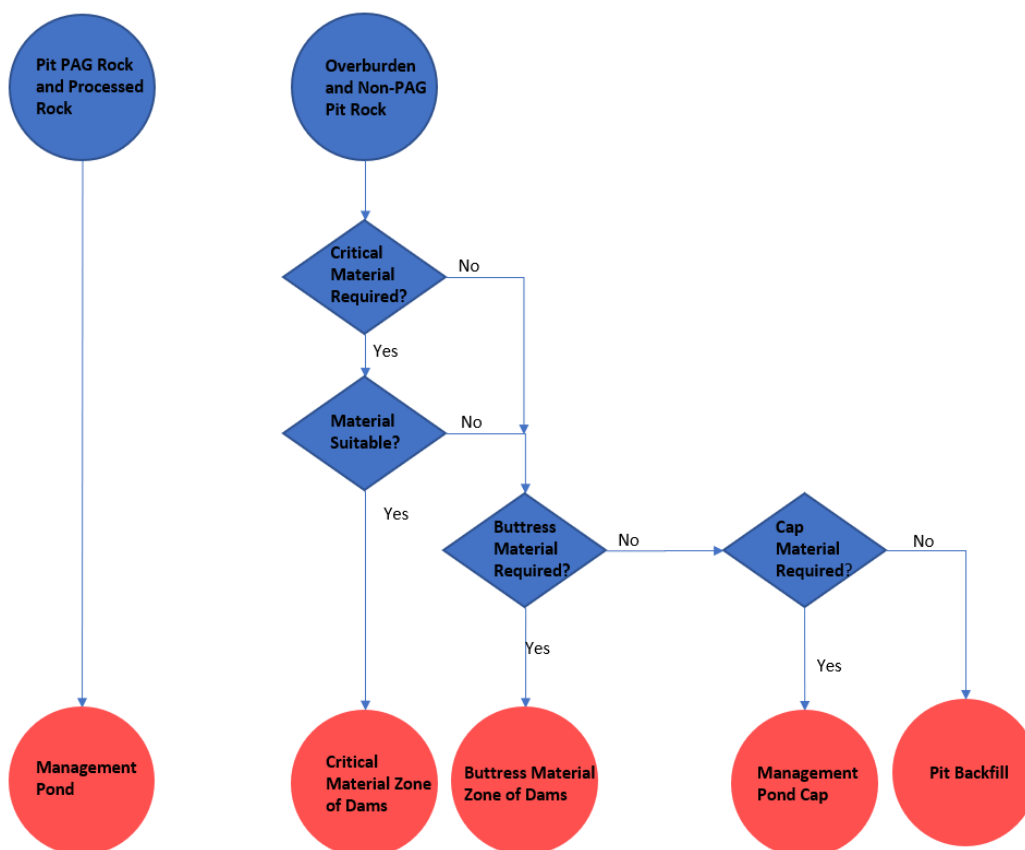


Figure 1.13-4: Material management decision flow diagram for Tenas Project

Table 1.13-2 provides a summary of material volumes described above while **Table 1.13-3** below provides the material balance for the open pit by mining phase.

Table 1.13-2: Summary of Material Volumes

Material	Volume or Tonnage
PAG Rock (BCM)	31.83 million
Non-PAG Rock (BCM) includes 0.82 million due to rehandle	29.52 million
Overburden (BCM) includes 0.55 million from the road	21.96 million
Dozer Push Material (Zone 4 non-PAG rock) (BCM)	3.39 million
Processed Rock (m ³)	3.28 million

Reclamation Materials (surface soils) (BCM)	2.26 million
Run-of-Mine Coal (tonnes at 5% moisture)	22.02 million
Processed Coal (tonnes at 10% moisture)	16.27 million

Notes: %=percent; BCM=bank cubic metre; m³=cubic metre; PAG=potentially acid generating

Table 1.13-3: Material Balance for the Open Pit for Entire Construction, and Operation Phases

Mining Phase	North Mgt Pond PAG Material	East Mgt Pond PAG Material	West Mgt Pond PAG Material	Tenas Control Pond Dam and Buttress	North Mgt Pond Dam and Buttress	East Mgt Pond Dam and Buttress	West Mgt Pond Dam and Buttress	Backfill of Open Pit	TOTAL
North (BCM)	895,423	1,928,293	10,442,422	5,094,546	520,359	10,799,811	34,798	2,476,516	32,192,168
Start (BCM)	251,379	717,412	-	-	2,054,369	-	-	-	3,023,160
Central North (BCM)	-	-	-	-	-	-	5,980,744	2,121,316	8,102,059
Central South (BCM)	-	-	-	-	-	-	11,796,994	12,643,470	24,440,464
South (BCM)	-	-	-	-	-	1,105,081	9,085,014	11,851,602	22,041,698
TOTAL	1,146,801	2,645,705	10,442,422	5,094,546	2,574,728	11,904,892	26,897,551	29,092,903	89,799,549

Notes: BCM=bank cubic metre; PAG=potentially acid generating; Mgt=Management

1.13.2.11 Material Pile and Backfill Design Guidelines

The proposed pile design guidelines are provided below in **Table 1.13-4**.

Table 1.13-4: Material Pile and Backfill Design Guidelines

Material Location Type	Material	Maximum Lift Height (m)	Lift Slope Face Angle (degree)	Berm Width (m)	Overall Slope Angle (degree)
Expit	non-PAG rock + OVB	12	37	12	18.0 (3.0:1)
Backfill	non-PAG rock + OVB	12	37	10	22.5 (2.5:1)
Backfill Submersed Underwater	PAG rock	6	37	5	22.5 (2.5:1)
Backfill Submersed Underwater	processed rock	3	37	3	18.0 (3.0:1)
Expit	reclamation materials (surface soils)	12	26.5	10	18.0 (3.0:1)
Expit Stockpiles	ROM coal (to CPP) processed coal (to port) processed rock (to management ponds)	15	37	12	37.0 (1.3:1)

Notes: m=metre; non-PAG=non-potentially acid generating; OVB=overburden; PAG=potentially acid generating; ROM=run-of-mine

Currently for the Project, all material will either be placed into the dam and its associated buttress used to construct the management ponds or placed as backfill within the ultimate open pit footprint.

1.13.2.12 Backfill Storage Piles Geotechnical Considerations**1.13.2.12.1 Foundation Investigations and Geotechnical Strengths Parameters**

The rock types encountered in the open pit slope geotechnical drilling program comprised Skeena Group mudstone, siltstone, sandstone, and coal. It is expected that the mudstones are located below the Seam 1 and/or Seam 1L, forming the immediate foundation below the backfills. Mudstones are fine grained, bedded, grey and dark grey, assessed fresh to highly weathered, generally estimated very weak to medium strong intact rock strength (R1 to R3). The mudstone is often interbedded with small coal seams and breaks on graphitic coated joints near major coal seams. See **Appendices 1.0-D Tenas Project Orica Canada's Fragmentation Study** and **Appendix 1.0-F SRK, Tenas Project Water Management Design Technical Report** for additional information, See **Figure 1.13-5** for a core picture of typical foundation rocks that make up foundation on footwall side of open pit.



Figure 1.13-5: Core picture of mudstone rock type

Geotechnical material parameters were selected to represent the foundation and rock materials. Material parameters used in the stability analyses were based on the field investigation results, laboratory testing, and experience with materials showing similar characteristics (SRK 2019a and SRK 2019b). Of importance to the footwall rocks are the following:

- ▶ The UCS test values were reviewed with consideration to final Seam-1 footwall location. The average values for the sedimentary rocks below the Seam-1 footwall is 41 MPa; and
- ▶ The direct shear testing on bedding surfaces indicated peak friction strengths of 31 degrees. A residual friction angle of 23 degrees was used to represent a possible weak bedding layer in the stability analyses within the footwall rock. At the inter-ramp scale, the inherent waviness was represented with the inclusion of some cohesion strength.

1.13.2.12.1.1 Foundation Bedding Orientations and Major Structures

The open pit footwalls are to be excavated along shallow to moderate dipping bedding structures as shown in **Figure 1.13-6**. The footwall bedding conditions have been described earlier in **1.11.2 Open Pit Geotechnical Considerations**. The steeper footwall slopes are in the southeast where a staged excavation and backfill strategy is required.

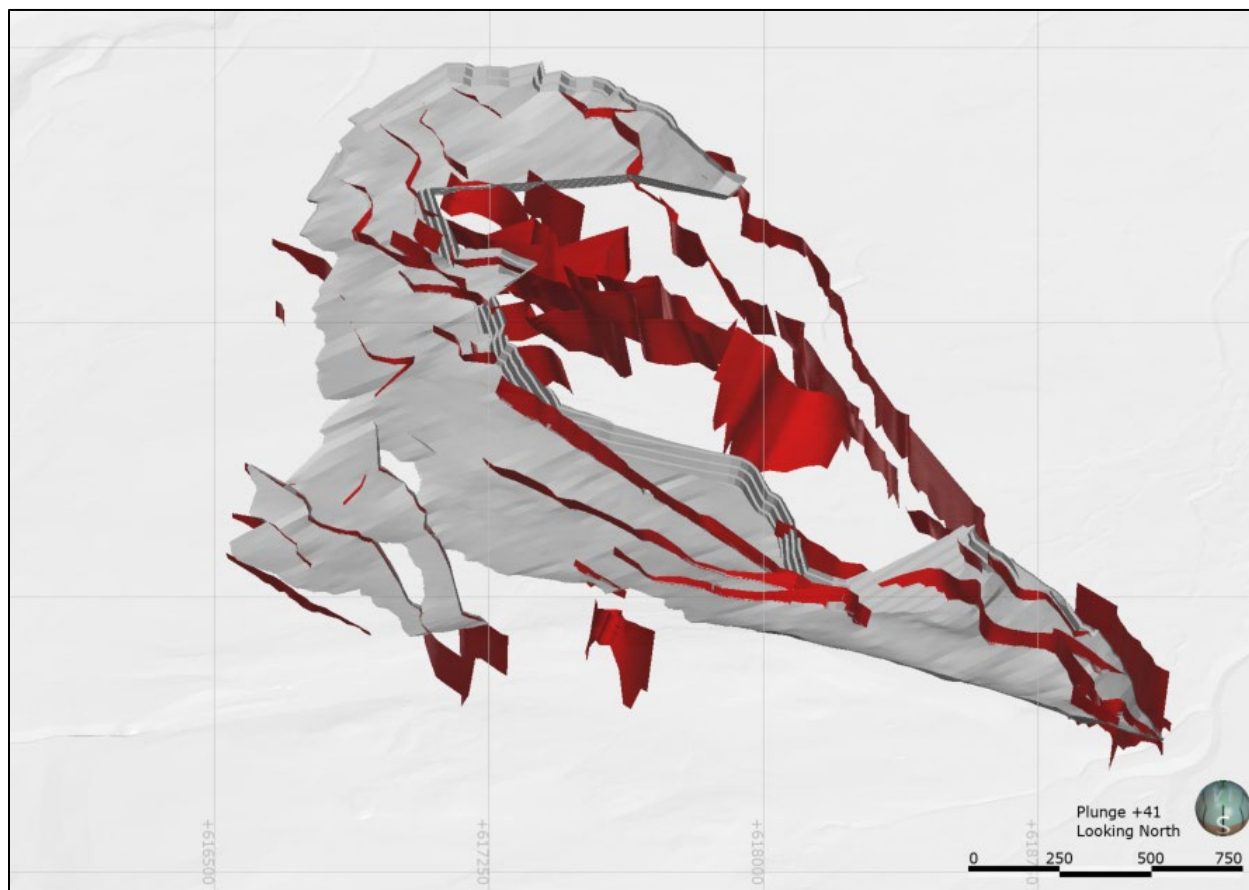


Figure 1.13-6: Fault model shown for the proposed environmental assessment (EA) open pit (red are faults and grey is open pit outline)

1.13.2.12.1.2 *Foundation Major Structures*

The 3D coal geology model and deposit structural geology has been defined by TCL using available exploration drillhole data (TCL 2018). The major structures at the Project are characterised by continuous north-south striking thrust and normal faults. A total of 36 fault segments have been interpreted. The sense of movement has been interpreted by TCL geologists, largely based on the offsets between each coal seam. Within the proposed open pit area, higher fault frequencies are expected in the southeast where the folding becomes tighter and bedding inclination is steeper. With consideration to the backfilling, interim slopes should be advanced over an undercut footwall section to reduce the probability of a bi-linear sliding mechanisms through the backfill rock and along the exposed bedding surfaces.

1.13.2.12.2 *Backfill Materials Description*

Only non-PAG rock and overburden will be placed as backfill material with non-PAG rock making up most of the material that is placed directly on the previous mined areas except for the West Management Pond where PAG material is placed. Overburden will be used to cover this material in closure to further reduce water infiltration into the non-PAG rock material or will be placed directly on shallow dipping portions of the open pit

1.13.2.12.3 Foundation Preparation for Backfills

No specific foundation preparation will be required for backfills as these areas have already been mined to a competent bedrock layer. The only preparation is to insure that the footwall has been adequately cleaned of all coal material and that any faults are identified and flagged for subsequent backfilling operation.

1.13.2.12.3.1 Backfill Hazard Classifications

A semi-qualitative Backfill Pile Stability Rating and Hazard Classification (BPRHC) using guidance provided by Hawley and Cuning (2017) was completed for each backfill area. The hazard ratings for each final backfill design are summarized in **Table 1.13-5**. The results of the BPRCH indicate that the backfills are considered a low hazard class.

Table 1.13-5: Summary of Backfill Stability Rating and Hazard Classification

Pile Name	Construction Material	Dump Stability Rating and Hazard Classification			
		Engineering Geology Index	Design and Performance Index	Dump and Stockpile Stability Rating	Hazard Rating (Class)
Phase 2 Backfill	non-PAG rock	37	33.5	70.5	Low
Phase 1/4 Backfill	non-PAG rock	36	29	65	Low
Phase 3 Backfill	non-PAG rock	37	31	68	Low

Notes: PAG=potentially acid generating

1.13.2.12.3.2 Slope Instability Mechanisms for Backfills

With consideration to the foundation conditions and expected slope performance, the following instability mechanisms were considered throughout the analyses and design work for the backfill piles to be constructed.

1. A deep-seated, overall slope instability that can be a combination of:
 - 1.1. An instability through a significant volume of the rock materials; or
 - 1.2. An instability through a significant volume of the rock materials and sliding along the footwall contact or weaker bedding layer; and
2. A shallow slope face instability through the dump materials caused either by over-steepening of the dump materials and/or concentrated weak rock layering due to end-dumping near the slope face.

Shallow slope face instabilities should be expected throughout construction as material settles and should be managed in accordance with the implemented standard operating procedures.

1.13.2.12.3.3 Backfill Acceptance Criteria

The recommended criteria are based on levels of confidence in the understanding of site conditions and material parameters and the consequences of instability in accordance with Hawley and Cuning (2017) and presented in **Table 1.13-6**. The acceptance criteria were compared against the results of the analyses for a deep-seated failure mechanism. For the backfills at the Project, a *moderate* possible failure consequence and a *moderate to high* data confidence were identified. A minimum static FOS of 1.3 and a pseudo-static FOS of 1.05 are recommended for end of construction backfill configurations.

In addition, selected short-term, during construction designs were analyzed, and these results were compared against a minimum design FOS values ranging from 1.1 to 1.3 in accordance with British Columbia Mined Rock and Overburden Piles (BCMROP) Interim Guidelines (Piteau 1991).

Table 1.13-6: Suggested Stability Design Criteria

Possible Consequence	Data Confidence ⁽¹⁾	Static Analyses		Pseudo-Static Analyses
		Minimum FOS	Maximum POF	Minimum FOS
Low	Low	1.3-1.4	10-15%	1.05-1.1
	Moderate	1.2-1.3	15-25%	1.0-1.05
	High	1.1-1.2	25-40%	1.0
Moderate	Low	1.4-1.5	2.5-5%	1.1-1.15
	Moderate	1.3-1.4	5-10%	1.05-1.1
	High	1.2-1.3	10-15%	1.0-1.15
High	Low	>1.5	<1%	1.15
	Moderate	1.4-1.5	1-2.5%	1.1-1.15
	High	1.3-1.4	2.5-5%	1.05-1.1

Source: Hawley and Cuning 2017

Notes: %=percent; FOS=factor of safety; POF=Probability of Failure

1. Data confidence in pile material and foundation shear strength parameters

1.13.2.12.3.4 Groundwater and Influence of End Pit Lakes

The groundwater influence on the foundation and dump material characteristics is critical to understanding the expected slope stability. The coarse-grained material in the open pit backfills are expected to be free-draining, and it has been assumed that elevated groundwater pressures will not develop during and post-construction. At the end of the open pit excavation, groundwater levels due to open pit inflows are expected to contribute to the formation of end pit lakes. At that time, the backfills will be buttressed against the opposing bedrock open pit and the lower slopes saturated. Predicted end pit lake elevations are shown in **Figure 1.13-7** and are included in the analyses.

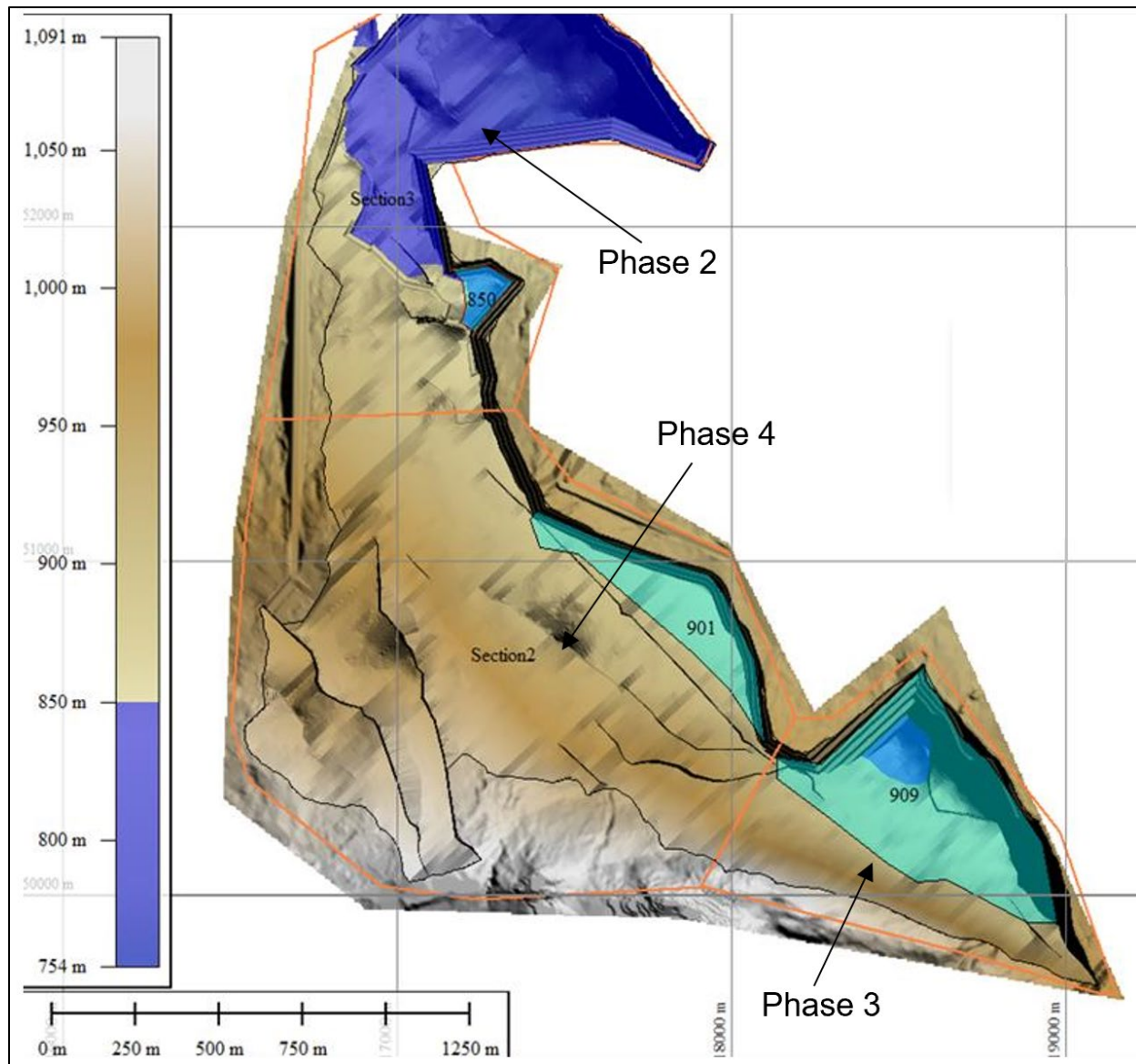


Figure 1.13-7: End pit lake elevations at the end of the Post-closure Phase

1.13.2.12.3.5 Seismicity

Pseudo-static analyses have been performed to assess the end of construction and reclamation configurations consideration to an earthquake event. Probabilistic peak ground acceleration (PGA) values determined by the 2015 National Building Code of Canada (Natural Resource Canada [NRCAN] 2019). The PGA values for 2% probability of exceedance in 50 years; i.e., the 2,475-year return period earthquake event is 0.049 times the force of gravity (g). For these analyses, it is common practice to use 50% of the PGA where there is no threat of liquefaction or severe loss of strength under seismic shaking. The rock is not expected to be susceptible to liquefaction or a severe loss of shear strength through the bedrock foundations. A PGA of 0.025 g (half of 0.049 g) was used in the pseudo-static analyses.

