

Central Queensland Coal Project

Appendix 4b – Geotechnical Assessment

**Environmental Impact
Statement**



**GEOTECHNICAL ASSESSMENT OF
OPEN CUT MINING ADJACENT TO
THE BRUCE HIGHWAY, CENTRAL
QUEENSLAND COAL PROJECT**

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**GEOTECHNICAL ASSESSMENT OF OPEN CUT MINING
ADJACENT TO THE BRUCE HIGHWAY, CENTRAL QUEENSLAND COAL PROJECT**

1.0 INTRODUCTION

At the Central Queensland Coal Project open cut mining is proposed on both sides of the Bruce Highway. Figure 1 is a locality plan and Figure 2 is the typical stratigraphy of the Styx Coal Measures in this area. Multi-seam mining is proposed with target seams shown in Figure 3.

There will be a final highwall on the south western side of the highway and a box cut on the north eastern side of the highway. Pit voids on each side of the Bruce Highway will only be temporarily opened up.

The average depth of clay and weathered rock in this area is about 25 m. All coal mining will occur below the LOX (oxidation) line.

2.0 DESIGN CRITERIA

Due to the proximity of the Bruce Highway, design criteria need to include proper stability of open cut excavations, permanent post-mining stability, prevention of any damage to the Bruce Highway infrastructure and ongoing erosion control measures.

Figure 4 is a type geotechnical section across the Bruce Highway showing excavations, safety bunds and drainage.

2.1 Open Cut Excavations

Open cut excavations adjacent to the Bruce Highway require safety factors of greater than 1.5, which is the minimum requirement for civil engineering projects. Slope stability analyses for rotational failure have been completed for voids batters adjacent to the Bruce Highway (Figure 4). Shear strength values used in stability analyses are included in Table 1.

TABLE 1 – SHEAR STRENGTH VALUES

MATERIAL	DENSITY (t/m ³)	FRICTION (DEG)	COHESION kPa)
Overburden (soil and weathered rock)	2.0	25	40
Spoil	1.9	34	0
Mudstone, Fr	2.4	35	100
Sandstone, Fr	2.5	40	200
Mudstone/sandstone, Fr, composite	2.45	37.5	150

Stability analyses have been completed for saturated slopes. Safety factors for 1 (horizontal) on 1 (vertical) and 0.5 (horizontal) on 1 (vertical) batters are included in Table 2.

TABLE 2 – SAFETY FACTORS FOR BATTERS

MATERIAL	BATTER ANGLE	SAFETY FACTOR
Soil and weathered rock	1 on 1	2.4
Mudstone/sandstone, Fr, composite	0.5 on 1	3.6

North east of the Bruce Highway the box cut low wall will undercut coal seams bedding planes (Figure 3). Translational failures of low walls occur when there are sheared, intraformational mudstone bands and bedding dips are greater than 10°. Sheared mudstone has a peak friction of 17°, peak cohesion of 25 kPa, residual friction of 9° and residual cohesion of 25 kPa. Geological investigations indicate that there are no sheared, intraformational bands adjacent to the Bruce Highway and bedding dips are to the east at less than 7°. In this area the translational resisting force is greater than the actuating force by a safety factor well above 1.5. During mining the low wall will be regularly monitored. It is recommended that box cut mining proceeds in blocks and buttress spoil is placed against the low wall immediately after coal extraction.

The above safety factors indicate that the batters adjacent to the Bruce Highway will be stable with no impact on the highway. As well, 20 m wide safety berms have been included for additional safety (Figure 4). The distance between the edge of the pits and the Bruce Highway mining lease boundaries is 58 m. The highway is within the road reserve (Figure 4). The pits batters will have no affect on the Bruce Highway.

During mining each pit will be opened up, coal extracted and then backfilled. The south western pit will only have a 200 to 400 m section of highwall exposed to the Bruce Highway at any one time. The final void will be progressively infilled and a sediment trap will be constructed at the northern end. The box cut excavation on the north eastern side will be immediately backfilled after coal extraction using strip two spoil. The mine plan period progress plot is shown in Figure 5. Cut 1 and 2 sections per mining period are included in Appendix 1. Because of the short durations for which the batters adjacent to the Bruce Highway will be open, batter deterioration will be minimised.

The open cut excavations can be free dug to a depth of about 25 m prior to drilling and blasting.

Properly designed production blasts are required to prevent any damage to infrastructure. Peak particle velocity from any blast shall not exceed 45 mm/sec, which will prevent any damage to the Bruce Highway infrastructure. Blast energy can be reduced by increasing the delay sequence and reducing the charge per delay. Safe blasting procedures and monitoring will be implemented while open pit voids are present adjacent to the Bruce Highway. Regular survey monitoring will be completed to ensure ongoing stability of batters.

2.2 Safety Bunds

Safety bunds are required to prevent access to pits, screen off mining operations from the Bruce Highway and control run off water, including any sedimentation. The proposed safety bunds are 6 m high with crest widths of 10 m. Batters are 1.5 (horizontal) on 1 (vertical) which is at the angle of repose. The batters will be topsoiled and seeded to prevent scour and erosion. Crests are to slope at 1% towards the lease. Bunds are to be constructed from track compacted, fresh spoil.

2.3 Drainage

Properly controlled drainage is required to prevent run off water and sediment discharging off the mining lease onto the Bruce Highway road reserve and to prevent erosion of exposed excavated faces. A table drain area with a width of 10 m has been included between the Bruce Highway lease boundaries and the outside toes of the safety bunds (Figure 4). All run off water will be drained inside the lease boundaries and all sediment will be contained. Sediment traps will be installed where required.

Catch drains will be constructed along the highwall edge of the final void south west of the Bruce Highway and along the low wall edge of the box cut north east of the highway. These drains will prevent erosion of exposed faces prior to backfilling.

