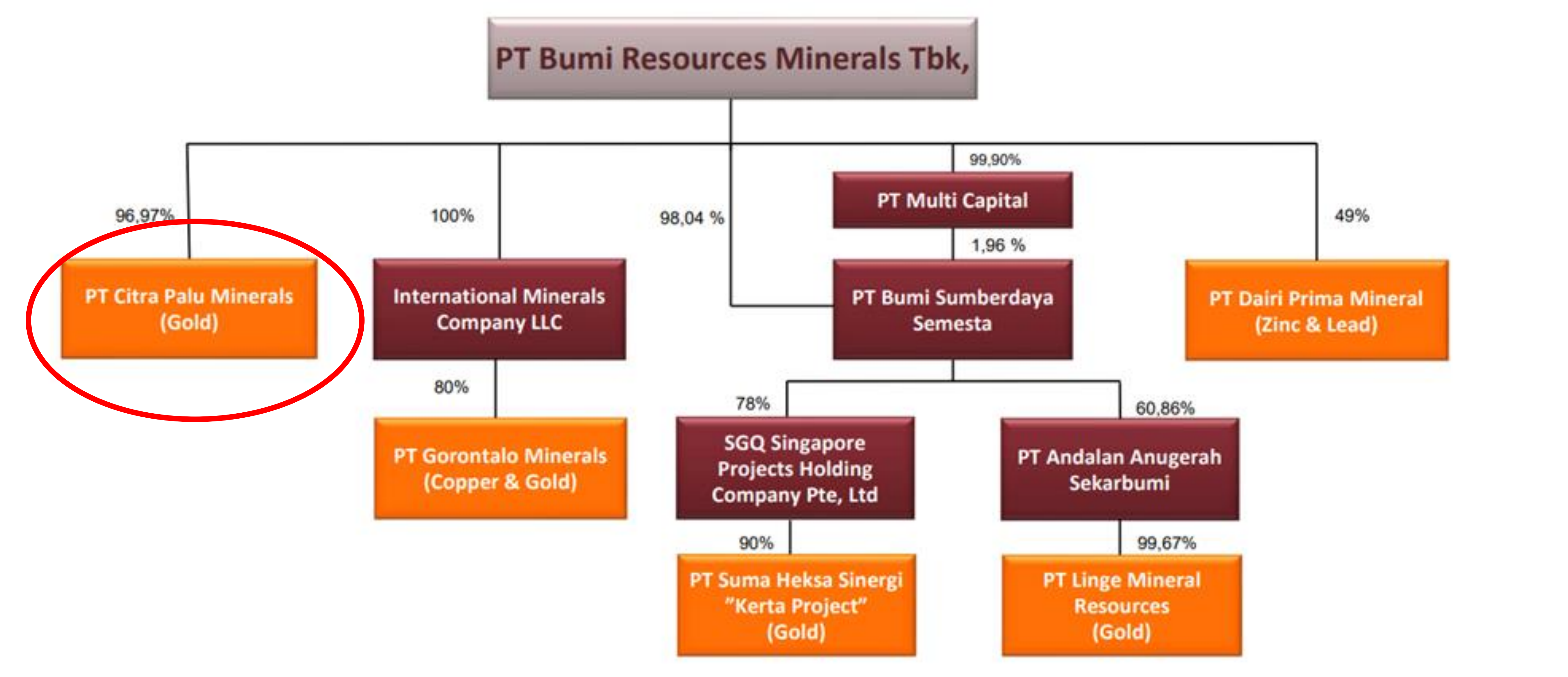
MINEGEOTECH

MAXIMISING VALUE THROUGH INNOVATION

VERIFICATION OF INITIAL DEVELOPMENT DESIGN AND NUMERICAL MODEL, POBOYA RIVER REEF, INDONESIA

INTRODUCTION



BLOK 1 - POBOYA (MINERAL RESOURCES / SUMBERDAYA MINERAL)						
Prospect	Classification	Tonase	Grade		Metal Content	
		Mton	Au (g/t)	Ag (g/t)	Au (Oz)	Ag (Oz)
RIVER REEF Vein - Open Pit	Indicated	6.8	2.0	6.2	431,000	1,363,000
	Inferred	0.0	4.1	16.1	1,000	3,000
	Sub Total	6.8	2.0	6.2	431,000	1,366,000
RIVER REEF Vein - Underground	Indicated	18.7	5.8	12.8	3,514,000	7,684,000
	Inferred	0.9	8.7	12.5	259,000	372,000
	Sub Total	19.6	6.0	12.8	3,774,000	8,057,000
Total Indicated		25.5	4.8	11.0	3,945,000	9,407,000
Total Inferred		0.9	8.7	12.5	260,000	375,000
Total River Reef		**26.4**	**4.9**	**11.1**	**4,205,000**	**9,422,000**

PT Bumi Resources Tbk is one of the largest mining companies in Indonesia and is structured as a holding company.

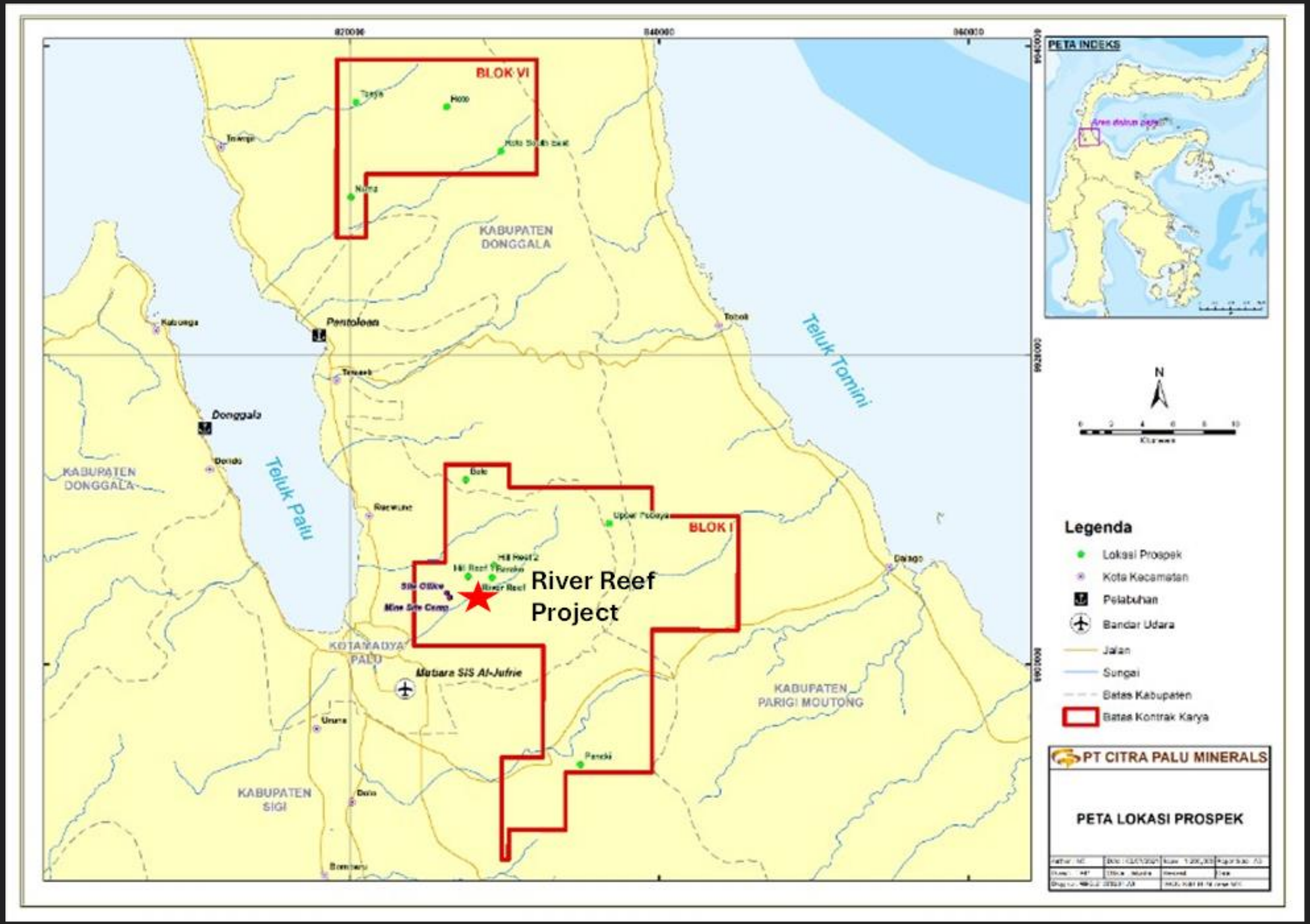
PT Citra Palu Minerals

CPM's contract area consists of 5 separate blocks, of which the Poboya gold prospects is the most promising.

River Reef underground has indicated and inferred resoursces of 8Moz.

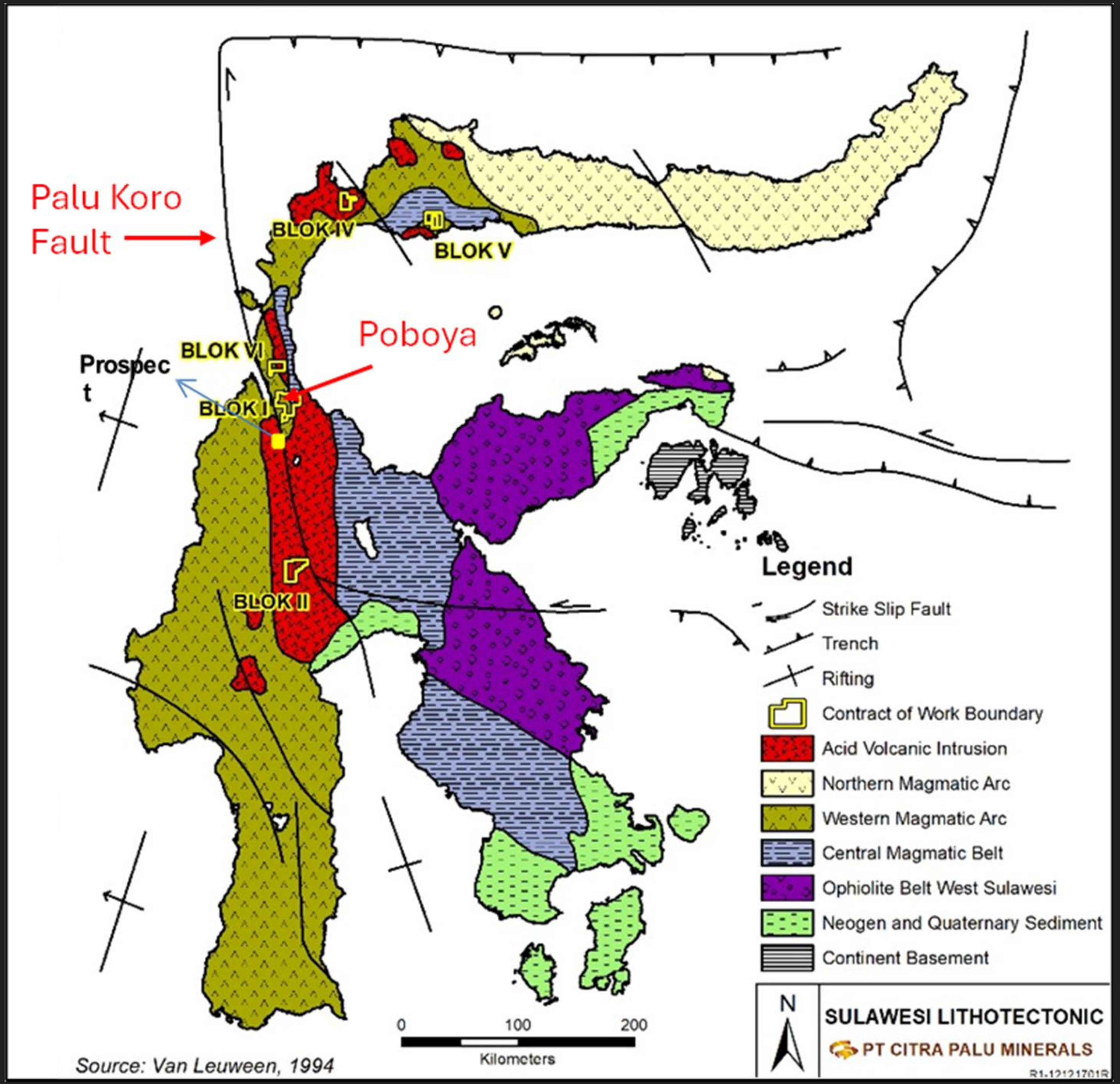
MGT Involved from early 2024 to undertake Prefeasibility Geotechnical Assessment

LOCATION



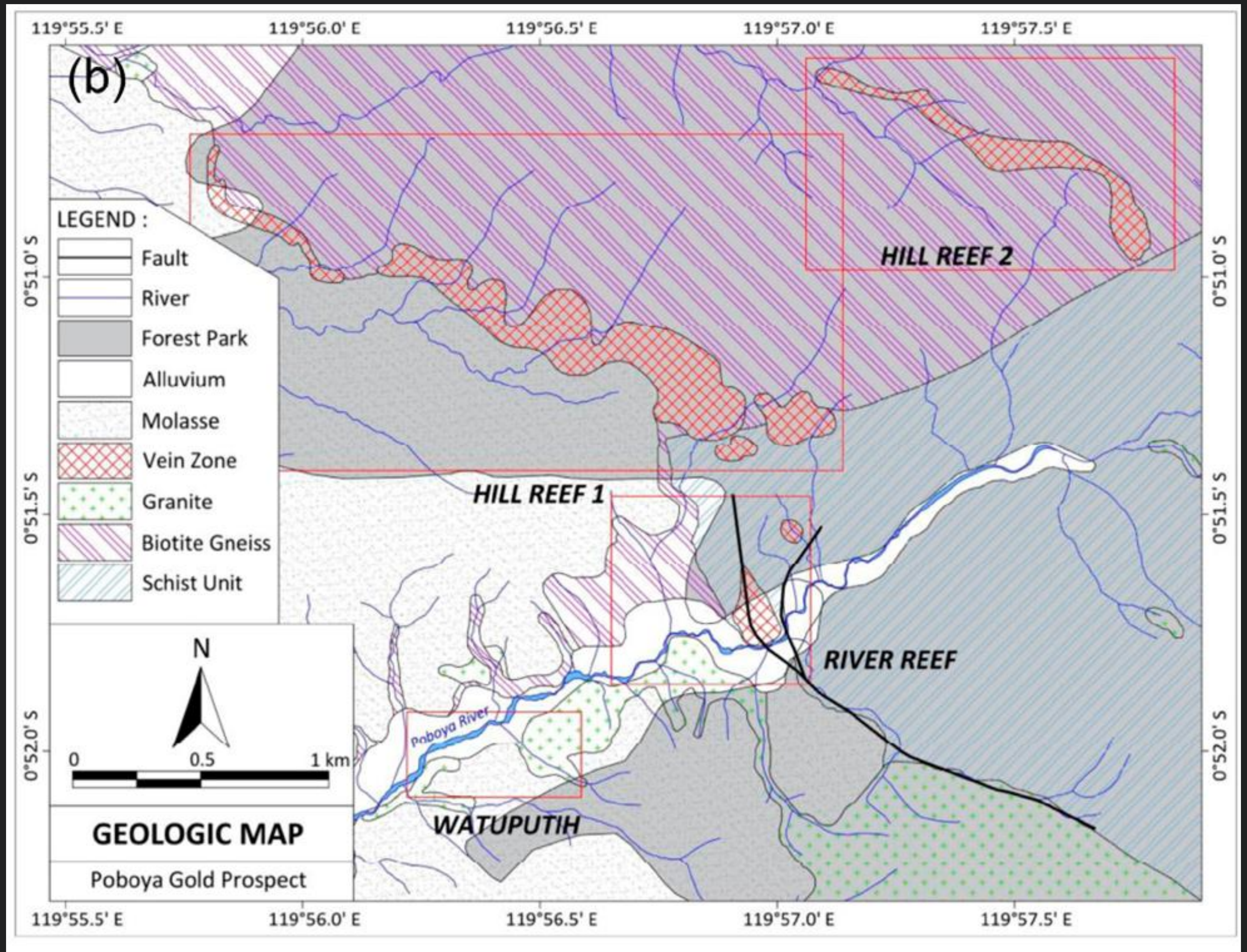
- The Poboya mining operation is located in the Mantikulore District, Palu Municipality, Central Sulawesi, approximately 7km northeast of Palu City, Central Sulawesi
- Topography is steep and dominated by the Poboya River valley on the southern side of the operation
- 720mm rainfall/year (60mm average monthly)
- 23° to 39° average daily temperatures

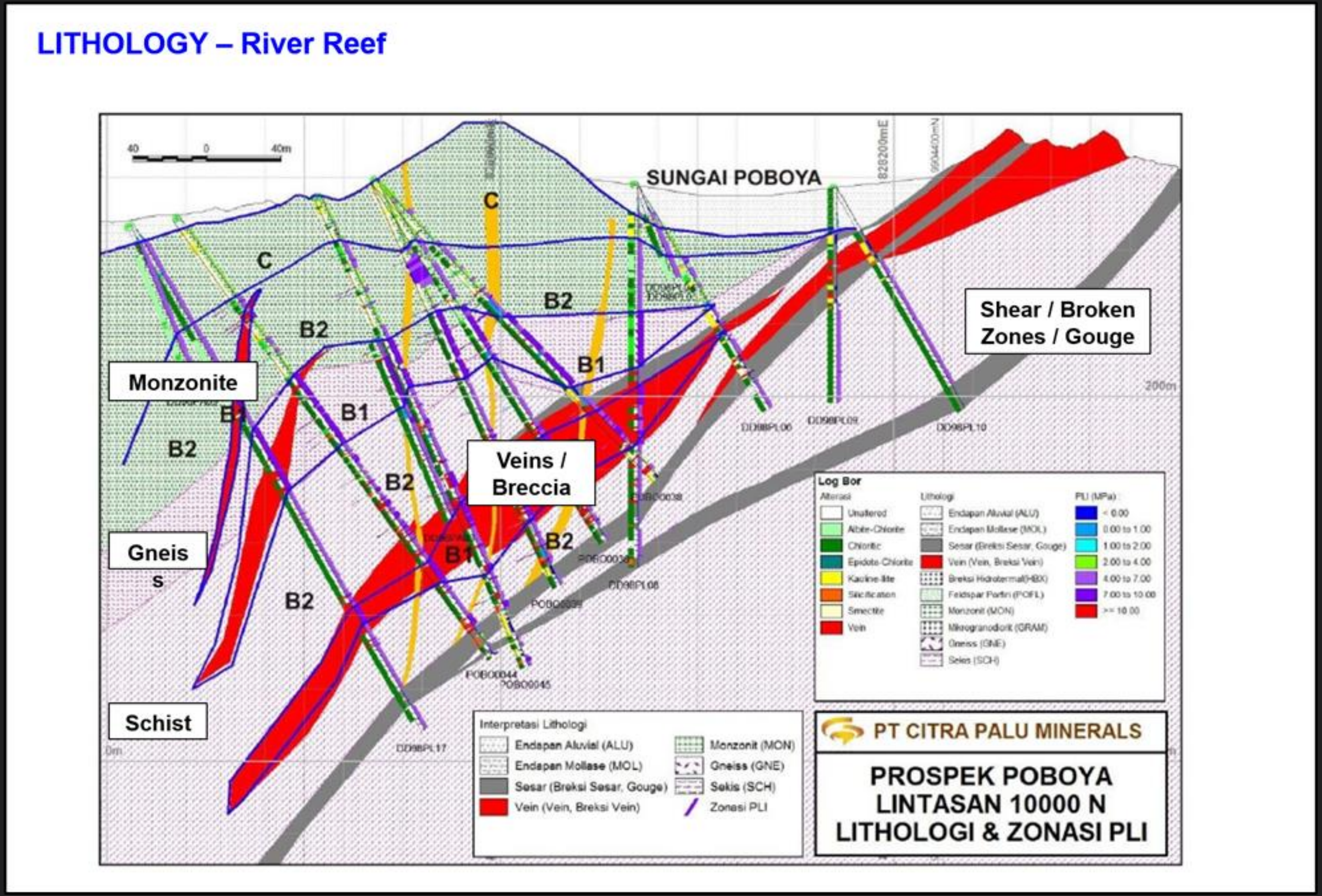
REGIONAL GEOLOGICAL SETTING



- Sulawesi primarily consists of several Tertiary arc-trough systems (1.8–65 Mya) generated by the complex interactions of the Southeast Asian, Pacific, and Indo-Australian plates
- With the opening of the Makasar Strait; folding and thrusting took place probably in the Late Oligocene to Early Miocene, resulting in greenschist metamorphism
- "Transtensional" movements during the Quaternary up to the present have caused the opening of basins resulting from traction such as the Palu Depression. The earthquakes that have occurred to date along the Palu - Koro fault show that the system is still active today.
- 7.5Mw 28/09/18 – Tsunami in Palu Bay