Given the relatively low seismic hazard for the Project Area and an approximate 26.5-year mine operating life, the 2,475 years is considered appropriate period for the end of Post-closure Phase conditions. The 2,475 return period was also selected due to the reduced consequence of failure within the open pit boundaries and that backfills are buttressed during the completion of subsequent mining. The return period for the operational design earthquake is recommended by the (BC MROP 1991) is an earthquake event with a 10% probability of exceedance in 50 years (with a corresponding return period of 475 years).

1.13.2.12.4 Backfill Geotechnical Stability Analyses

Slope stability analyses were carried out to evaluate the backfills during construction, at the end of construction and for the mine closure configuration. The analyzed foundation conditions and groundwater conditions previously described for the open pit slope stability analyses. For the EA backfill design, 2D and 3D LE analyses were carried using the Rocscience programs Slide2 and Slide3 (Rocscience 2020), under for both static and pseudo-static conditions (both the end of the Operation, and Decommissioning and Reclamation Project phases). SRK's full stability report of all backfills is provided in **Appendix 1.0-I SRK, Tenas Project, Pit Backfill Stability Assessment Report**, attached.

A total of five (5) 2D sections were selected for stability analysis and represented the steepest footwall slope foundations and where the backfill slopes are located closer to the active mining areas. The section locations are shown in **Figure 1.13-8** and include:

- ▶ **Section 1:** Mining Phase 2 Backfill. Although this section was not cut perpendicular to the footwall slope, the purpose was to evaluate the backfill set-back from a locally undercut footwall bench located above the West Management Pond;
- ▶ **Section 2:** Mining Phase 4 Backfill; and
- ▶ **Section 3 to 5:** Mining Phase 3 Backfill.

Two (2) 3D models were also developed to analyze the interim backfilling sequence through the Mining Phase 3 Pit area (**Figure 1.13-9**). An interim excavation and backfilling stage is shown in **Figure 1.13-10**. **Table 1.13-7** summarizes the geotechnical stability results for the backfills.

The results of the 2D stability analyses indicate the proposed rock backfill slopes are expected to achieve the design FOS and POF acceptance criteria, as outlined in **1.13.2.12.3.3**. The analyses evaluated a deeper-seated failure mechanism through the backfill and/or sliding along the footwall foundations that could be considered design constraining and pose a significant risk to people and equipment. Furthermore, pseudo-static analyses were carried for the *end of construction* and *reclamation* configuration, and the results indicate that acceptance design stability conditions are expected under the 2,475 years return period event.

Several during operation analyses were carried out to evaluate backfill performance while they are being built also satisfied the minimum adopted FOS of 1.30. Although shallow slope instabilities can exhibit a lower FOS or POF than those indicated in **1.13.2.12.3.3**, these lower consequence instabilities should be managed by the operational teams as the backfills are constructed.

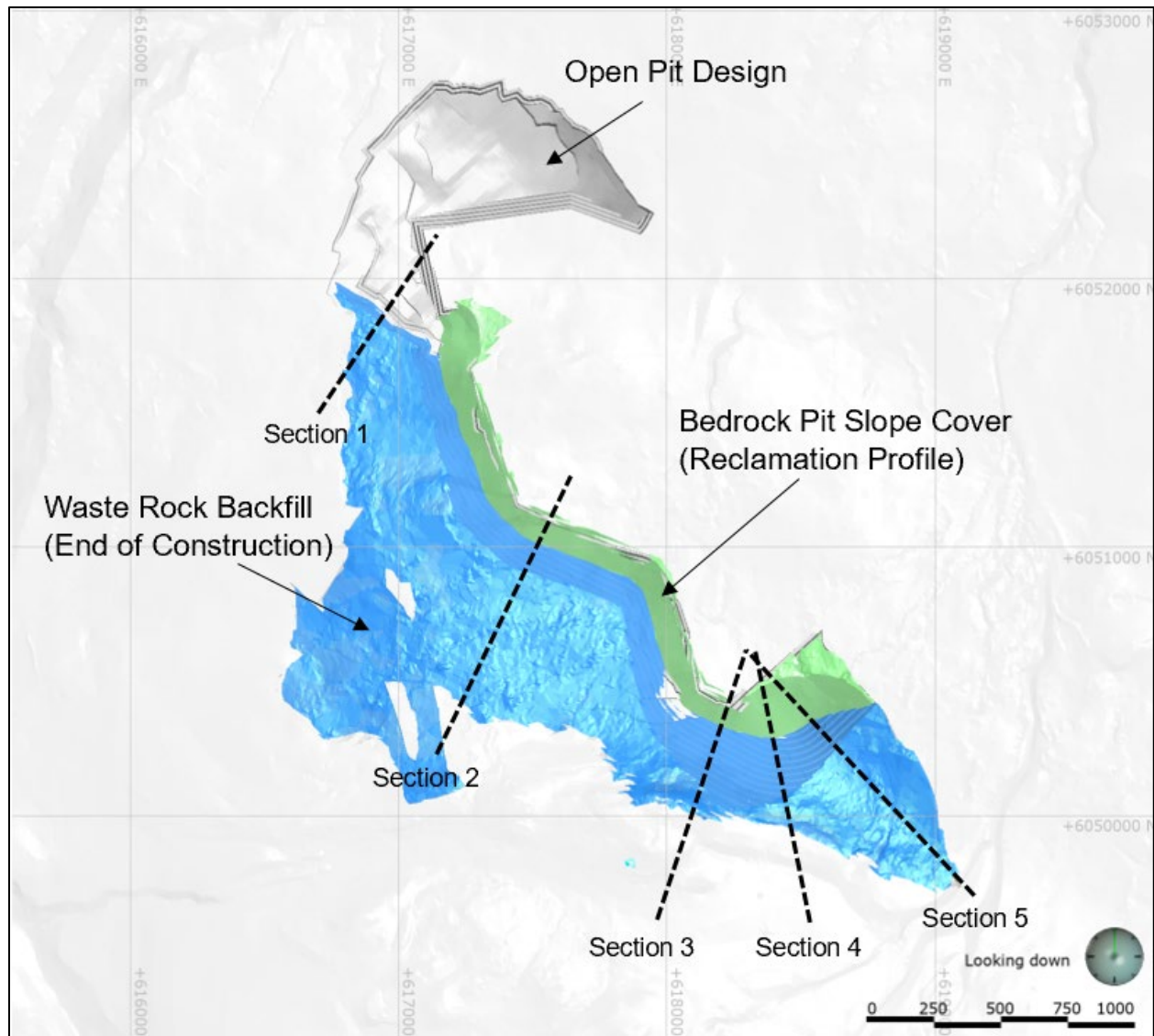


Figure 1.13-8: Location of backfill stability sections within environmental assessment (EA) open pit

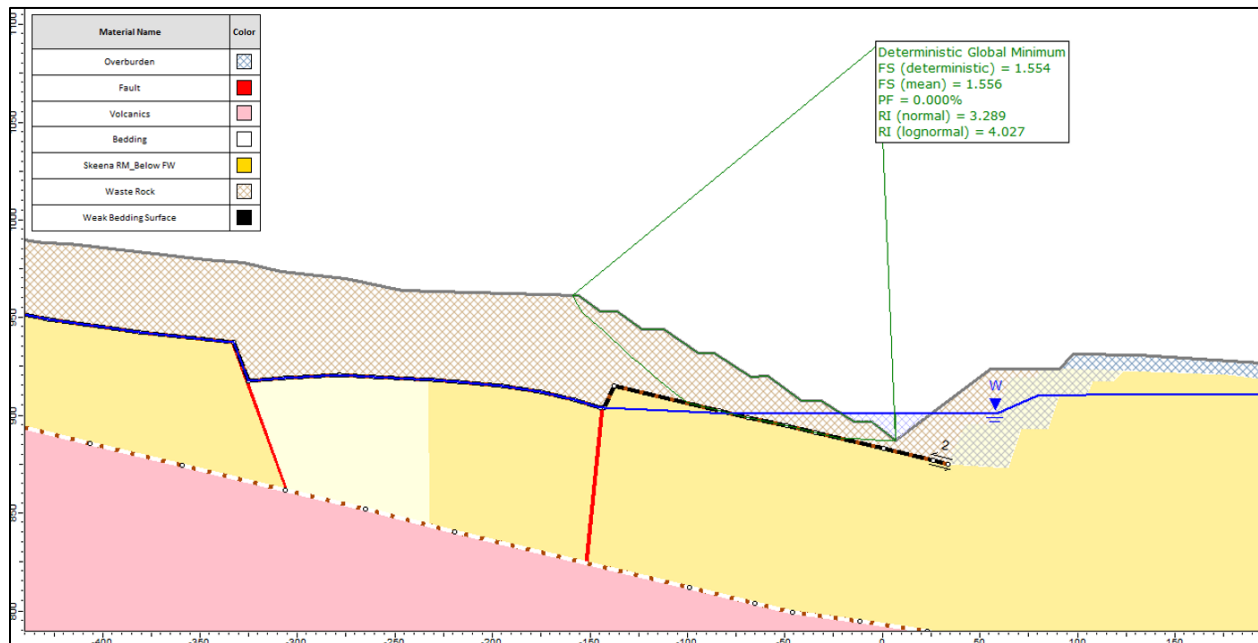


Figure 1.13-9: Backfill section 2 for Phase 4 open pit

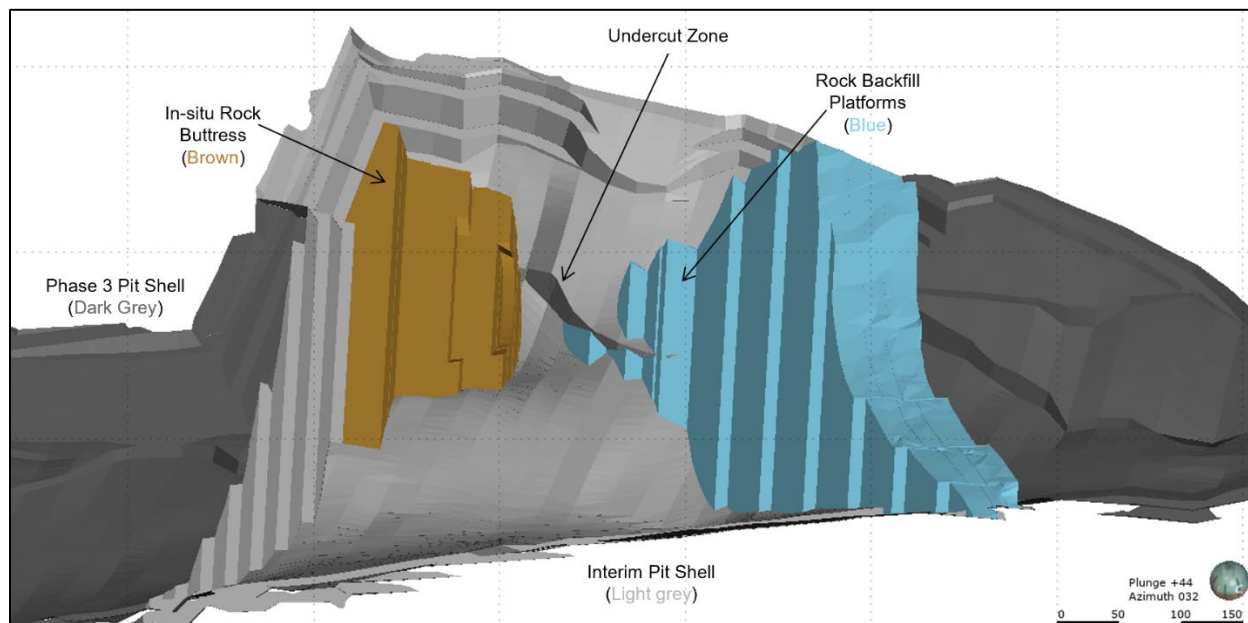


Figure 1.13-10: Schematic showing interim endwall and backfilling within the Phase 3 open pit

Table 1.13-7: Summary of Two-dimensional (2D) Stability Analyses for Open Pit Backfills

Backfill (Mining Phase)	Stability Section	Modelled Slope Height (m)	Modelled Footwall Slope Angle (°)	Construction Stage	Groundwater Conditions	Static Conditions				Pseudo-static Conditions	
						Minimum Acceptable Design FOS	Minimum Modelled FOS	Maximum Acceptable Design POF	Maximum Modelled POF	Minimum Acceptable Design FOS	Minimum Modelled FOS
Phase 2	1	20	5	End of Construction	Footwall elevation	1.3	1.3	10%	3%	1.1	1.3
Phase 4	2	65	10	During Construction	Footwall elevation	1.3	1.8	10%	<1%	n/a	-
		80	13	End of Construction	Footwall elevation	1.3	1.6	10%	<1%	1.1	1.5
		80	13	Mine Reclamation	End pit lake (901 m)	1.3	1.6	10%	<1%	1.1	1.5
Phase 3	3	95	41	End of Construction	Footwall elevation	1.3	1.4	10%	2%	1.1	1.3
		120	41	Mine Reclamation	Footwall elevation	1.3	1.4	10%	<1%	1.1	1.3
		120	41	Mine Reclamation	End pit lake (910 m)	1.3	1.3	10%	5%	1.1	1.2
	4	115	39	End of Construction	Footwall elevation	1.3	1.4	10%	4%	1.1	1.3
		135	39	Mine Reclamation	Footwall elevation	1.3	1.4	10%	4%	1.1	1.3
		135	39	Mine Reclamation	End pit lake (910 m)	1.3	1.4	10%	<1%	1.1	1.3
	5	75	5	During Construction – Stage 3	Footwall elevation	1.3	1.5	10%	<1%	n/a	-
		80	5	During Construction – Stage 6	Footwall elevation	1.3	1.5	10%	<1%	n/a	-
		90	12	During Construction – Stage 8	Footwall elevation	1.3	1.4	10%	<1%	n/a	-
		100	12	End of Construction – Stage 9	End pit lake (910 m)	1.3	1.3	10%	<1%	1.1	1.2
		100	12	End of Construction – Stage 9	Mine reclamation	1.3	1.3	10%	6%	1.1	1.2

Notes: °=degree; <=less than; %=percent; FOS=Factor of Safety; m=metre; n/a=not applicable; P1P – measured long analyzed slope; POF=Probability of Failure

The results of the 3D stability analyses(see **Table 1.13-8**) indicate the proposed interim Mining Phase 3 backfill slopes are expected to achieve the minimum FOS of 1.3 which was adopted for the operation conditions (**Table 1.13-8**). The modelled failures are representative of a consequential of a sliding surface through the backfill rock slopes and/or along the underlying footwall contact that could adversely impact the downslope mining activities, as shown in **Figure 1.13-11**. The modelled failures surfaces are similar in extent and resulting FOS to those evaluated using 2D LE methods provided previously in **Table 1.13-7**.

Table 1.13-8: Summary of 3D Stability Analyses for the Mining Phase 3 Open Pit Backfills

Backfill Mining Phase	Interim Construction Stage	Modelled Slope Height (m)	Construction Stage	Modelled Groundwater Conditions	Static Conditions	
					Minimum Acceptable Design FOS	Critical Modelled FOS
Phase 3	3	75	During Construction	Footwall elevation	1.3	1.5
	6	80	During Construction	Footwall elevation	1.3	1.5

Notes: FOS=Factor of Safety; m=metre

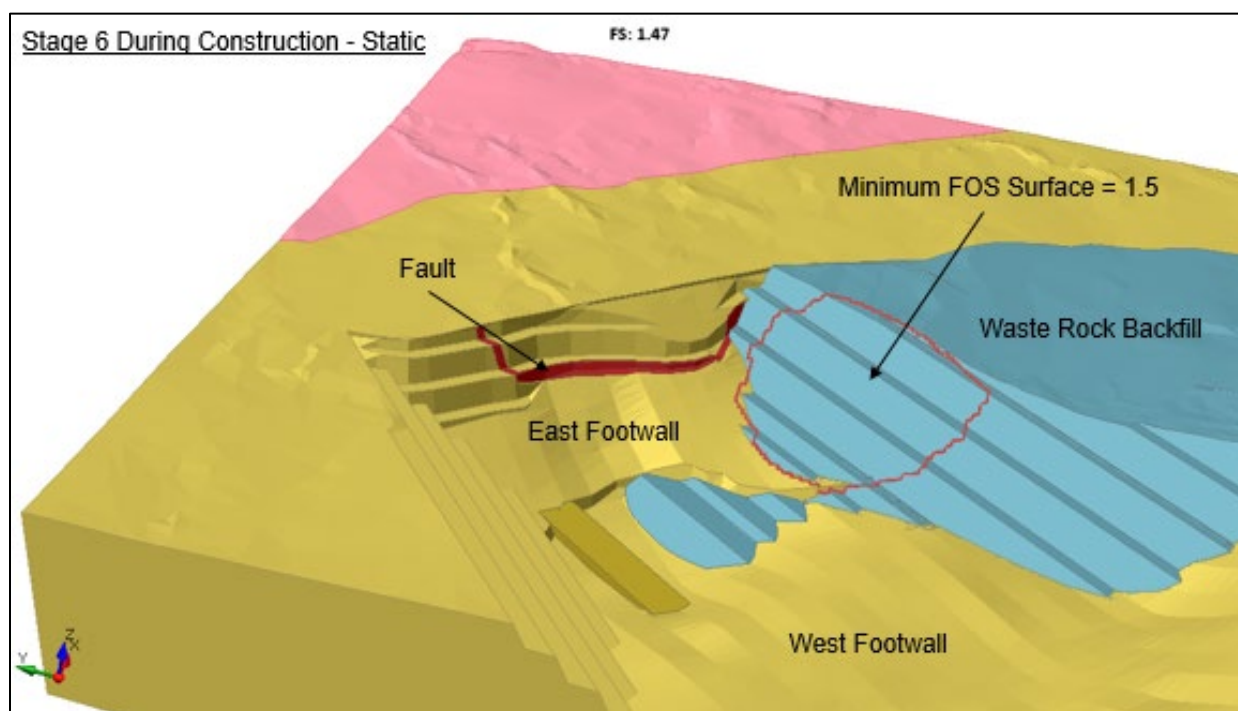


Figure 1.13-11: Slide analyses results for the Mining Phase 3 open pit with Stage 6 backfill as part of the excavation strategy

1.13.2.12.4.1 Backfill Run-out Risks

The results of the stability analyses indicate that acceptable design conditions are expected during construction and in the longer-term for the proposed backfills. This is primarily due to the shallow bedrock

foundations and lower overall slope heights. Given the above considerations, a failure with a significant volume is not expected to contribute to a consequential run-out event that can adversely impact people and equipment.

However, it is acknowledged that there is considerable historical mine material runout records from coal mines in BC. The majority of the recorded BC run-outs have occurred in an expit setting where materials have been channelized, fluidized by substrate, and can flow to significant distances (Hung 2002). At the Project, the inpit backfill platforms are relatively wide and placed onto uniformly shallower sloping footwalls which would encourage spreading of overland debris from an early stage (Hung 2002), should an unlikely event occur. The maximum recommended platform slope height is 40 m which can further reduce failure volumes of a shallower slumping event.

