Western Queen South

Geotechnical Review

Prepared for:

MEGA Resources

Effective Date: May 2025

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Executive Summary

The key findings of this study include:

- SME's focus in this study has been directed to a cutback referred to as Stage 3 of the existing Western Queen South open pit.
- The proposed pit extends to a maximum depth of approximately 190 m and is about 600 m long and 450 m wide at the crest.
- There is fair distribution of existing diamond drilling (most useful for geotechnical purposes) across WQS. Areas not covered as well spatially are the south end and the footwall side (east) of WQS. Note also that as all holes with structural orientation data have been drilled to the southeast, there is a hole orientation bias where structures dipping to the southeast (parallel to the holes) are less likely to be intersected in the hole and therefore underrepresented in the data.
- There is existing data that is geotechnically relevant including, rock strength, RQD, and structural orientations, geological wireframes and weathering equivalent surfaces.
- There is significant slope experience from the previous mining of Stage 1 (2007) and 2 (2013) and as such likely key geotechnical issues are understood. A critical factor is management of groundwater drawdown relative to mining schedule.
- Depth of weathering (to base of oxide) is variable, ranging from shallow at the north (~35 m) to quite deep in the south (~90 m) while the transition zone (between fresh and oxide) is relatively thin at around 10 – 20 m).
- The upper cover and weathered materials (oxide) can be described as 'Poor' rock mass, the transition materials can be described as 'Fair' rock mass, while the fresh rock mass can be described as 'Good' rock mass.
- Logging data indicates intact rock strengths are around 150 to 200 MPa in fresh rock materials, which is classified as 'very strong rock' requiring blasting with moderate to high powder factors to allow excavation.
- SME has provided the following slope design parameters to be used to revise the proposed Stage 3 pit design which has been completed.

Domain	Depth Range	Slope sector / Elevation	Batter Face Angle	Batter Height	Minimum Berm width at Toe	Inter-ramp[1] slope angle C to T
Cover / Oxide	From ground surface to base of oxide surface	Northern				
		Surface (391) to 385	45°	3.0 m	2.0 m	
		385 to 360	45°	5.0 m	3.0 m	~33.4°
		Central				
		Surface (391) to 385	45°	3.0 m	2.0 m	
		385 to 350	45°	5.0 m	3.0 m	~33.1°
		Southern				
		Surface (391) to 385	45°	3.0 m	3.0 m	
		385 to 330	45°	5.0 m	5.0 m	~29.1°
		330 to 310	50°	10.0 m	7.0 m	

Transition	From base of oxide surface to top of fresh surface	Northern 360 to 350	50°	10.0 m	5.0 m	~35.1°
		Central 350 to 330	50°	10.0 m	5.0 m	~34.8°
		Southern 310 to 300	50°	10.0 m	7.0 m	~29.4°
Fresh	From below top of fresh surface to base of pit	Northern 350 to 200	70°	20.0 m	7.0 m	~49.2°
		Central 330 to 200	70°	20.0 m	7.0 m	~46.7°
		Southern 300 to 200	70°	20.0 m	7.0 m	~43.3°

1. Inter-ramp angles are presented as Crest to Toe (C to T) from ground surface (i.e. height dependent)

- Prior to finalisation of this study, MER updated the pit design for WQS based on the parameters presented above.
- LE stability analysis was undertaken of the updated Stage 3 pit design along with the waste dump to the west of the pit, which will be cut by Stage 3, for the four sections (SW, W, NW and N) and adopting the same POBA (2012) material parameters along with LSAP materials in the SW and W and Generalised Hoek-Brown shear strength parameters for the fresh rock materials and assumed parameters for the waste dump materials. The following conclusions can be drawn with respect to likely slope stability against shear failure through the rock mass:
  - All sections returned minimum FoS above the design target of 1.2 for inter-ramp stability and 1.3 for overall stability.
  - The SW section with the deepest sequence of Cover and Oxide materials returned a FoS at around 1.23 through the upper part of the slope above the approximately 20 m thick LSAP layer.
  - The W section through the west wall and waste dump, returned a FoS of 1.6 through the upper part of the slope including the waste dump and when a thinner (about 10m thick) LSAP layer was included. When no LSAP layer is included, then the minimum FoS was 1.3 for the overall slope (i.e. still meets design target).
  - The NW section returned a minimum FoS above target of 1.3 through the upper part of the slope. Note that no LSAP material was included in this model.
  - The N section returned a minimum FoS well above target of 1.3.
- Given these results and the data made available, the updated Stage 3 pit design achieves adequate FoS and as such is suitable for development.
- Prism monitoring should be considered for WQS. Ideally, prisms are to be routinely installed at no more than 40 to 50 m spacing's across a single bench and every second to third berm level (20 to 30 m vertically) in a staggered pattern for the upper parts of the slope.

- SME recommends that approximately 10 standpipe piezometers be installed around the perimeter of the pit (four at north, four at south and one each east and west). These piezometers should be targeted at the main aquifer zone (nominally through the transition zone i.e. base of oxide to top of fresh) with recommendations provided by AECOM on their knowledge of the hydrogeological model etc.
- Short horizontal drains ('weep holes') from about 30 m to 50 m long should be implemented in the lower saprolite (oxide) and transitional zones to help promote drainage and reduce the groundwater levels / pressure behind the pit walls as was completed in Stage 2. Note that inflows are expected to be high at the north end due to the potential connection with the Western Queen pit and at the southern end as the deeper Cover and Oxide may represent a palaeochannel to the south of the pit.
- SME suggests that as part of the routine geological function at WQS, that ongoing geological mapping should be undertaken, recording (preferably on a bench-by-bench basis) observations of major structures and rock types intersecting the pit walls and floor (i.e. basic geological and structural mapping).
- Prior to the commencement of Mining a Ground Control Management Plan in line with Western Australia Dept. of Mining, Energy, Resources, Industry and Regulation guidelines must be developed for WQS (or incorporated into existing) which includes; operational controls such as inspections and slope monitoring, a Trigger Action Response Plan and responsibilities against these and requirements of the GCMP.
- Key areas of geotechnical uncertainty at the time of writing include:
    - drilling orientation and some spatial bias.
    - defect orientations and surface condition (joint condition is used to estimate defect shear strength for use in kinematic analysis and batter design).
    - quality of the rock mass near/immediately behind the proposed pit slopes especially on the footwall side of the deposit as there is limited geotechnical data.
    - location and character of major structures (faults and shears).
    - variability of material properties through the Cover / Oxide sequence which is significant at the southern end of the pit.

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Appendix A – Site Visit Wrap up presentation.

Standard abbreviations

MER	MEGA Resources
BFA	Bench face angle
BGS	Below Ground Surface
BI	Lilly's Blastability Index
FES	Field Estimated Strength
FGM	Fekola Gold Mine
FoS	Factor of safety
GSI	Geological strength index
IRA	Inter-ramp slope angle
IRS	Intact Rock Strength
Ja	Joint Alteration (Q System)
JCS / JWS	Joint wall compressive strength
Jn	Number of Joint Sets (Q System)
Jr	Joint Roughness (Q System)
JRC	Joint roughness coefficient
kPa	Kilo Pascal
LoM	Life-of-mine
m	metre
m3	cubic metre
MPa	Mega Pascal
OSA	Overall slope angle
OSH	Overall slope height
pf	Powder factor
QAQC	Quality Assurance Quality Control
RL	Reduced level
RQD	Rock Quality Designation
SME	SME Geotechnical Pty Ltd
TARP	Trigger Action Response Plan
TBC	To be confirmed
TCR	Total Core Recovery
UCS	Uniaxial or Unconfined compressive strength
USD	United States of America Dollars
x	Distance along horizontal access towards east (easting)
y	Distance along horizontal access towards north (northing)
z	Distance along vertical access / Depth

1 Introduction

MEGA Resources ("MEGA Resources") is evaluating re-commencing mining at the Western Queen South gold deposit ("WQS") in the Goldfields region of Western Australia for Rumble Resources Ltd ("Rumble"). As such MEGA Resources requires geotechnical design support for the project allowing for the determination of appropriate slope design parameters for mine design.

Will Sarunic, Principal Geotechnical Engineer of SME Geotechnical Pty Ltd ("SME") has been engaged to complete this assignment and work with MER to progress the development of the proposed project.

Figure 1.1 presents a recent aerial view of the existing (Stage 2) Western Queen South pit (sourced from Google Earth Pro image date 22/05/2023) which is currently filled with water and has not been mined since 2013.

Figure 1.1: Aerial View of Western Queen South Pit in 2023 (source Google Earth Pro).

2 2025 Preliminary Geotechnical Review

2.1 Background

The WQS deposit is located approximately 90 km northwest of Mt Magnet and 75 km west of Cue in the Murchison Province of Western Australia (refer Figure 2.1).

Large scale mining started in 1998 with mining of the Western Queen open pit and underground workings (just to the North of WQS), finishing up in 2002. In July 2007 Harmony Gold Australia commenced open pit mining on the WQS deposit, finishing up in November 2007 due to a combination of pit wall instability and the company closing down the Mt Magnet operation. Ramelius restarted the Mt Magnet mine in 2011 and mined the WQS pit (Stage 2) from March 2013 to March 2014. SME refers to the two periods of mining at WQS as WQS Stage 1 (2007) and WQS Stage 2 (2014).

Figure 2.1: Western Queen location (Ramelius 2014 WQS Closure Report Fig. 1)

The Western Queen project area comprises the historical Western Queen Open Pit and Underground along with Western Queen South open pit. For this study report SME's focus has been directed to the Western Queen South deposit and the proposed recommencement of mining of Stage 3 at Western Queen South.

2.2 SME's completed Scope of Work

SME completed the following scope of works:

1. Desk top review including:
   - Review the current geological, structural, hydrogeological and geotechnical data and associated models to determine the levels of confidence in these and how they might impact slope design and operations.
   - Review any previous geotechnical and hydrogeological studies, specifically reviewing the quantity and quality of geotechnical and hydrogeological data, the stability analyses undertaken and the derived slope design parameters.
   - Review of the proposed mine plan and schedule to assess if the geotechnical studies and associated slope designs are aligned.
   - Develop updated slope design parameters where applicable.
2. Reporting – Provide a brief summary report of findings highlighting risks and opportunities and requirements to address these.

2.3 Information Provided for this review

The following information pertinent to WQS was provided by MER and forms the basis of this review:

Reports

- 2007 (Nov.) AMC Consultants to Harmony: *Western Queen South Wall Stability- AMC Nov2007.doc*
- 2007 (Dec.) Harmony Surface Mining Geology Department: *WESTERN QUEEN SOUTH_Closure Report.pdf*
- 2012 (May) Peter O'Bryan & Associates to Ramelius: *Western_Queen_South_ Geotechnics_May_2012_FINAL.pdf*
- 2012 (Nov.) Peter O'Bryan & Associates to Ramelius: *Western_Queen_South_ Geotechnical_Assessment_Nov_2012.pdf + Appendices A to E*
- 2014 (Jun.) Ramelius Resources Closure report: *Western Queen South Open Pit Closure Report 18062014.docx.*

Wireframes

- Pre-mining Topography: cube_3DM_oxide_June2021.dtm
- Topo 2021: *wq_all_ground_sub_1m_topo.dtm / str*
- Stage 2 as built – *contour.str*
- Base of completely oxidised (boco): *cube_3DM_oxide_June2021.dtm / str*
- Top of fresh (tofr) (same as base of trans): *cube_3DM_fresh_June2021.dtm / str*
- Base of Transported units (cover): *Cube_TGRV_Cover_contacts.dtm / str*

Note that boco and tofr surfaces represent the base of completely oxidised sulphides and top of fresh sulphides and are analogous to geotechnical weathering but not the same.

- Transported Cover: *Lithology Model Simplified - Transported Cover.dtm*
- Banded Mafic: *Lithology Model Simplified - Banded Mafic.dtm / str*
- Eastern Ultramafic: *Lithology Model Simplified - Eastern Ultramafic.dtm / str*
- Pegmatite: *Lithology Model Simplified - Pegmatite.dtm / str*
- Western Ultramafic: *Lithology Model Simplified - Western Ultramafic.dtm / str*

Pit Shells / Designs

- Proposed Design – *Queen.dtm / str*

Drilling Data / Core Photos

- Drilling database (Corrected) - *WESTERN QUEEN_LF_Export_2025_02_21.zip*
    - 01_DHAlteration_P0_2025_02_21.CSV
    - 01_DHAssays_P0_2025_02_21.CSV
    - 01_DHCollar_2025_02_21.CSV
    - 01_DHEvents_2025_02_21.CSV
    - 01_DHLithology_P0_2025_02_21.CSV
    - 01_DHMagsus_2025_02_21.CSV
    - 01_DHMinerals_P0_2025_02_21.CSV
    - 01_DHpXRF_2025_02_21.CSV
    - 01_DHSpecficGravity_2025_02_21.CSV
    - 01_DHStructureOrient_2025_02_21.CSV
    - 01_DHSurveys_P0_2025_02_21.CSV
    - 01_DHVeins_P0_2025_02_21.CSV
    - 01_DHWaterAssays_2025_02_21.CSV
    - 01_PTAssays_2025_02_21.CSV
    - 01_Standard_Samp_pXRF_2025_02_21.CSV
- Extracts from previous drilling data base (*WQ_20210416.accdb*) including:
    - o *DH_GeotechWQ20210416.xlsx*
    - o *DH_Density_WQ20210416.xlsx*

Note that all orientations/coordinates discussed in this document are relative to MGA grid unless specifically defined.

3 Review of previous studies

The following discussions presents the key aspects of previous studies work that influence the development of February 2025 geotechnical model and associated slope design parameters.

3.1 From **Peter O'Bryan and Associates ("POBA")** (Nov. 2007)

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2 Relevant Previous Geotechnical Assessment

Peter O'Bryan (2007) did a preliminary Geotechnical Assessment of the Western Queen South pit in January 2007. Because of limited data, the guidelines given were described as preliminary.

Some of the conclusions were drawn from the original Western Queen pit roughly 700m north of the Western Queen South pit. The original pit was mined to a depth of 60m (331mRL) with major slope failures in the west, north and east pit walls. The failure mechanisms are unknown because of access restrictions.

No specific geotechnical drilling or material strength testing has been carried out for Western Queen South. Recommendations were based on an internal Harmony Mount Magnet (HMM) report and anecdotal information.

O'Bryan recommended that the proposed wall design parameters by HMM be moderated and suggested preliminary face angles of 40° in the transported material and ≤60° in the oxidised rocks. For this he assumed that depressurisation (weep) holes would be drilled and be successful in dissipating hydraulic pressures behind the pit walls.

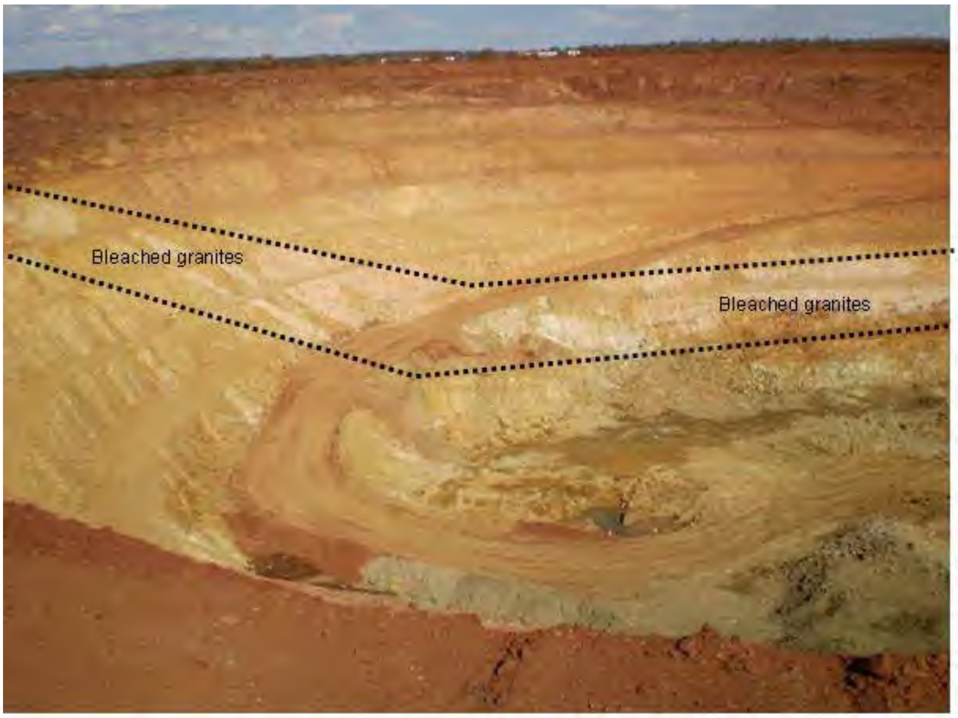
Standing ground water in the original Western Queen pit was estimated at 355mRL (36m below natural ground surface). No data was available for the groundwater level in the Western Queen South pit area, but it was assumed that it would be different from the original Western Queen pit and was expected at 55m below ground surface. O'Bryan recommended hydrogeological investigations before the start of mining.

3 Site Observations

AMC first inspected Western Queen South the afternoon of 16 November 2007 and again on the morning of 18 November 2007.

Water is the driving force behind the current failures. It results in destabilising pore pressure and weakening of the clay-rich material on both sides of the bleached granites. The bleached granite is jointed, but more solid with better permeability than the surrounding clay-rich material. It appears that the granites channel the water, saturating the clay-rich oxidized material in the vicinity. When the weathered material below the granites fails, the granites are too weak to resist the deformation. The resulting movement in the granites is more pronounced than in the surrounding swelling clay-rich material.

Figure 3.1: Western Queen South - Afternoon of 16 November 2007 (AMC 2007 Fig. 3.1)



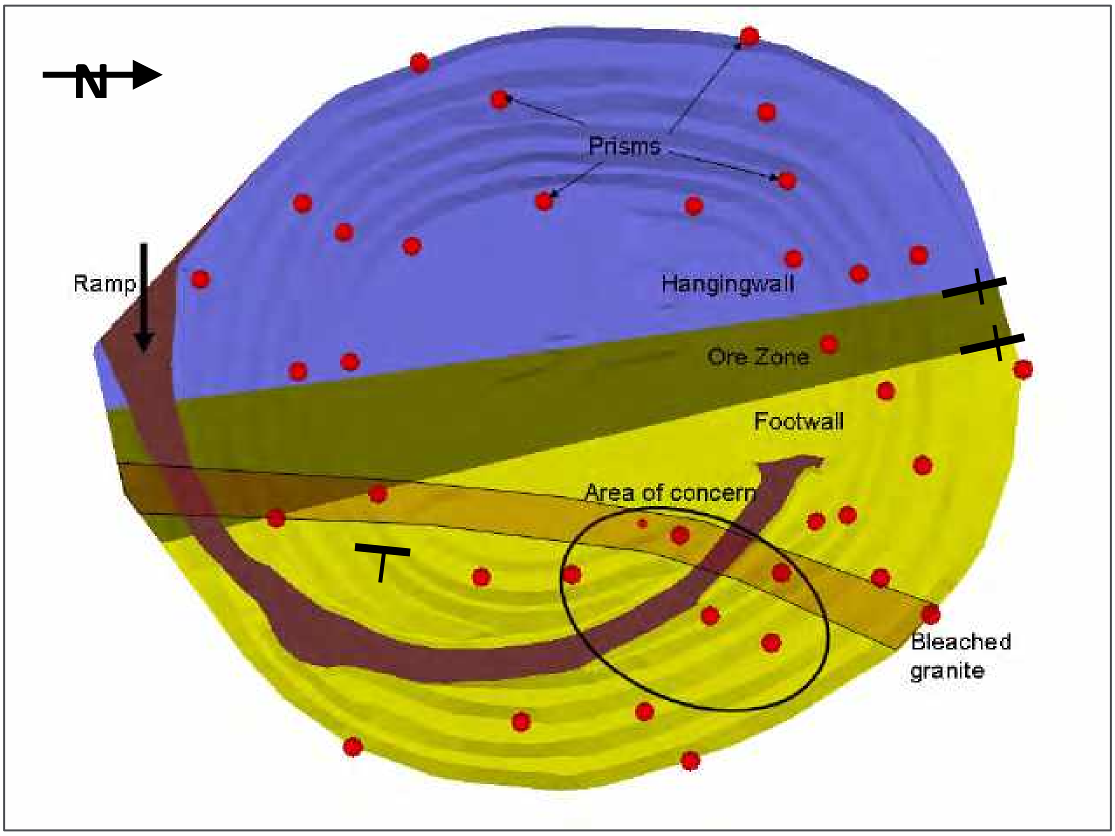
Observations in the pit indicate that the pit bottom is now well below the natural water level. These observations are in agreement with the water level in the original Western Queen pit around 700m further north. The water level in this pit is estimated at ~~255~~ 355mRL*, and the Western Queen South pit is currently at* ~~250~~350mRL *(5m below* ~~255~~355mRL*).*

Figure 3.2: Original Western Queen pit water level ~ 255mRL (AMC 2007 Fig. 3.2)

The pit shell in Figure 3.3 is for the end of October 2007 and close to the estimated water level. The pit is roughly 8m deeper than the representation in Figure 3.3.

The pit shell in Figure 3.3 is for the end of October 2007 and close to the estimated water level. The pit is roughly 8m deeper than the representation in Figure 3.3.

Figure 3.3 Schematic Picture of the Western Queen South pit



The changes that occurred from the first to the second visit were obvious. Multiple cracks appeared in the ramp, berms and batters. Some of these new cracks were more than a centimetre wide….

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5 Failure Mechanism

Water is the driving force behind the current failures. It results in destabilizing pore pressure and weakening of the clay-rich material on both sides of the bleached granites. The bleached granite is jointed, but more solid with better permeability than the surrounding clay-rich material. It appears that the granites channel the water, saturating the clay-rich oxidized material in the vicinity. When the weathered material below the granites fails, the granites are too weak to resist the deformation. The resulting movement in the granites is more pronounced than in the surrounding swelling clay-rich material.

The resulting failure mechanism is circular failure through the oxidized material driven by hydrostatic pressure from the ground water.

6 Potential Corrective Actions

To stabilise the wall, the water pressure will have to be removed. This is normally done with weep (dewatering) holes. To drill weep holes, access would be required below the unstable pit wall. An alternative could be to drill surface holes and pump the water.

The best target for the weep or surface holes would be in the granites. Assuming drainage could be successfully done and the wall stabilised, the next step would be to secure the toe of the moving wall. Waste could be dumped and dozed up the wall. Much the pit floor would be lost to build the stabilising bund.

Discussions with Mike Sandy, who was previously involved with the original Western Queen pit and an underground study, revealed that water was always difficult to manage in the area.

A hydrological study done at Western Queen in 1997 indicates that the peak dewatering abstraction needed for the original Western Queen was estimated at between 6 000 - 8 000 kL/day to achieve a vertical decline of 0.5m per day. The report mentions that the capacity required could even be as high as 12 000 kL/day when fault zones or fractured pegmatite veins are intersected. The static water level was at 379mRL (15m below ground surface) at the time of the study.

3.2 From Harmony WQS Stage 1 Closure Report (Dec. 2007)

Local Geology

At Western Queen the greenstone sequence dips steeply west and comprises interbedded schistose amphibolites of mafic to ultramafic composition with thin iron formation horizons, spinifex textured komatiitic basalt, dolerite sills, talc chlorite schist and other assorted ultramafics. Later dolerite dykes and pegmatoid felsic intrusives cut the amphibolites. Recrystallised batholithic granitoids surround and have embayed the contacts with the layered sequence.

The mineralised system that plays host to the Western Queen South deposit is located within sheared amphibolite host material. This mafic lithology corresponds to the hangingwall of the Western Queen deposit, and exhibits abundant steeply west-dipping structures.

These mafic lithologies are overlain by a significant layer of transported overburden comprising of barren pisolitic colluvium and ferruginous clays, capped with a Tertiary laterite (which occasional exhibits anomalous gold values over mineralised portions of the saprolite.)

Depth of weathering increases on progression to the south (corresponding with increasing depth of transported overburden). Regolith depth ranges from forty metres in the northern extremity of the deposit, to ninety metres in the south, and in general there is a sharp gradation from oxidised to fresh material.

Mineralisation

The Western Queen and Western Queen South deposits are within the Kylie Mining Group and are the largest known deposits within the Warda Warra belt.

The Western Queen deposit is associated with the upper and lower contacts of a concordant, sheared cherty, micaceous volcano-sedimentary (?) horizon. The horizon is sandwiched between ultramafic schist in the hangingwall and a basalt footwall (W. Johnson and Associates 1986). It is associated with sulphidic vein quartz and has an overall steep westerly dip and a shallow southerly plunge. The horizon is reported as hosting mineralisation for 990m along strike and lies near the apparent top of the belt sequence, close to the western granitoid contact. Pegmatite sills cut the mineralisation.

The deposit at Western Queen South is a southern extension / repetition of the Western Queen deposit setting and comprises a generally north-south striking zone of sheared amphibolite (trending 028° locally) that dips steeply to the west. The mineralised envelope has a strike length of 350m and a vertical extent of about 300+m (not closed-off in either direction). Within this sits a central high-grade core which has a strike of approximately ninety metres. Horizontal widths vary from up to 13m near the upper parts to about 3m near the base of the envelope.

The base of oxidation is generally shallow and varies from 50m in the north to 80m in the south. There is a pronounced southerly plunge on the envelope of approximately fifty degrees.

The resource is masked by a layer of transported cover that varies in thickness from 15m over the north end of the deposit, to 30m at the south end. Mineralisation is generally visually distinct from host lithologies, with the bulk of the mineralised zone described as alternating layers of silicified calc-silicate / quartzo-feldspathic and amphibole rich material. Accessory minerals include scheelite, pyrrhotite and chalcopyrite, with the presence of K-feldspar +/- quartz thought to indicate an acidic volcanic derivation. The oxidised portion of the resource is generally distinguishable by its high limonite content, with limonite formed parallel to foliation. There is also evidence of supergene processes having played a part in gold distribution throughout the orebody by way of observed horizontal layering of limonite-rich zones. The mineralised fresh rock can be described as silicified, with biotite and sulphide alteration. There is mention of scheelite as an accessory mineral, and also of tungsten, bismuth, molybdenum and copper.

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Mining Issues

Prior to mining commencing there was no validation of drill holes or data carried out at Western Queen South after Harmony acquired the lease. It was noted very early in the mine life that the survey pick up of the natural surface did not match the ResDev natural surface, from which the block model had been created. Many of the drill hole collar positions were displaced by up to 3.5m, however, not consistently across the surface, the distances varied across the whole area. The drill holes had to be individually appended to the natural surface, the ore solids edited and the block model recreated.

Early in the mine life of the pit a bore hole was drilled for 100m South of the pit to assess the groundwater. ***The original Western Queen pit was known to have significant issues with water throughout the mine life culminating in the underground workings being halted due to problems with groundwater****. The bore did not produce excessive water and it was decided that the water would be managed by sumps and a number of pumps in the pit, as and when required. The water table sits approximately 35m below the surface. As the pit only reached 42m in depth water was not the worst issue during mining, however it did slow down production due to the floor becoming boggy from still water that did not flow through the impermeable clay material.*

Geotechnical issues and wall stability eventually resulted in the early closure of Western Queen South, with the Eastern wall deemed too unstable for continuing use. The ramp was positioned travelling up the Eastern wall which inevitably meant great pressure from heavy vehicles and increased instability of the wall, putting lives at risk. Without the imposed time constraints it may have been possible to create a new access ramp into the pit; however it was deemed not economically viable in the time left with Harmony.

As the pit advanced it was noted that cracks were appearing along a significant contact on the Eastern wall. A porphyry felsic dyke rich in quartz and muscovite plunged 65degrees west into the pit wall just below the ramp at the 360mRL. This weathered felsic showed strong shearing in the surrounding mafic as well as re-crystallisation of aquifer related minerals. Once the water table had dropped the felsic dried into a compacted sand with a rock strength of <0.03Mpa. With the dyke situated in the east wall defects continued to propagate up to and across the pit ramp. Prisms monitoring showed a continuous movement in the east wall averaging up to 5mm a day and cracks noticeable widened on a daily basis.

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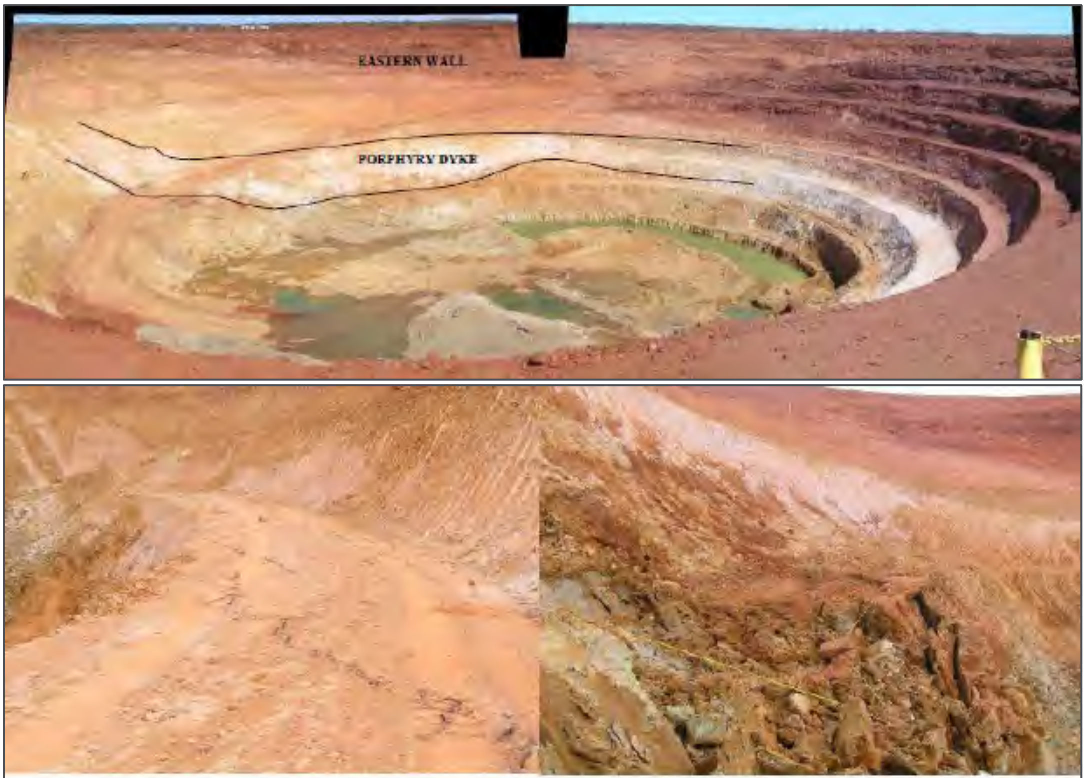
Figure 3.3: WQs Pit at end of mining 2007 and Geotech issues (Harmony 2007 Fig. 1)



The above photos both show the Eastern wall at the end of the mine life. Failures and cracking along the berm are clearly seen.

3.3 From **Peter O'Bryan and Associates (Nov. 2012)**

Note that the POBA 2012 report is the most recent and most comprehensive historical geotechnical assessment of WQS. Relevant extracts from POBA report are presented below.

2.0 Background Information

2.1 Past Mining

The WQS open pit was previously mined by Harmony Australia from June 2007 to November 2007. The final as-mined WQS pit is shown in Figure 3.4*, with views of the pit provided as Plates 1 and 2.*

The as-mined survey file (file: ws_topo.dtm) indicates that WQS pit was mined to a final depth of ~ 41m.

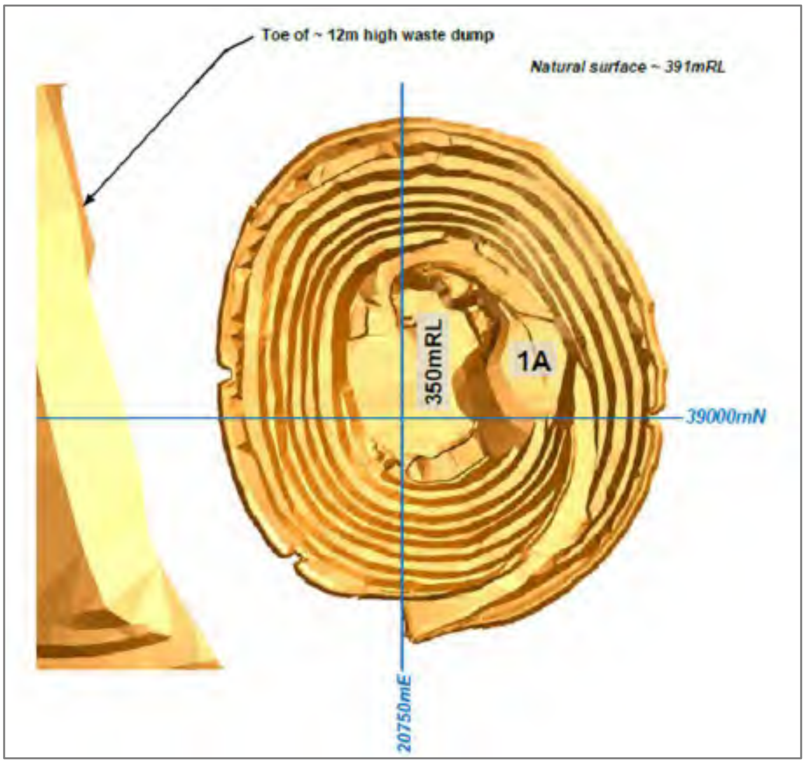
A ~ 12m high waste dump has been constructed to the west of the existing WQS pit, with the dump toe located ~ 52m from the pit crest.

As-mined wall parameters applied at WQS are provided in detail in Appendix A.

In summary, the following were achieved:

Batter Height	*up to 6m*
Batter Face Angle	*40° to 55°*
Berm Width	*3 to 7m*
Overall Slope Angle (OSA)	*26° to 36°*

Figure 3.4: WQS Pit as mined 2012 (POBA 2012 Fig. 1)



Note the figure above is relative to local grid and has been rotated from MGA north.

Figure 3.5: WQS Pit December 2011 view looking east (POBA 2012 Plate 1)

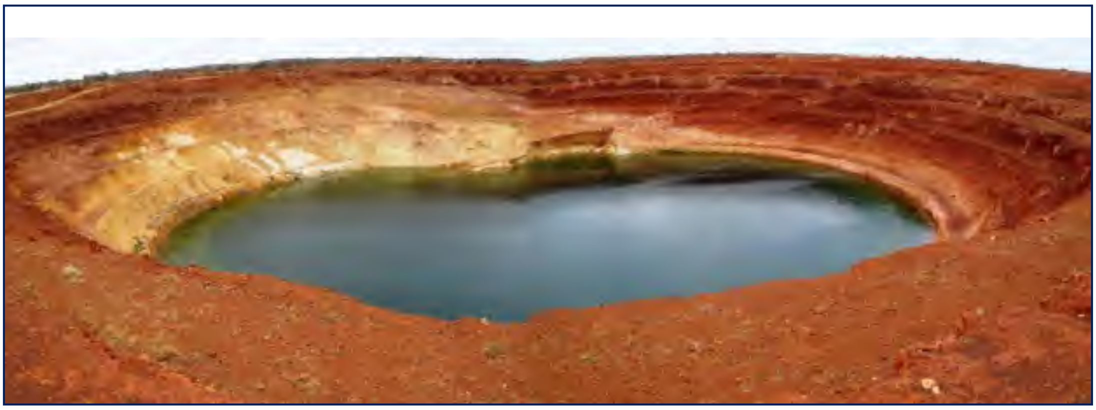


Figure 3.6: WQS East Wall Instability December 2011 view looking south (POBA 2012 Plate 2)

2.2 Current Stability Conditions

The WQS pit is currently flooded to ~ 366mRL. Pit wall stability conditions in visible portions of the WQS pit were assessed to be fair generally, with some areas where conditions are locally poor.

At the east wall location indicated by 1A (Figure 1 and Plate 2), slumping failure has occurred between the ramp at ~ 367mRL and the pit floor. This ramp failure is reported to have ended mining at WQS prematurely in November 2007.

A geotechnical assessment of the east wall instability carried out by AMC Consultants 1 concluded the following:

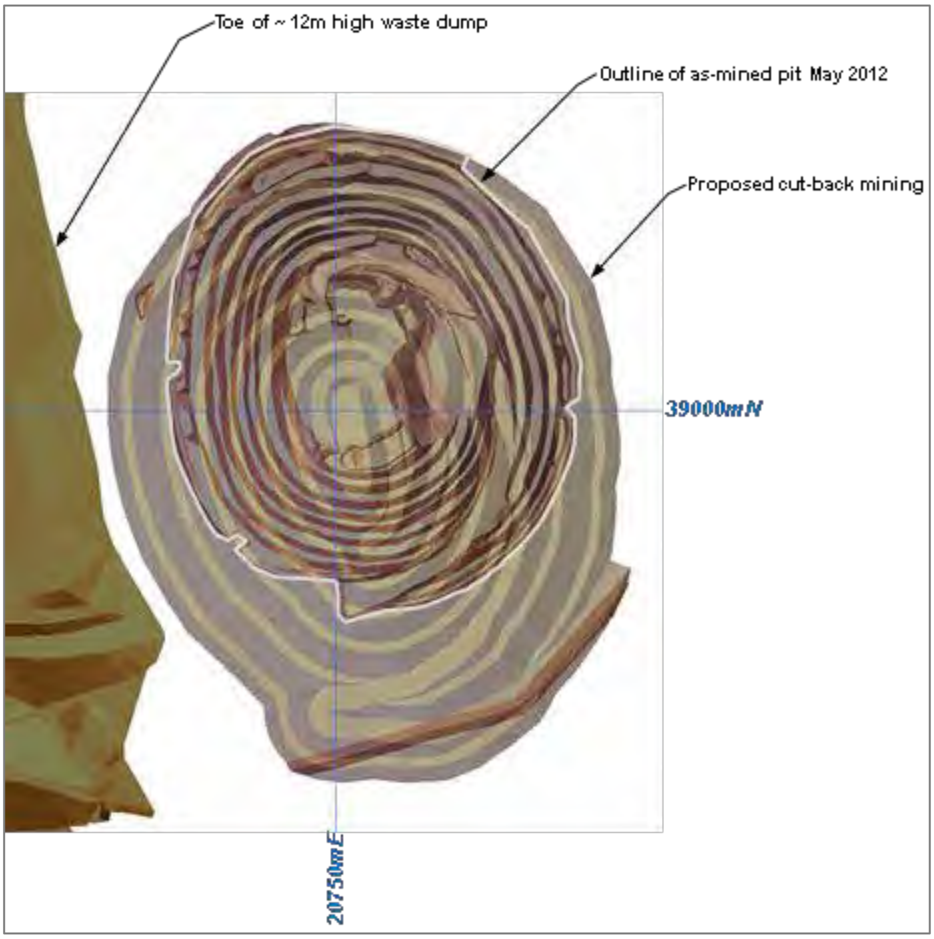
- *Pore water pressure destabilised clay material on either side of bleached granites.*
- *Collapse occurred due to circular failure through oxidized material driven by hydrostatic pressure from groundwater.*

3.0 Proposed Mining

Design file pdwq5c_wf.dxf which shows proposed WQS cut-back mining was provided by MMG for review (Figures 2 and 3).