LOCAL GEOLOGICAL SETTING

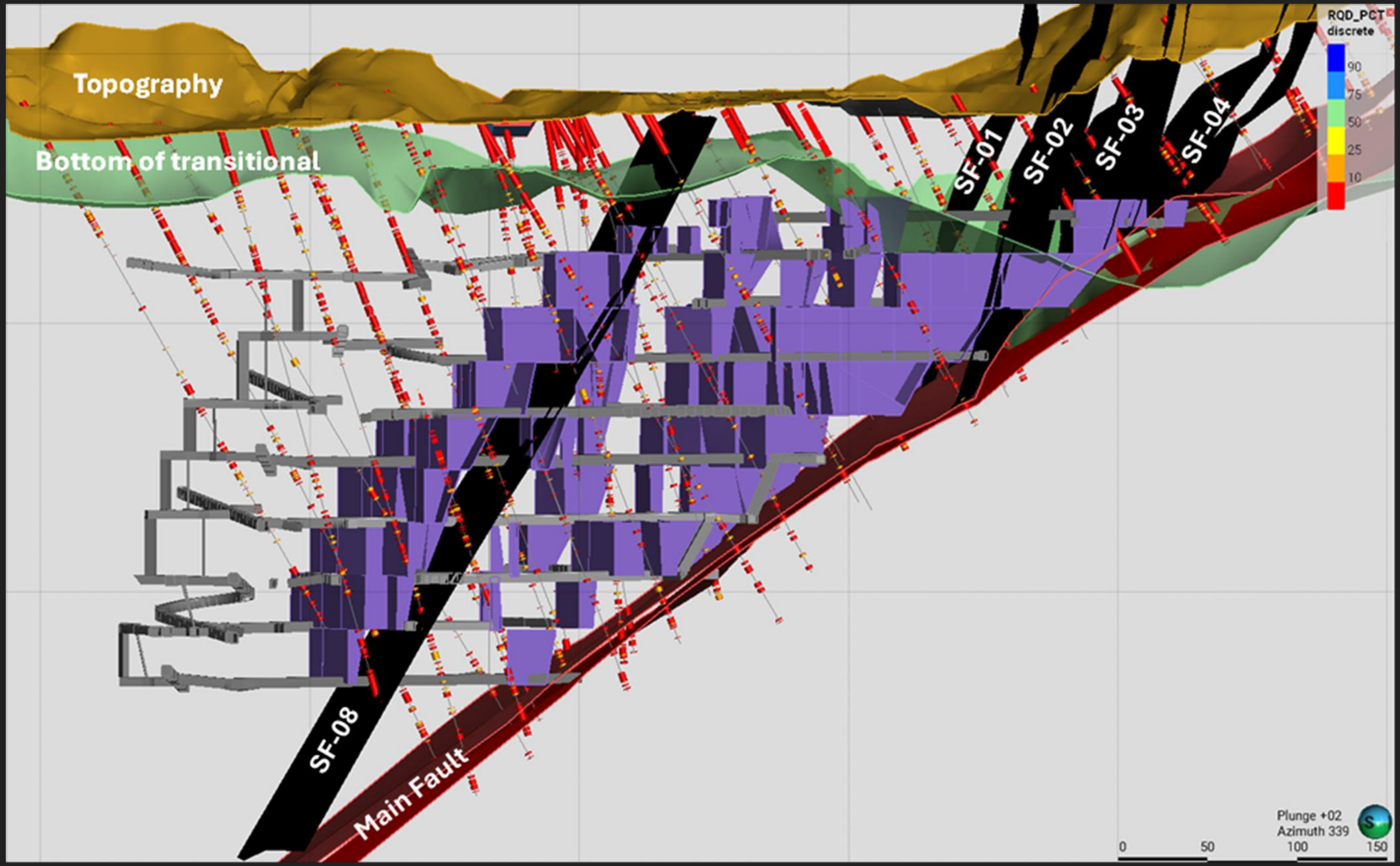




- Surface cover of alluvium in the valley
- Weathered oxidised Monzonite

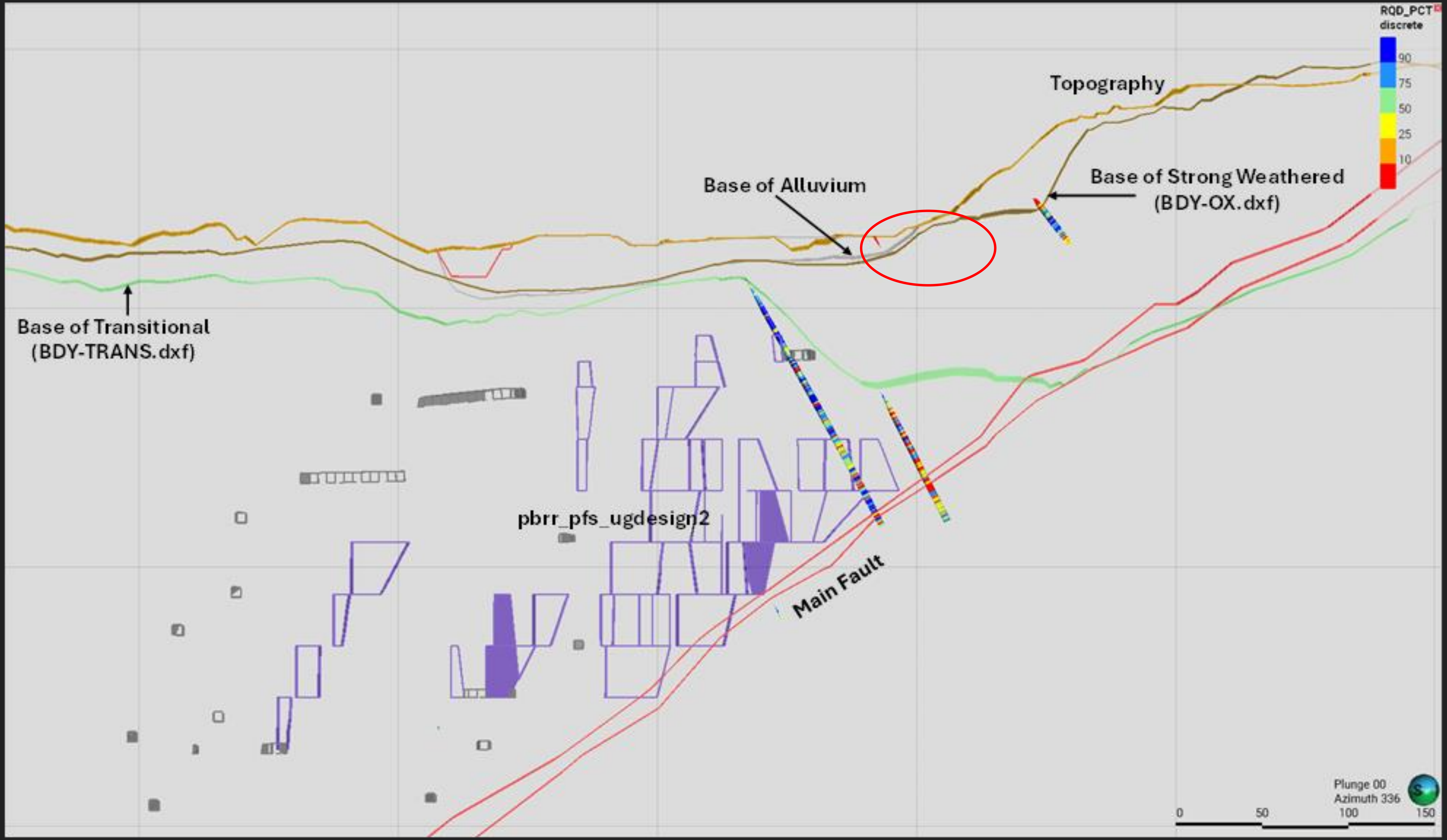
- Underground, Monzonite, Gneiss, Schist, Veins & Hydrothermal Breccia
- Alteration of Smectite, Albite-Chlorite and Epidote-Chlorite

MINING APPROACH



- Mineralisation in a series of steeply dipping splays and vein systems above a basal (Main) fault.
- Underground mining is proposed for long hole open stoping and paste backfill,
- Either longitudinal or transverse retreat.

ROCK MASS DOMAINS – PORTAL & DECLINE



- Strongly Weathered Domain - Boxcut
- Transitional Domain – Portal Face and Initial Decline Development

BOXCUT STABILITY

STRONGLY WEATHERED DOMAIN

Core photos from the Strong Weathered Domain (a) alluvial material (b) strongly weathered rock

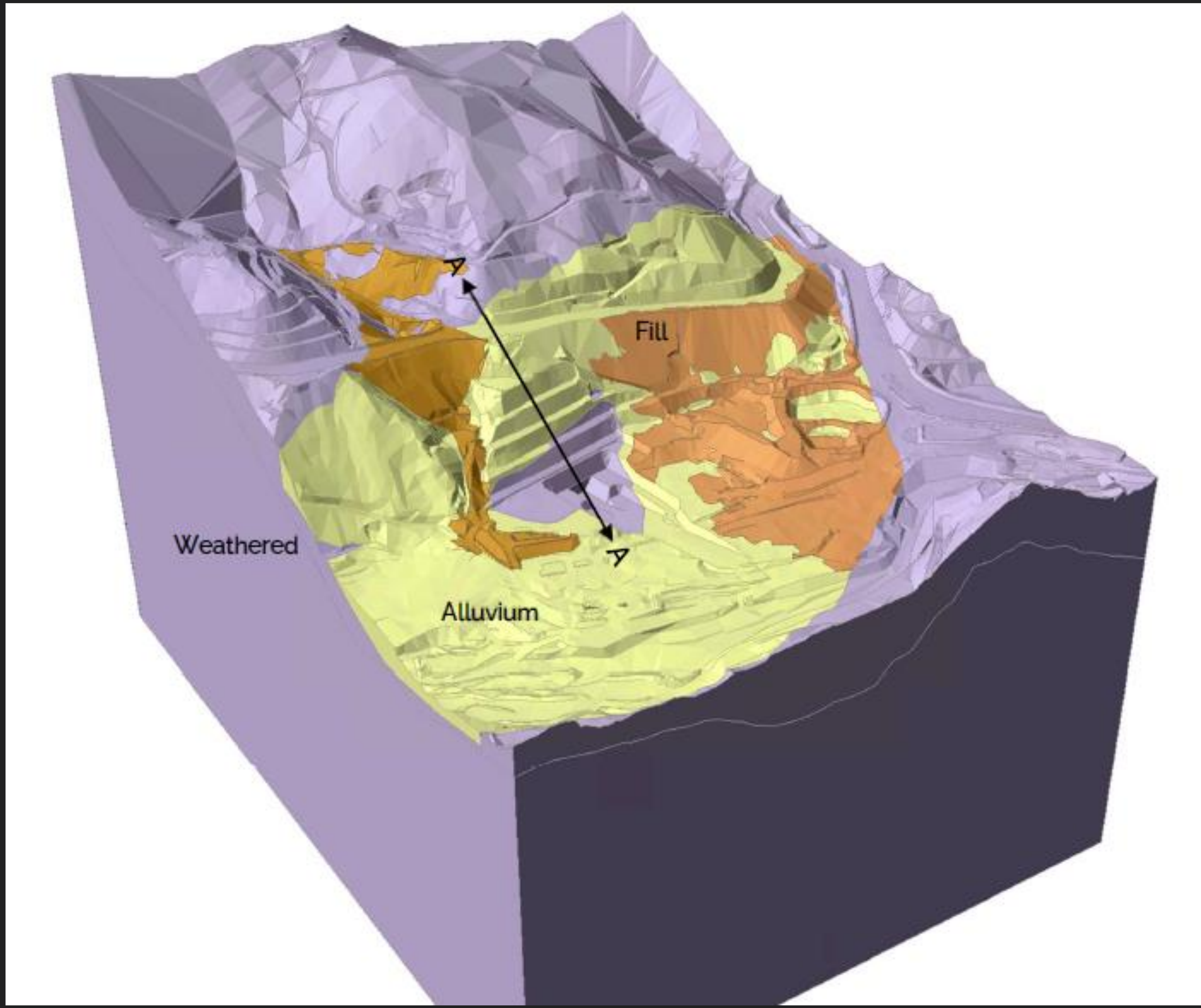
Strongly Weathered Domain

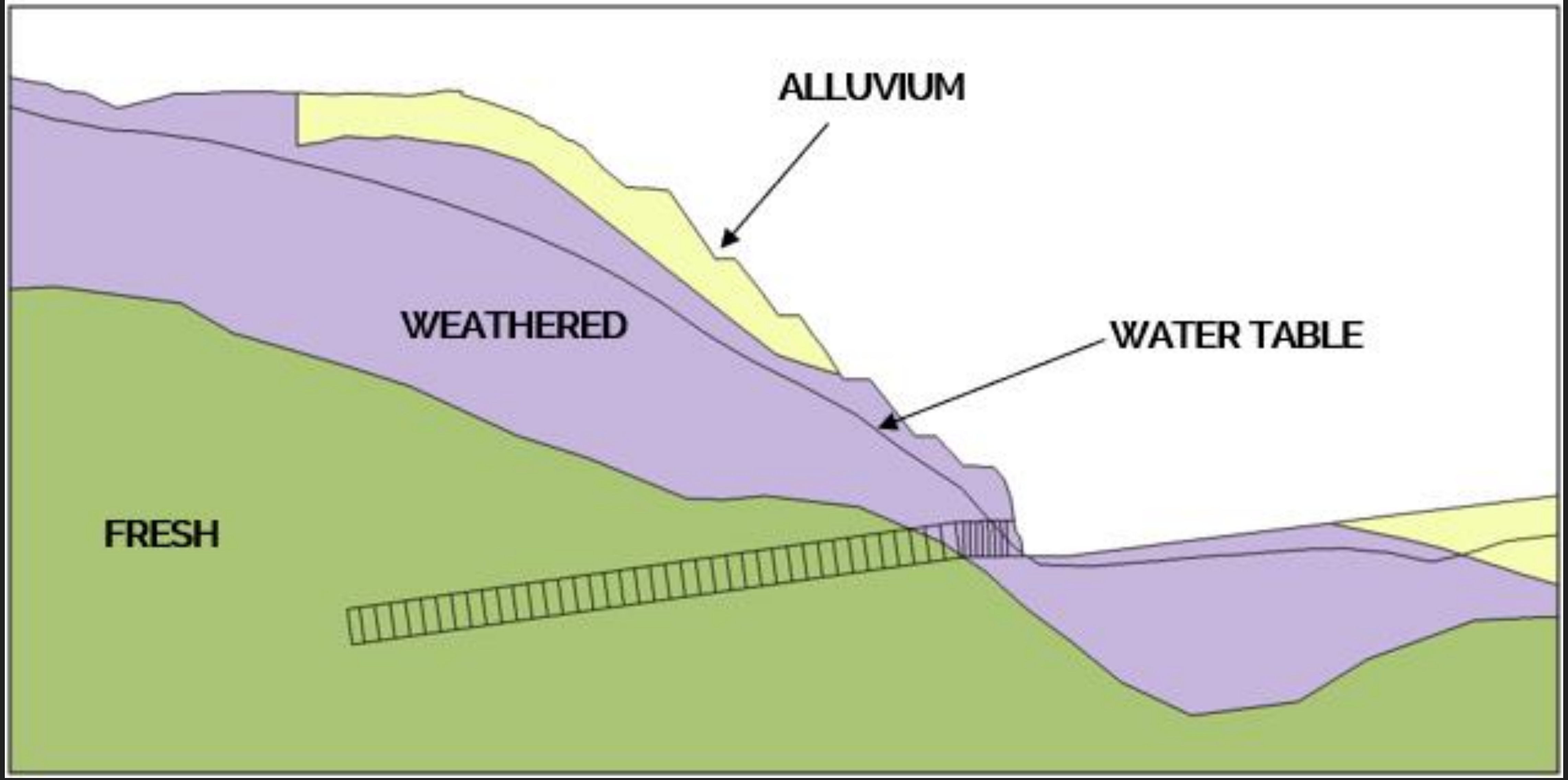
- comprises alluvial material and heavily weathered rock.
- To 25m below surface.
- unconsolidated gravel, silt and sand sized fragments with rounded shape and poor sorting.
- The rock fragments are a mixture of schist, gneiss, monzonite and vein material.

BOXCUT DESIGN

- Boxcut Sides (Highly Weathered Domain); 60° batters, 10m high, 2m benches – overall slope 50°
- Portal Face (Transitional Monzonite); 14.5m height at batter angle of 70°
- Above portal (Weathered & Alluvium); 50° batters, 10m high, 4.5m benches – overall slope 45°
- Side-cast fill from the haul road, minor failures, buttress to support

BOXCUT, PORTAL & INITIAL DECLINE GEOTECHNICAL MODEL





THE MAGIC AND DARK ARTS

Analysis carried out on unsupported boxcut by means of the three-dimensional inelastic finite-element code RS3 (Rocscience, 2024).