A primary geotechnical goal for the Mining Phase 3 excavation/backfill strategy is to reduce the mining interaction with potential stability/run-out risks as discussed in the previous sections. The backfill platform heights are limited to 20 m and an overall 2.5H:1V slope profile has been incorporated in the Mining Phase 3 mine plan. In the most part, the excavation working benches are to be located above the open pit floor and provides an additional run-out buffer (**Figure 1.13-12**).

Given the need to haul PAG materials from the Mining Phase 3 Pit to the management ponds, there is reduced production pressures to continually short-haul rock between the active excavation face and backfill. Therefore, TCL could tactically place rock (i.e., during night-shift) to minimize mining interactions.

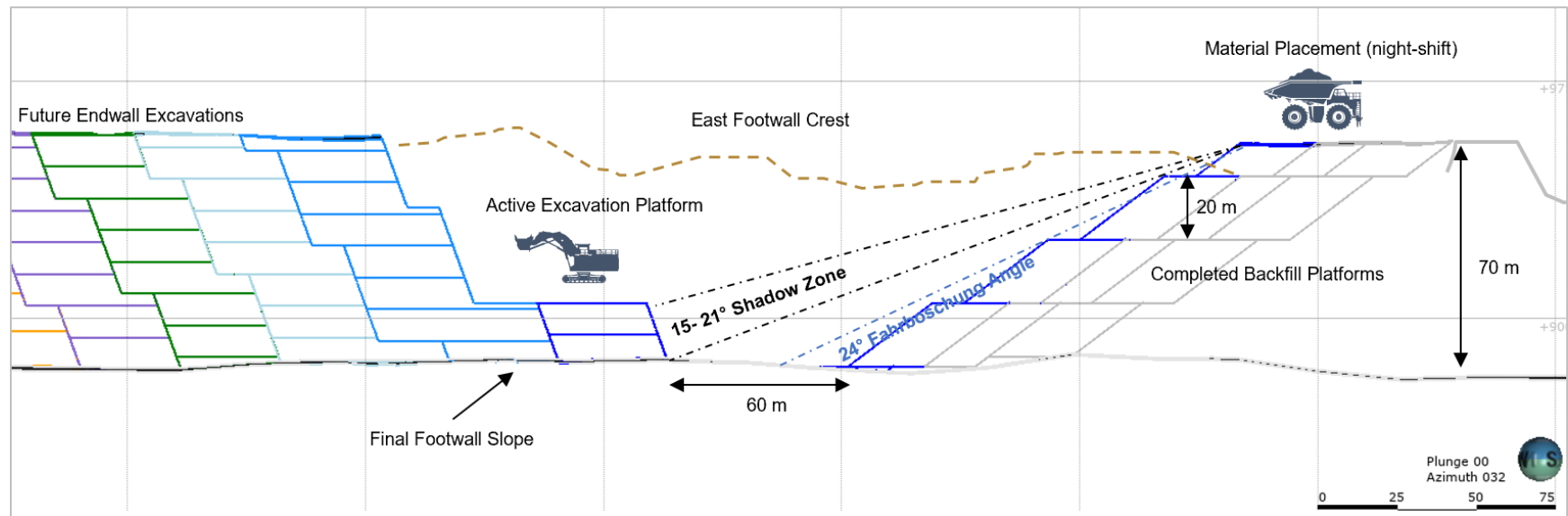


Figure 1.13-12: Schematic showing the mining of Phase 3 (south phase) open pit excavation and backfilling sequence

1.13.2.12.4.2 Backfill Roll-out Risks

TCL will have strict controls in place that will not allow for backfill to be used if mining operations are active below it during the same shift. Prior to mining starting below a backfill, the backfill is to be closed with a physical barrier.

1.13.2.12.4.3 Backfill Risk Assessment

The hazard classifications were used to inform the risk assessment conducted for the various backfills. As part of the risk assessment the following definitions were used for likelihood:

- ▶ **Rare** which is defined as almost no chance of this occurring over the life of the Project;
- ▶ **Possible** which is defined as a chance of the event occurring in the next five years; and
- ▶ **Almost Certain** which is defined as the chance of the event occurring in the subsequent year.

The following definitions were used for consequence:

- ▶ **Insignificant** which is an event that will not cause a property damage or injury;
- ▶ **Moderate** which is an event that will cause a lost time injury; and
- ▶ **Extreme** which is an event that will cause a fatality.

Combining the consequence and likelihood provided together the following overall risk assessment **Table 1.13-9** below that is provided below.

Table 1.13-9: Risk Assessment Table Used for Backfill Classification

Likelihood	Consequence		
	Low	Medium	High
Almost Certain	Moderate	Significant	High
Possible	Moderate	Moderate	Significant
Rare	Low	Low	Moderate

The risk assessment was completed considering the controls and mitigations that would be in place for the backfill piles in question and is summarized by **Table 1.13-10** below.

Table 1.13-10: Risk Assessment Classifications for Backfills for Tenas Project

Backfill (Mining Phase)	Likelihood	Consequence	Risk Assessment
Phase 2 Backfill	Rare	Low	Low
Phase 1 and 4 Backfill	Rare	Low	Low
Phase 3 Backfill	Possible	Low	Moderate

1.13.2.12.4.4 Backfill Monitoring Requirements

Implementation of a monitoring program will be needed to validate the design stability conditions presented above and provide data to reliably predict stability risks. The backfill platforms will be inspected daily for signs of deformation, including tension cracks, over-steepening, and bulging. Third-party periodic inspections will also be carried out by a qualified geotechnical engineer. Several monitoring tools will be used to assist with monitoring such as:

- ▶ Wireline Slope Extensometers;
- ▶ Global Navigation Satellite System (GNSS) Stations; and
- ▶ Prism Monitoring.

A groundwater monitoring network has been established at the Project, and it will be increased to tactically monitor the open pit walls.

1.13.2.12.4.5 Backfill Operating Practices

The following subsection details operational considerations related to the construction and monitoring of the backfill slopes. These aspects are expanded as part of the **Appendix 1.0-lb Tenas Project Ground Control Management Plan**.

1.13.2.12.4.6 Standard Operating Procedures (SOPs)

Standard operating procedures (SOPs) for the backfill construction will be implemented to improve the safety for operating staff who are tasked with building the backfills in the open pit. The SOPs will be implemented prior to construction and approved by a qualified engineer and operating personnel.

1.13.2.12.4.7 Construction Methodology

The backfills are initially constructed over the shallow to moderately sloping footwalls. There may be some shallow slumping as the backfill rock materials are initially placed and loaded on these footwalls. To reduce the risk of instability, bottom-up construction methods will be used where footwalls are steeper and/or located closer to the active mining areas. Bottom-up construction is to be implemented within the lower Mining Phase 3 Pit backfill platforms.

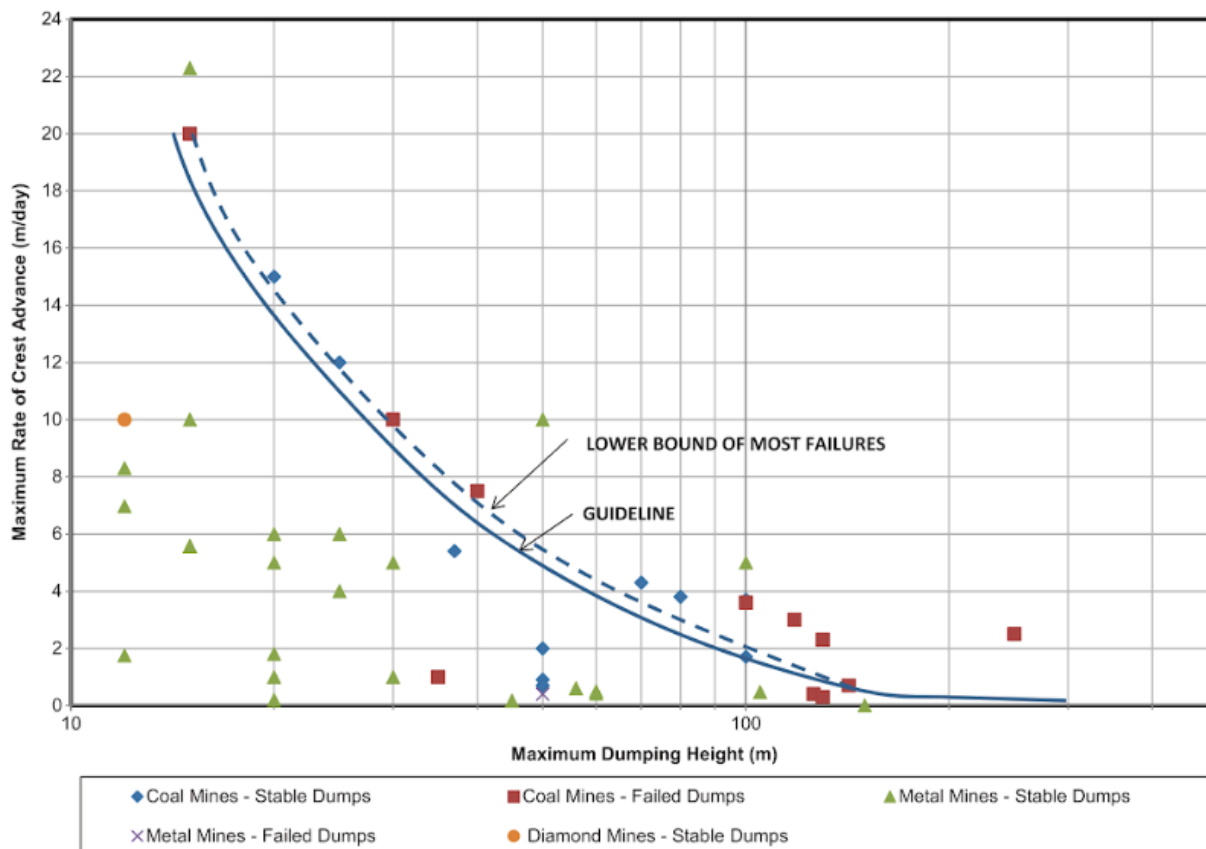
1.13.2.12.4.8 Backfill Material Quality

The quality of materials will be managed during the backfill construction and especially during the initial placement of material. Trained personnel should regularly characterise the materials that are being excavated from the open pit and hauled to the backfill piles. This includes any concentration and rapid advancement with weaker materials. Any overburden should be stockpiled and placed above the earlier completed backfill platforms or placed on completed backfill lifts. Strict controls should be implemented to ensure that overburden is located away from the backfill foundations.

1.13.2.12.4.9 Advance Rates

The backfill headings are generally wide and advance rates should be more-easily managed with the spreading of material across the crest widths. However, there may be circumstances where concentrated material placement occurs over a short duration. The advance rates will be managed and inspected by mine operations regularly.

A case study stability chart for pile height versus advance rate is provided in **Figure 1.13-13** for short-term mine planning guidance (Hawley and Cuning 2017) that will be initially used for the Project. An actual stability relationship between advance rate and pile height is site-specific and will be determined from a site geotechnical inspections and monitoring data collected from operation.



Source: Hawley and Cunninq 2017

Figure 1.13-13: Plot of pile crest advance rate versus pile height

1.13.2.12.4.10 Seasonality

During the winter seasons, the shallow foundation conditions can become frozen, and instabilities have sometimes occurred where foundations have been quickly loaded during winter and the shallow frost zone has limited time to dissipate any elevated pore pressure, resulting in a loss of shear strength. As such backfills will be planned as a bottom dump methodology and on shallower slope during winter conditions to mitigate this risk.

1.13.2.13 *Geohazards for Material Piles and Backfills*

The backfill piles for the Project are located on a shallow sloping plateau located between the Tenas and Goathorn creeks and is not subject to any hazards due to adverse terrain. Furthermore, there are no large watercourses at the upslope end of the piles that would cause mudflows and/or debris flows. Lastly, with the shallow slope present the area is not at risk from avalanches. The only hazards the backfills face

are the ones induced by excavating the open pit which are addressed through the geotechnical analysis conducted by SRK.

1.14 Material Stockpiles

The number and location of material stockpiles was affected by the material types present for this Project. Based on the work completed to date, TCL has identified several types of material associated with coal extraction that will need to be temporarily stockpiled:

- ▶ **Reclamation materials (surface soils, non-PAG)** is the top 0.20 to 0.50 m of material and contains the bulk of organic material and material acceptable for the growth of vegetation. There is approximately 2.24 million m³ of this material. This material will be stockpiled in designated locations for reclamation activities or direct placed on areas available for reclamation material (soil surface) placement;
- ▶ **Processed rock (PAG)** is the rock produced during coal processing to produce a processed coal suitable for the marketplace, that will be separated from the coal through gravity separation methods, such as cyclones. This material is classified as PAG material, as its NPR ratio is <1.2. There will be approximately 6,500 tonnes of this material in stockpile at any one time and this material will need to be turned over every 180 days and placed underwater in the management ponds to eliminate the likelihood of ARD occurring. If a situation arises that excavated ROM coal needs to be stored for longer than 12 months without placed underwater, this material will be rehandled and placed within the management ponds underwater;
- ▶ **ROM coal (PAG)** is the coal that is recovered in the open pit from mining operations and then hauled to the CPP to be placed into one (1) of two (2) stockpiles. These stockpiles are expected to be constantly changing in response to open pit production sequence, marketing requirements, and plant production requirements. There will be approximately 40,000 tonnes of this material in stockpile at any one time and this material will need to be turned over every 180 days and placed underwater in the management ponds to eliminate the likelihood of ARD occurring. If a situation arises that excavated ROM coal needs to be stored for longer than 12 months without being processed, this material will be rehandled and placed within the management ponds underwater; and
- ▶ **Processed coal (PAG)** is the coal after it has been washed in the CPP removing unwanted rock from the coal so that it is suitable for the marketplace. There will be approximately 10,000 tonnes of this material in stockpile at any one (1) time at site and 30,000 tonnes at the Rail Infrastructure and this material will need to be turned over every 180 days and placed underwater in the management ponds to eliminate the likelihood of ARD occurring. If a situation arises that excavated ROM coal needs to be stored for longer than 12 months without being processed, this material will be rehandled and placed within the management ponds underwater.

The majority of salvaged reclamation materials (surface soils) will be temporarily stored in stockpiles for use in reclamation or will be “direct placed” on reclaimed management pond embankments and buttresses and/or backfilled materials. The heights of all reclamation materials stockpiles will be limited to a maximum of 12 m but in general will be 6 m in height and will be developed with 3:1 (H:V) overall slopes to ensure stability. The reclamation material (surface soil) stockpiles will be seeded as they are developed to mitigate potential erosion and sediment generation concerns. During reclamation activities, reclamation materials (surface soils) from these stockpiles will then be excavated, hauled, and placed on backfilled materials and/or completed management pond embankments and buttresses. There are eleven (11) distinct reclamation material (surface soil) stockpiles identified for the Project which are identified as:

1. Reclamation Material (surface soil) Stockpile 1: located at the Rail Infrastructure;
2. Reclamation Material (surface soil) Stockpile 2: located at the Rock Quarry;
3. Reclamation Material (surface soil) Stockpile 3: located at the Gravel Quarry;
4. Reclamation Material (surface soil) Stockpile 4: located along the east part of the TAC;
5. Reclamation Material (surface soil) Stockpile 5: located along the west part of the TAC;
6. Reclamation Material (surface soil) Stockpile 6: located at the Explosive Facility;
7. Reclamation Material (surface soil) Stockpile 7: located at the Explosive Magazine;
8. Reclamation Material (surface soil) Stockpile 8: located at the east side of the North Management Pond;
9. Reclamation Material (surface soil) Stockpile 9: located at the south end of the West Management Pond;
10. Reclamation Material (surface soil) Stockpile 10: located at the south end of the East Management Pond; and
11. Reclamation Material (surface soil) Stockpile 11: located in the central portion of the open pit.

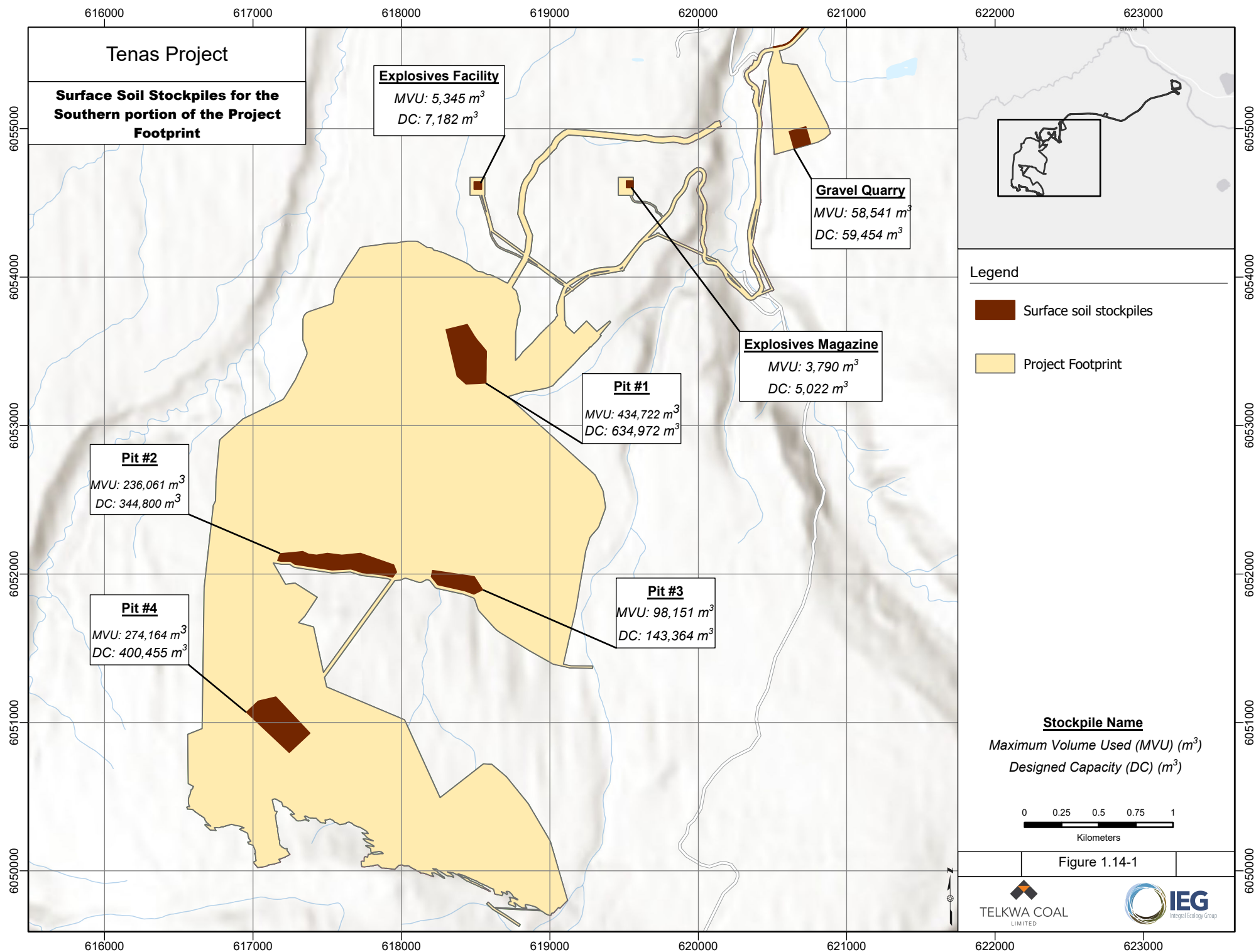
Table 1.14-1 below provides the expected growth medium volumes stored in each of these locations.

