Report on Desktop Mine Subsidence Assessment

Gillieston Public School Redevelopment and New Public Preschool

Project No.304501632-004.3

Prepared for

Department of Education

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Stantec

Contact Information

Stantec Australia Pty Ltd
ABN: 17 007 820 320

Suite 22, Level 2
22 Honeysuckle Drive
Newcastle NSW 2300
Australia
www.stantec.com

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Author(s):		Effective Date
Jesse Graczyk Senior Geotechnical Engineer		6/11/2024
Reviewed By:	Approved By:	Date Approved
Ian Piper Technical Services Manager, Geotechnical	George Ashworth Group Leader – Geotechnical Engineering	6/11/2024

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1	5/11/2024	First Draft to Client	JG	IGP/GA
2	26/11/2024	Amendment as per planner and client comment	JG	GA
3	15/01/2025	Amendments to wording as per SI Planning and client request	JG	JG/GA

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Activity

The Gillieston Public School have been identified by the NSW Department of Education (DoE) as requiring redevelopment. The proposed redevelopment of Gillieston Public School is driven by service need including increase in expected student enrolments and the and removing demountable structure and replacement with permanent teaching spaces.

The Gillieston Public School redevelopment and new public preschool comprises the following activity:

- *Demolition and removal of existing temporary structures.*
- *Site preparation activity, including demolition, earthworks, tree removal.*
- *Construction of new:*
  - *32 permanent general learning spaces and 3 support teaching spaces*
  - *Administration and staff hubs*
  - *Hall, canteen and library*
  - *Out of school hours care*
  - *Public preschool (standalone building for 60 places)*
  - *Covered Outdoor Learning Areas (COLAs)*
  - *Outdoor play areas, including games courts and yarning circle*
  - *New at-grade car parking*
  - *Extension of the existing drop-off / pick-up area and new bus bay*
  - *Realignment of the existing fencing*
  - *Associated stormwater infrastructure upgrades*
  - *Associated landscaping*
  - *Associated pedestrian and road upgrade activity*

Significance of Environmental Impacts

Based on the identification of potential impacts and an assessment of the nature and extent of the impacts of the proposed activity, it is determined that all potential impacts can be appropriately mitigated to ensure that there is minimal impact on the locality, community and/or the environment.

Further information on the mitigation measures for the identified risks associated with mine subsidence are outlined in Section 7.

1 Background

1.1 Introduction

This report presents the findings of a desktop mine subsidence assessment undertaken by Stantec Australia Pty Ltd (Stantec) for proposed redevelopment of Gillieston Public School located at 100 Ryans Road and 19 Northview Street, Gillieston Heights NSW.

The assessment has been undertaken in conjunction with other engineering services by Stantec that have been commissioned by NSW Department of Education ('DoE') (the 'client').

1.2 Proposed Activity

Based on information provided by Johnstaff, the client's representative, the redevelopment of Gillieston Public School comprises the following activity.

> *'Demolition and removal of existing temporary structures,*
> *Site preparation activity, including demolition, earthworks, tree removal, and*
> *Construction of new:*
> - *32 permanent general learning spaces and 3 support teaching spaces*
> - *Administration and staff hubs*
> - *Hall, canteen and library*
> - *Out of school hours care*
> - *Public preschool (standalone building for 60 places)*
> - *Covered Outdoor Learning Areas (COLAs)*
> - *Outdoor play areas, including games courts and yarning circle*
> - *New at-grade car parking*
> - *Extension of the existing drop-off / pick-up area and new bus bay*
> - *Realignment of the existing fencing*
> - *Associated stormwater infrastructure upgrades*
> - *Associated landscaping*
> - *Associated pedestrian and road upgrade works'*

Based on review of concept plans it's understood that one of the proposed permanent structures is in the order of four (4) storeys high.

1.3 Purpose and Objectives

The purpose of this assessment is to support the Review of Environmental Factors (REF) for the proposed site redevelopment, as described in Section 2. This Assessment and report has been undertaken in order to address the following requirement.

'21. Mine Subsidence

- *Provide a mine subsidence risk assessment undertaken by a suitably qualified geotechnical practitioner to address any potential subsidence risks from active or non-active underground mining, in accordance with the Subsidence Advisory NSW advice (attached).'*

Review of the letter from Subsidence Advisory (SA) NSW (Ref.EOTH24-00188,Dated. 2 July 24) indicated the following regarding the site,

> The property is not within a declared Mine Subsidence District and thus approval by SA NSW is not required.
> The property is underlain by workings of the Homeville Top Split Seam at 390 m depth of cover.
> The property is within the angle of draw of workings of the Greta Top Split Seam at 320 m cover.

> Recommendations that a desktop mine subsidence study is undertaken by a suitable consultant and structures are designed *'to remain serviceable for any recommended subsidence parameters contained in the study'*

Although not within a mine subsidence district and given that district extents can change, the desktop assessment has been undertaken by considering the proposed activity with respect to the Subsidence Advisory (SA) NSW Merit Assessment Policy [1].

The desktop mine subsidence assessment has been based on the available data. If any additional data is made available at the completion of the report, review of the assessment findings would be necessary.

The recommendations within the report are based upon mine survey plans (typically referred to as record tracings') obtained from the NSW Resource Regulator (Department of Primary Industries and Regional Development). The plans which can be viewed in person at our offices are not available for reproduction due to a confidentiality agreement between Stantec and the Resource Regulator; however, extracts of the plans are included in the report.

2 Site Description

The Site is identified as 100 Ryans Road and 19 Northview Street, Gillieston Heights, legally described as Lot 51 DP 1162489 and part Lot 2 DP1308605.

The Site is located within the Maitland Local Government Area (LGA) and is zoned RU2 Rural Landscape and R1 General Residential zone under the provisions of the Maitland Local Environmental Plan 2011 (MLEP2011).

Existing attributes of the subject site are noted as follows:

- *The subject site exhibits an area of approximately 23,385m² and is located in the suburb of Gillieston Heights;*
- *The subject site has a frontage to Ryans Road to the east, Gillieston Road to the north, and Northview Street to the south;*
- *In its existing state, the subject site comprises the existing Gillieston Public School. Existing school buildings are primarily located in the west portion of the subject site with a large area of open space situated in the eastern portion. There are limited permanent structures located on the subject site with thirteen (13) existing demountable classrooms currently occupying the subject site. Permanent buildings consist of the Main Administration Building, Original Brick Cottage, Library and GLS building located in the centre of the subject site; and*
- *Carparking is provided from Gillieston Road for staff. Pedestrian access is available via this main entrance from Gillieston Road and via a separate pedestrian-only access gates on Northview Street and Ryans Road.*

The existing site context is shown in Figure 2-1 and Figure 2-2 below.

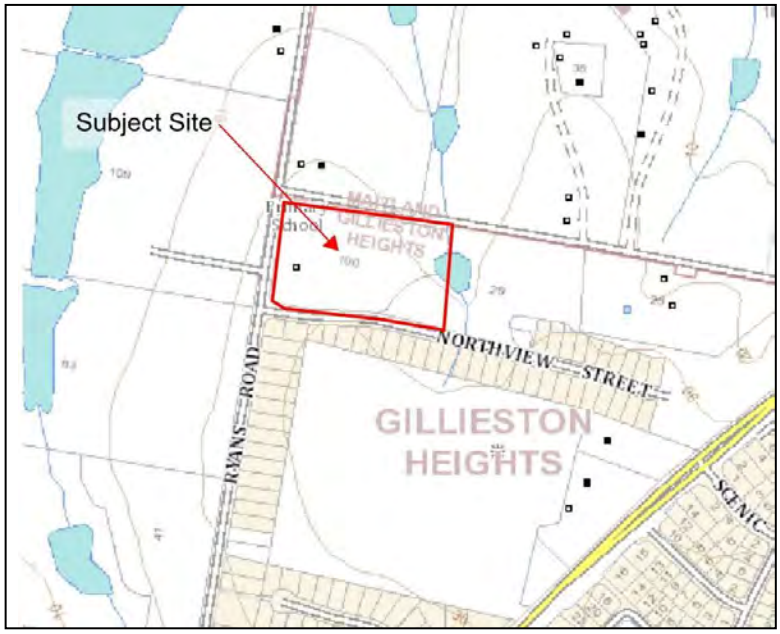


Figure 2-1 Cadastral Map (Source: NSW Spatial Viewer, 2024)

Figure 2-2 Site Aerial Map (Source: Near Map, 2024)

Topography at the site is governed by a broad south to north ridgeline falling through the western portion of the site. From this ridge, site slopes in the eastern portion fall to a south to north trending gulley situated at the eastern boundary of the site. Slopes from the western boundary (Ryans Road) fall west to a low-lying flood plain approximately 200 to 250 m to the west.

Surface elevations at the site are estimated as generally 28 m Australian Height Datum (AHD) in the south-western portion of the site to 16 m in the north-eastern corner based on a review of Mecone mosaic [2] (See Figure 2-3)

Observations relating to mine subsidence made during a site walkover are summarised in Section 4.

Figure 2-3 Approximate Site Location obtained from Mecone Mosaic [2]

3 Desktop Review

The desktop assessment has been generally limited to review of the following;

- Online published geological mapping,
- Accessible public exploration borehole data,
- NSW Planning portal,
- Mine tracing plans relevant to the site purchased from the NSW Resource Regulatory, and
- Geospatial Data provided by SA NSW.

3.1 Published Geology

A review of the NSW Seamless Geology layer on the NSW Government's online web mapping application "Minview" [3] indicates the site to be underlain by the Branxton Formation (**Pmtb**). This formation is known to comprise conglomerate, sandstone and siltstone.

Alluvial backswamp deposits (**Q_ab**) and Greta Coal Measures (**Pgr**) are noted to be mapped approximate 250-300 m to the west. It is anticipated that the coal seams that were mined and are potentially impacting the site were undertaken on Coal Seams of the Greta Coal Measures (**Pgr).** It is expected that the mined seams daylight/outcrop in this location and dip to the east below the Branxton Formation (**Pmtb**). The Greta Coal Measures are understood to comprise *'Sandstone, siltstone, pellet claystone, coal, chert, sporadic conglomerate.'*

Figure 3-1 Published Geology at the site obtained from NSW Government's "Minview" [3]

3.2 Nearby Published Boreholes

A review of published exploration boreholes was undertaken utilising NSW Government's online data viewer "Minview" [3] was undertaken for the site. No boreholes within suitable distance to the site were noted.

3.3 NSW Planning Portal

A review of NSW Government's online Planning Portal "ePlanning Spatial viewer" [4] indicates that the site is not situated within a Mine Subsidence District. The eastern boundary of the Maitland West district is noted to be on the other side of Ryans Road (west of the site). Review of the underground mining layer on the planning portal indicates the site is partially underlaid by known mine workings.

The review of planning portal is consistent with SA NSW's advice (Ref.EOTH24-00188, Dated. 2 July 24).

3.4 Mine Record Tracings

Stantec were supplied with mine record tracings by the NSW Resource Regulator. Review of the supplied tracings indicated the following tracings relevant to the site with historical mine workings either underlying or potentially impacting the site,

- RT422 – Sheet 1
- RT423 – Sheet 1

Record Tracings RT435, RT516, M19297 (Sheets 1 to 6) and M19200 were also provided but appear to either be associated with workings well away from the site or give no additional information to those listed above.

The site has been approximately overlaid onto an extract of RT422 and RT423 and are attached as **Drawing 1** and **Drawing 2** in **Appendix A** respectively. It should be noted that the overlays are approximate only and were scaled and orientated utilising limited details on the record tracings including indicative road envelopes.

Review of the tracing RT422 and RT423 indicate that extensive mining of two seams by the East Greta Colliery has been undertaken adjacent and/or below the site referred to as the 'Top Seam' and the 'Bottom Seam' respectively. Dates on the tracings indicate the first workings within both seams were undertaken in the 1920s with cessation of operations in 1928. Both tracings were signed by a registered surveyor in 1962.

3.4.1 East Greta Colliery - Top Seam (RT422)

Review of RT422 indicated the following regarding mine workings of the Top Seam potentially impacting the site.

- The Top Seam has been extensively mined to the west of the site by the East Greta Colliery.
- The panel of Top Seam mine workings associated with the East Greta Colliery mine is noted to be generally 400-500 m wide in the east-west direction and 3 km long in the south-north direction.
- Based on the overlay of the plans, the eastern limit of the mine workings is situated approximately 20 m from the western boundary of the site.
- The workings of this seam are noted to be generally bord and pillar workings presumably hand-worked given the age. Approximately 300 m to the west to south-west a range of pillars are half shaded indicating pillar robbing/extraction (secondary extraction). These are dated 1962. Pillar robbing/extraction was also noted at the northern extent of the mine approximately 700-800 m north of the site.
- Pillars are generally long and slender with widths of generally less than 10 m (scaled off the plans). Pillars are generally orientated in a south to north direction.
- A range of generally east trending tunnel entrances are noted on the western side of the mine with the closest approximately 500 m from the site.
- Notation on RT422 indicates the dip of the seam to be generally east to south-east and is steep at approximately 38 to 43◦.
- Using the seam dip noted on the entry roadways, tunnel locations and estimated surface RLs from Mecone Mosaic [5] cover depths are anticipated to range from 0 m at the tunnels to 320 to 340 m deep in the eastern portion in proximity to the site
- A schematics of the seam depicted on the tracing at location A (approximately 650 m to the south-west) indicates the seam to be approximately 8.8 m thick (See Table 5-3). It is noted in the schematic that the seam comprises bands of inferior or dirty coal including a 6 to 7 foot inferior. It is unlikely that the full seam was extracted during mining.
- The schematic does not have any notes on the roof material. Fire Clay is noted in the floor beneath the inferior coal.
- A Stone Drive from the bottom Seam (assuming to be connecting the two seams) is depicted approximately 500 m south-west of the site.

It is noted that SA NSW in their letter (Ref.EOTH24-00188,Dated. 2 July 24) refer to the seam as the Greta Top split Seam.

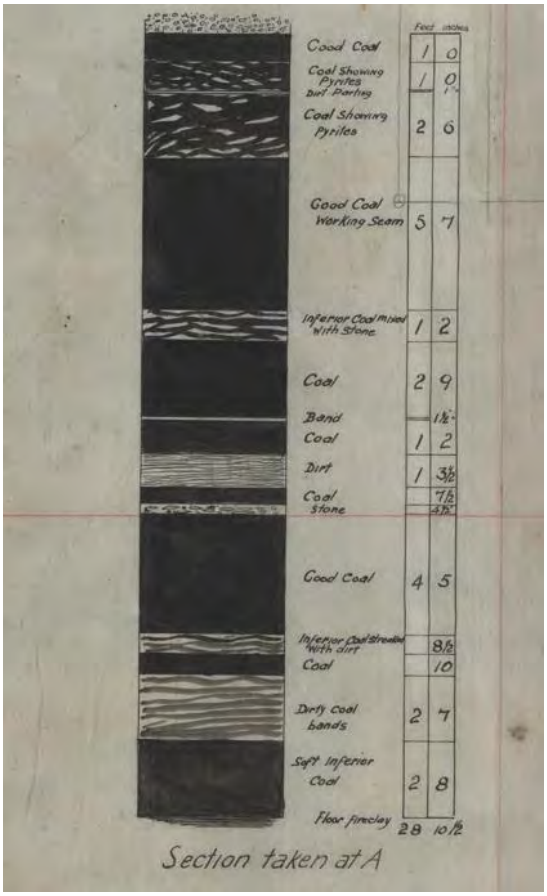


Figure 3-2 Schematic of the Top Seam workings of the East Greta Colliery - Location A on RT422

3.4.2 East Greta Colliery - Bottom Seam (RT423)

Review of RT423 indicated the following regarding mine workings of the Bottom Seam potentially impacting the site.

Type of Mining and History

- The Bottom Seam has been extensively mined to the west and within the western portion of the site by the East Greta Colliery.
- The panel of Top Seam mine workings associated with the Easte Greta Colliery mine is noted to be up to 600 m wide in the east-west direction and 5 km long in the south-north direction.
- The workings of this seam are noted to be originally bord and pillar workings (first workings) presumably hand-worked given the age. Complete Pillar removal (Secondary Extraction) has been undertaken on sections of pillars indicated by the shading within 100 m of the site's western boundary. No indication of the secondary extraction being undertaken at a different date to first workings(1920s) could not be found on the tracing.
- First working pillars are generally long and slender with widths of generally less than 12 m (scaled off the plans). Pillars are generally orientated in a south to north direction.
- A range of generally east trending tunnel entrances are noted on the western side of the mine with the closest approximately 500 m from the site. It is noted that these tunnels are slightly west of those for the Top Seam.

Seam Dip, Details and Cover Depth

- Notation on RT423 indicates the dip of the seam to be generally east to south-east and is steep at approximately 45 to 46◦ at the notated location closest to the site. The dip is noted up to 50-55ish degrees further south.

- Using the seam dip noted on the entry roadways, tunnel locations and estimated surface RLs from Mecone Mosaic [5] cover depths are anticipated to range from 0 m at the tunnels to possibly up to 450 m deep in the eastern portion underneath the site.
- Schematics of the seam depicted on the tracing indicate the seam to be approximately 3 – 3.6 m thick converted from feet and inches(See Figure 3-3 and Figure 3-4).
- The schematics indicates the immediate roof to contain shale of 2 foot or less thickness overlain by hard conglomerate. It is assumed that this conglomerate unit is the main unit separating the Bottom and Top Seams. The schematics also indicate the floor to be soft shale.