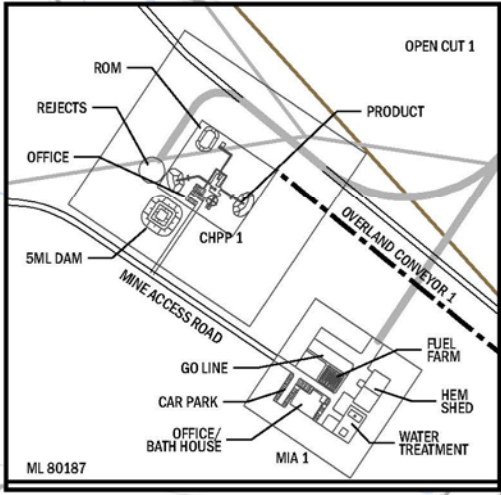
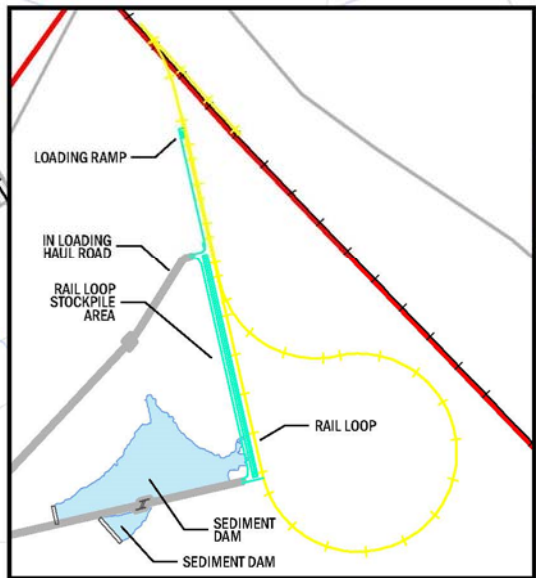
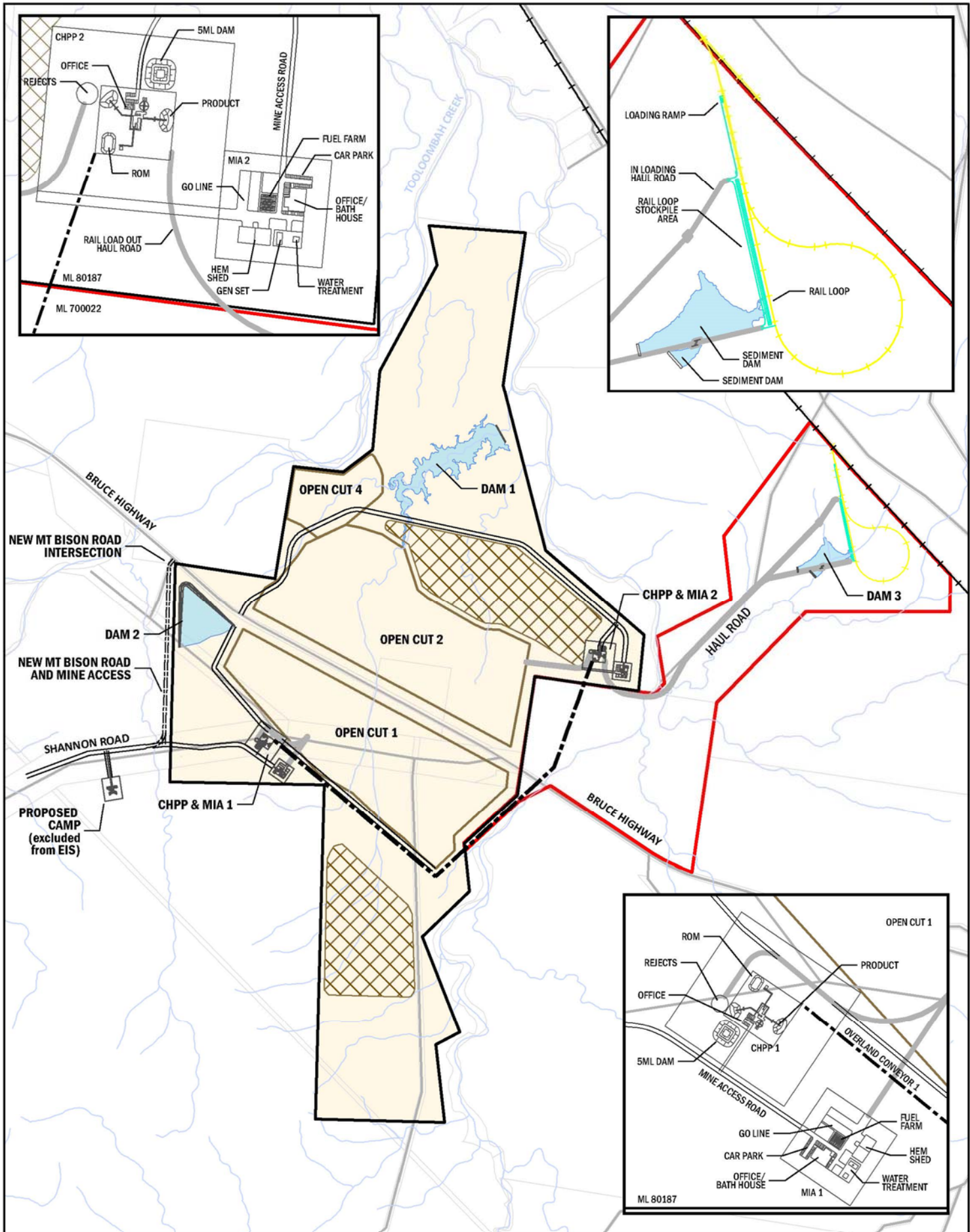
Any areas which will require topsoiling and seeding will be remediated as soon as possible to prevent scouring.