The proposed WQS design indicates that planned mining will cut-back all existing walls and deepen the pit by ~ 60m (from ~ 350mRl to 290mRL). The proposed WQS design shows a final pit of ~ 340m length (north-south), ~ 270m width (east-west) and ~ 100m depth (from 390mRL to 290mRL) (refer Figure 3.7*).*

Figure 3.7: WQS: As-Mined Pit Sept 2012 and Proposed Cut-Back (POBA 2012 Fig. 2)

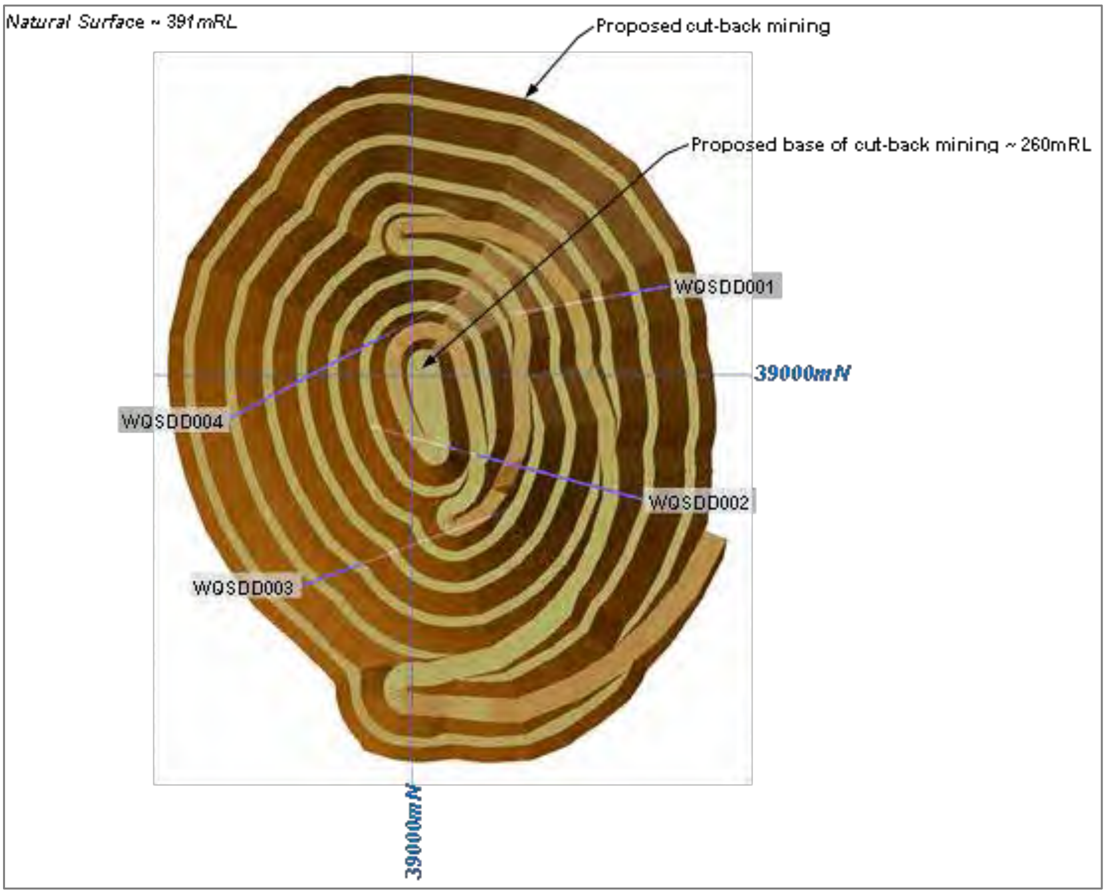


Note the figure above is relative to local grid and has been rotated from MGA north.

The wall design parameters used by MMG for preliminary cut-back design at WQS (refer Figure 3.8) *were:*

Face Height	*10m*	*Natural surface to 380mRL*
	20m	*380mRL to 260mRL (proposed base of mining)*
Face Angle	*50°*	*Natural surface to 360mRL*
	53°	*360mRL to 340mRL*
	57°	*340mRL to 320mRL*
	60°	*320mRL to 260mRL*
Berm Width	*5.5m*	*All berms*
Indicative Overall Slope Angle		*~ 46.9°*

Figure 3.8: WQS: Proposed Cut-Back and Geotechnical Investigation Boreholes (POBA 2012 Fig. 3)



Note the figure above is relative to local grid and has been rotated from MGA north.

4.0 Assessment of Geotechnical Conditions

4.1 Previous Geotechnical Work

Preliminary geotechnical assessment of proposed WQS open pit mining was carried out by Peter O'Bryan & Associates in 2007.

4.2 Current Studies

Assessment of likely geotechnical conditions at WQS has been based on geotechnical logging data obtained from cores of four (4) geotechnical investigation boreholes and inferences made from inspection of as-mined conditions within visible portions of walls in the existing open pit.

4.2.1 Geotechnical Investigation Boreholes & Logging

Geotechnical assessment of proposed open pit cut-back mining at WQS has been based largely on data derived by geotechnical logging of cores from the four (4) HQ3 core-oriented boreholes, drilled in future cut-back wall locations as listed in Table 3.1*. The locations of the holes relative to proposed mining are shown in relation to preliminary pit designs in* Figure 3.8.

Table 3.1: Geotechnical logged Boreholes (POBA 2012 Tab. 1)

Borehole	Collar coordinates*			Orientation*		Depth (m)
	mE	mN	RL	Dip	Azimuth	
WQSDD001	20900	39050	391	51°	260°	146.2
WQSDD002	20880	38931	390	48°	285°	243.0
WQSDD003	20390	38886	390	54°	071°	195.3
WQSDD004	20641	38971	390	48°	065°	236.9

**All coordinates and directions relative to WMC grid*

4.2.2 Geotechnical Core Logging

Geotechnical data was collected by MMG geologists from cores of geotechnical investigation boreholes…

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4.2.3 Rock Mass Classification

Rock mass classification is used to summarise the characteristics of weathered and fresh rock masses. The WQS rock masses were classified using Bieniawski's RMR_{89} system[3], with values further adjusted to Laubscher's MRMR[4] system.

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5.0 Assessed Geotechnical Conditions

5.1.1 Geology

The geological descriptions that follow have been summarised from the Harmony Western Queen South Open pit Closure report 6.

Regional Geology

The Western Queen South tenements lie within the Archaean Warda Warra Greenstone Belt, a north trending enclave within the Murchison Province of the Yilgarn Craton. The belt is interpreted to be ~ 35 km in length, and at the southern end near the WQS deposit, is 2 km wide. The north striking and west dipping layered sequence has been metamorphosed to amphibolites grade and is enveloped by recrystallised granitoids.

Local Geology

At WQS the greenstone sequence is interpreted to dip steeply to the west and comprises interbedded schistose amphibolites of mafic to ultramafic composition with thin iron formation horizons, komatiitic basalts, dolerite sills, talc chlorite schist and other ultramafics. Later dolerite dykes and pegmatoid felsic intrusives cut the amphibolites. Recrystallised batholithic granitoids surround and have embayed the contacts with the layered sequence.

The WQS deposit is located within sheared amphibolite host material. This mafic lithology corresponds to the hangingwall of the WQS deposit and exhibits abundant steeply west-dipping structures. The mafic lithologies are overlain by a significant layer of transported overburden.

[3] Bieniawski, Z.T. 1989: *Engineering rock mass classifications*, New York: Wiley.

[4] Laubscher, D.H. 1990: *A Geomechanics classification system for the rating of rock mass in mine design*, Journal of South African Institute of Mining and Metallurgy. Vol 90. No 10. Oct 1990.

The depth of weathering at WQS increases to the south, corresponding with increasing depth of transported overburden.

5.1.2 Rock Weathering

Rock weathering depths at WQS vary considerably. Rock weathering is interpreted to extend to greater depths on the southern side of the deposit.

The depth of transported cover material is interpreted to be ~ 3m on the northern side of the proposed mining area and ~ 41m on the southern side.

The depth of the base of complete oxidation (BOCO) is interpreted to be located at ~ 41m depth on the northern side of the deposit and ~ 70m on the southern side.

Across the proposed WQS mining area the transitional weathering zone is fairly limited, with a sharp gradation between BOCO and the top of fresh rock (TOFR). TOFR is interpreted to lie at ~ 50m depth in the north and ~ 81m in the south of the deposit.

5.1.3 Rock Strength

No laboratory rock strength or defect direct shear strength data are available for WQS.

Rock strength at WQS is predominantly governed by rock weathering grade. The depth to the top of fresh rock (TOFR) is interpreted to be ~ 50 to 81m below natural surface.

Rock strength index test results obtained during geotechnical logging of cores indicate the following material strengths:

- *Highly weathered (or greater) rocks are extremely weak (UCS 0.25 – 1.0 MPa) to very weak (UCS 1.0 – 5.0 MPa).*
- *Moderately weathered rocks are extremely weak (UCS 0.25 – 1.0 MPa) to very strong (UCS 100 – 250 MPa).*
- *Slightly weathered to fresh rocks are generally very strong (UCS 100 – 250 MPa), but can be very weak (UCS 1 – 5 MPa) in the case of talc ultramafics.*

Based on observations of rock defects in borehole cores and experience in similar rock types, defect shear friction angles are expected to generally be low (Φ ≤ 20°) within major geological structures/ contacts and clay/ soft mineral filled defects. Defect shear friction angles can reasonably be expected to range between medium (Φ ≥ 20˚ and < 30°) to high (Φ ≥ 35°) for clean defects in fresh rocks.

Note that POBA adopted a defect shear strength of 30° (no cohesion) for their kinematic assessments (from Appendix D, POBA 2012) of WQS.

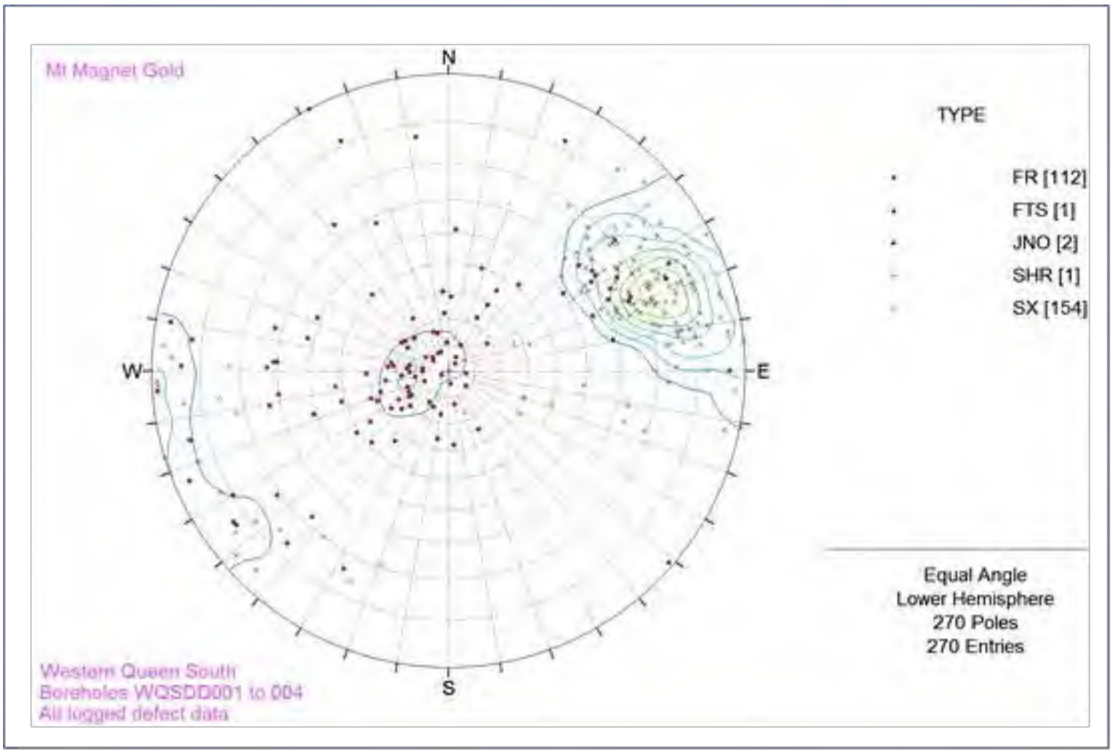
5.1.4 Rock Structure

MMG provided structural discontinuity orientation data collected from four (4) diamond cored geotechnical investigation boreholes (WQSDD001 to 004).

*Borehole discontinuity data were processed and analysed using the Rocscience DIPS 7 program (*Figure 3.9*). Stereoplots are provided in Appendix C.*

From the structural data analysis, two (2) dominant discontinuity sets were identified. The mean orientations and characteristics of each set are listed in Table 3.2.

Figure 3.9: WQS: Boreholes WQSDD001 to 004 Structural Data Pole Plot (POBA 2012 Fig. 4)



** Directions relative to WMC grid.*

Table 3.2: **Dominant Defect "Sets" for all WQS Borehole WQSDD001**-004 data (POBA 2012 Tab. 2)

Defect Set	Defect Description	Dip (°)	Dip Direction (°)
1	Foliation, fractures, a shear and fault – Steep west dipping	74	248
2	Fractures – Flat lying to shallow east dipping	13	099

** Directions relative to WMC grid.*

Structural data from WQS boreholes indicates the following are dominant:

- *Steep west dipping to sub-vertical foliation and fractures*
- *Sub-horizontal to shallow easterly dipping fractures.*

5.1.5 Hydrogeology

MWES Consulting carried out a hydrogeological review of the proposed WQS mining area in 2012. Key findings of the hydrogeological review were:

- *The standing groundwater level at WQS is interpreted to be located ~ 30m below surface (at ~ 361mRL).*
- *All identified aquifers are within fractured rock and were located along the fresh rock/ saprolite boundary.*
- *Fractured rock aquifers were found to have low hydraulic conductivity and low to moderate flow rates (up to 2.9 L/s)*

From additional discussion held with MWES 9 on the findings of WQS hydrogeological assessments the following are inferred:

- *Clays of upper pit wall levels may hold significant groundwater and are inferred to have low permeability.*
- *Ex-pit dewatering via bores will likely have limited success due to the low hydraulic conductivity of clays/ weathered rocks between surface and ~ 90m depth.*
- ***The current WQS pit should be de-watered well in advance of the commencement of proposed mining**.*
- *In-pit dewatering methods will be required at WQS.* ***The use of sub-horizontal depressurisation holes to (aim to) relieve hydrostatic pressure in wall material/ rocks is recommended.***

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6.1 Kinematic Stability Analyses

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In summary, for the proposed WQS pit:

- *Potential for planar sliding failures exists for east and west wall (and possibly north wall) orientations.*
- *Potential for wedge instability exists for west and south wall orientations.*
- *Theoretical potential for toppling failure exists for west walls.*

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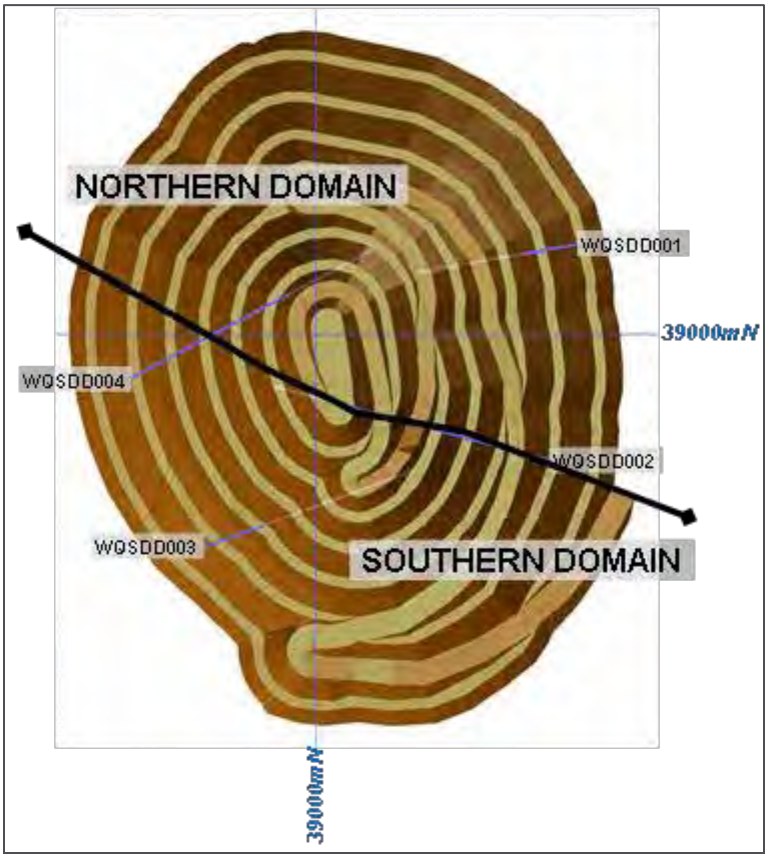
7.0 Implications for Mining

7.1 Geotechnical Design Domains

The WQS mining area has been divided into two (2) geotechnical domains/ design sectors (Figure 6). Design sector selection was based on depth of rock weathering and sectors are as follows:

- *Northern Domain*
- *Southern Domain*

Figure 3.10: WQS: Geotechnical Design Domains and Investigation Boreholes (POBA 2012 Fig. 6)



Note the figure above is relative to local grid and has been rotated from MGA north.

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8.0 Recommended Base Case Design Parameters

North Domain

Based on rock weathering information provided and observation of as-mined conditions in the existing pit; the upper ~ 3 to 25m of proposed North Domain wall development will be carried out in extremely weathered, extremely weak to very weak predominantly transported material.

Below this depth to ~ 350mRL (~ 41 metres below surface (mbs)) North Domain wall development will be carried out in predominantly highly weathered, extremely weak to very weak clays/ saprolite.

Between ~ 41m and 58m depth wall development will be carried out in moderately weathered extremely weak to very strong felsic, mafic and ultramafic rocks. Below this depth, lower wall development to ~ 260mRL will be carried out in slightly weathered to fresh, very strong mafic and felsic rocks.

Essentially drained/ depressurised wall rock conditions have been assumed for mining.

Transported/ Cover Material *(surface (391mRL) to ~ 365mRL)*

Face Height	*3m*	*Surface to 385mRL*
	5m	*385mRL to 365mRL*
Face Angle	*45°*	*All batters*
Berm Width	*2m*	*At 388 and 385mRL 380mRL, 375mRL,*

		370mRL and 365mRL
IRA Surface to 385mRL	*31.0°*	
IRA 385mRL to 365mRL	*35.5°*	
Slope Segment Angle	*35.8°*	

Saprolite/ Clay *(~ 365mRL to ~ 350mRL)*

Face Height	*5m*	*365mRL to 360mRL*
	10m	*360mRL to 350mRL*
Face Angle	*50°*	*All batters*
Berm Width	*4m*	*All berms*
IRA 365mRL to 360mRL	*50.0°*	
IRA 360mRL to 350mRL	*50.0°*	
Slope Segment Angle	*42.1°*	

Moderately to Slightly Weathered Rocks *(~ 350mRL to ~ 320mRL)*

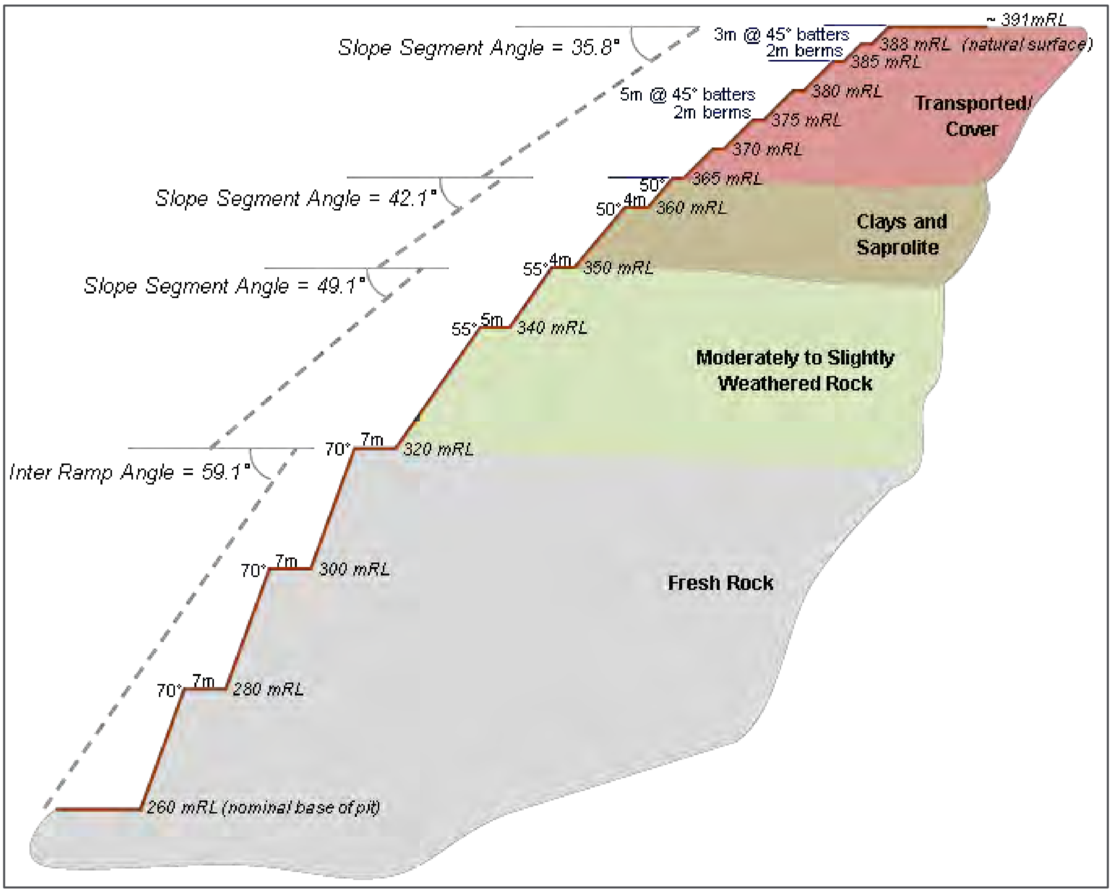
Face Height	*10m*	*350mRL to 340mRL*
	20m	*340mRL to 320mRL*
Face Angle	*55°*	*All batters*
Berm Width	*5m*	*At 340mRL*
	7m	*At 320mRL*
IRA 350 to 340mRL	*55.0°*	
IRA 340 to 320mRL	*55.0°*	
Slope Segment Angle	*49.1°*	

Fresh Rocks *(~ 320mRL to proposed base of mining at ~ 260mRL)*

Face Height	*20m*	*All batters*
Face Angle	*70°*	*All batters*
Berm Width	*7m*	*At 300mRL and 280mRL*
IRA 320 to 260mRL	*54.5°*	
Slope Segment Angle	*59.2°*	

Overall Slope Angle *45.8°*

Figure 3.11: WQS: North Domain Recommended Base Case Design Parameters (POBA 2012 Fig. 7)



South Domain

Based on rock weathering information provided and observation of as-mined conditions in the existing pit; the upper ~ 41m of proposed South Domain wall development will be carried out in extremely weathered, extremely weak predominantly transported material.

Below this depth to ~ 321mRL (~ 70 mbs) South Domain wall development will be carried out in predominantly highly weathered, extremely weak to very weak saprolite.

Between ~ 70m and 81m depth wall development will generally be carried out in moderately weathered extremely weak to very strong felsic, mafic and ultramafic rocks. Below this depth the lower ~ 50m of wall development will generally be carried out in slightly weathered to fresh, very strong mafic, felsic and ultramafic rocks.

Kinematic stability analyses indicate a theoretical potential for structurally controlled failures from east, west and south batter orientations at WQS. Toppling from western batters and planar sliding from eastern batters inferred to be failures modes with the highest potential.

Essentially drained/ depressurised wall rock conditions have been assumed for mining.

The following base case design parameters are recommended for ongoing WQS cut-back mining evaluation:

Transported/ Cover Material *(surface (391mRL) to ~ 350mRL)*

Face Height	*3m*	*Surface to 385mRL*
	5m	*385mRL to 350mRL*
Face Angle	*45°*	*All batters*

Berm Width	*2m*	*At 388mRL, 385mRL, 380mRL, 375mRL, 370mRL, 365mRL, 360mRL, 355mRL and 350mRL*
IRA Surface to 385mRL	*31.0°*	
IRA 385mRL to 350mRL	*35.5°*	
Slope Segment Angle	*35.7°*	

Saprolite/ Clay *(~ 350mRL to ~ 321mRL)*

Face Height	*10m*	*350mRL to 320mRL*
Face Angle	*50°*	*All batters*
Berm Width	*4m*	*At 340mRL, 330mRL and 320mRL*
IRA 350mRL to 321mRL	*38.9°*	
Slope Segment Angle	*42.1°*	

Moderately to Slightly Weathered Rocks *(~ 321mRL to ~ 300mRL)*

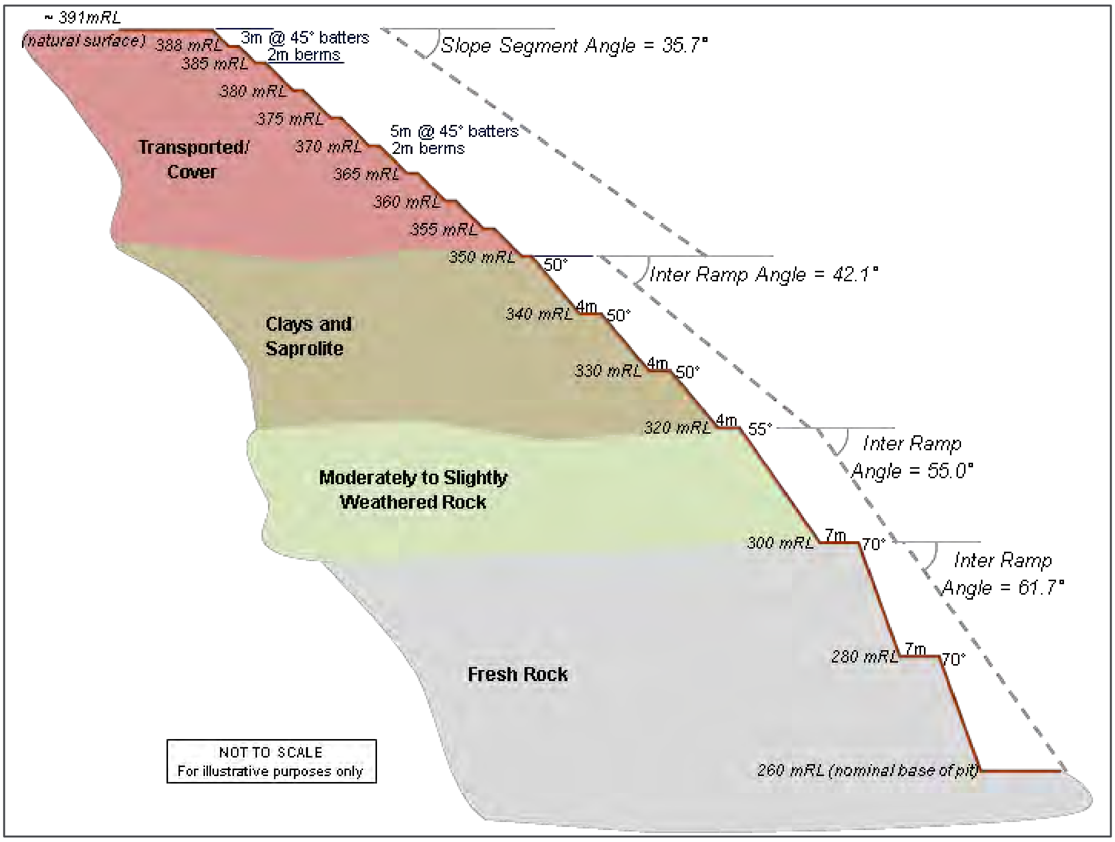
Face Height	*20m*	*320mRL to 300mRL*
Face Angle	*55°*	*All batters*
Berm Width	*7m*	*At 300mRL*
IRA 320 to 300mRL	*55.0°*	

Fresh Rocks *(~ 300mRL to proposed base of mining at ~ 260mRL)*

Face Height	*20m*	*All batters*
Face Angle	*70°*	*All batters*
Berm Width	*7m*	*At 280mRL*
IRA 300 to 260mRL	*54.5°*	
Slope Segment Angle	*61.7°*	

Overall Slope Angle *43.4°*

Figure 3.12: WQS: South Domain Recommended Base Case Design Parameters (POBA 2012 Fig. 8)



8.1 Comments on Proposed Pit Designs

8.1.1 Wall Design

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In general terms, the proposed WQS cut-back design wall geometries and layouts are considered satisfactory.

Nevertheless it is pertinent to note that:

- *The recommended base case[5] parameters are not necessarily conservative.*

It is possible that locally more conservative slopes will be necessary to satisfy stability requirements, for example by locally flattening batters and/or widening berms. Conversely, there may be opportunity for local wall steepening.

- *A key performance indicator for the Mining Group should be achievement of designed berm width in ≥ 85% of cases in all areas.*
- *The designs assume walls are essentially dry, that is, largely dewatered/ depressurised.*
- *Successful use of appropriate mining techniques, particularly in development of final walls, will be critical to the achievement of the design and maintenance of wall stability.*

[5] *Base case parameters are derived using interpretations based on available data and local experience. Variability of geological/ geotechnical conditions means that adjustment to the design during implementation many be necessary. Ongoing geotechnical re-assessment based on mapping and slope monitoring data is essential to identify such variations and to derive suitable amendments to the design parameters. Required application of such amendments may be local or could be widespread.*

- *Mining to the recommended wall parameters may be accompanied by some local batter scale wall failures.*
- *Observed actual conditions (as identified by stability monitoring and wall mapping) must be assessed to confirm/ adjust slope parameters for final walls.*
- *No use of artificial reinforcement or support is anticipated.*

8.1.2 Proximity of Existing Waste Dump

A portion of the proposed WQS western pit crest will be located within □ 30m of the existing rehabilitated waste dump.

This distance is inside the limit that would be defined by the WA generic guidelines for design of Safety Bund Walls around Abandoned Open Pit Mines.

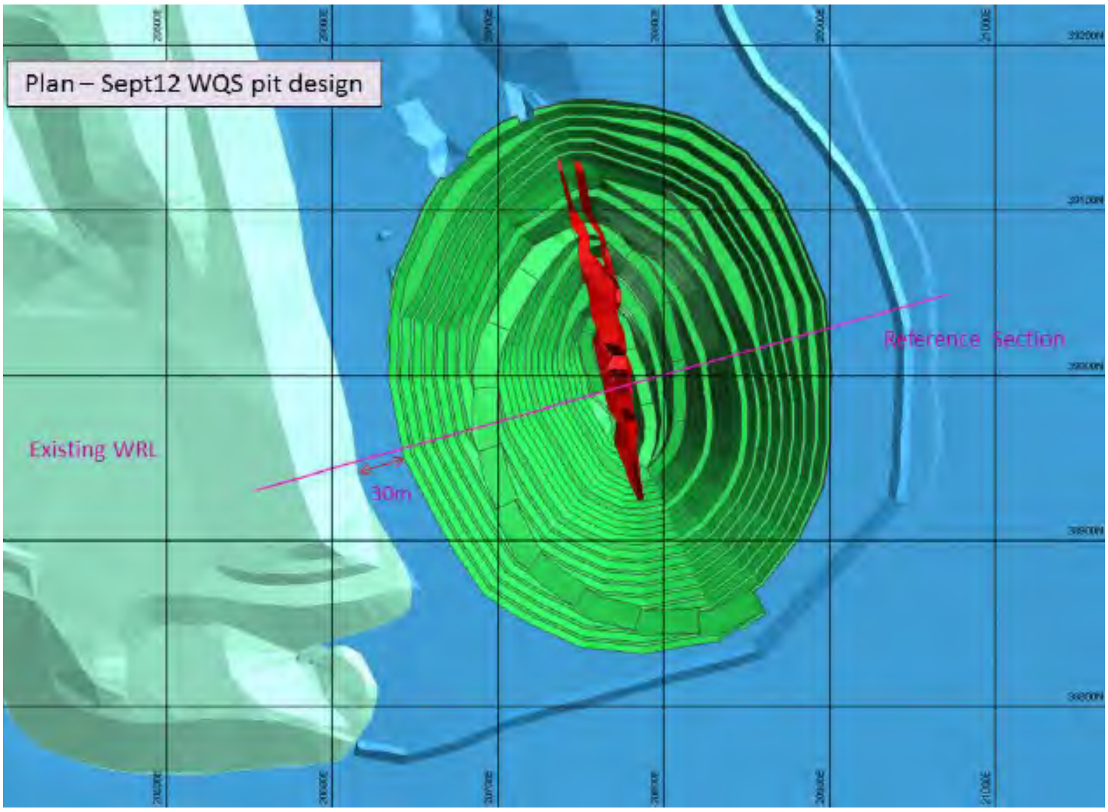
However, in this instance it is considered that:

- *Very long term deterioration of the adjacent pit slope will not destabilise the waste rock landform.*
- *The safety of mining operations and the stability of the future western wall will not be adversely affected by the proximity of the waste dump.*

It is inferred that the current design satisfies the intent of the post-mining environmental and access guidelines/ requirements, given that;

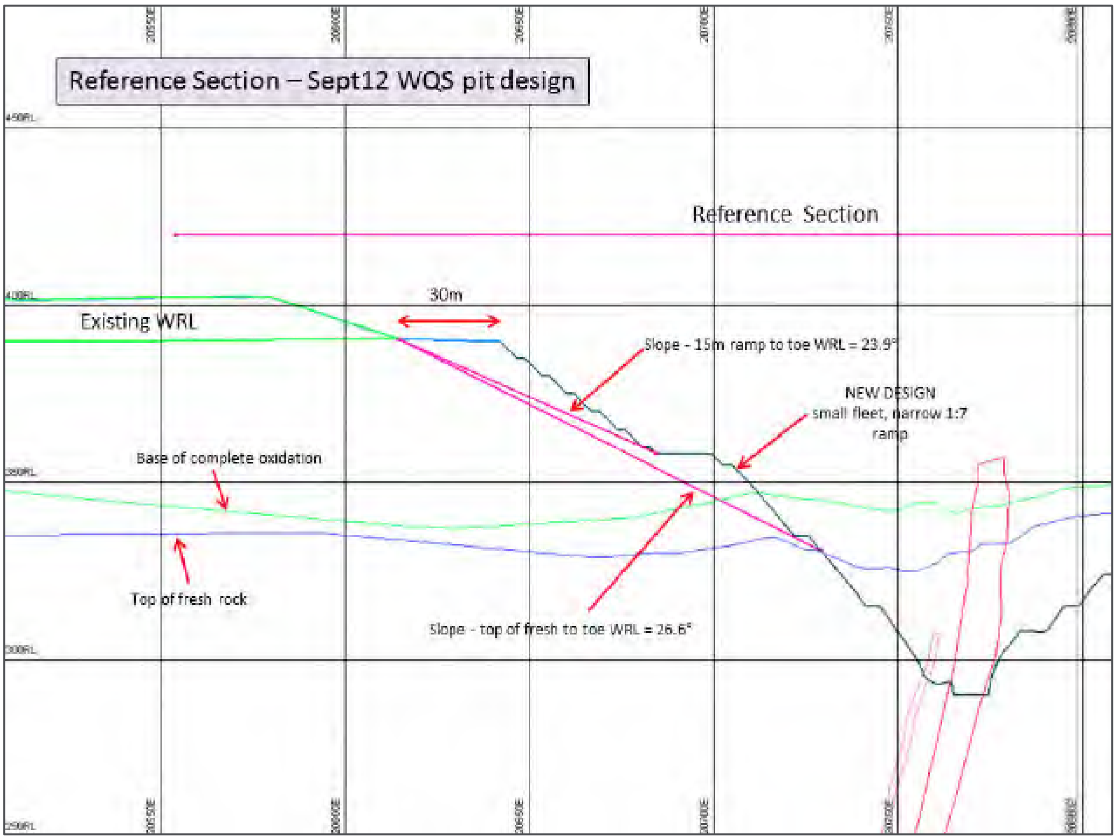
- *The proposed pit design has adopted conservative wall angles. Figure 10, section A-A indicates the effective overall slope angle (OSA) in fresh rock is ~ 40° and the effective OSA for the weathered and transitional rocks is ~ 30.5°.*
- *The subtended angle from the top of fresh rock - pit wall intersection point to the foot of the existing waste dump is ~ 26.6°.*
  From the base of complete oxidation (top of transitional) it is ~ 23.2°.