Inputs to the RS3 model include:

- Intact Rock Strength.
- Soil Strength
- Rock Mass Quality (Geological Strength Index)
- Pre-excavation groundwater level and hydraulic conductivities.
- Pre-excavation stress field and earthquake loading
- Geological solids provided by client
- Weathering surfaces provided by client
- Boxcut design provided by client

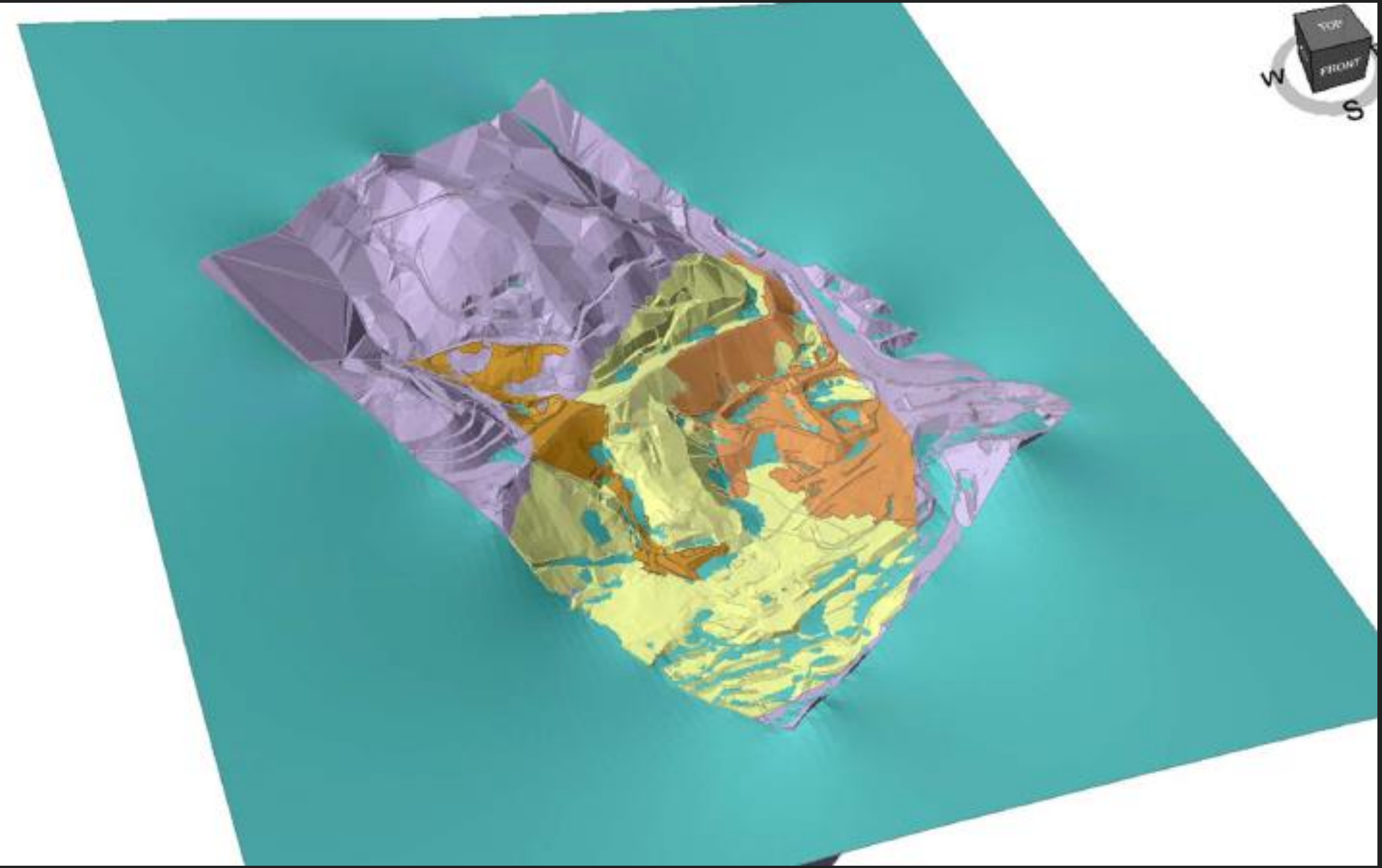
MOHR COULOMB FAILURE CRITERION

Design Domain	Density (t/m^3)	Modulus (MPa)	Cohesion (kPa)	Friction Angle (°)
Fill	2	200	20	37.5
Alluvium	2.2	500	273 (178)*	37.5
Weathered	2.5	1000	1300	49

* Std Dev in brackets

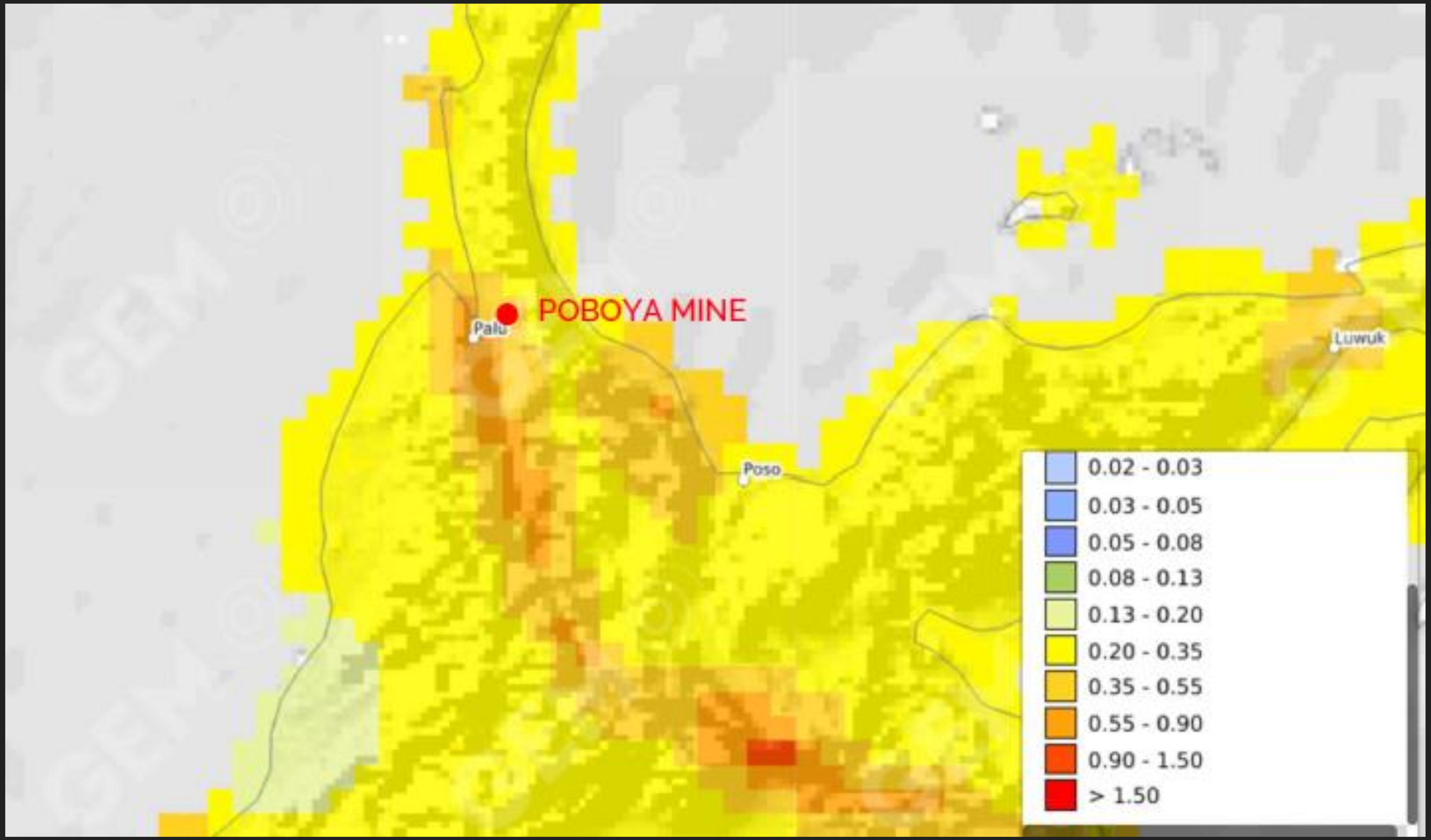
- Intact rock and soil strength inputs have been derived from laboratory data and back analysis existing slopes

WATER TABLE AND HYDRAULIC CONDUCTIVITY



- A pre-excavation water surface assumed to be a constant 8m below the existing topography.
- Typical hydraulic conductivities have been assumed for the materials included in the model and are not considered critical in this analysis as a worst-case drawdown scenario was adopted.

INSITU STRESS AND SEISMIC LOADING



- Based on the Global Seismic Hazard Map (Pagani, 2018), a seismic acceleration coefficient of 0.4g is used for Poboya Mine Site.
- Far-field stress has been assumed to be lithostatic with a ratio of horizontal to vertical stress of 0.4.
- The rationale for this assumption is alluvial and weathered material in hilly terrain, unlikely that high horizontal stresses can be sustained.

WILL IT STAND UP EVEN IF WE GIVE IT A SHAKE?

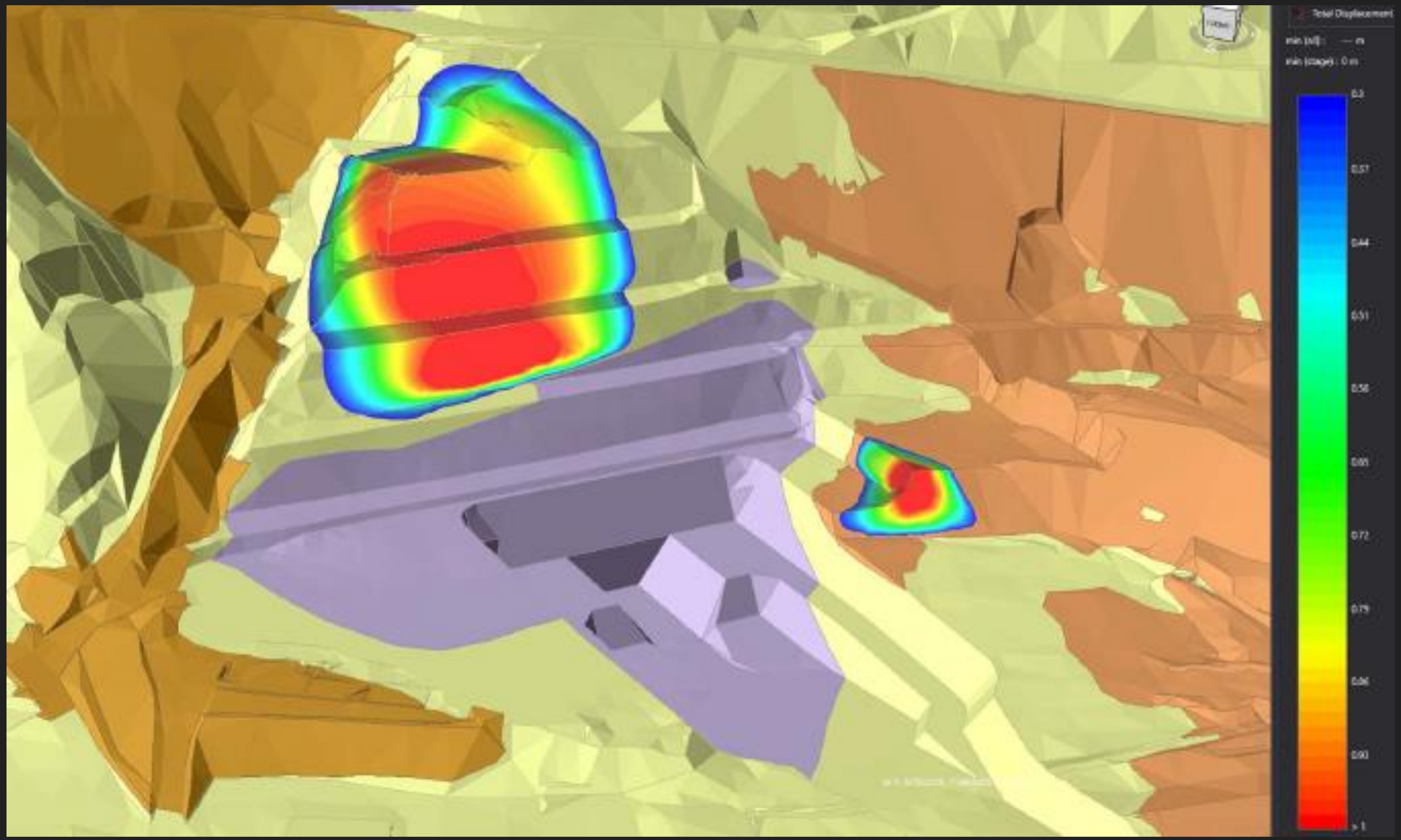
The methodology for assessing stability from the models is as follows:

1. The pre-excavation state is established using the assumed stress field and groundwater level.
2. The boxcut design is excavated with groundwater drawdown.
3. Model is run to convergence with average strength parameters
4. An additional run at Strength Reduction Factor (SRF) = 2.0 is run to convergence to verify that the FoS > 2.0 acceptance criterion is met.
5. A further run, with earthquake loading applied, is carried out to verify that the FoS will not drop below 1.0 during the maximum expected earthquake.

The concept of Shear Strength Reduction (SSR) methodology is as follows:

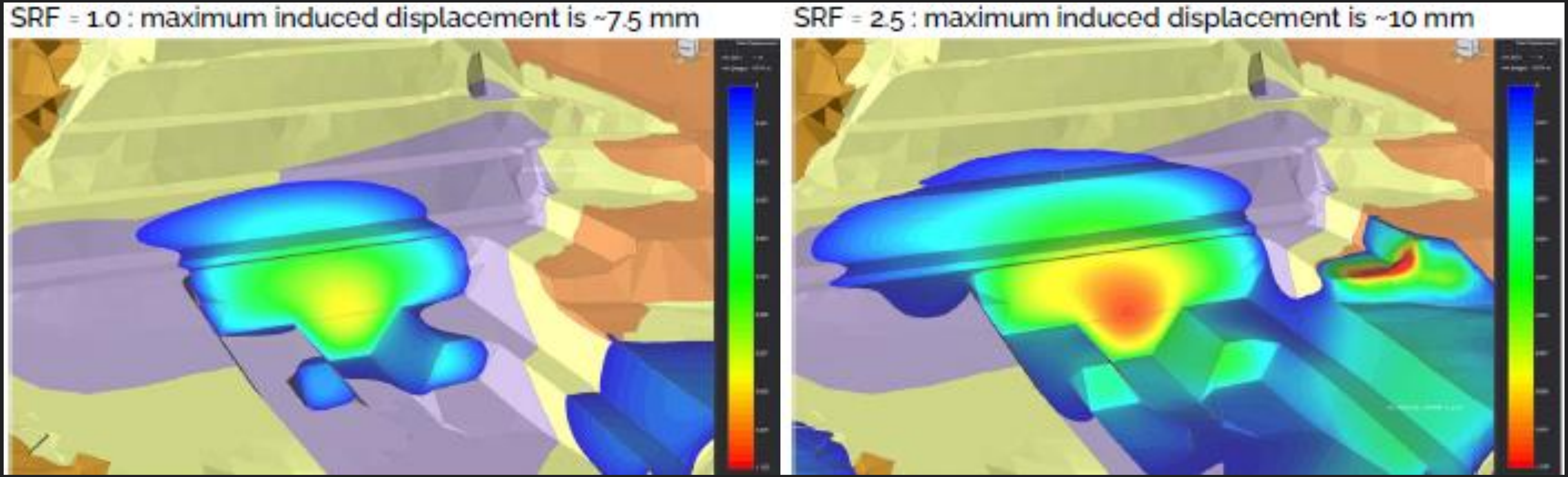
1. The strength parameters of a slope are reduced by a strength-reduction-factor (SRF) and the FE stress analysis is computed.
2. If the model converges, the critical SRF (FoS) is higher than the specified SRF.

MODELLED CRITICAL SRF



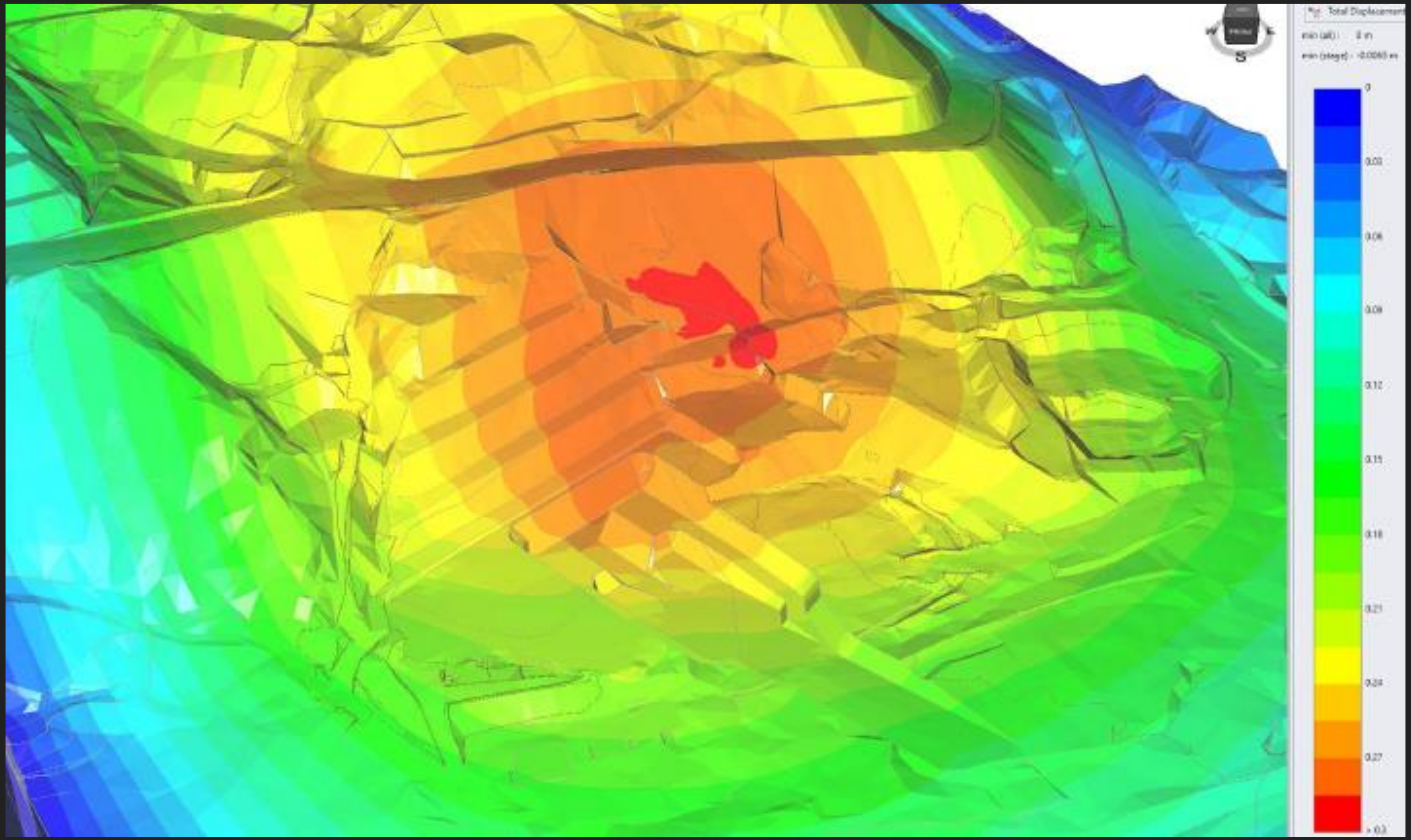
- The model is stable at a SRF of 2.0, (Factor-of-Safety > 2.0).
- The critical SRF (FoS) is 4.1 and the potential instability at this level of SSR.
- for this instability to occur, the material strength would need to be ~25% of the mean input values.
- The Probability-of-Failure, based on the statistical variation of the alluvium material, is 13%.