It is noted that SA NSW in their letter (Ref.EOTH24-00188,Dated. 2 July 24) refer to the seam as the Homeville Top Split Seam.

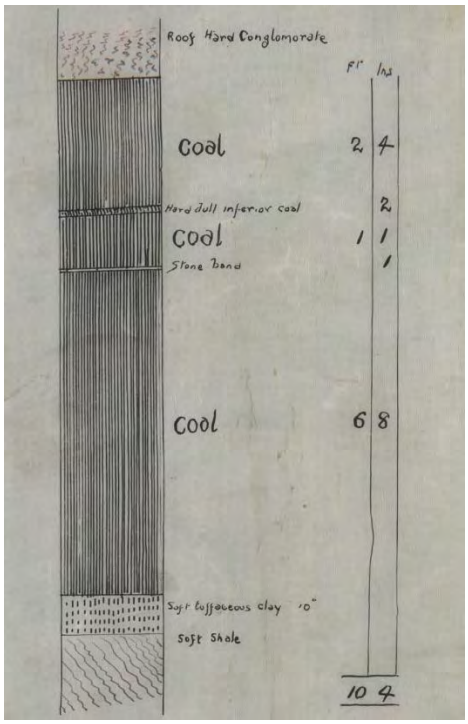


Figure 3-3 Schematic A of the Bottom Seam Workings of the East Greta Colliery – RT423

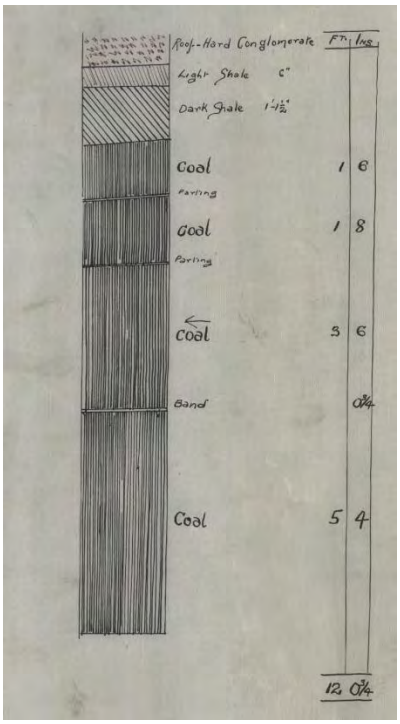


Figure 3-4 Schematic B of the Bottom Seam Workings of the East Greta Colliery – RT423

3.5 Subsidence Advisory

Stantec also retrieved geospatial information held by SA NSW for the site for review. The following was noted upon review of the information provided.

- Interpretation of the limit of workings for both seams was generally consistent with those interpreted by Stantec,
- The Bottom seam has in fact been referred to as the ‘Homeville Seam’,
- Estimated cover depths for the Top Seam are noted to be up to 320 m, and
- Estimated cover depths for the Bottom Seam (Homeville Seam) are noted to be up to 430 m.

Due to confidentiality requirements the retrieved data from SA NSW has not been attached to this report.

4 Site Walkover

On the 17th of October an experienced geotechnical engineer from Stantec undertook a site inspection in order to identify any obvious signs of mine subsidence at the surface. The following observations were noted during the inspection.

- Existing structures in the western portion of the site were predominantly prefab demountable structures and founded on a combination of brick and concrete tapered piers. Two permanent structures were noted, one weatherboard founded on piers and another brick structure. Other than occasional wear and tear and minor movement, no obvious major signs of mine subsidence were identified in the externals of the structures. No significant cracking was observed in the piers and bearers were typically fully founded on piers.
- Other structures such as the school cola were briefly inspected with no obvious signs of subsidence.
- The eastern portion of the site was noted to be grassed play areas with gentle east trending slopes. No clear indications of subsidence were noted in the eastern portion of the site other than typical gentle undulations that are likely part of the natural landform.

It should be noted that where trough subsidence occurs it can be difficult to identify at the surface, particularly for workings of such depth where the resultant subsidence bowl would cover a large area.

Considering the age of the mining (1920s), it should also be noted that where subsidence had occurred prior to construction of the structures, defects may be limited and would be limited to causes of further subsidence (e.g. residual subsidence / creep etc). This is particularly relevant to the demountable structures that are likely more modern. A range of the permanent structures based on aerial review have been there since at least 1954; however, it is unknown if they were constructed pre or post the first majority of mining (1920s).

5 Mine Subsidence Assessment

Stantec have undertaken a mine subsidence assessment for the proposed activity. Although not within a proclaimed mine subsidence district, Subsidence Advisory (SA) NSW indicated that the site is impacted by two sets of deep (300+ m) mine workings and thus recommended a desktop mine subsidence study be undertaken for the site by a geotechnical consultant.

While the site is in proximity but not within a dedicated mine subsidence district, Stantec have assessed the site with consideration of SA NSW's Merit Assessment Policy [1]. It should also be noted that mine subsidence district extents are subject to change. The policy assesses for two main types of subsidence risk including sinkhole (pothole) and trough subsidence. The policy also outlines SA NSW's likely requirements for the activity if it were in a mine subsidence district.

5.1 Sinkhole (Pothole) Subsidence Risk

With reference to the Merit Policy [1], sinkhole subsidence risk is typically assessed on the basis of cover depth, the state of the workings, overburden characteristics, seam dip, previous history of pothole formation and the age and type of mine workings present.

A typically used rule of thumb for the presence of sinkhole risk is for workings with cover depths less than 10 times the mined seam thickness.

Based on the desktop review undertaken, the depth to the mine workings impacting the site (within the Angle of Draw) are significantly deeper than 10 times the seam thickness assuming a conservative combined extraction thickness of 10 m for both seams. As such, sinkhole risk at the site would be considered negligible and has not been considered in this report.

5.2 Trough Subsidence Risk

Considering the depth of workings impacting the site, trough subsidence will be the main risk of subsidence. Within the Merit Policy, SA NSW have different design requirements (e.g. mitigation measures) for areas with trough subsidence risk based on;

- The type of proposed structure (building classification),
- The Geotechnical Risk Factor (GRF); and
- The pillar panel Factor of Safety (FoS) i.e. stability of coal pillars.

5.2.1 Building Category

Based on understanding of the project, it is anticipated that the proposed activity would be classified as a **category B3 building** in accordance with Attachment A of the Merit Assessment Policy [1].

5.2.2 Geotechnical Risk Factor (GRF)

The level of geotechnical uncertainty is categorised on the level of confidence in the following factors with reference to the respective weightings:

- Geological environment (R1=3);
- Level of geotechnical investigation (R2=2);
- Quality of coal mine plans and records (R3=3); and
- Method used to assess stability and impact (R4=3).

The following equation is used to determine the uncertainty factor:

$$GRF = (R1\ x\ U) + (R2\ x\ U) + (R3\ x\ U) + (R4\ x\ U)$$

The Geotechnical Risk Factor (GRF) for the Bottom Seam (RT423) and Top Seam (RT422) mine workings impacting the site have been calculated in accordance with SA NSW's Merit Assessment Policy [1] as per the assumptions outlined in Table 5-2 and Table 5-1 respectively.

Table 5-1 Determination of Uncertainty Values for GRF Calculation – Bottom Seam (Based on Table C1 of the Merit Policy [1])

Parameter	Weighting factor (Ri)	Level of uncertainty (Ui)	Weighting x Value (Ri x Ui)	Justification
Geological Environment	R1 = 3	Low (1)	3	No indications of faults, dykes and any other adverse geological structures within and in close proximity (immediate panel) to the site were noted on the relevant record tracings.
Level of geotechnical investigation (R2)	R2 = 2	High (3)	6	No investigation undertaken at the site.
Coal Mine Plans and Records (R3)	R3 = 3	Moderate (2)	6	Pillar widths and lengths show some variation but an approximate alignment along their long axis. Pillars show similar shape in plan. Secondary extraction of pillars undertaken further than 50 m away.
Method used to assess stability and impact	R4 = 3	High (3)	9	Pillar loading environment complicated by geological factors - Multi Seam workings, secondary extraction areas. Geotechnical Model based on no support by geotechnical data.
GRF			= 24	High Geotechnical Risk Factor

Table 5-2 Determination of Uncertainty Values for GRF Calculation – Top Seam (Based on Table C1 of the Merit Policy [1])

Parameter	Weighting factor (Ri)	Level of uncertainty (Ui)	Weighting x Value (Ri x Ui)	Justification
Geological Environment	R1 = 3	Low (1)	3	No indications of faults, dykes and any other adverse geological structures within and in close proximity to the site were noted on the relevant record tracings.
Level of geotechnical investigation (R2)	R2 = 2	High (3)	6	No investigation undertaken at the site.
Coal Mine Plans and Records (R3)	R3 = 3	High (5)	15	Pillar widths and lengths show some variation but an approximate alignment along their long axis. Pillars show similar shape in plan. Secondary extraction of pillars undertaken further than 50 m away. **However, pillars impacting the site can have an average w/h <2 based on assumptions.**

Parameter	Weighting factor (Ri)	Level of uncertainty (Ui)	Weighting x Value (Ri x Ui)	Justification
Method used to assess stability and impact	R4 = 3	High (3)	9	Pillar loading environment complicated by geological factors - Multi Seam workings, secondary extraction areas. Geotechnical Model based on no support by geotechnical data.
GRF			= 33	High Geotechnical Risk Factor

Based on the levels of uncertainty adopted in Table 5-2 and Table 5-1 above, a Geotechnical Risk Factor (GRF) corresponding to a **high** level of geotechnical risk was calculated for mine workings of both seams.

SA NSW's likely requirements and criteria can be seen outlined in Table C2 of the Merit Policy [1]. Where a high geotechnical risk has been identified, a minimum pillar FoS is not specified, and design requirements (e.g. mitigation measures) are dependent on the building type irrespective of the calculated FoS. Regardless, the stability of Pillars has been assessed in Section 5.2.3 below to inform the likelihood of trough subsidence occurring at the site and the likely consequences.

With reference to Table C2, the following design requirements are required for a B3 development with a high GRF,

- *Design for Serviceability to accommodate the subsidence design parameters provided by a geotechnical practitioner or by Subsidence Advisory.*
- *If the proposed structure is not able to be designed to be Serviceable, mitigation or elimination of the subsidence risk of mine subsidence by grouting of the mine will be required. This will include a Grout Design, Implementation, Verification Plan completed in accordance with Attachment E, followed by a peer review as outlined in Attachments D.*
- *Following design, a Mine Subsidence Design Structural Engineer Certification Form (Attachment F) or Engineering Impact Statement is required, demonstrating the structure will remain Serviceable under either the subsidence design parameters or the residual subsidence parameters given in the grout design.*
- *Detailed design drawings prior to commencement construction are required to be submitted, with the subsidence design parameters designed for clearly marked on the plan.*
- *Several permanent survey marks will be required so that building movement can be monitored should mine subsidence occur.*
- *Following construction, confirmation that the construction is in accordance with the plans approved by Subsidence Advisory is required.'*

Section 4.8 of the Merit Policy [1] outlines the definition for Safey and Serviceability design requirements.

5.2.3 Pillar Stability Assessment

An assessment of pillar stability has been performed for the site for both Bottom Seam (RT423) and Top Seam (RT422). The assessments aim was to evaluate the likelihood of pillars collapsing and impacting the site or conversely, remain standing. The assessment was performed based on the review of tracings and a range of assumptions described below in Section 5.2.3.1.

An approximate Angle of Draw 'AoD' has been also depicted on Drawing 3 and Drawing 4 around the site envelope. The AoD represents a horizontal zone of influence where collapse of workings within this zone would impact the site once the subsidence propagated to the surface. The typically adopted AoD for the coalfields in the Hunter is taken as 26.5◦ off vertical or 1H:2V (L. Holla [6]). In other words, a horizontal distance approximately half of the vertical depth to the mine workings. It is noted that the adopted angle of draw is likely conservative given the seam dip with shallower cover depth to the west.

It is noted when referring to the Merit Assessment Policy [1], the average FOS of the mined panel is to be considered. The concept of a mined panel is understood to be typically defined by pillars of similar size bound by barrier pillars or unmined areas. Review of the relevant tracing has indicated that defining a distinct mined panel beneath the site to be difficult. As such the following has been assessed for assessment of each seam;

- Bottom Seam (RT423) – Pillars within the angle of draw and bound by areas of secondary extraction as these have been assumed to have collapsed.
- Top Seam (RT422) – pillar assessment has been limited to those within the angle of draw. It was intended to expand the assessment further west however based on the preliminary results it is likely that this would provide sufficient information.

The assessed pillars can be seen depicted in **Drawing 3 and Drawing 4** attached in Appendix A.

5.2.3.1 Assumptions for Assessment

Typical assumptions adopted for assessment of the stability of the pillars under the site are shown in Table 5-3 with the pillar geometry notation generally defined in Figure 5-1. The pillar dimensions have been measured for the pillars depicted in Drawing 3 and Drawing 4 (Appendix A) with the assessment considering the average of individual pillar stability results as per SA NSW Merit Assessment Policy [1].

Abutment loading has been applied to pillars of the Bottom Seam (RT423) in proximity to the areas of complete pillar extraction using the concepts laid out in "*Pillar Abutment Loading – New Concepts for Coal mining industry"* [7]. This was applied by considering 70% of the abutment load on the immediate pillars and 30% on the second row of pillars.

The pillars have been analysed using the NSW and Queensland Maximum Likelihood Eq. 40a/40b of Galvin's paper [8] using an in-house Stantec spreadsheet.

Given the significant depth of the workings below the site, no additional imposed load as a result of proposed structures have been applied to the pillars for the purpose of pillar stability.

Anecdotally and indicated on the tracings the two seams impacting the site are separated by a hard conglomerate unit. Given the distance between the seams for pillars within the angle of draw, no interaction between the seams has been assumed for the pillar assessment to allow simplicity of calculations.

The pillars analysed as part of the assessment can be seen depicted in **Drawing 3** and **Drawing 4**, attached in Appendix A with pillar stability calculations contained in Appendix B.

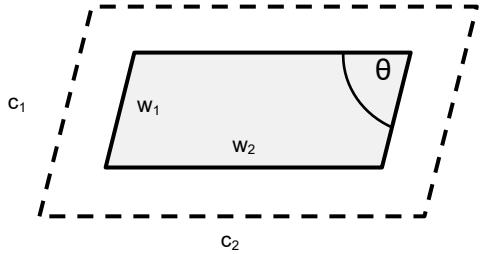


Figure 5-1 Pillar geometry definition

Table 5-3 Dimensions of Workings and Assumptions for Pillar Stability Assessment of the Bottom Seam and Top Seam at the Site

Variable / Parameter	Seam		Comments
	Bottom Seam (Homeville) (RT423)	Top Seam (RT422)	
Cover to Seam (H) m	Variable - ranging from 310 m to 430 m within the angle of draw area	Variable - ranging from 230 m to 320 m within the angle of draw area	Consideration of SA NSW provided geospatial data and interpretation of cover depths based on seam and roadway dip (tracings), tunnel locations and R.Ls approximated from Mecone mosaic [2]. Refer to Calculations contained within Appendix B.
Approximate Seam thickness (m)	3.6 m	8.8 m	In the absent of additional information, an assumed full seam extraction has been assumed for the Bottom Seam. Reduced extraction has been assumed for the Top Seam due to the presence of inferior coal in the floor.
Extraction thickness, h (m)	3.6 m Sensitivity (3.0 m) Sensitivity (2.5 m)	6.8 m Sensitivity (5.3 m) Sensitivity (3.5 m)	
Angle of draw (degrees)	26.50		As suggested by L. Holla [6] Interpreted based on cover depth and associated zone of influence depicted on **Drawing 1** to **Drawing 4** attached in Appendix A.
Unit weight of rock (kN/m^3)	24		As assumed by Galvin et al. [8]
Pillar width w_1 (m)	Variable. Refer to Calculations contained within Appendix B		Dimensions estimated by measuring off the overlaid mine record tracing. 0.5 m subtracted from pillar dimensions and subsequently 0.25 m added to measured bored widths to allow for some plan inaccuracies. In the event of an irregular shaped pillars, generally the average of the widths of the opposing sides was approximately taken and an equivalent rectangle considered for complex shapes (or use of angle between side adjustments where appropriate).
Pillar width w_2 (m)			
Bord width x_1 (m)			
Bord width x_2 (m)			
Tributary Area Width, $c_1 = w_1 + 2*(x_1/2)$ (m)			
Tributary Area Width, $c_2 = w_2 + 2*(x_2/2)$ (m)			
Effective pillar width w_{eff} (to nearest m)			As calculated by Galvin et al. [8]
Average R = w/h			As calculated by Galvin et al. [8]
Angle between adjacent pillar sides (°)			Measured off overlaid mine record plans
General Extraction ratio	33%	30%	Estimated from overlaid mine record tracing
Groundwater	The assessment has been undertaken in a dry state.		No allowance for buoyancy forces.