Figure 3.13: WQS: Proposed Pit and Existing Waste Dump (POBA 2012 Fig. 9)



Note the figure above is relative to local grid and has been rotated from MGA north.

Figure 3.14: WQS: WQS: Reference Section (POBA 2012 Fig. 10)



- *The pit has been designed to be stable for the operational and medium term period. Longer term degradation via erosion may result in minor instability and crest retreat.*
- *Long term retreat of the pit crest would not undercut the dump. The modest upper slope angle is such that there would be minimal change in overall slope profile if failure occurred. Debris would be retained on the slope.*
- *A 15m wide pit ramp has been placed on the western side of the pit between 20m and 40m vertical depth. The ramp effectively breaks the slope into two independent segments.*
- *The existing waste dump adjacent to the WQS pit is one (1) lift high (12m) and has a shallow rehabilitated slope angle of 18° and hence is inferred to be highly stable. The dump has not shown any sign of instability or development of significant erosion since construction. Local slope instability, if occurrent, would result from erosion rather than slope failure.*
- *There are no obstacles to establishing a final Abandonment Safety Bund (to prevent inadvertent access to the pit) around the final pit and across (or around) the existing waste dump to comply with the generic Guideline.*

8.2 Hydrological & Hydrogeological Conditions

Review and appraisal of pit design parameters has been based on the assumption that drained/ depressurised wall rock conditions will be achieved.

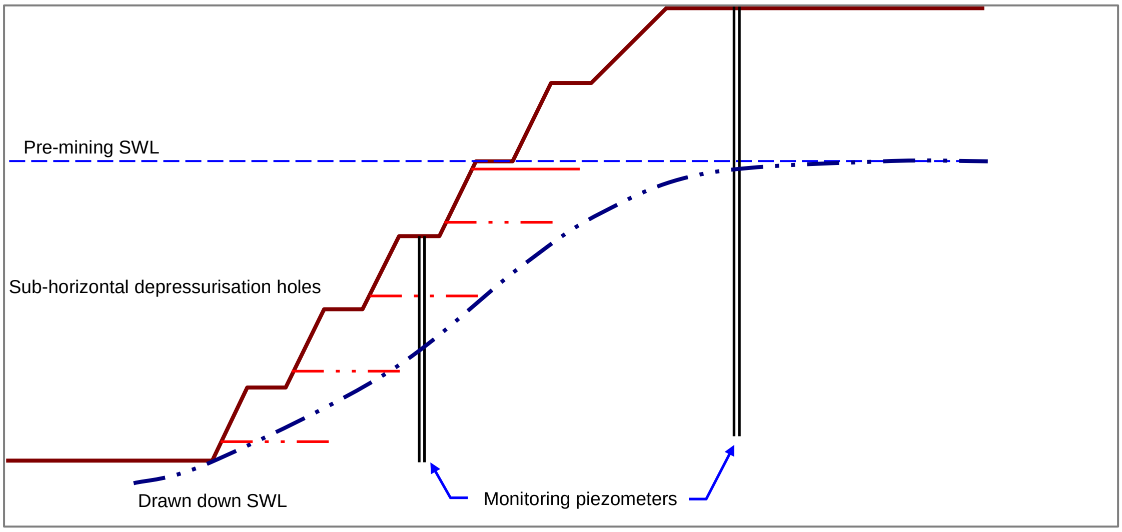
*Accordingly **it is recommended that allowance be made to commence drilling sub-horizontal (± 10°) depressurisation (weep) holes once mining has progressed to the pre-mining water table**. The initial depressurisation holes should be drilled around the periphery of the pit at that level.*

The depressurisation holes should be drilled to a length of ≥ 25m, which is inferred to be the minimum length at which the toe of the holes would be at the limit of the zone which could conceivably be involved in slope instability.

It is important that the effectiveness of dewatering and depressurisation is monitored. This should be implemented in two ways:

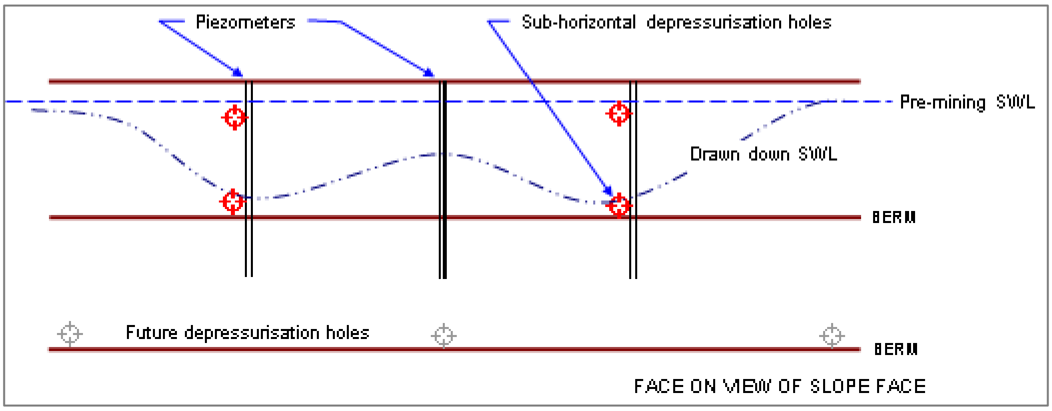
- *A number of groundwater monitoring transects should be developed around the pit. Monitoring bores would be established on these transects (*Figure 3.15*). The first monitoring bore (piezometer) should be located back from the pit crest with at least one (1) and possibly two (2) bores at locations down the pit wall, with the aim of estimating the groundwater profile (and changes therein) behind the pit wall.*

Figure 3.15: Groundwater monitoring transect (schematic only) (POBA 2012 Fig. 11)



- *To assess the effectiveness of depressurisation drilling and to refine the depressurisation array specifications, a number of short piezometers should be installed in a selected area (or areas) in the dominant wall rock types, intersecting the target area of the first round of drilling (see* Figure 3.16*). The piezometers should be installed and have equilibrated prior to drilling the adjacent depressurisation holes. The aim of the monitoring is to observe the response of the water table to the presence of the depressurisation holes and thereby to adjust/refine the drillhole spacing to (aim to) optimise their effectiveness. In particular the degree of positive interference between adjacent holes needs to be assessed in order to appropriately adjust the horizontal spacing of the holes. It may be preferable to install the piezometers from two (2) berms above the depressurisation holes so that the monitored point is further behind the wall.*

Figure 3.16: Depressurisation trial monitoring (POBA 2012 Fig. 12)



3.4 From Ramelius WQS Stage 2 Closure Report (Jun. 2014)

Figure 3.17: WQS at completion of Stage 2 mining (Ramelius 2014 Cover Photo)

WQS - Production Summary	
Commenced Mining	01/03/2013
Completed Mining	12/03/2014
Total BCMs Moved	1,251,589
Start RL	390
Finish RL	300
Claimed Ore Mined (t)	165,067
Grade (g/t)	3.84
Ounces (oz)	20,397
Ore Haulage and Milling completed May 2014	
Ore Hauled (t)	163,407
Grade (g/t)	3.97
Ore Milled (t)	159,284
Head Grade (g/t)	3.69
Contained Gold (oz)	18,887
Metal Recovery (%)	91.5
Recovered Gold (oz)	17,288

The Western Queen South (WQS) project experienced two major geotechnical failures over the life of the mine. This necessitated re-designing the pit, leading to decreased production compared to the ore reserve (-17%).

Failures, combined with higher water in-flows than predicted, led to a longer mine life than originally proposed. The longer mine life and high haulage costs impacted the project significantly. Overall WQS was a loss making project.

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3. Geology

3.1 Regional

The Western Queen tenements lie within the Archaean Warda Warra Greenstone Belt, a north trending enclave within the Murchison Province of the Yilgarn Craton.

The belt is about 35km in length, and at the southern end near the Western Queen deposit it is 2km wide. To the north, it is up to 7km wide. The north striking and west dipping layered sequence has been metamorphosed to amphibolite grade and is enveloped by recrystallised granitoids.

3.2 Local

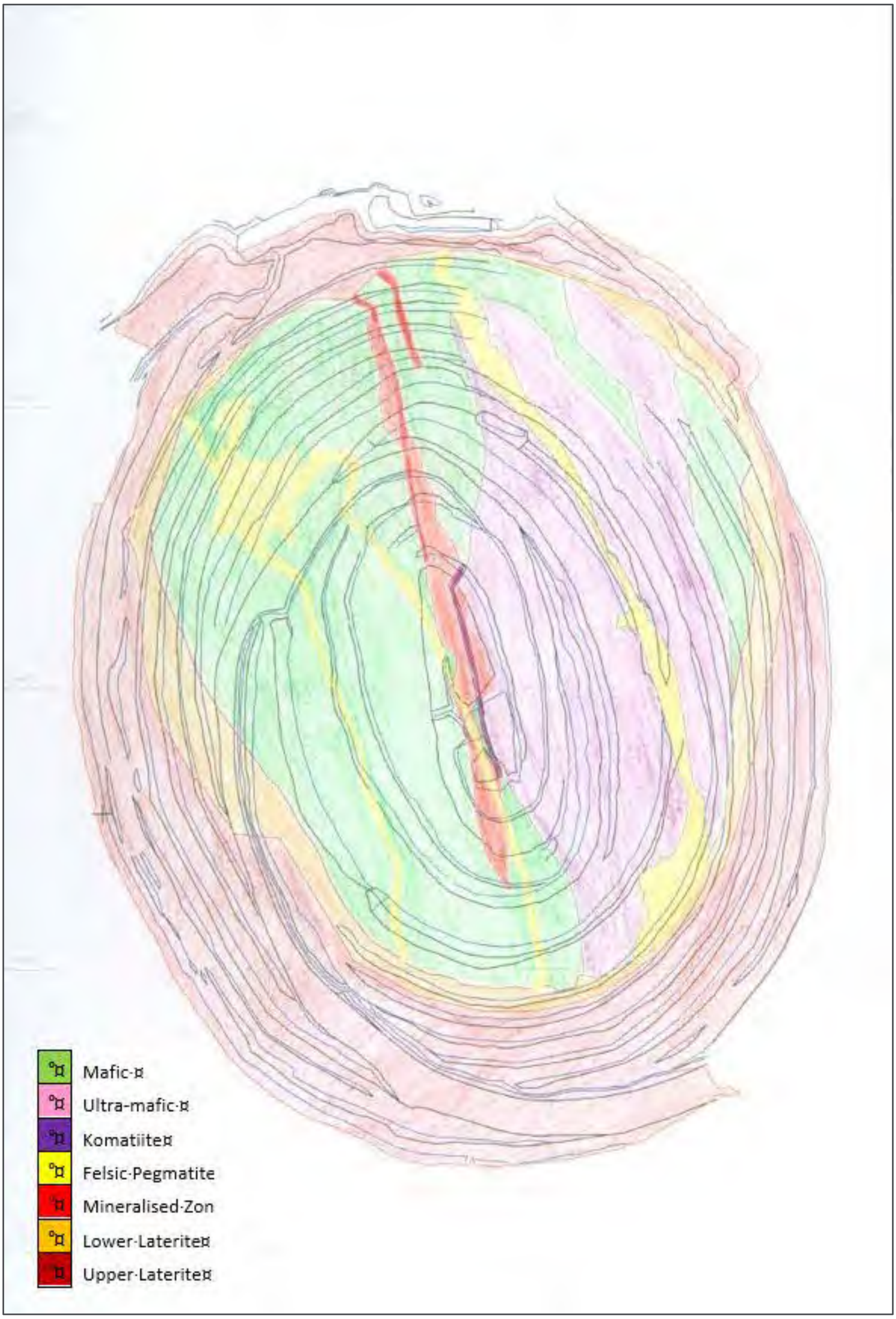
At Western Queen the geology is broadly a steeply West dipping greenstone sequence comprised of inter-bedded schistose amphibolites of mafic to ultramafic composition with thin iron formation horizons, spinifex textured komatiitic basalt, dolerite sills, talc chlorite schist and other assorted ultramafics. Later dolerite dykes and pegmatoid felsic intrusives cut the amphibolites.

These mafic lithologies are overlain by a significant layer of transported overburden comprising of barren pisolitic colluvium and ferruginous clays, capped with a Tertiary laterite. Depth of weathering increases on progression to the south (corresponding with increasing depth of transported overburden).

The mineralised system that plays host to the WQS deposit is a continuation of the mined Western Queen deposit immediately to the North. Located within sheared, mafic amphibolite host material this zone exhibits a steep dip to the West, with the hanging wall being a continuation of the mafic amphibolite and the footwall a more ultramafic composition amphibolite. Between the mafic and ultramafic amphibolites a green, komatiitic unit has been observed; it has been included in ore blocks, having been shown by drilling to be mineralised and to display signs of alteration associated with WQS mineralisation. Both the East and West sides of the mineralised zone are intruded by predominantly concordant pegmatite dykes, stringers of which do cut the mineralised zone. These later lithologies are barren of gold mineralisation and where the material could be picked out of the ore blocks it was (see Figure 2 for a geology map of the WQS pit).

The envelope of mineralisation at WQS has a strike length of over 300m and a vertical extent 150-200m, although the base of mineralisation has not been closed off and may extend further. The depth of the top of the envelope increases North to South (along with the oxidation and overburden) from 370mRL in the North of the pit, 340mRL in the South of the pit to 280mRL South of the WQS pit extents. A supergene gold zone was present however this was mined out, along with the upper part of the oxidised mineralised zone, in 2007 by Harmony Gold Australia for a total of 61,660 t @ 3.46 g/t.

Figure 3.18: Geology map of Western Queen South open pit (Ramelius 2014 Fig. 2)



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5. Mining

5.1 Method

The Harmony Gold Australia's 2007 pit went from the 390 to 350 RL and was approximately 260 m long by 220 m wide. For this project it was not suitable for immediate use due to the ramp along the Eastern wall having collapsed and the high water table (25-30 m from surface) filling the pit. A cut back was consequently planned with the ramp entering on the Western side, only reaching the Eastern side lower down in fresher, more competent rock. Once at the 350 RL floor normal mining would commence down to 290 mRL. With the cutback the pit would be approximately 360 m long by 270 m wide by 100 m deep. Kalgoorlie based GWH Equipment was contracted to carry out the mining using a 90 t excavator and 40-50 t articulated trucks. Drill and blast was subcontracted by GWH.

Mining was carried out on 2.5 m flitches of 5 m benches via drill and blast and load and haul using excavators and articulated haul trucks. The oxidised layer was soft enough to allow free digging, although in the transitional ore zones blasting was often required due to the hardness of silicified rock. Ore blocks were marked out post blasting and extracted under the supervision of a geologist. Unsupervised ore digging during night shift was only carried out when un-avoidable.

The ore was mined both conventionally and by top loading, depending on water conditions within the pit. Top loading was favoured in the wet and soft transitional zones which slowed mining rates significantly and caused issues with over/under-dug floors, with flooding hampering visibility and preventing the use of a laser.

Figure 3.19: Difficult digging conditions in wet oxide material (Ramelius 2014 Image 2)

Fresh ore (and waste) is very hard and requires high powder factors when blasting. 5 - 7 m of heave became common during blasts. To minimise the potential for dilution the shot boundaries were planned along the ore block boundaries to try and minimise waste inclusion. When heave was encountered, excess ore rock was dug down to the original *floor level and the next two flitches were taken out as normal. Heave was included in the production records as the top flitch.*

Although dilution was estimated for mined ore during the project, some potential for additional dilution exists given the difficult digging conditions in wet oxide and transitional material, major heave in fresh material and issues with truck factor tonnage reconciliations.

Truck factors were used to estimate the ore removed from the pit, however inconsistent filling of trucks, due mainly to excess water, is likely to have rendered some of these estimates inaccurate.

Figure 3.20: Top loading of fresh ore around 320mRL (Ramelius 2014 Image 3)

Ore is difficult to visually differentiate from a distance and on ore margins. Colour is similar. Fresh ore is more siliceous and possibly a little lighter in colour. It contains fine sulphides but these can only be seen at hand specimen level. Some degree of increased structure and foliation is also present and can be seen in Figure 3.20 *above where the excavator is digging.*

5.2 Water

Harmony Gold Australia reports had noted that ground water had been an issue in the historical open pit and underground workings to the North, eventually leading to the cessation of underground works. Additionally it was stated that water had been a contributing factor to slow production in the 2007 excavation of WQS.

Hydrogeological studies, prior to the Ramelius cutback, had indicated potential inflows of 5-6 l/s. To provide a buffer flows of up to 15 l/s were planned for, however, as Figure 3.21 *indicates, water flows into the pit started between 10-15 l/s and in September/October* ***increased to over 30 l/s. This coincided with the exposure of less oxidised and more competent conditions in the Northern end of the pit. Fresher rocks means natural fissures and structures, less open in strongly oxidised rock, allow increased fluid***

movement along them, thus water inflows increased when the transitional and fresh rock boundaries were passed as the pit progressed.

Figure 3.21: Estimated water inflow into WQS pit over life of project (Ramelius 2014 Fig. 7)

Ramelius dewatered the existing pit as the cutback was mined to the 350 mRL floor, however due to the oxide nature of the rock below this level (top of fresh was approximately 335 mRL in the North end and 320 mRL in the South end) it was still very wet. The resulting swampy conditions significantly slowed production until the fresh rock boundary had been reached across the majority of the pit. ***Numerous sub-horizontal dewatering holes were drilled in the cutback walls to promote drainage*** *(see* Figure 3.23*). These holes were locally successful in drying out the walls and bringing the water table down in oxide and transitional zones. Some small flows however, were still present at relatively high-levels (see* Figure 3.30*) which shows the relatively poor connectivity of water flows at WQS.*

Figure 3.22: Wall holes draining water from the East on the 355 RL (Ramelius 2014 Image 4)

Once the pit reached fresh rock the largest flows occurred and remained at the weathering interface. One area on the north-eastern wall had a major flow from around the 345 mRL which remained quite constant for the rest of the pit.

Figure 3.23: Major inflow location top of fresh rock around 345mRL (Ramelius 2014 Image 5)

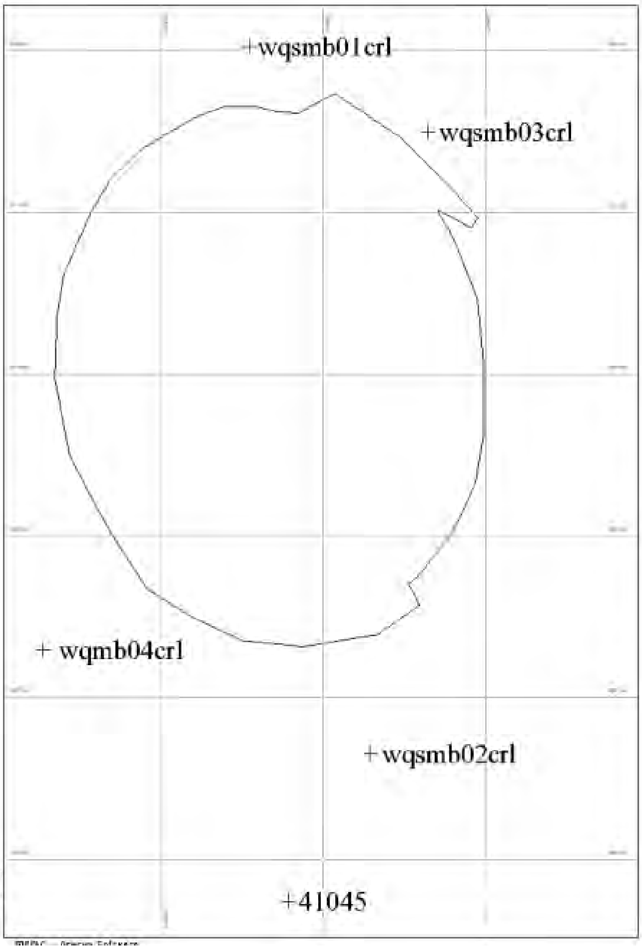
No significant drop-off in flow occurred as mining continued below the transitional/fresh interface. Significant recharge is likely to have been occurring from the main Western Queen pit 600 m to the north.

Below the fresh rock interface water still slowed production. Any interruption to pumping tended to incur flooding of the pit floor. Dewatering was managed by digging sumps every bench and continuous pumping taking water out of the WQS pit and putting it into the Western Queen pit to the North.

Dewatering of the pit continued throughout the project. It reached a reasonably steady rate of 25 -30 litres per second by mid- September 2013. Pit inflows were stable from then and did not drop off significantly once the pit reached fresh rock.

Ground water levels were monitored via five surface bores; four drilled by Ramelius (WQSMB01, 02, 03, 04), situated around the pit and one historical bore (41045) approximately 150m south of the pit (see Figure 3.24*). All the bores showed a steady decrease in water level around the pit during the first five months, during which the pit was being drained.*

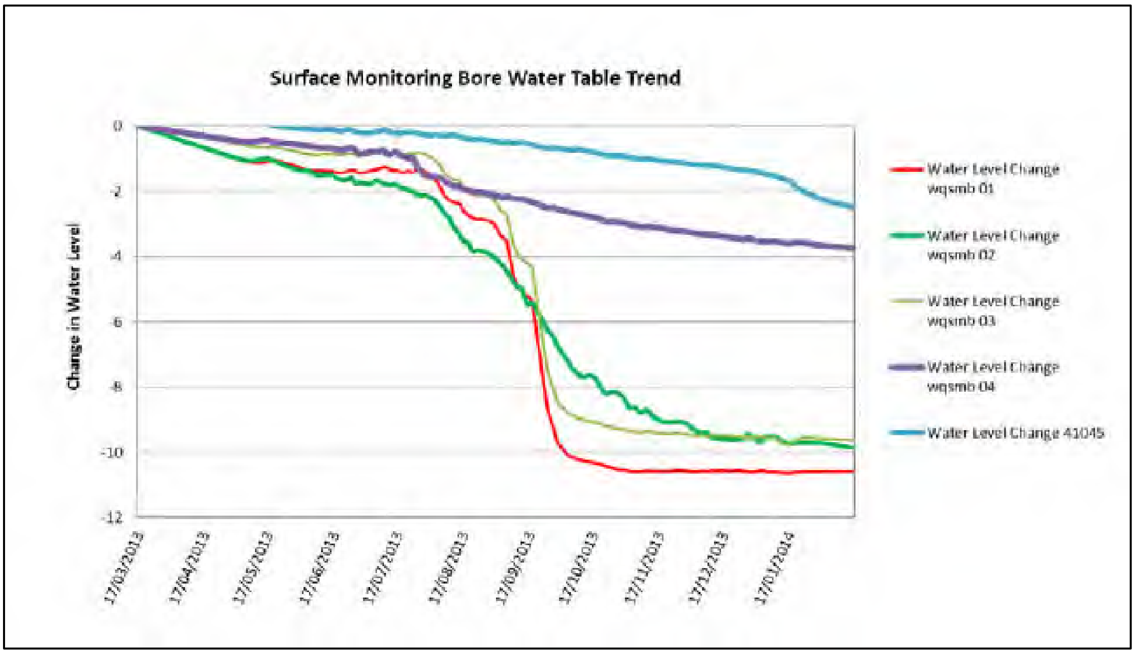
Figure 3.24: Plan showing pit outline and water monitoring bore locations (Ramelius 2014 Fig. 8)



Note the figure above is relative to local grid and has been rotated from MGA north.

> *August/September marks a sharp drop in ground water level in three of the bores. This coincides with the commencement of blasting and digging on the 350 mRL, and the initial drilling of weep holes in the walls. From October equilibrium is reached; the drop in water levels slows and plateaus out. The other two boreholes did not follow this trend and continued the steady decrease. See* Figure 3.25 *for trend lines.*

Figure 3.25: Graph of groundwater levels over duration of project (Ramelius 2014 Fig. 9)



6. Geotechnical

6.1 Reports

Over the life of WQS mine three geotechnical reports were produced by Peter O'Bryan and Associates (PBA). The first in June 2013 was to assess why the 2007 Eastern wall ramp collapsed and how such problems could be avoided in the future. Recommendations included; to ensure walls were dug to plan (there had been some localised over-steepening), use of survey prisms and pit wall de-pressurisation via the drilling of weep holes.

August 2013 PBA were called back in due to increasing movement in the North East wall prisms and a subsequent slump. Recommendations included; leaving the water saturated oxide walls to dry out before steepening them to design, the creation and implementation of a consistent pit floor mining and de-watering strategy.

December 2013 PBA were again called back to investigate a collapse on the Western wall. Remedial and preventative measures were recommended, including; increased wall de-pressurisation, prism monitoring above and on top of the collapse, flattening of the failure slope and a wider berm at the foot of the collapse.

6.2 Survey

Wall stability was known to be an issue from the Eastern wall ramp collapse, leading to extensive use of prism monitoring during the life of the pit. A total of 120 prisms were installed on the berms of the pit, 72 on the Western wall, 48 on the Eastern wall. The majority of the prisms, 75, are located between the 375 and 360 mRLs. No prisms were put in below the 335 mRL because this was in the fresh layer where the walls were more geotechnically stable.

The prisms were monitored daily unless movement or visible signs of instability (cracks in berms, minor slippage of wall material) were noted, whereupon the frequency of monitoring was increased.

Prism monitoring highlighted the beginnings of North Eastern failure, allowing it to be monitored closely before and after the initial failure. Movement was detected to the South *of the Western failure for several days before the collapse occurred. The failure itself occurred too quickly for the twice daily prism monitoring to pick up.*

6.3 Wall Failures

Walls in the oxidised layer were initially saturated with water and consequently too soft to dig to the designed slope, additionally geotechnical surveys suggested that a contributing factor toward the eastern ramp failure could have been a build-up of water pressure between two rock types; amphibolite and the pegmatitic, felsic intrusion. The solution used was to drill weep holes around the walls, allowing water to drain (see Figure 3.22*), once the walls dried out they were strong enough to be steepened, where possible, to design. Some walls, once dry, were unable to meet design requirements due to a weaker material strength than originally assumed. An example of this is the East wall on the 250 mRL where intensive oxidisation of a section of pegmatite, characterised by granular quartz, had produced a soft, sandy consistency that could be scraped away with a bare hand. In areas such as this the pit walls had to be re-designed at a shallower angle with larger berms.*

***On 31/08/2013 a portion of the oxide zone of the NE wall failed** (refer* Figure 3.26*), slumping along a slip plane in the ultramafic, characterised by wet, talc textured clay. The lateritic overburden was not affected. It was slow moving and once stabilised, the slump material was removed and the wall was laid back at a shallower angle. A bund was also placed at the foot of the slump to strengthen the base of the wall and prevent further movement (refer* Figure 3.27*). This slump did not enter the working are or cover the ramp and so did not significantly affect production, however remedial measures did add to the overall cost of the pit.*

Figure 3.26: Northeastern wall failure soon after initial slump, over the next week it continued to creep and grow larger (Ramelius Image 6)

Figure 3.27: *Northeastern wall failure remediation* (Ramelius Image 7)

***On 04/12/2013 a large section of the Western wall failed** (refer Figure 3.28, Figure 3.29) between the ramp at 355 mRL and the pit floor (325 mRL). The failure was caused by toppling along steep, smooth, westerly dipping geological structures and contacts, spanning the oxide and transitional zones of the weathered insitu saprolite – saprock zone.*

Figure 3.28: *Top of Western wall collapse showing failure planes* (Ramelius Image 8)

The relatively competent lateritic overburden was not affected. Hydrostatic pressure from groundwater was also deemed to be a factor, despite the presence of weep holes with initially high outflows. Once the failure had stabilised the rock debris was dug out and the *slope laid back. The pit design was also changed to include an extra-large berm at the 325 mRL to strengthen the wall and prevent further slippage (refer* Figure 3.30*). This design change had a knock on effect of limiting the maximum pit depth from 290-300 mRL. Another issue resulting from the failure was the loss of a 40 by 6m section of ramp, forcing the ramp into a single lane higher than expected, also slowing production.*

Although the majority of water flows has dropped to the transitional/fresh rock interface, there were still some small inflows at higher levels and the overall amount of inflow was very high. This points to a poor drawdown of the water table outside the pit wall and is likely to have been significant contributor to the failures.

Figure 3.29: *Western wall collapse soon after failure* (Ramelius Image 9)

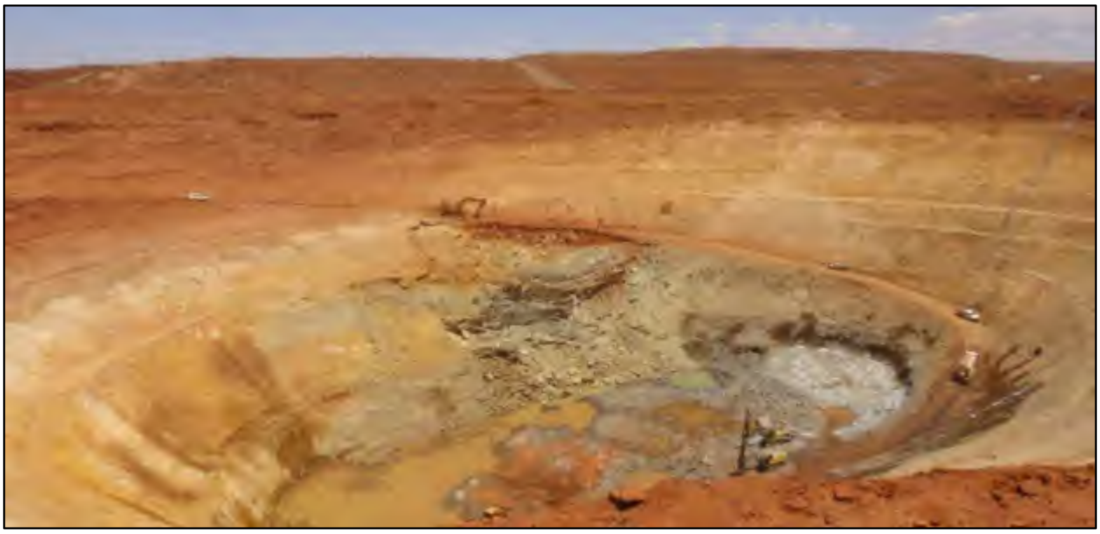
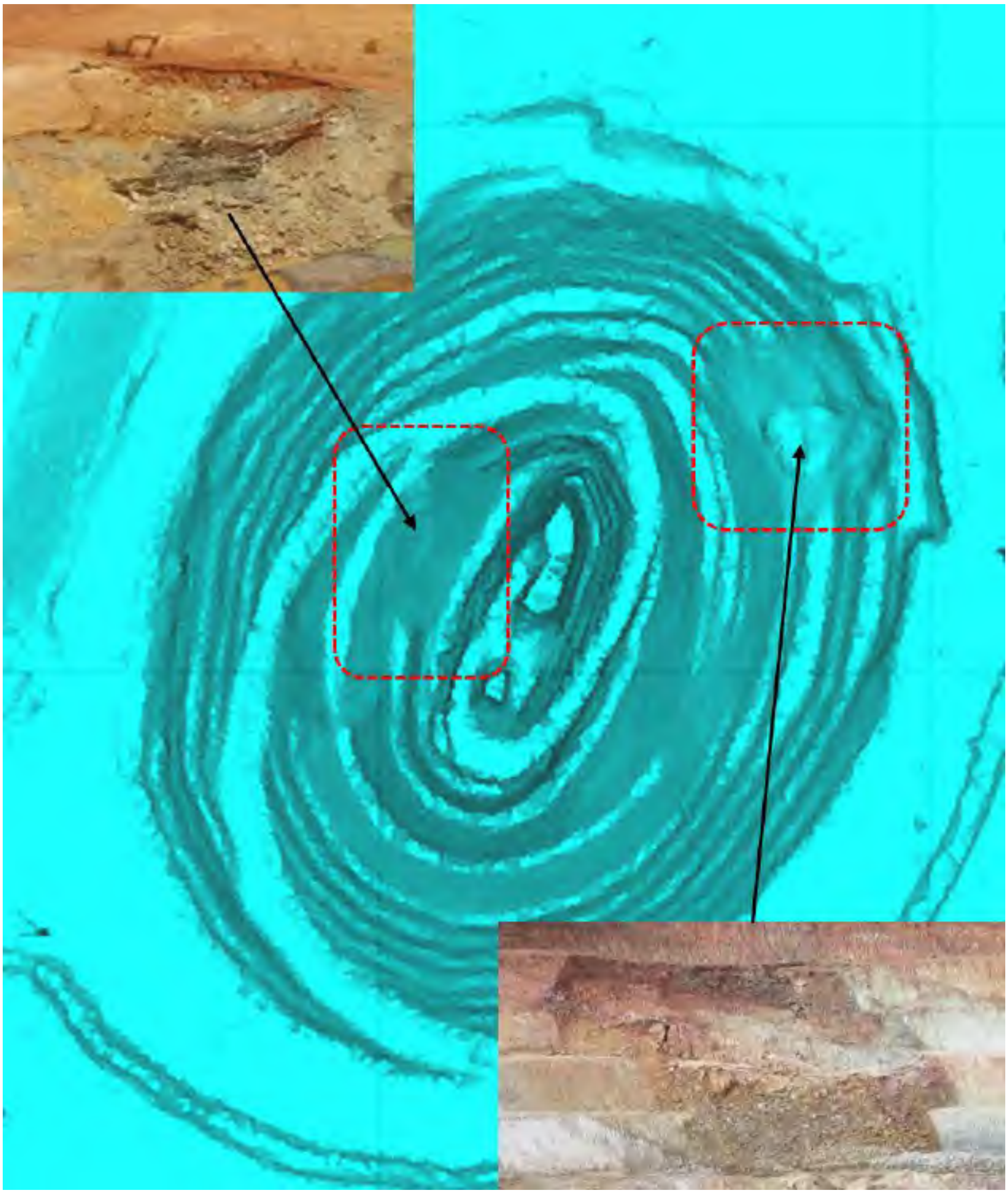


Figure 3.30: *Western wall after remediation* (Ramelius Image 10)

4 2025 Geotechnical Assessment

Figure 4.1 shows the WQS pit as built at completion of mining Stage 2 in 2014 along with the locations and images of the Geotech issues that occurred. Note that the deepest point within the WQS pit was around the 300 mRL, approximately 90 mBGS (Below Ground Surface).

Figure 4.1: WGS Stage 2 as built showing Geotech issues



Two wall Geotech issues (failures) occurred during the mining of WQS Stage 2. This included a slumping failure along the northeast wall and a toppling failure along the west as indicated in Figure 4.1. The circular style slumping failure along the northeast wall is described in Ramelius (2014) as:

> *On 31/08/2013 a portion of the oxide zone of the NE wall failed, slumping along a slip plane in the ultramafic, characterised by wet, talc textured clay. The lateritic overburden was not affected.*

The toppling failure along the west wall is described in Ramelius (2014) as:

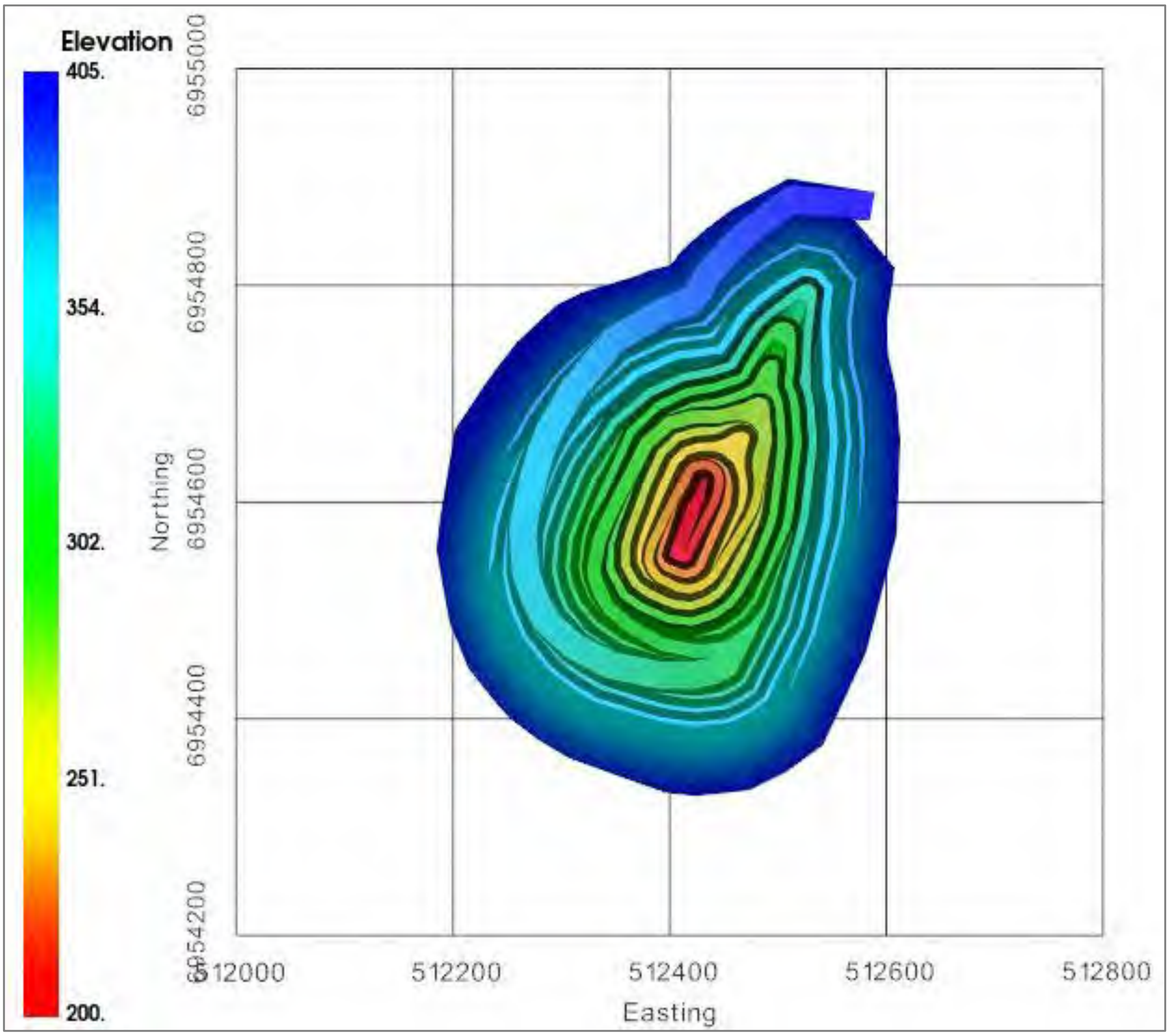
> *On 04/12/2013 a large section of the Western wall failed between the ramp at 355 mRL and the pit floor (325 mRL). The failure was caused by toppling along steep, smooth, westerly dipping geological structures and contacts, spanning the oxide and transitional zones of the weathered insitu saprolite – saprock zone.*

SME notes that in general the pit slopes in WQS Stage 2 performed well with the exception of the two issues noted. The northeast wall slump is principally a result of wall orientation and an over-steep slope relative to a weak ultramafic oxide material and unfavourably orientated structure. The toppling failure along the west wall is principally a result of wall orientation and an over-steep slope relative to weak strongly foliated/sheared weathered mafic rock with steeply dipping planes.