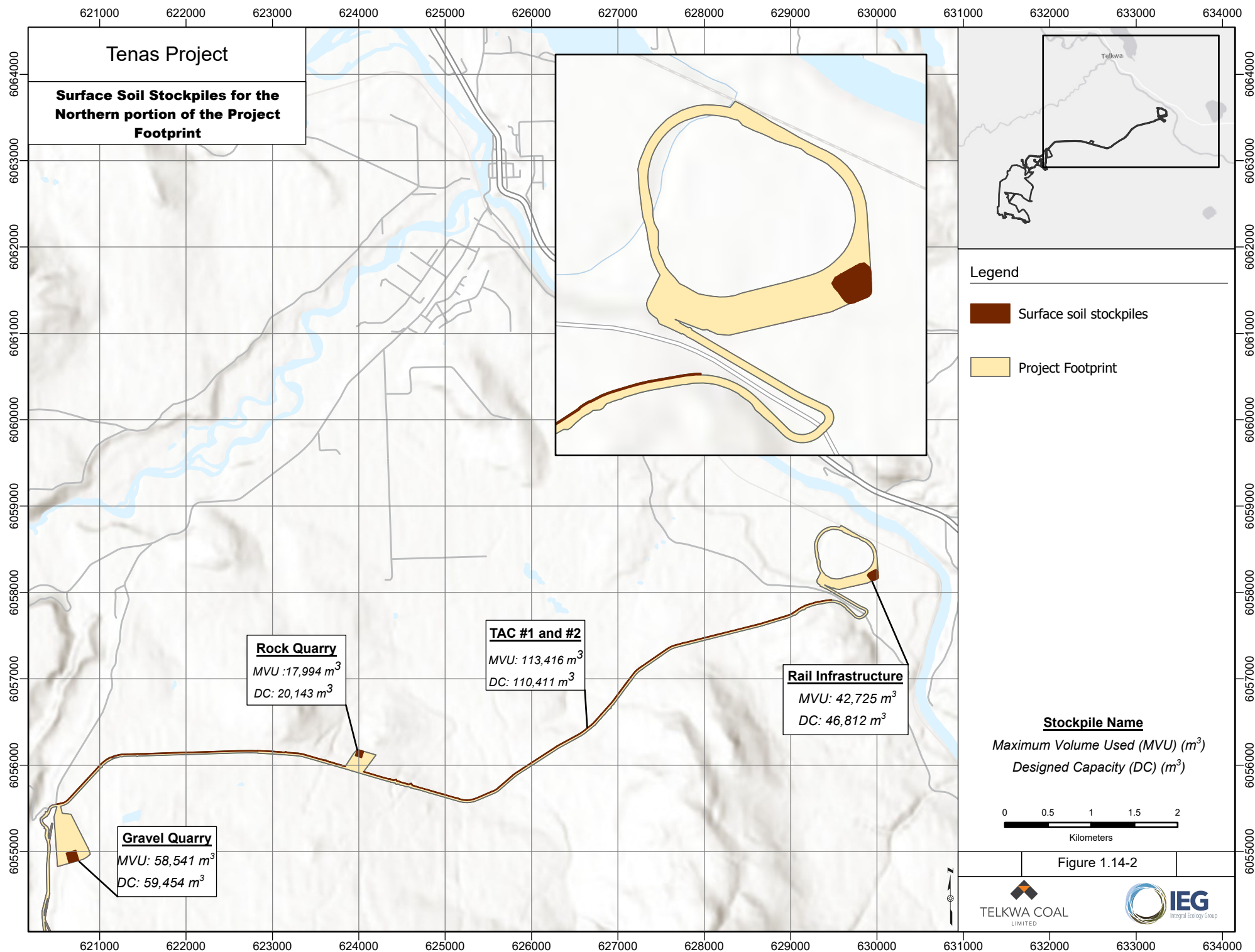
Table 1.14-1: Reclamation Material (Surface Soil) Stockpile Storage Volumes

Reclamation Material (Surface soil) Stockpile Identifications	Designed Storage Capacity (m ³)
Rail Infrastructure	46,821
Rock Quarry	20,143
Gravel Quarry	59,454
Tenas Access Corridor 1	101,197
Tenas Access Corridor 2	9,214
Explosive Facility	7,182
Explosive Magazine	5,022
Pit 1	634,972
Pit 2	344,800
Pit 3	143,364
Pit 4	400,455
Direct Place	491,250
TOTAL	2,263,873

Note: m³=cubic metre

The reclamation material (surface soil) stockpiles and their maximum volume used, and designed capacity are shown by **Figure 1.14-1** and **Figure 1.14-2** below.





Overburden and non-PAG rock will be directed to following two (2) locations:

1. embankments and/or buttresses for the management and control ponds; and
2. backfilling of the open pit.

The backfilling of the open pit will be completed in lifts using a bottom-up approach with an overall slope of 2.5H to 1V, with the non-PAG material being targeted for the base of these piles to promote improved stability. Material destined for the dams around the management ponds will follow the procedures for construction of these structures. Generally, overburden will be destined for the upstream slope of the dam while the non-PAG will be destined for the downstream side of the dam to act as buttressing material. In both instances the material will be placed in lifts with the upstream side being compacted to limit water ingress into the structure.

The PAG material from the open pit will be placed into external flooded management ponds or within flooded portions of the open pit after the material is mined within an average six (6)-month period. PAG material will be placed in lifts and the water level will then be allowed to be raised flooding these lifts. Furthermore, all processed rock generated from the CPP will be backfilled within the management ponds to be immersed underwater. This material will be placed at the same time as PAG rock in lifts within the management ponds.

Any excavated PAG rock will not require stockpiling but will be placed in its final position in the interior portion of the management ponds for the eventual submersion with water.

Any non-PAG rock excavated will not require stockpiling but will be placed in its final position either in the buttress portion of the dam for the management ponds and/or the downstream portion of the dams and/or backfilled into the open pit.

Any overburden excavated will not require stockpiling but will be placed in final position either in buttress portion of the dam for the management ponds and/or upstream portion of the dams and/or backfilled into the open pit.

ROM coal will be placed within two (2) to four (4) stockpiles with a combined storage tonnage of approximately 40,000 tonnes and they will be located adjacent to the feed side of the CPP. The ROM stockpiles will have a target height of 5 m and maximum height of 15 m and will utilize a slope of 37 degrees as these structures are temporary in nature. From the ROM stockpiles, FELs will be used to reclaim material into the CPP.

Processed coal will be placed into a stockpile with a combined storage tonnage of approximately 10,000 tonnes adjacent to the CPP that will be constructed using a radial stacking conveyor and will have a maximum height of 15 m and a slope angle of 37 degrees.

Processed coal will also be placed into two (2) stockpiles at the Rail Infrastructure with a combined storage tonnage of approximately 30,000 tonnes. The two (2) stockpiles at the CPP will have a maximum height of 8 m and again utilize a slope of 37 degrees as these stockpiles are temporary in nature. FELs will be used to reclaim material from processed coal stockpiles located at the CPP into super B-train trucks. The two (2) stockpiles at the Rail Infrastructure will have a target height of 10 m and again they will use a slope of 37 degrees. FELs will be used to reclaim coal from the stockpiles at the Rail Infrastructure into 116-car unit trains.

Processed rock will be placed into a stockpile with an approximate storage tonnage of 6,500 tonnes and located adjacent to the CPP that is constructed using a radial stacking conveyor. The processed rock

stockpile will have a maximum height of 15 m and slope angle of 37 degrees. From here processed rock will be reclaimed using a FEL which will load mine haul trucks and then haul the processed rock to the management ponds where it will be placed inside the management ponds in lifts co-mingled with PAG rock from the open pit for permanent storage underwater.

During Construction, and Operation phases, there may be some minor amounts of overburden that needs to be placed in temporary stockpiles. These stockpiles will be limited to a maximum height of 15 m and a 2.0H to 1V slope will be used for these materials.

1.14.1 Stockpile Design Guidelines

Table 1.14-2 below provides a summary of the design guidelines for the stockpiles for the Project.

Table 1.14-2: Stockpile Design Guidelines

Stockpile Material	Maximum Height Lift (m)	Stockpile Face Slope Angle (°)	Maximum Overall Stockpile Slope Angle (°)
Overburden, if required	6	37	22 (2.5:1)
Rock, if required	12	37	37 (1.30:1)
Reclamation Material (surface soil) Stockpiles	3	27	18 (3:1)
Coal Stockpiles (Run-of-mine [ROM] Coal, Processed Coal, and Processed Rock)	5	37	37 (1.30:1)

Notes: °=degree; %=percent; m=metre

1.14.2 Foundation Characterisation and Material Properties for Stockpiles

The selected geotechnical strength parameters are summarised **Table 1.14-3**.

Table 1.14-3: Geotechnical Strength Parameters for Stockpiles

Material	Unit Weight (kN/m ²)	Friction Angle (°)	Cohesion (kPa)
Overburden	18	30	2
Reclamation Material (surface soil)	15	15	0
Processed Coal	17	30	0
Processed Rock	19	35	0
ROM Coal	17	32	0

Notes: °=degree; %=percent; kN/m²=kilonewton per square metre; kPa=kilopascal

1.14.3 Material Stockpile Geotechnical Stability

The following sections summarize the expected stockpile geotechnical stability.

1.14.3.1 *Stockpile Hazard Rating*

A semi-qualitative Material Pile and Stockpile Stability Rating and Hazard Classification (MPSSRHC) using guidance provided by Hawley and Cuning (2017) was completed. A low rating is assigned to each stockpile primarily due to the relatively small heights and volumes proposed by TCL. No ratings were provided for material piles as there are no external piles proposed by the Project.

1.14.3.2 *Stockpile Stability Analysis*

Stability analyses were carried out using the limit-equilibrium program Slide2 (Rocscience 2020). The analyses were performed to evaluate a range of FOS values for the following stockpile configurations:

- ▶ reclamation materials (surface soils) - 3H:1V slope gradient (18-degree slope angle);
- ▶ ROM Coal – 1.3H:1V slope gradient (37-degree slope angle);
- ▶ processed rock – 1.3H:1V slope gradient; and
- ▶ processed coal – 1.3H:1V slope gradient.

The analyses considered stockpile heights of 6 m (reclamation materials (surface soils) only), 10 m, and 15 m. It is understood that the conveyor spreading equipment will limit the heights of the processed road and processed coal stockpiles to a maximum 15 m high.

The analyses were based on possible failure mechanism that could be consequential to people, equipment, and infrastructure directly downslope of the stockpile. A range of material saturation conditions within the stockpiles, represented as R_u , were analyzed to consider possible longer-term infiltration. For this review, an R_u of 0 is considered dry and an R_u of 0.30 considered partially saturated. It is likely that the coarse rock (i.e., ROM coal, processed rock and processed coal stockpiles) will be drained in the short- and long-term and an R_u of 0 is most representative. Partial saturation of the reclamation material (surface soil) stockpiles may occur through continual infiltration and these structures requires perimeter surface water control and slope profiling to increase run-off away from the critical sloping areas.

The results are summarised in **Figure 1.14-3** to **Figure 1.14-6**. For short-term stockpiles, with lower consequence of failure, a design stability with a FOS greater than 1.1 is considered acceptable. For any long-term stockpile, a FOS greater than 1.3 is considered appropriate for a consequential event.

The results indicate that the reclamation material (surface soil) stockpile slopes are most sensitive to saturation due to the expected finer grained material composition and presence of organics. For a reclamation material (surface soil) stockpiles designed at a 3H:1V profile, groundwater conditions representing at R_u less than approximately 0.3 should be used as a target to validate acceptable design stability conditions (**Figure 1.14-3**). Where a reclamation material (surface soil) stockpile is considered to exhibit a higher slope risk, water level or pore pressure monitoring would be installed to support validation of the saturation conditions. For stockpiles that are to be higher than 6 m in height a catch bench of 25 m should be included between a maximum lift height of 6 m to give an overall slope of 5 to 1.

As discussed, the other stockpiles are expected to be drained the results of an R_u of 0 representative of the design conditions in most cases. The results indicates that a FOS greater than 1.2 was achieved for the processed coal, processed rock and ROM coal stockpile under an R_u of 0. **Figure 1.14-4** through **Figure 1.14-6** provide the sensitivity analysis for the various stockpiles using a 2H:1V slope which is expected to behave like a 1.35 to 1 slope.

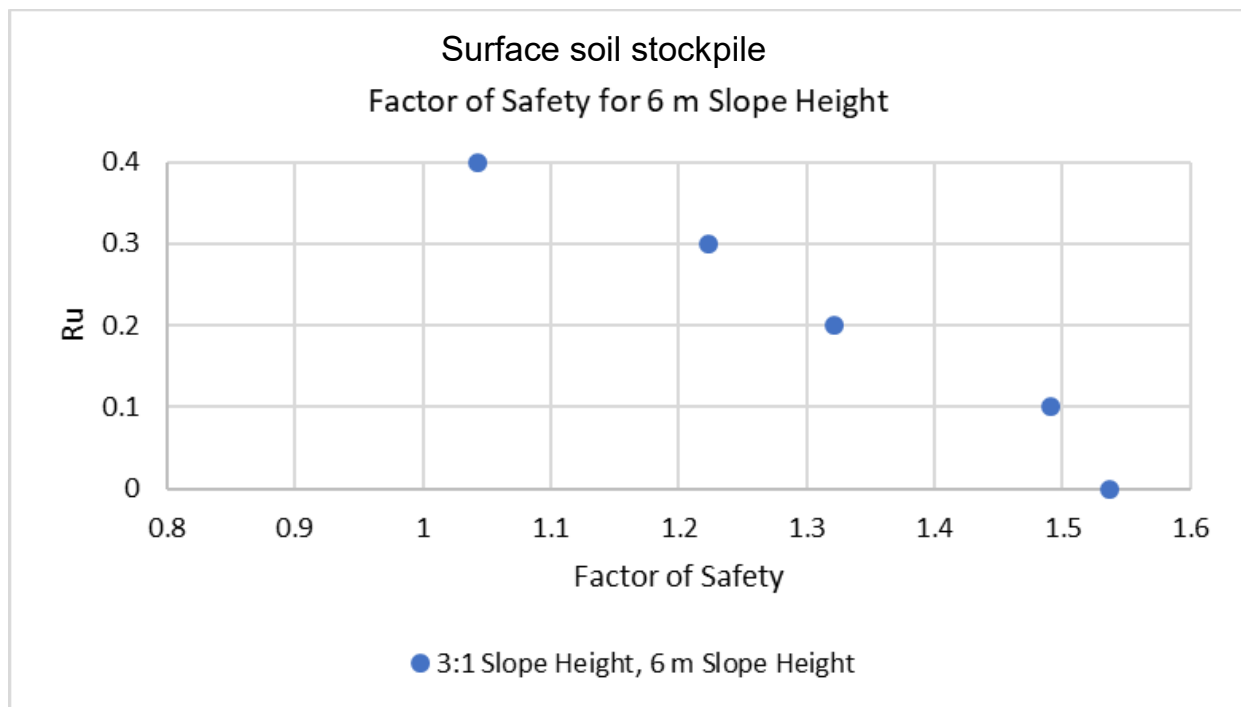


Figure 1.14-3: Reclamation material (surface soil) stockpile stability analyses results