5.2.3.2 Pillar Stability

On the basis of the probabilistic analysis of pillar performance data in NSW and Queensland presented by Galvin [4], a relationship between Factor of Safety and Probability of Failure has been defined. The relationship for the Power Law formula is listed in Table 5-4.

Table 5-4 Relationship Between FOS and Probability of Failure (Galvin et al, 1998) [4]

Probability of Failure	Factor of Safety
8 in 10	0.87
5 in 10	1.00
1 in 10	1.22
1 in 20	1.30
1 in 50	1.38
1 in 100	1.44
1 in 1,000	1.63
1 in 10,000	1.79
1 in 100,000	1.95
1 in 1,000,000	2.11

It is noted that the SA Merit Assessment Policy [1], does not have a required FoS for high uncertainty (high GRF) sites. For a quantifiable value, a commonly acceptable level of risk is typically considered as 1 in 1,000,000 i.e. FoS ≥ 2.11.

Stantec have undertaken the assessment with consideration of the above factors for the risk assessment of mine working collapse and potential damage to the proposed activity. The procedure presented by Galvin [4] has been used to assess the pillars within the site and angle of draw.

The pillars analysed as part of the assessment can be seen depicted in Site Plans **Drawing 3** and **Drawing 4.** The results of the assessment are summarised below in Table 5-5 and Table 5-6 with calculation tables within Appendix B.

5.2.3.3 Bottom Seam

Table 5-5 Summary Results of Pillar Stability Analysis for the Bottom Seam (RT423)

Extraction thickness (m)	**3.6**		**3.0**		**2.5**	
	w/h	**FoS**	**w/h**	**FoS**	**w/h**	**FoS**
Average Values for Assessed Pillars	2.67	**0.6**	3.21	**0.72**	3.85	**0.88**

Notes to Table:
w/h – width to height ratio of pillars (slenderness)
FoS – Factor of Safety – calculated using concepts including equations 40a/40b by Galvin [8].

Based on the pillar stability assessment of the Bottom Seam, an average pillar FoS for the assessed pillars is noted to be 0.6 indicating the pillars have likely already failed. The low FoS values can be predominantly attributed to,

- The depth of workings as the pillar stability assessment assumes full overburden tributary load over each pillar.
- The abutment loads associated with secondary extracted areas loading pillars.
- The relatively narrow widths of the pillars.

It was noted that for an extraction thickness of 3.6 m only a single pillar (#90) was noted to have FoS greater than 1.0. When abutment loading from surrounding pillars with FoS<1 was applied, this pillar's FoS also dropped below 1.

Sensitivity assessments were undertaken also for smaller extraction thicknesses (3.0 m and 2.5 m) with the resultant average FoS still less than 1. It was noted that many individual pillars had FoS greater than 1 for

the sensitivity assessment (and predominantly less than 1.2); however, no abutment load was applied to these pillars from adjacent collapsed pillars which would likely drop the FoS values below 1.

Additionally, when considering the poor floor materials for the Bottom Seam indicated on the schematic ('soft shale') with the overburden load and the fact the working are probably at least partially flooded, failure is also likely if not from pillar crushing (stability).

Based on the pillar stability assessment, it is considered that the Bottom Seam workings are unstable and likely have already collapsed. Proving the workings are collapsed via drilling would be generally unfeasible given the depth and as such, nominal mine subsidence parameters have been provided for in the unlikely event the workings are still standing and considering the requirements of the policy [1].

5.2.3.4 Top Seam

Table 5-6 Summary Results of Pillar Stability Analysis for the Top Seam (RT422)

Extraction thickness (m)	6.8		5.3		3.5	
	w/h	FoS	w/h	FoS	w/h	FoS
Average Values for Assessed Pillars	1.34	**0.54**	1.72	**0.66**	2.6	**0.94**

Notes to Table:
w/h – width to height ratio of pillars (slenderness)
FoS – Factor of Safety – calculated using concepts including equations 40a/40b by Galvin [8].

Based on the pillar stability assessment of the Top Seam pillars within the conservative angle of draw, the average pillar FoS was calculated as 0.54. Similar to the Bottom seam, this indicates the pillars have likely already failed considering the depth of workings and relatively narrow widths.

The assessment was also undertaken for an extraction of 5.3 m considering the floor and roof surrounding the thicker 'good coal' seams was undertaken (See Figure 3-2). Resultant average FoS values were 0.66 with no pillars above 1.0, again indicating pillars are likely failed.

To further investigate, a nominal thinner extraction of 3.5 m was also considered with a resultant average FoS of 0.94. Approximately 80% of the pillars still had FoS <1 with the other 20% predominantly falling between approximately 1.0 and 1.2.

It is noted that for both seams, moving west FoS and associated pillar stability will increase as a result of shallower cover depths; however, given these are out of the angle of draw of the site and the workings within are likely collapsed, these pillars are unlikely to impact the site. This would only become an issue where the pillars within the angle of draw are still fully standing. Given the low FoS associated with the assessed pillars, in the unlikely scenario the pillars are still standing, the risk of a pillar run propagating towards the site in the event of collapse to the west would be moderate to high risk.

Based on the pillar stability assessment, it is considered that similar to the Bottom Seam, the Top Seam workings within the site's angle of draw are unstable and likely have already collapsed. The likely failure/crushing of the Bottom Seam workings would also likely impact the stability of the overlying workings.

Similar to the top seam, nominal mine subsidence parameters have been provided for in the unlikely event the workings are still standing.

5.3 Mine Subsidence Parameters

Given the proposed activity includes a relatively large structure (four storeys) within a school environment it would be prudent to design for subsidence impact parameters considering pillars are still standing (although low probability based on the assessment).

It is noted that given the multi-seam scenario and steep seam dip associated with the mine workings impacting the site, any subsidence is likely to manifest in a complex manner. It is anticipated that the empirical method outlined in 'Surface Subsidence Prediction in the Newcastle Coalfield' by L. Holla [6] would result in sufficient parameters for design.

In accordance with SA NSW Merit Assessment Policy (Table C2) [1], subsidence impact parameters have been estimated assuming all pillars with w/h ratios of less than 5 and FoS less than 2.1 fail as per SA NSW's merit policy [1].

The subsidence impact parameters have been calculated for each seam individual and then combined to formulate final recommendations for design.

5.3.1 Bottom Seam

The Bottom Seam subsidence parameters (See Table 5-7) have been estimated considering collapse of a panel of pillars with width spanning between the limit of workings and the area of secondary extraction (assumed collapsed).

Table 5-7 Subsidence Prediction Parameters – Bottom Seam (RT423) - based on Holla 1987 [6]

Parameter	Value
Panel Width, W (m)	160
Average Cover Depth over panel width, H (m)	370
Extraction Thickness (m)	3.6
Average Extraction Ratio (%)(1)	33 %
Effective Seam Thickness, T (m)	1.19 (m)
Recommended Parameters for the Site considering the Bottom Seam	
Maximum Subsidence S_{max} (mm)	**45**
Maximum Tensile Strain $+E_{max}$ (mm/m)	**0.1**
Compressive Strain - E_{max} (mm/m)	**0.3**
Maximum Tilt G_{max} (mm/m)	**0.1**
Radius of Curvature (km)	**20**

Notes to Table:

tensile (+Emax), Compressive (-Emax), Tilt (Gmax) and Radius of Curvature were taken from Figures 8,11,13 and 14 of Holla 1987 [6] Respectively.

(1) Estimated based on mine tracing.

5.3.2 Top Seam

Although it is anticipated that based on the pillar stability assessment the Top Seam pillars within the angle of draw of the site have collapsed, parameters have been derived considering pillars to be still standing. In the absence of additional data to that reviewed in the assessment, the working/extraction thickness of the Top Seam may be smaller than assumed which would increase FoS values and thus potential for pillars to still be standing.

In the absence of barriers and secondary extraction, the entire width of mined pillars has been assumed to collapse from a standing state for the purpose of defining worst case subsidence parameters.

The concepts in L. Holla [6] have been utilised to formulate a typical subsidence profile and relative location of the site on this profile. The interpretation of RT422 indicates workings to be approximately 20 m west of the proposed activity. To allow for inaccuracies in the tracing, the 'goaf edge' as defined by Holla [6] has been assumed to coincide with the western boundary of the site.

The recommended Top Seam subsidence impact parameters for the site can be seen in Table 5-8Table 5-7.

Table 5-8 Subsidence Prediction Parameters – Top Seam (RT422) - based on Holla 1987 [6]

Parameter	Value
Nominal Panel Width, W (m)	360
Average Cover Depth over panel width, H (m) (1)	160
W/H (2)	1.67
Extraction Thickness	6.8
Average Extraction Ratio (%)(4)	30 %
Effective Seam Thickness, T (m)	2.04
Maximum Subsidence Impact parameters across the panel(3)	
Maximum Subsidence S_{max} (mm)	1140
Maximum Tensile Strain $+E_{max}$ (mm/m)	2.9
Maximum Compressive Strain - E_{max} (mm/m)	4.3
Maximum Tilt G_{max} (mm/m) (6)	13.0
Consideration of the Sites Location on The Subsidence Curve	
Approximate location of inflection point (5)	Inside Goaf
Goaf Side Subsidence / Smax(6)	0.13
Goaf Side Subsidence (mm)	150
Distance from Goaf Edge to trough edge (7) (m)	80
Tilt between Goaf Edge and Trough Edge (mm/m)	1.9
Average Cover depth for workings impacting the site (eastern half of the curve) (Used for calculating tilts and strains)(3) (m)	240
Recommended Parameters for the Site considering the Top Seam	
Vertical Subsidence	**150 mm**
Tensile Strain	**1.9 mm/m**
Tilt	**1.9 mm/m**
Radius of Curvature	**6 km**

Notes to Table:

Maximum values - tensile (+Emax), Compressive (-Emax), Tilt (Gmax) and Radius of Curvature were taken from Figures 10,11,13 and 14 of Holla 1987 [6] Respectively.

(1) Cover depths ranging from 0 to 320 m deep for mining width.
(2) Utilised for calculating maximum subsidence
(3) Utilised for calculating tilts and strains eastern portion of workings, more applicable for the site.
(4) Estimated based on mine tracing.
(5) Based on Figure 12 of Holla 1987 [6]
(6) Based on Figure 15 of Holla 1987 [6]
(7) Utilised average cover of 160 m. Given cover depth adjacent site - likely further - however shorter distance adopted for conservatism of adopting tilt.

5.3.3 Final Parameters

Based on the subsidence impact predictions of both seams above, the following set of parameters in Table 5-9 are recommended to be incorporated in the design of any structural elements associated with the proposed redevelopment at the site. As per Subsidence Advisory's advice *'that structures be designed to remain serviceable for any recommended subsidence parameters'.*

Table 5-9 Recommended subsidence Parameters for design of infrastructure associated with the site – based on Holla 1987 [6]

Parameter	Value
Maximum Subsidence S_{max} (mm)	**200**
Maximum Tensile Strain $+E_{max}$ (mm/m)	**2.0**
Compressive Strain - E_{max} (mm/m)	**1.0**
Tilt G_{max} (mm/m)	**2.0**
Radius of Curvature (km)	**6 km**

5.3.4 Residual Subsidence

Based on the assessment it is likely the workings impacting the site have collapsed. Where this can be proven, subsidence impact parameters may be reduced subject to confirmation by a suitable geotechnical consultant. In this instance, potential further subsidence impacting the site would be limited to residual subsidence including consolidation of goaf materials.

A range of published data indicates that residual subsidence typically comprises in the order of less than 10% of the total subsidence and occurs within a few years of mining. As such, given the age of the workings, it has been assumed that any further residual subsidence movement at the site would comprise a conservative 5% of the total subsidence predicted prior to collapse. Table 5-10 below contains indicative residual subsidence parameters on the basis that workings underneath the site have collapsed and this is proven.

Table 5-10 Indicative Residual subsidence Parameters in the event workings have collapsed – based on Holla 1987 [6]

Parameter	Value
Maximum Subsidence S_{max} (mm)	**100**
Maximum Tensile Strain $+E_{max}$ (mm/m) Compressive Strain - E_{max} (mm/m)	**0.5**
Tilt G_{max} (mm/m)	**1.0**
Radius of Curvature (km)	**10 km**

6 Conclusion

Stantec have undertaken a desktop mine subsidence assessment for the proposed redevelopment of Gillieston Public School at 100 Ryans Road and 19 Northview Street, Gillieston Heights, Newcastle NSW.

Although not within a proclaimed mine subsidence district, Subsidence Advisory (SA) NSW indicated that the site is impacted by two sets of mine workings and thus recommended a desktop mine subsidence study be undertaken for the site by a geotechnical consultant. The desktop assessment has been undertaken by considering the proposed activity with respect to the Subsidence Advisory (SA) NSW Merit Assessment Policy [1] as this is common practice for developments within mine subsidence districts.

The desktop assessment comprised review of available resources included publicly available exploration holes, geological mapping and mine tracing purchased from the NSW Resource Regulator.

Based on review of available mine tracings, the proposed activity is underlain by bord and pillar mine workings of the Bottom Seam at depths in the order of 430 m and is located within the angle of draw (zone of influence) of workings of the Top Seam undertaken as deep as 320 m adjacent the site. Schematics on the seams indicate a variable seam thickness of 3-3.6 m and 8.8 m for the Bottom and Top seam respectively.

Given the depth of workings, the risk of pothole subsidence has been assessed as low.

In accordance with SA's Merit policy [1], the risk of trough subsidence at the site has been assessed as moderate corresponding with a required Factor of Safety (FoS) of 2.1 for a B3 Building.

A pillar stability assessment was undertaken on pillars of both seams with results indicating pillars with average Factors of Safety generally less than 1, including when considering smaller extraction heights. As such it was deemed that the pillars potentially impacting the site are likely already goafed/crushed. This can be attributed to cover depths, secondary extraction areas, poor floor conditions and relatively narrow pilar widths.

Although considered low risk, subsidence impact parameters were estimated using the empirical concepts of L. Holla [6] for both seams in the event pillars are still standing and collapse in the future. Given the low factors of safety calculated, if pillars were standing the risk of a pillar run and/or collapse was deemed too high.

Parameters were estimated considering the typical subsidence profile and location of the site relative to this.

Any structures associated with the proposed redevelopment of the school shall be designed to accommodate the subsidence parameters in Table 5-9 such as the structures remain serviceable (as defined by SA NSW in their Merit Policy [1]). It is noted that the above does not include conventional geotechnical surface movement predictions such as settlements.

Residual subsidence parameters were also provided in the event the workings have collapsed and this can be confirmed. The residual parameters should be confirmed by a geotechnical consultant.

It should be noted that the above assessment has been based on desktop review of available resources. Where any resources were made available to Stantec that could complement or contradict the assessment findings, Stantec would need to consider and reassess.

7 Mitigation Measures

See the below Table 7-1 that outlines the appropriate mitigation measures for risks associated with mine subsidence outlined in this report.

Table 7-1 Mitigation Measures as Required by the Preamble

Project Stage Design (D) Construction (C) Operation (O)	Mitigation Measures	Relevant Section of report
D	The identified risk of damage to proposed activity relating to mine subsidence shall be mitigated by incorporation of the estimated subsidence parameters in the design such that the structures and infrastructure remain serviceable (Table 5-9). This must be implemented in the next design phase post REF.	Section 5.3
D / C	Typical SA NSW requirements for similar activities shall be implemented (if not by SA NSW) including the need for sign off from the structural engineer that the structures associated with the activity have been designed to remain serviceable for the recommended subsidence parameters as well as the below. 1. 'The proposed structure(s) associated with activity shall be designed to be "safe, serviceable and readily repairable" using the subsidence parameters outlined below: • Maximum vertical subsidence: 200 mm • Maximum tensile strains: 2.0 mm/m • Maximum compressive strains: 1.0 mm/m • Maximum tilt: 2.0 mm/m • Minimum radius of curvature: 6 km Any ancillary structures or services identified in the activity shall be designed with flexible joints and remain safe, serviceable and repairable using the mine subsidence design parameters provided above.' 2. 'Roadworks identified in the subdivision plan shall be designed as a flexible pavement with a bitumen or asphalt treated surface over one or more unbound base courses in accordance with the relevant Australian Standards and Codes of Practice.'	-

8 Limitations

Stantec have performed investigation and consulting services for this project in general accordance with current professional and industry standards. The extent of testing was limited to discrete test locations and variations in ground conditions can occur between test locations that cannot be inferred or predicted.

A geotechnical consultant or qualified engineer shall provide inspections during construction to confirm assumed conditions in this assessment. If subsurface conditions encountered during construction differ from those given in this report, further advice shall be sought without delay.

Stantec, or any other reputable consultant, cannot provide unqualified warranties nor does it assume any liability for the site conditions not observed or accessible during the investigations. Site conditions may also change subsequent to the investigations and assessment due to ongoing use.

This report and associated documentation were undertaken for the specific purpose described in the report and shall not be relied on for other purposes. This report was prepared solely for the use by the Department of Education and any reliance assumed by other parties on this report shall be at such parties' own risk.

9 References

[1] Subsidence Advisory (SA) NSW, Development Application - Merit Assessment Policy, ver. 2, 5 April 2023.