4.1 Proposed Design

Figure 4.2 presents the proposed pit design (*Queen.dtm/str*) for WQS provided by MER. Note that the pit has a depth of approximately 190 m, extending from ground surface at around 391 mRL down to the 200 mRL and about 600 m long and 450 m wide at the crest.

Figure 4.2: Proposed WQS Stage 3 pit design (*Queen.dtm*)



4.2 Geotechnical Data

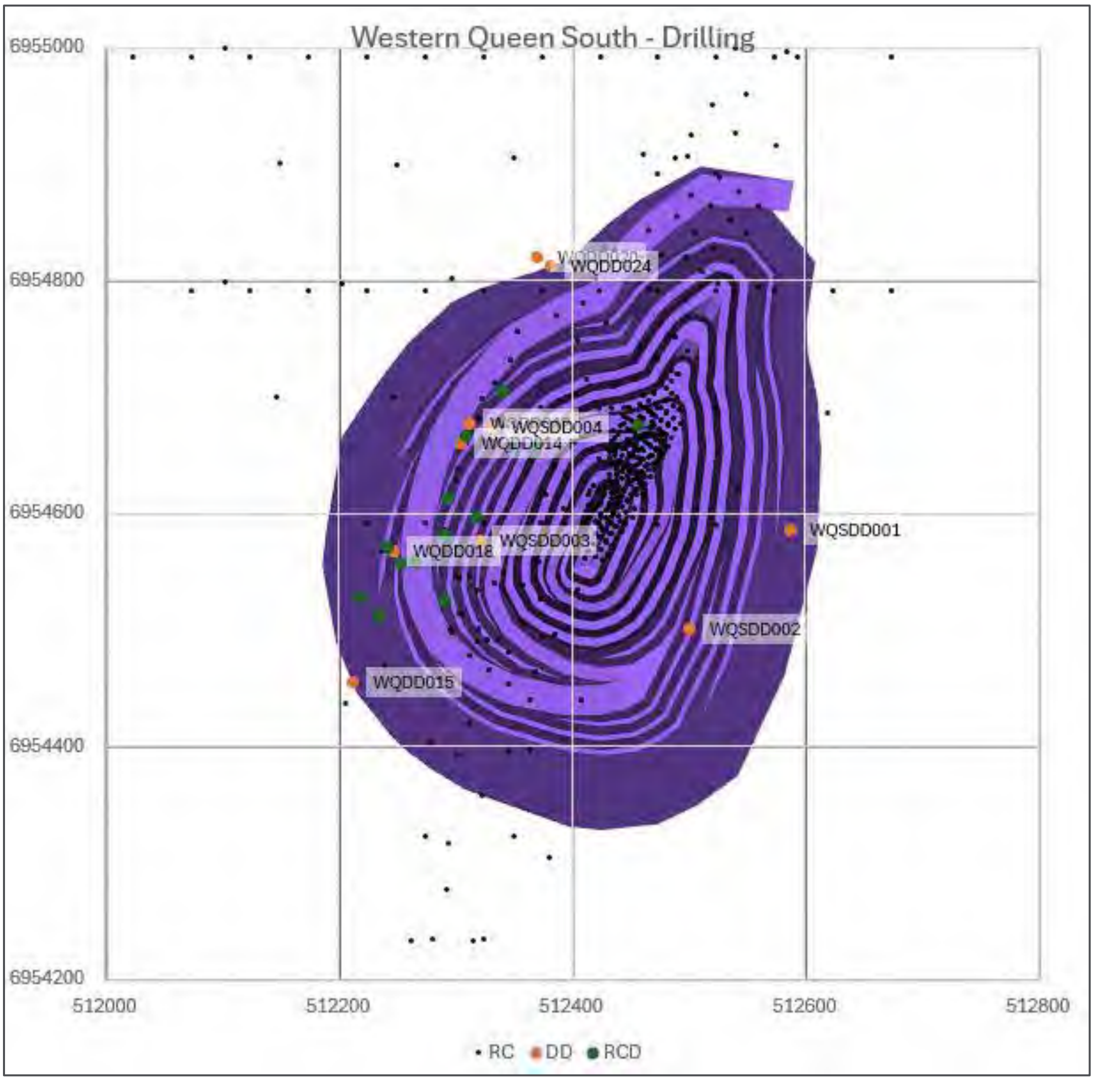
Based on the data provided, SME has compiled the following geotechnically pertinent information.

Geotechnical useful data from the drilling database included the following:

- Drill hole collars and down hole survey (*01_DHCollar_2025_02_21 & 01_DHSurveys_P0_2025_02_21* tables)
- Down hole rock density (*DH_Density_WQ20210416*)
- Geotechnical core logging data (*DH_GeotechWQ20210416*)
- Drill intersected lithology (*01_DHLithology_P0_2025_02_21*)
- Logged structural orientations (*01_DHStructureOrient_2025_02_21*)

Figure 4.3 presents the location of drill holes, including diamond (orange dots), RCD (green dots) and RC (small black dots) drilled across the WQS deposit and relative to the proposed Stage 3 design. The diamond holes represent a total of 2,440 m of drilling to a maximum down hole depth of 390 m (average hole depth 245 m). Note that all the key data listed above was not available for all of these diamond / diamond tail holes presented in Figure 4.3.

Figure 4.3: Historic drill holes by type across WQS



4.2.1 Main Rock Types

SME reviewed the logged lithologies from the drill database and determined the total logged drill metres by 'Lith1_Description'. This data was further simplified by parent rock type (e.g. all descriptions with same prefix grouped together such as Laterite – massive or nodular or pisolitic or (undif) etc, grouped as Laterite). Table 4.1 presents a summary of the Lith1_Description data and drill intersects for the 32,619.8 m of drilling (RC, RCD and DD) across the WQS deposit ranked by percentage occurrence.

Table 4.1 shows that approximately 16% of the drilling was logged as Amphibolite, followed by Mafic 11.5%, then Saprolite 11.1%, Laterite 10.5%, Dolerite 5.9% and Schist 6.7%. Note that the top 6 rock types represent 61% of the logged metres, while the top 12 represent 85% (down to Komatiite) of the logged metres.

Table 4.1: Drill metres (RC & DDH) by Lithology.

Lith Simplified	Drill metres	% of Total m
Amphibolite	5285.38	16.2%
Mafic	3747.42	11.5%
Saprolite	3631.95	11.1%
Laterite	3436.35	10.5%
Dolerite	1914.35	5.9%
Schist	1869.59	5.7%
Basalt	1851.02	5.7%
Ultramafic	1585.87	4.9%
Upper SAP	1369.94	4.2%
Ferricrete	1213.1	3.7%
Pegmatite	884.35	2.7%
Komatiitic Basalt	791.9	2.4%
remainder	5038.6	~15%
Total Drill metres	**32,619.8**	

4.2.2 Weathering profile depths

Figure 4.4 shows the proposed WQS Stage 3 design colour coded relative to the weathering profile (i.e. Red - Cover and Oxide, Purple – Transition, Green – Fresh). As can be seen a significant portion of the slope will be cut through Cover and Oxide materials (red) which is significantly deeper on the south side of the pit, down to the about 300 mRL.

Figure 4.5 presents a long section view along the centre of the pit showing the Stage 2 as built and the proposed Stage 3 design. As can be seen the weathering surfaces get deeper to the south with the top of fresh intersecting Stage 2 slope at around 320 mRL, while for Stage 3 it intersects the slope at around 305 mRL.

Figure 4.4: Proposed pit design colour coded by weathering surface

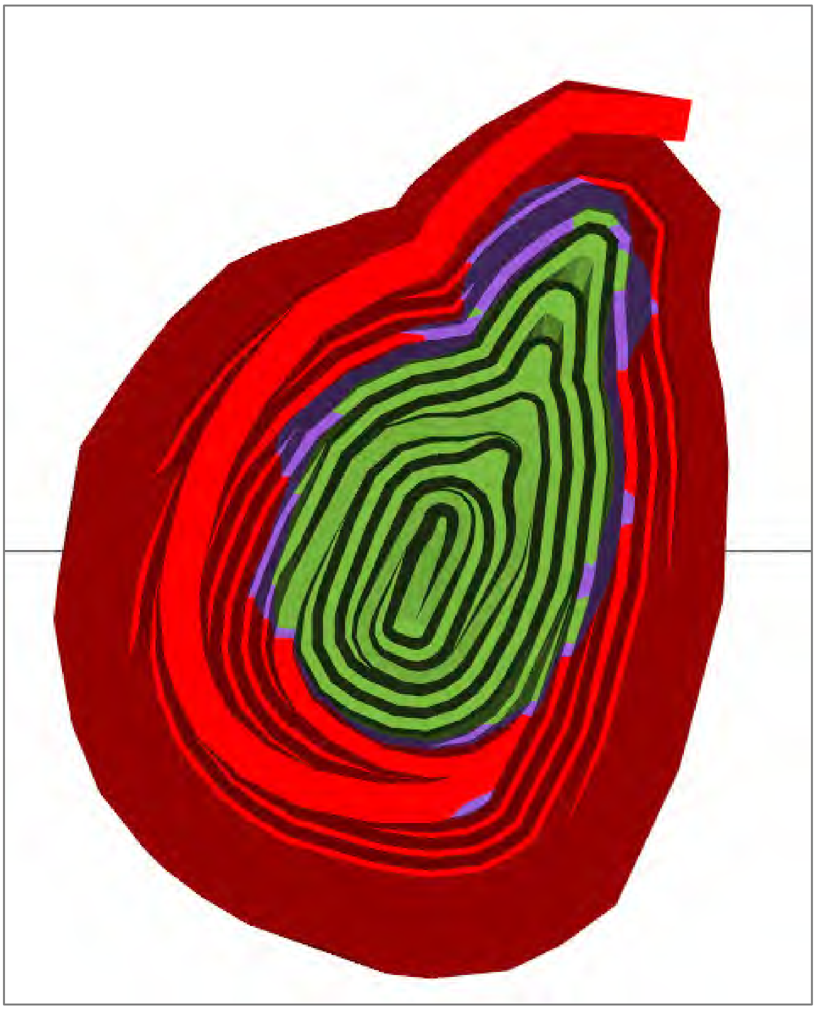
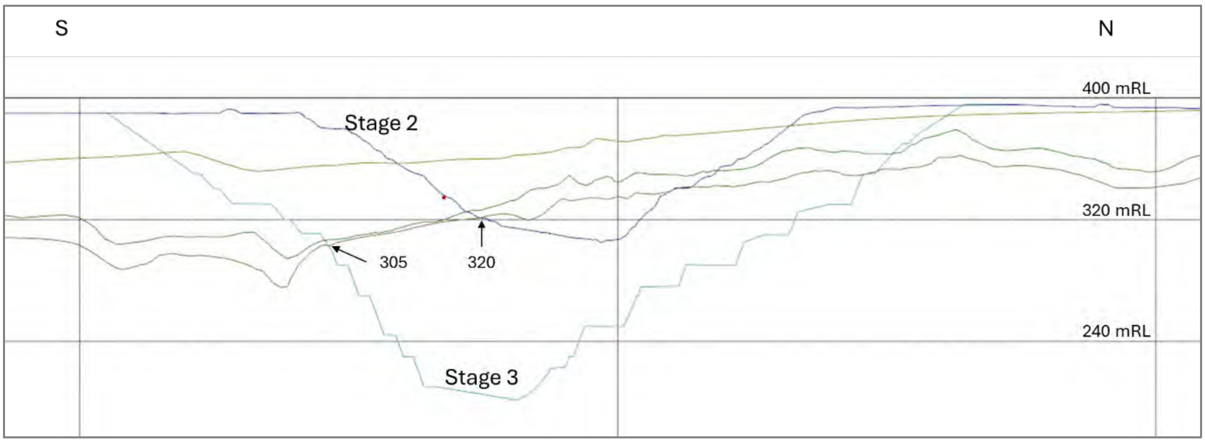


Figure 4.5: Long section view of pit and weathering profiles



4.2.3 RQD, Recovery, Rock Strength and Weathering

SME reviewed the downhole variability in RQD, Recovery, Rock Strength and Weathering, utilising the available geotechnical logging data within the drill database that was provided. This included 5 holes, namely WQSDD001 to 004 and QND-39050-1.

SME averaged the geotechnical logging data across all available diamond holes across WQS withing the drilling database (*WQ_20210416.accdb*), over downhole depth intervals set at 5 m.

Figure 4.6 presents the averaged data along with data count (number of drill intervals within the depth interval) against downhole depth for WQS. This data highlights the general improvement in rock mass properties with depth, with key observations as follows:

- The data (RQD) count (black dotted line, use lower X axis labels) suggests that there are ‘good’ quantities of data (i.e. more than 20 drill intervals per 5 m depth interval) from 75 m down to a depth of around 140 m down hole and ‘fair’ quantities of data (i.e. between 10 and 20 intervals per 5 m depth interval) or better from 0 to 240 m hole depth.
- The averaged RQD data per 5 m interval (red line); starts at around 20% increasing slightly for the first 10 m down hole, then drops to zero until about 50 m down hole, then picks rapidly until it reaches 90% at around 90 m hole depth and then remains above 90% until the end of data at 240 m down hole. Note the rock quality descriptions and corresponding RQD ranges are as follows:

Rock Quality Descriptor	RQD (%)
o Very Poor quality rock	<25%
o Poor quality rock	25 to 50%
o Fair quality rock	51 to 75%
o Good quality rock	76 to 90%
o Very Good quality rock	91 to 100%

- The averaged Recovery data (purple line) per 5 m interval is typically above 90% down to 20 m down hole depth, then less than 90% down to a depth of about 70 m, increases over the next 10 m then is at or near 100% after that. Note Recovery is not a parameter used in geotechnical assessments such as RQD, but it helps understand ground conditions, as poor ground usually has poor recovery and vice versa.
- The averaged logged Strength category data (green line) per 5 m interval is typically less than 10 MPa down to a depth of about 60 m, then rapidly increases to about 150 MPa at around 85 m down hole depth then increases slightly more and sits between 160 MPa and 190 MPa to the end of data at around 240 m down hole. Strength is the field estimated compressive strength of the intact rock logged by category. Note that the rock strength categories / descriptors and corresponding strength ranges are as follows:

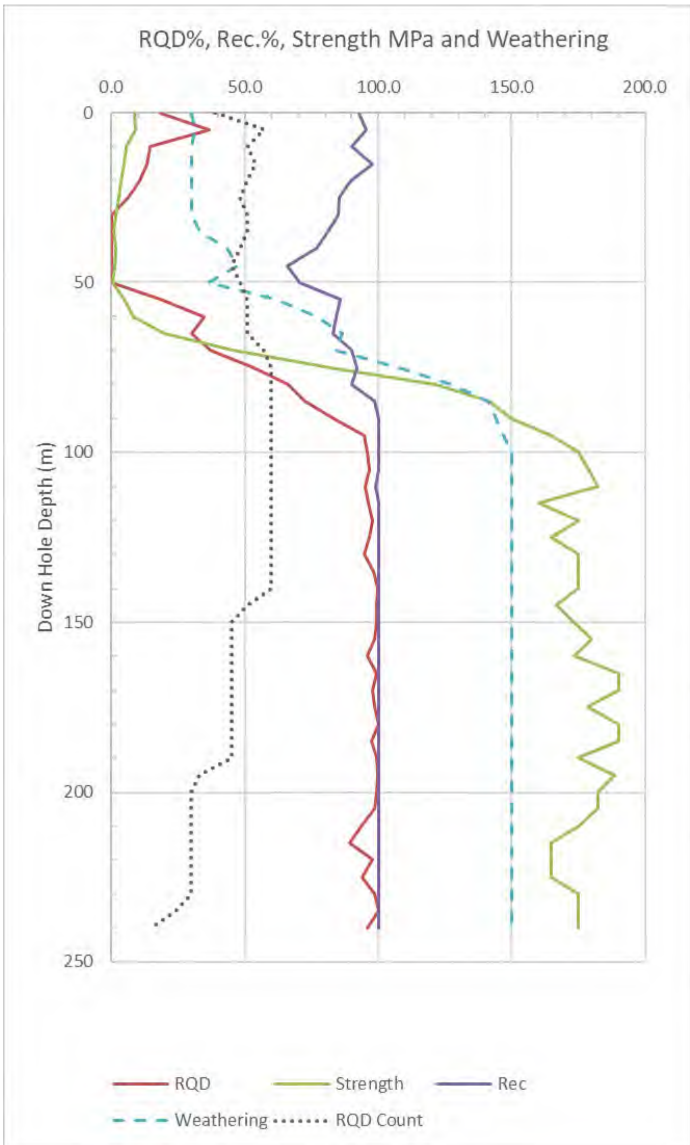
Rock Strength Descriptor	MPa range
o Extremely Weak Rock	< 1 MPa
o Very Weak Rock	1 to 5 MPa
o Weak Rock	5 to 25 MPa
o Medium Strong Rock	25 to 50 MPa
o Strong Rock	50 to 100 MPa
o Very Strong Rock	100 to 250 MPa
o Extremely Strong Rock	> 250 MPa

- The averaged logged Weathering category data (light blue dashed line, use lower X axis labels) per 5 m interval is typically Completely Weathered (CW) down to a depth of about 35 m, then between CW and Highly Weathered (HW) down to 55 m, then between HW and Moderately Weathered (MW) down to 70 m then increasing until it reaches fresh (FR) at around 100 m down hole. Note that the logged Weathering categories and descriptors are as follows:

Weathering Descriptor	Definition

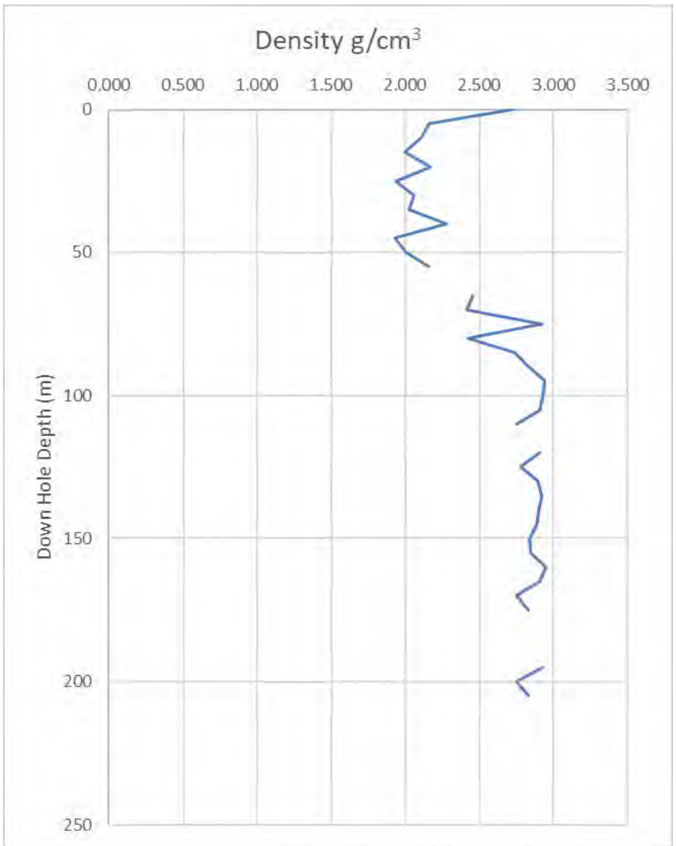
o Completely Weathered	100% of rock is decomposed / disintegrated to soil
o Highly Weathered	more than 50% of rock is decomposed / disintegrated to soil
o Moderately Weathered	less than 50% of rock is decomposed / disintegrated to soil
o Weekly Weathered	discolouration / iron staining on discontinuity surfaces only, less than 5% decomposed
o Fresh	No visible signs of weathering

Figure 4.6: Rock mass data averaged over 5m intervals versus down hole depth



Similarly, SME reviewed the downhole variability in density data from the drilling database (*WQ_20210416.accdb*), averaging the data every 5 m down hole. Figure 4.7 presents the averaged density data. As can be seen the average density starts at about 2.7 T/m^3 at surface then drops to around 2.1 T/m^3 down to a depth of around 50 m down hole, then increase up to around 2.8 T/m^3 at a depth of around 85 m down hole which seems to reflect the fresh rock density as it reasonably consistent at this level down to a depth of around 200 m down holes. Note that there is limited data (less than 5 / 5m interval). Note that generally weathered rocks tend to have lower densities than unweathered (i.e. fresh) rocks.

Figure 4.7: Density data averaged over 5m intervals versus down hole depth



4.2.4 Hydrogeology

Based on historic water levels in the pit after each stage of mining it appears that the pre-Stage 3 mining ground water level is at around 365 to 370 mRL, about 20 to 25 mBGS. As such 370 mRL has been adopted as the pre-mining groundwater level for stability modelling purposes.

SME note that AECOM has undertaken a detailed groundwater assessment of both the requirements and impacts of extracting the water within the current pit lake in WQS and the ongoing dewatering of the rock mass once mining commences. This report was not yet complete at the time of writing.

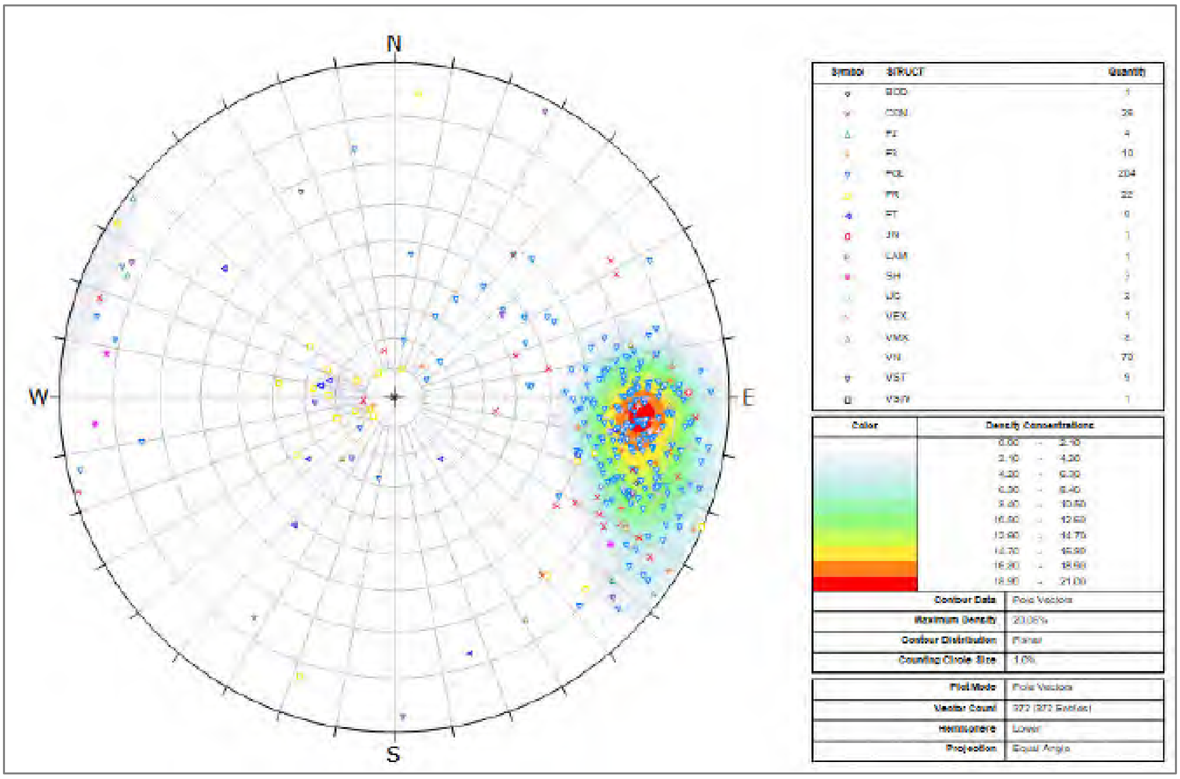
4.2.5 Structural data

From the drilling database SME extracted structural logging data (DHStructure_Orient table). The recorded alphas and betas were converted, using Rocscience's software DIPS, to dip and dip direction using down hole surveys (Survey Table) and **assumed bottom of hole 'orie lines'** for all data.

Figure 4.8 presents the stereonet for the approximately 370 features, a majority (~2/3) of which are labelled as FOL (foliation). The stereonet shows a high concentration of features plotting in the centre of the right-hand side and near the edge of the stereonet, representing features that dip at steep angles (60° to 90°) towards just north of west and some overturned, and with a minor concentration dipping back to the east at flat angles (10 to 30°).

Note the 370 features presented in Figure 4.8 is slightly greater in number and a different data set when compared to that used by POBA in 2012. POBA worked with the four Geotechnical holes drilled for their assessment program, namely WQSDD001 to 004, drilled two on the east and two on the west of the pit / orebody (refer Figure 3.8), while the structural logging data contained within the 'DHStructure_Orient' table contains data from six diamond holes, namely WQSDD0012 to 15, 18 and 20, which are all located on the western side of the deposit and drilled to SE. Note the defect orientation logging data for WQSDD001 to 004 was not available in either of the drilling databases provided to SME.

Figure 4.8: Stereonet of all structural + defect logging data Julia and Robb (all drilling)



4.2.6 Orientation biases

Table 4.2 presents the average dip and azimuth from down hole surveys, for the 6 diamond holes drilled at WQS with structural orientation data. With regard to dip, the average dip of the holes is -56° and ranging from -48° to -67°, while the average downhole azimuth of the holes is 127°, ranging from 124° to 140°.

Table 4.2: Average actual Dip and Azimuth for diamond drill holes with Structural data at WQS

Hole ID	Average Hole Dip (°)	Average Hole Azimuth (°)
WQDD012	-55.6	126
WQDD013	-60.0	128
WQDD014	-48.6	129
WQDD015	-56.3	124
WQDD018	-67.0	127
WQDD020	-51.8	140
Group Total	**-56.4**	**127**

Note that given that all of the holes from which structural orientation data has been sourced, are drilled in one direction (i.e. to southeast, azimuth 127°), then there is significant potential for orientation bias in the recorded orientations. Additionally, given that all holes are drilled from the western side of the orebody then there is also a spatial bias.

Figure 4.9 presents the approximate orientation bias 'blind' zone on a stereonet for the drilling orientation of -56° towards 127°, indicating the potential orientations of structures, should they exist, that are less likely to be intersected / sampled in the drilling.

Figure 4.9: **Orientation bias 'blind' zones** on stereonet.

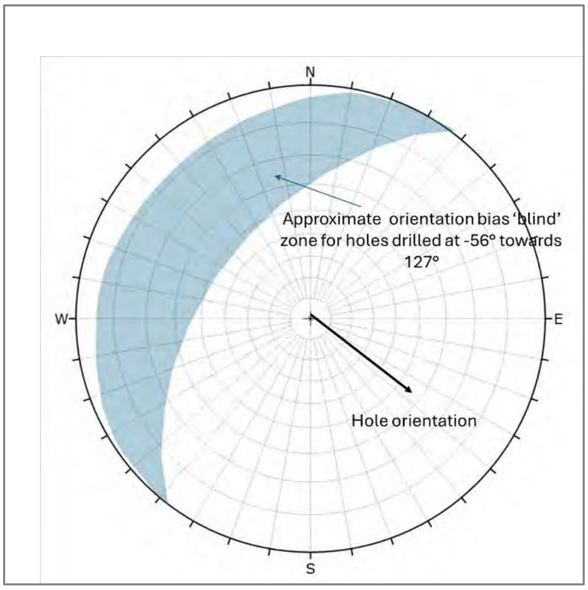
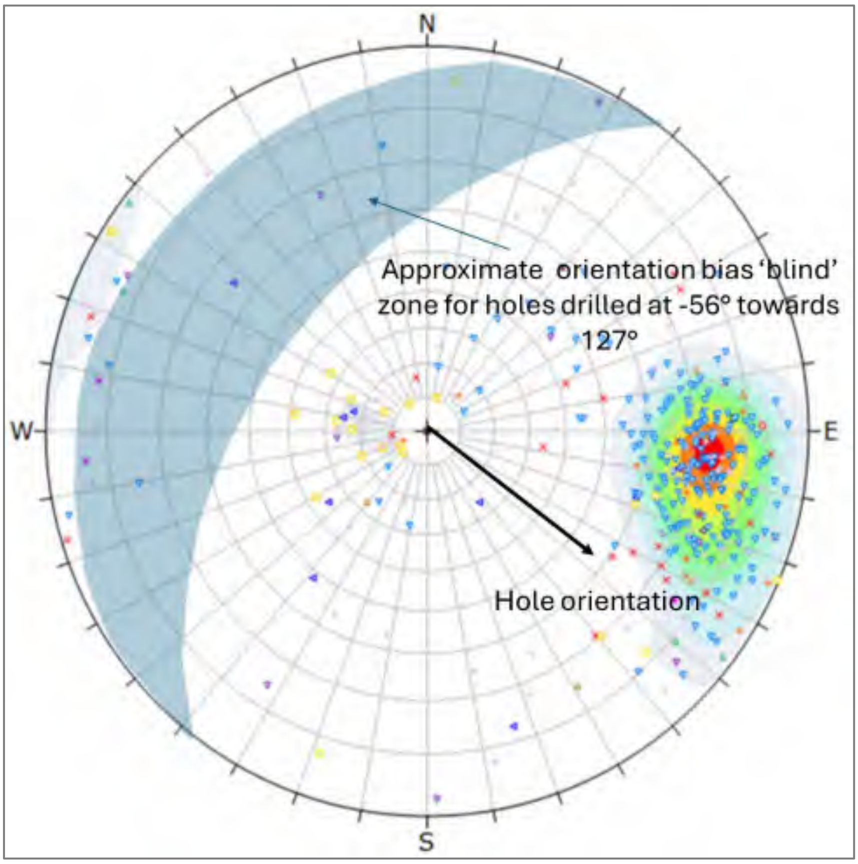


Figure 4.10 shows the stereonet of the logged structural and defect data from Figure 4.8 as well as the orientation bias blind zone likely impacting the data. As such structures dipping to the southwest at moderate to steep angles maybe under-represented, which has the potential to impact the design of the northeast wall (i.e. features that would control batter stability). However given the previous mining at WQS, the slope experience indicates that these features have not had a significant impact on slope stability or achieving design.

Figure 4.10: **Structural data with Orientation bias 'blind' zone.**



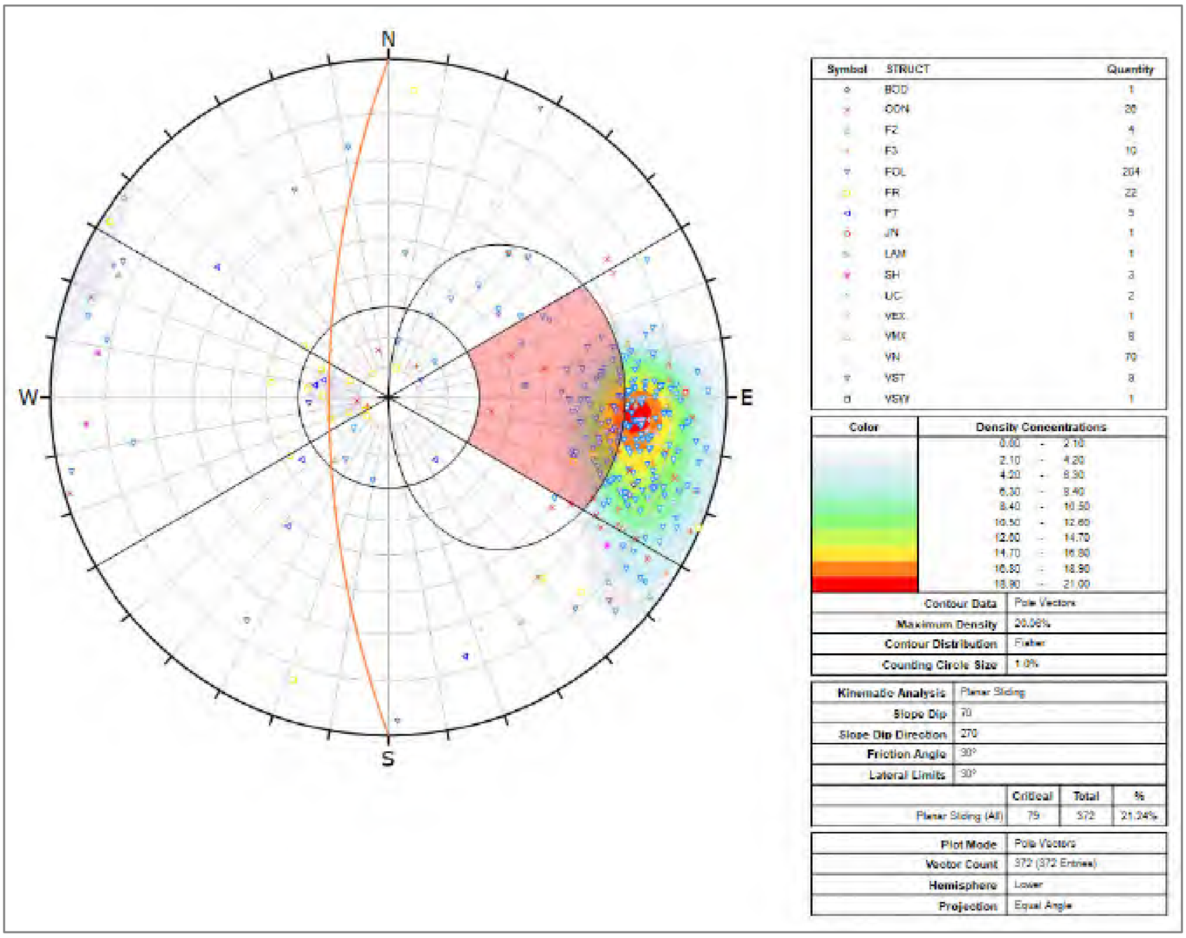
A simple kinematic assessment (refer Figure 4.11) was completed for 70° and 80° batters dipping towards the west (dip direction 270°), northwest (dip direction 300°) and southeast (120°) using a defect friction angle of 30° (as per POBA 2012). These orientations respectively represent the east, southeast and northwest walls and the data concentrations on the stereonet in Figure 4.8. The kinematic assessment results using all structures (including closed features such as veins) are presented in Table 4.3 and resulted in a probability of sliding ("PoS") of less than 30% for Bench Face Angles ("BFA") of 70° and in the order of 50% to 60% for BFA's of 80°, which is well above what is considered acceptable (typical industry practice to under 30% occasionally up to 50%).

Table 4.3: Kinematic assessment results for all Structural data at WQS

Slope Dip Direction (°)	BFA	Planar Sliding	Wedge Sliding	Flexural Toppling	Direct Toppling		
					Direct Toppling	Oblique Toppling	Base Plane
270	70°	21.24	29.89	4.03	0.5	1.24	25.27
	80°	56.18	60.54	4.03	0.91	1.24	59.14
300	70°	13.44	18.53	3.76	0.38	1.70	18.28
	80°	41.67	40.53	3.76	0.85	1.70	45.43
120*	70°	1.08	2.90	55.91	12.46	17.26	9.14
Colour key	<10%	10-20%	20-25%	25-30%	>30%		

* - slope with a dip direction of 120 (i.e. towards the SE) are likely to have been impacted by the drilling orientation bias and therefore PoS results might underestimate actual performance.

Figure 4.11: Kinematic assessment 70° batters towards 270 (i.e. west).



Given these results then a BFA of 70° is suggested in fresh rock materials to mitigate sliding style failure (i.e. planar and wedge) which is inline with recommendations made by POBA in 2012.

With regard to Flexural Toppling, a high probability (55.9%) was returned in the kinematic assessment of the NW wall (i.e. dip direction to 120°). This reflects the performance of the slopes along the west / northwest side of WQS Stage 2 where a flexural toppling failure occurred between 350 mRL and 330 mRL. Note the Flexural toppling is only likely to occur where spacing between planes is small (generally less than 1 m) and in the weathered zone where the tensile strength has been reduced to allow flexure. Key drivers for the flexural toppling are the dip of the slope and the slope orientation (i.e. when slope is near parallel to the foliated structure) through the transitional materials on the hangingwall side of the pit (west), as such the suggested slope design parameters will take these factors into account.