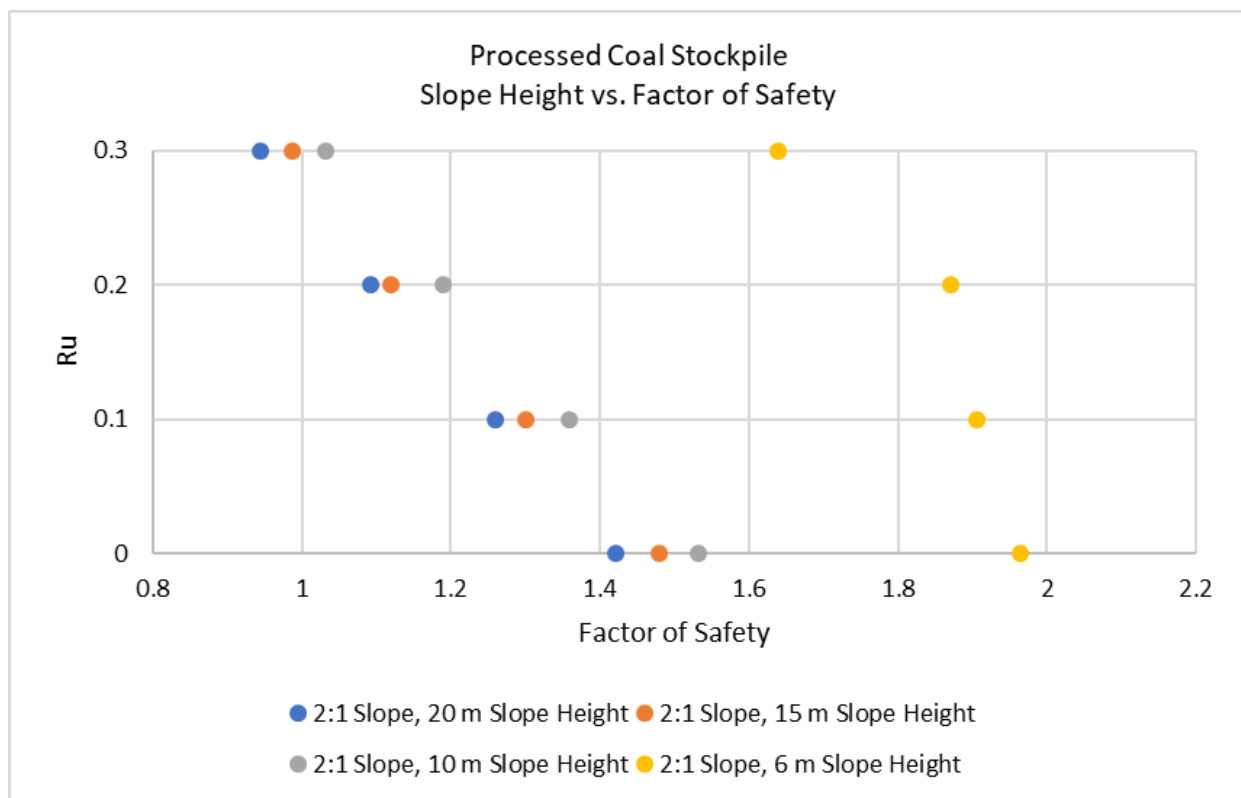


Figure 1.14-4: Processed coal stockpile stability analyses results

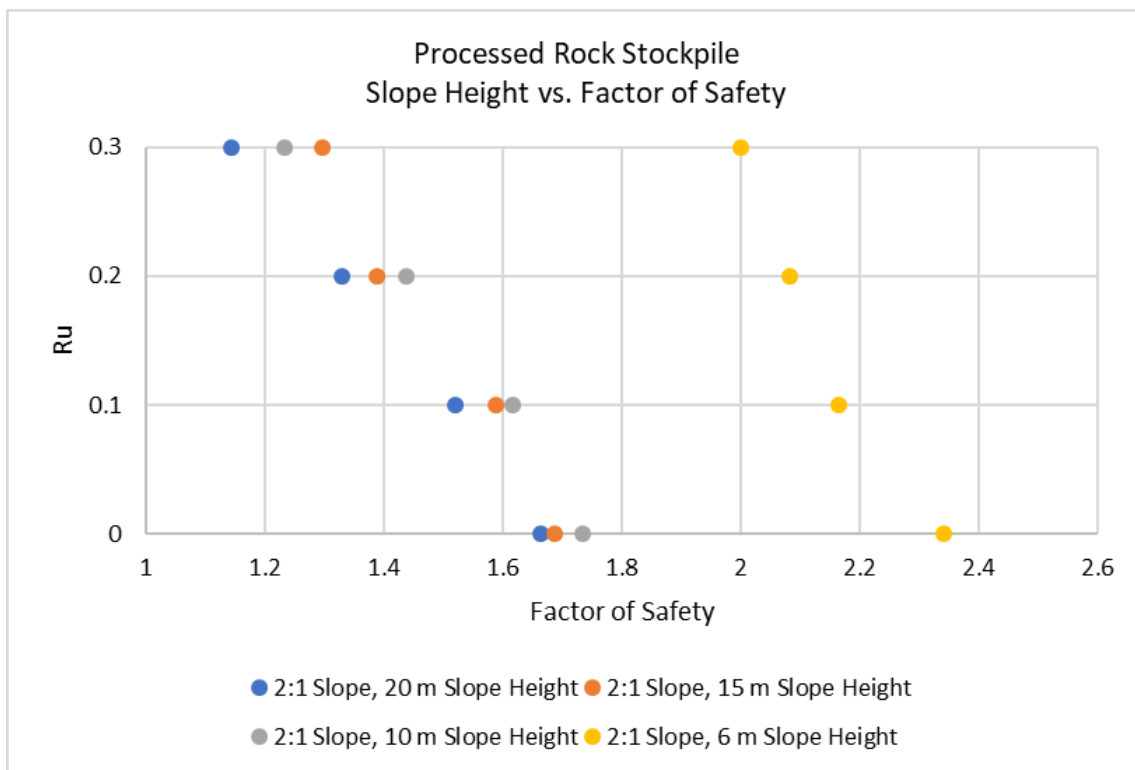


Figure 1.14-5: Processed rock stockpile stability analyses results

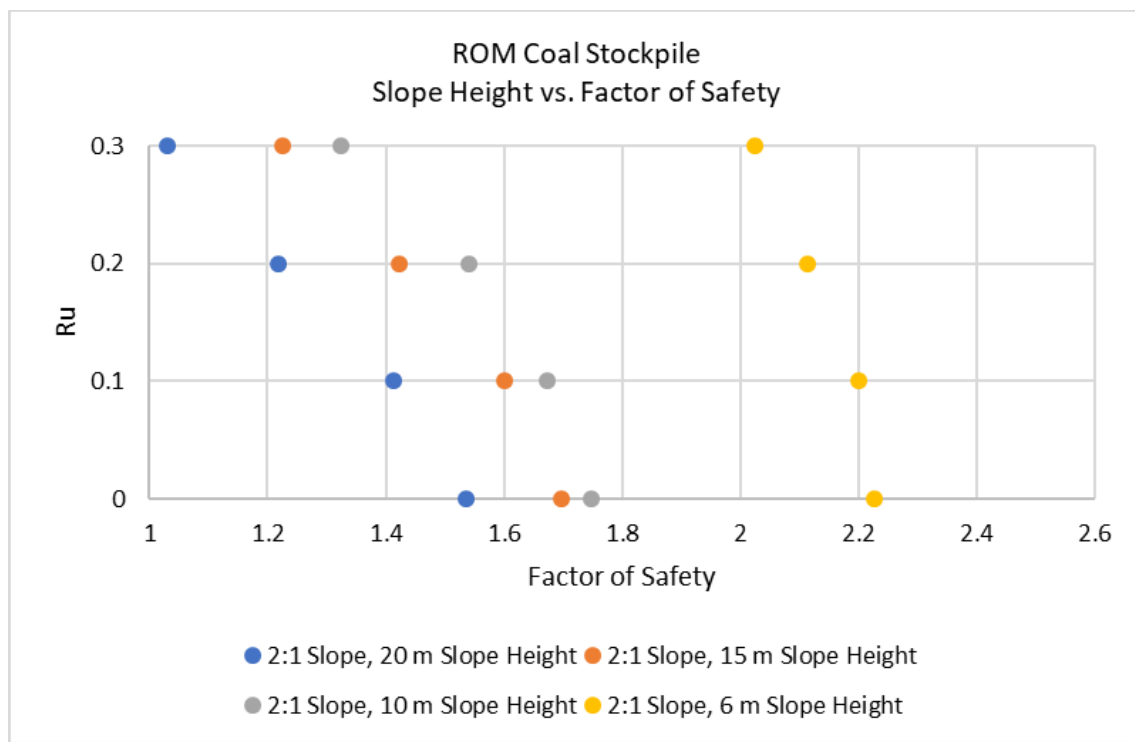


Figure 1.14-6: Run-of-mine (ROM) coal stockpile stability analyses results

1.14.4 Geohazards for Material Stockpiles

The stockpiles for the Project are located on a shallow sloping plateau located between the Tenas and Goathorn creeks and is not subject to any hazards due to adverse terrain. Furthermore, there are no large watercourses at the upslope end of the piles that would cause mudflows and/or debris flows. Lastly, with the shallow slope present the area is not at risk from avalanches. The only hazards the stockpiles face are the ones induced by the management ponds which are addressed through the geotechnical analysis conducted by SRK.

1.15 Coal Processing Plant (CPP) and Associated Coal Handling and Stockpiles

ROM coal will be stockpiled in three (3) to four (4) separate stockpiles depending on coal seams being recovered in the open pit at the CPP. The ROM coal is fed by a FEL into a hopper with a 305 mm by 305 mm grizzly (a type of screening device) to limit the maximum lump size entering subsequent size reduction stage which is being performed by a typical aggregate jaw crusher. The ROM stockpile will be uncovered and have an approximate operating tonnage of 40,000 tonnes. The crushing plant is designed to have a maximum capacity of 175 tonnes per hour (t/h), and will include an interconnecting conveyor, scalping screen, a cone crusher, and a dust suppression system. This crushing plant will reduce the ROM coal to be less than 50 mm; and the crushed 50 mm ROM coal will then be conveyed to the processing circuits.

The CPP will be constructed to process 145 t/h of ROM coal at 5% moisture over the mine life. **Figure 1.15-1** and **1.15-2** below present 3D renderings of the CPP.

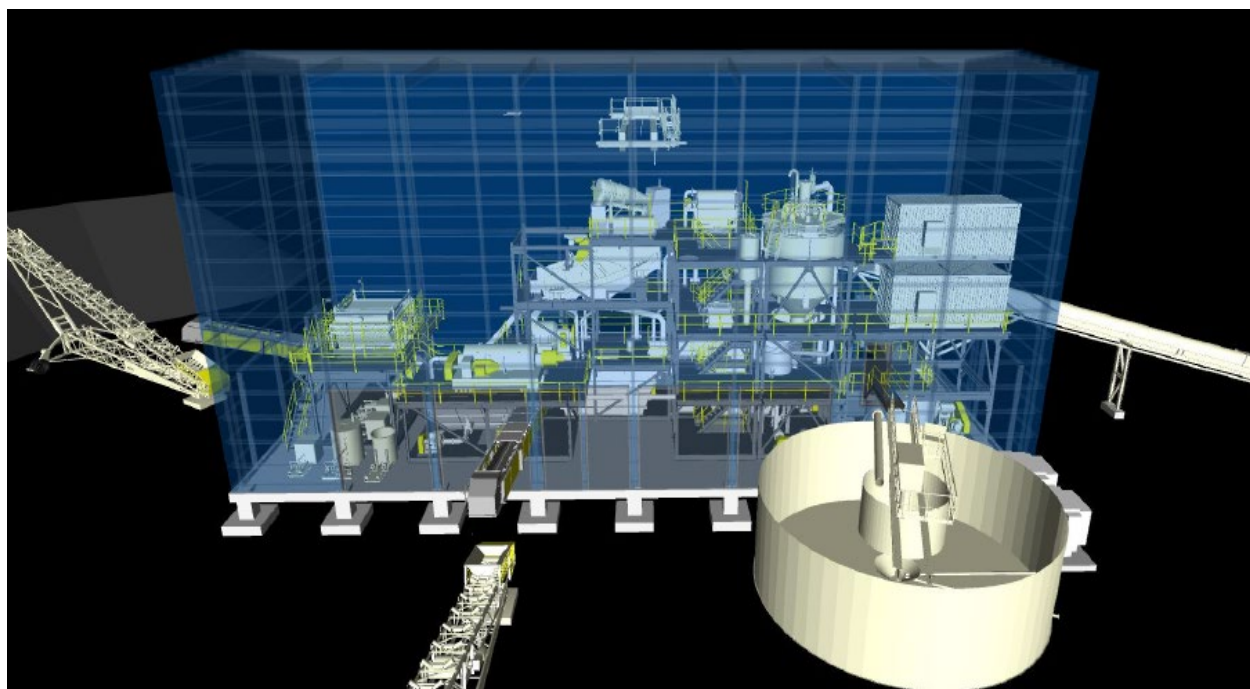


Figure 1.15-1: Coal Processing Plant (CPP) isometric view from the thickener

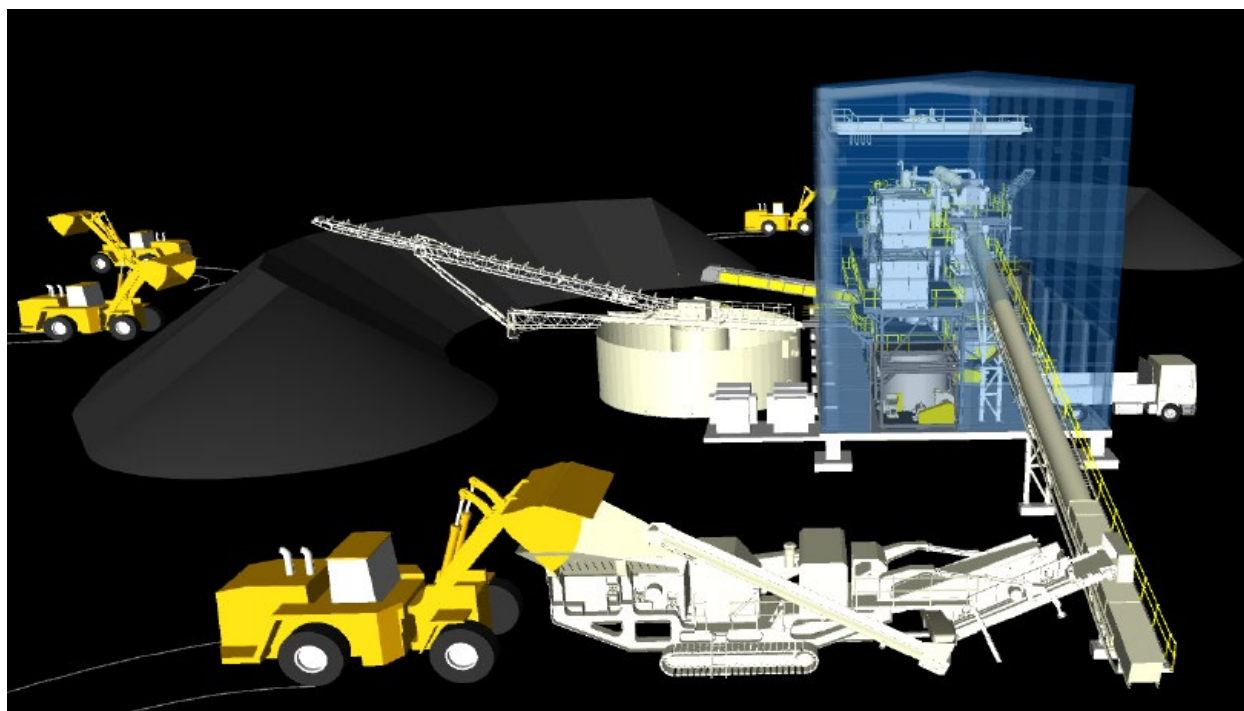


Figure 1.15-2: Coal Processing Plant (CPP) isometric view from the feed point

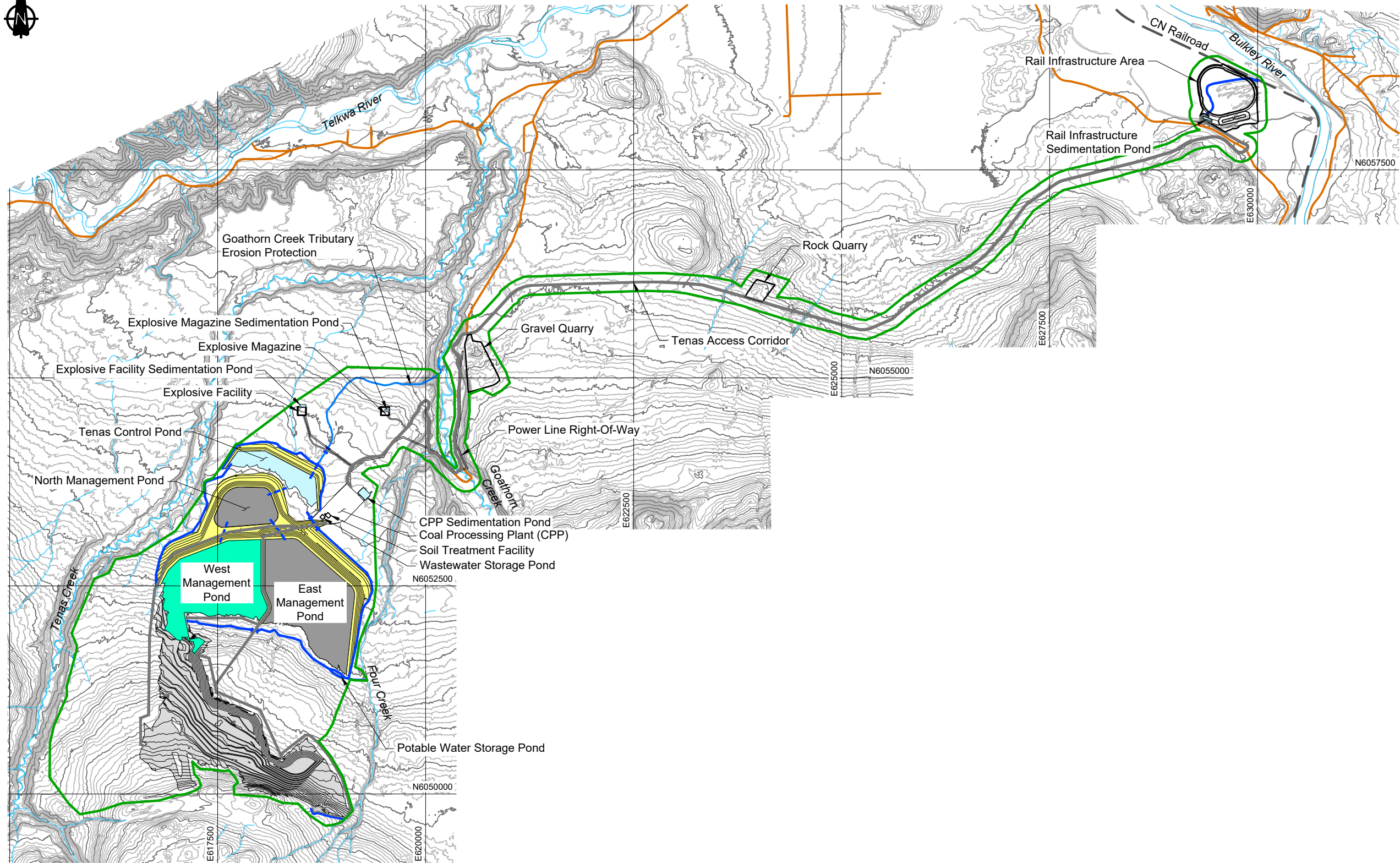
After the coal is crushed and makes its way into the CPP it will have water added to it to allowed to go through the initial screening process to direct ROM coal >0.5 mm to the dense media cyclone (DCM) and ROM coal <0.5 mm to the froth flotation circuit. The plant configuration will be a DMC and flotation plant capable of processing 145 t/h for the entire mine life. The main factor in determining the CPP processing rate was a desire by TCL to use a modular plant to both reduce the upfront capital expenditure and simplify the onsite construction process. After going through the dense media cyclones, the coarse processed coal will be directed to a centrifuge for dewatering requirements while the fine processed coal after the flotation circuit will be directed a screen bowl centrifuge for dewatering before being combined with the coarse processed coal. The processed rock from the coarse circuit will be added to the fine processed rock being produced from the belt filter press to produce a combined material for disposal.

The processed coal will leave the Project with 9.0% +/- 0.5% moisture content, allowing for another 1% of moisture to be added at Ridley Terminals in Prince Rupert, BC due to rainfall which meets the seaborne metallurgical coal moisture guideline of 10.0% +/- 0.5%. A coal processing circuit has been developed to achieve the above quality. The proposed CPP will be similar than other coal plants operating in the province.

1.15.1 Coal Processing Plant (CPP) Location

The CPP is located within the MIC pad which is located approximately 1 km to the northeast of the open pit. This location was selected due to having a relatively flat profile that would require less civil earthworks to construct the pad. This area has also experienced some blowdown of the trees and previous logging so less logging would be required for this location as well.

The location of the CPP facility is shown on **Figure 1.15-3** below.



LEGEND

- Water Management Feature
- Spillway
- Existing Watercourse
- Existing Road
- Proposed Road
- Project Area
- Dam and Buttress
- Sedimentation and Control Pond
- Active Management Pond
- Backfill / NAG Pile
- Covered Inactive Management Pond

NOTES

- Contours shown at 5.0m intervals.
- All dimensions shown in meters unless otherwise stated.
- Mine Infrastructure designs by Telkwa Coal Limited (TCL).

REFERENCE

NAD83 UTM Zone 9.



SRK JOB NO.: 1CT027.003
FILE NAME: 1CT027.003 Overview.dwg



Telkwa Coal

Environmental Assessment

Tenas Project Coal Processing Plant (CPP) Location

DATE:
2022/04/05

APPROVED:
SAB

FIGURE:
1.15-3

Figure 1.15-4 below shows the detailed site plan for the CPP's location. The pre-engineered steel CPP building covers much of the process equipment, with only the thickener tank sitting outside. The raw coal stockpile is located near the ROM coal crusher, from where it is directly fed onto the crushed ROM coal conveyor. Processed coal and rock materials exit the CPP via conveyors to radial stackers, which deposit the processed coal and rock on their respective stockpiles. Heavy vehicle haul roads are used to access both the processed coal and rock loading areas. An Administrative Building along with all other support buildings are located north of the CPP.

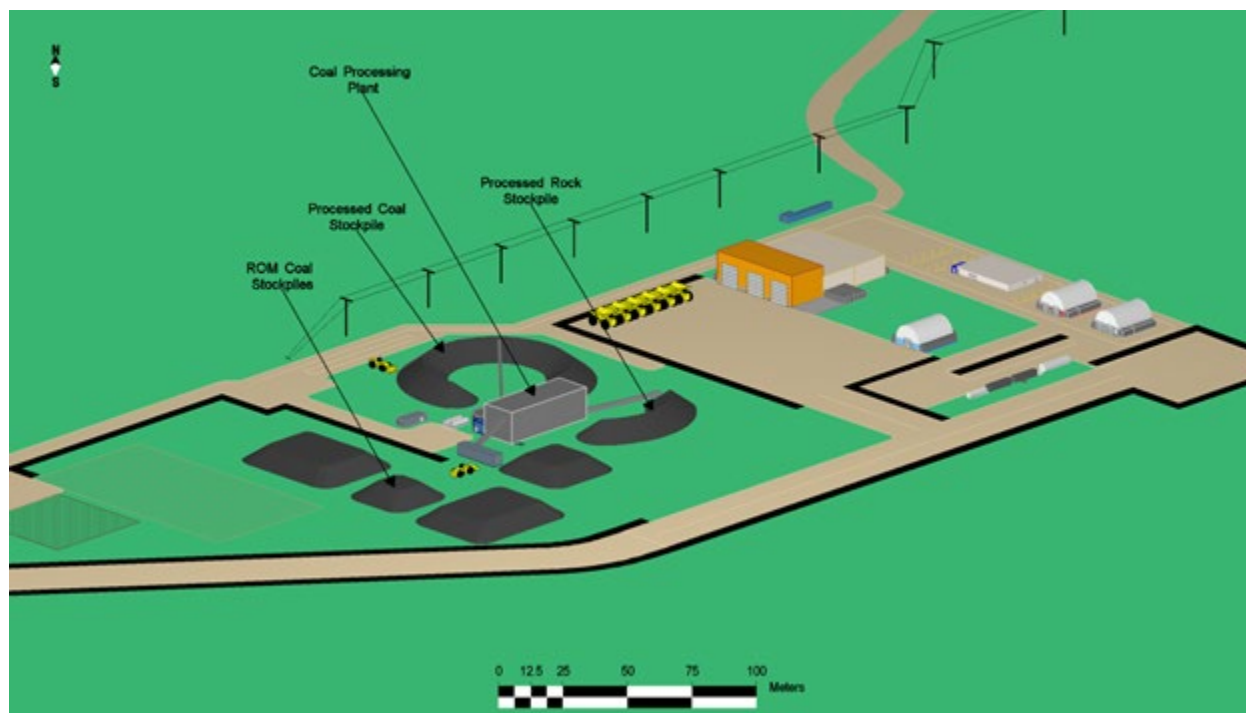


Figure 1.15-4: Tenas Project Coal Processing Plant (CPP) isometric view

1.15.2 Coal Processing Plant (CPP) Design Criteria

The key CPP design objectives for the Project include:

- ▶ the upfront capital cost of CPP construction will be minimized;
- ▶ the CPP will be designed for a minimum 25 year plus operating life;
- ▶ the CPP will be designed for an annual operating run time of 7,200 hours;
- ▶ the CPP module will be designed to receive and process 145 t/h (as received moisture of 5%) of ROM coal;
- ▶ the CPP will be of modular construction to allow the CPP to be relocated in the future if required;
- ▶ the CPP will be of modular construction to allow the CPP to be easily dismantled during the Decommissioning and Reclamation Phase; and

- ▶ the CPP will be designed for a safe and economical operation suited to the seasonal weather conditions.