DISPLACEMENT INDUCED BY EXCAVATION



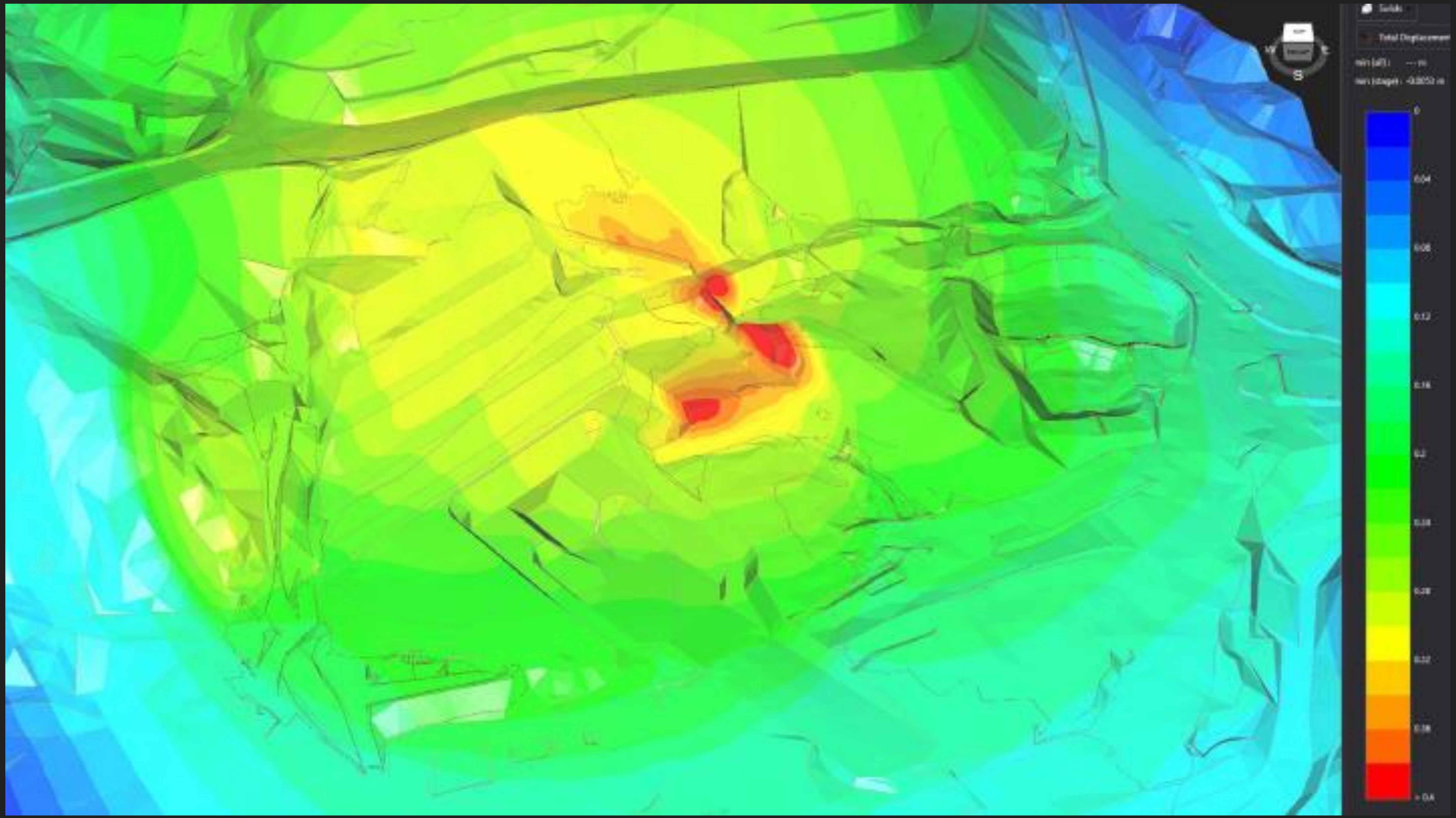
- The negligible difference in induced displacement (i.e. displacement due to excavation) between the SRF=1.0 and SRF=2.5 cases

MAXIMUM EXPECTED EARTHQUAKE LOAD



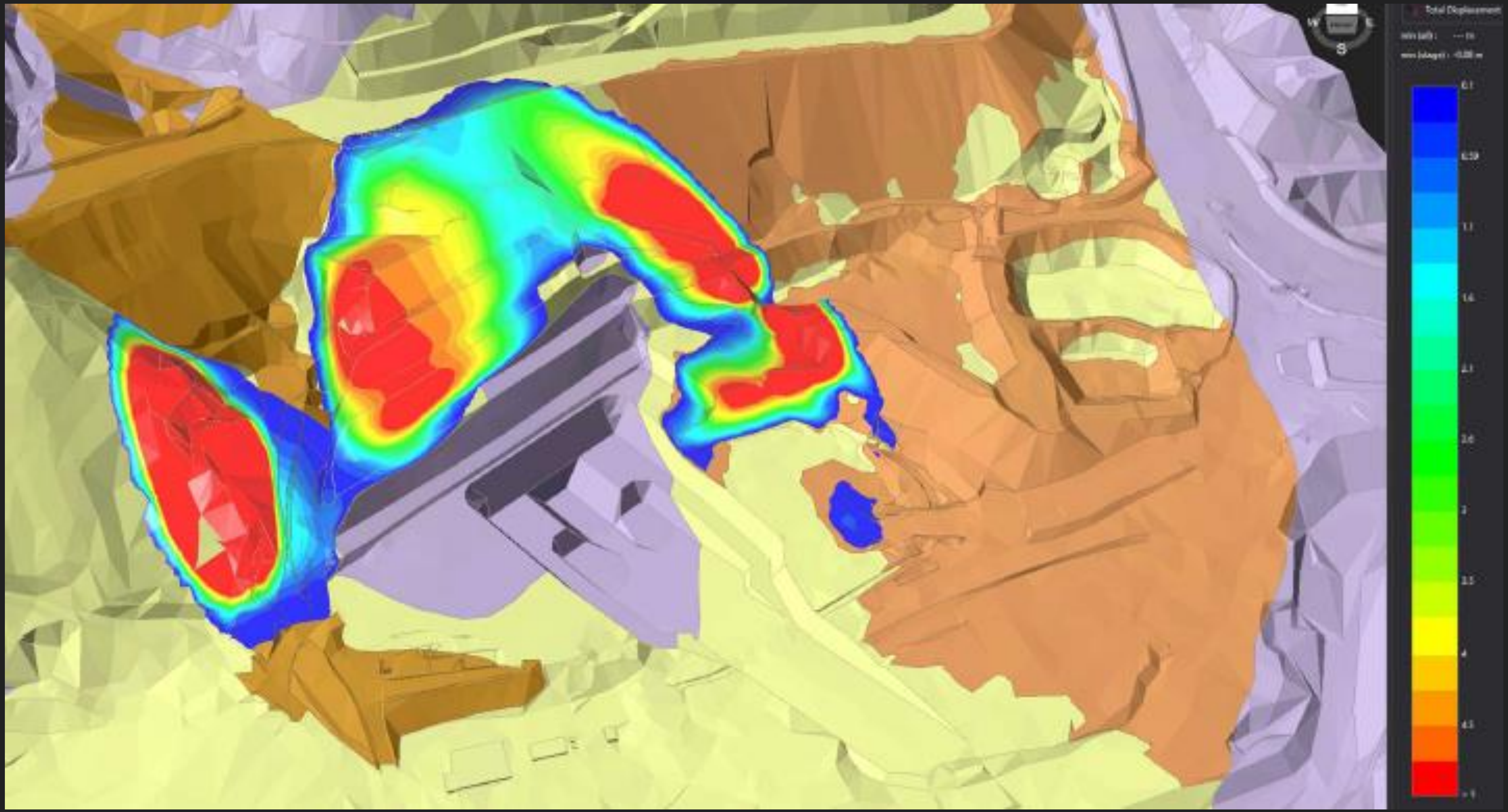
- Applying the earthquake load coefficient of 0.4g in the direction of the portal axis (135deg) does not result in instability at a SRF of 1.0
- Induced displacement (300mm) at SRF of 1.0 during the maximum expected earthquake event.

CRITICAL SRF UNDER EARTHQUAKE LOADING



- The critical SRF is 2.7 under maximum expected earthquake event.
- Induced displacement of 400mm.
- The Probability-of-Failure, based on the statistical variation of the alluvium material, is 17%.

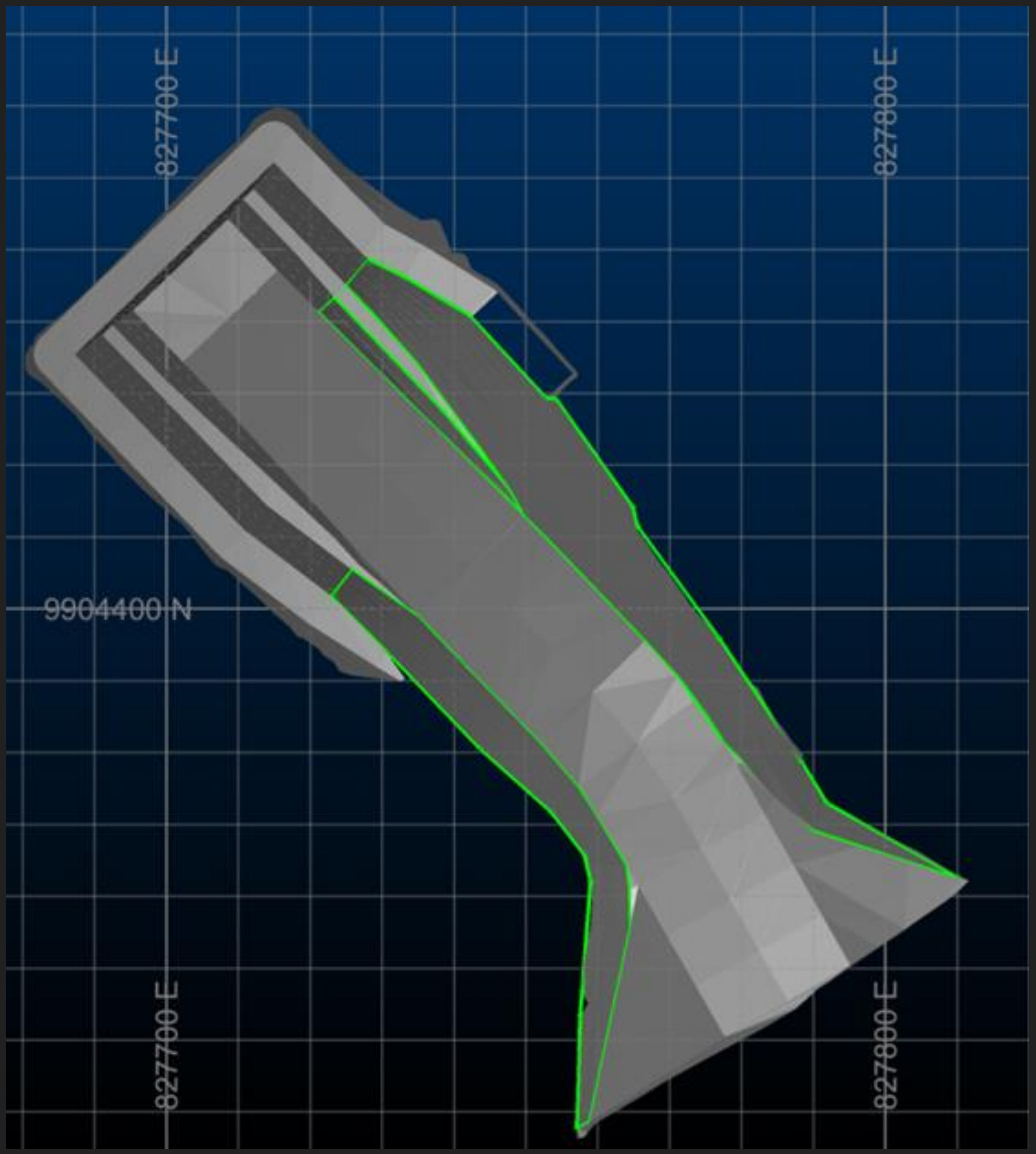
WORST CASE

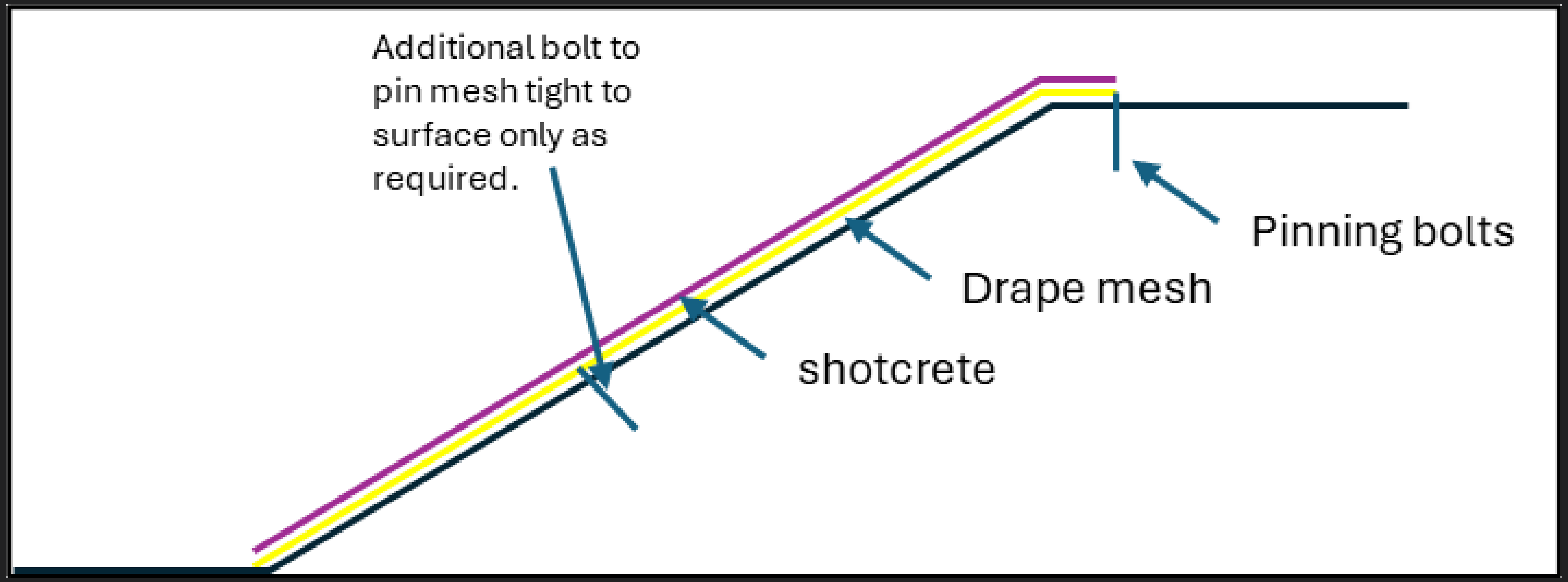


- The model forecast instability areas for SRF > 2.7
- For this instability to occur, the material strength would need to be ~37% of the mean values