3.0 CLOSURE REQUIREMENTS

All spoil piles will be made geotechnically stable and be topsoiled and seeded. All voids will be backfilled, topsoiled and seeded, with sediment traps installed where required.

At closure, long term stability of the safety bunds will be assured. Drainage pathways will be remediated, then topsoiled and seeded. Sediment traps will be constructed.

FIGURES



0 0.5 1 km

Scale @ A4 1:55,000
Date: 17/07/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Open-cut Mine Pit
- Dam Catchment
- Waste Dump Area
- Overland Conveyor
- Haul Roads
- Rail Loadout Facility
- Rail Loop
- Proposed Mine Infrastructure
- Watercourse
- North Coast Rail Line
- Main Road
- Cadastral Boundary

**FIGURE 1
LOCALITY PLAN**

DATA SOURCE
QLD Open Source Data, 2017
Esri Basemaps



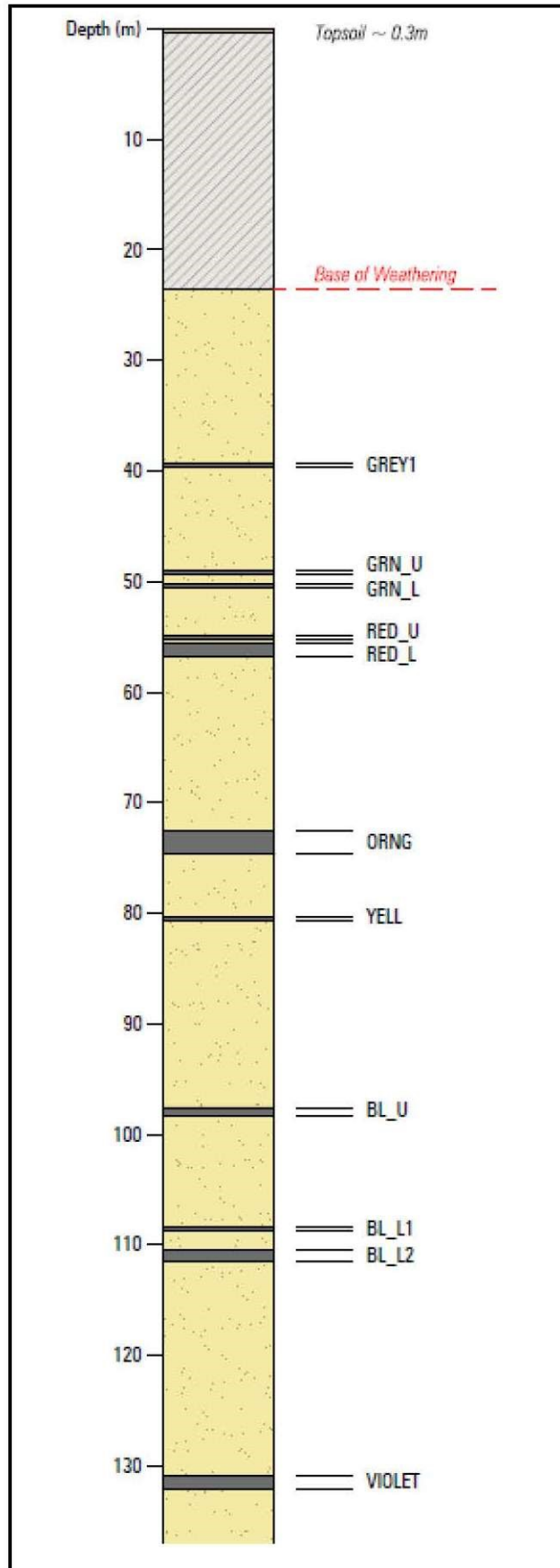


FIGURE 2 : TYPICAL STRATIGRAPHY, STYX COAL MEASURES

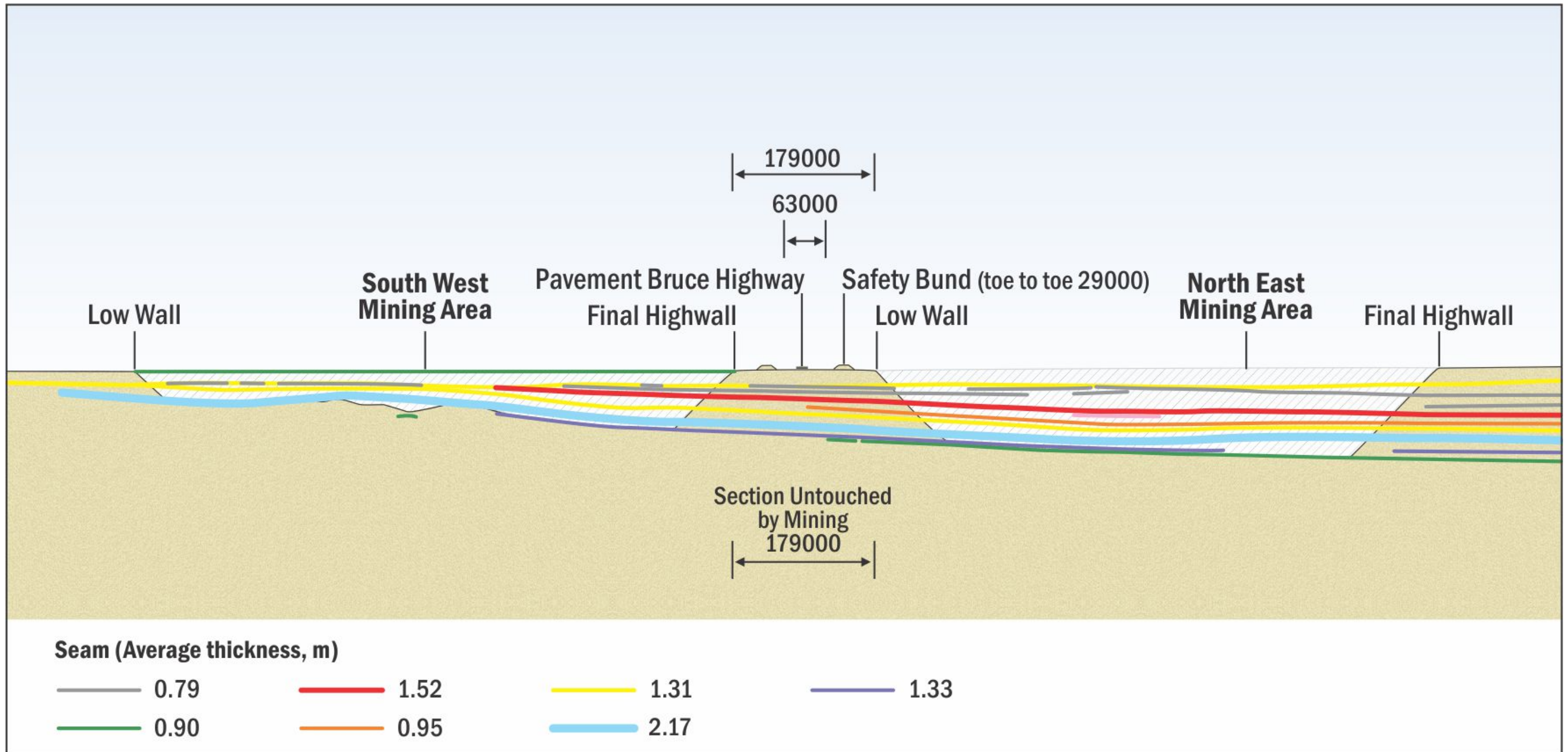


FIGURE 3 : MINING SECTIONS ACROSS THE BRUCE HIGHWAY

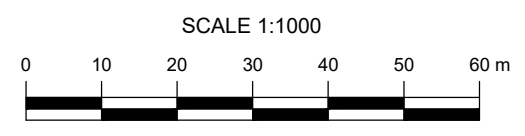
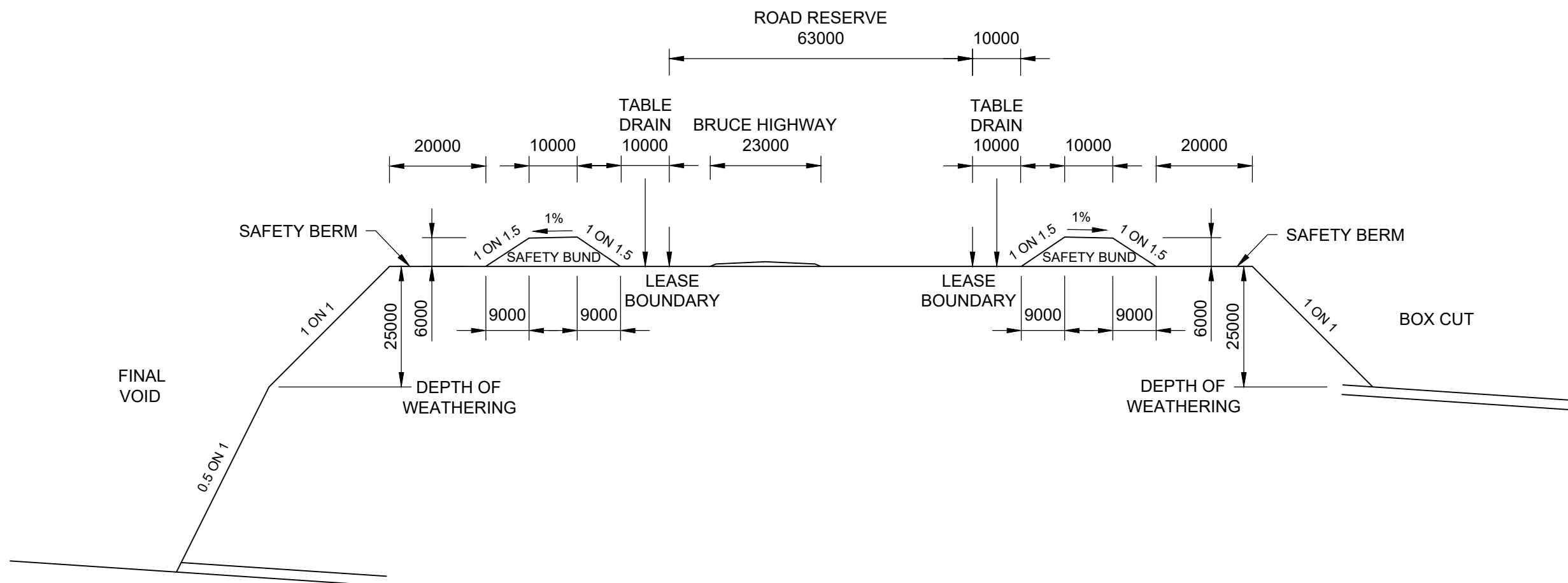
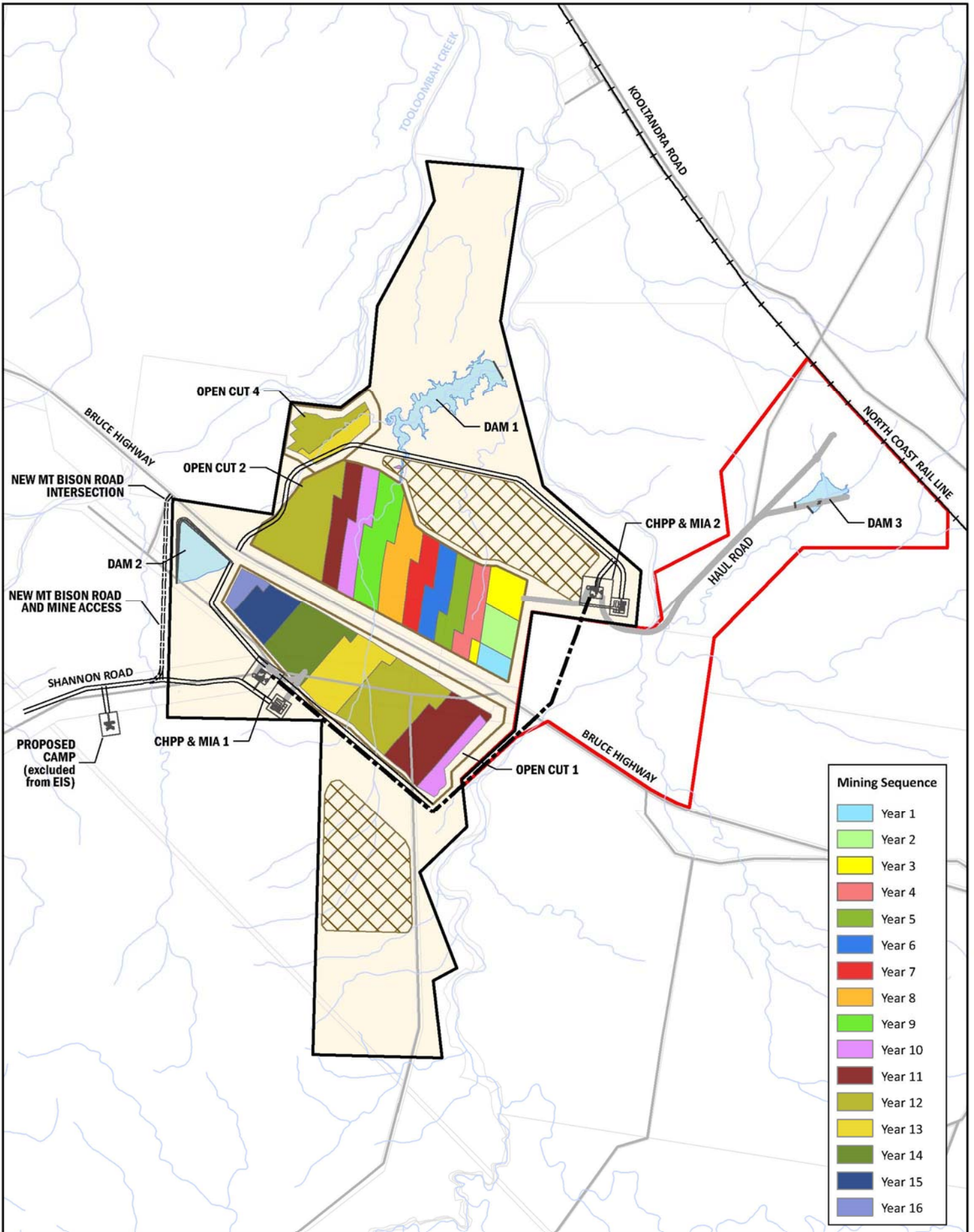