[2] Mecone Mosaic, “Mecone Mosaic,” Mapbox, v6.1.2 - 2024. [Online]. Available: https://www.mecone.com.au/mosaic/. [Accessed 7 October 2024].

[3] NSW Government - Geological Survey of NSW, “Minview,” Version.2024.09.16. [Online]. Available: https://minview.geoscience.nsw.gov.au/#/?lon=151.5299&lat=-32.75300&z=17&bm=bm1&l=ge611:n:100,ge610:n:100,ge69:n:100,ge68:n:100,ge67:n:100,ge66:n:100,ge65:n:100,ge64:n:100,ge63:n:100,ge62:n:100,ge61:n:100,ge612:y:100,hi1:n:25,wa1:y:100,ut1:y:50,ad0:y:100. [Accessed 3 October 2024].

[4] NSW Government, “ePlanning Spatial Viewer,” NSW Government Department of Customer Service, 2020. [Online]. Available: https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address. [Accessed 07 10 2024].

[5] Mecone Mosaic, “Mecone Mosaic,” Mapbox, [Online]. Available: https://www.mecone.com.au/mosaic/. [Accessed 3 June 2022].

[6] L. Holla, “Mining Subsidence in NSW - Surface Subsidence Prediction in the Newcastle Coalfield,” Department of Mineral Resources, Sydney, Jan 1987.

[7] R. S. A. S. R. T. David Hill, Pillar Abutment Loading - New Concepts for Coal Mining Industry, 5th Coal Operators' Conference, University of Wollongong, The Australasian Institute of Mining and Metallurgy and Mine Managers Association of Australia, 2015, 204-211., 3015.

[8] J.M. Galvin, B. K. Hebblewhite, M. D. G. Salamon and B. B. Lin, Establishing the Strength of Rectangular and Irregular Pillars, ACARP, 1998.

[9] NSW Government, “Sixmaps,” [Online]. Available: https://maps.six.nsw.gov.au/. [Accessed 07 10 2024].

APPENDIX A

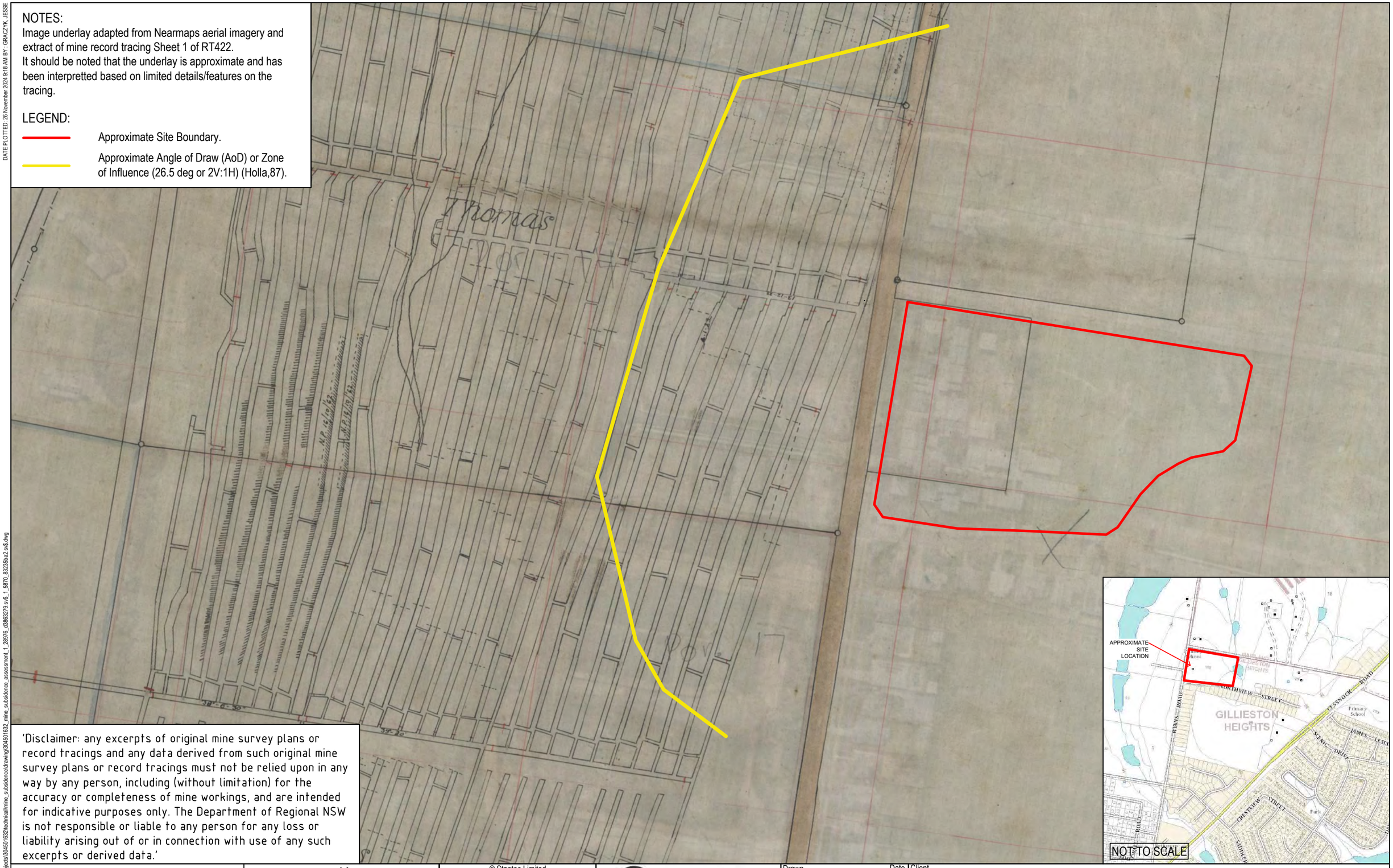
DRAWINGS

NOTES:
Image underlay adapted from Nearmaps aerial imagery and extract of mine record tracing Sheet 1 of RT422.
It should be noted that the underlay is approximate and has been interpretted based on limited details/features on the tracing.

LEGEND:

Approximate Site Boundary.

Approximate Angle of Draw (AoD) or Zone of Influence (26.5 deg or 2V:1H) (Holla,87).



'Disclaimer: any excerpts of original mine survey plans or record tracings and any data derived from such original mine survey plans or record tracings must not be relied upon in any way by any person, including (without limitation) for the accuracy or completeness of mine workings, and are intended for indicative purposes only. The Department of Regional NSW is not responsible or liable to any person for any loss or liability arising out of or in connection with use of any such excerpts or derived data.'

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SCALE 1:2000 @A3

NORTH

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Suite 2, Level 2, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn JG	Date 26/11/24	
Checked GA	Date 26/11/24	
Designed	Date	
Verified	Date	
Approved		

Client: Department of Education

Project: Desktop Mine Subsidence Assessment
Proposed Redevelopment
Gillieston Public School, Gillieston Heights, NSW

Title: Site Plan with RT422 Underlay (Greta Top Split Seam)

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
304501632	1:2000	A3

Figure Number: Drawing 1

Revision: A

DATE PLOTTED: 26 November 2024 9:18 AM BY: GRACZYK, JESSE

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NOTES:
Image underlay adapted from Nearmaps aerial imagery and extract of mine record tracing Sheet 1 of RT423.
It should be noted that the underlay is approximate and has been interpretted based on limited details/features on the tracing.

LEGEND:

Approximate Site Boundary.

Approximate Angle of Draw (AoD) or Zone of Influence (26.5 deg or 2V:1H) (Holla,87).

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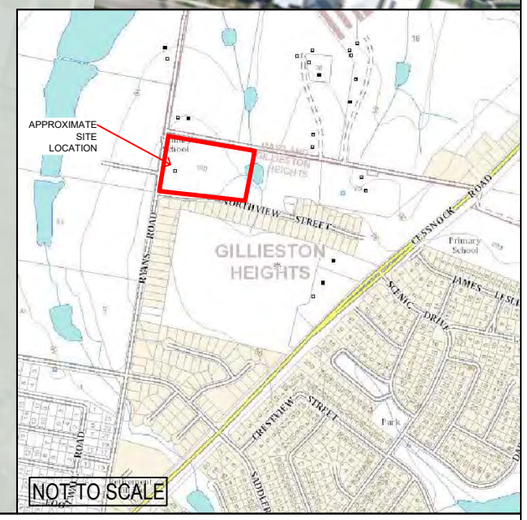

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NORTH

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Suite 2, Level 2, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn	JG	Date 26/11/24
Checked	GA	Date 26/11/24
Designed		Date
Verified		Date
Approved		

Client: Department of Education

Project: Desktop Mine Subsidence Assessment
Proposed Redevelopment
Gillieston Public School, Gillieston Heights, NSW

Title: Site Plan with RT423 Underlay (Greta Bottom Split Seam)

Status: FOR INFORMATION ONLY
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Project Number	Scale	Size
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Figure Number: Drawing 2

Revision: A

DATE PLOTTED: 26 November 2024 9:18 AM BY: GRACZYK, JESSE

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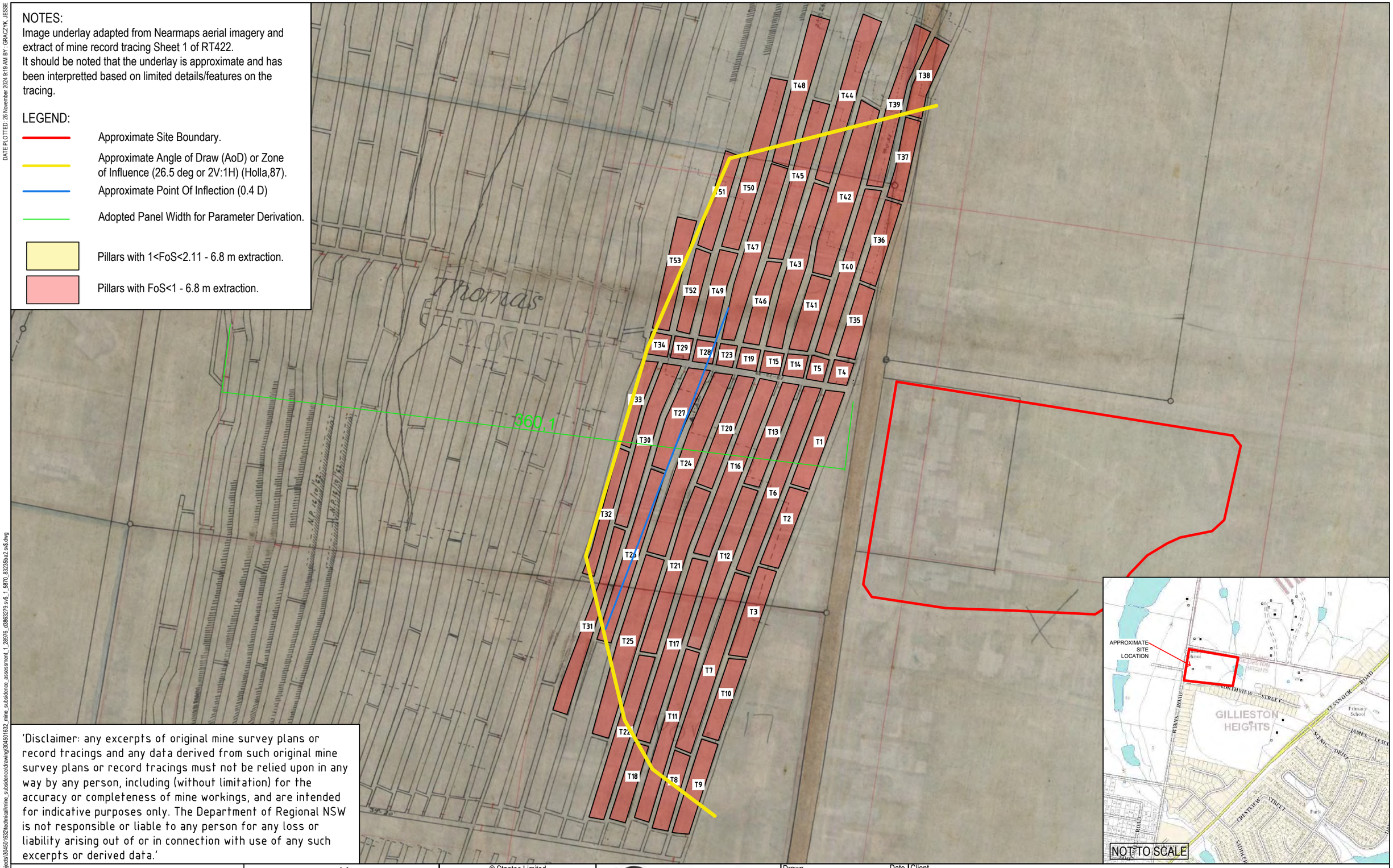
DATE PLOTTED: 26 November 2024 9:19 AM BY: GRACZYK, JESSE

NOTES:
Image underlay adapted from Nearmaps aerial imagery and extract of mine record tracing Sheet 1 of RT422.
It should be noted that the underlay is approximate and has been interpretted based on limited details/features on the tracing.

LEGEND:

- Approximate Site Boundary.
- Approximate Angle of Draw (AoD) or Zone of Influence (26.5 deg or 2V:1H) (Holla,87).
- Approximate Point Of Inflection (0.4 D)
- Adopted Panel Width for Parameter Derivation.
- Pillars with 1<FoS<2.11 - 6.8 m extraction.
- Pillars with FoS<1 - 6.8 m extraction.



'Disclaimer: any excerpts of original mine survey plans or record tracings and any data derived from such original mine survey plans or record tracings must not be relied upon in any way by any person, including (without limitation) for the accuracy or completeness of mine workings, and are intended for indicative purposes only. The Department of Regional NSW is not responsible or liable to any person for any loss or liability arising out of or in connection with use of any such excerpts or derived data.'

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SCALE 1:2000 @A3

NORTH

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Suite 2, Level 2, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn	JG	Date 26/11/2204
Checked	GA	Date 26/11/2024
Designed		Date
Verified		Date
Approved		

Client: Department of Education

Project: Desktop Mine Subsidence Assessment
Proposed Redevelopment
Gillieston Public School, Gillieston Heights, NSW

Title: Pillar Stability Assessment - Top Seam (RT422)

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
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Figure Number: Drawing 3
Revision: A

XREFs:
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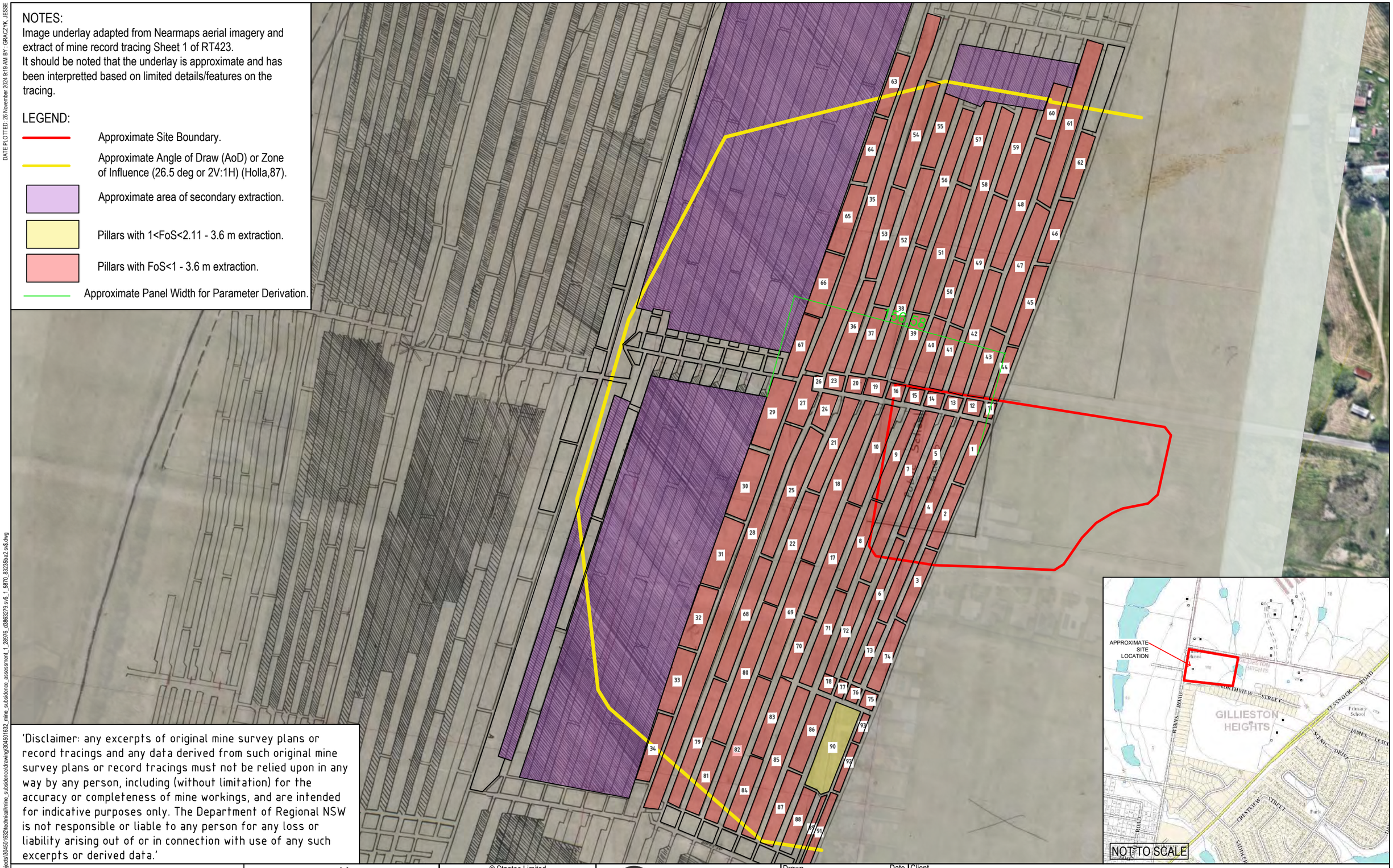
NOTES:
Image underlay adapted from Nearmaps aerial imagery and extract of mine record tracing Sheet 1 of RT423.
It should be noted that the underlay is approximate and has been interpretted based on limited details/features on the tracing.