BOXCUT GROUND SUPPORT

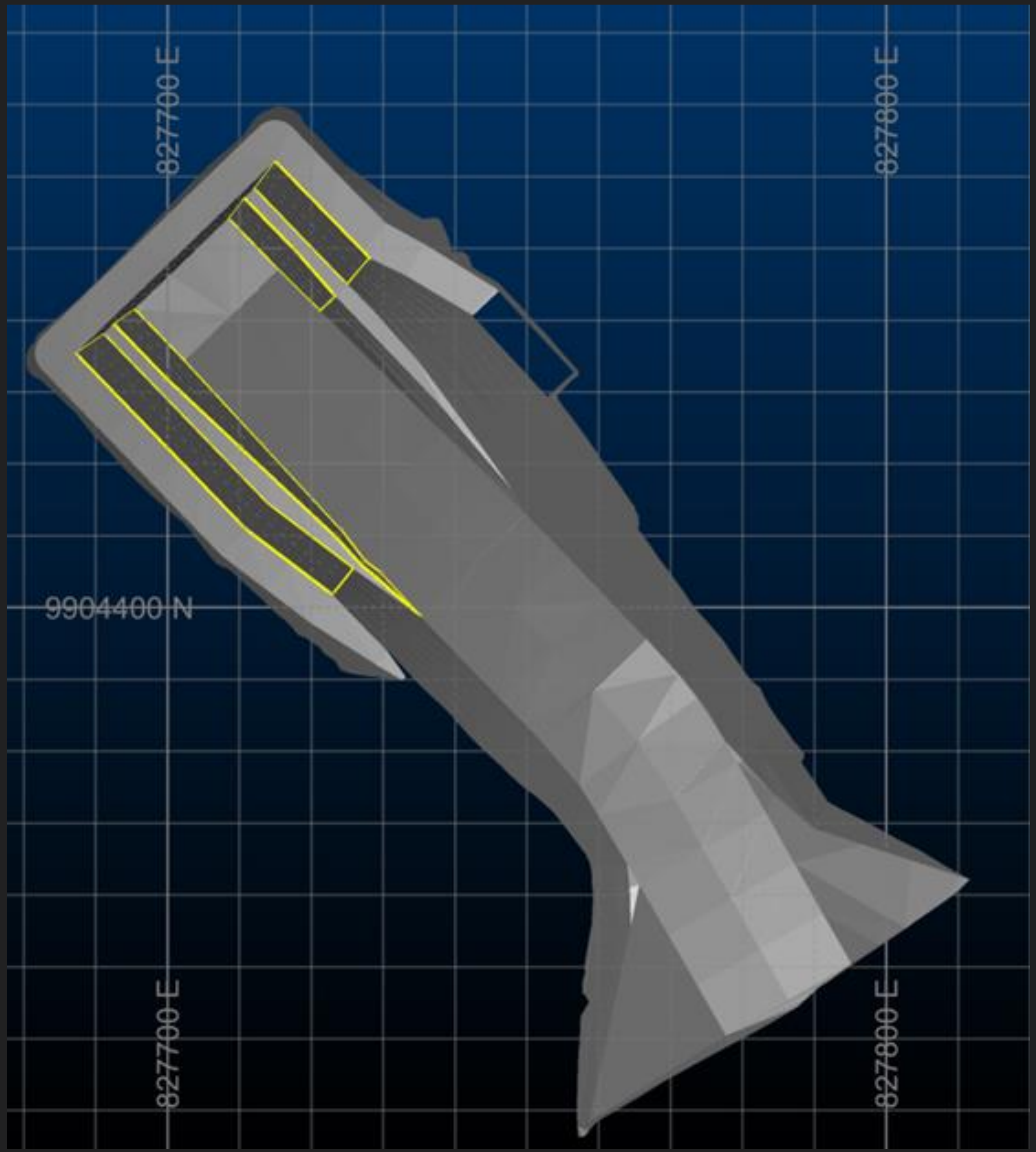
ALLUVIAL MATERIAL





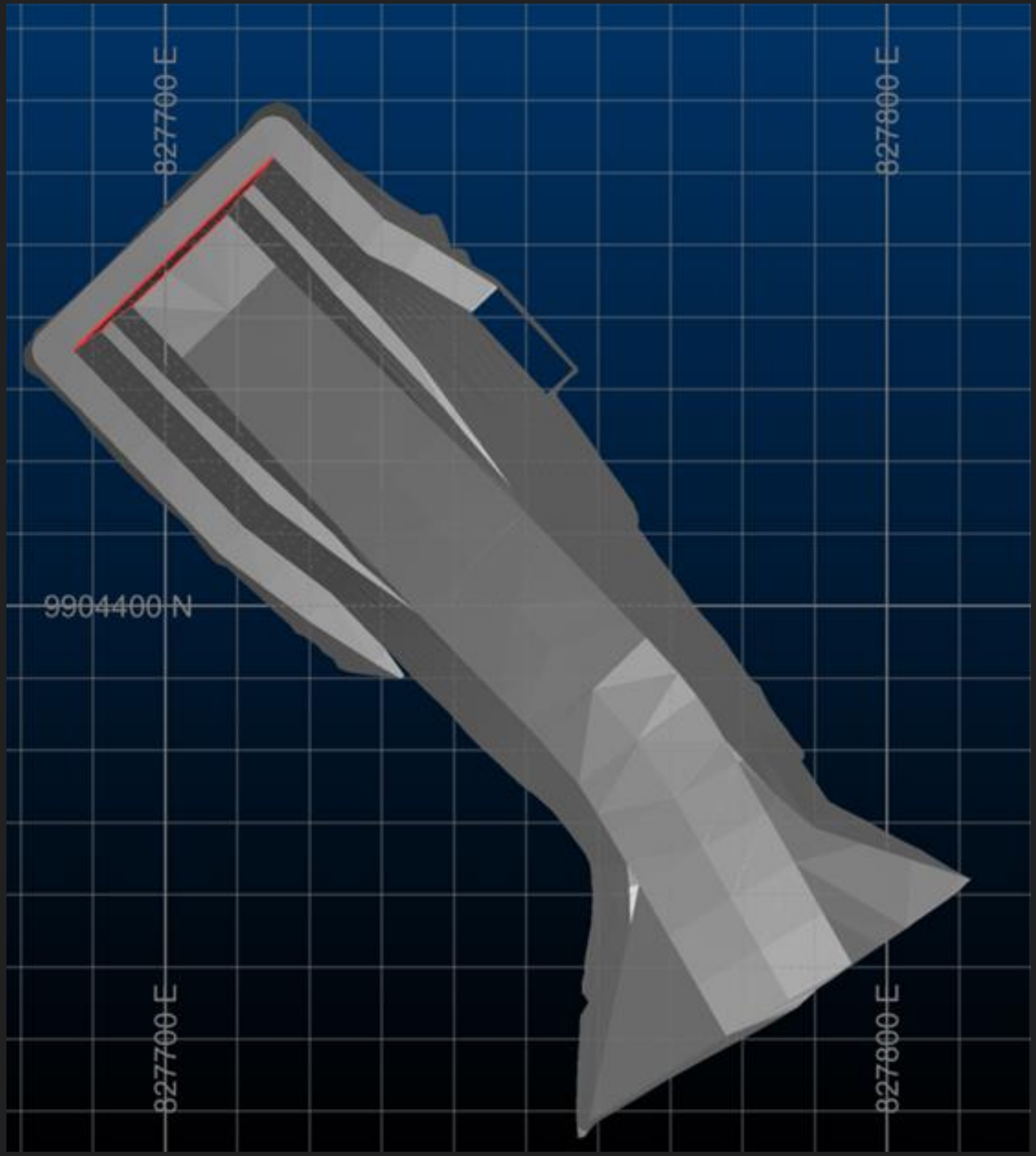
- Slope protection from erosion and for aesthetics
- Chain link mesh drape overlapped and pinned 1m back from crest.
- Crest pinning at 1m spacing with either split sets or rebar driven directly into the ground.
- Additional 0.9m split sets can be used to ensure the mesh conforms tightly to the face to minimize shotcrete consumption.
- 50mm of shotcrete or until the mesh is covered.

TRANSITIONAL MONZONITE – WALLS



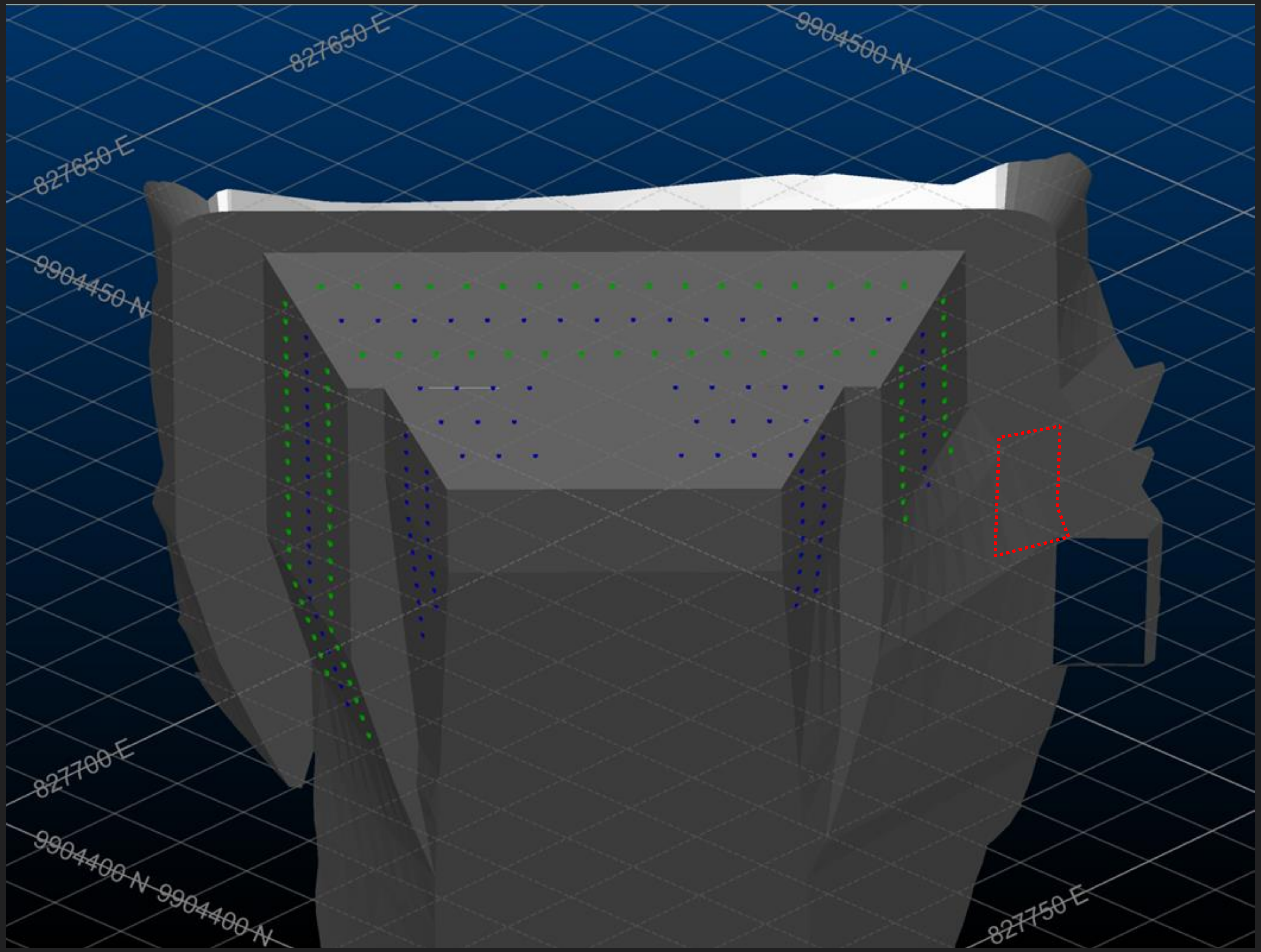
- The walls where the transitional monzonite is present is fibrecreted, 75mm thick.
- Mesh is not required prior to the installation of fibrecrete.
- Cable Bolts and solid bar rock bolts.

TRANSITIONAL MONZONITE – BOX CUT FACE



- The box cut face is to be fibrecreted to 100mm thick.
- Mesh is not required prior to the installation of fibrecrete.
- Cable Bolts and solid bar rock bolts.

BOLTING – WALLS AND BOX CUT FACE



- Cables and bolts are spaced on an approximately 2m x 2m spacing. 2 rows of cable bolts.
- All cables and bolts grouted
- 96 (6m) cable bolts and 115 (2.4m) rebar rock bolts.
- Self-drilling anchors required on the north-eastern wall due to the fill buttress.

DECLINE GROUND SUPPORT

TRANSITIONAL DOMAIN

Transitional Domain –

- General description of the weathered rock mass.
- Different lithology units are present; Portal will be in Monzonite
- Very weak rock
- Foliated
- Weathered

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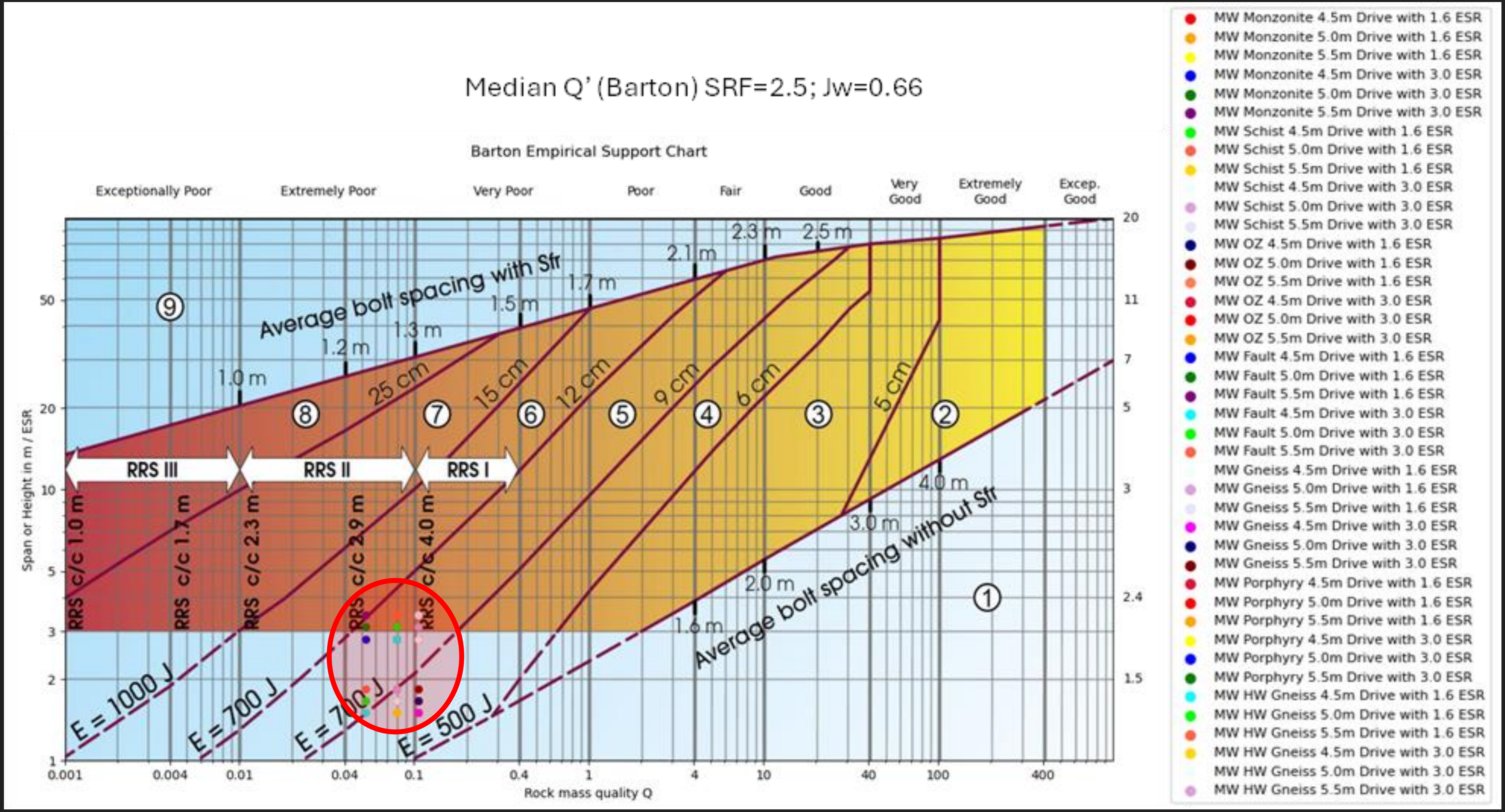
ROCK MASS CHARACTERISTICS – HOEK-BROWN

Lithology	No. of valid UCS	No. of valid TRX	Ave Density	Std Dev Density	Ave Valid Modulus (MPa)	Std Dev Modulus (MPa)	Intact Rock Strength (MPa)	Intact Rock Strength Std Dev (MPa)	Average Tensile	Hoek-Brown (mi)
Feldspar Porphyry (Fresh)	5 (7)	3	2.39	0.16	9730	1492	39.9	29.4	-5.5	9.44
Gneiss (Fresh)	2 (15)	10 (15)	2.54	0.17	13468	887	91.2	40.6	-8.0	9.2
Gneiss (Transitional)	4 (6)	-	-	-	7726	1679	41.1	34.5	-6.8	55
Monzonite (Fresh)	9 (20)	21.	2.42	0.09	5943	6685	89.7	50.8	-2.7	11.2
Monzonite (Transitional)	5	-	2.18	0.09	2224	1758	11.3	10.2	-3.6	51.1
Schist (Fresh)	10 (29)	42 (51)	2.61	0.13	11056	2588	71.1	40.1	-5.5	9.25
Schist (Transitional)	3	-	2.33	0.00	704	747	4.1	4.1	-0.6	4

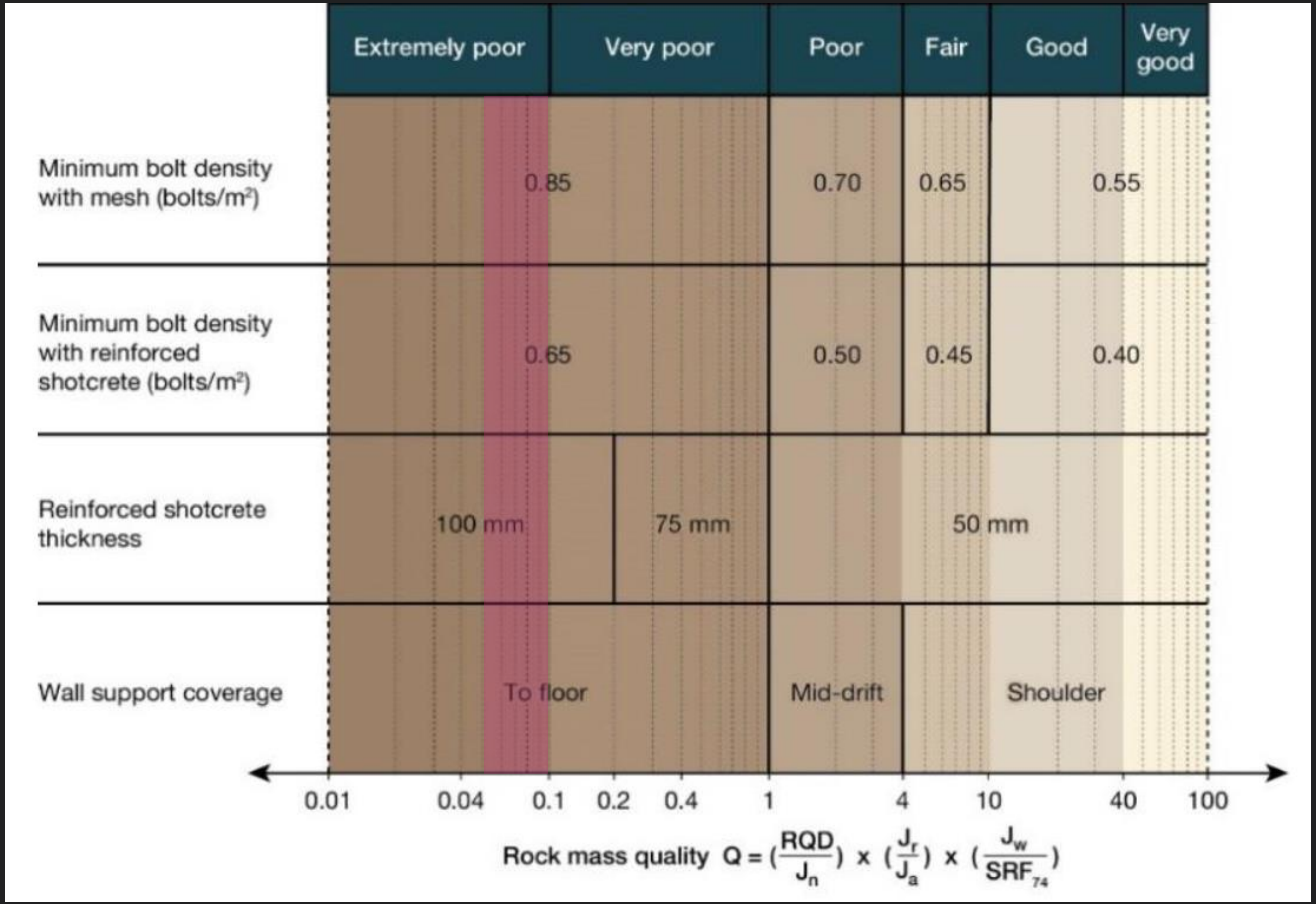
ROCK MASS QUALITY

Statistic	Monzonite		Gneiss		Schist		Ore	
	RQD	Q'	RQD	Q'	RQD	Q'	RQD	Q'
Count	7151	7151	344	344	1293	1293	5478	5478
Sum of Weights	6193.8	6193.8	186.9	186.9	905.2	905.2	3077	3077
Minimum	0	0.002	0	0.01	0	0.002	0	0.002
Maximum	100	116.6	94	21.5	100	46.4	100	184.8
10th Percentile	0	0.02	0	0.03	0	0.02	0	0.02
1st Quartile	0	0.03	0	0.09	0	0.04	0	0.04
Median	17	0.1	0	0.1	0	0.09	0	0.1
3rd Quartile	67	1.2	30	0.4	40	0.5	50	0.9
90th Percentile	90	4	60	1.6	70	1.8	82	4
Mean	32.6	1.6	17	0.8	21.6	0.9	26.1	1.9
Variance	1328.6	17.7	695.8	5.2	848.1	8.7	1071.7	54.4
Standard Deviation	36.4	4.2	26.4	2.3	29.1	2.9	32.7	7.4