1.15.2.1 General Site Conditions

General site conditions are outlined in subsections **1.15.2.1.1** through **1.15.2.1.7**.

1.15.2.1.1 Altitude

- ▶ altitude 400 m to 600 m above sea level (masl).

1.15.2.1.2 Temperature

- ▶ January 1% design temperature: -31 degrees Celsius (°C);
- ▶ January 2% design temperature: -29 °C;
- ▶ July 2.5% design dry bulb (DB) temperature: 26 °C; and
- ▶ July 2.5% design wet bulb (WB) temperature: 17 °C.

1.15.2.1.3 Precipitation

- ▶ maximum 15-minute rainfall: 13 mm;
- ▶ one day rainfall: 60 mm; and
- ▶ annual total precipitation: 500 mm.

1.15.2.1.4 Snow and Rail Loads

- ▶ ground snow load for a 1-in-50-year event is 3.5 kilopascals (kPa); and
- ▶ associated rain load for a 1-in-50-year event is 0.2 kPa.

1.15.2.1.5 Wind Loads

- ▶ wind reference velocity pressure (1 in a 10-year event): 0.31 kPa; and
- ▶ wind reference velocity pressure (1 in a 30-year event): 0.40 kPa.

1.15.2.1.6 Seismic Loads

Design Seismic Load Spectral Accelerations (SLS_a):

- ▶ SLS_a(0.2) = 0.11;
- ▶ SLS_a(0.5) = 0.08;
- ▶ SLS_a(1.0) = 0.053; and
- ▶ SLS_a(2.0) = 0.034.

PGA = 0.059 of the force of gravity (g)

1.15.2.1.7 Frost Penetration

The Freezing Index in Smithers, BC is 823 degree-days below 0°C. This equates to frost penetration of 60" or 1.52 m. As the Project is located at a higher elevation than Smithers a frost penetration of 1.83 m shall be used for Project infrastructure designs.

1.15.2.2 Material Properties and Characteristics

Table 1.15-1 below summarizes the solids property values that have been used for the CPP design.

Table 1.15-1: Material Design Criteria for CPP

Parameter	Unit	Value	
Specific Gravity			
ROM coal (as received) (ar)	Relative Density (RD)	1.40 to 1.80	
Crushed ROM coal (ar)	RD	1.35 to 1.68	
Processed coal (ar)	RD	1.30 to 1.60	
Processed rock (ar)	RD	1.60 to 2.26	
Total Moisture			
ROM coal	% (arb)	5	
Processed coal at site	% (arb)	8.5	
Processed coal load into ships	% (arb)	10	
Processed rock	% (arb)	35-40	
Air Dried Moisture			
ROM coal	% (arb)	1	
Processed coal	% (arb)	1	
Bulk Density		Volume Design	Mass Design
ROM coal	kg/m ³	900	950
Processed coals	kg/m ³	850	970
Coarse Processed rock	kg/m ³	1100	1300
Fine Processed rock	kg/m ³	1000	1300
Angles of Repose and Withdrawal		ROM Coal	Processed Coal / Rock
For lateral extent (perm structures)	°	36	36
For vertical heights	°	40	40
For capacity	°	37	37
Withdrawal angle	°	65 to 68	65 to 68
Angle of Surcharge			
ROM coal	°	20	
Processed coal (100% minus 50 mm)	°	20	

Parameter	Unit	Value
Processed Rock	°	20
Ash (Rock) Content		
ROM coal	% (arb)	15-30
Processed coal	% (arb)	7-12
Hardgrove Index (HGI)		
ROM Coal	Index	65-85
Uniaxial Compressive Strength (UCS)		
ROM Coal	MPa	<50
Dilution material (maximum)	MPa	>50
Dilution proportion		
ROM coal	%	Between 5%-25%
Materials	Sandstone, siltstone, mudstone, shale, various surface soils; Clay, till, sand, gravel	N/A

Notes: %=percent; arb=as received basis; kg/m³=kilogram per cubic metre; MPa=megapascal; RD=relative density; ROM=run-of-mine

1.15.2.3 Coal Processing Plant (CPP) Process Design Criteria

For the design of the CPP, coal quality sizing, and yield windows have been assumed based on a similar Canadian coal processed within the province of BC and from the site-specific test work completed on the Project. The coal sizing and yield windows designed for the CPP are summarized in **Tables 1.15-2** and **1.15-3** below.

Table 1.15-2: Process Mass Percent Distribution Between Coal Processing Plant (CPP) Circuits

Process Circuit	Size Range	Finest (%)	Nominal (%)	Coarsest (%)
DMC circuit	-50 mm + 0.5 mm w/w	79.1	84.2	88.4
Flotation circuit	-0.5 mm w/w	20.9	15.8	11.6

Notes: %=percent; DMC=dense medium cyclone; mm=millimetre; w/w=weight by weight

Table 1.15-3: Coal Processing Plant (CPP) Yield Window Air Dried Basis (adb)

Process Circuit	Size Range	Min Yield (%)	Nom Yield (%)	Max Yield (%)
DMC circuit	-50 mm + 0.5 mm w/w	56.0	75.0	80.0
Flotation circuit	-0.5 mm w/w	41.0	70.0	75.0

Notes: %=percent; DMC=dense medium cyclone; mm=millimetre; w/w=weight by weight

For the design on the CPP the solids property values and physical properties have been developed based on site specific testing and/or similar coals being processed, and they are summarized in **Tables 1.15-4** through **1.15-11** below.

Table 1.15-4: Solids Density of Materials for the Coal Processing Plant (CPP)

Density	Value	Units
ROM coal	1.40 to 1.80	t/m ³
Crushed ROM coal	1.35 to 1.68	t/m ³
Processed coal	1.30 to 1.60	t/m ³
Coarse processed rock	1.60 to 2.26	t/m ³
Fine processed rock	1.60 to 2.26	t/m ³

Notes: ROM=run-of-mine; t/m³=tonnes per cubic metre

Table 1.15-5: Bulk Density of Materials for the Coal Processing Plant (CPP)

Bulk Density	Volume Design	Mass Design	Units
ROM coal	0.90	0.95	t/m ³
Crushed ROM coal	0.90	0.95	t/m ³
Processed coal	0.85	0.97	t/m ³
Coarse processed rock	1.10	1.30	t/m ³
Fine processed rock suspension	1.00	1.30	t/m ³

Notes: ROM=run-of-mine; t/m³=tonnes per cubic metre

Table 1.15-6: Angles of Repose for Materials at the Coal Processing Plant (CPP)

Angles of Repose	ROM Coal	Processed Coal	Coarse and Fine Processed Rock	Units
For capacity (nominal)	37.0	37.0	37.0	Degrees

Note: ROM=run-of-mine

Table 1.15-7: Hardgrove Index (HGI) for Coal Processing Plant (CPP) Design

Hardgrove Index	Value
ROM Coal	60-85

Notes: ROM=run-of-mine

Table 1.15-8: Uniaxial Compressive Strength (UCS) for Materials for Coal Processing Plant (CPP) Design

Uniaxial Compressive Strength	Value	Units
ROM Coal	<30	MPa
Dilution rock	>30	MPa

Notes: >=greater than; <= less than; MPa=megapascal; ROM=run-of-mine

Table 1.15-9: Particle Size for Coal Processing Plant (CPP) Design

Feed Stream	Value	Units
ROM maximum lump size	500 x 500 x 500	mm
ROM nominal top size (d95)	500	mm
CPP feed nominal top size (d95)	50	mm

Notes: CPP=Coal Processing Plant; d95=size that 95% of material is less than; mm=millimetre; ROM=run-of-mine; X=multiplied by

Table 1.15-10: Total Moisture for Coal Processing Plant (CPP) Design

Total Moisture (as)	Value	Units
Raw coal	5.0	%
Processed coal at the plant	9.0	%
Processed coal at the port	10.0	%
Coarse processed rock	12	%
Fine processed rock	35	%
Combined processed rock material	22	%

Note: %=percent; as=American Standard

Table 1.15-11: Dilution Material Performance Objectives for Coal Processing Plant (CPP) Design

Dilution Material by Volume	Value	Units
Maximum proportion in the rom coal	5-25%	%
Material types	Siltstone, sandstone, mudstone, shale, clay, till, sand, gravel	n/a

Note: %=percent; n/a=not applicable

1.15.2.4 Coal Processing Plant (CPP) Capacity and Operating Inputs

The capacity and operating criteria for the CPP are outlined in **Table 1.15-12** below.

Table 1.15-12: Coal Processing Plant (CPP) Capacity and Operating Data

Criteria	Life-of-mine (LOM)
Stockpiles	
ROM coal capacity (nominal)	40.0 kt as received (ar)
Processed coal capacity at CPP (nominal)	10.0 kt (ar)
Processed coal capacity at Rail Infrastructure (nominal)	30.0 kt (ar)
Processed rock capacity at CPP (nominal)	6.5 kt (ar)
ROM Coal Handling	
ROM grizzly	slotted 600 mm aperture

Criteria	Life-of-mine (LOM)
ROM nominal top size (d95)	500 mm
ROM coal CPP feed nominal top size (d95)	250 mm
CPP feed conveyor nominal capacity	145 t/h (as)
ROM coal truck specification	90-tonne truck
ROM coal feed loader specification	6.4 to 7.7 m ³ loader
Coal Processing Plant	
CPP capacity	145 t/h (as)
Fine processed rock filter design capacity	12 t/h (as)
CPP process water make-up required	130 L/ROM tonne
Processed Coal Handling	
Processed coal conveyor capacity	120 t/h (as)
Processed coal stockpile capacity	10,000 tonnes
Processed coal bin capacity	n/a
Processed coal truck specification	Super B-train trucks – side dump configuration
Processed coal haulage to Rail Infrastructure distance	16.0 km
Processed Rock Handling	
Plant rock conveyor capacity	46 t/h (as)
Plant rock conveyor capacity	6,600 tonnes
Plant rock truck specification	90-tonne truck
Plant rock bin capacity	n/a
Rail Infrastructure	
Rail configuration	2.0 km loop and 0.30 km spur connection
Loadout stockpile size	30,000 tonnes
Loadout stockpile management	Front-end loader
Train loading method	Front-end loader
Train loading rate	500 to 1,200 t/hr
Train size	116 aluminum rail cars, 2 to 3 locomotives
Car size	110 tonnes

Notes: ar=as received; as=American Standard; d95=size that 95% of material is less than; CPP=Coal Processing Plant; km=kilometre; kt=kilotonne; ktpa=kilotonne per annum; L= litre, mm=millimetre; n/a=not applicable; ROM=run-of mine; t/h=tonne per hour

* Dependent on actual yield obtained

1.15.2.5 Coal Processing Plant (CPP) Process Description

The following provides a high-level overview of the CPP functions used for the Project. **Appendix 1.0-N; Sedgman Canada Ltd., Coal Processing Plant Additional Background Technical Information** attached provides further information of CPP details.

1.15.2.5.1 *Run-of mine (ROM) Receiving and ROM Coal Handling*

ROM coal will be delivered from the open pit to ROM coal stockpiles located directly outside of the CPP. ROM coal from the ROM coal stockpile will then be reclaimed by a FEL and transferred to a mobile crushing and screening plant.

This crushing and screening plant reduces the ROM coal delivered by mining to a top size below 50 mm and then directs this material onto the ROM coal conveyor. There will be a 305 mm by 305 mm grizzly over the crushing and screening plant to protect it from oversized material. The ROM coal conveyor will have a ferrous and non-ferrous metal detector to trip the conveyor and prevent damage to downstream equipment in the CPP.

A cross-belt sampler will also be installed on this conveyor after the crushing process to allow for ROM coal sample collection, as well as a weigh scale to control the feed rate.

1.15.2.5.2 *Coal Processing Plant (CPP) Process High Level Flowsheet for a Feed Rate of 145 tonnes per hour (t/hr)*

The CPP will be a DMC/flotation plant, with fine processed rock dewatering by a belt filter press. The CPP process circuits will consist of:

- ▶ DMC: -50 mm + 0.5 mm weight by weight (w/w); and
- ▶ flotation: -0.5 mm w/w.

The block flow diagram in **Figure 1.15-5** below provides a high level CPP process overview.

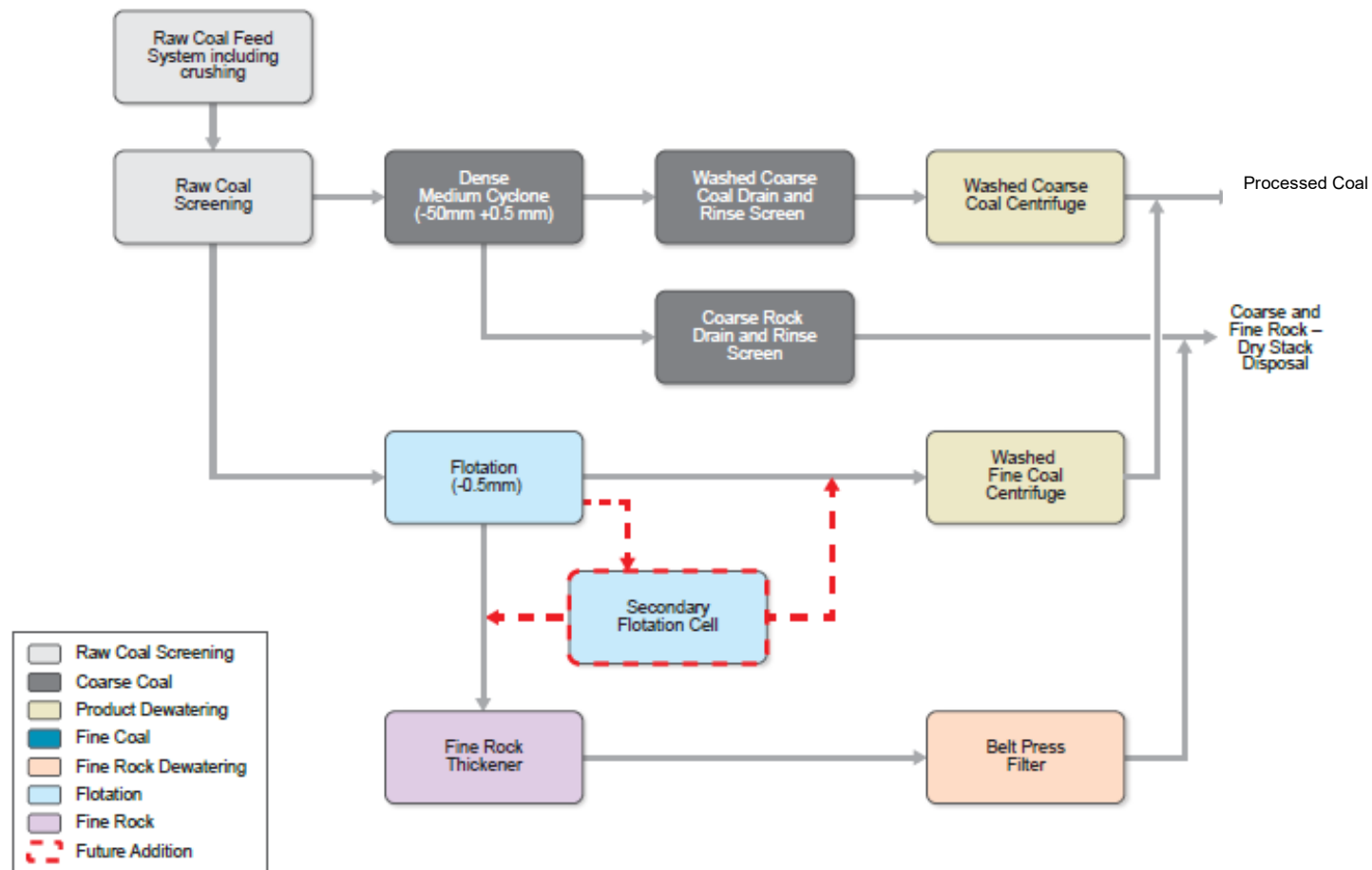


Figure 1.15-5: Dense Medium Cyclone (DMC)/flotation Coal Processing Plant (CPP) block flowsheet schematic

1.15.2.5.3 *Coal Processing Plant (CPP) Detailed Flowsheet for Feed Rate of 145 tonnes per hour (t/h)*

The CPP will reside inside a fully enclosed, heated, and insulated building. This building will incorporate a 5-tonne capacity overhead travelling crane to service the main CPP process modules.

The CPP flowsheet identifying the streams and quantities of equipment is presented in **Figure 1.15-6**, and shows the following main circuits:

- ▶ ROM coal;
- ▶ DMC;
- ▶ flotation;
- ▶ coarse and fine processed rock dewatering;
- ▶ processed coal dewatering;
- ▶ processed coal handling; and
- ▶ coarse and fine processed rock handling.

1.15.2.5.4 Coal Processing Plant (CPP) Feed, Desliming, and Coarse Processed Coal Circuit

ROM coal after crushing will be fed into the CPP via a multi-slope desliming screen and this is where water will be added.

High flow-rate water sprays will assist the desliming operation and the undersize material and water will be collected in the desliming screen underpan and piped into the ultrafine materials feed sump.

Oversize material will discharge from the end of the desliming screen and will be flushed with correct medium into the DMC feed sump.

The DMC feed sump will be of a wing tank design with a constant sump level maintained through excess medium overflow to the correct medium sump. Mixed dense medium and coarse coal will be pumped from the DMC feed sump into a DMC cyclone.

DMC overflow containing medium and processed coal will discharge directly to a screen feed box which will distribute the slurry onto the product side of the partitioned multi-slope drain and rinse screen. Processed coal will discharge from the end of the screen into the processed coal centrifuge for dewatering.

DMC underflow containing medium and coarse processed rock will discharge directly into a feed box which will distribute the slurry onto the processed coarse rock side of the partitioned multi-slope drain and rinse screen. Coarse processed rock will directly discharge onto the coarse processed rock conveyor from the end of the screen.

Medium drained material from the partitioned screen drain section will be returned directly to the DMC feed sump. Adhering medium will be rinsed from the processed coal and reject material by clarified water sprays on the rinse section of the screen. Underflow from the screen rinse section will be piped to the dilute medium sump for magnetite recovery. **Figure 1.15-7** below shows a simplified schematic of the coarse processed coal circuit.