FIGURE 4
 GEOTECHNICAL SECTION
 ACROSS THE BRUCE HIGHWAY



Mining Sequence	
[Light Blue]	Year 1
[Light Green]	Year 2
[Yellow]	Year 3
[Pink]	Year 4
[Light Green]	Year 5
[Blue]	Year 6
[Red]	Year 7
[Orange]	Year 8
[Light Green]	Year 9
[Purple]	Year 10
[Dark Red]	Year 11
[Olive Green]	Year 12
[Yellow]	Year 13
[Dark Green]	Year 14
[Dark Blue]	Year 15
[Purple]	Year 16

**FIGURE 5
MINE DEVELOPMENT
SEQUENCES**



0 0.5 1 km

Scale @ A4 1:55,000
Date: 17/07/17
Drawn: Gayle B.

Legend			
[Black line]	ML 80187	[Black line with cross-ticks]	North Coast Rail Line
[Red line]	ML 700022	[Grey line]	Haul roads
[Brown outline]	Open-cut Mine Pit	[Grey line]	Proposed mine infrastructure
[Light blue fill]	Dam Catchment	[Blue line]	Watercourse
[Cross-hatch pattern]	Waste Dump Area	[Grey line]	Main road
[Dashed black line]	Overland Conveyor	[White outline]	Cadastral boundary