4.3 Likely Failure Modes

The potential failure modes likely to affect the stability of open pit slopes at WQS are discussed in the following sections.

Figure 4.12 presents the likely failure modes expected, which includes the following; circular, planar sliding, wedge sliding and block and flexural toppling. The failure mode by rock mass material type is as follows:

Weathered rock mass (Oxide)

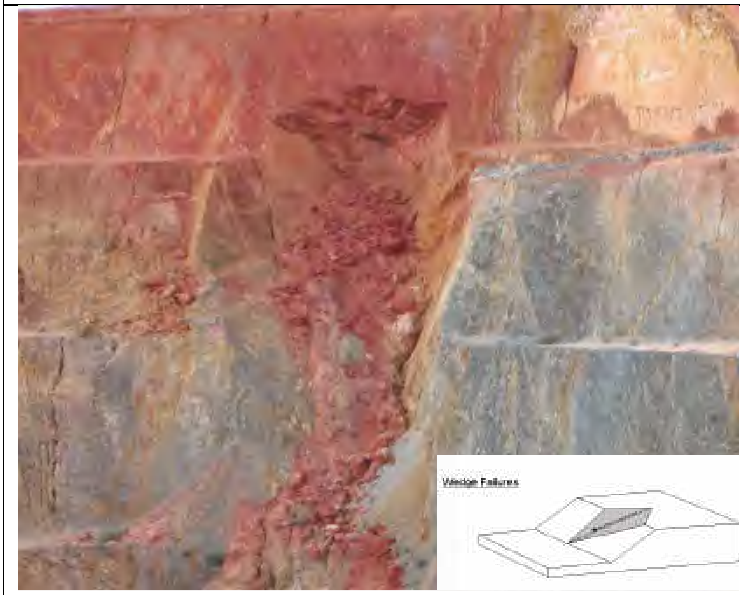
- Most likely – Circular (already experienced in NE of previous pit refer Figure 4.1)
- Less likely – Flexural toppling, planar or wedge sliding.

Fresh rock mass

- Most likely – Kinematic failures (i.e. planar or wedge sliding, block or flexural toppling) (flexural toppling already experienced on W side of previous pit refer Figure 4.1)
- Less likely – Circular.

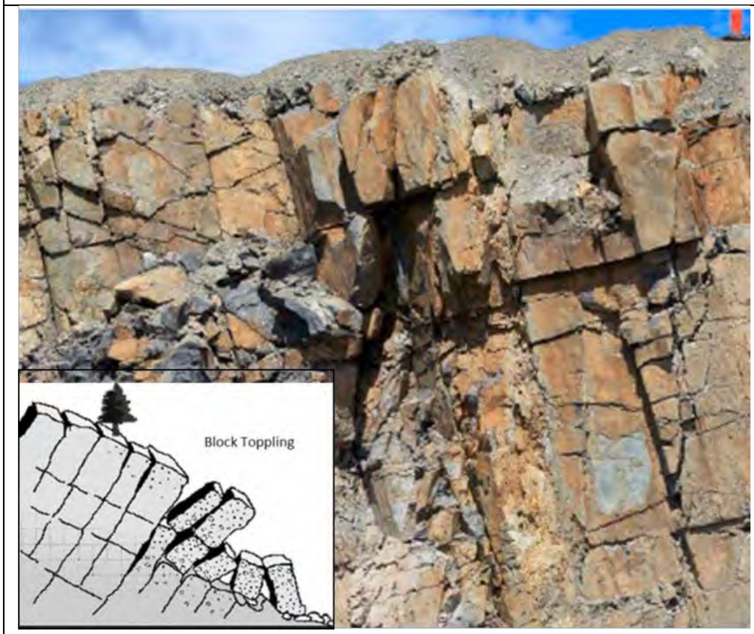
Figure 4.12: **Types of slope instability hazard**

Planar Sliding

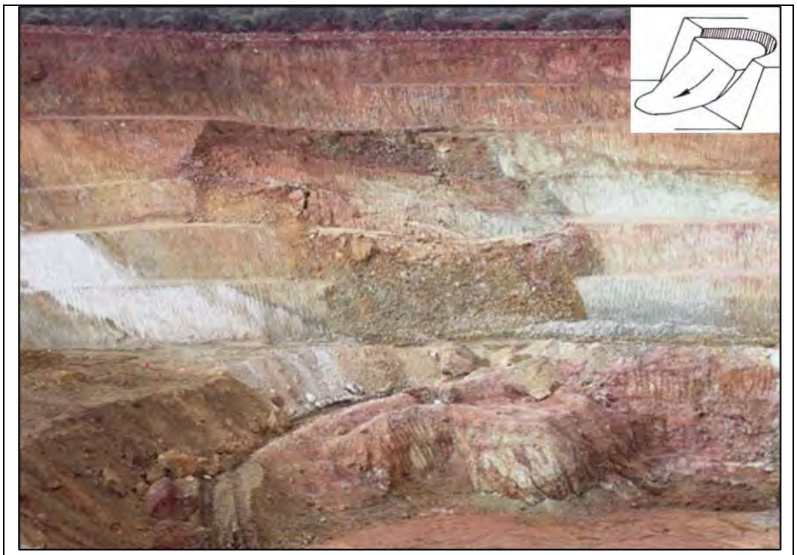


Wedge Sliding

Flexural Toppling



Block Toppling



Circular Failure

4.4 Stability check at overall slope scale

SME assessed the preliminary design provided by MER (*Queen.dtm*) to test what slope design parameters mitigate the risk of larger scale slope instability through rock mass shearing (i.e. circular style instabilities). These were done to help define the inter-ramp slope angles required given the variable depth of oxide materials across the pit.

4.5 Limit Equilibrium Analyses

Limit equilibrium ("LE") stability analysis of the provided pit design was undertaken using Rocscience's SLIDE2 software, to test the proposed pit slope design at an inter-ramp and overall slope scale against rock mass shear failure utilising the rock mass shear strength parameters from POBA 2012 (Appendix E) which are replicated in Table 4.4.

Table 4.4: POBA 2012 material properties used in LE analysis

Material Properties Material: Waste Dump Strength Type: Mohr-Coulomb Unsaturated Unit Weight: 19 kN/m3 Saturated Unit Weight: 21 kN/m3 Cohesion: 5 kPa Friction Angle: 35 degrees Water Surface: Water Table Custom Hu value: 1	Material: Fresh Strength Type: Mohr-Coulomb Unsaturated Unit Weight: 26 kN/m3 Saturated Unit Weight: 26 kN/m3 Cohesion: 350 kPa Friction Angle: 35 degrees Water Surface: Water Table Custom Hu value: 1
Material: Oxide Strength Type: Mohr-Coulomb Unsaturated Unit Weight: 20 kN/m3 Saturated Unit Weight: 22 kN/m3 Cohesion: 100 kPa Friction Angle: 15 degrees Water Surface: Water Table Custom Hu value: 1	Material: Transistional Strength Type: Mohr-Coulomb Unsaturated Unit Weight: 24 kN/m3 Saturated Unit Weight: 26 kN/m3 Cohesion: 250 kPa Friction Angle: 30 degrees Water Surface: Water Table Custom Hu value: 1

Note that SME considers these parameters to be conservative but has adopted these for preliminary analyses.

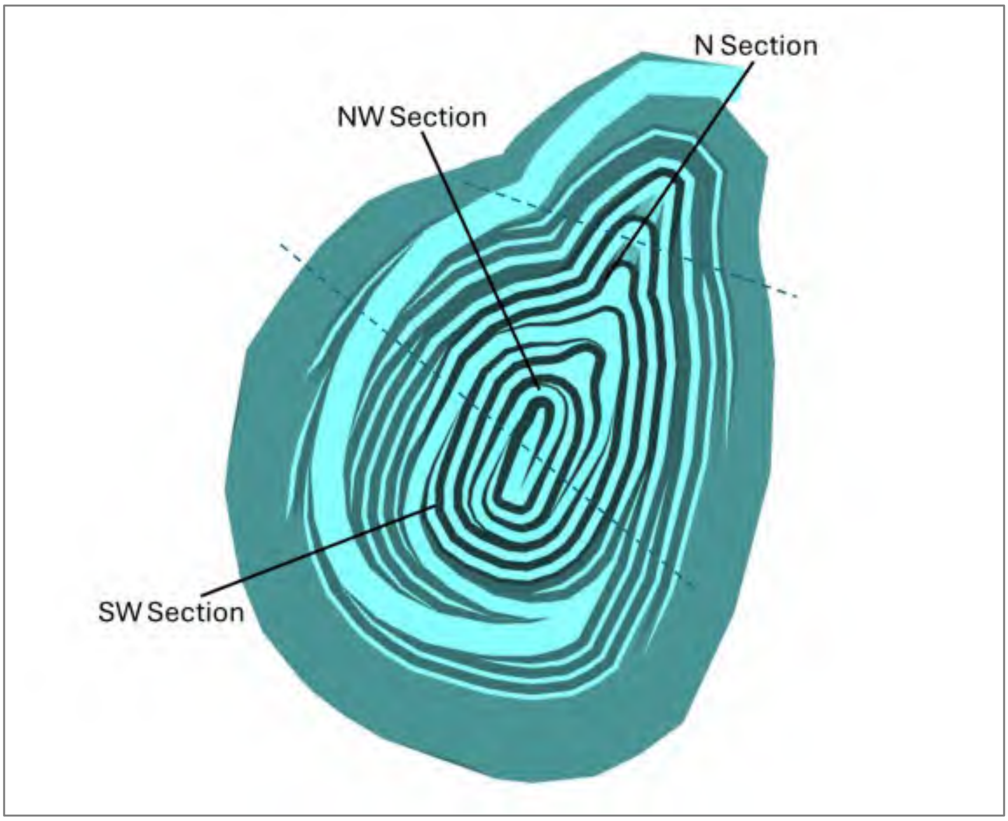
Stability analyses typically involved auto-search unrestricted non-circular failure modes to find the minimum FoS failure surface. Analyses estimated the minimum FoS using two methods, including Spencer and Morgenstern-Price method of slices using optimised auto-search routines to define failure paths.

Analyses adopted an unrestricted approach where failure paths could find minimum factor of safety failure surfaces at any scale (i.e. batter and upwards) and through any part of the slope.

4.5.1 Stability Analysis Results

SME assessed three sections located through the SW, NW and N walls of pit design (*Queen.dtm)* representing one section in each slope design sector. Note that the proposed pit design was developed prior to development of suggested slope design parameters presented above.

Figure 4.13: Slope stability section locations.



Note images show the minimum FoS slip surface for the Spencer method.

Figure 4.14: SW Section stability analysis result.

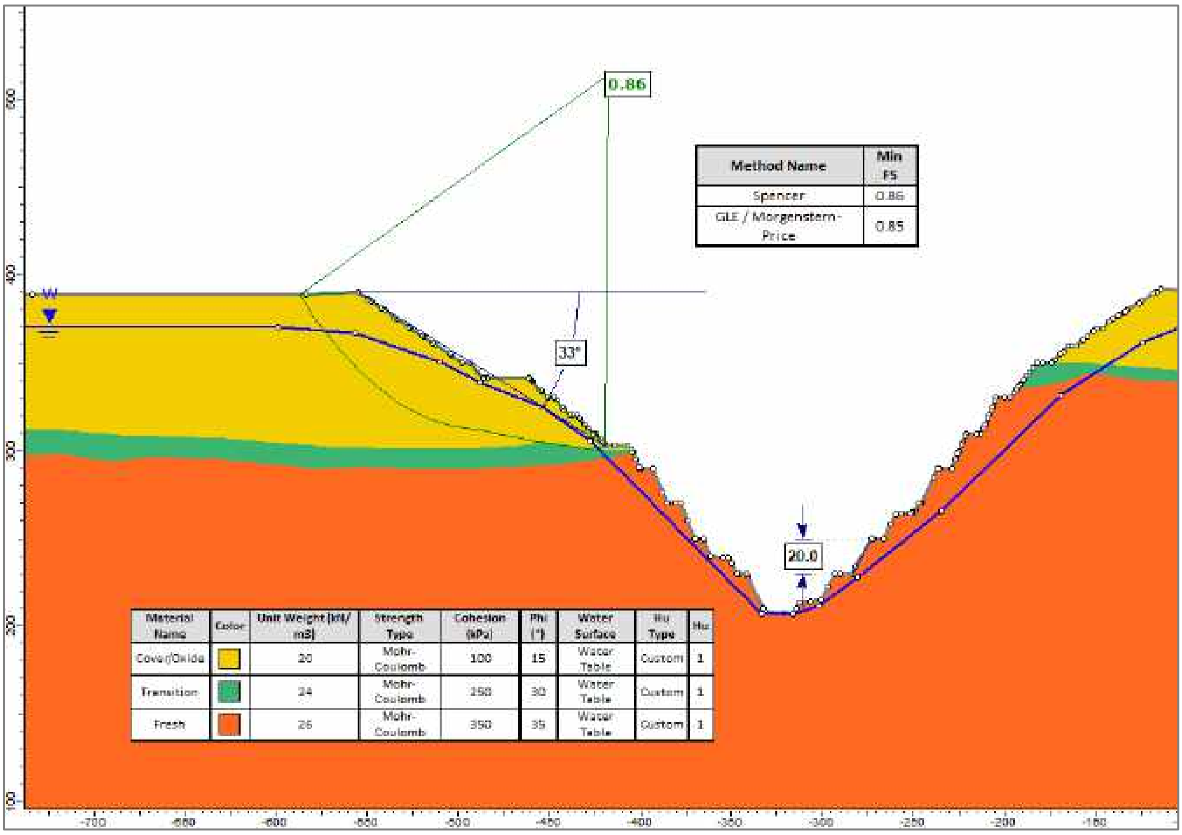


Figure 4.15: NW Section stability analysis result.

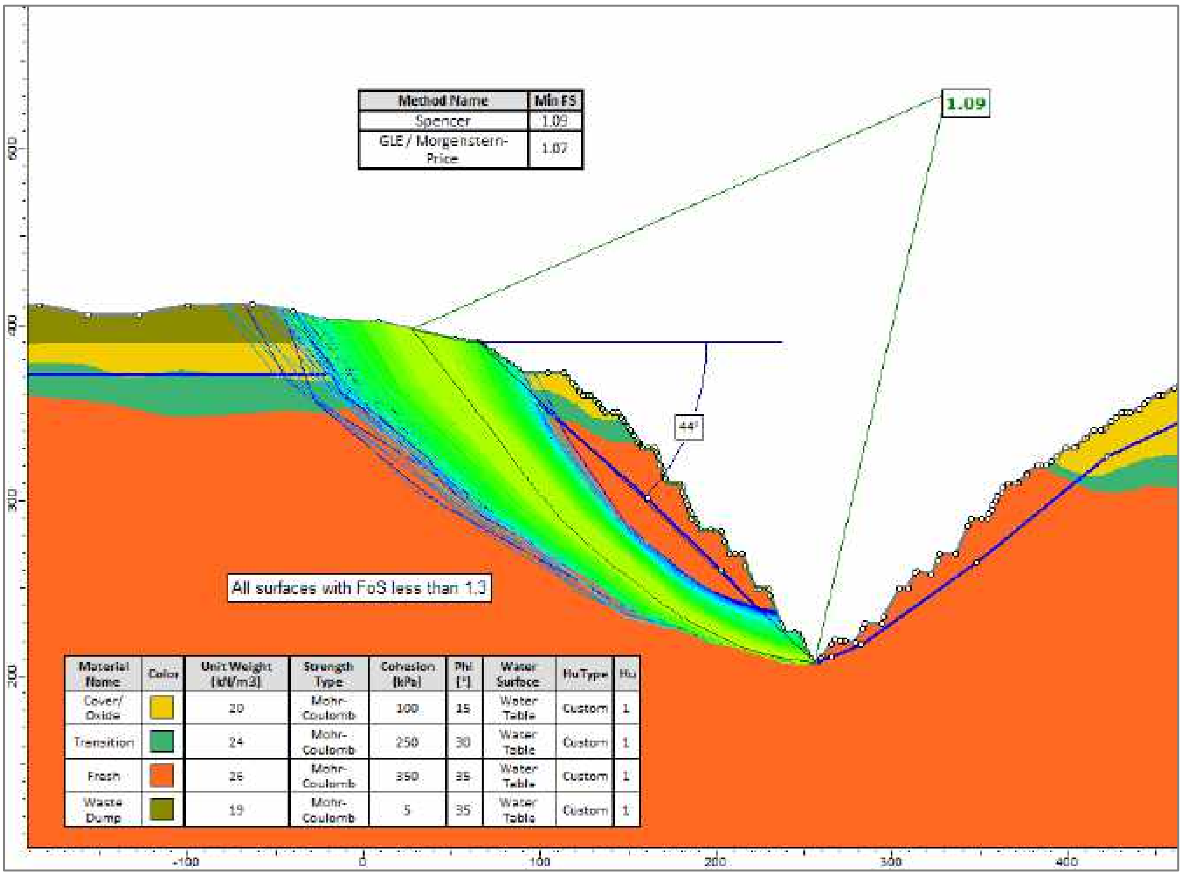
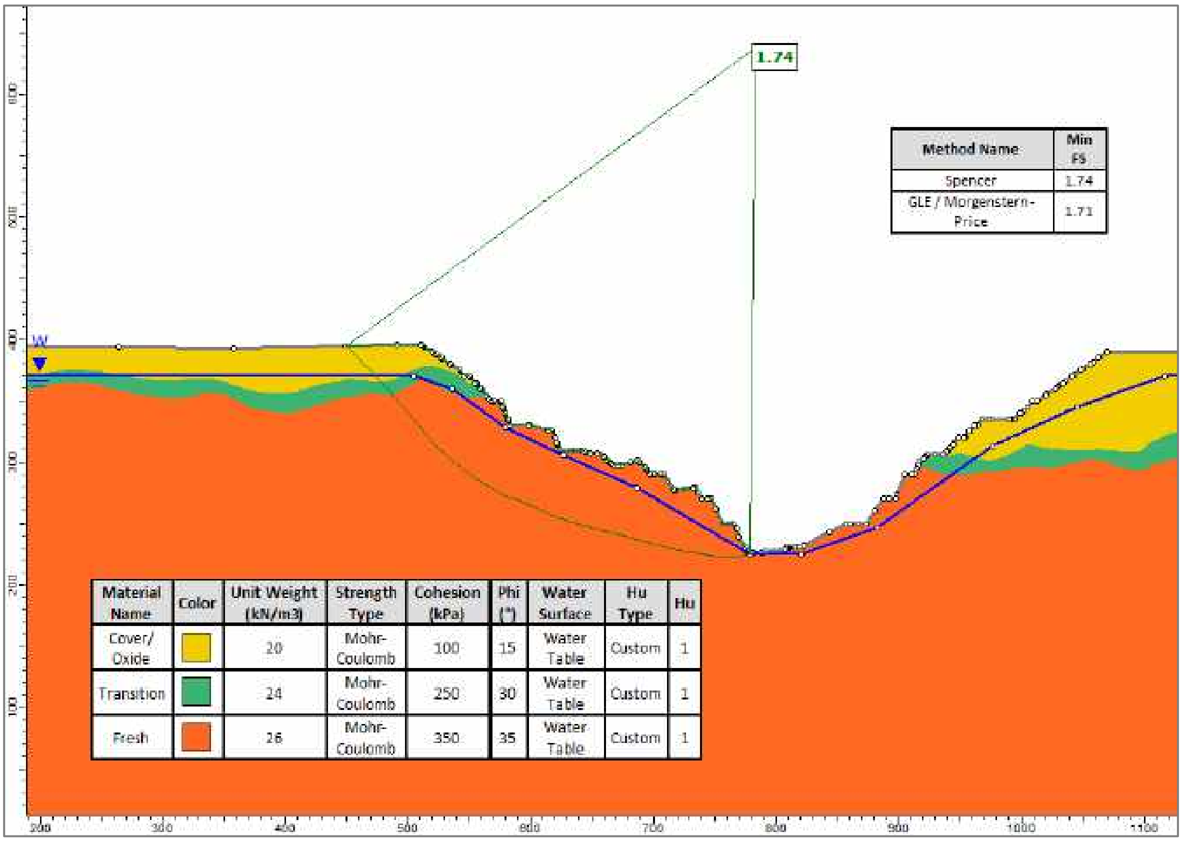


Figure 4.16: N Section stability analysis result.

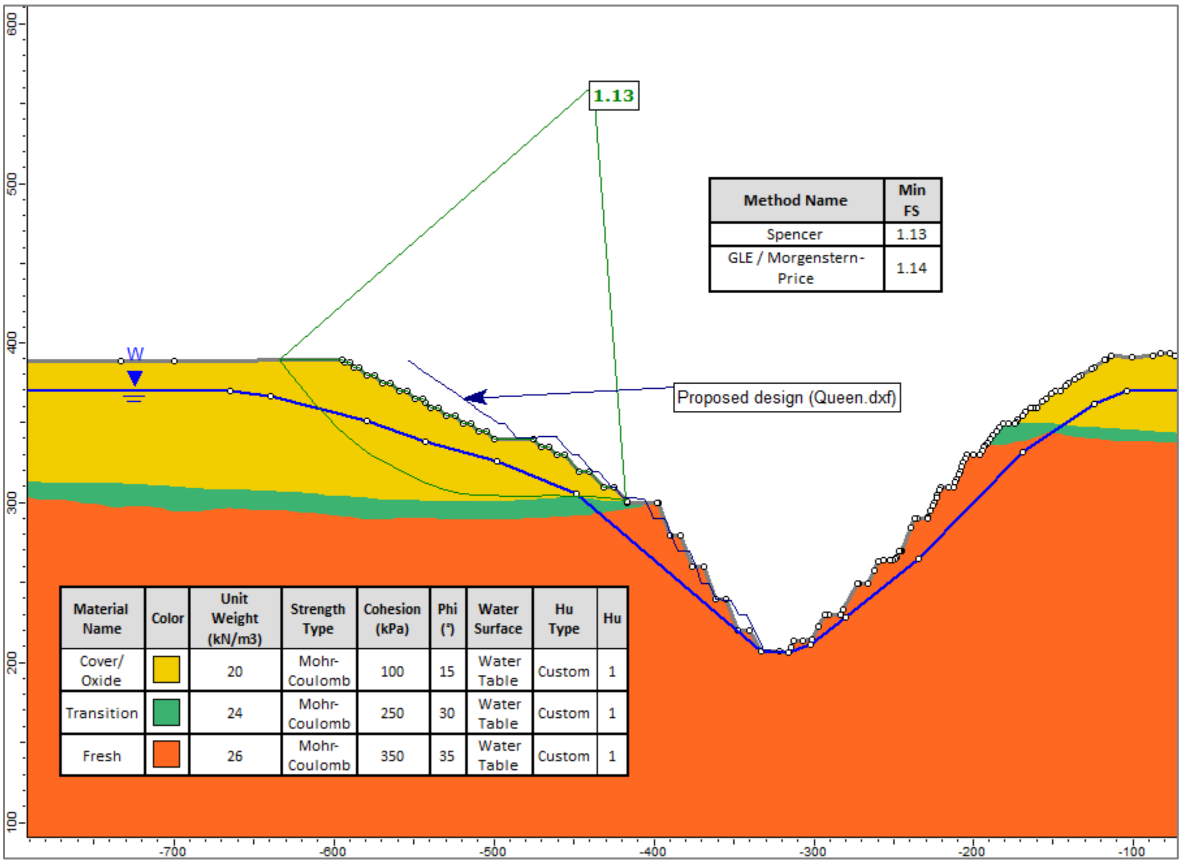


Based on the stability analysis results for the preliminary pit design presented in Figure 4.14, Figure 4.15 and Figure 4.16 for the SW, NW and N sections respectively, the following conclusions can be drawn with respect to likely slope stability against shear failure through the rock mass:

- The SW section with the deepest sequence of Cover and Oxide materials returned a Factor of Safety ("FoS") significantly less than 1.0 suggesting slope failure is likely. This result is likely at the lower end of expected given the simple model i.e. all Cover and Oxide materials have the same conservative parameters. As such the slope profile in this area will need to be flattened.
- The NW section returned a FoS marginally above 1.0 (i.e. at 1.09 is likely to be stable) but less than target of 1.2 to 1.3. Figure 4.15 also presents all failure surfaces with a FoS of 1.3 or less, with all surfaces affecting the entire slope. This indicates that the upper parts of the slope through Cover/Oxide have a FoS above the target of 1.3. Similarly this result is likely at the lower end of expected performance given the conservative parameters used.
- The N section returned a FoS well above target range of 1.2 to 1.3.

Note that these analyses presented above were for the provided design (*Queen.dtm*) developed prior to any updated slope design parameters. As such SME has revaluated the SW Section (deepest weathering profile) adopting likely slope design parameters and ramps to assess the overall stability against shear failure. Figure 4.17 presents the results for this analysis indicating a FoS of around 1.13, which is likely stable but slightly below target of 1.2.

Figure 4.17: SW Section stability analysis result for proposed slope design parameters.

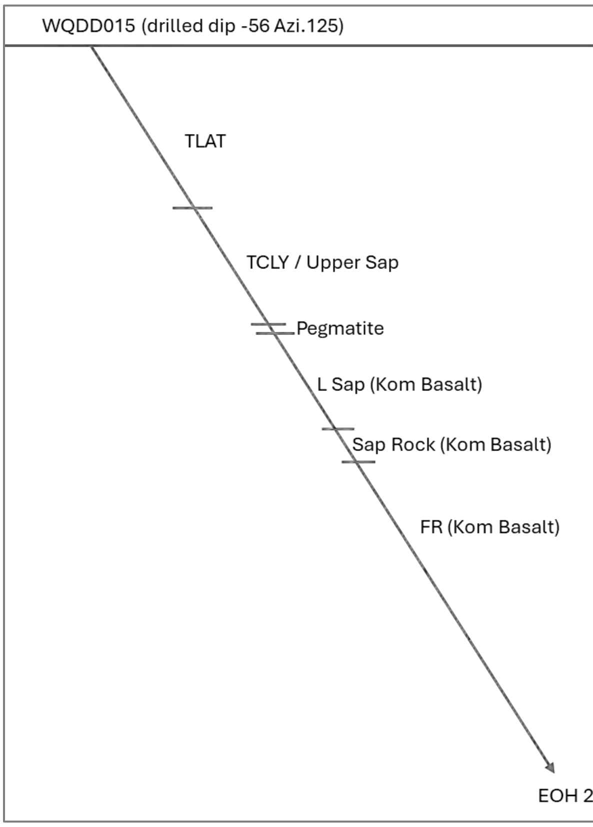


Additionally, given the significant thickness of Cover/Oxide material, SME reviewed the drilling data in the area to assess any indications of variability to improve the model. Drill hole WQDD015, located in close proximity to the SW Section and drilled across the section to SE (refer Figure 4.3 for location), provided the following lithology intersections:

- TLAT: 0 – 46 m (downhole depths)
- TCLY/SAP (Upper): 46 – 80 m
- Lower SAP: 80 – 111 m (Komatiitic Basalt)
- SROCK: 111 to 123 m (Komatiitic Basalt)
- FR: 123 – 234 (Komatiitic Basalt)
- EOH at 299 m.

Figure 4.18 presents the drill log downhole drill intersections for WQDD015.

Figure 4.18: WQDD015 Lithology intersections.

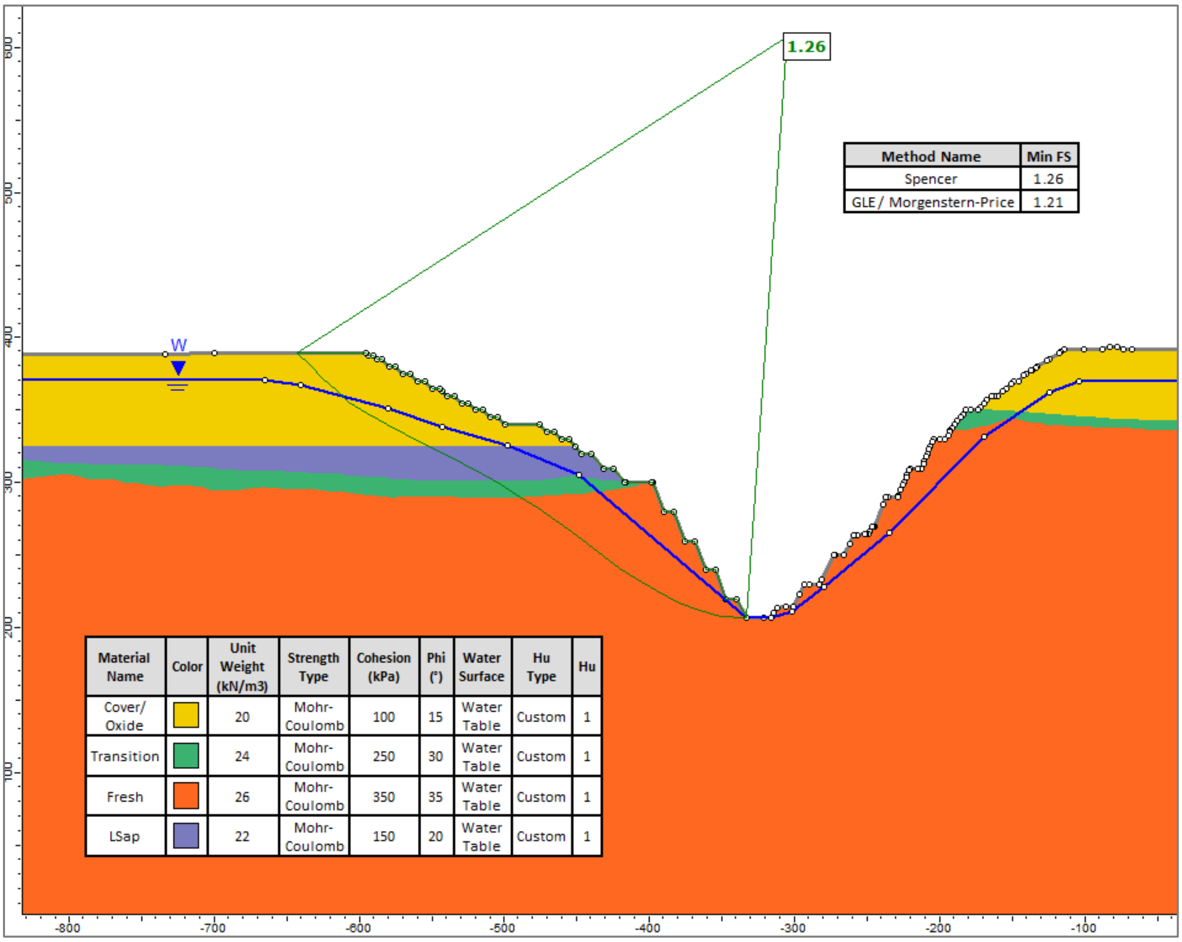


Hole_ID	Depth_I	Depth_T	Lith1_Description	Lith1_Cod	Lith1_Har	Lith1_p	Lith1_R	Lith1_O
WQDD015	0	40	Laterite (undif)	TLAT	0	100	COV	CW
WQDD015	40	46	Laterite (undif)	TLAT	0	100	COV	CW
WQDD015	46	61	Clay	TCY	0	100	US	CW
WQDD015	61	71	Clay	TCY	0	100	US	CW
WQDD015	71	75	Clay	TCY	0	100	US	CW
WQDD015	75	80	Clay	TCY	0	100	US	CW
WQDD015	80	82	Pegmatite	FPG	2	100	LS	HW
WQDD015	82	91	Komatiitic basalt (high Mg)	MBK	2	100	LS	MW
WQDD015	91	111	Komatiitic basalt (high Mg)	MBK	0	100	LS	HW
WQDD015	111	113.9	Komatiitic basalt (high Mg)	MBK	2	100	SR	WW
WQDD015	113.9	119.8	Komatiitic basalt (high Mg)	MBK	2	100	SR	WW
WQDD015	119.8	120.2	No recovery (describe in com	NOREC		100		
WQDD015	120.2	121.7	Komatiitic basalt (high Mg)	MBK	2	100	SR	WW
WQDD015	121.7	121.8	No recovery (describe in com	NOREC		100		
WQDD015	121.8	122.6	Komatiitic basalt (high Mg)	MBK	2	100	SR	WW
WQDD015	122.6	125.7	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR
WQDD015	125.7	126.2	Komatiitic basalt (high Mg)	MBK	2	100	FR	JW
WQDD015	126.2	141.9	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR
WQDD015	141.9	142.9	Komatiitic basalt (high Mg)	MBK	3	70	FR	FR
WQDD015	142.9	234.5	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR
WQDD015	234.5	247.4	Dolerite/diabase	MD	3	100	FR	FR
WQDD015	247.4	247.6	Pegmatite	FPG	4	100	FR	FR
WQDD015	247.6	247.9	Dolerite/diabase	MD	3	100	FR	FR
WQDD015	247.9	248	Breccia (undif)	BX	4	100	FR	FR
WQDD015	248	272.8	Dolerite/diabase	MD	3	100	FR	FR
WQDD015	272.8	272.9	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR
WQDD015	272.9	273.3	Breccia (undif)	BX	3	100	FR	FR
WQDD015	273.3	280.1	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR
WQDD015	280.1	280.4	Major vein - sulphide	Vsx	4	100	FR	FR
WQDD015	280.4	302	Komatiitic basalt (high Mg)	MBK	3	100	FR	FR

Figure 4.18 suggests a vertical depth to FR (fresh) rock of about 90 m which matches the modelled surface used to develop the SW Section stability model. It also indicates that the LSAP (lower Saprolite) extends for about 25 m vertically above this. As such SME has included a LSAP layer in the model and assumed strength parameters between those adopted for COVER/Oxide and Transition (i.e. Friction 20°, Cohesion 150 kPa).

Figure 4.19 presents the stability analysis results for the SW Section incorporating the proposed slope design parameters and a LSAP horizon. Overall slope FoS returned a value of just over 1.20, which meets design acceptance criteria.

Figure 4.19: SW Section stability analysis result for proposed design parameters including LSAP.



4.6 Sensitivity to material properties

SME note that the parameters adopted from POBA 2012, for all material types utilised Mohr-Coulomb shear strength parameters, a simplified linear shear strength model most commonly used in soil like materials. Note that a more typical industry practice for defining rock mass shear strength in slope stability analyses for 'hard/fresh' rock would be to use the curved Hoek-Brown failure criterion as opposed to the straight-line Mohr-Coulomb parameters.

To test the impact of this, SME completed the following assessment. Using the geotechnical logging data for the WQSDD001 to 004 holes, SME has estimated Bieniawski's 1989 Rock Mass Rating ("RMR_{89}") as described in Hoek, Kaiser and Bawden (1995)[6] utilising the logged: RQD, field estimated strength and fracture spacing. Joint condition (roughness, infill type and width, joint wall weathering, etc) was assumed and set at 10 representing the lower 1/3 of possible values (i.e. 10 out of 30). The typical value of RMR_{89} estimated from logging data returned a value of around 65 in fresh rock which equates to a Geological Strength Index ("GSI") of 60, which along with intact rock strength, rock constant m_i and Blast Disturbance can be used to estimate the rock mass shear strength using the Generalised Hoek-Brown ("GHB") methodology as described in Hoek, Kaiser and Bawden (1995). Key inputs include UCS, GSI, m_i, and D where:

- UCS is the compressive strength of the rock derived from the field estimated strength obtained during logging of drill core

[6] Hoek, E., Kaiser, P.K. and Bawden, W.F., 1995. Support of Underground Excavations in Hard Rock, Pub. A.A. Balkema, Rotterdam.

- GSI (Geological Strength Index) is derived from RMR using the formula:

  $GSI = RMR_{89} - 5$

- m_i is a rock constant and depends on lithology and rock texture and is based on published tables or laboratory testing data (rock triaxial tests), in this case published tables were used. Published values for m_i from Read and Stacey (2009) are presented in Table 4.5. Note that the m_i values for metamorphic rocks range from range from 7 +/- 4 to 29 +/- 3.
- D is a disturbance factor to account for blast disturbance and stress relaxation and acts to reduce the shear strength of the rock mass. Within the analysis software SLIDE by Rocscience, used for open pit stability analysis, there are two options of D = 0.7 for “Good Blasting” or D = 1.0 for “Poor Blasting” (refer Figure 4.20). Note that the maximum value allowed to be entered is 1.0. Also note the commentary in red at the bottom of the image indicating that the disturbance factor should only be applied to the damaged rock around the excavation or behind the slope and not the entire rock mass.