LEGEND:

- Approximate Site Boundary.
- Approximate Angle of Draw (AoD) or Zone of Influence (26.5 deg or 2V:1H) (Holla,87).
- Approximate area of secondary extraction.
- Pillars with 1<FoS<2.11 - 3.6 m extraction.
- Pillars with FoS<1 - 3.6 m extraction.
- Approximate Panel Width for Parameter Derivation.



'Disclaimer: any excerpts of original mine survey plans or record tracings and any data derived from such original mine survey plans or record tracings must not be relied upon in any way by any person, including (without limitation) for the accuracy or completeness of mine workings, and are intended for indicative purposes only. The Department of Regional NSW is not responsible or liable to any person for any loss or liability arising out of or in connection with use of any such excerpts or derived data.'

0 50 100m
SCALE 1:2500 @A3

NORTH

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Suite 2, Level 2, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn	JG	Date 26/11/2024
Checked	GA	Date 26/11/2024
Designed		Date
Verified		Date
Approved		

Client: Department of Education
Project: Desktop Mine Subsidence Assessment
Proposed Redevelopment
Gillieston Public School, Gillieston Heights, NSW
Title: Pillary Stability Assessment - Bottom Seam (RT423)

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
304501632	1:2500	A3

Figure Number: Drawing 4
Revision: A

DATE PLOTTED: 26 November 2024 9:19 AM BY: GRACZYK, JESSE

XREFs:
CAD File: \\au2012-ntap01_cifs02\shared_projects\304501632\technical\mine_subsidence\drawing\304501632_mine_subsidence_assessment_1_28976_d3863279.rvt$_1_5870_83235bc2.rvt$.dwg

APPENDIX

B

PILLAR STABILITY CALCULATIONS

Stantec

PILLAR STABILITY CALCULATIONS - BOTTOM SEAM - RT423
- EXTRACTION - 3.6 m

Angle of Draw 26.50 deg 18

General Inputs / **Abutment Loading Input and Calcs**

Pillar	Rock unit weight (kN/m³)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m³/m width	c/c dimension over which abutment load is applied	Abutment
1	24	430	3	4	3	2.5	8.3	46.3	3.6	98	0	0	0	0	C1	11.25
2	24	430	4	2.5	2.5	2.25	8.5	47.5	3.6	94	0	0	0	0	C1	11.75
3	24	430	4.5	2.4	2.5	2.25	8.3	53.7	3.6	94	0	0	0	0	C1	11.8
4	24	420	4.3	4	4.3	2.25	8.5	156.3	3.6	99	0	0	0	0	C1	12.8
5	24	415	4.7	4	4.3	3.5	6.1	91.6	3.6	102	0	0	0	0	C1	10.6
6	24	415	5.2	3	4	2	5.3	107.3	3.6	85	0	0	0	0	C1	9.9
7	24	410	4.5	2.5	4.8	3.5	8.5	120.0	3.6	101	0	0	0	0	C1	13.15
8	24	400	5.3	1.8	5.1	1.8	8.2	67.3	3.6	91	0	0	0	0	C1	13.35
9	24	400	5.9	4.1	4	1.8	8.1	69.7	3.6	103	0	0	0	0	C1	13
10	24	390	5.9	1.7	4.8	4.5	10.5	74.6	3.6	98	0	0	0	0	C1	15.85
11	24	420	3.3	3.8	3.7	2.4	5.8	10.9	3.6	80	0	0	0	0	C1	9.3
12	24	420	2.4	3	4.1	3.5	10.8	11.9	3.6	83	0	0	0	0	C1	14.05
13	24	415	3.9	3	2.5	2.5	10.1	10.8	3.6	80	0	0	0	0	C1	13.3
14	24	410	3.4	2.8	2.4	2.5	10.9	11.8	3.6	81	0	0	0	0	C1	13.75
15	24	400	3.8	2.8	2.2	2.5	10.6	10.9	3.6	82	0	0	0	0	C1	13.6
16	24	390	2.7	4.5	2.8	2.1	10.8	11.6	3.6	95	0	0	0	0	C1	13.55
17	24	380	5	2.5	5.3	2.5	9.8	84.7	3.6	88	0	0	0	0	C1	14.95
18	24	370	5.1	4.5	4.2	1.6	9.8	121.8	3.6	90	0	0	0	0	C1	14.45
19	24	380	2.5	2.7	4.4	1.5	12.2	13.6	3.6	83	0	0	0	0	C1	15.65
20	24	370	4.2	2.3	2.6	1.3	11.7	12.0	3.6	84	0	0	0	0	C1	15.1
21	24	370	4	3.8	5	2.5	9.9	71.7	3.6	87	0	0	0	0	C1	14.4
22	24	360	5.1	1.5	3.8	2.9	10.3	83.9	3.6	90	0	0	0	0	C1	14.7
23	24	350	3.6	2.8	2.4	2.35	10.8	12.8	3.6	86	0	0	0	0	C1	13.8
24	24	350	5	3.2	3.8	3.6	11.0	25.0	3.6	100	0	0	0	0	C1	15.4
25	24	350	3.8	2.9	5.2	2.8	9.6	95.6	3.6	92	0	0	0	0	C1	14.1
26	24	345	2.6	3.9	1.7	2.2	4.1	7.1	3.6	90	0	0	0	0	C1	6.25
27	24	345	3.9	4	3	2	13.2	31.0	3.6	87	0	0	0	0	C1	16.65
28	24	340	5.3	2.8	3.6	2.05	11.7	293.0	3.6	103	80	11.7	30	3181.438457	C2	295.425
29	24	335	0	3.7	2.9	3	14.5	51.0	3.6	92	80	14.5	70	7328.448484	C2	54.35
30	24	335	0	2.5	3.1	3.7	15.3	49.5	3.6	88	80	15.3	70	7336.086077	C2	52.6
31	24	330	0	1.8	2.5	2.5	14.6	50.2	3.6	86	80	14.6	70	7204.921322	C2	52.35
32	24	320	0	1.7	3.6	2.3	13.8	45.2	3.6	86	80	13.8	70	6947.322614	C2	47.15
33	24	320	0	2.3	3	2.4	12.6	46.2	3.6	92	80	12.6	70	6935.423433	C2	48.55
34	24	315	0	2.4	2.7	2.6	10.0	49.5	3.6	99	80	10.0	70	6784.643584	C2	52
35	24	330	4	4	2.8	4	11.1	270.0	3.6	80	125	11.1	30	4020.693837	C2	274
36	24	340	4.3	2.4	4.1	2.1	9.5	68.7	3.6	80	0	0	0	0	C1	13.7
37	24	350	4.7	2.5	4.6	2.6	9.7	49.2	3.6	79	0	0	0	0	C1	14.35
38	24	365	4.3	2.3	4.1	2.5	8.7	96.3	3.6	83	0	0	0	0	C1	12.9
39	24	380	3.8	1.8	4.7	2.1	10.5	50.6	3.6	86	0	0	0	0	C1	14.75
40	24	390	3.5	2.1	3.6	1.8	10.2	50.4	3.6	90	0	0	0	0	C1	13.75
41	24	390	4.4	2.3	3.5	2.5	9.4	45.9	3.6	86	0	0	0	0	C1	13.35
42	24	400	4.1	2.9	4.3	2.5	9.6	92.0	3.6	87	0	0	0	0	C1	13.8
43	24	410	4	2.6	4.1	2.5	11.2	48.5	3.6	100	0	0	0	0	C1	15.25
44	24	420	4.1	2	3.3	2.4	7.1	40.0	3.6	82	0	0	0	0	C1	10.8
45	24	410	3.6	2.1	3.1	2.6	9.2	59.0	3.6	84	0	0	0	0	C1	12.55
46	24	410	3.9	2.6	3	2.95	9.5	46.5	3.6	78	0	0	0	0	C1	12.95
47	24	400	4.2	2.65	3.9	2.6	11.3	92.0	3.6	96	0	0	0	0	C1	15.3
48	24	390	4.7	2.7	4.5	2.9	10.1	97.0	3.6	90	0	0	0	0	C1	14.7
49	24	390	3.8	2.3	3.5	2.5	10.0	96.0	3.6	86	0	0	0	0	C1	13.65
50	24	380	4.4	1.9	3.8	2.3	8.4	41.4	3.6	89	0	0	0	0	C1	12.5
51	24	370	4.3	1.85	4.7	2.7	11.0	93.0	3.6	82	0	0	0	0	C1	15.5
52	24	370	5.7	2	3.8	2.3	10.1	102.7	3.6	80	0	0	0	0	C1	14.85
53	24	360	4.2	2.5	5.2	2.3	8.5	66.7	3.6	88	0	0	0	0	C1	13.2
54	24	320	5.8	2.7	4.8	2.3	9.3	78.2	3.6	90	0	0	0	0	C1	14.6
55	24	330	4.6	1.8	4.9	0	10.1	53.1	3.6	88	35	53.1	100	5308.629929	C1	14.85
56	24	340	4.9	2.3	4.8	2.8	8.1	102.2	3.6	92	35	102.2	100	5561.577722	C1	12.95
57	24	350	4.4	2.8	5.1	0	9.1	61.6	3.6	93	35	61.6	100	5663.371531	C1	13.85
58	24	365	4.1	2.3	4.5	2.4	8.9	112.0	3.6	78	35	112.0	100	6002.195227	C1	13.2
59	24	380	4.6	2.5	4.85	0	10.2	65.0	3.6	95	35	65.0	100	6176.890076	C1	14.925
60	24	380	3.6	2.9	4.8	0	10.1	38.8	3.6	88	18	38.8	100	3279.084653	C1	14.3
61	24	390	3.7	2.65	4.4	4.6	11.3	121.2	3.6	104	0	0	0	0	C1	15.35
62	24	400	3.6	2.85	3.4	2.8	10.1	47.4	3.6	101	0	0	0	0	C1	13.6
63	24	320	0	3	3	1.8	9.3	45.5	3.6	89	125	9.3	70	8975.626356	C2	47.9
64	24	320	0	3	3.2	2.5	9.7	47.7	3.6	78	125	9.7	70	8985.645402	C2	50.45
65	24	330	0	2	3	2.9	12.0	50.0	3.6	86	125	12.0	70	9404.372474	C2	52.45
66	24	340	0	1.3	2.8	1.9	13.1	46.0	3.6	92	125	13.1	70	9792.37396	C2	47.6
67	24	340	0	1.3	3.8	2.3	11.2	45.3	3.6	89	125	11.2	70	9743.220231	C2	47.1
68	24	340	4	2.8	4.2	2	9.7	91.3	3.6	94	0	0	0	0	C1	13.8
69	24	360	4.1	1.6	5.3	1.7	9.9	86.7	3.6	90	0	0	0	0	C1	14.6
70	24	370	5.3	2.1	5.1	2.2	9.0	44.8	3.6	86	0	0	0	0	C1	14.2
71	24	370	5	1.8	5.1	3.3	8.8	71.0	3.6	89	0	0	0	0	C1	13.85
72	24	380	5.1	0	5	2.75	8.6	69.5	3.6	88	0	0	0	0	C1	13.65
73	24	410	4	2.2	4.2	2.9	6.3	45.5	3.6	89	0	0	0	0	C1	10.4
74	24	430	4.5	2.75	2.4	2.6	9.0	51.7	3.6	88	0	0	0	0	C1	12.45
75	24	430	2.4	2.5	3.2	3.7	9.5	11.8	3.6	90	0	0	0	0	C1	12.3
76	24	430	2.5	4.2	2.6	3	8.1	11.1	3.6	90	0	0	0	0	C1	10.65
77	24	420	2.3	3.85	2.4	2	6.2	12.0	3.6	91	0	0	0	0	C1	8.55
78	24	410	5.5	3.95	2.4	0	9.3	11.7	3.6	90	0	0	0	0	C1	13.25
79	24	320	5	2.25	4.6	2	9.2	94.7	3.6	90	0	0	0	0	C1	14
80	24	340	4.3	1.5	4.3	2	10.2	104.0	3.6	92	0	0	0	0	C1	14.5
81	24	340	4.8	2	4.9	2.2	10.1	52.2	3.6	90	0	0	0	0	C1	14.95
82	24	355	4.5	1.7	5.1	2.2	9.9	10.9	3.6	90	0	0	0	0	C1	14.7
83	24	365	5.3	1.5	4.6	2.1	8.8	58.0	3.6	90	0	0	0	0	C1	13.75
84	24	365	4.9	2.1	4.2	1.5	9.8	54.3	3.6	90	0	0	0	0	C1	14.35
85	24	380	4.6	1.7	4.5	3.3	9.8	113.0	3.6	88	0	0	0	0	C1	14.35
86	24	395	4.5	3.9	4.4	2.3	10.5	55.6	3.6	94	0	0	0	0	C1	14.95
87	24	405	4.7	2.3	4.9	2.2	9.8	55.0	3.6	90	0	0	0	0	C1	14.6
88	24	420	5	2.1	5	2.1	9.1	48.0	3.6	85	0	0	0	0	C1	14.1
89	24	420	5	2.3	1.9	3.5	3.0	63.5	3.6	91	0	0	0	0	C1	6.45
90	24	420	4.5	4.2	2.2	2.3	18.5	62.0	3.6	89	0	0	0	0	C1	21.85
91	24	430	1.8	3.7	3.1	3	5.0	67.7	3.6	90	0	0	0	0	C1	7.45
92	24	430	2.8	2.5	2.8	1.9	4.8	35.7	3.6	89	0	0	0	0	C1	7.6
93	24	430	2.4	3.7	2.7	1.9	4.9	20.9	3.6	89	0	0	0	0	C2	23.7