DATA SOURCE
QLD Open Source Data, 2017

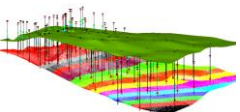
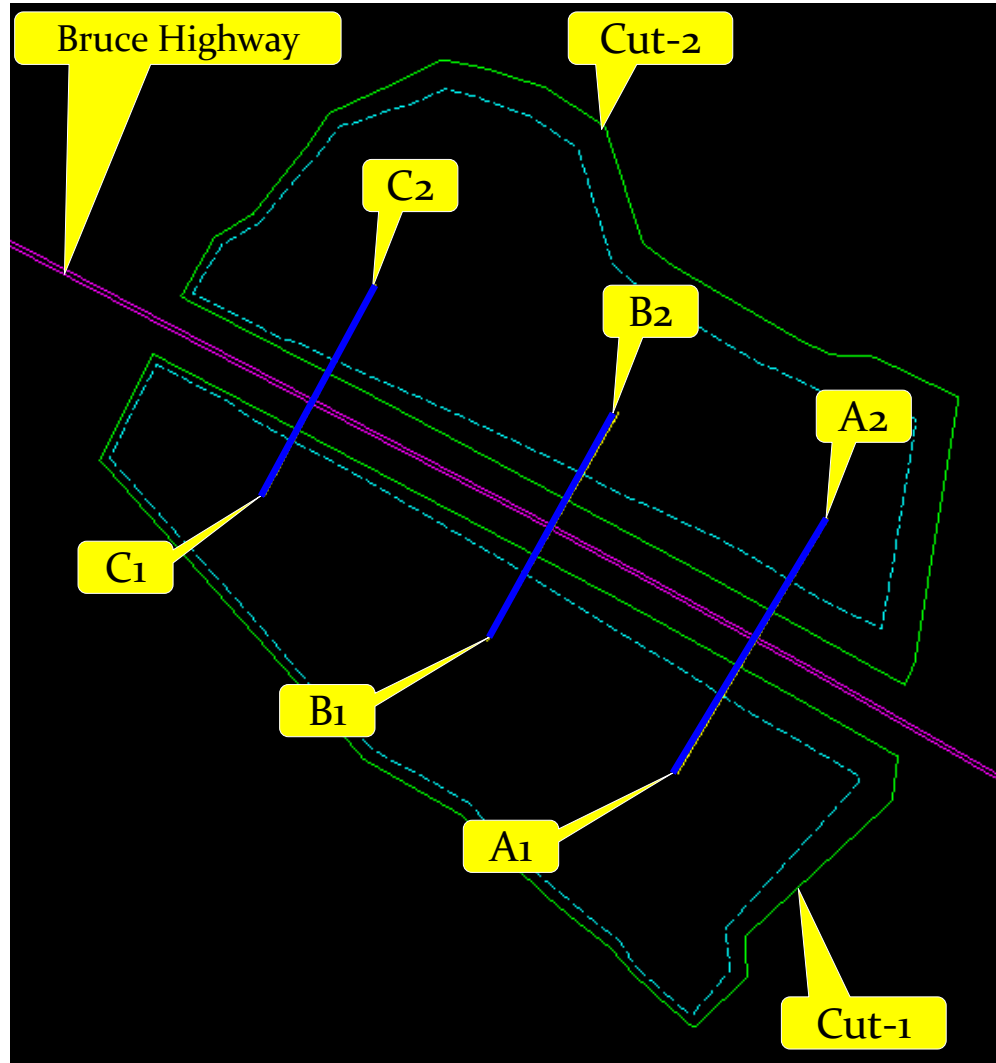


APPENDIX 1

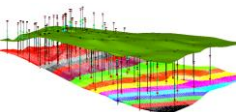
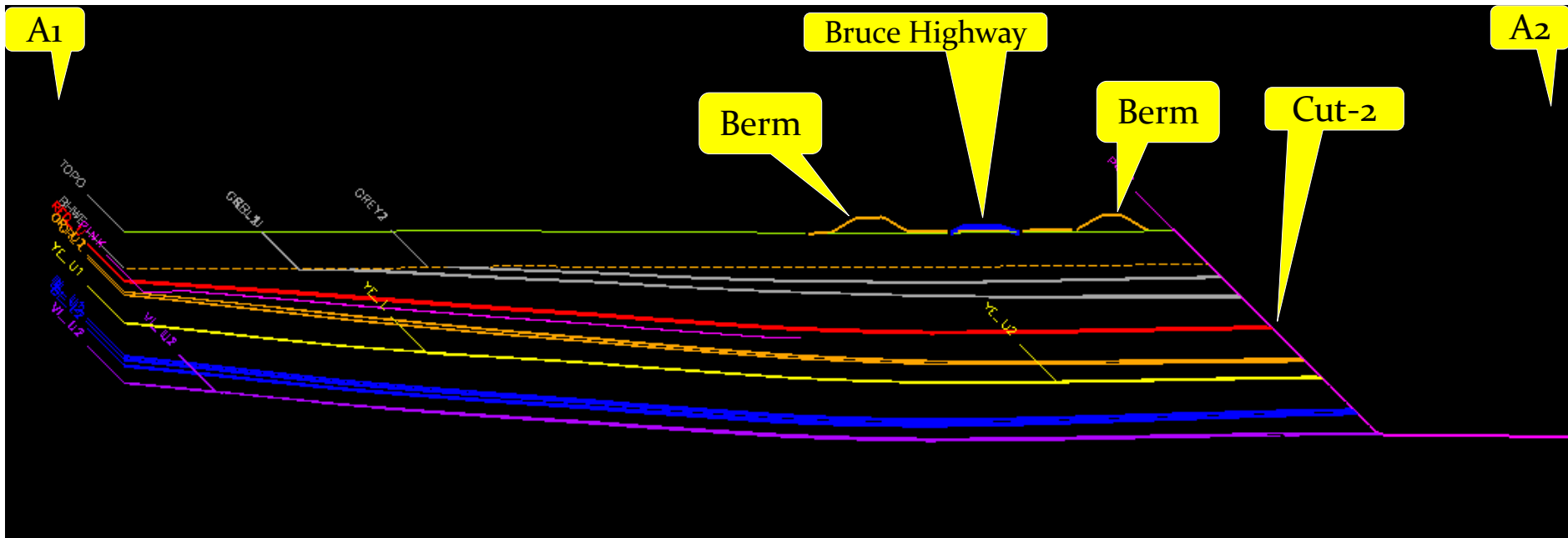
CUT 1 AND 2 SECTIONS PER MINING PERIOD