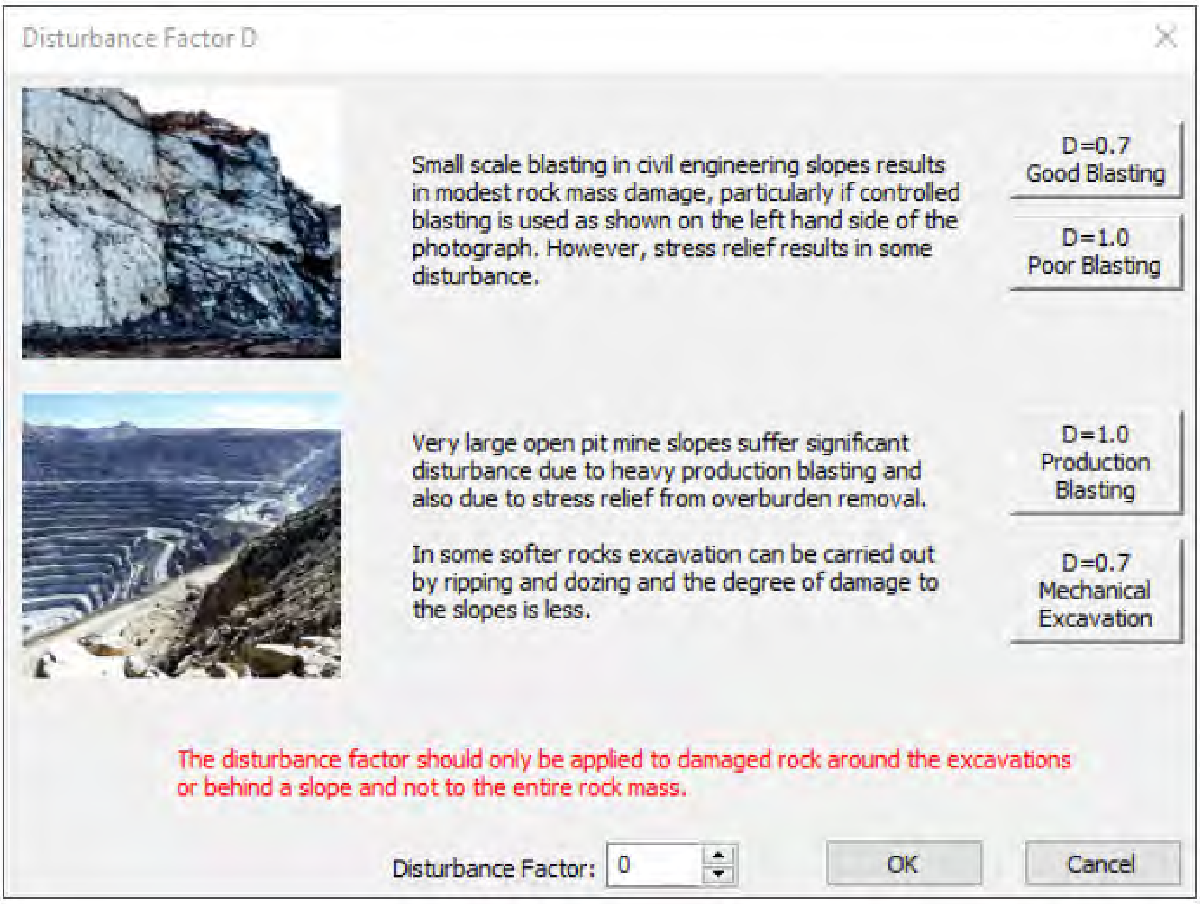
Table 4.5: Published values for mi (Read and Stacey 2009 Table 5.38).

Table 5.38: Indicative values for m_i for some rocks

Rock type	Class	Group	Texture: Coarse (> 2 mm)	Texture: Medium (0.6–2 mm)	Texture: Fine (0.2–0.6 mm)	Texture: Very fine (< 0.2 mm)
SEDIMENTARY	Clastic		Conglomerates® (see Notes)		Sandstones® (15 ± 7)	Siltstones® 7 ± 2
			Breccias® (see Notes)		Greywackes® (16 ± 5)	Claystones® 4 ± 2
						Shales® (6 ± 2)
						Marls® (7 ± 2)
	Non-clastic	Carbonates		Crystalline limestone® (12 ± 3)		Micritic limestone® (9 ± 2)
					Sparitic limestone® (10 ± 2)	
					Dolomites® (9 ± 3)	
		Evaporites			Gypsum® (8 ± 2)	Anhydrite® (12 ± 2)
		Organic				Chalk® 7 ± 2
METAMORPHIC	Non-foliated			Marble® 9 ± 3		
				Hornfels® (19 ± 4)	Quartzites® 20 ± 3	
				Meta-sandstones® (19 ± 3)		
	Lightly foliated			Gneisses® 28 ± 5		
				Amphibolites® 26 ± 6		
				Migmatites® (29 ± 3)		
	Foliated				Phyllites® (7 ± 3)	Slates® 7 ± 4
				Schists® 12 ± 3		
IGNEOUS	Intrusive	Light	Granites® 32 ± 3		Diorites® 25 ± 5	
				Granodiorites® (29 ± 3)		
		Dark	Norites® 20 ± 5	Gabbros® 27 ± 3		
					Dolerites® (16 ± 5)	
	Hypabyssal		Peridotites® (25 ± 5)		Diabases® (15 ± 5)	
				Porphyries® (20 ± 5)		
	Volcanics	Lavas	Rhyolites® (25 ± 5)		Basalts® (25 ± 5)	Obsidians® (19 ± 3)
					Dacites® (25 ± 3)	Andesites® 25 ± 5
		Pyroclastics	Agglomerates® (19 ± 3)		Tuffs® (13 ± 5)	
			Breccias® (19 ± 5)			

Values in brackets are estimates; the others are from triaxial tests
Source: Karzulovic (2006)

Figure 4.20: Disturbance factor input table from SLIDE analysis software.



Utilising a GSI of 60, a rock strength of 170 MPa, a m_i of 10 and D of 1.0 along with a density of around 2.9 T/m^3, Rocscience's ROCLAB software was used to estimate the shear strength of the fresh rock masses using the Hoek-Brown Criterion (curved strength profile) and which returned a Mohr-Coulomb equivalent of friction 44.3° and Cohesion of 1,280 kPa. These results along with the parameters adopted from POBA (2012) for fresh materials (friction 35° and Cohesion of 350 kPa) are presented in Figure 4.21. Note the significant difference between the two profiles.

The NW section stability analysis was re-run adopting these fresh rock shear strength parameters which returned a minimum FoS of 2.3, well above target and with a failure surface through the upper part of the slope (refer Figure 4.22).

Figure 4.21: Rock mass shear strength profiles.

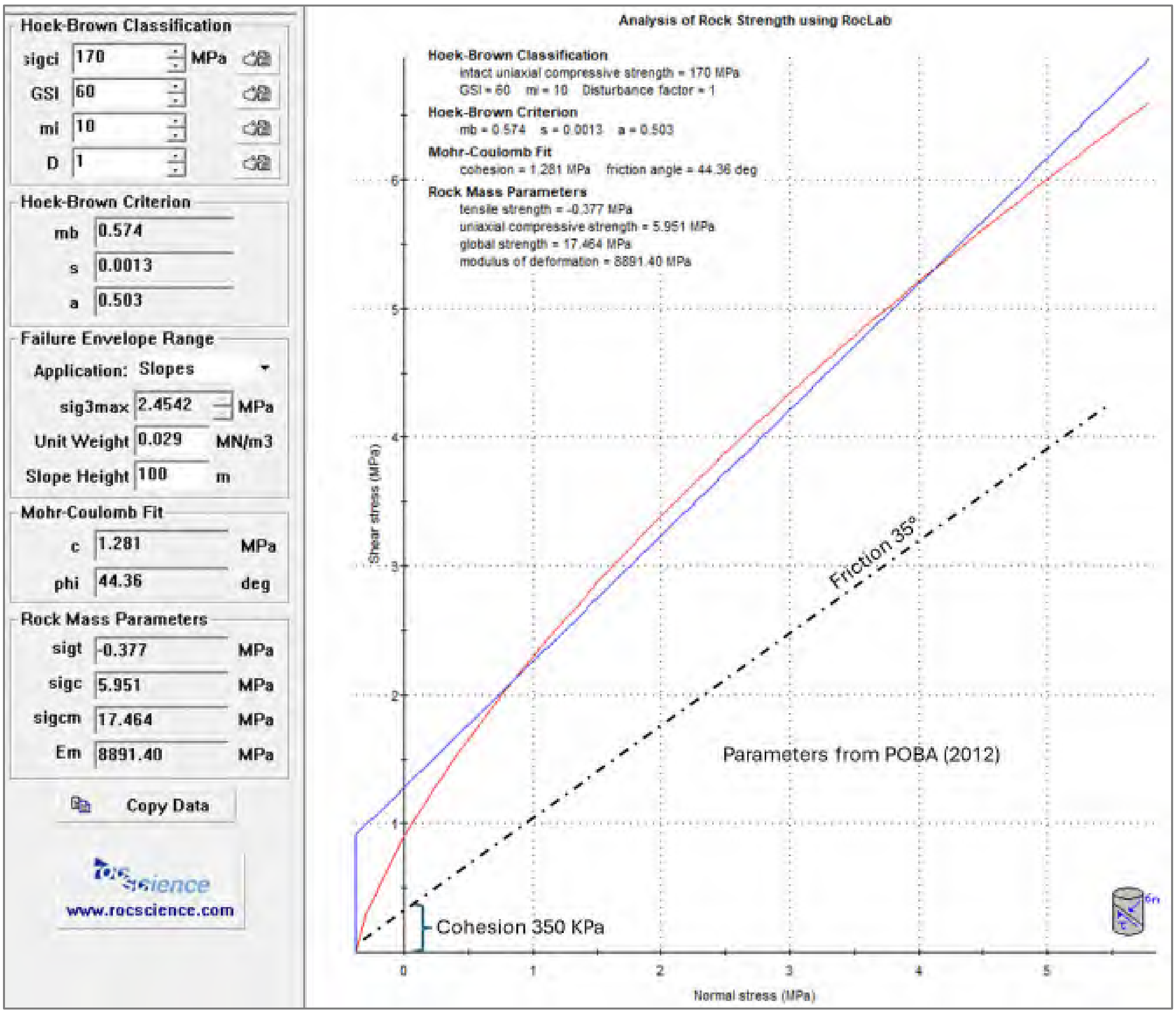
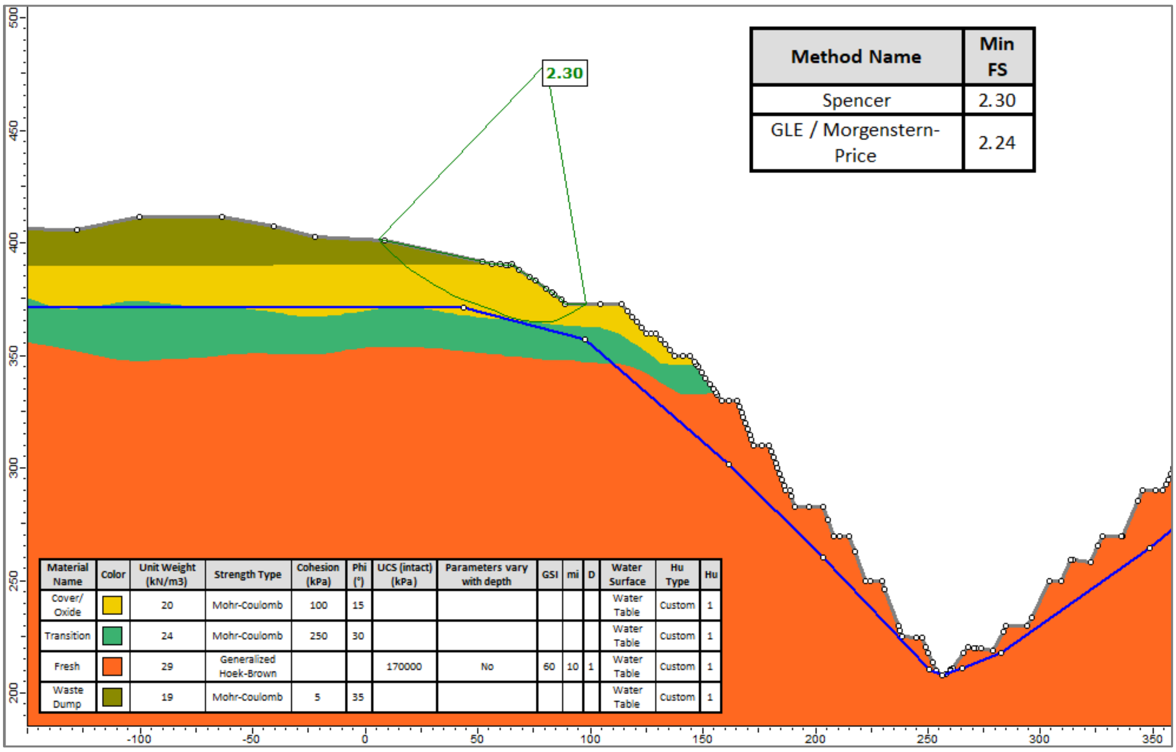


Figure 4.22: NW Section stability analysis utilising alternate strength parameters.



Method Name	Min FS
Spencer	2.30
GLE / Morgenstern-Price	2.24

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh		29	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1
Waste Dump		19	Mohr-Coulomb	5	35						Water Table	Custom	1

Similarly, if these parameters are applied to the fresh rock of the SW Section then the FoS will improve further (i.e. likely above 1.3).

Additionally it’s likely that a similar upgrade in strength, maybe not as large, could also be applied to the transition (equivalent to moderately weathered rock) and parts of the Cover/Oxide profile such as the hardpan layer, which will likely lead to further improvements in FoS. However more detailed analysis of the drilling data would be required.

Additionally, the updated slope design parameters would also need to be applied to allow proper estimation of the updated slope profile with ramps, which should result in a flatter slope and therefore improved FoS.

5 Suggested Slope Design Parameters

5.1 Geotechnical domains

The depth of cover / oxide and top of fresh surfaces vary across the WQS deposit as illustrated in Figure 4.4 (i.e. deeper at southern end of WQS). As such, SME has utilised these surfaces to guide the definition of geotechnical slope sectors.

Based geotechnical data, SME has subdivided the geological units into the following geotechnical domains, which include:

- Cover / Oxide – all materials above the oxide (*cube_3DM_oxide_June2021.dtm / str*) surface and generally include transported cover materials and saprolite (highly to extremely weathered bedrock). The Cover / Oxide unit is around 25 m deep at the north end and up to 85 m deep at the south.

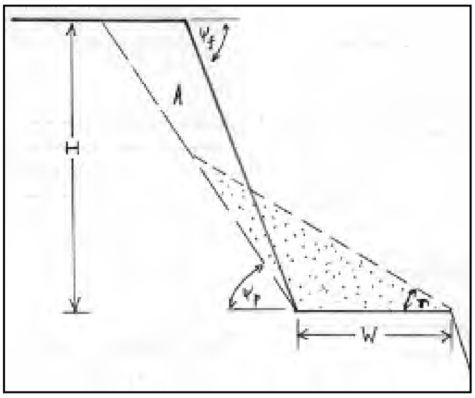
  Note that there is likely a palaeochannel at or near the south end of the pit which is likely to produce increased pit inflows compared to the east and west sides of the pit of the pit.
- Transition – an up to 25 m thick sequence below the Cover / Oxide horizon and above the top of fresh surface (*cube_3DM_fresh_June2021.dtm / str)*.
- Fresh - all materials beneath the top of fresh surface.

5.2 Design Berm Width

Design berm widths can be determined using several approaches, usually combinations of methods, including:

- failure volume catch requirements as per the geometrical method as described in Martin and Piteau[7] (i.e. likely failure volume, including bulking, is estimated based on angle of most likely sliding plane (refer Figure 5.1)).

Figure 5.1: Geometrical method for estimating berm width.



- rock fall assessment to design berms to limit the potential for a majority of rock falls to fall beyond one berm, based on an acceptance criteria (this usually requires some field testing to better define key inputs such as coefficient of restitution).

[7] Martin D., Piteau D., 1978: *Select berm width to control local failure*, Engineering and Mining Journal, June edition.

- using published relationships relative to batter height such as the 'Modified Ritchie Criteria'[8] or Ryan and Prior which utilise the following formulas:

  Modified Ritchie - Berm Width (m) = 0.2 * Bench Height (m) + 4.5

  Ryan and Prior - Berm Width (m) = 0.17 * Bench Height (m) + 3.5

Note that the likely crest loss should also be factored into these determinations. Note also that SME considers the Ryan and Prior methodology to be slightly aggressive unless batters are only formed by pre-split blasting with exceptional results.

Given that batters in fresh rock are likely to be formed with 20 m inter-berm height (i.e. double benched) then berm widths based on; Modified Ritchie Criteria would need to be 8.5 m wide, or 6.9 m using Ryan and Prior. For 10 m inter-berm height berm widths would need to be 6.5 m and 5.2 m respectively.

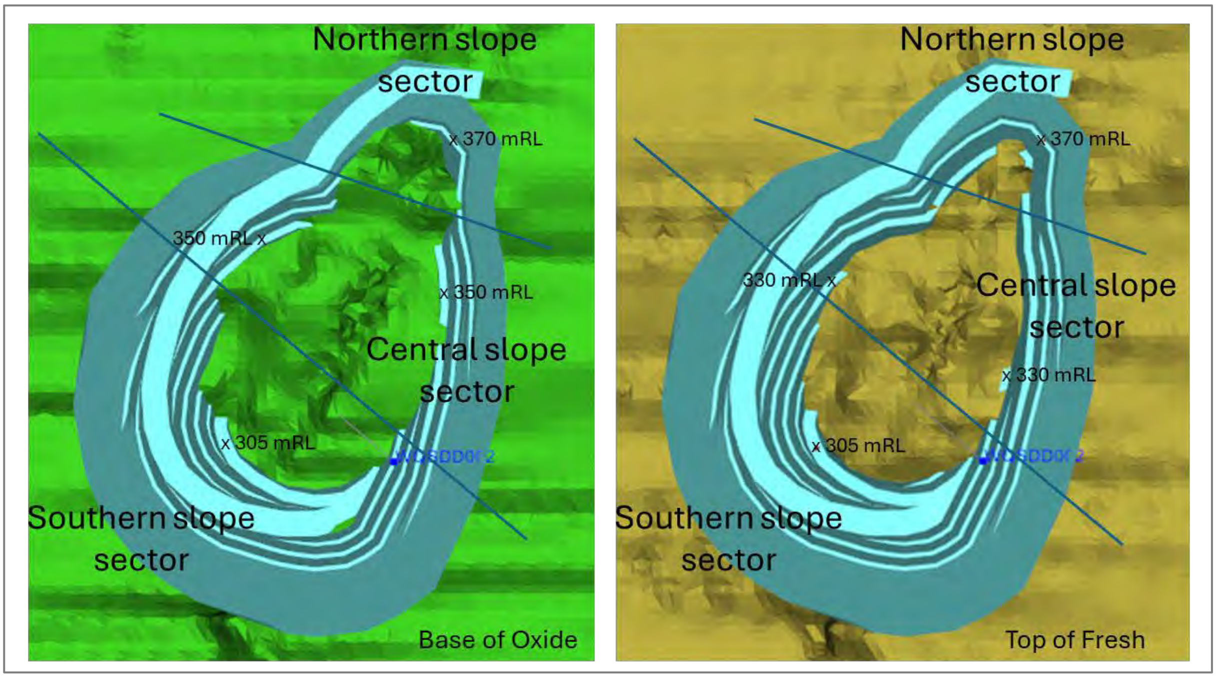
5.3 Slope Design Parameters

With this in mind, SME proposes the following slope design parameters. Note that given current high levels of uncertainty (drilling orientation bias, spatial distribution bias, limited intercepts of FW materials, etc), then these design parameters should be implemented with significant caution and controls.

Note that SME has identified three slope sectors including the Northern, Central and Southern, which are presented in Figure 5.2 relative to the proposed Stage 3 design and base of oxide and top of fresh surfaces, to reflect the significant variation in depths across the proposed pit.

The Southern Slope Sector aligns approximately with POBA (2012) "Southern Domain" where the boundary aligned with drill hole WQSDD002. The new boundary follows a steep drop off on the base of oxide slightly north of the POBA boundary. SME has also added a Northern Slope Sector where there is another step in the base of oxide surface.

Figure 5.2: Slope deign sectors.



[8] Storey, A.W., 2010: *Design Optimization of Safety Benches for Surface Quarries through Rockfall testing and Evaluation*, Master of Science in Mining Engineering Thesis, Virginia Polytechnic Institute.

Table 5.1 presents SME's suggested slope design parameters for the proposed WQS Stage 3 pit. Note the provided Stage 3 design (*Queen.dtm)* does not meet these criteria and should be modified. Note also that slope parameters are included for the waste dump where the proposed pit will cut through the existing dump located west of the current Stage 2 pit void. These parameters are assumed based on possible conditions within the dump.

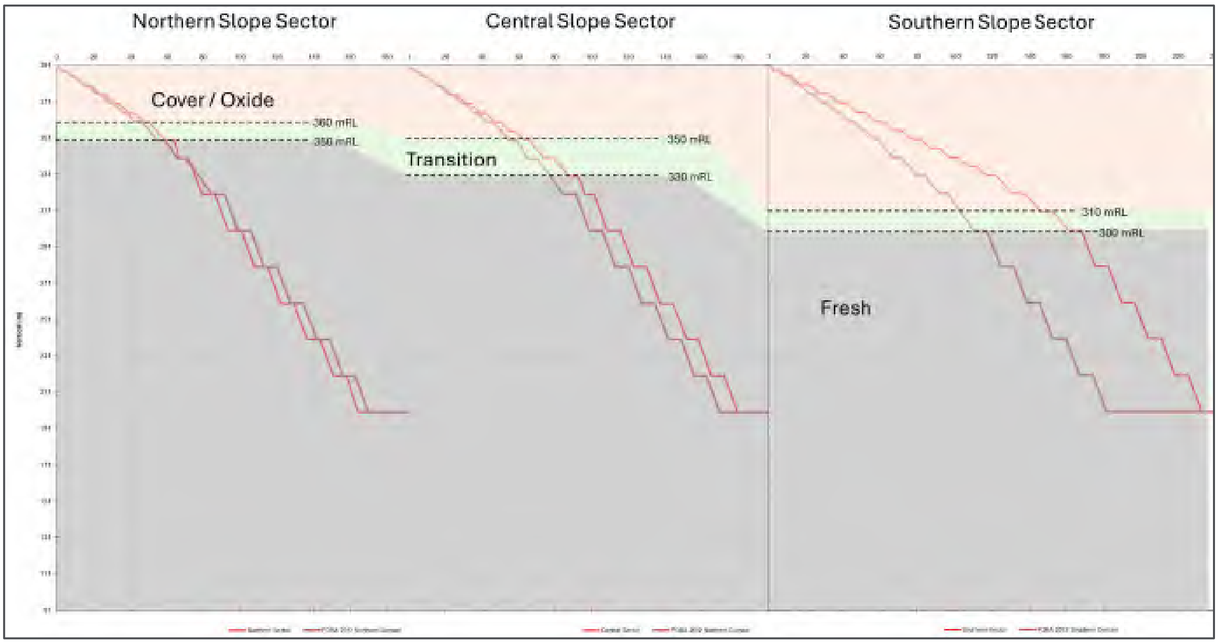
Figure 5.3 presents the slope design profiles in section view for the three slope sectors. Note the increase in depth of weathering towards the south. Note also that the profiles also show the POBA design profiles for their equivalent slope design domain. The bright red line represents the SME design, while the darker red line represents the POBA (2012) profile. Note that the SME profile has a steeper overall slope (ground surface to proposed pit bottom at 200 mRL) for the Northern Slope Sector, and flatter overall slope for the Central and Southern Slope Sectors. The steeper Northern Slope Sector reflects the significantly shallower depth of weathering in the area, while the flatter Central Slope Sector reflects the slope performance at the northern end of Stage 2 through the lower oxide / transition materials. The flatter Southern Slope Sector reflects the significantly deeper depth of weathering at the southern end of the Stage 3 pit when compared to the southern end of Stage 2.

Table 5.1: Suggested batter - berm design parameters.

Domain	Depth Range	Slope sector / Elevation	Batter Face Angle	Batter Height	Minimum Berm width at Toe	Inter-ramp[1] slope angle C to T
Waste Dump[2]	Above ground surface	All	< 20°	< 30 m	10 m	N/A
Cover / Oxide	From ground surface to base of oxide surface	Northern Surface (391) to 385 385 to 360	 45° 45°	 3.0 m 5.0 m	 2.0 m 3.0 m	~33.4°
		Central Surface (391) to 385 385 to 350	 45° 45°	 3.0 m 5.0 m	 2.0 m 3.0 m	~33.1°
		Southern Surface (391) to 385 385 to 330 330 to 310	 45° 45° 50°	 3.0 m 5.0 m 10.0 m	 3.0 m 5.0 m 7.0 m	~29.1°
Transition	From base of oxide surface to top of fresh surface	Northern 360 to 350	50°	10.0 m	5.0 m	~35.1°
		Central 350 to 330	50°	10.0 m	5.0 m	~34.8°
		Southern 310 to 300	50°	10.0 m	7.0 m	~29.4°
Fresh	From below top of fresh surface to base of pit	Northern 350 to 200	70°	20.0 m	7.0 m	~49.2°
		Central 330 to 200	70°	20.0 m	7.0 m	~46.7°
		Southern 300 to 200	70°	20.0 m	7.0 m	~43.3°

1. Inter-ramp angles are presented as Crest to Toe (C to T) from ground surface (i.e. height dependent)
2. Waste dump parameters are assumed as there is no indication/records of the placement of materials within the dump (i.e. all combined or oxides in centre and fresh rock around the outside), as such the parameters cater for a majority of the likely scenarios.

Figure 5.3: Slope deign profiles.



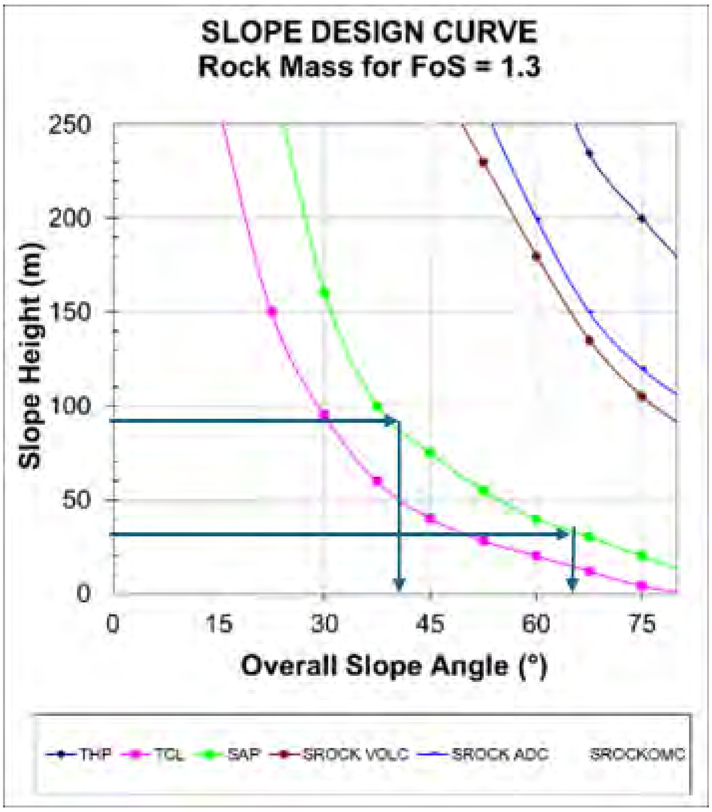
Note the significant flattening of the slope design in the Southern Slope Sector where the depth to transition is almost double compared to the Central Slope Sector. The reasoning for this is explained in the following commentary.

Figure 5.4 presents an example of a slope design curve developed by the author for a different project. The graph, generated from slope stability analyses for the specific material types / parameters, highlights a key consideration in slope design, which is that there is a slope height and slope angle relationship in the form of a curve when looking at a failure mode of shearing through rock or soil mass (more important in soil /oxide materials). This indicates that the higher the slope the flatter the design angle required to maintain a consistent stability (i.e. Factor of Safety ("FoS")). Using the example for SAP (Saprolite) from Figure 5.4, a slope height of 30 m in SAP would allow a slope angle of around 65° to give a FoS of 1.3, while a slope height of 90 m in the same material would need the slope angle to be around 40° to achieve the same FoS.

Note the graph presents design curves for a number of different material types. TCL (pink line) represents Transported Clays, a material with weaker properties than SAP, while SROCK VOLC (brown line), SROCK ADC (blue line) and SROCK OMC (dark blue line) represent curves for Saprock or transitional materials for three different rock types, namely Volcanics and Ortho-Meso Cumulate and Adcumulate Ultramafics, all materials with stronger properties than SAP.

So with this in mind it is important that depth / thickness of material as well as material type be considered in slope design.

Figure 5.4: Example of slope design curves (not to be used for slope design at WQS)



6 Slope Stability Assessment

Updated slope design parameters were developed based on stability assessment of the preliminary design provided by MER (*Queen.dtm*). The updated parameters were then used to develop an updated pit design (*queen250326_CROPPED_surface.dxf)* and the following section presents the overall slope scale assessment of the slopes based on a rock mass shearing failure mechanism.

6.1 Design Acceptance Criteria

The 2009 CSIRO publication titled *Guidelines for Open Pit Slope Design*[9] by Read and Stacey provides design acceptance criteria values (refer Table 6.1) which is a globally accepted and is in line with older WA publications.

Table 6.1: Guidelines for Open Pit Slope Design (Read and Stacey 2009 Table 9.9)

Table 9.9: Typical FoS and PoF acceptance criteria values

Slope scale	Consequences of failure[b]	Acceptance criteria[a] FoS (min) (static)	FoS (min) (dynamic)	PoF (max) P[FoS ≤ 1]
Bench	Low-high	1.1	NA	25–50%
Inter-ramp	Low	1.15–1.2	1.0	25%
	Medium	1.2	1.0	20%
	High	1.2–1.3	1.1	10%
Overall	Low	1.2–1.3	1.0	15–20%
	Medium	1.3	1.05	5–10%
	High	1.3–1.5	1.1	≤5%

a: Needs to meet all acceptance criteria
b: Semi-quantitatively evaluated (see Figure 13.9)

As such for the purpose of this assessment SME has adopted a target FoS of 1.2 inter-ramp and 1.3 overall slope, corresponding to a 'medium consequence' slope at inter-ramp scale and overall slope scale for static assessment.

6.2 Updated pit design

Prior to finalisation of this study, MER updated the pit design for WQS based on the parameters presented in Table 5.1 including slope parameters for the waste dump. Figure 6.1 presents an oblique view of the new design (*queen250326_CROPPED_surface.dxf*) looking west-southwest and showing the flat batters at 45° (colour-coded green) above the boco surface also shown.

9 Read J., Stacey P., 2009, Guidelines for Open Pit Slope Design, CSIRO Publishing.

Figure 6.1: Oblique view of updated design (*queen250326_CROPPED_surface.dxf*).

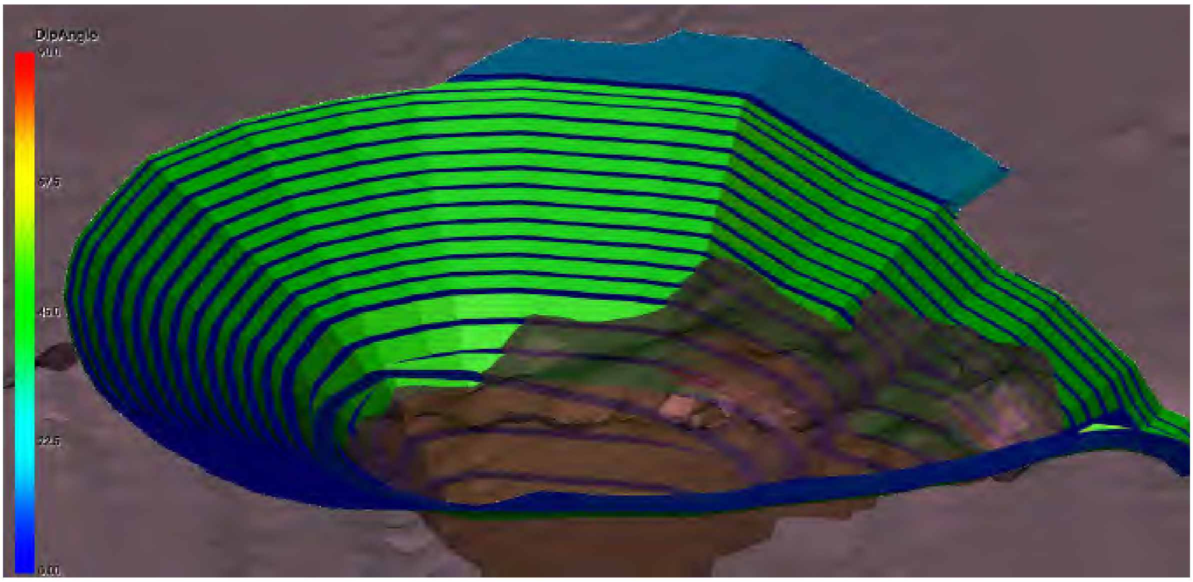


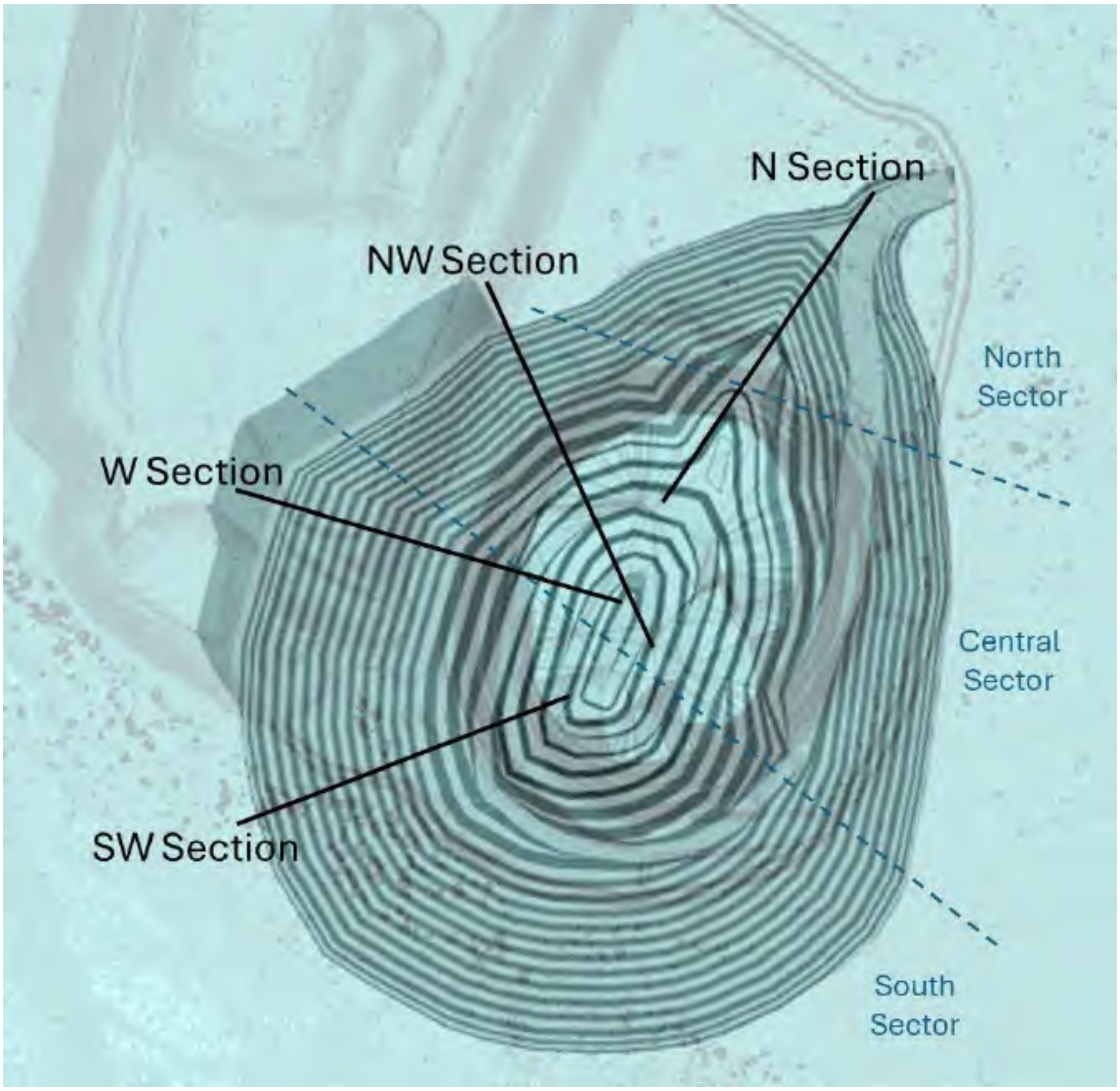
Figure 6.2 presents a plan view showing the updated design and the existing topography with a waste dump located immediately west of the pit. The design will cut through a portion of the approximately 12 m high dump.

Stability assessment of the new design has been completed using the same three sections used previously. Additional, given the position of the waste dump an additional stability section was analysed through the west wall of the pit. The locations of the four sections are also presented on Figure 6.2.

Stability analyses typically involved auto-search unrestricted non-circular failure modes to find the minimum FoS failure surface. Analyses estimated the minimum FoS using two methods, including Spencer and Morgenstern-Price method of slices using optimised auto-search routines to define failure paths.

Analyses adopted an unrestricted approach where failure paths could find minimum factor of safety failure surfaces at any scale (i.e. batter and upwards) and through any part of the slope.

Figure 6.2: Updated design along with topo and section locations.



Similarly, LE stability analysis using Rocscience's SLIDE2 software was undertaken of the updated Stage 3 pit design (*queen250326_CROPPED_surface.dxf*) for the four sections (SW, W, NW and N) and adopting the same material parameters as presented in Table 4.4 along with LSAP materials in the SW and W (as per Figure 4.19 model), and GHB parameters for the fresh rock materials (as per Figure 4.22) and assumed parameters for the waste dump materials.

Figure 6.3 to Figure 6.6 present the analysis results for the four sections, namely SW, W, NW and N, respectively.

Figure 6.3: SW Section stability analysis result– Updated design.