BARTON EMPIRICAL SUPPORT CHART

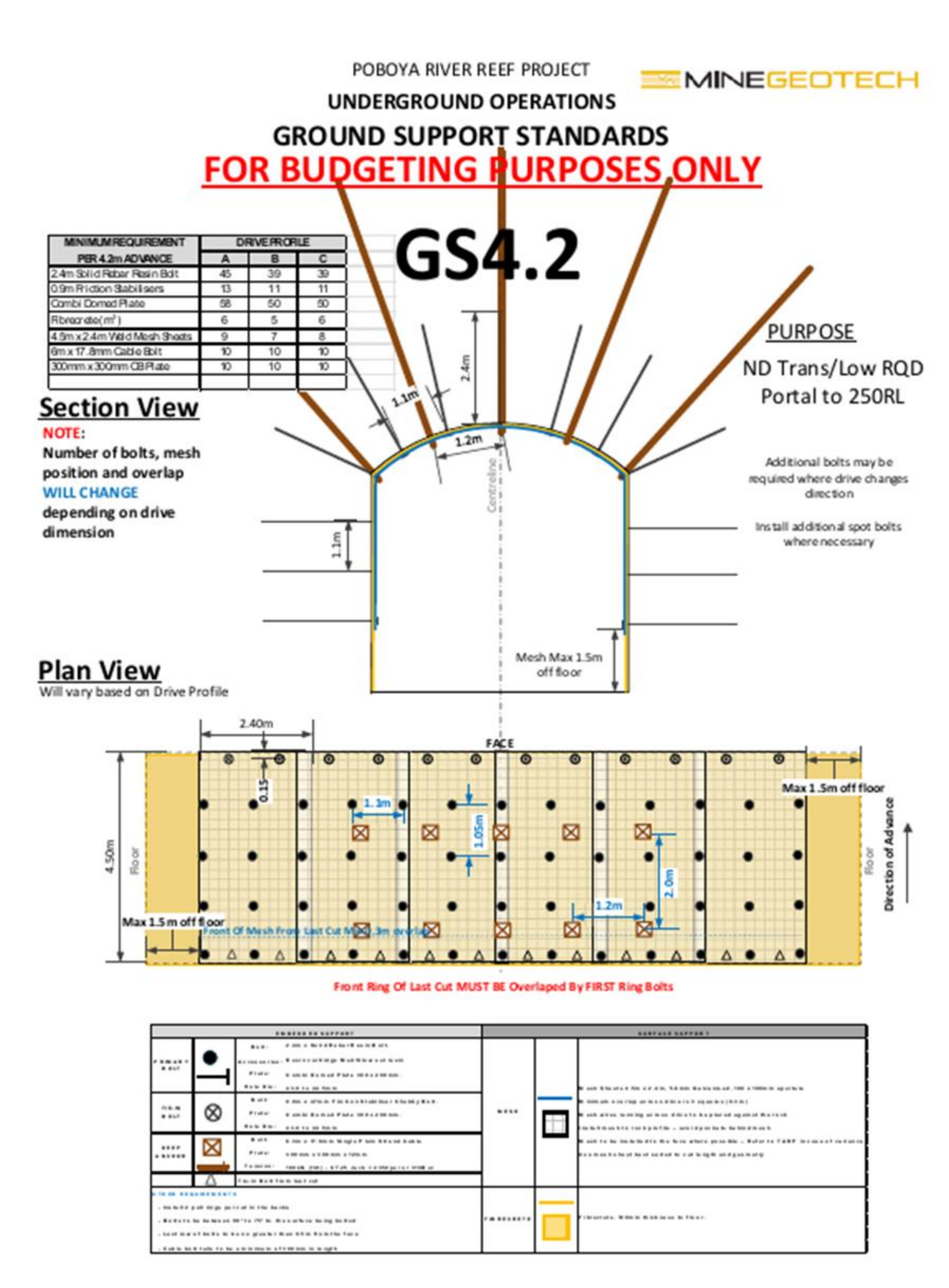


POTVIN EMPIRICAL GROUND SUPPORT CHART



- Transitional Monzonite – SRF2.5, Jw 0.66
- Extremely Poor to Very Poor
- 100mm fibrecrete
- Wall support to floor
- Bolt density 0.65 bolts/m²

DECLINE GROUND SUPPORT SCHEME

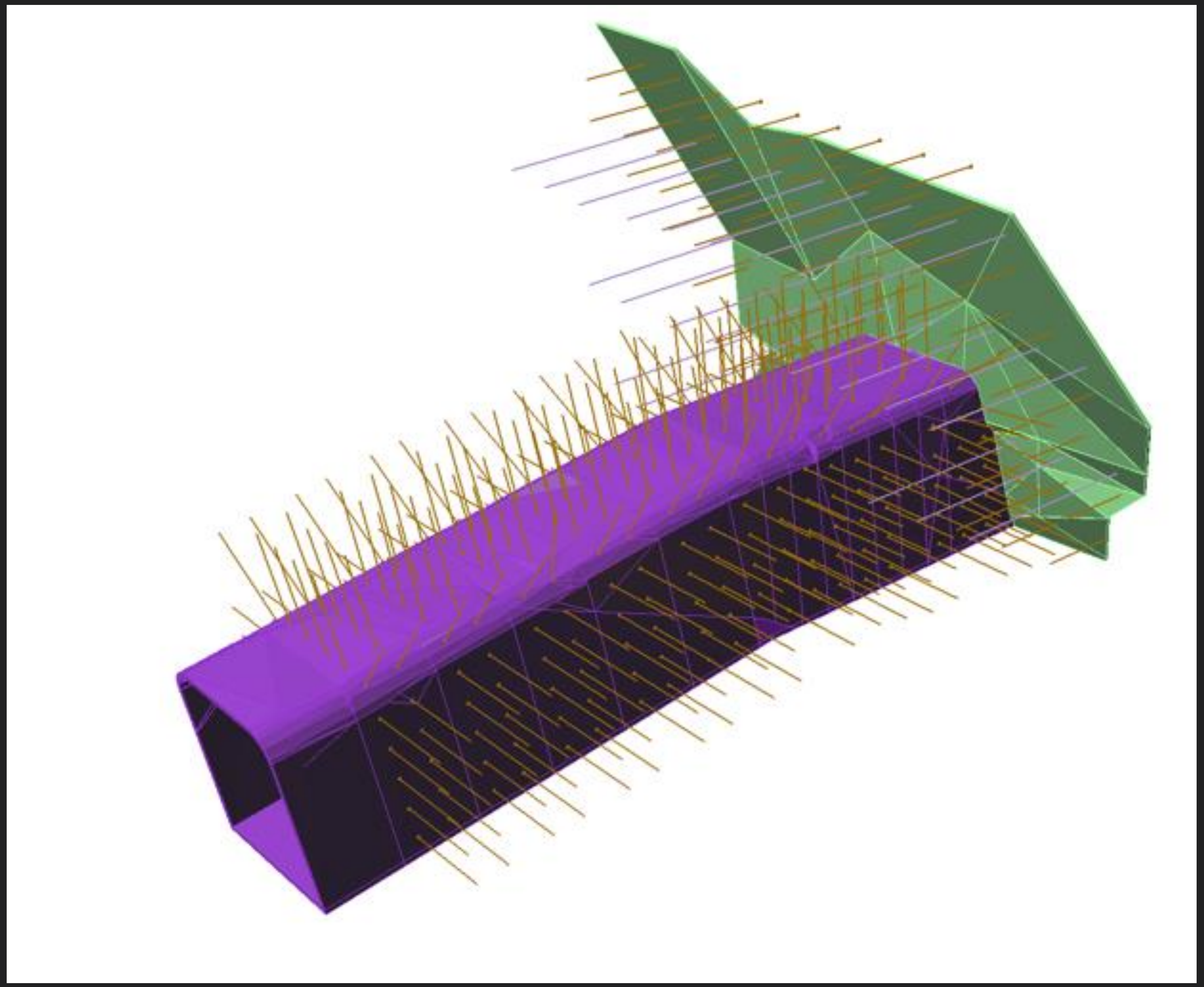


Initial 20m

- 150mm fibrecrete
- Wall support to floor
- 2.4m x 4.5m Weld Mesh
- 2.4m Solid Bar Resin bolts
- Bolt spacing 1.3m x 1.05m
- 6m length 17.8mm twin strand cable bolts
- Cable bolt spacing 2.0m x 1.2m

DECLINE AND PORTAL MODELLING

PORTAL FACE AND DECLINE GROUND SUPPORT MODEL

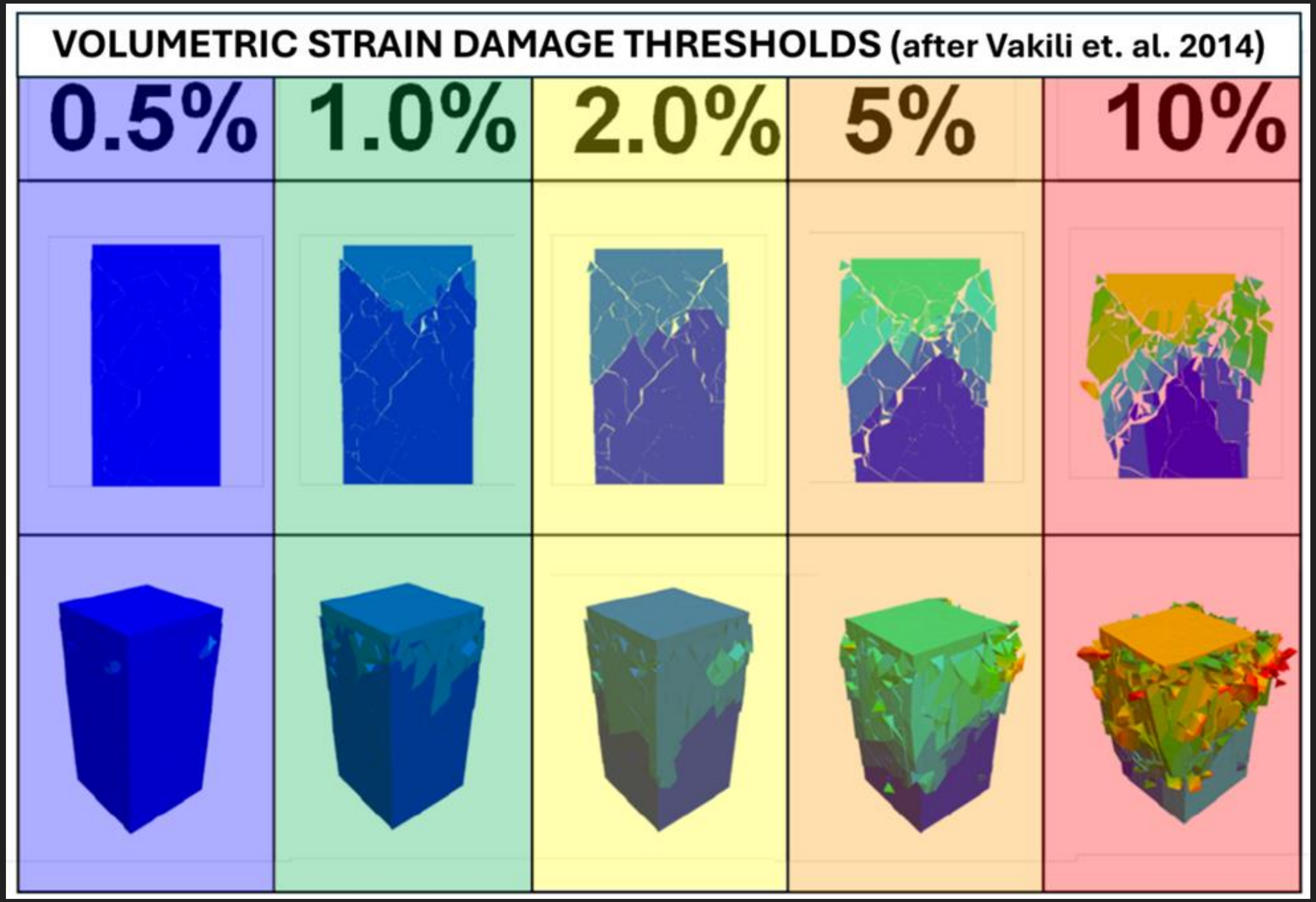


- Initial 20m of decline development showing liner (purple) and rockbolts.
- Portal face support also shown.

	Modulus (MPa)	Shear Strength (MPa)	Compressive Strength (MPa)	Tensile Strength (MPa)	Thickness (mm)
Portal Face Fibrecrete	30000	5	35	5	100
Decline Fibrecrete	30000	5	35	5	150

	Length (m)	Bolt Diameter (mm)	Hole Diameter (mm)	Modulus (GPa)	Tensile Capacity (MN)	Bond Strength (MN/m)	Bond Shear Stiffness (MPa)
Single Strand bulbed Cables (with face plates)	6.0	16	35	200	0.25	50	100
Portal Face rockbolts (with face plates)	2.4	32	35	200	0.22	50	100
Decline rockbolts (with face plates)	3.0	32	35	200	0.22	50	100

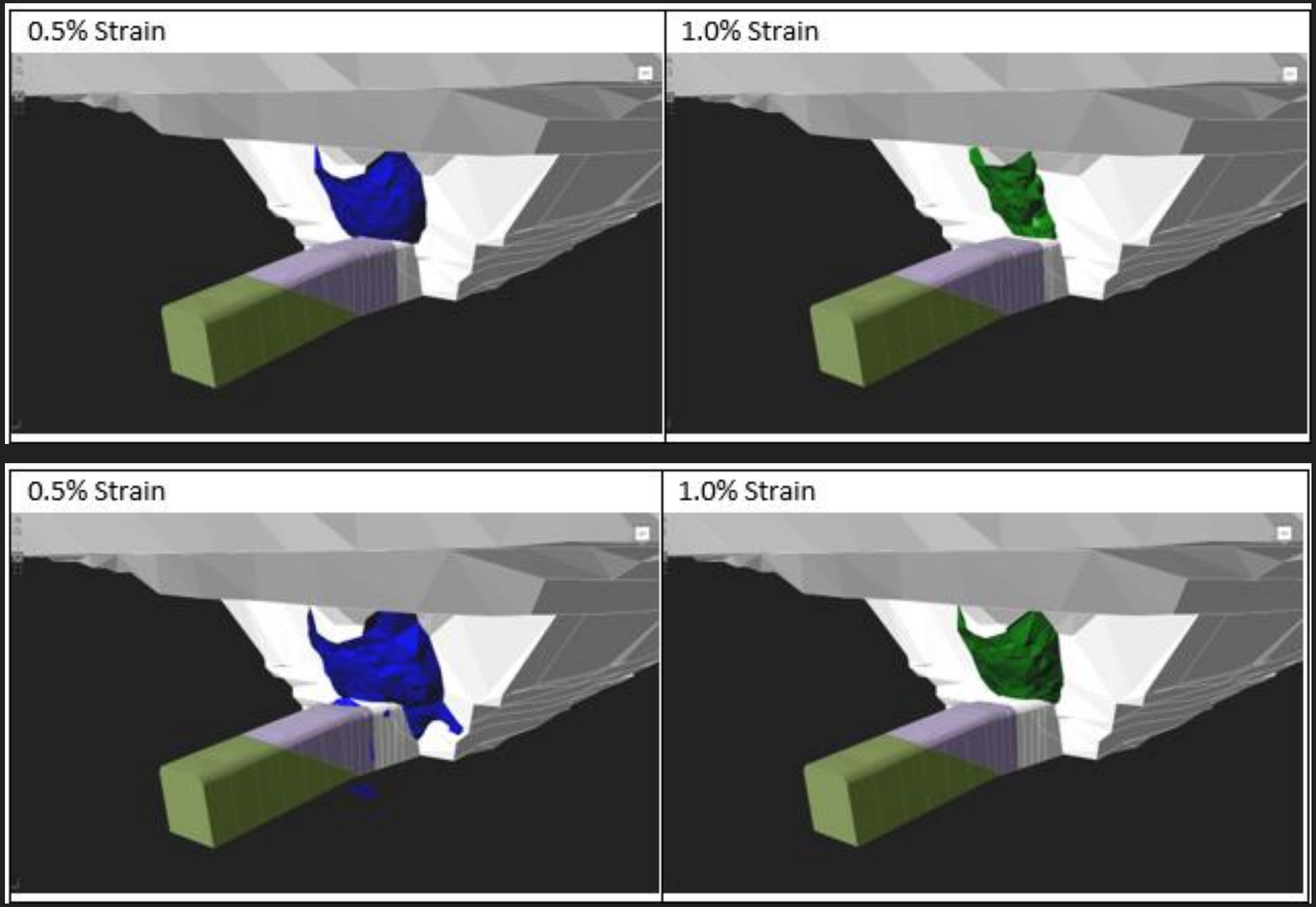
VOLUMETRIC STRAIN



Assessment criteria for results include:

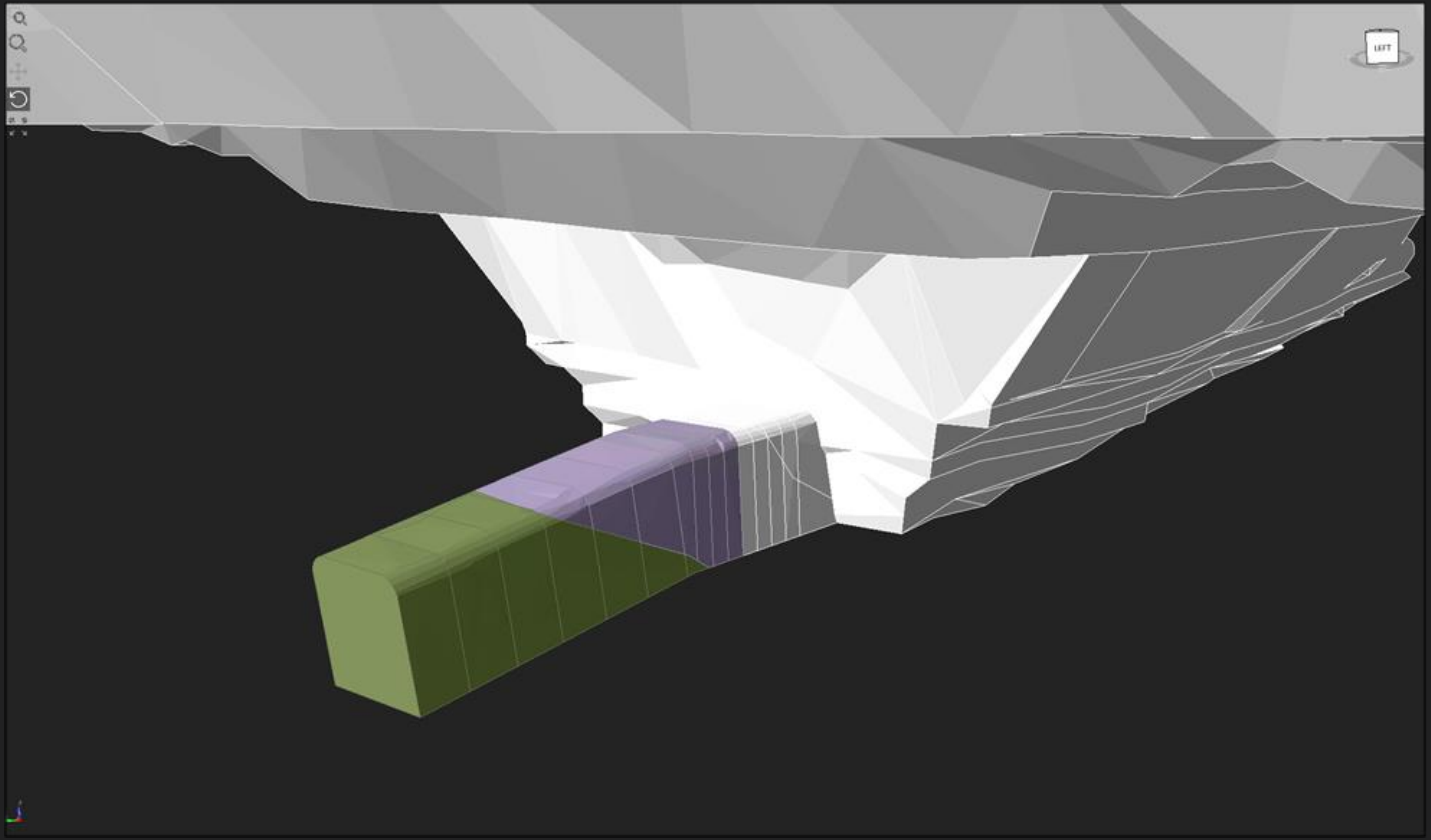
- Volumetric strain – a measure of rock mass damage due to inelastic deformation
- Liner yield
- Rockbolt and cable yield
- Rockbolt and cable load