Cut-1&2 Sections per Mining Period

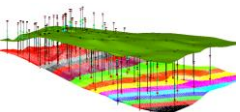
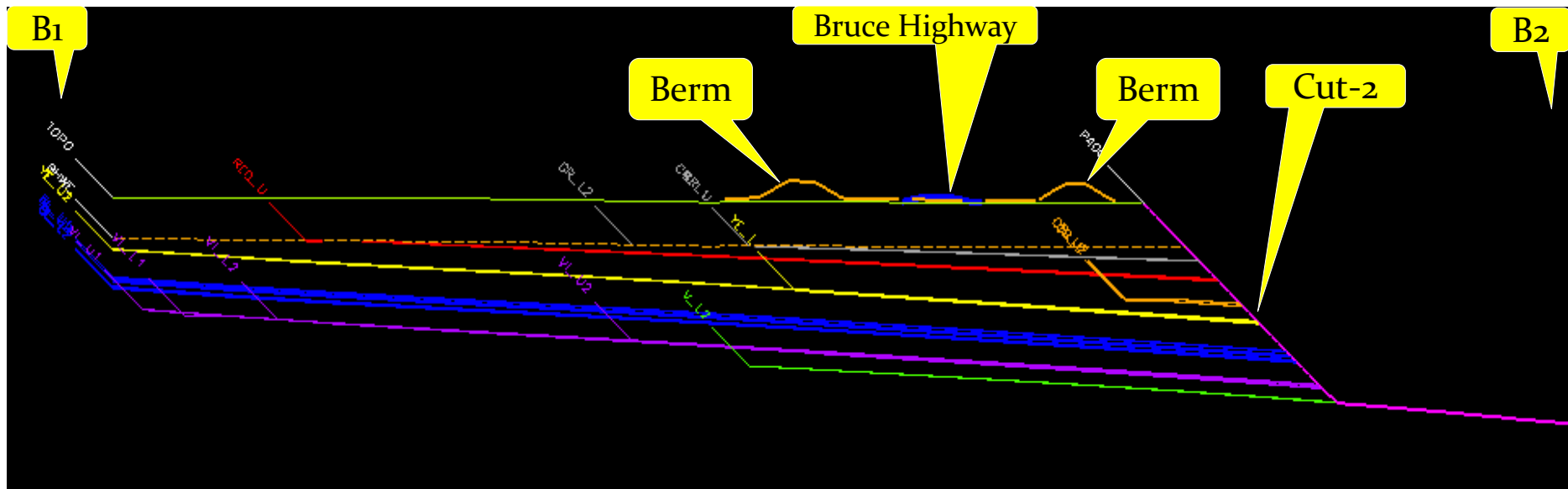
Cross Section Locations Cut-1 & 2



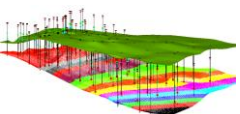
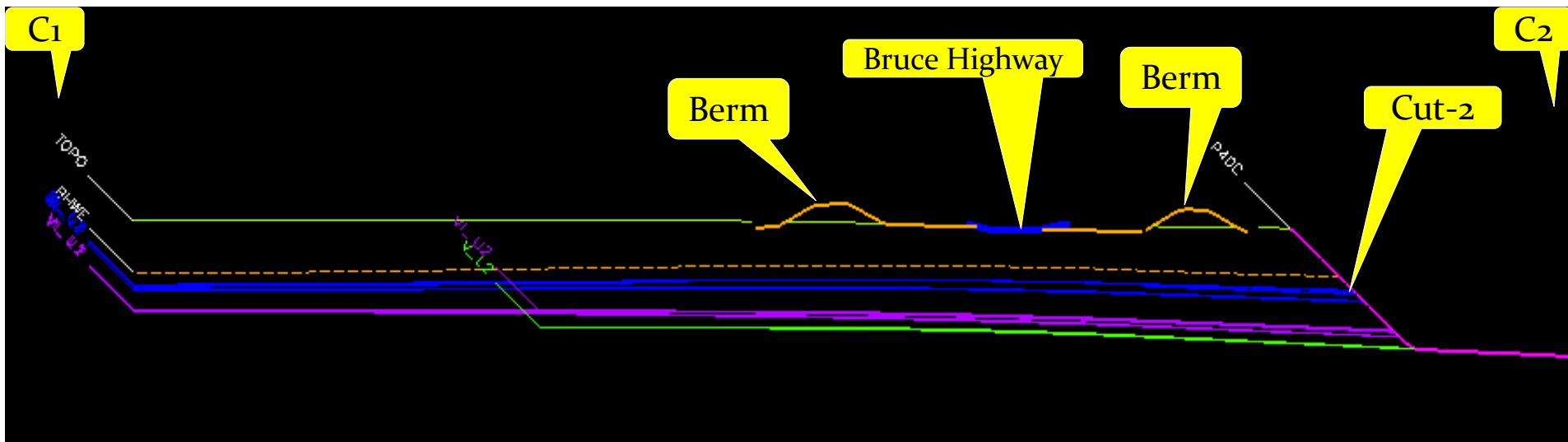
Cross Section Cut-2, Period-04