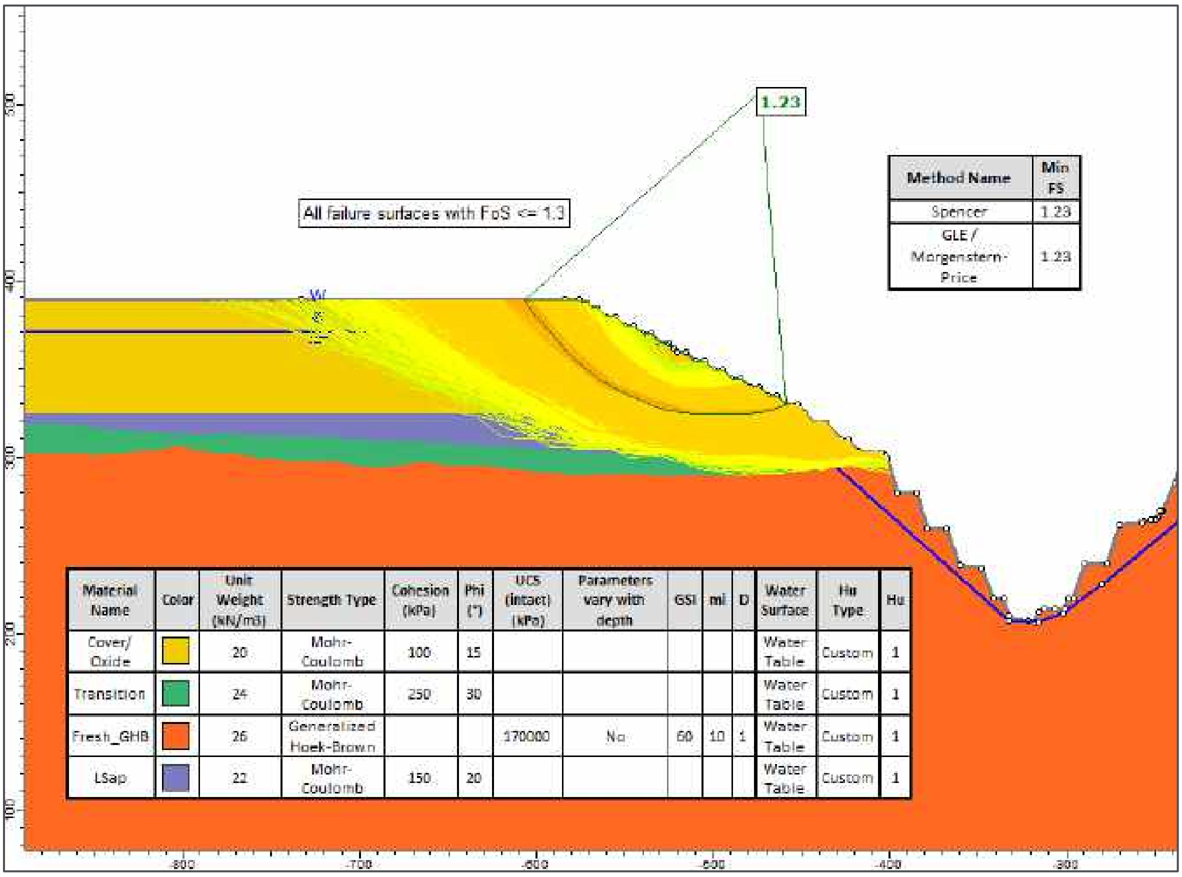


Figure 6.4: W Section stability analysis result– Updated design.

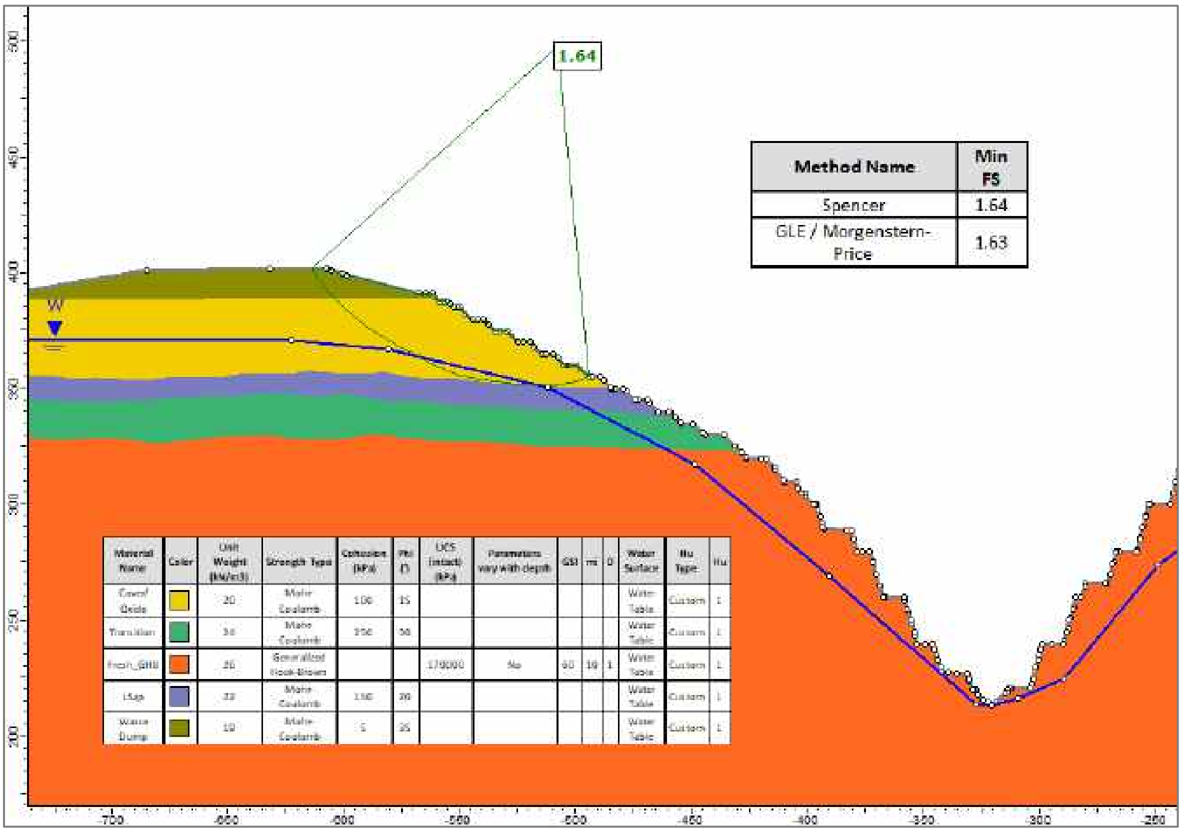


Figure 6.5: NW Section stability analysis result– Updated design.

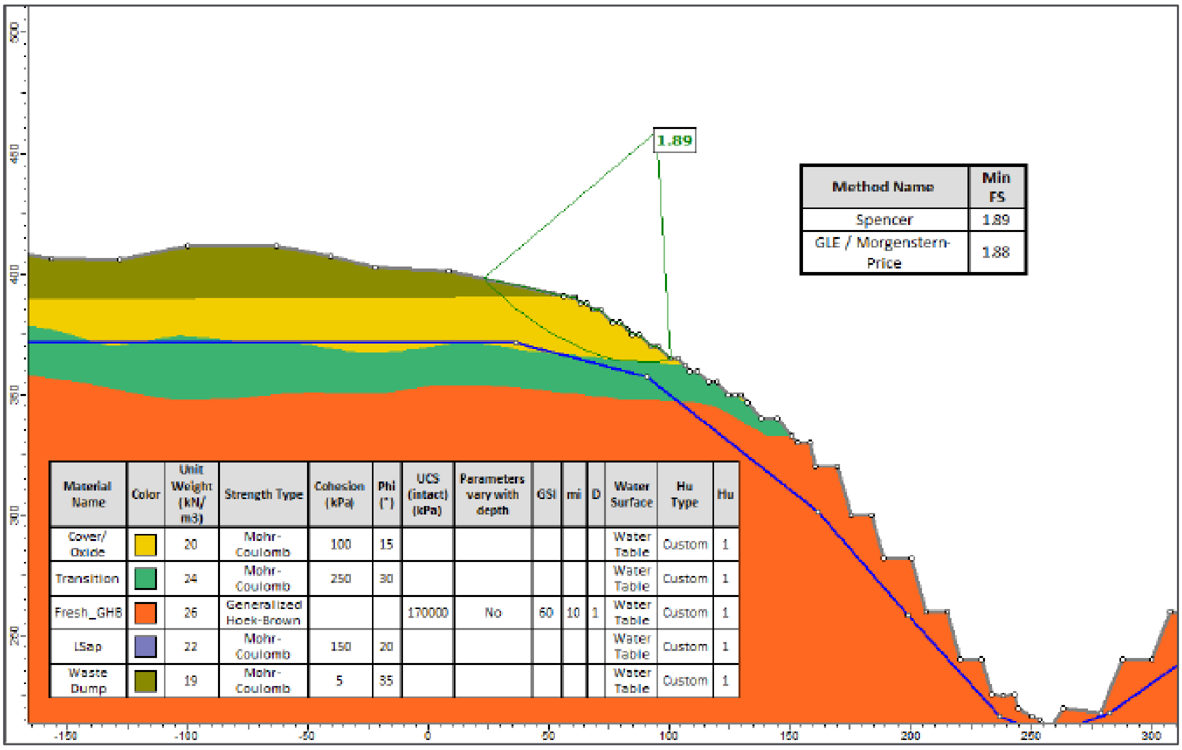
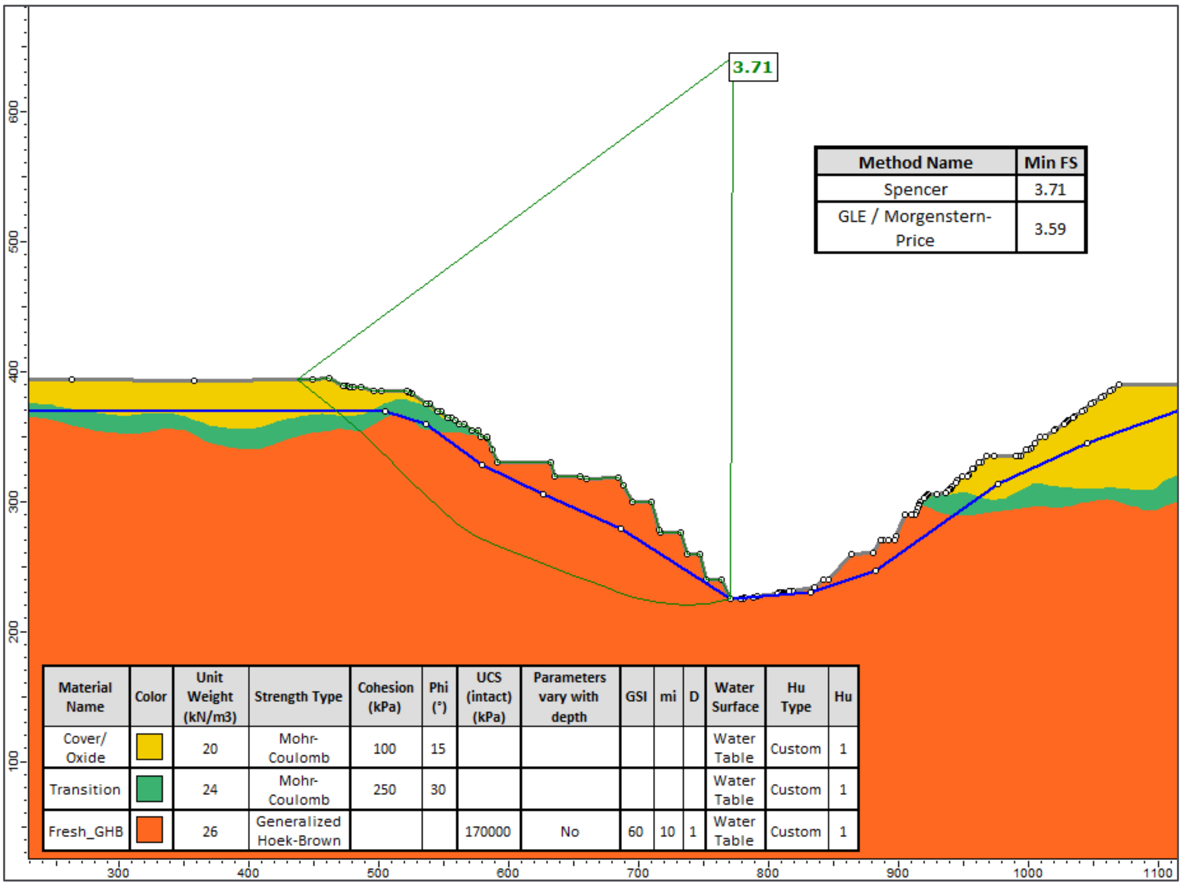


Figure 6.6: N Section stability analysis result – Updated design.



Based on the stability analysis results for the updated pit design presented in Figure 6.3 to Figure 6.6 for the SW, W, NW and N sections respectively, the following conclusions can be drawn with respect to likely slope stability against shear failure through the rock mass:

- All sections returned minimum FoS above the design target of 1.2 for inter-ramp stability and 1.3 for overall stability.
- The SW section with the deepest sequence of Cover and Oxide materials returned a FoS at around 1.23 through the upper part of the slope above the approximately 20 m thick LSAP layer. When the LSAP layer was not included in the model, the minimum FoS was around 1.0 also through the upper part of the slope (i.e. above transition). Note Figure 6.3 shows all failure surfaces less than 1.3 which are restricted to the upper part of the slope through the Oxide materials.
- The W section through the west wall and waste dump, returned a FoS of 1.6 through the upper part of the slope including the waste dump and when a thinner (about 10 m thick) LSAP layer was included. When no LSAP layer is included, then the minimum FoS was 1.3 for the overall slope (i.e. still meets design target).
- The NW section returned a minimum FoS above target of 1.3 and through the upper part of the slope. Note that no LSAP material was included in this model.
- The N section returned a minimum FoS well above target of 1.3.

Given these results and the data made available, the updated pit design achieves adequate FoS and as such is suitable for development.

7 Operational Considerations

Prior to the commencement of Mining a Ground Control Management Plan, in line with Department of Energy, Mines, Industry Regulation and Safety ("DEMIRS"), Western Australia guidelines (2019), should be developed for WQS (or incorporated into existing) which includes; operational controls such as inspections and slope monitoring, a Trigger Action Response Plan and responsibilities against these and requirements of the GCMP.

7.1 Slope Performance Monitoring

Slope performance monitoring is a fundamental part of open cut mining practice and a key element in safe and efficient management of pit walls. Monitoring is necessary both as a component of standard mining operations to provide routine coverage of an area, and to target specific zones identified as requiring particular attention due to observed instability or changes in monitored parameters. Both approaches are key components of risk management for the operation.

Slope performance monitoring of the ground conditions that the slopes are formed in at WQS and the performance of these slopes, includes the following:

- Inspections and Audits
- Monitoring (displacement)
- Collection of ground quality data (mapping and logging)

7.1.1 Visual Assessments

The most fundamental form of slope monitoring is visual assessments. Records of visual observations of pit slopes play an important part in building up a history of ground behaviour for assessment of pit wall conditions, particularly for identifying potential slope failures and the onset of slope displacement. Visual monitoring therefore assists in minimising the risk posed to personnel and equipment working on and beneath pit walls from rock fall and other slope instability.

Visual signs that may be indicative of potential, impending or existing slope failure include (but are not limited to) the following:

- Unravelling or sloughing of batter faces
- Bulging of the face or toe of a slope
- Floor heave
- Loose debris or rock falls on benches or berms
- Poor crest condition
- Undercutting or removal of lateral support at the toe of a slope (could be caused by uncontrolled excavation, erosion or previous failure)
- Erosion and undercutting caused by surface water run-off and flow
- Formation and dilation of tension cracks
- Displacements (offsets) along rock discontinuities, boreholes, etc
- New or increased water seepage or flow, or disappearance of water
- Water ponding on berms or infiltrating tension cracks
- Deformation or distortion of rock support elements;
- Rock noise and ejection, and
- Evidence of previous failures.

Assessment and monitoring of the above factors forms the basis of the visual monitoring system. Appearance of any of these warning signs requires implementation of appropriate action.

Key points to consider when undertaking any visual assessments are as follows:

- An overview of the area is required to identify potential safety issues and to establish a general awareness of the surroundings prior to entering. Do not proceed in the event of unsafe conditions. The planned visual assessment should also be communicated to the appropriate operations personnel in order to ensure mining activities or other issues will not impact on the person preparing to undertake the task
- Persons undertaking the assessments should be trained and experienced in basic geotechnical evaluation skills
- Look for evidence of failure or potential failure (refer to the list of signs above)
- Locate and record unfavourably orientated structures in the face or rock mass; and
- Delineate any new cracks or unstable areas by painting or flagging them and having them surveyed. Those areas considered to be more critical may also be photographed and have other details collected as per the standard report forms.

All slopes (including pits waste dumps) should be visually assessed at least once per week. Visual assessments of slopes as discussed above will be routinely inspected at each shift by Pit Supervisor, Daily by QM, weekly for Pit Slopes and Monthly for Waste Dumps and Stockpiles by site personnel with geotechnical responsibility and quarterly by specialist geotechnical engineer.

Areas that display or indicate one or more signs of instability (either potential or existing) or considered at higher risk due to the likelihood and/or consequences of a slope failure, should be visually assessed at more frequent intervals, particularly if there is a significant exposure to personnel or equipment.

The size, nature and potential consequences of the instability will dictate the increased frequency of monitoring required. Particular attention must be paid to areas of previously observed instability, and any changes in ground conditions in these areas.

7.1.2 Monitoring

Monitoring of slopes allows for the quantification of slope performance through direct measurement of slope movement using methods such as survey prisms, radar or extensometer, or indirect semi-quantitative measurement using methods such as crack intensity surveys or rock fall debris assessment.

Monitoring at WQS should include findings from the routine inspections as well as routine drone imagery and survey. On a monthly basis the detailed drone imagery would be reviewed, compared to previous and reported by WQS personnel to look for, and document indications of slope distress, such as tension cracks, surface ponding that disappears etc.

The task is the equivalent of ‘berm inspections’ and could be alternated between areas. Documentation should include a file note to relevant monitoring folder on the network indicating the following:

- Area reviewed.
- Any cracks, erosion gullies or other changes observed.
- If cracks, how many in each location and a semi-quantitative description of length and width i.e. width = trace, narrow or wide, length = <10m long, 10-30m, >30m.
- Consideration should be given to surveying or digitising the cracks, for improved future reference.
- Reporting in the monthly report (i.e. 2 parallel narrow cracks observed on 250 mRL berm east wall around XX mE, approximately 10-30m long etc.).

Dependent on risk level more rigorous monitoring methods such as prism or radar maybe deployed to further mitigate the consequence of any instability that may develop. Requirement for these more rigorous monitoring methods will be directed by the Mine Management with specifications provided by the specialist geotechnical engineer.

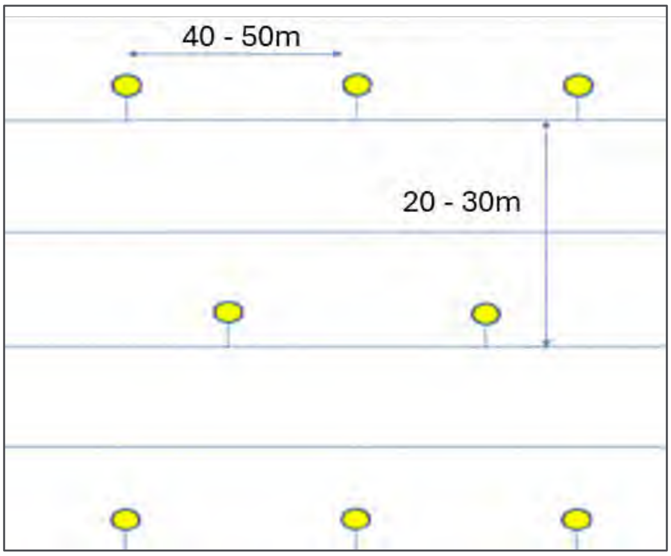
7.1.3 Displacement Monitoring

Prism monitoring should be considered for WQS. Prism monitoring allows precise measurement of the position of survey prisms located on the pit wall slopes. The data is integrated with other monitoring data to assess slope displacement and provides an indication of pit slope stability. Prisms monitoring requires specialist equipment and appropriately skilled personnel to undertake the measurements.

Prism Placement

Ideally, prisms are to be routinely installed at no more than 40 to 50 m spacing's across a single bench and every second to third berm level (20 to 30 m vertically) in a staggered pattern for the upper parts of the slope (refer Figure 7.1).

Figure 7.1: Idealised prism pattern (not to scale).



Prisms are deployed across the entirety of the pit so baseline stability data can be obtained. In areas which show potential for failure, additional prisms are placed to track movements.

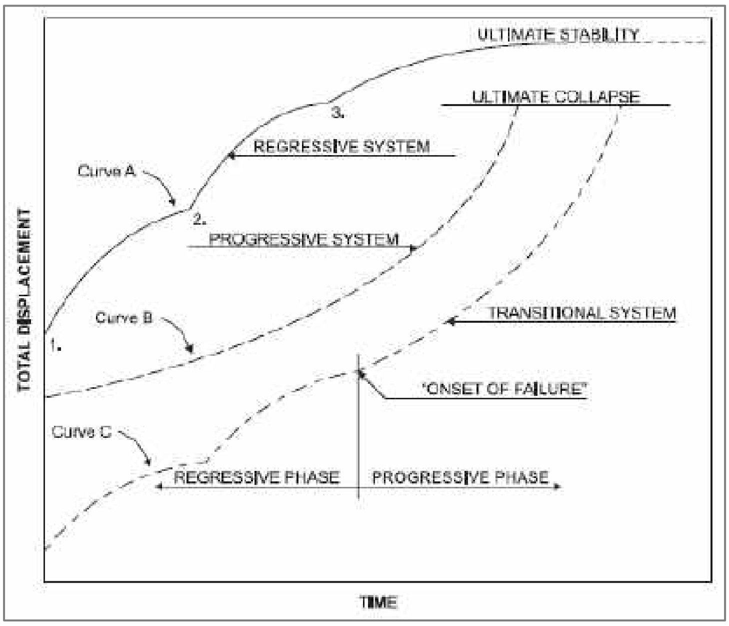
Ideally the prisms are read as soon as practically possible once they have been installed. Monitoring should be undertaken daily for at least the first two weeks and then the frequency adjusted based on movement rates.

Prism Monitoring and Movement Rates

The prism movement trends should initially show relatively rapid movement in response to mining, referred to as relaxation, which then slows down with time as the wall movement settles down. This movement style is known as an as a "regressive" system which trends to stability as opposed to a "progressive" system which continues to accelerate towards failure. These movement trends are as described in the paper on slope stability by Broadbent & Zavodni (1982)[10] (refer Figure 7.2).

[10] Broadbent CD & Zavodni ZM (1982). *Influence of rock structure on stability*. In Stability in Surface Mining, vol. 3. Society of Mining Engineers.

Figure 7.2: Typical regressive/progressive stage displacement curves (after Broadbent & Zavodni1982)



Trigger levels will be calibrated against the prism movements observed at the start of monitoring and set to match monitoring frequency and expected movement rates.

Starting Trigger Levels for prism monitoring and the required associated actions are presented below in Table 7.1. Further refinement of these will occur once mining starts in WQS and a history of movement for the exposed rock masses is recorded.

Table 7.1: Suggested Trigger Levels (assumes daily monitoring)

	Green Level 1 Typical Conditions	Yellow Level 2 Caution	Orange Level 3 Plan for Action	Red Level 4 Slope is likely Failing
Condition of Slope	Long term cracks Minor batter scale failures expected	Existing cracks opening with new cracks forming Multiple batter scale failures in one area possible	Rapid opening of cracks >10mm in a day	Slope is likely failing (multi batter)
Prism Movements Oxide Fresh	 <= 2 mm/day <= 1mm/day	3 days at 2 to 5 mm/day 1 to 2 mm/day	3 days at 5 to 10 mm/day 2 to 5 mm/day	 > 10 mm/day > 5 mm/day
Conditions for downgrading Trigger Level Oxide Fresh		7 days at <= 2 mm/day <= 1mm/day	7 days at 2 to 5 mm/day 1 to 2 mm/day	Slope has failed and material has been stable for minimum of 3 days or 7 days at 5 to 10 mm/day 2 to 5 mm/day
Actions	Normal operating practices Cracks measured Weekly Prisms Monitored 2 x week	Additional controls Cracks measured daily Prisms Monitored daily	Operate under JSA in affected area Cracks measured twice per day Prisms Monitored 2 x day	Exclusion zone around affected area including placement of bund to stop access (no operation)

7.1.4 Mine Stability Radar Monitoring

Mine stability radars ("MSR") are not currently anticipated to be required for WQS, however remain a potential mitigation measure as they can be deployed to an area which has been identified geotechnically as a high risk to mining operations. This high risk can be due to various causes, including:

- previous failures in the area
- displacement being detected from other monitoring systems (e.g. prisms)
- critical areas recognised in the mine and pit design, or
- areas of high risk due to known geological and geotechnical structures.

MSRs allow very precise slope distance measurements or scans to be taken of large areas in a small amount of time. This technology allows real time data to be recorded and analysed within a short time of being deployed.

Alarm thresholds for the MSR are set so that excessive movement (i.e. potential pre-cursor to slope failure) will trigger an alarm, even though this movement may not result in a failure of the pit slope. In this way, the intent is that personnel will have enough time to be safely evacuated from the pit if the alarm turns out to be real.

7.1.5 Groundwater Monitoring

Given the current relatively high levels of water in the existing (old) pit at WQS, groundwater levels behind the pit slopes are likely to be an important consideration in pit slope instability and as such should be incorporated into the WQS monitoring strategy. Notwithstanding, if ground water monitoring is undertaken it remains important that the groundwater surface is drawn down as much as practicable, so that the pit slopes are not saturated.

It is anticipated that sump-pump methods will be sufficient to dewater the pit to the current final design level. Depressurisation, in the form of sub-horizontal drains (weep holes), is a potential mitigation measure in the event significant/excessive flow is observed on the exposed pit batter face.

As mining proceeds below the groundwater table, the groundwater conditions should be reassessed and, where necessary, the mining process should be adjusted accordingly.

SME note that AECOM has undertaken a detailed groundwater assessment of both the requirements and impacts of extracting the water within the current pit lake in WQS and the ongoing dewatering of the rock mass once mining commences. This report was not yet complete at the time of writing.

SME understand that the proposed pit lake dewatering strategy is to pump water from WQS to WQ pit for storage there. This will raise the level in WQ and cause potential flow back to WQS over time as well as raise the groundwater table between the two pits. As such there is potential that the groundwater levels used in stability assessments at the north end of the pit might be lower than what occurs once WQ lake levels are raised. This issue is somewhat mitigated by the favourable geology (thin Oxide zone) at the north end, relatively flat slope designs and the high FoS obtained. However to mitigate further this issue then standpipe monitoring piezometers should be installed between the two pits in several locations (to be recommended by AECOM based on their knowledge of the hydrogeological model etc.). Additionally, consideration should be given to installation of cut-off dewatering bores located along significant structures that might have higher hydraulic conductivities which would allow faster and higher flows between the two pits.

Additionally, the stability of the southern slopes of the pit, where there is a thick sequence of weathered (Oxide) materials, are highly susceptible to groundwater levels behind the pit walls and as such groundwater level monitoring should also occur in this area.

Short horizontal drains ('weep holes') from about 30 m to 50 m long should be implemented in the lower saprolite (oxide) and transitional zones to help promote drainage and reduce the groundwater levels / pressure behind the pit walls as was completed in Stage 2. Note that inflows are expected to be high at the north end due to the potential connection with the Western Queen pit and at the southern end as the deeper Cover and Oxide may represent a palaeochannel to the south of the pit.

With this in mind, SME recommends that approximately 10 standpipe piezometers be installed around the perimeter of the pit (four at north, four at south and one each east and west). These piezometers should be targeted at the main aquifer zone (nominally through the transition zone i.e. base of oxide to top of fresh) with recommendations provided by AECOM on their knowledge of the hydrogeological model etc.

7.1.6 Collection of ground quality data

Collection of ground quality (aka geotechnical) data involves the collection or geology, structure, groundwater and engineering properties of the ground prior to mining to allow development of a ground model. This model's accuracy is dependent on the quantity/ spacing and quality of the data relative to the complexity of ground conditions. Once mining commences and key aspect of understanding slope performance is reconciling the model against actual conditions observed.

The ground model is based on the geological setting (i.e. distribution of rock types and weathering) and includes major structures (i.e. faults) which may result in changes in conditions as well as minor structures (i.e. joints) along with strength and degree of fracturing which define the key aspects of rock mass characteristics for each rock type.

7.1.7 Data Collection and Management

Collection of ground quality or geotechnical data and slope reconciliation is an integral part of the overall geotechnical risk assessment and management process. Ongoing face, floor and blast hole mapping will be carried out by the Senior Geologist, with existing maps being updated on a regular basis with the new mapping data.

The geotechnical data collection process aims to provide comparison of all major input parameters utilised in slope design studies. Any significant difference between observed and accepted design parameters should be highlighted and if significant, should instigate a reassessment of the design.

Data required for the management of ground control during open pit mining is collected using a number of methods and at different times either routine or in campaigns. These may include:

- Geotechnical, structural and geological mapping of rock and soil exposures.
- Geotechnical logging and sampling of diamond drill core.
- Bulk material sampling and testing.
- Digital terrestrial photogrammetry / Drone imagery and survey.
- Monitoring, which includes:
    - Visual assessments, photography.
    - Aerial drone photography and survey.
    - Measurement of slope displacement using monitoring instrumentation.
    - Measurement of groundwater levels, flow rates and pore pressures.

- Formal recording and reporting of slope instability, slope failures and rock falls.
- Slope design (i.e. as built toe and crest positions vs design).
- Slope performance (i.e. slope monitoring, where relevant).

Mapping activities must comply with geotechnical standard work practice for working near batters as per the standard procedure for working on or near pit walls.

Data collection prior to excavation is required to build geological and geotechnical databases, to undertake interpretations and construct models. The data is used in stability analyses for the design of pit slopes. Collected data is also used in the selection and verification of mining methods and sequences, blasting techniques and monitoring requirements.

During excavation, data collection is required to record and map exposed geological structure in pit walls and slopes, to establish or confirm material properties, and to monitor slope performance. This data is then used to identify existing and developing ground hazards, and to communicate any slope stability changes to mine personnel.

Data collected is also validated and reconciled against previously collected data, which enables review of slope designs and other ground control processes such as monitoring, dewatering and blasting, and modification where necessary.

7.1.8 Geotechnical Data

Suitable electronic and hard copy filing systems are essential for the effective storage, management and subsequent manipulation of geotechnical data.

The following data should is to be maintained on site:

- Records/reports of site (e.g. walkover) visual assessments
- Reports on slope failures, rockfalls, slope instability and monitoring failures
- Geological drilling logs and core photographs
- Mapping data (where collected by site personnel), logs, and associated analyses
- Drillhole databases (for all geological and geotechnical drilling)
- Geological interpretations and resource models
- Records of any other analyses undertaken by site personnel
- Reports associated with the above, and
- All specialist geotechnical engineer reports prepared for the operation

7.1.9 Geological Mapping

SME suggests that as part of the routine geological function at WQS, that ongoing geological mapping is undertaken, recording (preferably on a bench by bench basis) observations of major structures and rock types intersecting the pit walls and floor (i.e. basic geological and structural mapping).

No geotechnical mapping should be undertaken without associated geological mapping being completed, as geotechnical models are implicitly linked to geological models. As a minimum, geotechnical mapping should only be undertaken after preliminary geological mapping has been completed. Structural mapping data is fundamental to geotechnical analysis, so geotechnical mapping is to be performed as an adjunct to the geological mapping program for the open pits, with the mapping often best conducted simultaneously, depending on available resources.

Where possible/evident, units exposed in the final pit walls should be geologically mapped as mining progresses. Mapping should identify geological contacts, and any significant changes in material properties within each unit. All mapping points should be surveyed such that the information can be digitised for ongoing design reviews.

Geological mapping is the responsibility of the Senior Geologist, with periodic support and review to be undertaken by the geotechnical engineering specialist.

7.1.10 Geotechnical Mapping

Geotechnical mapping (including basic geological and structural mapping) is required to be routinely undertaken during pit excavation at the operation to identify, delineate and record:

- Geological contacts
- Significant variations (e.g. in strength, structure, stability, weathering and erosion) within each geological unit, and
- Record sufficient data to identify typical characteristics, orientation, spacing and continuity of discontinuities, and to identify and record significant spatial changes to those parameters.

Geotechnical mapping data is principally required as a basis for review of pit slope designs, i.e. confirmation of the structural model used in determining pit slope design criteria. Mapping is also a fundamental tool for identifying the mechanisms, scale and likelihood of potential slope failures. Geotechnical mapping should be completed on a routing basis as spelt out in the GCMP.

7.1.11 Digital Terrestrial or Aerial (drone) Photogrammetry

Regular Drone imagery will be undertaken at WQS as part of the standard as-built survey of the open pit operations. SME understands that this is likely to involve weekly drone imagery/surveys producing updated as-built plans of open pit as well as a compiled detailed aerial images. This data provides both a visual record as well as giving the ability to review any changes in conditions that may have arisen over time.

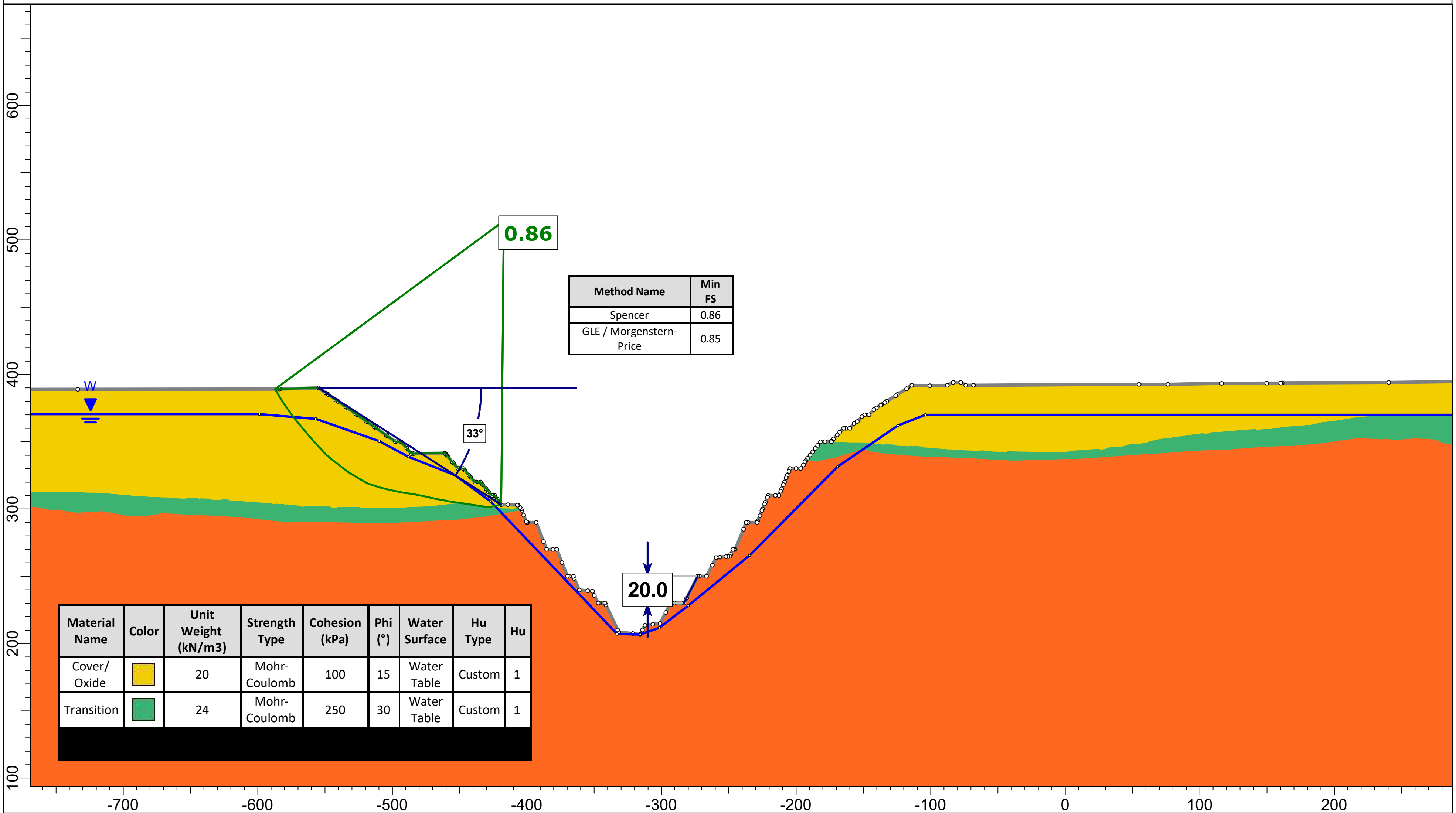
Given the nature of the rock mass, and relatively low assessed risks, terrestrial photogrammetry is not currently anticipated to be required for the WQS. However, it remains an invaluable method of providing high-level mapping coverage and should be considered in the event of slope failure or identification of undue/unexpected structures.

7.1.12 Ground Control Management Plan

Prior to the commencement of Mining a Ground Control Management Plan in line with Western Australia Dept. of Mining, Energy, Resources, Industry and Regulation guidelines should be developed for WQS (or incorporated into existing) which includes; operational controls such as inspections and slope monitoring, a Trigger Action Response Plan and responsibilities against these and requirements of the GCMP.