PROGRESSION OF DAMAGE TO THE PORTAL FACE - UNSUPPORTED



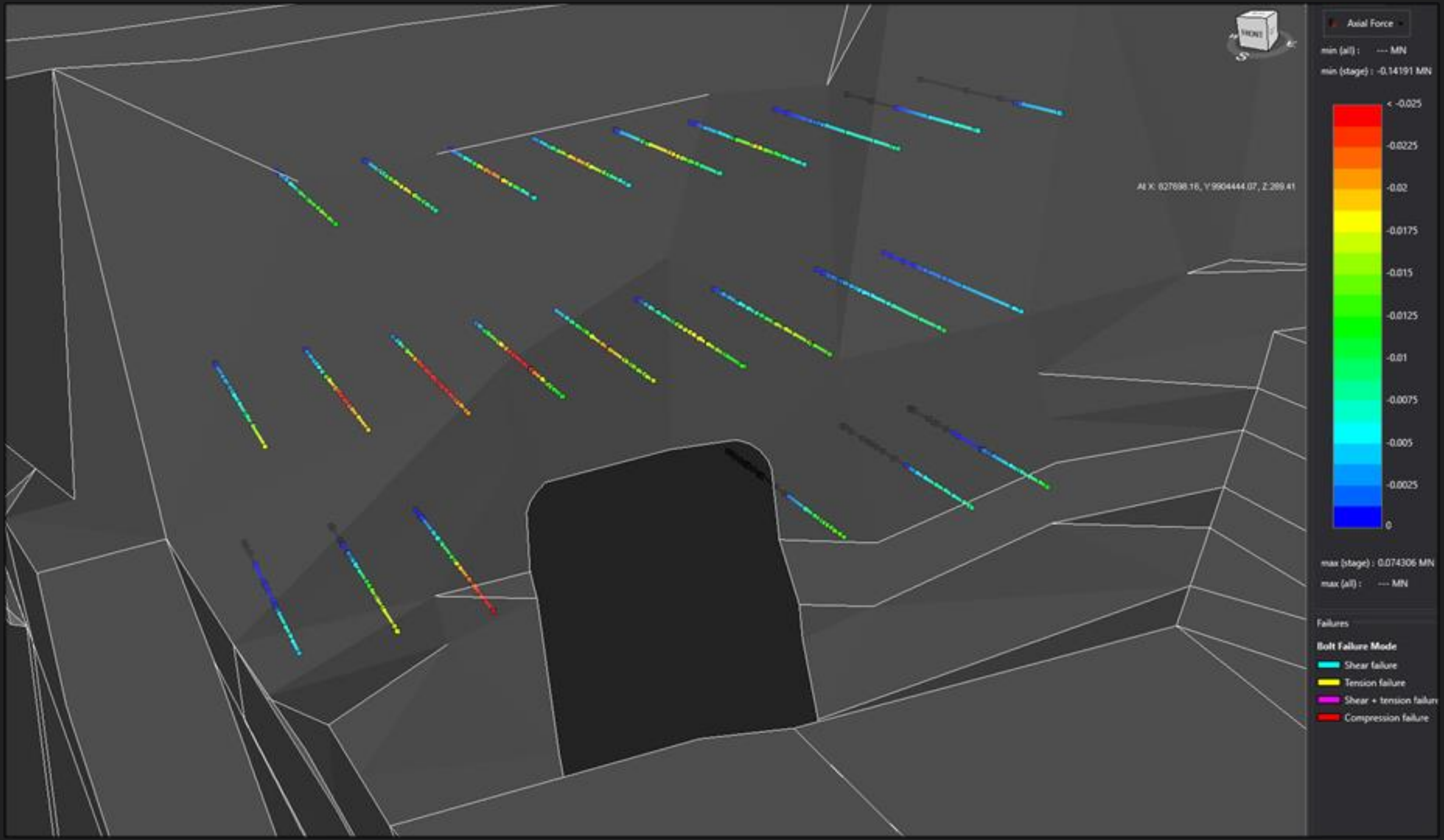
- 2m advance
- 5m advance

PROGRESSION OF DAMAGE TO THE PORTAL FACE - SUPPORTED



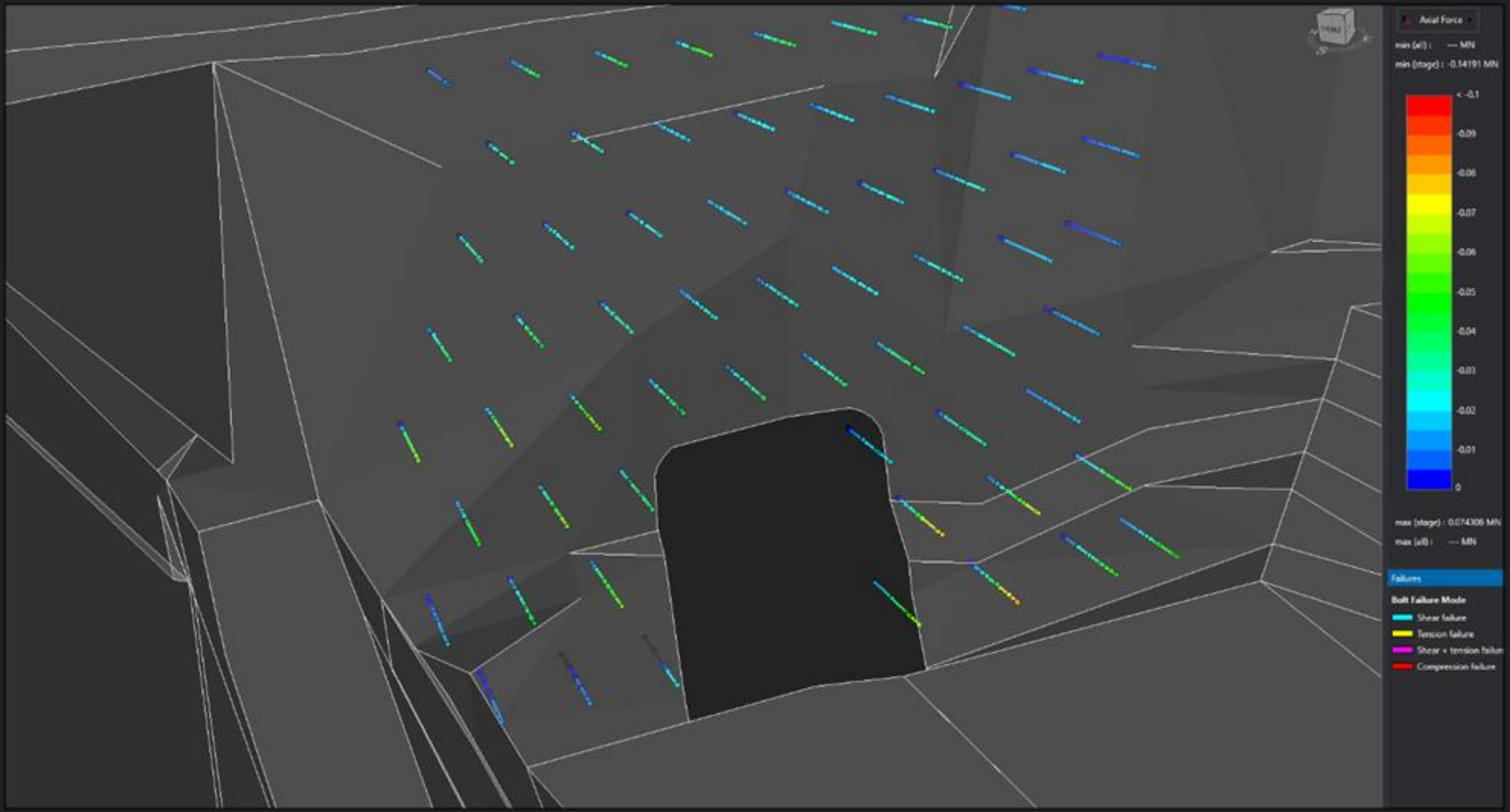
- 5m advance - no damage is forecast to the portal face

AXIAL FORCE (MN) ON INSTALLED CABLE BOLTS (25M DEVELOPMENT)



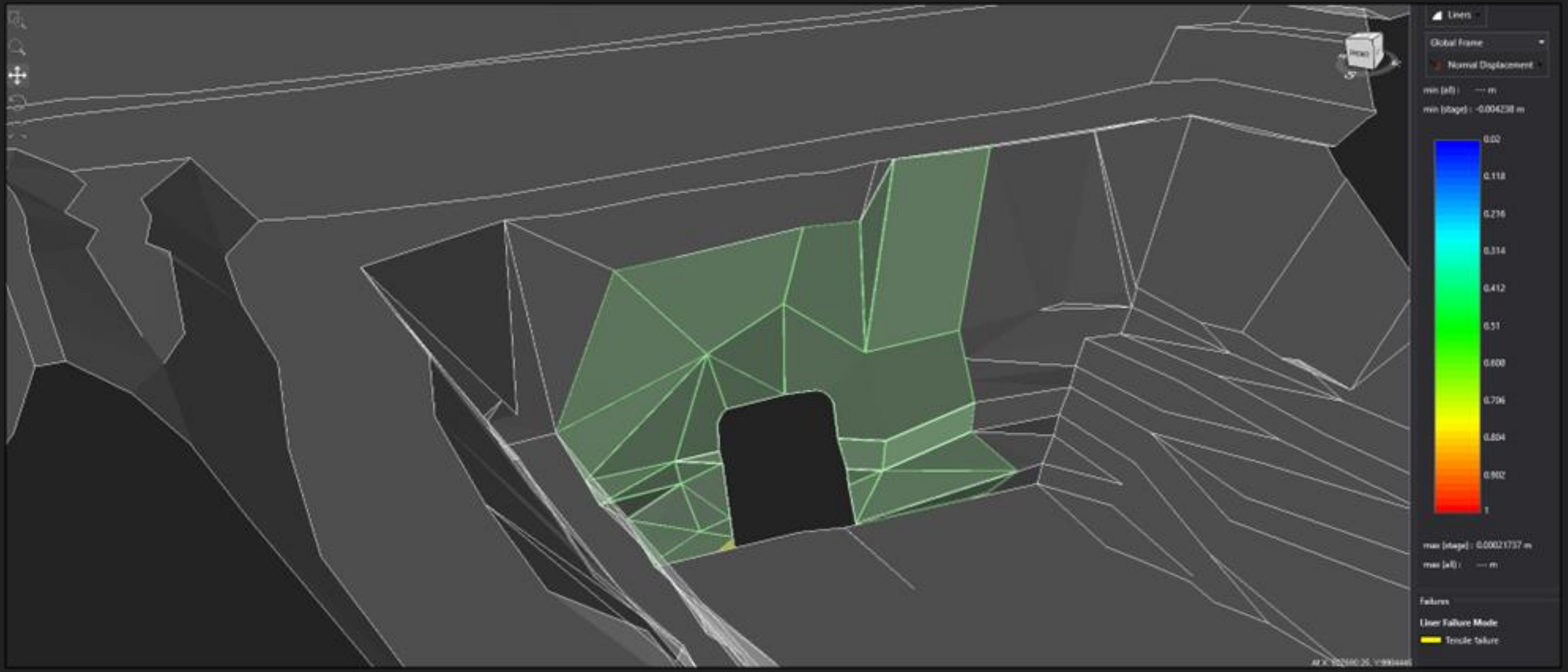
- 0.025MN
- 10% of the rated capacity of the cable

AXIAL FORCE (MN) ON INSTALLED ROCK BOLTS (25M DEVELOPMENT)



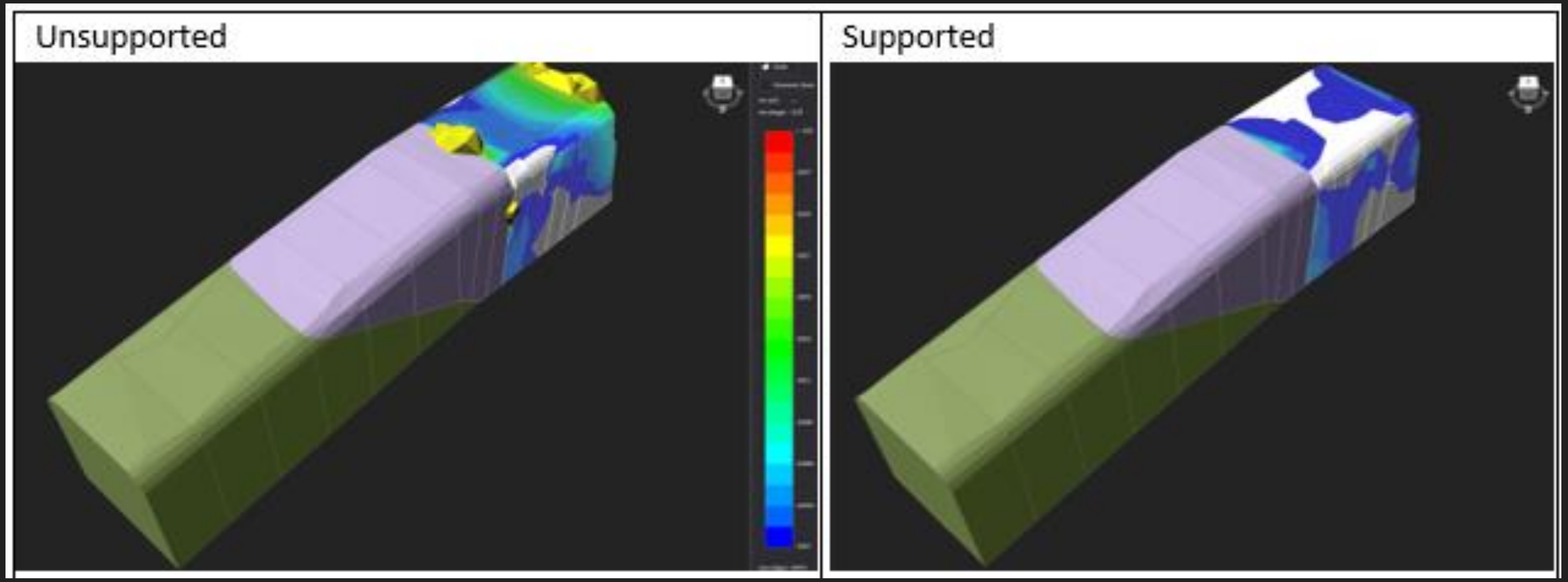
- 0.1MN
- 50% of the rated capacity of the bolt

PORTAL FACE FIBRECRETE

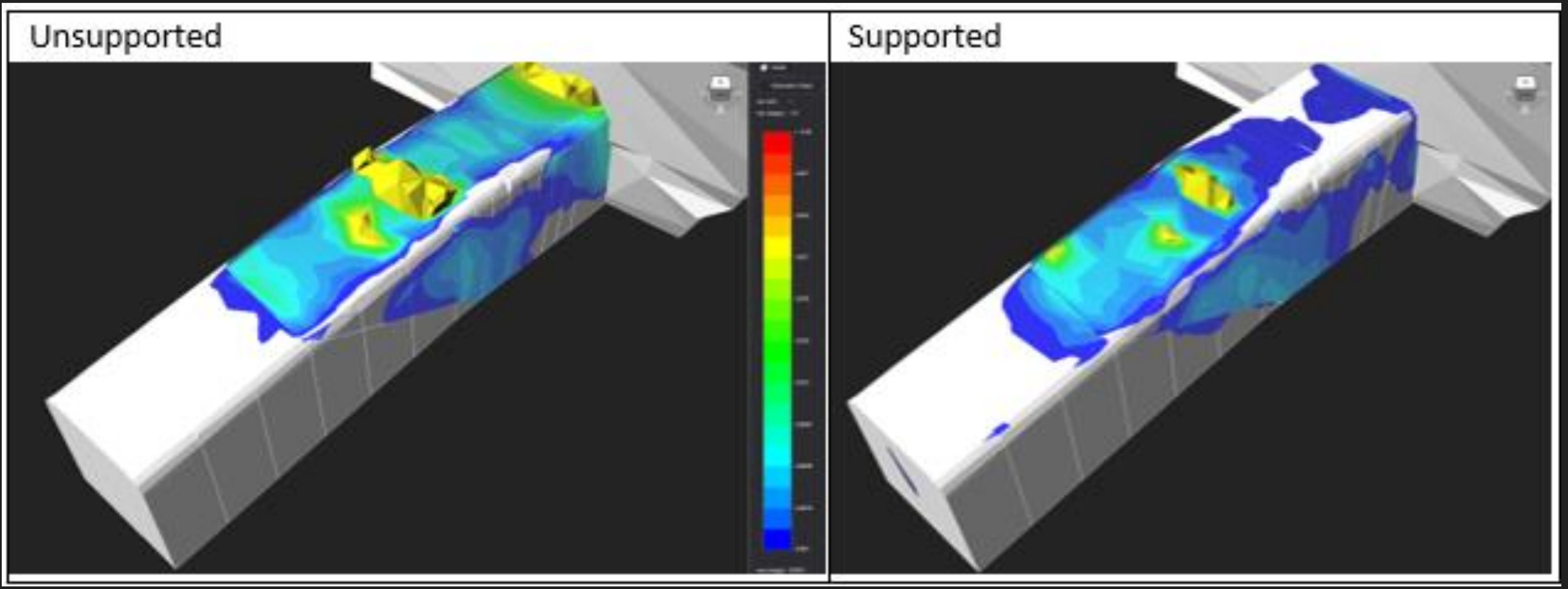


- 100mm fibrecrete around the portal shows negligible yield
- No performance issues expected