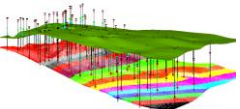
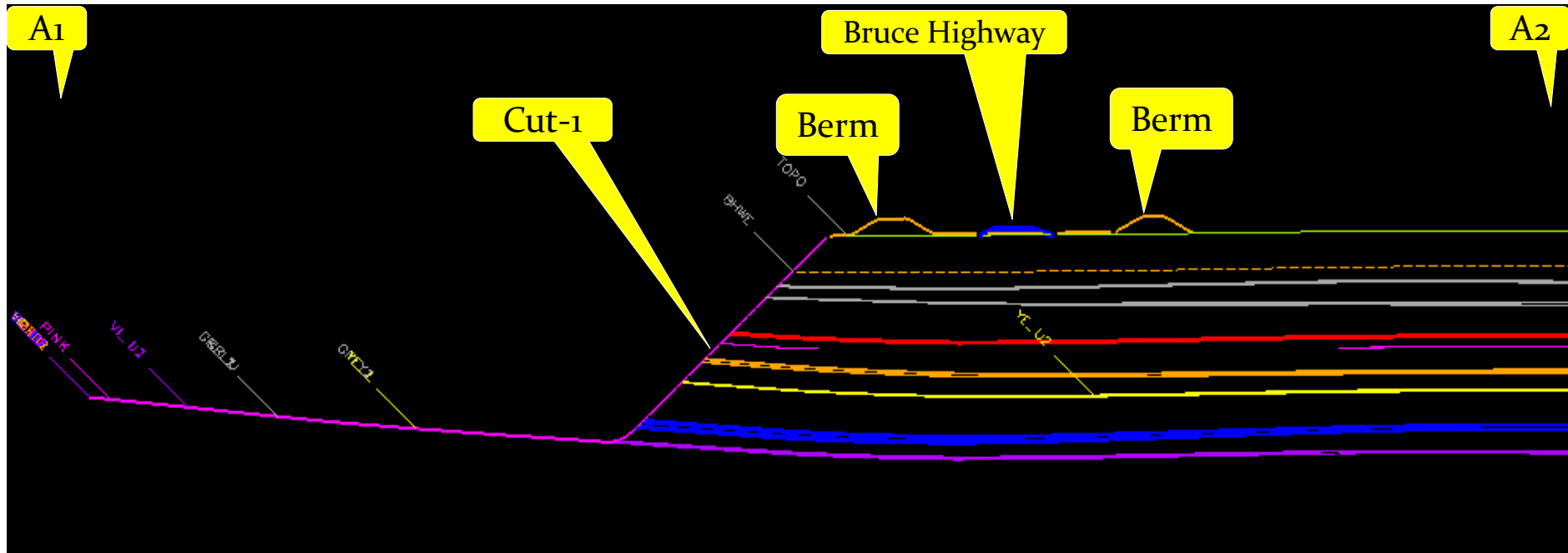
Cross Section Cut-2, Period-07



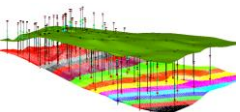
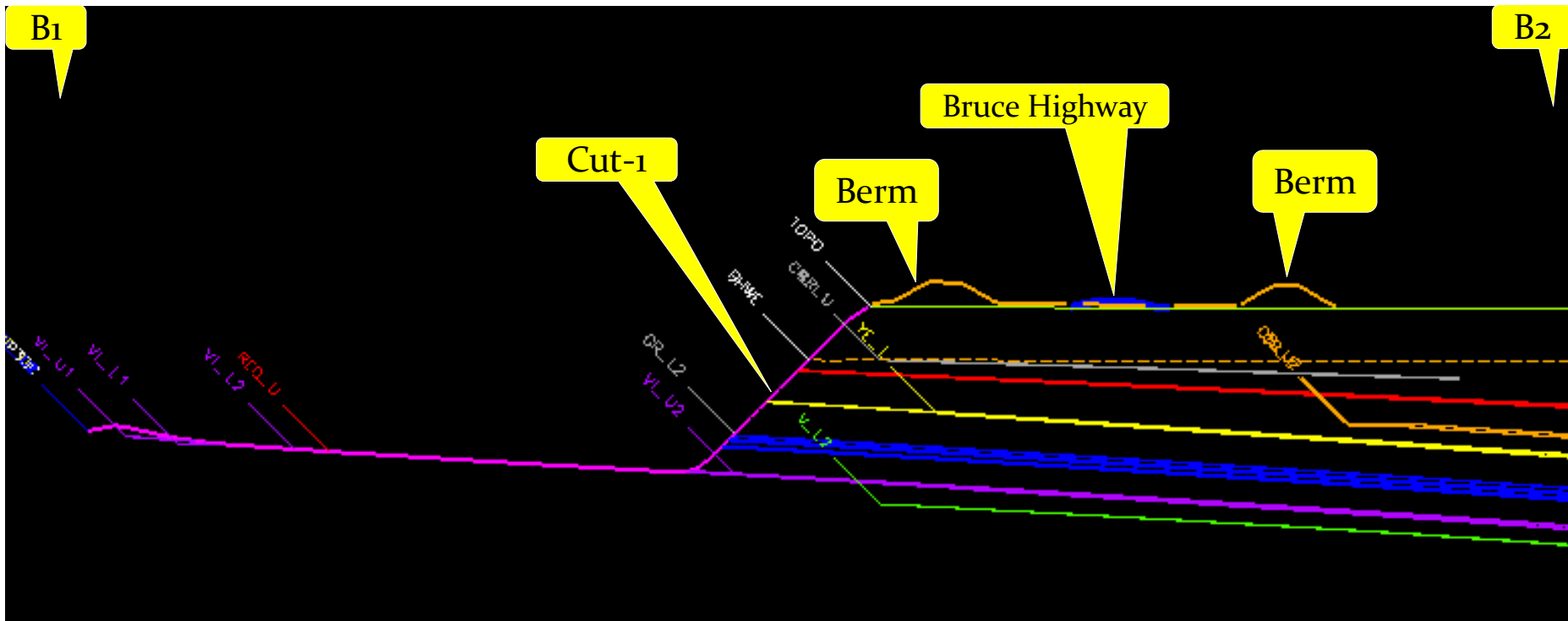
Cross Section Cut-2, Period-10



Cross Section Cut-1, Period-11



Cross Section Cut-1, Period-13



Cross Section Cut-1, Period-14