Pillar Strength σ_{S2} / **Pillar load (kN)**

Pillar	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	Θ_o = ($2*w_2/(w_1+w_2)$)	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
1	8.17	2.27	1.70	1.00	8.17	-	8.56	11.34	8.56	11.25	49.55	5752755	0	5752755	15060.554	15.061	0.57
2	8.48	2.36	1.70	1.00	8.48	-	8.72	11.31	8.72	11.75	49.88	6047843	0	6047843	14979.176	14.979	0.58
3	8.28	2.30	1.73	1.00	8.28	-	8.62	11.33	8.62	11.80	56.03	6822500	0	6822500	15307.039	15.307	0.56
4	8.40	2.33	1.90	1.00	8.40	-	8.68	11.32	8.68	12.80	159.43	20569651	0	20569651	15482.783	15.483	0.56
5	5.97	1.66	1.88	1.00	5.97	-	7.29	11.80	7.29	10.60	95.35	10066672	0	10066672	18016.092	18.016	0.40
6	5.28	1.47	1.91	1.00	5.28	-	6.85	12.04	6.85	9.90	109.75	10821789	0	10821789	19038.200	19.038	0.36
7	8.34	2.32	1.87	1.00	8.34	-	8.65	11.32	8.65	13.15	123.00	15915708	0	15915708	15603.635	15.604	0.55
8	8.15	2.26	1.78	1.00	8.15	-	8.55	11.34	8.55	13.35	69.05	8849448	0	8849448	16146.050	16.146	0.53
9	7.84	2.18	1.79	1.00	7.84	-	8.38	11.39	8.38	13.00	72.65	9066720	0	9066720	16159.263	16.159	0.52
10	10.40	2.89	1.75	1.00	10.40	-	9.68	11.23	9.68	15.85	77.70	11527261	0	11527261	14716.279	14.716	0.66
11	5.71	1.59	1.31	1.00	5.71	-	7.13	11.88	7.13	9.30	14.00	1312416	0	1312416	20759.506	20.760	0.34
12	10.72	2.98	1.05	1.00	10.72	-	9.83	11.24	9.83	14.05	15.15	2145604	0	2145604	16694.706	16.695	0.59
13	9.95	2.76	1.03	1.00	9.95	-	9.46	11.23	9.46	13.30	13.50	1788318	0	1788318	16470.808	16.471	0.57
14	10.72	2.98	1.04	1.00	10.72	-	9.83	11.24	9.83	13.75	14.45	1955085	0	1955085	15270.523	15.271	0.64
15	10.50	2.92	1.01	1.00	10.50	-	9.73	11.24	9.73	13.60	13.55	1769088	0	1769088	15311.477	15.311	0.64
16	10.76	2.99	1.04	1.00	10.76	-	9.85	11.24	9.85	13.55	14.90	1889737	0	1889737	15084.109	15.084	0.65
17	9.79	2.72	1.79	1.00	9.79	-	9.39	11.23	9.39	14.95	87.20	11889197	0	11889197	14323.298	14.323	0.66
18	9.80	2.72	1.85	1.00	9.80	-	9.39	11.23	9.39	14.45	124.85	16020253	0	16020253	13421.344	13.421	0.70
19	12.11	3.36	1.05	1.01	12.19	-	10.50	11.37	10.50	15.65	15.70	2240830	0	2240830	13505.482	13.505	0.78
20	11.64	3.23	1.01	1.00	11.65	-	10.26	11.30	10.26	15.10	13.75	1843710	0	1843710	13186.783	13.187	0.78
21	9.89	2.75	1.76	1.00	9.89	-	9.43	11.23	9.43	14.40	74.85	9571219	0	9571219	13483.819	13.484	0.70
22	10.25	2.85	1.78	1.00	10.25	-	9.61	11.23	9.61	14.70	86.10	10935389	0	10935389	12715.938	12.716	0.76
23	10.77	2.99	1.08	1.00	10.77	-	9.86	11.24	9.86	13.80	15.38	1782270	0	1782270	12892.578	12.893	0.76
24	10.83	3.01	1.39	1.00	10.84	-	9.89	11.25	9.89	15.40	28.40	3673824	0	3673824	13359.360	13.359	0.74
25	9.59	2.67	1.82	1.00	9.59	-	9.29	11.24	9.29	14.10	98.45	11660418	0	11660418	12705.302	12.705	0.73
26	4.10	1.14	1.27	1.00	4.10	-	6.02	12.62	6.02	6.25	10.15	525262.5	0	525263	18044.057	18.044	0.33
27	13.18	3.66	1.40	1.08	14.20	-	11.35	11.92	11.35	16.65	34.00	4687308	0	4687308	11454.809	11.455	0.99
28	11.40	3.17	1.92	1.04	11.82	-	10.33	11.49	10.33	16.15	295.43	38932288	22557034.94	61489323	17936.852	17.937	0.58
29	14.49	4.03	1.56	1.16	16.86	-	12.39	12.65	12.39	15.95	54.35	6969735	9559228.203	16528964	22351.540	22.352	0.55
30	15.24	4.23	1.53	1.19	18.15	-	12.86	12.99	12.86	16.80	52.60	7104787	9261075.064	16365862	21680.228	21.680	0.59
31	14.56	4.05	1.55	1.16	16.97	-	12.42	12.67	12.42	15.85	52.35	6571600	9052263.149	15623863	21317.283	21.317	0.58
32	13.77	3.82	1.53	1.12	15.48	-	11.86	12.28	11.86	15.60	47.15	5648947	7861590.27	13510537	21683.820	21.684	0.55
33	12.59	3.50	1.57	1.08	13.57	-	11.09	11.84	11.09	14.10	48.55	5257382	8081155.384	13338538	22913.725	22.914	0.48
34	9.88	2.74	1.66	1.00	9.88	-	9.43	11.23	9.43	11.35	52.00	4461912	8467235.192	12929147	26119.489	26.119	0.36
35	10.93	3.04	1.92	1.01	11.02	-	9.97	11.30	9.97	14.50	274.00	31466160	26440082.67	57906243	19321.402	19.321	0.52
36	9.36	2.60	1.76	1.00	9.36	-	9.17	11.25	9.17	13.70	70.95	7931642	0	7931642	12152.980	12.153	0.75
37	9.52	2.64	1.67	1.00	9.52	-	9.25	11.24	9.25	14.35	51.75	6237945	0	6237945	13070.876	13.071	0.71
38	8.64	2.40	1.83	1.00	8.64	-	8.80	11.29	8.80	12.90	98.70	11153495	0	11153495	13312.678	13.313	0.66
39	10.47	2.91	1.66	1.00	10.47	-	9.72	11.24	9.72	14.75	52.55	7069026	0	7069026	13305.150	13.305	0.73
40	10.20	2.83	1.66	1.00	10.20	-	9.58	11.23	9.58	13.75	52.35	6737445	0	6737445	13105.830	13.106	0.73
41	9.38	2.60	1.66	1.00	9.38	-	9.18	11.25	9.18	13.35	48.30	6035375	0	6035375	13988.260	13.988	0.66
42	9.59	2.66	1.81	1.00	9.59	-	9.29	11.24	9.29	13.80	94.70	12545856	0	12545856	14205.000	14.205	0.65
43	11.03	3.06	1.62	1.01	11.14	-	10.03	11.31	10.03	15.25	51.05	7660563	0	7660563	14102.656	14.103	0.71
44	7.03	1.95	1.70	1.00	7.03	-	7.93	11.53	7.93	10.80	42.20	4594061	0	4594061	16176.270	16.176	0.49
45	9.15	2.54	1.73	1.00	9.15	-	9.07	11.26	9.07	12.55	61.35	7576234	0	7576234	13957.690	13.958	0.65
46	9.29	2.58	1.66	1.00	9.29	-	9.14	11.25	9.14	12.95	49.28	6279015	0	6279015	14213.955	14.214	0.64
47	11.19	3.11	1.78	1.02	11.42	-	10.15	11.38	10.15	15.30	94.63	13898520	0	13898520	13428.522	13.429	0.76
48	10.10	2.81	1.81	1.00	10.10	-	9.54	11.23	9.54	14.70	99.80	13731682	0	13731682	14016.211	14.016	0.68
49	9.98	2.77	1.81	1.00	9.98	-	9.48	11.23	9.48	13.65	98.40	12571978	0	12571978	13095.810	13.096	0.72
50	8.40	2.33	1.66	1.00	8.40	-	8.68	11.32	8.68	12.50	43.50	4959000	0	4959000	14259.834	14.260	0.61
51	10.89	3.03	1.79	1.01	10.95	-	9.94	11.28	9.94	15.50	95.28	13113651	0	13113651	12818.818	12.819	0.78
52	9.95	2.76	1.82	1.00	9.95	-	9.46	11.23	9.46	14.85	104.85	13826360	0	13826360	13329.567	13.330	0.71
53	8.49	2.36	1.77	1.00	8.49	-	8.73	11.31	8.73	13.20	69.05	7875014	0	7875014	13900.559	13.901	0.63
54	9.30	2.58	1.79	1.00	9.30	-	9.14	11.25	9.14	14.60	80.70	9048730	0	9048730	12442.221	12.442	0.73
55	10.09	2.80	1.68	1.00	10.09	-	9.53	11.23	9.53	14.85	54.00	6351048	1891995.707	8243044	15369.924	15.370	0.62
56	8.10	2.25	1.85	1.00	8.10	-	8.52	11.35	8.52	12.95	104.75	11069142	1728538.356	12797680	15459.496	15.459	0.55
57	9.09	2.52	1.74	1.00	9.09	-	9.04	11.26	9.04	13.85	63.00	7329420	1882504.697	9211925	16433.432	16.433	0.55
58	8.71	2.42	1.85	1.00	8.71	-	8.84	11.29	8.84	13.20	114.35	13222519	1901495.448	15124015	15172.567	15.173	0.58
59	10.16	2.82	1.73	1.00	10.16	-	9.57	11.23	9.57	14.93	66.25	9017685	2212562.025	11230247	16938.532	16.939	0.56
60	10.09	2.80	1.59	1.00	10.09	-	9.53	11.23	9.53	14.30	40.25	5249244	1125381.853	6374626	16266.780	16.267	0.59
61	10.96	3.05	1.83	1.01	11.07	-	9.99	11.30	9.99	15.35	124.83	17934357	0	17934357	13094.977	13.095	0.76
62	9.91	2.75	1.65	1.00	9.91	-	9.45	11.23	9.45	13.60	50.23	6557376	0	6557376	13697.155	13.697	0.69
63	9.30	2.58	1.66	1.00	9.30	-	9.14	11.25	9.14	10.80	47.90	3973018	10318380.06	14291398	33773.834	33.774	0.27
64	9.49	2.64	1.66	1.00	9.49	-	9.24	11.24	9.24	11.30	50.45	4378253	10879819.45	15258072	32976.879	32.977	0.28
65	11.97	3.33	1.61	1.05	12.61	-	10.68	11.63	10.68	13.50	52.45	5607954	11838224.07	17446178	29076.963	29.077	0.37
66	13.09	3.64	1.56	1.10	14.38	-	11.42	12.02	11.42	14.50	47.60	5632032	11186808.01	16818840	27910.455	27.910	0.41
67	11.20	3.11	1.60	1.02	11.40	-	10.14	11.36	10.14	13.10	47.10	5034802	11013736.15	16048538	31631.460	31.631	0.32
68	9.68	2.69	1.81	1.00	9.68	-	9.33	11.24	9.33	13.80	93.65	10545739	0	10545739	11914.407	11.914	0.78
69	9.90	2.75	1.80	1.00	9.90	-	9.44	11.23	9.44	14.60	88.35	11144822	0	11144822	12984.310	12.984	0.73
70	8.98	2.49	1.67	1.00	8.98	-	8.98	11.27	8.98	14.20	46.95	5920207	0	5920207	14683.054	14.683	0.61
71	8.80	2.44	1.78	1.00	8.80	-	8.89	11.28	8.89	13.85	73.55	9045767	0	9045767	14477.861	14.478	0.61
72	8.59	2.39	1.78	1.00	8.59	-	8.78	11.30	8.78	13.65	70.88	8823087	0	8823087	14761.732	14.762	0.60
73	6.30	1.75	1.76	1.00	6.30	-	7.50	11.70	7.50	10.40	48.05	4917245	0	4917245	17154.177	17.154	0.44
74	8.99	2.50	1.70	1.00	8.99	-	8.99	11.27	8.99	12.45	54.38	6986318	0	6986318	15014.652	15.015	0.60
75	9.50	2.64	1.11	1.00	9.50	-	9.24	11.24	9.24	12.30	14.90	1891346	0	1891346	16871.957	16.872	0.55
76	8.10	2.25	1.16	1.00	8.10	-	8.52	11.35	8.52	10.65	14.70	1615648	0	1615648	17969.610	17.970	0.47
77	6.20	1.72	1.32	1.00	6.20	-	7.44	11.73	7.44	8.55	14.93	1286296	0	1286296	17288.927	17.289	0.43
78	9.30	2.58	1.11	1.00	9.30	-	9.14	11.25	9.14	13.25	13.68	1782947	0	1782947	16385.870	16.386	0.56
79	9.20	2.56	1.82	1.00	9.20	-	9.09	11.25	9.09	14.00	96.83	10410624	0	10410624	11949.203	11.949	0.76
80	10.19	2.83	1.82	1.00	10.19	-	9.58	11.23	9.58	14.50	105.75	12512340	0	12512340	11795.192	11.795	0.81
81	10.10	2.81	1.68	1.00	10.10	-	9.54	11.23	9.54	14.95	54.30	6624166	0	6624166	12564.329	12.564	0.76
82	9.90	2.75	1.05	1.00	9.90	-	9.44	11.23	9.44	14.70	12.81	1604376	0	1604376	14922.481	14.922	0.63
83	8.80	2.44	1.74	1.00	8.80	-	8.89	11.28	8.89	13.75	59.80	7202910	0	7202910	14112.284	14.112	0.63
84	9.80	2.72	1.69	1.00	9.80	-	9.39	11.23	9.39	14.35	56.10	7052107	0	7052107	13252.352	13.252	0.71
85	9.79	2.72	1.84	1.00	9.79	-	9.39	11.23	9.39	14.35	115.50	15115716	0	15115716	13649.735	13.650	0.69
86	10.47	2.91	1.68	1.00	10.47	-	9.72	11.24	9.72	14.95	58.70	8319316	0	8319316	14250.285	14.250	0.68
87	9.80	2.72	1.70	1.00	9.80	-	9.39	11.23	9.39	14.60	57.25	8124462	0	8124462	15073.213	15.073	0.62
88	9.07	2.52	1.68	1.00	9.07	-	9.03	11.26	9.03	14.10	50.10	7120613	0	7120613	16301.769	16.302	0.55
89	3.00	0.83	1.91	1.00	3.00	-	5.13	13.44	5.13	6.45	66.40	4317062	0	4317062	22661.745	22.662	0.23
90	18.50	5.14	1.54	1.36	25.17	-	15.19	15.08	15.08	21.85	65.25	14371182	0	14371182	12529.365	12.529	1.20
91	5.00	1.39	1.86	1.00	5.00	-	6.66	12.16	6.66	7.45	71.05	5462608	0	5462608	16137.690	16.138	0.41
92	4.80	1.33	1.76	1.00	4.80	-	6.53	12.25	6.53	7.60	37.90	2972573	0	2972573	17346.947	17.347	0.38
93	4.85	1.35	1.62	1.00	4.85	-	6.56	12.22	6.56	7.40	23.70	1809922	0	1809922	17855.489	17.855	0.37
		Av. W/H															Av. FOS
		2.67															0.60

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)