DECLINE VOLUMETRIC STRAIN

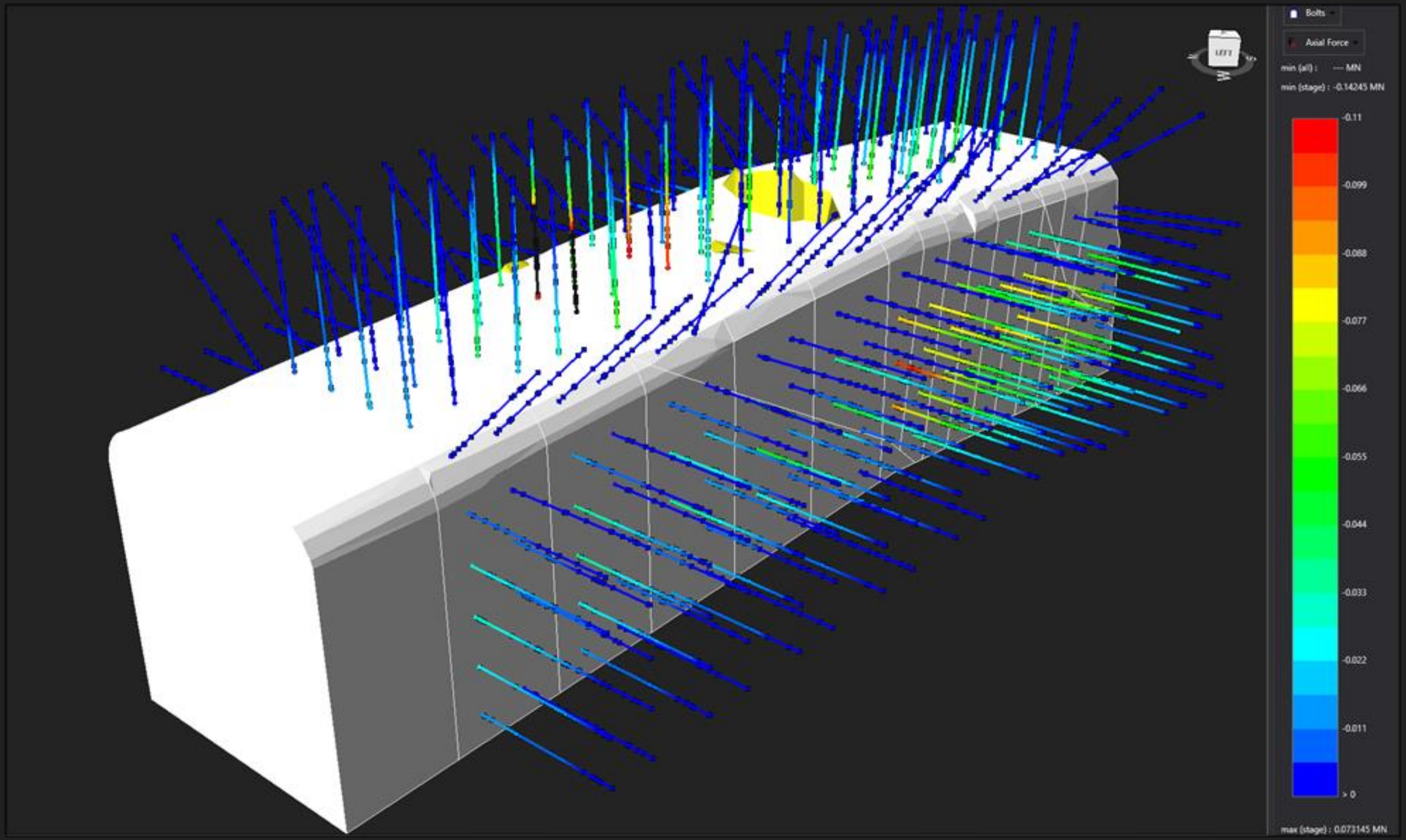


- Volumetric strain surface contours and 2% strain isosurface at 6m advanced



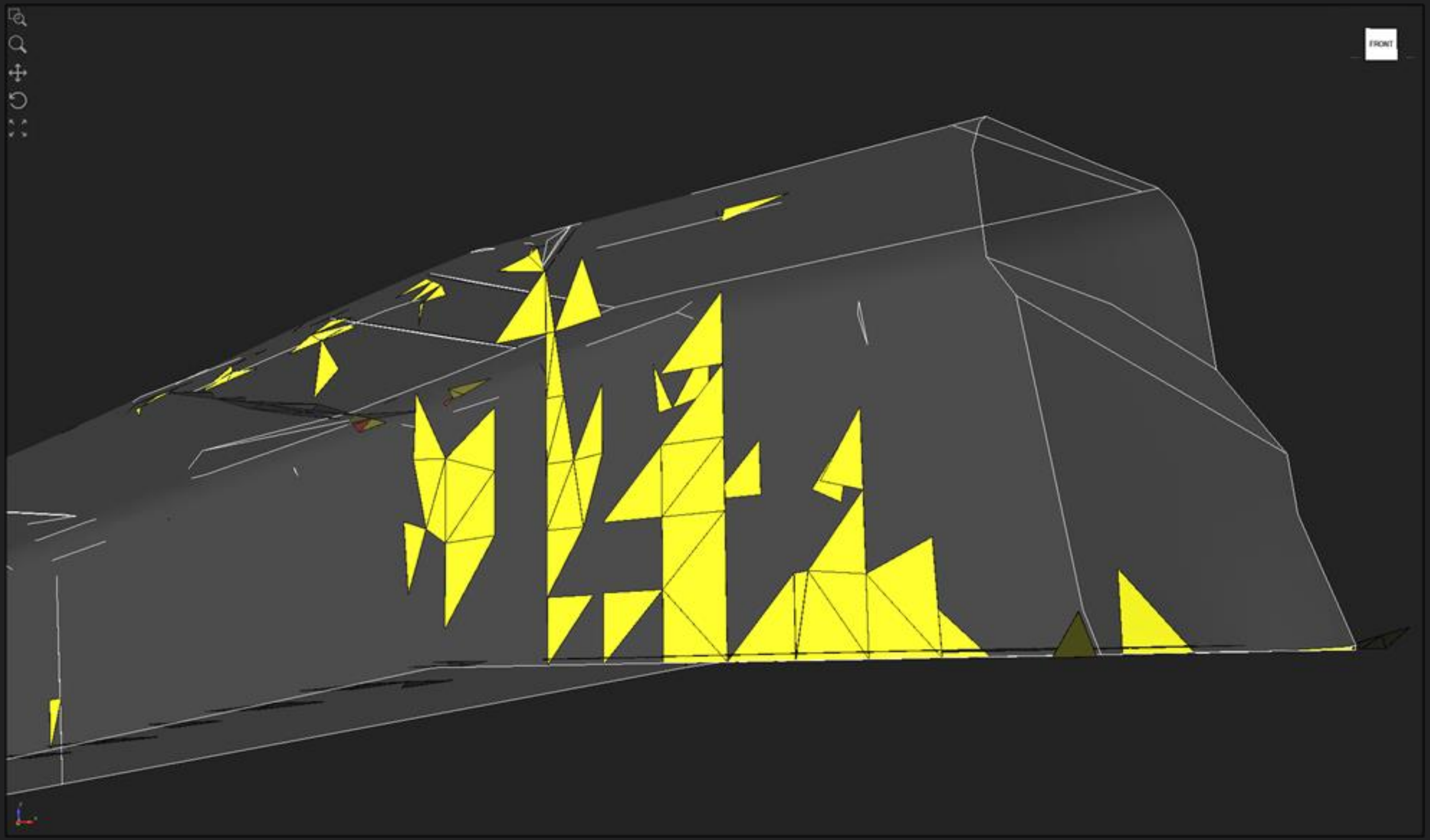
- Volumetric strain surface contours and 2% strain isosurface at 20m advanced

AXIAL FORCE (MN) ON INSTALLED ROCK BOLTS (20M DEVELOPMENT)



- 0.1MN
- 50% of the rated capacity of the bolt

DECLINE FIBRECRETE LINER



- 150mm fibrecrete shows tensile yield (cracking)
- Confined to first 10m (weathered Domain)
- No yield thereafter

SITE VISIT AND VERIFICATION

SITE VISIT (MARCH 2025)

- Boxcut & portal Face
- Mesh & fibrecrete on alluvium slopes

SITE VISIT (MARCH 2025)

- Boxcut wall
- Fibrecrete & bolts installed on Transitional Monzonite

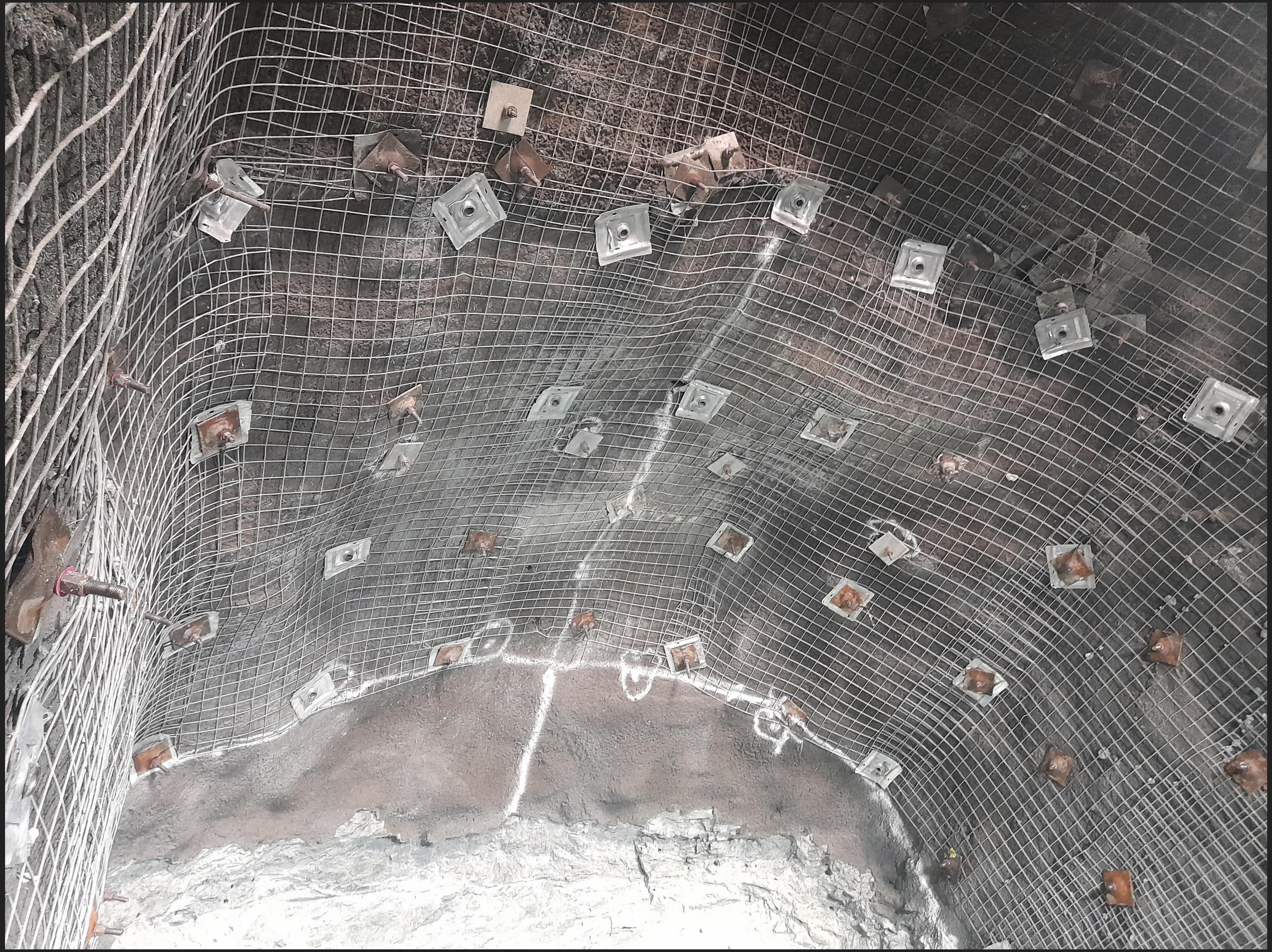
SITE VISIT (MARCH 2025)

- Boxcut wall & Portal Face
- Fibrecrete, cable bolts & solid bar installed on Transitional Monzonite

SITE VISIT (MARCH 2025)

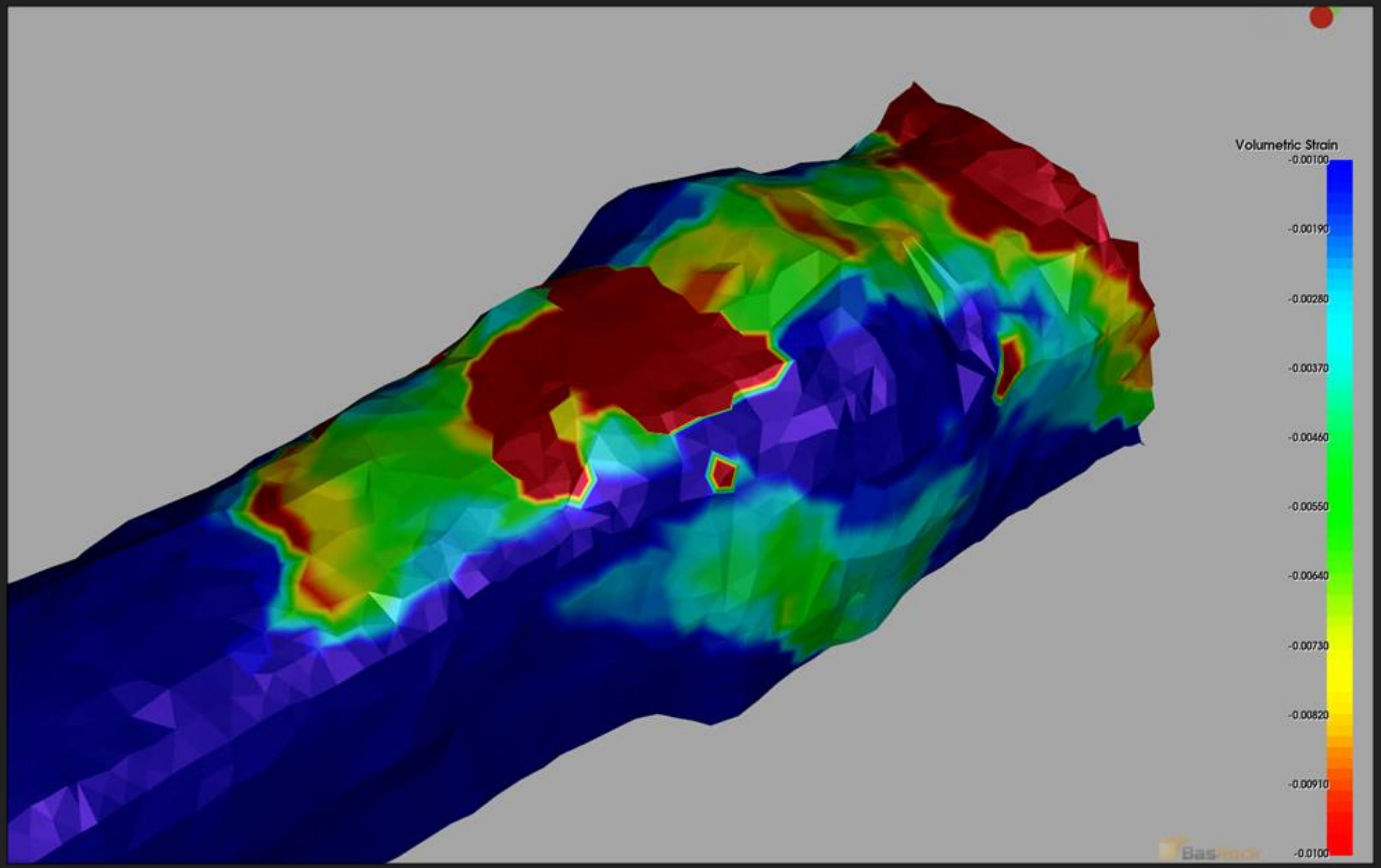
- Decline face (approx. 20m)
- Good profile
- Mapped Q of 3.13 (Average 3.13 for last 4 cuts)
- Mapped RQD of 50 (Average 46 for last 4 cuts)
- Improving ground approaching "fresh"
- Remains very weak, foliated rockmass

SITE VISIT (MARCH 2025)

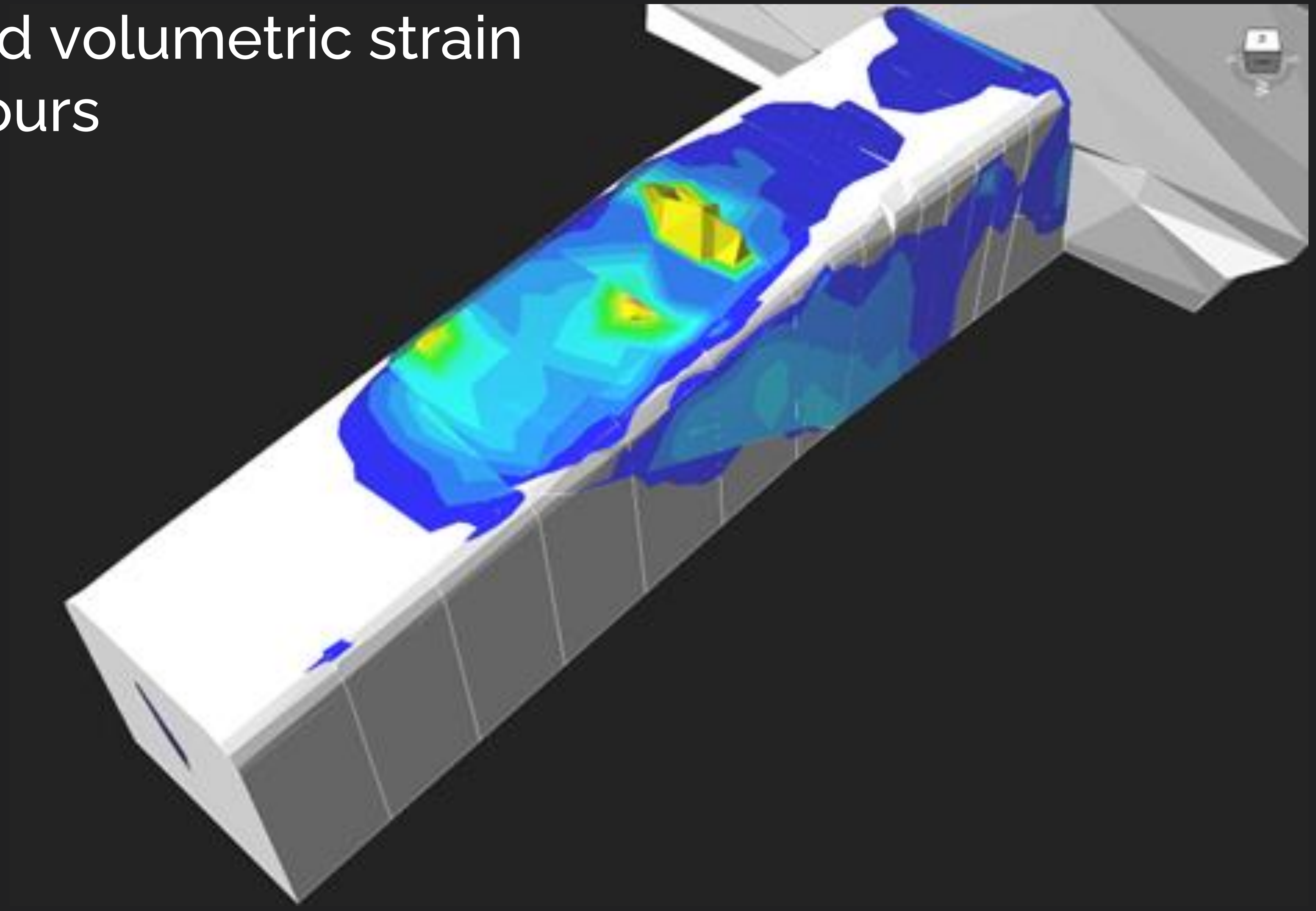


- Decline Support
- GS4.2 installed: Fibrecrete, cable bolts & solid bar installed in Transitional Monzonite
- Improving ground approaching "fresh"
- Case for dropping the GSS level

HOW DOES IT COMPARE TO THE MODEL?



- Reasonable correlation between overbreak and volumetric strain surface contours



CONCLUSION

- Model correlates reasonably with measured overbreak
- Observed portal face and ground support performing as designed and modeled
- Decline liner cracking in the weathered zone not present
- Design inputs verified by observed conditions better than expected
- Encountered conditions in line or better than modelled conditions

STRATEGIES GOING FORWARD....

- Damage mapping of the fibrecrete liner to detect cracking
- QAQC Fibrecrete thickness measurement to verify that as-placed matches design
- Borehole camera damage logging to determine extent of fracturing in the backs and walls
- Mapping the geological contact between the weathered and fresh domains to compare with the model
- Displacement monitoring of the boxcut batter face to confirm stability
- On-going validation of the rock mass domaining, feedback into live and evolving geotechnical model
- Increasing confidence and avoidance of complacency

TAKE-AWAY

- All design inputs require verification in the field
- All numerical models require verification in the field
- Continued data gathering to feed back into the geotechnical model keeps it live
- Increases design confidence

- IF YOUR MODEL DOESN'T MATCH FIELD OBSERVATIONS – YOUR MODEL IS WRONG!

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