Appendix A: Stability Analysis Results

Section SW, Preliminary Design, MC Parameters



Method Name	Min FS
Spencer	0.86
GLE / Morgenstern-Price	0.85

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15	Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30	Water Table	Custom	1

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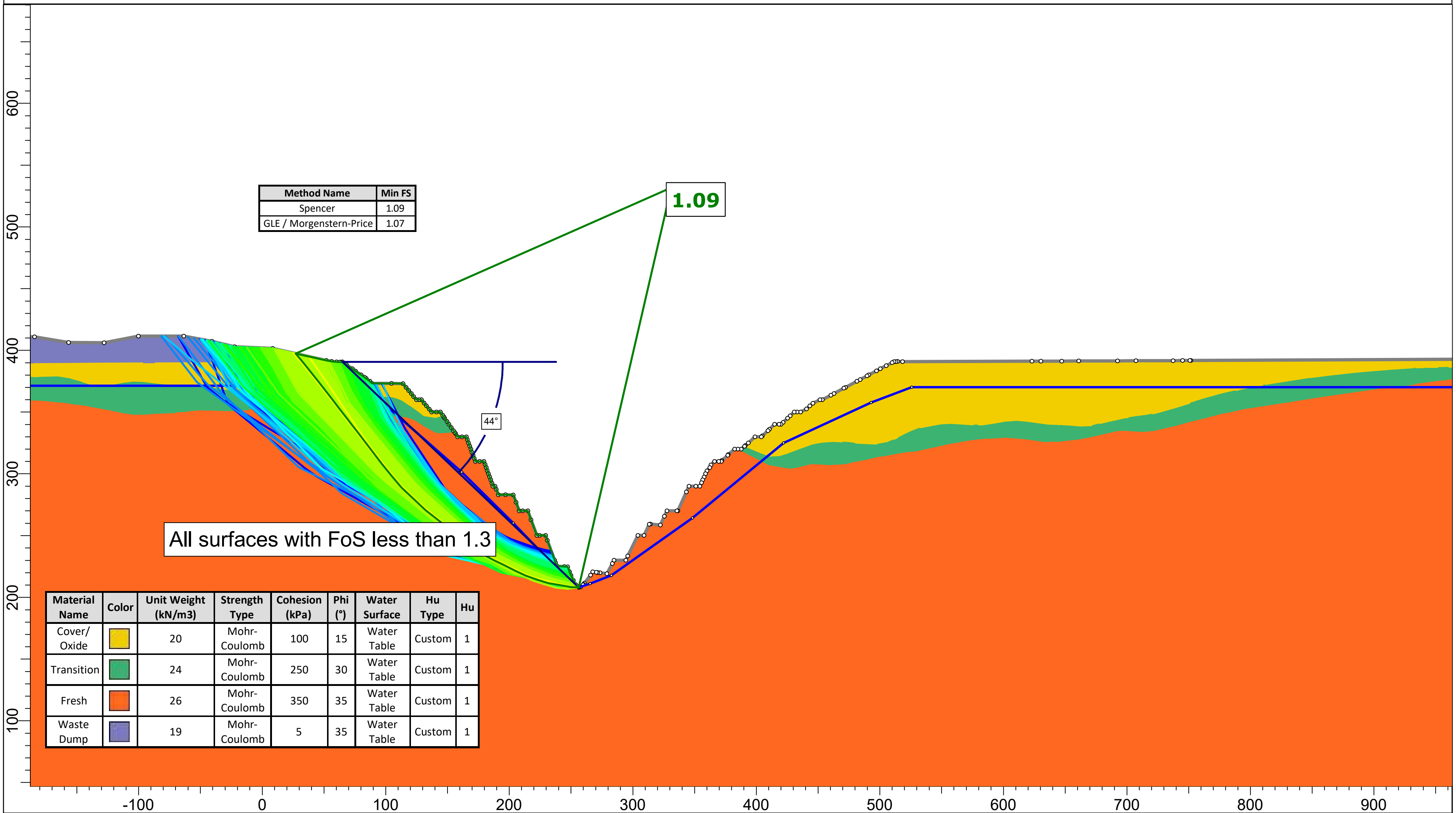
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_SW_A.slmd

Section NW, Preliminary Design, MC Parameters



Method Name	Min FS
Spencer	1.09
GLE / Morgenstern-Price	1.07

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15	Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30	Water Table	Custom	1
Fresh		26	Mohr-Coulomb	350	35	Water Table	Custom	1
Waste Dump		19	Mohr-Coulomb	5	35	Water Table	Custom	1

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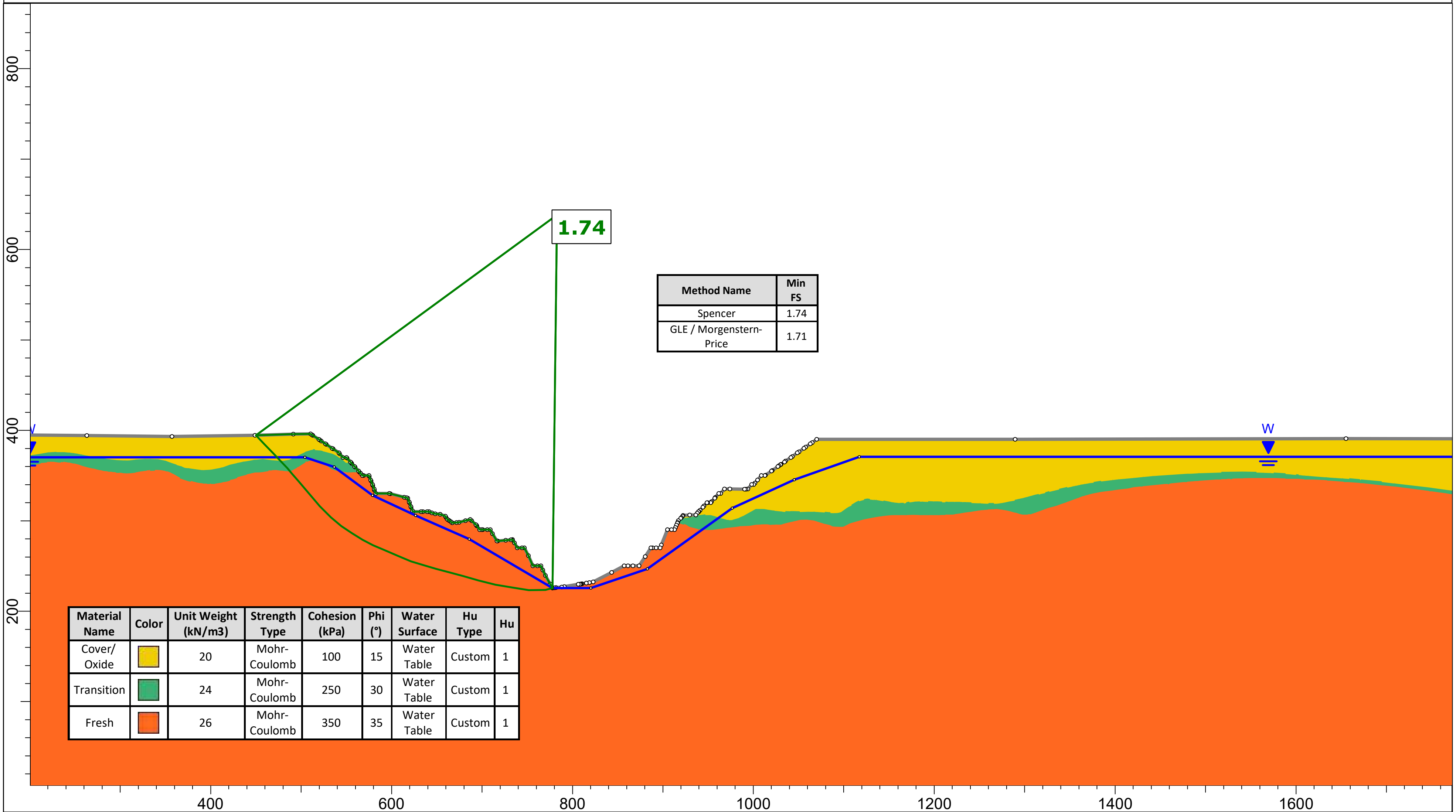
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_NW_A.slmd

Section N, Preliminary Design, MC Parameters



Method Name	Min FS
Spencer	1.74
GLE / Morgenstern-Price	1.71

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15	Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30	Water Table	Custom	1
Fresh		26	Mohr-Coulomb	350	35	Water Table	Custom	1

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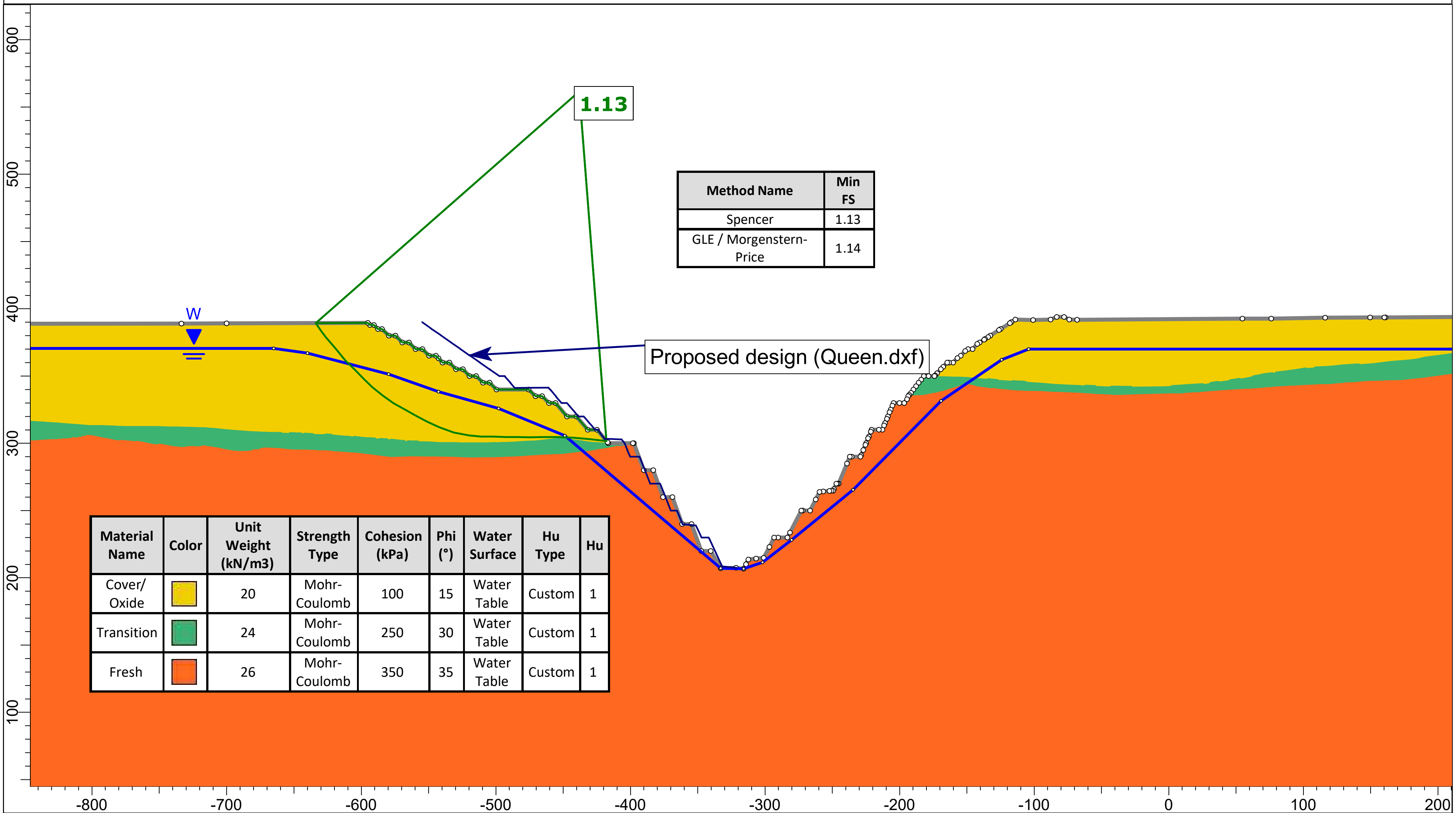
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_N_B.slmd

Section SW, Proposed Slope Design, MC Parameters



Method Name	Min FS
Spencer	1.13
GLE / Morgenstern-Price	1.14

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15	Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30	Water Table	Custom	1
Fresh		26	Mohr-Coulomb	350	35	Water Table	Custom	1

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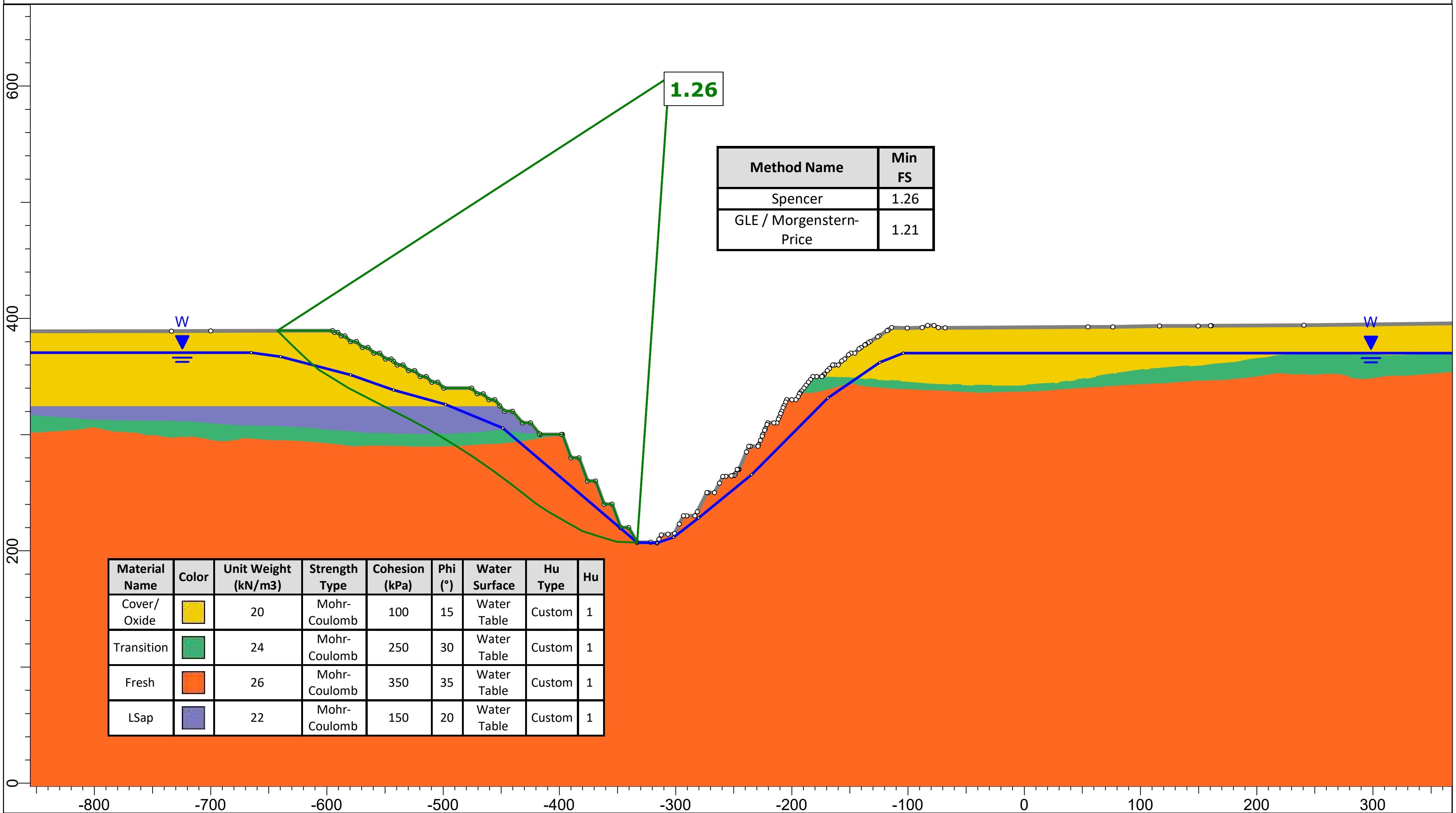
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment
Group	Limit Equilibrium Analyses
Scenario	Master Scenario
Drawn By	WAS
Company	SME Geotechnical
Date	May 2025
File Name	Sect_SW_A_NewParameters3.slmd

Section SW, Proposed Slope Design, MC Parameters with LSap



Method Name	Min FS
Spencer	1.26
GLE / Morgenstern-Price	1.21

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Water Surface	Hu Type	Hu
Cover/ Oxide	(yellow)	20	Mohr-Coulomb	100	15	Water Table	Custom	1
Transition	(green)	24	Mohr-Coulomb	250	30	Water Table	Custom	1
Fresh	(orange)	26	Mohr-Coulomb	350	35	Water Table	Custom	1
LSap	(purple)	22	Mohr-Coulomb	150	20	Water Table	Custom	1

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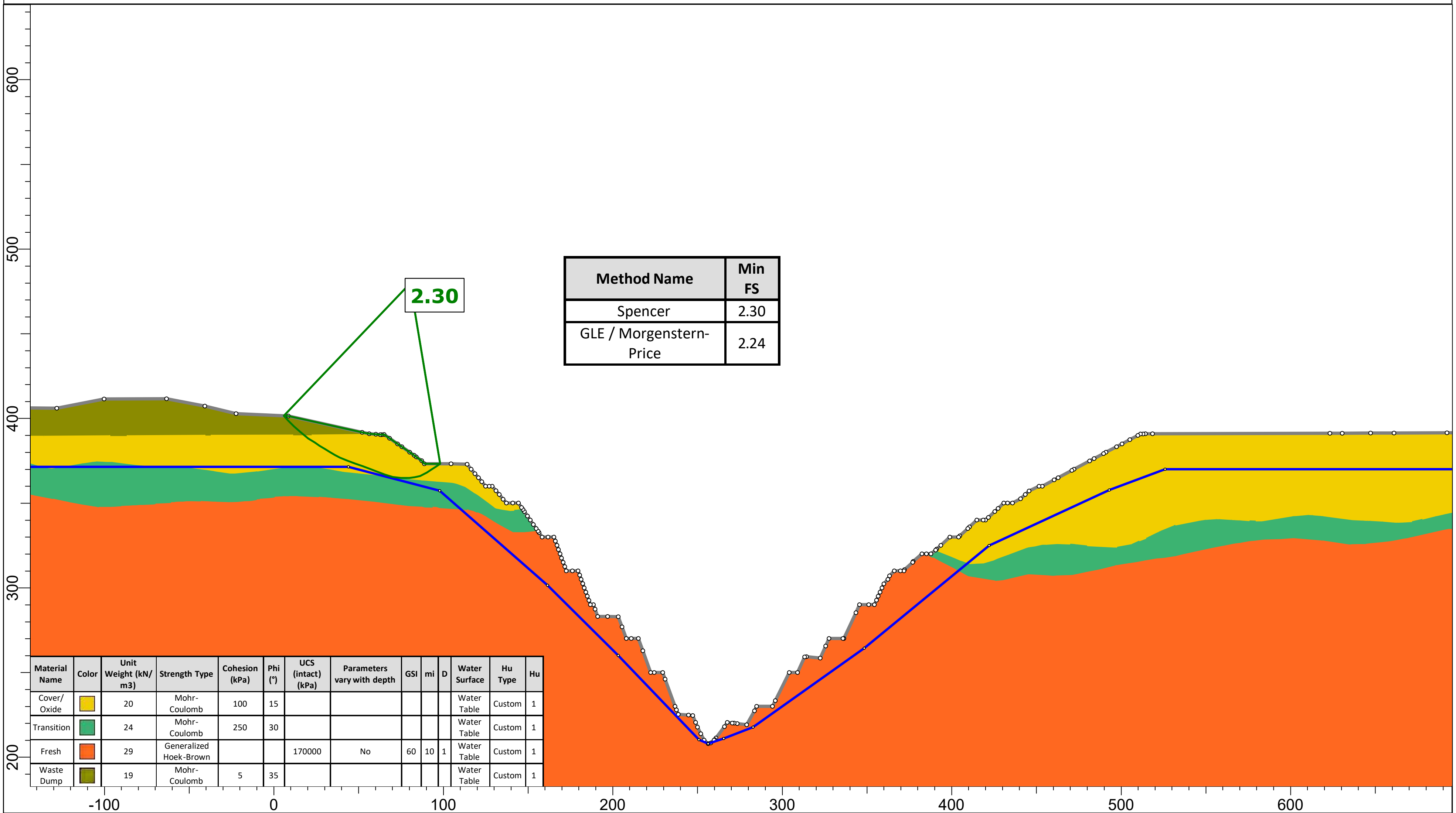
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_SW_A_NewParameters3_Lsap.slmd

Section NW, Preliminary Design, GHB with Dump



Method Name	Min FS
Spencer	2.30
GLE / Morgenstern-Price	2.24

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh		29	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1
Waste Dump		19	Mohr-Coulomb	5	35						Water Table	Custom	1

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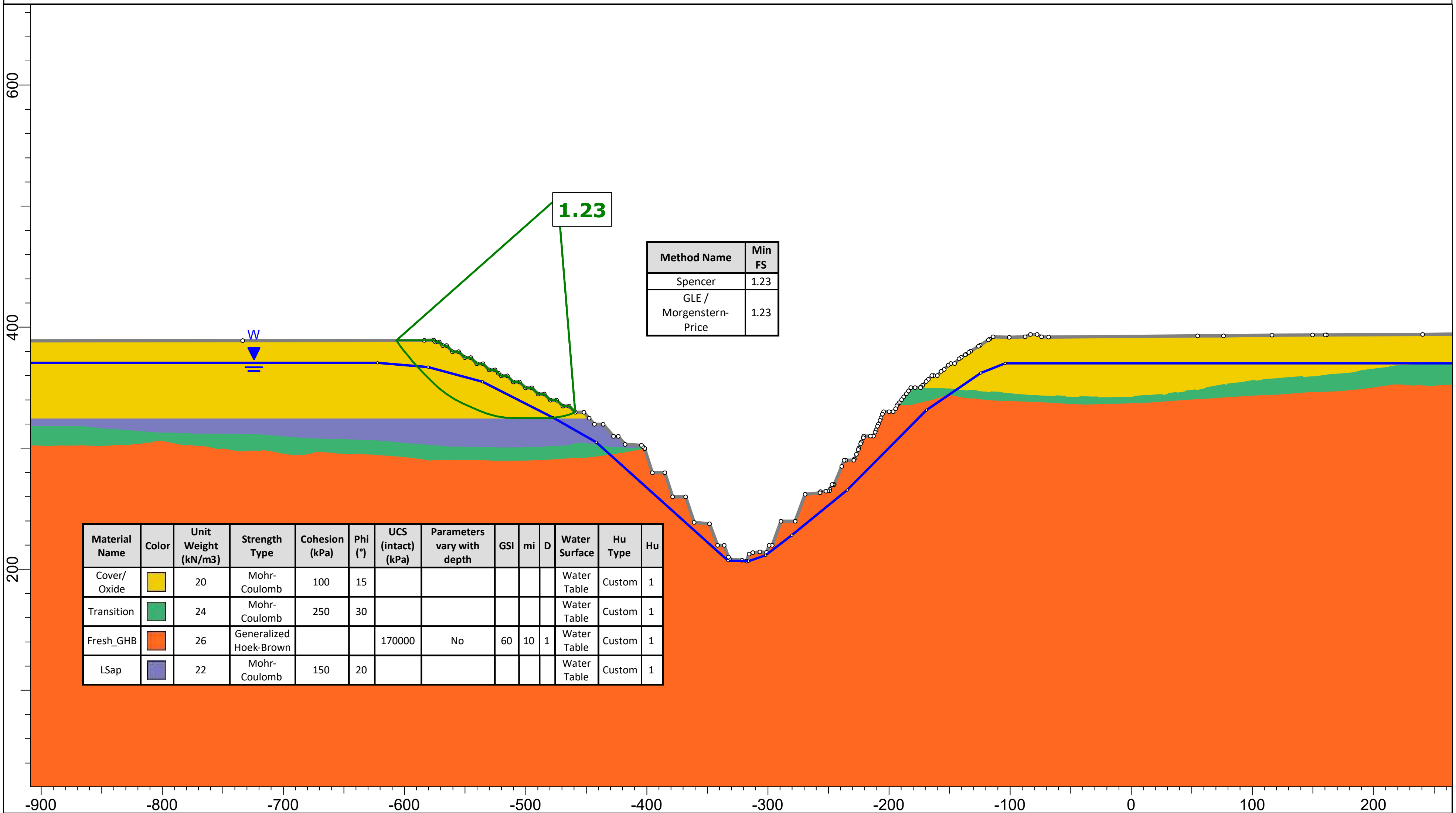
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment
Group	Limit Equilibrium Analyses
Scenario	Master Scenario
Drawn By	WAS
Company	SME Geotechnical
Date	May 2025
File Name	Sect_NW_A_GHB.slmd

Section SW, Updated Design, MC + GHB + LSap



Method Name	Min FS
Spencer	1.23
GLE / Morgenstern-Price	1.23

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh_GHB		26	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1
LSap		22	Mohr-Coulomb	150	20						Water Table	Custom	1

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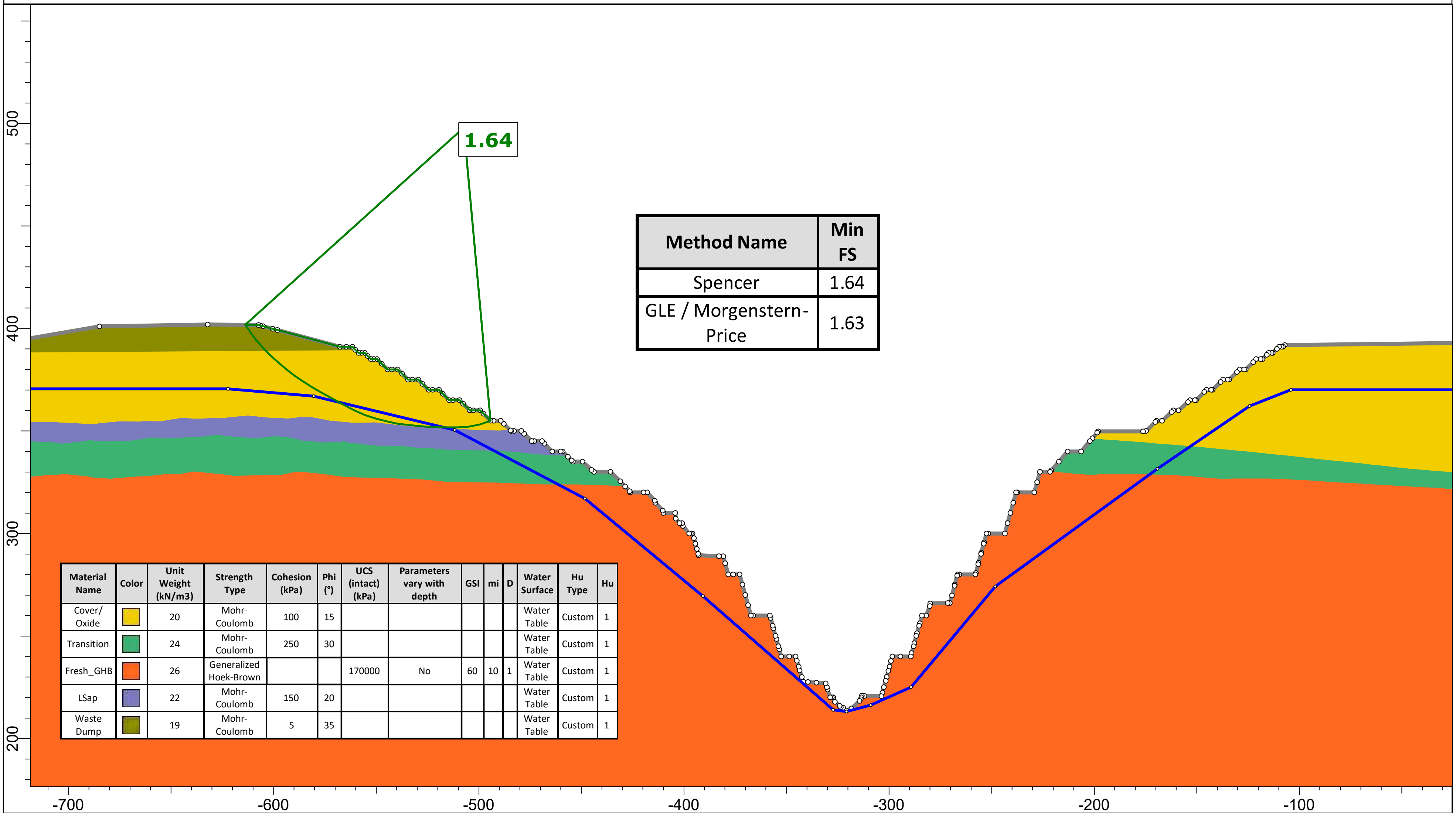
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment
Group	Limit Equilibrium Analyses
Scenario	Master Scenario
Drawn By	WAS
Company	SME Geotechnical
Date	May 2025
File Name	Sect_SW_NewA_LSap.slmd

Section W, Updated Design, MC + GHB + LSap and Dump



Method Name	Min FS
Spencer	1.64
GLE / Morgenstern-Price	1.63

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh_GHB		26	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1
LSap		22	Mohr-Coulomb	150	20						Water Table	Custom	1
Waste Dump		19	Mohr-Coulomb	5	35						Water Table	Custom	1

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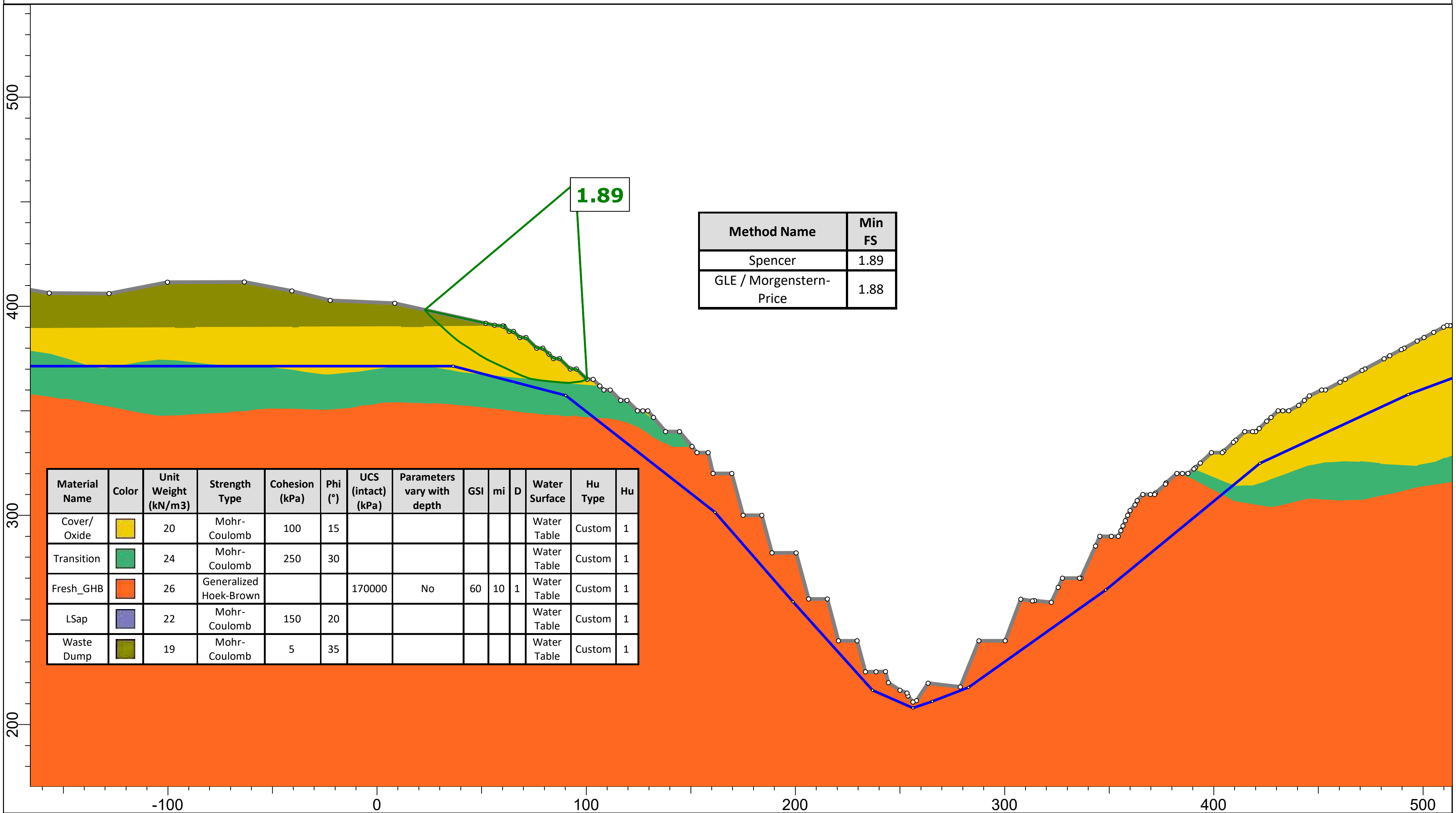
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_W_NewA_LSap_GHB.slmd

Section NW, Updated Design, MC + GHB + LSap and Dump



Method Name	Min FS
Spencer	1.89
GLE / Morgenstern-Price	1.88

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh_GHB		26	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1
LSap		22	Mohr-Coulomb	150	20						Water Table	Custom	1
Waste Dump		19	Mohr-Coulomb	5	35						Water Table	Custom	1

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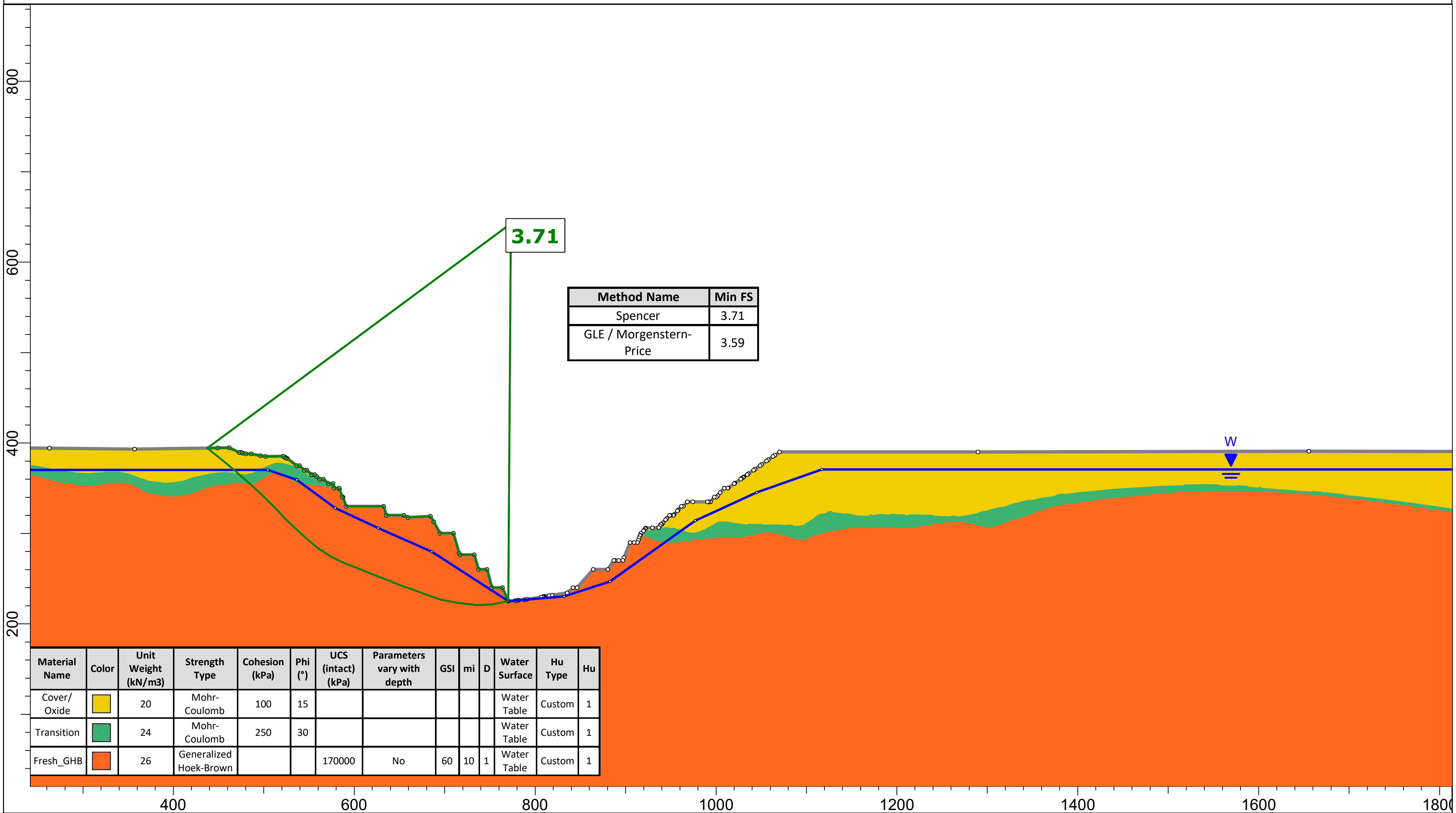
SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_NW_NewA_LSap_GHB.slmd

Section N, Updated Design, MC + GHB + LSap



Method Name	Min FS
Spencer	3.71
GLE / Morgenstern-Price	3.59

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu
Cover/ Oxide		20	Mohr-Coulomb	100	15						Water Table	Custom	1
Transition		24	Mohr-Coulomb	250	30						Water Table	Custom	1
Fresh_GHB		26	Generalized Hoek-Brown			170000	No	60	10	1	Water Table	Custom	1

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SLIDEINTERPRET 9.037

Project	Western Queen South Slope Stability Assessment		
Group	Limit Equilibrium Analyses	*Scenario*	Master Scenario
Drawn By	WAS	*Company*	SME Geotechnical
Date	May 2025	*File Name*	Sect_N_NewA_LSap_GHB.slmd