PILLAR STABILITY CALCULATIONS - BOTTOM SEAM - RT423
SENSITIVITY ANALYSIS - EXTRACTION - 3.0 m

Angle of Draw 26.50 deg 18

General Inputs / **Abutment Loading Input and Calcs**

Pillar	Rock unit weight (kN/m^3)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m^3/m width	c/c dimension over which abutment load is applied	Abutment
1	24	430	3	4	3	2.5	8.3	46.3	3	98	0	0	0	0	C1	11.25
2	24	430	4	2.5	2.5	2.25	8.5	47.5	3	94	0	0	0	0	C1	11.75
3	24	430	4.5	2.4	2.5	2.25	8.3	53.7	3	94	0	0	0	0	C1	11.8
4	24	420	4.3	4	4.3	2.25	8.5	156.3	3	99	0	0	0	0	C1	12.8
5	24	415	4.7	4	4.3	3.5	6.1	91.6	3	102	0	0	0	0	C1	10.6
6	24	415	5.2	3	4	2	5.3	107.3	3	85	0	0	0	0	C1	9.9
7	24	410	4.5	2.5	4.8	3.5	8.5	120.0	3	101	0	0	0	0	C1	13.15
8	24	400	5.3	1.8	5.1	1.8	8.2	67.3	3	91	0	0	0	0	C1	13.35
9	24	400	5.9	4.1	4	1.8	8.1	69.7	3	103	0	0	0	0	C1	13
10	24	390	5.9	1.7	4.8	4.5	10.5	74.6	3	98	0	0	0	0	C1	15.85
11	24	420	3.3	3.8	3.7	2.4	5.8	10.9	3	80	0	0	0	0	C1	9.3
12	24	420	2.4	3	4.1	3.5	10.8	11.9	3	83	0	0	0	0	C1	14.05
13	24	415	3.9	3	2.5	2.5	10.1	10.8	3	80	0	0	0	0	C1	13.3
14	24	410	3.4	2.8	2.4	2.5	10.9	11.8	3	81	0	0	0	0	C1	13.75
15	24	400	3.8	2.8	2.2	2.5	10.6	10.9	3	82	0	0	0	0	C1	13.6
16	24	390	2.7	4.5	2.8	2.1	10.8	11.6	3	95	0	0	0	0	C1	13.55
17	24	380	5	2.5	5.3	2.5	9.8	84.7	3	88	0	0	0	0	C1	14.95
18	24	370	5.1	4.5	4.2	1.6	9.8	121.8	3	90	0	0	0	0	C1	14.45
19	24	380	2.5	2.7	4.4	1.5	12.2	13.6	3	83	0	0	0	0	C1	15.65
20	24	370	4.2	2.3	2.6	1.3	11.7	12.0	3	84	0	0	0	0	C1	15.1
21	24	370	4	3.8	5	2.5	9.9	71.7	3	87	0	0	0	0	C1	14.4
22	24	360	5.1	1.5	3.8	2.9	10.3	83.9	3	90	0	0	0	0	C1	14.7
23	24	350	3.6	2.8	2.4	2.35	10.8	12.8	3	86	0	0	0	0	C1	13.8
24	24	350	5	3.2	3.8	3.6	11.0	25.0	3	100	0	0	0	0	C1	15.4
25	24	350	3.8	2.9	5.2	2.8	9.6	95.6	3	92	0	0	0	0	C1	14.1
26	24	345	2.6	3.9	1.7	2.2	4.1	7.1	3	90	0	0	0	0	C1	6.25
27	24	345	3.9	4	3	2	13.2	31.0	3	87	0	0	0	0	C1	16.65
28	24	340	5.3	2.8	3.6	2.05	11.7	293.0	3	103	80	11.7	30	3181.438457	C2	295.425
29	24	335	0	3.7	2.9	3	14.5	51.0	3	92	80	14.5	70	7328.448484	C2	54.35
30	24	335	0	2.5	3.1	3.7	15.3	49.5	3	88	80	15.3	70	7336.086077	C2	52.6
31	24	330	0	1.8	2.5	2.5	14.6	50.2	3	86	80	14.6	70	7204.921322	C2	52.35
32	24	320	0	1.7	3.6	2.3	13.8	45.2	3	86	80	13.8	70	6947.322614	C2	47.15
33	24	320	0	2.3	3	2.4	12.6	46.2	3	92	80	12.6	70	6935.423433	C2	48.55
34	24	315	0	2.4	2.7	2.6	10.0	49.5	3	99	80	10.0	70	6784.643584	C2	52
35	24	330	4	4	2.8	4	11.1	270.0	3	80	125	11.1	30	4020.693837	C2	274
36	24	340	4.3	2.4	4.1	2.1	9.5	68.7	3	80	0	0	0	0	C1	13.7
37	24	350	4.7	2.5	4.6	2.6	9.7	49.2	3	79	0	0	0	0	C1	14.35
38	24	365	4.3	2.3	4.1	2.5	8.7	96.3	3	83	0	0	0	0	C1	12.9
39	24	380	3.8	1.8	4.7	2.1	10.5	50.6	3	86	0	0	0	0	C1	14.75
40	24	390	3.5	2.1	3.6	1.8	10.2	50.4	3	90	0	0	0	0	C1	13.75
41	24	390	4.4	2.3	3.5	2.5	9.4	45.9	3	86	0	0	0	0	C1	13.35
42	24	400	4.1	2.9	4.3	2.5	9.6	92.0	3	87	0	0	0	0	C1	13.8
43	24	410	4	2.6	4.1	2.5	11.2	48.5	3	100	0	0	0	0	C1	15.25
44	24	420	4.1	2	3.3	2.4	7.1	40.0	3	82	0	0	0	0	C1	10.8
45	24	410	3.6	2.1	3.1	2.6	9.2	59.0	3	84	0	0	0	0	C1	12.55
46	24	410	3.9	2.6	3	2.95	9.5	46.5	3	78	0	0	0	0	C1	12.95
47	24	400	4.2	2.65	3.9	2.6	11.3	92.0	3	96	0	0	0	0	C1	15.3
48	24	390	4.7	2.7	4.5	2.9	10.1	97.0	3	90	0	0	0	0	C1	14.7
49	24	390	3.8	2.3	3.5	2.5	10.0	96.0	3	86	0	0	0	0	C1	13.65
50	24	380	4.4	1.9	3.8	2.3	8.4	41.4	3	89	0	0	0	0	C1	12.5
51	24	370	4.3	1.85	4.7	2.7	11.0	93.0	3	82	0	0	0	0	C1	15.5
52	24	370	5.7	2	3.8	2.3	10.1	102.7	3	80	0	0	0	0	C1	14.85
53	24	360	4.2	2.5	5.2	2.3	8.5	66.7	3	88	0	0	0	0	C1	13.2
54	24	320	5.8	2.7	4.8	2.3	9.3	78.2	3	90	0	0	0	0	C1	14.6
55	24	330	4.6	1.8	4.9	0	10.1	53.1	3	88	35	53.1	100	5308.629929	C1	14.85
56	24	340	4.9	2.3	4.8	2.8	8.1	102.2	3	92	35	102.2	100	5561.577722	C1	12.95
57	24	350	4.4	2.8	5.1	0	9.1	61.6	3	93	35	61.6	100	5663.371531	C1	13.85
58	24	365	4.1	2.3	4.5	2.4	8.9	112.0	3	78	35	112.0	100	6002.195227	C1	13.2
59	24	380	4.6	2.5	4.85	0	10.2	65.0	3	95	35	65.0	100	6176.890076	C1	14.925
60	24	380	3.6	2.9	4.8	0	10.1	38.8	3	88	18	38.8	100	3279.084653	C1	14.3
61	24	390	3.7	2.65	4.4	4.6	11.3	121.2	3	104	0	0	0	0	C1	15.35
62	24	400	3.6	2.85	3.4	2.8	10.1	47.4	3	101	0	0	0	0	C1	13.6
63	24	320	0	3	3	1.8	9.3	45.5	3	89	125	9.3	70	8975.626356	C2	47.9
64	24	320	0	3	3.2	2.5	9.7	47.7	3	78	125	9.7	70	8985.645402	C2	50.45
65	24	330	0	2	3	2.9	12.0	50.0	3	86	125	12.0	70	9404.372474	C2	52.45
66	24	340	0	1.3	2.8	1.9	13.1	46.0	3	92	125	13.1	70	9792.37396	C2	47.6
67	24	340	0	1.3	3.8	2.3	11.2	45.3	3	89	125	11.2	70	9743.220231	C2	47.1
68	24	340	4	2.8	4.2	2	9.7	91.3	3	94	0	0	0	0	C1	13.8
69	24	360	4.1	1.6	5.3	1.7	9.9	86.7	3	90	0	0	0	0	C1	14.6
70	24	370	5.3	2.1	5.1	2.2	9.0	44.8	3	86	0	0	0	0	C1	14.2
71	24	370	5	1.8	5.1	3.3	8.8	71.0	3	89	0	0	0	0	C1	13.85
72	24	380	5.1	0	5	2.75	8.6	69.5	3	88	0	0	0	0	C1	13.65
73	24	410	4	2.2	4.2	2.9	6.3	45.5	3	89	0	0	0	0	C1	10.4
74	24	430	4.5	2.75	2.4	2.6	9.0	51.7	3	88	0	0	0	0	C1	12.45
75	24	430	2.4	2.5	3.2	3.7	9.5	11.8	3	90	0	0	0	0	C1	12.3
76	24	430	2.5	4.2	2.6	3	8.1	11.1	3	90	0	0	0	0	C1	10.65
77	24	420	2.3	3.85	2.4	2	6.2	12.0	3	91	0	0	0	0	C1	8.55
78	24	410	5.5	3.95	2.4	0	9.3	11.7	3	90	0	0	0	0	C1	13.25
79	24	320	5	2.25	4.6	2	9.2	94.7	3	90	0	0	0	0	C1	14
80	24	340	4.3	1.5	4.3	2	10.2	104.0	3	92	0	0	0	0	C1	14.5
81	24	340	4.8	2	4.9	2.2	10.1	52.2	3	90	0	0	0	0	C1	14.95
82	24	355	4.5	1.7	5.1	2.2	9.9	10.9	3	90	0	0	0	0	C1	14.7
83	24	365	5.3	1.5	4.6	2.1	8.8	58.0	3	90	0	0	0	0	C1	13.75
84	24	365	4.9	2.1	4.2	1.5	9.8	54.3	3	90	0	0	0	0	C1	14.35
85	24	380	4.6	1.7	4.5	3.3	9.8	113.0	3	88	0	0	0	0	C1	14.35
86	24	395	4.5	3.9	4.4	2.3	10.5	55.6	3	94	0	0	0	0	C1	14.95
87	24	405	4.7	2.3	4.9	2.2	9.8	55.0	3	90	0	0	0	0	C1	14.6
88	24	420	5	2.1	5	2.1	9.1	48.0	3	85	0	0	0	0	C1	14.1
89	24	420	5	2.3	1.9	3.5	3.0	63.5	3	91	0	0	0	0	C1	6.45
90	24	420	4.5	4.2	2.2	2.3	18.5	62.0	3	89	0	0	0	0	C1	21.85
91	24	430	1.8	3.7	3.1	3	5.0	67.7	3	90	0	0	0	0	C1	7.45
92	24	430	2.8	2.5	2.8	1.9	4.8	35.7	3	89	0	0	0	0	C1	7.6
93	24	430	2.4	3.7	2.7	1.9	4.9	20.9	3	89	0	0	0	0	C2	23.7

Pillar Strength σ_{S2} / **Pillar load (kN)**

Pillar	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	Θ_o = (2*w_2/(w_1+w_2))	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
1	8.17	2.72	1.70	1.00	8.17	-	9.98	11.93	9.98	11.25	49.55	5752755	0	5752755	15060.554	15.061	0.66
2	8.48	2.83	1.70	1.00	8.48	-	10.17	11.93	10.17	11.75	49.88	6047843	0	6047843	14979.176	14.979	0.68
3	8.28	2.76	1.73	1.00	8.28	-	10.04	11.93	10.04	11.80	56.03	6822500	0	6822500	15307.039	15.307	0.66
4	8.40	2.80	1.90	1.00	8.40	-	10.12	11.93	10.12	12.80	159.43	20569651	0	20569651	15482.783	15.483	0.65
5	5.97	1.99	1.88	1.00	5.97	-	8.50	12.21	8.50	10.60	95.35	10066672	0	10066672	18016.092	18.016	0.47
6	5.28	1.76	1.91	1.00	5.28	-	7.98	12.42	7.98	9.90	109.75	10821789	0	10821789	19038.200	19.038	0.42
7	8.34	2.78	1.87	1.00	8.34	-	10.08	11.93	10.08	13.15	123.00	15915708	0	15915708	15603.635	15.604	0.65
8	8.15	2.72	1.78	1.00	8.15	-	9.96	11.93	9.96	13.35	69.05	8849448	0	8849448	16146.050	16.146	0.62
9	7.84	2.61	1.79	1.00	7.84	-	9.77	11.94	9.77	13.00	72.65	9066720	0	9066720	16159.263	16.159	0.60
10	10.40	3.47	1.75	1.09	11.35	-	11.79	12.63	11.79	15.85	77.70	11527261	0	11527261	14716.279	14.716	0.80
11	5.71	1.90	1.31	1.00	5.71	-	8.31	12.28	8.31	9.30	14.00	1312416	0	1312416	20759.506	20.760	0.40
12	10.72	3.57	1.05	1.01	10.82	-	11.51	12.19	11.51	14.05	15.15	2145604	0	2145604	16694.706	16.695	0.69
13	9.95	3.32	1.03	1.00	9.98	-	11.05	12.04	11.05	13.30	13.50	1788318	0	1788318	16470.808	16.471	0.67
14	10.72	3.57	1.04	1.01	10.80	-	11.50	12.18	11.50	13.75	14.45	1955085	0	1955085	15270.523	15.271	0.75
15	10.50	3.50	1.01	1.00	10.52	-	11.35	12.11	11.35	13.60	13.55	1769088	0	1769088	15311.477	15.311	0.74
16	10.76	3.59	1.04	1.01	10.83	-	11.52	12.18	11.52	13.55	14.90	1889737	0	1889737	15084.109	15.084	0.76
17	9.79	3.26	1.79	1.05	10.31	-	11.23	12.32	11.23	14.95	87.20	11889197	0	11889197	14323.298	14.323	0.78
18	9.80	3.27	1.85	1.06	10.35	-	11.26	12.34	11.26	14.45	124.85	16020253	0	16020253	13421.344	13.421	0.84
19	12.11	4.04	1.05	1.02	12.33	-	12.31	12.56	12.31	15.65	15.70	2240830	0	2240830	13505.482	13.505	0.91
20	11.64	3.88	1.01	1.00	11.67	-	11.97	12.34	11.97	15.10	13.75	1843710	0	1843710	13186.783	13.187	0.91
21	9.89	3.30	1.76	1.06	10.45	-	11.31	12.36	11.31	14.40	74.85	9571219	0	9571219	13483.819	13.484	0.84
22	10.25	3.42	1.78	1.08	11.11	-	11.67	12.56	11.67	14.70	86.10	10935389	0	10935389	12715.938	12.716	0.92
23	10.77	3.59	1.08	1.02	10.95	-	11.58	12.24	11.58	13.80	15.38	1782270	0	1782270	12892.578	12.893	0.90
24	10.83	3.61	1.39	1.07	11.58	-	11.92	12.58	11.92	15.40	28.40	3673824	0	3673824	13359.360	13.359	0.89
25	9.59	3.20	1.82	1.04	9.98	-	11.05	12.23	11.05	14.10	98.45	11660418	0	11660418	12705.302	12.705	0.87
26	4.10	1.37	1.27	1.00	4.10	-	7.02	12.95	7.02	6.25	10.15	525262.5	0	525263	18044.057	18.044	0.39
27	13.18	4.39	1.40	1.17	15.43	-	13.80	13.84	13.80	16.65	34.00	4687308	0	4687308	11454.809	11.455	1.20
28	11.40	3.80	1.92	1.19	13.57	-	12.92	13.41	12.92	16.15	295.43	38932288	22557034.94	61489323	17936.852	17.937	0.72
29	14.49	4.83	1.56	1.31	18.99	-	15.34	15.23	15.34	15.95	54.35	6969735	9559228.203	16528964	22351.540	22.352	0.69
30	15.24	5.08	1.53	1.34	20.46	-	15.93	15.81	15.81	16.80	52.60	7104787	9261075.064	16365862	21680.228	21.680	0.73
31	14.56	4.85	1.55	1.31	19.09	-	15.38	15.27	15.38	15.85	52.35	6571600	9052263.149	15623863	21317.283	21.317	0.72
32	13.77	4.59	1.53	1.25	17.25	-	14.61	14.57	14.61	15.60	47.15	5648947	7861590.27	13510537	21683.820	21.684	0.67
33	12.59	4.20	1.57	1.20	15.08	-	13.64	13.80	13.64	14.10	48.55	5257382	8081155.384	13338538	22913.725	22.914	0.60
34	9.88	3.29	1.66	1.05	10.38	-	11.27	12.32	11.27	11.35	52.00	4461912	8467235.192	12929147	26119.489	26.119	0.43
35	10.93	3.64	1.92	1.15	12.58	-	12.43	13.08	12.43	14.50	274.00	31466160	26440082.67	57906243	19321.402	19.321	0.64
36	9.36	3.12	1.76	1.02	9.57	-	10.81	12.10	10.81	13.70	70.95	7931642	0	7931642	12152.980	12.153	0.89
37	9.52	3.17	1.67	1.03	9.81	-	10.95	12.16	10.95	14.35	51.75	6237945	0	6237945	13070.876	13.071	0.84
38	8.64	2.88	1.83	1.00	8.64	-	10.26	11.93	10.26	12.90	98.70	11153495	0	11153495	13312.678	13.313	0.77
39	10.47	3.49	1.66	1.09	11.38	-	11.81	12.62	11.81	14.75	52.55	7069026	0	7069026	13305.150	13.305	0.89
40	10.20	3.40	1.66	1.07	10.92	-	11.56	12.48	11.56	13.75	52.35	6737445	0	6737445	13105.830	13.106	0.88
41	9.38	3.13	1.66	1.02	9.58	-	10.82	12.10	10.82	13.35	48.30	6035375	0	6035375	13988.260	13.988	0.77
42	9.59	3.20	1.81	1.04	9.97	-	11.04	12.22	11.04	13.80	94.70	12545856	0	12545856	14205.000	14.205	0.78
43	11.03	3.68	1.62	1.12	12.31	-	12.29	12.89	12.29	15.25	51.05	7660563	0	7660563	14102.656	14.103	0.87
44	7.03	2.34	1.70	1.00	7.03	-	9.24	12.01	9.24	10.80	42.20	4594061	0	4594061	16176.270	16.176	0.57
45	9.15	3.05	1.73	1.01	9.23	-	10.62	12.01	10.62	12.55	61.35	7576234	0	7576234	13957.690	13.958	0.76
46	9.29	3.10	1.66	1.02	9.45	-	10.74	12.06	10.74	12.95	49.28	6279015	0	6279015	14213.955	14.214	0.76
47	11.19	3.73	1.78	1.15	12.88	-	12.58	13.13	12.58	15.30	94.63	13898520	0	13898520	13428.522	13.429	0.94
48	10.10	3.37	1.81	1.08	10.86	-	11.53	12.49	11.53	14.70	99.80	13731682	0	13731682	14016.211	14.016	0.82
49	9.98	3.33	1.81	1.07	10.64	-	11.41	12.43	11.41	13.65	98.40	12571978	0	12571978	13095.810	13.096	0.87
50	8.40	2.80	1.66	1.00	8.40	-	10.12	11.93	10.12	12.50	43.50	4959000	0	4959000	14259.834	14.260	0.71
51	10.89	3.63	1.79	1.13	12.31	-	12.30	12.95	12.30	15.50	95.28	13113651	0	13113651	12818.818	12.819	0.96
52	9.95	3.32	1.82	1.07	10.59	-	11.39	12.41	11.39	14.85	104.85	13826360	0	13826360	13329.567	13.330	0.85
53	8.49	2.83	1.77	1.00	8.49	-	10.18	11.93	10.18	13.20	69.05	7875014	0	7875014	13900.559	13.901	0.73
54	9.30	3.10	1.79	1.02	9.48	-	10.76	12.08	10.76	14.60	80.70	9048730	0	9048730	12442.221	12.442	0.87
55	10.09	3.36	1.68	1.07	10.75	-	11.48	12.43	11.48	14.85	54.00	6351048	1891995.707	8243044	15369.924	15.370	0.75
56	8.10	2.70	1.85	1.00	8.10	-	9.93	11.93	9.93	12.95	104.75	11069142	1728538.356	12797680	15459.496	15.459	0.64
57	9.09	3.03	1.74	1.01	9.14	-	10.56	11.98	10.56	13.85	63.00	7329420	1882504.697	9211925	16433.432	16.433	0.64
58	8.71	2.90	1.85	1.00	8.71	-	10.30	11.93	10.30	13.20	114.35	13222519	1901495.448	15124015	15172.567	15.173	0.68
59	10.16	3.39	1.73	1.07	10.90	-	11.56	12.49	11.56	14.93	66.25	9017685	2212562.025	11230247	16938.532	16.939	0.68
60	10.09	3.36	1.59	1.06	10.68	-	11.43	12.39	11.43	14.30	40.25	5249244	1125381.853	6374626	16266.780	16.267	0.70
61	10.96	3.65	1.83	1.14	12.51	-	12.40	13.03	12.40	15.35	124.83	17934357	0	17934357	13094.977	13.095	0.95
62	9.91	3.30	1.65	1.05	10.43	-	11.30	12.33	11.30	13.60	50.23	6557376	0	6557376	13697.155	13.697	0.82
63	9.30	3.10	1.66	1.02	9.46	-	10.75	12.06	10.75	10.80	47.90	3973018	10318380.06	14291398	33773.834	33.774	0.32
64	9.49	3.16	1.66	1.03	9.75	-	10.92	12.14	10.92	11.30	50.45	4378253	10879819.45	15258072	32976.879	32.977	0.33
65	11.97	3.99	1.61	1.17	14.02	-	13.14	13.45	13.14	13.50	52.45	5607954	11838224.07	17446178	29076.963	29.077	0.45
66	13.09	4.36	1.56	1.22	16.01	-	14.06	14.12	14.06	14.50	47.60	5632032	11186808.01	16818840	27910.455	27.910	0.50
67	11.20	3.73	1.60	1.12	12.57	-	12.43	12.97	12.43	13.10	47.10	5034802	11013736.15	16048538	31631.460	31.631	0.39
68	9.68	3.23	1.81	1.05	10.12	-	11.12	12.27	11.12	13.80	93.65	10545739	0	10545739	11914.407	11.914	0.93
69	9.90	3.30	1.80	1.06	10.50	-	11.34	12.38	11.34	14.60	88.35	11144822	0	11144822	12984.310	12.984	0.87
70	8.98	2.99	1.67	1.00	8.98	-	10.47	11.94	10.47	14.20	46.95	5920207	0	5920207	14683.054	14.683	0.71
71	8.80	2.93	1.78	1.00	8.80	-	10.36	11.93	10.36	13.85	73.55	9045767	0	9045767	14477.861	14.478	0.72
72	8.59	2.86	1.78	1.00	8.59	-	10.24	11.93	10.24	13.65	70.88	8823087	0	8823087	14761.732	14.762	0.69
73	6.30	2.10	1.76	1.00	6.30	-	8.74	12.14	8.74	10.40	48.05	4917245	0	4917245	17154.177	17.154	0.51
74	8.99	3.00	1.70	1.00	8.99	-	10.48	11.94	10.48	12.45	54.38	6986318	0	6986318	15014.652	15.015	0.70
75	9.50	3.17	1.11	1.01	9.55	-	10.80	12.01	10.80	12.30	14.90	1891346	0	1891346	16871.957	16.872	0.64
76	8.10	2.70	1.16	1.00	8.10	-	9.93	11.93	9.93	10.65	14.70	1615648	0	1615648	17969.610	17.970	0.55
77	6.20	2.07	1.32	1.00	6.20	-	8.67	12.16	8.67	8.55	14.93	1286296	0	1286296	17288.927	17.289	0.50
78	9.30	3.10	1.11	1.00	9.33	-	10.68	11.98	10.68	13.25	13.68	1782947	0	1782947	16385.870	16.386	0.65
79	9.20	3.07	1.82	1.01	9.32	-	10.67	12.03	10.67	14.00	96.83	10410624	0	10410624	11949.203	11.949	0.89
80	10.19	3.40	1.82	1.08	11.04	-	11.63	12.55	11.63	14.50	105.75	12512340	0	12512340	11795.192	11.795	0.99
81	10.10	3.37	1.68	1.07	10.76	-	11.48	12.43	11.48	14.95	54.30	6624166	0	6624166	12564.329	12.564	0.91
82	9.90	3.30	1.05	1.00	9.94	-	11.03	12.04	11.03	14.70	12.81	1604376	0	1604376	14922.481	14.922	0.74
83	8.80	2.93	1.74	1.00	8.80	-	10.36	11.93	10.36	13.75	59.80	7202910	0	7202910	14112.284	14.112	0.73
84	9.80	3.27	1.69	1.05	10.27	-	11.21	12.29	11.21	14.35	56.10	7052107	0	7052107	13252.352	13.252	0.85
85	9.79	3.26	1.84	1.06	10.34	-	11.25	12.34	11.25	14.35	115.50	15115716	0	15115716	13649.735	13.650	0.82
86	10.47	3.49	1.68	1.09	11.41	-	11.83	12.63	11.83	14.95	58.70	8319316	0	8319316	14250.285	14.250	0.83
87	9.80	3.27	1.70	1.05	10.27	-	11.21	12.30	11.21	14.60	57.25	8124462	0	8124462	15073.213	15.073	0.74
88	9.07	3.02	1.68	1.00	9.10	-	10.54	11.97	10.54	14.10	50.10	7120613	0	7120613	16301.769	16.302	0.65
89	3.00	1.00	1.91	1.00	3.00	-	5.98	13.75	5.98	6.45	66.40	4317062	0	4317062	22661.745	22.662	0.26
90	18.50	6.17	1.54	1.54	28.49	-	18.86	19.27	19.27	21.85	65.25	14371182	0	14371182	12529.365	12.529	1.54
91	5.00	1.67	1.86	1.00	5.00	-	7.77	12.52	7.77	7.45	71.05	5462608	0	5462608	16137.690	16.138	0.48
92	4.80	1.60	1.76	1.00	4.80	-	7.61	12.60	7.61	7.60	37.90	2972573	0	2972573	17346.947	17.347	0.44
93	4.85	1.62	1.62	1.00	4.85	-	7.65	12.58	7.65	7.40	23.70	1809922	0	1809922	17855.489	17.855	0.43
		Av. W/H 3.21															Av. FOS 0.72