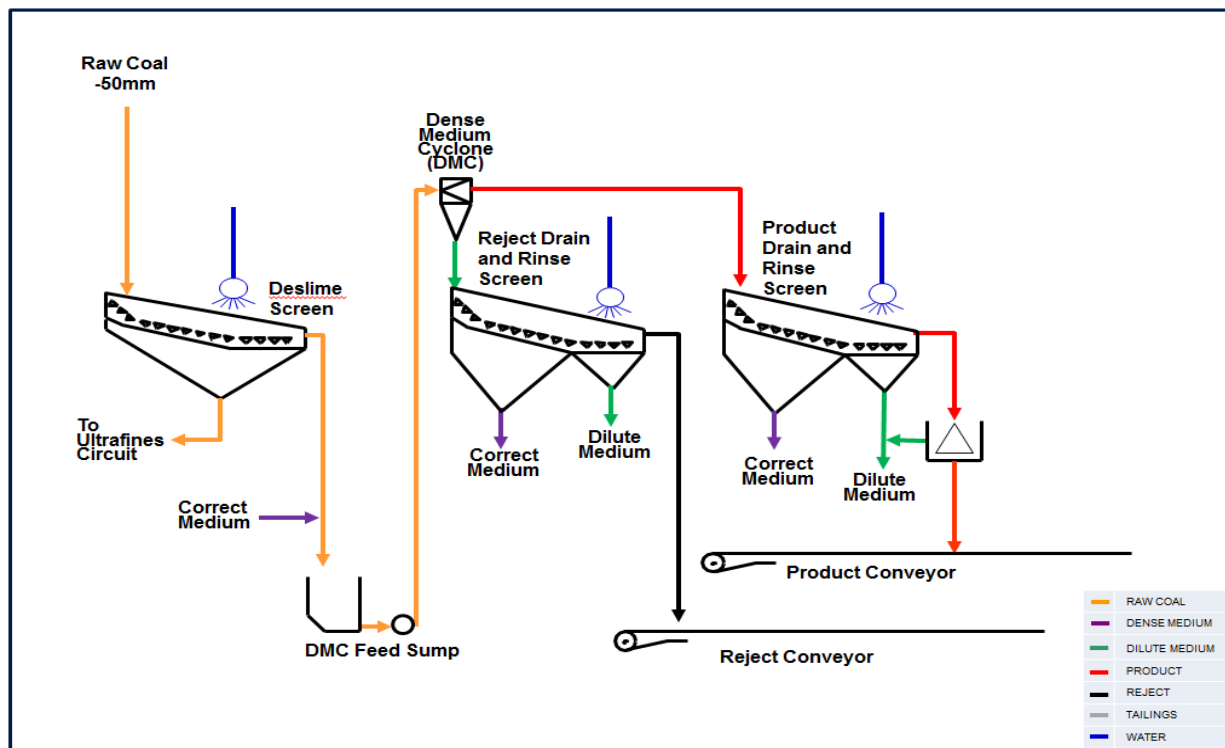


Figure 1.15-7: Coal Processing Plant (CPP) coarse ROM coal circuit schematic

1.15.2.5.5 Coal Processing Plant (CPP) Correct Medium Circuit

The correct medium circuit will be controlled by maintaining over-dense medium in the correct medium sump and injecting clarified water into the suction of the correct medium pump to maintain the target operating density. To maintain over-dense medium in the correct medium sump, a bleed of medium from the screen drain section will be directed to the dilute medium sump where it, together with dilute medium, will be pumped to a magnetic separator and returned to the correct medium sump as a magnetite concentrate with a typical relative density of 2.20 to 2.40.

1.15.2.5.6 Coal Processing Plant (CPP) Fine/Ultrafine Processed Coal Circuit

The flotation circuit will consist of a single air-induced flotation cell. Deslime screen underflow will be piped to the flotation feed sump where collector reagents will be added. The frother agent is injected into the flotation feed pump suction line. The collector reagent used in this process is diesel while the frother reagent is methyl isobutyl carbinol (MIBC). This fine material will then be pumped to the flotation cell. Flotation tailings will report to a flotation underflow box, where the tailings will be split. A portion of the tailings will be recirculated to the flotation feed sump and the rest will be fed to the tailing's thickener.

Flotation concentrate product will gravitate to the screen bowl centrifuge feed sump. The concentrate is then pumped from the screen bowl feed sump to the screen bowl centrifuge for dewatering. Dewatered ultrafine product coal will be discharged from the screen bowl centrifuge onto the product coal conveyor. The centrifuge effluent will be collected in the filtrate sump and will be pumped to the fine rock thickener. **Figure 1.15-8** below shows a simplified schematic of the flotation circuit.

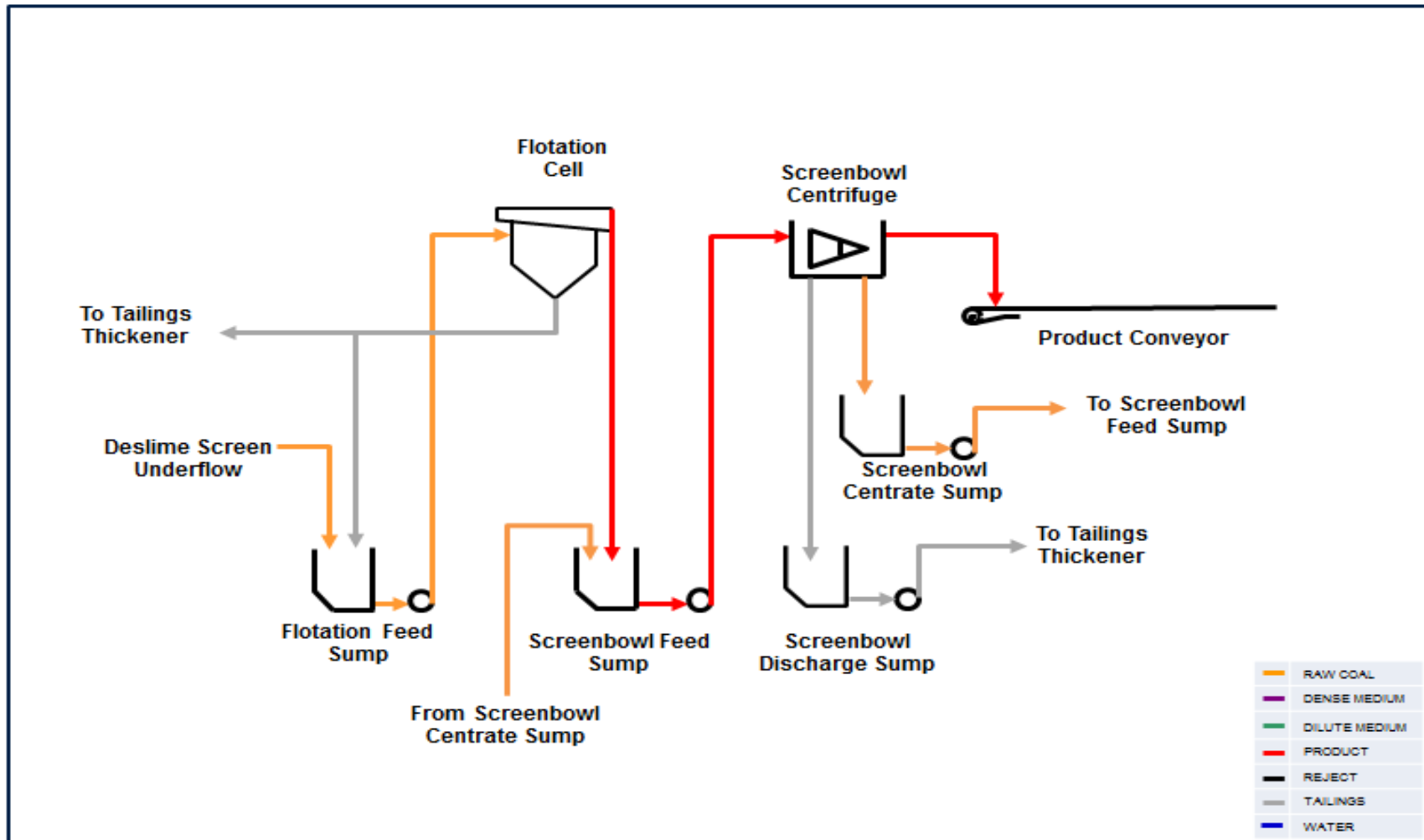


Figure 1.15-8: Coal Processing Plant (CPP) flotation circuit schematic for fine run-of-mine (ROM) coal

1.15.2.5.7 Coal Processing Plant (CPP) Fine Processed Rock (Tailings/Reject) Thickener

Flotation sinks will be directed to the screen bowl which will be fed into the fine processed rock thickener. Both anionic and cationic flocculant will be added to the thickener feed launder to assist with solids settling within the thickener.

Thickener underflow will be pumped to the belt press filter feed sump at approximately 30% weight by weight (w/w) solids. Clarified water will overflow from the thickener into a clarified water tank and will be recirculated through the CPP for most process water requirements.

1.15.2.5.8 Coal Processing Plant (CPP) Belt Press Filter for Dewatering Fine Processed Rock (Tailings/Reject)

Thickened fine processed rock in the belt press filter feed sump will be pumped up to a single-belt filter press by a dedicated feed pump. Both anionic and cationic flocculants will be used to achieve the required fine processed rock dewatering performance.

Belt filter press filter cake with approximately 40% w/w solid will discharge directly onto the coarse processed rock conveyor and belt press filter effluent will report to the filtrate sump and will be pumped back to the fine processed rock thickener.

The coarse and fine processed rock materials will get blended through the transport and placement of this material into the processed rock stockpile at the CPP.

Figure 1.15-9 below provides a schematic of the fine processed rock and belt press filter circuit.

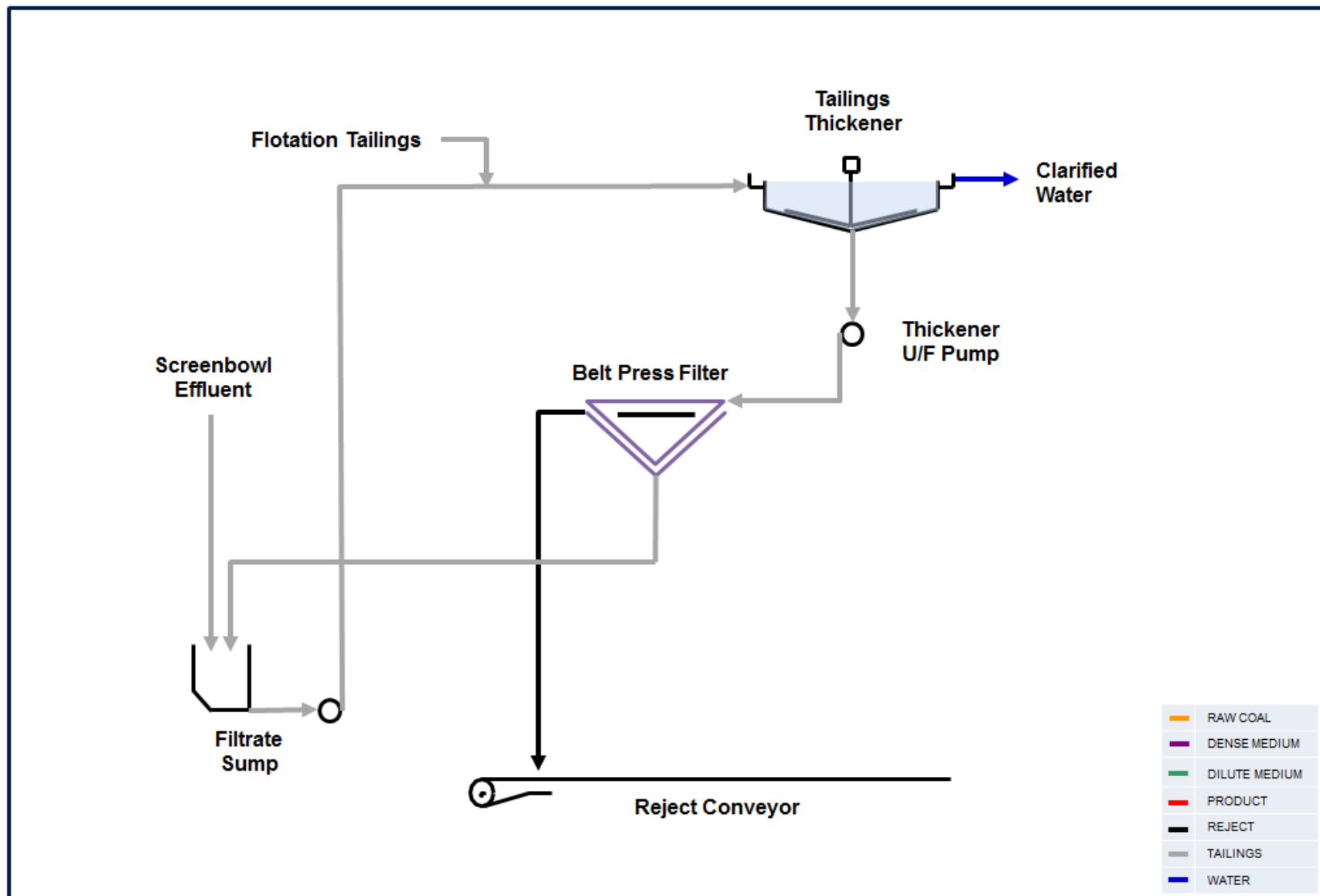


Figure 1.15-9: Coal Processing Plant (CPP) fine processed rock (reject) circuit schematic

1.15.2.5.9 Coal Processing Plant (CPP) Processed Rock Handling (Tailings/Reject)

Fine and coarse processed rock material will be combined on the processed rock conveyor and will be discharged from the CPP onto a radial stacker. The radial stacker will distribute the processed rock into a stockpile. Coarse and fine processed rock material will be reclaimed by a FEL and loaded onto trucks for co-emplacement in the management ponds. There will be a weigh scale installed on the process rock conveyor to record the instantaneous and cumulative tonnes of the CPP rock separated from the coal. In the future, an automatic bin loading system might be installed which would eliminate the requirement of a FEL.

1.15.2.5.10 Coal Processing Plant (CPP) Processed Coal Handling

Coarse and fine processed coal will be combined on the product conveyor and will be discharged from the CPP onto a radial stacker. The radial stacker will distribute the product onto a stockpile. Processed coal will be reclaimed by a FEL and loaded onto trucks, to be hauled to the Rail Infrastructure approximately 16 km away. The product will be stockpiled and then loaded onto the trains using FELs. A cross-belt sampler and weigh scale will be installed on the product conveyor to allow for processed coal sample collection and the instantaneous product rate and cumulative tonnes to be monitored and recorded. In the future, an automatic bin loading system might be installed which would eliminate the requirement of a FEL.

1.15.2.5.11 Coal Processing Plant (CPP) Process Water and Dewatering Requirements

All process water fed into the plant will be reused or recycled or go out with the processed and/or processed rock material streams. The CPP will require 11,375 m³ of process water per month to provide make-up water requirements caused by the difference in processed coal, processed rock, and ROM coal moisture levels. Processed rock will be dewatered using a combination of screen roll centrifuges and belt filter presses depending on the size of the processed rock in question. Coarser processed rock will be dewatered using screen roll centrifuges while a belt filter press will be used for the finer processed rock components. The CPP will require make-up water to replace any water that is entrained in the processed coal and/or the processed rock. The CPP will produce a processed rock material with a moisture content of 20-22% for the combined coarse and fine processed rock components and will be placed into management ponds for permanent storage.

1.15.2.5.12 Coal Processing Plant (CPP) Process Reagents

- ▶ **Diesel:** Used as a flotation collector. Diesel will be stored inside double-walled 20,000 L capacity tanks. Dosing pumps will transfer the diesel from storage tanks to the required dosing points within the flotation circuit. This tank will be in the Process Reagent Storage Site;
- ▶ **MIBC:** Used as a flotation frother (surfactant). MIBC is an organic chemical compound, and a liquid derivative of acetone. MIBC will be stored inside double-walled 20,000 L capacity tanks. Dosing pumps will transfer the MIBC from storage tanks to the required dosing points within the flotation circuit. This tank will be in the Process Reagent Storage Site;
- ▶ **Magnetite:** An iron ore with magnetic properties. It is mixed with water to create a solution which is used to separate coal from rejects. The lighter particles (coal) will float to the top of the solution while the heavier rejects sink to the bottom. Magnetite will be added to make-up for DMC circuit medium losses by hosing bulk magnetite into the coarse circuit process sump. The magnetite will be remotely stored outside on a hard stand area and transported by a skid steer loader to the floor sump for hosing into the circuit. A maximum stockpile of approximately 80 tonnes will be maintained on site which will provide approximately one month of storage. The stockpile will be

located adjacent to the CPP where it can be rehandled with skid steers or small loader to be fed into the magnetite feed hopper which has live storage capacity of 24 hours;

- ▶ **Flocculant:** Used as a clarifying agent to cause the solid particles to aggregate. Both anionic and cationic flocculant is dosed at the tailing's thickener and the belt press filter. The CPP will be fitted with small vendor supplied flocculant preparation and dosing plants. Due to the anticipated dosing rates, anionic and cationic flocculant will be delivered to site in liquid form and stored within 1 m³ totes. Anionic flocculant is a polymer flocculent with a negative charge and cationic flocculant is a polymer flocculent with a positive charge. These flocculants will be stored in totes near or in the CPP;
- ▶ **Dust suppressant:** Floset DC09 (or equivalent) is a concentrated dust suppressant product designed for railcar topcoat applications in dry climates/environments. The product is a synthetic homo polymer that contains no nonyl-phenol ethoxylates, and which is not regulated under Transportation of Dangerous Goods (TDG) and/or BC MOTI. These materials will be stored in the dust suppression sea container located adjacent to the loading area at the Rail Infrastructure and in another sea container located adjacent to the CPP;
- ▶ **Antifreeze:** Flopolymer H44W (or equivalent) is a cold weather dust suppressant/release agent designed for road, conveyor belt, coal truck, and coal car applications. The product has a freeze point of -36°C and can therefore be stored outdoors in unheated tanks. Flopolymer H44W is a vegetable derived product which is suitable to use in even sensitive environmental situations. Most of the product is Glycerol, Canadian Abstract Service (CAS) number 56-81-5. These material will be stored in the side release sea container located adjacent to the loading area at the Rail Infrastructure; and
- ▶ **Radiation sources:** There will be sources of radiation within the CPP. These radiation sources will be used for accurate density measurement of slurries in the coarse circuit (to measure correct medium density) as well as on the thickener underflow. These radiation sources will be as per regulation and have all appropriate marked off sections as per Canadian Standards Association (CSA) standards. The active source will be Cesium-137 or Cobalt-60 as per CSA standards.

1.15.2.5.13 *Coal Processing Plant (CPP) Construction Materials, Construction Methodology, and Foundation Material Characteristics*

The design for the CPP will use a pre-assembled steel modular approach, instead of a traditional wood frame build construction methodology. The pre-assembled modular strategy offers the following benefits:

- ▶ maximizing the offsite pre-assembly of the modules reduces the onsite construction duration, particularly with respect to the low productivity winter months;
- ▶ reducing onsite durations reduces site construction costs;
- ▶ controlling supply and fabricated items together with quality inspections prior to delivery, lowers erection and rework risks on site; and
- ▶ allows easier expansion capability through the addition of pre-fabrication process modules.

Typical CPP modular arrangements are shown in **Figures 1.15-10** and **1.15-11** below.

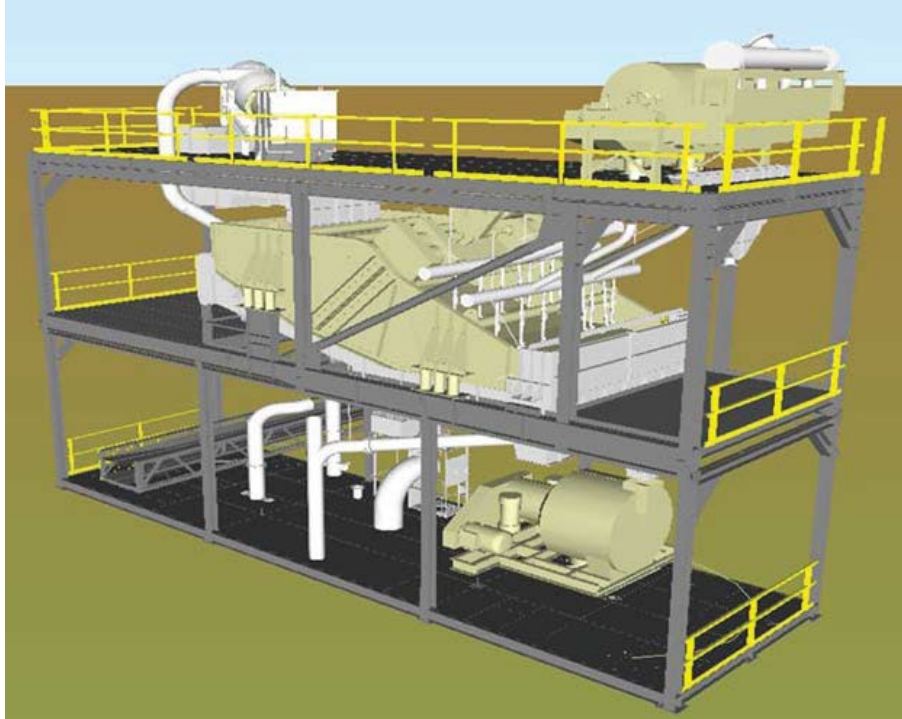


Figure 1.15-10: Coal Processing Plant (CPP) typical modular arrangement sample 1

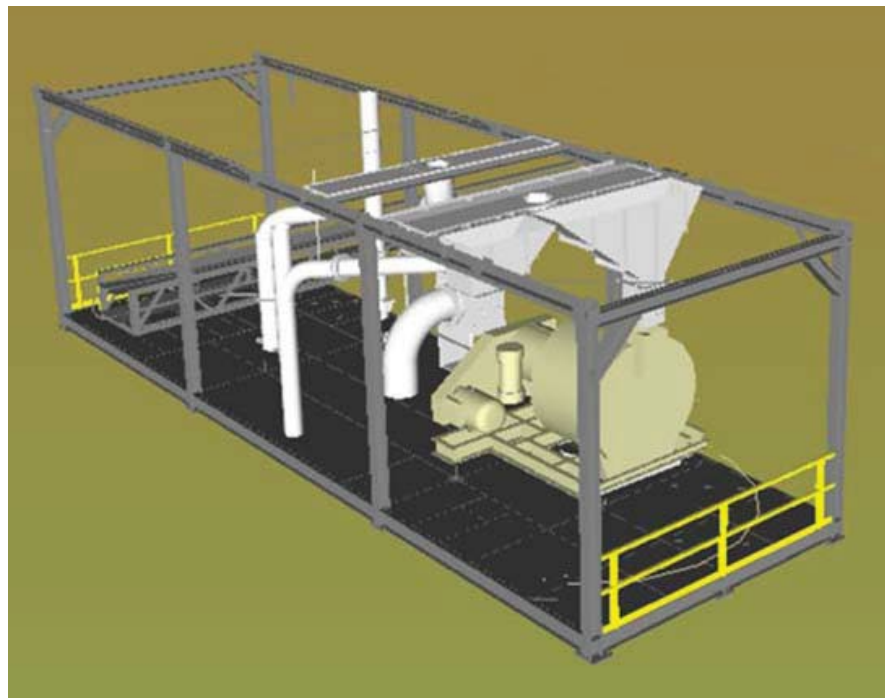


Figure 1.15-11: Coal Processing Plant (CPP) typical modular arrangement sample 2

Once onsite, the modules sit on a concrete foundation to facilitate hosing and clean-up. The plant modules stack on top of each other in a modular format with locating pins to guide and secure final placement. Once the plant modules are stacked in the required arrangement, interconnecting services are connected between the modules. Modules are constructed primarily out of medium steel.

The plant modules will be enclosed by a building. The building shell will be a pre-engineered steel building delivered as stick steel and requiring onsite assembly.

The foundation materials onsite will either be blasted rock placed in compacted lifts on the existing ground surface or gravel will be brought in from offsite from a quarry and placed in compacted lifts. The ground will have required reclamation material (surface soil) salvaged and vegetation cleared and removed prior to construction activities starting.

SRK completed an investigation of two (2) primary areas for onsite infrastructure. This investigation included the Explosive Facility pad, and the MIC pad where the CPP is located. Several test pits and sonic drillholes were targeted for these areas, targeting the footings on the explosive storage silos, the CPP thickener, CPP building, and the Maintenance Facility. Based on the material recovered, the anticipated bearing capacity of the material is between 200 and 250 kPa which would support the design of shallow spread concrete foundations versus deeper pile foundations (**Appendix 1.0-O SRK, Tenas Project Foundation Assessment**). Where infrastructure is planned, proper ground preparation is required to remove all organic material and any poor material within planned footing locations.

1.15.2.5.14 Coal Processing Plant (CPP) Foundation Design and Criteria and Rationale

The CPP will be built on a concrete foundation with shallow footings. All concrete will be designed to Canadian standards, including CSA A23.1 to A23.3.

Footing design criteria includes:

- ▶ minimum allowable bearing capacity for underside of CPP foundations to be approximately 250 kPa;
- ▶ minimum allowable bearing capacity for underside of the thickener foundations to be 150 kPa;
- ▶ total settlement, caused by the bearing pressures, shall not exceed 20 mm. Differential settlement across the CPP shall not exceed 10 mm; and
- ▶ finished surface level tolerance is ± 20 mm, with a surface profile tolerance of 10 mm vertical over 3.0 m horizontal.

All reactive materials (e.g., expansive clays, etc.) will be removed and replaced with engineered fill. The engineered fill shall be free from organic material, rubbish, large stones, excessive clay, or silt. **Tables 1.15-13 and 1.15-14** present quantitative specifications. Engineered fill shall be placed, compacted, and tested (every 400 square metre [m^2]) to achieve 98% of modified maximum dry density in layers no thicker than 230 mm.

Table 1.15-13: Engineering Fill Specifications

Property	Depth Below the Working Platform	
	≤150 mm	>150 mm
Laboratory California Bearing Ratio (CBR) (%)	≥10	≥10
Maximum aggregate size (mm)	75	75
Weighted plasticity index (WPI)	<1200	<2200
Swell (%)	≤0.5	≤2.5
Plasticity index (PI)	>4	>4

Notes: >=greater than; ≥= greater than or equal; <= less than; %=percent; CBR = California Bearing Ratio; mm=millimetre; PI= plasticity index; WPI=the product of the PI and the % passing 0.425 mm sieve

Table 1.15-14: American Standard (AS) Sieve Sizing

AS Sieve Size (mm)	Percent (by mass) Passing Sieve	
	Gravel	Loam
37.5	100	100
9.5	60 - 85	100
2.36	25-70	70-100
0.425	10-40	10-40
0.075	3-30	3-30
Other Properties - Linear Shrinkage	≤ 8	≤ 6

Notes: ≥= greater than or equal; AS=American Standard; mm=millimetre

Where “non-select fill” is specified, its material properties shall be defined as that of CBR 5 to 15 with no particles larger than 150 mm and is also suitable for compaction in 300 mm layers.

No allowance has been made for groundwater effects.

Foundation design will meet the minimum requirements outlined by the 2015 National Building Code of Canada (NRCAN 2019) based on the site classification and the following the seismic parameters:

- ▶ Seismic Load Spectral Accelerations (Sa) (0.2) = 0.11;
- ▶ Sa (0.5) = 0.08;
- ▶ Sa (1.0) = 0.053;
- ▶ Sa (2.0) = 0.034; and
- ▶ PGA = 0.059g.

The Freezing Index in Smithers, BC is 823 degree-days below 0°C. This equates to frost penetration of 1.52 m. Footings will be founded below the depth of frost penetration of 1.80 m and detailed to limit

adfreeze stresses and/or insulated appropriately for the conditions. Enclosed building foundations (CPP) will be protected by perimeter insulation.

1.15.2.5.15 Coal Processing Plant (CPP) Coal Laboratory

For the Project to meet customer contracts for metallurgical coal on the seaborne market, a modular pre-built coal laboratory will be required for the Project. The CPP laboratory will be a pre-fabricated modular sea container structure completely pre-fitted out with laboratory equipment and furnishings, lighting, power, fume and dust extraction, heating, ventilation, and air conditioning (HVAC) equipment to enable year-round production sampling and monitoring of both ROM coal, processed coal and processed rock. An additional prefabricated sea container will be included and fitted to the coal laboratory for sample drop-off and storage.

The coal laboratory will be fitted out with laboratory and sampling equipment to allow shift measurements of ROM, processed rock, and processed coal ash, moisture, sulfur, volatile matter, oxidization ranking, and FSI determinations.

The layout and equipment fit-out for the CPP coal laboratory is shown by **Figure 1.15-12** below.

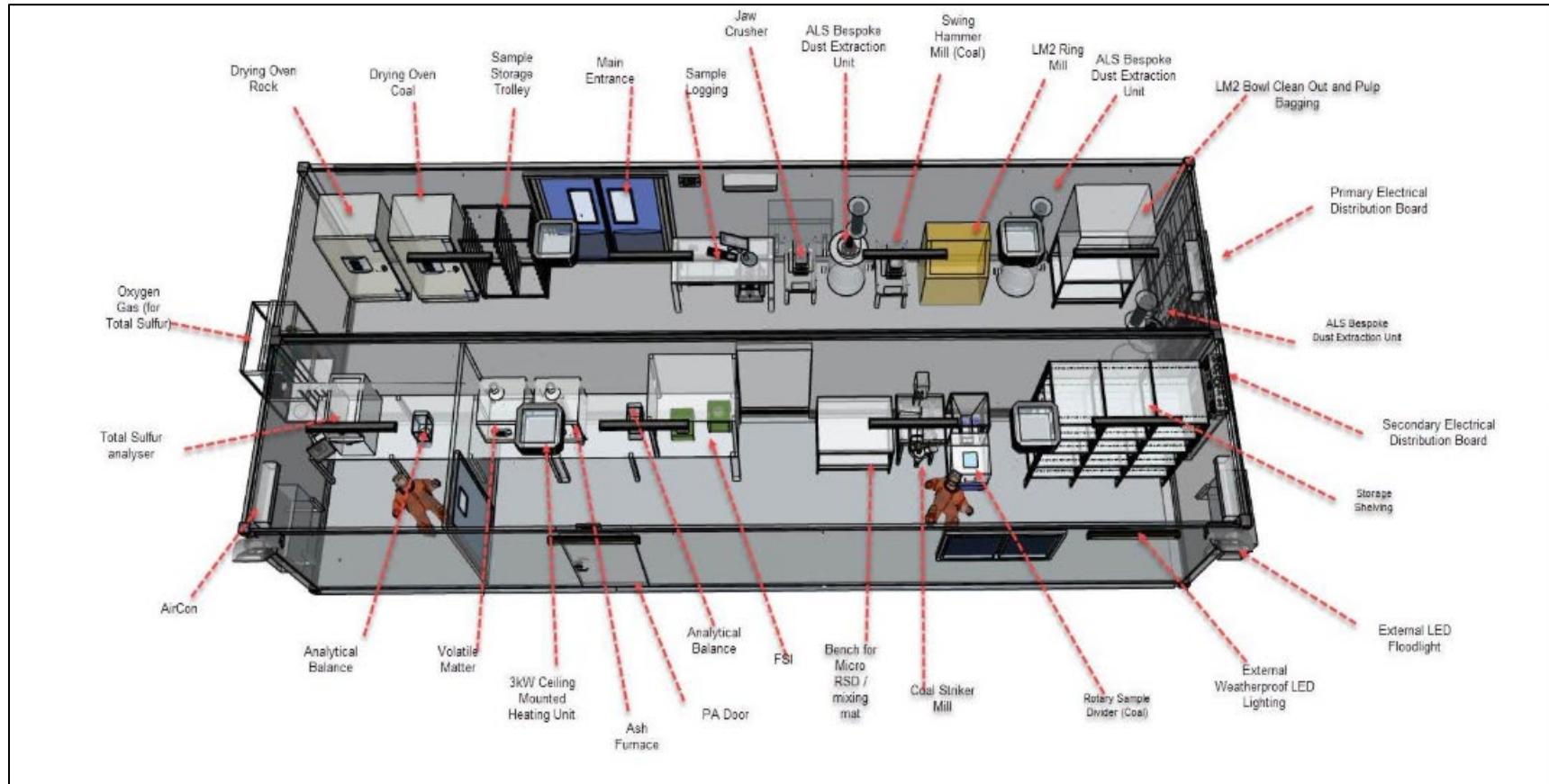


Figure 1.15-12: Coal Processing Plant (CPP) laboratory layout

*1.15.2.5.16 Coal Processing Plant (CPP) Services**1.15.2.5.16.1 Process, Gland, and Washdown Water*

Process water for CPP make-up will be directed to the clarified water tank to account for the moisture losses from the processed coal and processed rock streams. The CPP will minimize water consumption by recovering water from the fine processed rock belt filters and other streams within the CPP. Clarified water will overflow from the thickener into the clarified water tank that will be used for process water.

A portion of the clarified water will be filtered and used for pump gland seal water, the flocculant make-up system and for the belt filter press cloth wash water sprays. CPP washdown water will generally be provided through Minsup™ couplings and ball valves installed off the CPP clarified water header at required locations. There is an option in the future to install a further processed coarse rock dewatering circuit to further reduce make-up water requirements and increase water recycling.

1.15.2.5.16.2 Air Services

Compressed air will be used to control instrumentation within the CPP. The compressed air system will comprise of a skid-mounted compressor and an air dryer and receiver to provide compressed and instrument air at a nominal 700 kPa pressure. The compressor system will be connected to a ring main to provide compressed air at nominal points around the CPP. The materials handling system will not have a compressed air system.

1.15.2.5.17 Run-of-mine (ROM) Coal and Processed Rock Mobile Equipment

To support the CPP, a list of mobile equipment is required to support the reclaim of ROM coal into the plant, the delivery of supplies and removal of processed rock back to the open pit. **Table 1.15-15** provides a summary of mobile equipment required for the CPP.

Table 1.15-15: Summary of Mobile Equipment

Equipment	Number
15-tonne Bucket Front-End Loader (FEL)	2
Tool Carrier (Cat 938 size)	1
Skid Steer Loader	1
Light Vehicles (LV)	2

1.15.2.5.18 Processed Coal Mobile Equipment

To support the handling of processed coal from the CPP to the Rail Infrastructure, and for the loading of unit trains, loaders and trucks are required. FELs will be used for the loading of super B-train trucks at the CPP and the loading of unit trains. To allow for loading of the unit trains in a 12-hour period at least 2 loaders will be required. The same size and type FELs as what are used at the CPP and in the mine to standardize the fleet between the various Project activities. **Figure 1.15-13** below provides an example of the super B-train trucks that will be utilized for the Project which are very similar to the trucks used by the logging industry in the region. Other equipment to provide maintenance tasks associated with the road such as graders, sanding trucks, and water trucks are required.



Figure 1.15-13: Super B-train truck configuration

Table 1.15-16 below summarizes the mobile equipment requirements to support the processed coal handling.

Table 1.15-16: Summary of Mobile Equipment for Processed Coal

Equipment	Number
15-tonne Bucket Sized Front-end Loader	2
super B-train trucks	3 to 4
3.26 m Blade Grader	1
Sanding/Water Trucks	1

Note: m=metre

1.15.2.5.19 Coal Processing Plant (CPP) and Processed Coal Personnel Requirements

The CPP personnel and related personnel requirements were developed from first principles and the necessity of operating the plant on a 365 day/24 hours-a-day schedule. **Table 1.15-17** provides a summary of the personnel requirements.

Table 1.15-17: Summary of Coal Processing Plant (CPP) Personnel and Related Requirements

Equipment	Number
CPP Plant Operators	14
Processed Coal Truck Haulage	12
CPP Technical, Supervisory, and Rail Infrastructure	8

Note: CPP=Coal Processing Plant

1.16 Mine Infrastructure Complex (MIC)

The MIC contains all ancillary facilities like the Administration Building, Light Vehicle Maintenance Building, Mine Rescue Building, Maintenance Facility, Tire Shop, Containerized Storage and Hydraulic Hose Shop, Welding Pad, Sewage Treatment Plant, Potable Water Treatment Plant, Potable Water Storage Pond, Wastewater Storage Pond, and Soil Treatment Facility.

In addition to ancillary facilities, the MIC also includes previously discussed coal processing infrastructure including the CPP, ROM coal stockpiles, processed coal stockpiles, processed rock stockpiles and the CPP Sedimentation Pond.

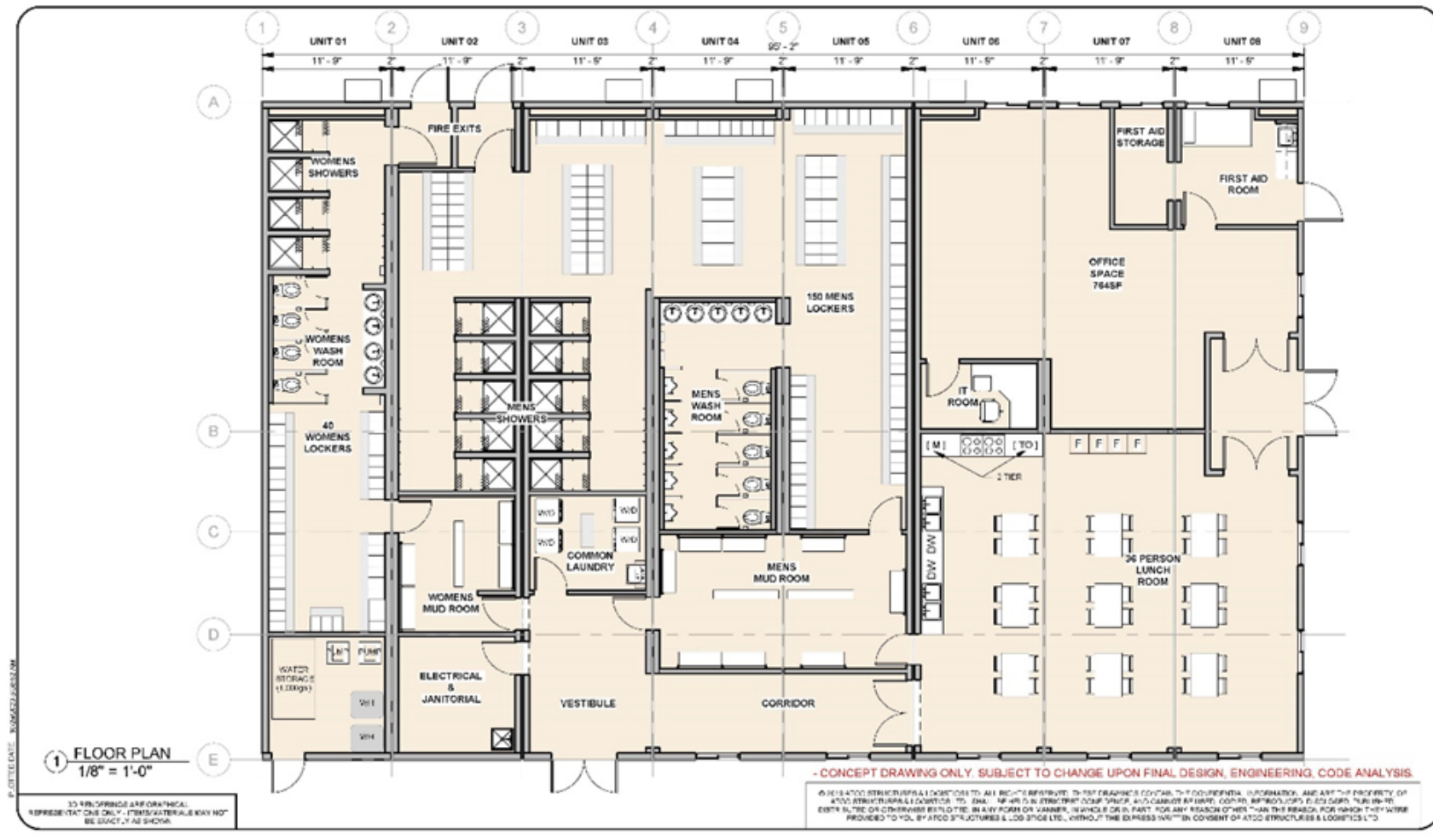
The entire area of this pad will be considered disturbed area, where all vegetation will be cleared and reclamation material (surface soil) salvaged, and stockpiled. The area will then be levelled using overburden materials within the Project Footprint), and drainage patterns established so that all precipitation that falls on the MIC pad is directed towards the CPP Sedimentation Pond. After the area is levelled and drainage established, a layer of compacted crush will be added to the pad, likely up to 30 centimetres (cm) as a maximum.

1.16.1 Administration and Mine Dry Building

The Administration and Mine Dry Building will be constructed by the end of Year 0 and will be a demountable style building anchored on either wood cribbing and/or concrete blocks and will house both mine dry and office facilities for the Project. It will be used to house several site management, supervisory, professional, and administration personnel required to support mine production. The Administration Building will include the following:

- ▶ site offices;
- ▶ mine dry facilities;
- ▶ light vehicle car parking;
- ▶ first aid room; and
- ▶ lunchroom and meeting room facilities.

ATCO was approached to provide a design for this building. **Figure 1.16-1** below illustrates the proposed floor plan for the Administration Building.



ATCO

DRAWN BY: NM
DATE: 2020-10-29
DESCRIPTION: ISSUED FOR REVIEW

TELKWA COAL
ADMINISTRATION BUILDING

SALES DRAWING
NOT FOR CONSTRUCTION

2020-085 R2 BD-01 REV. B

Figure 1.16-1: Proposed floor plan for the Administration and Mine Dry Building