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)

PILLAR STABILITY CALCULATIONS - BOTTOM SEAM - RT423
SENSITIVITY ANALYSIS - EXTRACTION - 2.5 m

Angle of Draw 26.50 deg 18

General Inputs / **Abutment Loading Input and Calcs**

Pillar	Rock unit weight (kN/m^3)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m^3/m width	c/c dimension over which abutment load is applied	Abutment	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	$Θ_o$ = ($2*w_2/(w_1+w_2)$)
1	24	430	3	4	3	2.5	8.3	46.3	2.5	98	0	0	0	0	C1	11.25	8.17	3.27	1.70
2	24	430	4	2.5	2.5	2.25	8.5	47.5	2.5	94	0	0	0	0	C1	11.75	8.48	3.39	1.70
3	24	430	4.5	2.4	2.5	2.25	8.3	53.7	2.5	94	0	0	0	0	C1	11.8	8.28	3.31	1.73
4	24	420	4.3	4	4.3	2.25	8.5	156.3	2.5	99	0	0	0	0	C1	12.8	8.40	3.36	1.90
5	24	415	4.7	4	4.3	3.5	6.1	91.6	2.5	102	0	0	0	0	C1	10.6	5.97	2.39	1.88
6	24	415	5.2	3	4	2	5.3	107.3	2.5	85	0	0	0	0	C1	9.9	5.28	2.11	1.91
7	24	410	4.5	2.5	4.8	3.5	8.5	120.0	2.5	101	0	0	0	0	C1	13.15	8.34	3.34	1.87
8	24	400	5.3	1.8	5.1	1.8	8.2	67.3	2.5	91	0	0	0	0	C1	13.35	8.15	3.26	1.78
9	24	400	5.9	4.1	4	1.8	8.1	69.7	2.5	103	0	0	0	0	C1	13	7.84	3.14	1.79
10	24	390	5.9	1.7	4.8	4.5	10.5	74.6	2.5	98	0	0	0	0	C1	15.85	10.40	4.16	1.75
11	24	420	3.3	3.8	3.7	2.4	5.8	10.9	2.5	80	0	0	0	0	C1	9.3	5.71	2.28	1.31
12	24	420	2.4	3	4.1	3.5	10.8	11.9	2.5	83	0	0	0	0	C1	14.05	10.72	4.29	1.05
13	24	415	3.9	3	2.5	2.5	10.1	10.8	2.5	80	0	0	0	0	C1	13.3	9.95	3.98	1.03
14	24	410	3.4	2.8	2.4	2.5	10.9	11.8	2.5	81	0	0	0	0	C1	13.75	10.72	4.29	1.04
15	24	400	3.8	2.8	2.2	2.5	10.6	10.9	2.5	82	0	0	0	0	C1	13.6	10.50	4.20	1.01
16	24	390	2.7	4.5	2.8	2.1	10.8	11.6	2.5	95	0	0	0	0	C1	13.55	10.76	4.30	1.04
17	24	380	5	2.5	5.3	2.5	9.8	84.7	2.5	88	0	0	0	0	C1	14.95	9.79	3.92	1.79
18	24	370	5.1	4.5	4.2	1.6	9.8	121.8	2.5	90	0	0	0	0	C1	14.45	9.80	3.92	1.85
19	24	380	2.5	2.7	4.4	1.5	12.2	13.6	2.5	83	0	0	0	0	C1	15.65	12.11	4.84	1.05
20	24	370	4.2	2.3	2.6	1.3	11.7	12.0	2.5	84	0	0	0	0	C1	15.1	11.64	4.65	1.01
21	24	370	4	3.8	5	2.5	9.9	71.7	2.5	87	0	0	0	0	C1	14.4	9.89	3.95	1.76
22	24	360	5.1	1.5	3.8	2.9	10.3	83.9	2.5	90	0	0	0	0	C1	14.7	10.25	4.10	1.78
23	24	350	3.6	2.8	2.4	2.35	10.8	12.8	2.5	86	0	0	0	0	C1	13.8	10.77	4.31	1.08
24	24	350	5	3.2	3.8	3.6	11.0	25.0	2.5	100	0	0	0	0	C1	15.4	10.83	4.33	1.39
25	24	350	3.8	2.9	5.2	2.8	9.6	95.6	2.5	92	0	0	0	0	C1	14.1	9.59	3.84	1.82
26	24	345	2.6	3.9	1.7	2.2	4.1	7.1	2.5	90	0	0	0	0	C1	6.25	4.10	1.64	1.27
27	24	345	3.9	4	3	2	13.2	31.0	2.5	87	0	0	0	0	C1	16.65	13.18	5.27	1.40
28	24	340	5.3	2.8	3.6	2.05	11.7	293.0	2.5	103	80	11.7	30	3181.438457	C2	295.425	11.40	4.56	1.92
29	24	335	0	3.7	2.9	3	14.5	51.0	2.5	92	80	14.5	70	7328.448484	C2	54.35	14.49	5.80	1.56
30	24	335	0	2.5	3.1	3.7	15.3	49.5	2.5	88	80	15.3	70	7336.086077	C2	52.6	15.24	6.10	1.53
31	24	330	0	1.8	2.5	2.5	14.6	50.2	2.5	86	80	14.6	70	7204.921322	C2	52.35	14.56	5.83	1.55
32	24	320	0	1.7	3.6	2.3	13.8	45.2	2.5	86	80	13.8	70	6947.322614	C2	47.15	13.77	5.51	1.53
33	24	320	0	2.3	3	2.4	12.6	46.2	2.5	92	80	12.6	70	6935.423433	C2	48.55	12.59	5.04	1.57
34	24	315	0	2.4	2.7	2.6	10.0	49.5	2.5	99	80	10.0	70	6784.643584	C2	52	9.88	3.95	1.66
35	24	330	4	4	2.8	4	11.1	270.0	2.5	80	125	11.1	30	4020.693837	C2	274	10.93	4.37	1.92
36	24	340	4.3	2.4	4.1	2.1	9.5	68.7	2.5	80	0	0	0	0	C1	13.7	9.36	3.74	1.76
37	24	350	4.7	2.5	4.6	2.6	9.7	49.2	2.5	79	0	0	0	0	C1	14.35	9.52	3.81	1.67
38	24	365	4.3	2.3	4.1	2.5	8.7	96.3	2.5	83	0	0	0	0	C1	12.9	8.64	3.45	1.83
39	24	380	3.8	1.8	4.7	2.1	10.5	50.6	2.5	86	0	0	0	0	C1	14.75	10.47	4.19	1.66
40	24	390	3.5	2.1	3.6	1.8	10.2	50.4	2.5	90	0	0	0	0	C1	13.75	10.20	4.08	1.66
41	24	390	4.4	2.3	3.5	2.5	9.4	45.9	2.5	86	0	0	0	0	C1	13.35	9.38	3.75	1.66
42	24	400	4.1	2.9	4.3	2.5	9.6	92.0	2.5	87	0	0	0	0	C1	13.8	9.59	3.83	1.81
43	24	410	4	2.6	4.1	2.5	11.2	48.5	2.5	100	0	0	0	0	C1	15.25	11.03	4.41	1.62
44	24	420	4.1	2	3.3	2.4	7.1	40.0	2.5	82	0	0	0	0	C1	10.8	7.03	2.81	1.70
45	24	410	3.6	2.1	3.1	2.6	9.2	59.0	2.5	84	0	0	0	0	C1	12.55	9.15	3.66	1.73
46	24	410	3.9	2.6	3	2.95	9.5	46.5	2.5	78	0	0	0	0	C1	12.95	9.29	3.72	1.66
47	24	400	4.2	2.65	3.9	2.6	11.3	92.0	2.5	96	0	0	0	0	C1	15.3	11.19	4.48	1.78
48	24	390	4.7	2.7	4.5	2.9	10.1	97.0	2.5	90	0	0	0	0	C1	14.7	10.10	4.04	1.81
49	24	390	3.8	2.3	3.5	2.5	10.0	96.0	2.5	86	0	0	0	0	C1	13.65	9.98	3.99	1.81
50	24	380	4.4	1.9	3.8	2.3	8.4	41.4	2.5	89	0	0	0	0	C1	12.5	8.40	3.36	1.66
51	24	370	4.3	1.85	4.7	2.7	11.0	93.0	2.5	82	0	0	0	0	C1	15.5	10.89	4.36	1.79
52	24	370	5.7	2	3.8	2.3	10.1	102.7	2.5	80	0	0	0	0	C1	14.85	9.95	3.98	1.82
53	24	360	4.2	2.5	5.2	2.3	8.5	66.7	2.5	88	0	0	0	0	C1	13.2	8.49	3.40	1.77
54	24	320	5.8	2.7	4.8	2.3	9.3	78.2	2.5	90	0	0	0	0	C1	14.6	9.30	3.72	1.79
55	24	330	4.6	1.8	4.9	0	10.1	53.1	2.5	88	35	53.1	100	5308.629929	C1	14.85	10.09	4.04	1.68
56	24	340	4.9	2.3	4.8	2.8	8.1	102.2	2.5	92	35	102.2	100	5561.577722	C1	12.95	8.10	3.24	1.85
57	24	350	4.4	2.8	5.1	0	9.1	61.6	2.5	93	35	61.6	100	5663.371531	C1	13.85	9.09	3.64	1.74
58	24	365	4.1	2.3	4.5	2.4	8.9	112.0	2.5	78	35	112.0	100	6002.195227	C1	13.2	8.71	3.48	1.85
59	24	380	4.6	2.5	4.85	0	10.2	65.0	2.5	95	35	65.0	100	6176.890076	C1	14.925	10.16	4.06	1.73
60	24	380	3.6	2.9	4.8	0	10.1	38.8	2.5	88	18	38.8	100	3279.084653	C1	14.3	10.09	4.04	1.59
61	24	390	3.7	2.65	4.4	4.6	11.3	121.2	2.5	104	0	0	0	0	C1	15.35	10.96	4.39	1.83
62	24	400	3.6	2.85	3.4	2.8	10.1	47.4	2.5	101	0	0	0	0	C1	13.6	9.91	3.97	1.65
63	24	320	0	3	3	1.8	9.3	45.5	2.5	89	125	9.3	70	8975.626356	C2	47.9	9.30	3.72	1.66
64	24	320	0	3	3.2	2.5	9.7	47.7	2.5	78	125	9.7	70	8985.645402	C2	50.45	9.49	3.80	1.66
65	24	330	0	2	3	2.9	12.0	50.0	2.5	86	125	12.0	70	9404.372474	C2	52.45	11.97	4.79	1.61
66	24	340	0	1.3	2.8	1.9	13.1	46.0	2.5	92	125	13.1	70	9792.37396	C2	47.6	13.09	5.24	1.56
67	24	340	0	1.3	3.8	2.3	11.2	45.3	2.5	89	125	11.2	70	9743.220231	C2	47.1	11.20	4.48	1.60
68	24	340	4	2.8	4.2	2	9.7	91.3	2.5	94	0	0	0	0	C1	13.8	9.68	3.87	1.81
69	24	360	4.1	1.6	5.3	1.7	9.9	86.7	2.5	90	0	0	0	0	C1	14.6	9.90	3.96	1.80
70	24	370	5.3	2.1	5.1	2.2	9.0	44.8	2.5	86	0	0	0	0	C1	14.2	8.98	3.59	1.67
71	24	370	5	1.8	5.1	3.3	8.8	71.0	2.5	89	0	0	0	0	C1	13.85	8.80	3.52	1.78
72	24	380	5.1	0	5	2.75	8.6	69.5	2.5	88	0	0	0	0	C1	13.65	8.59	3.44	1.78
73	24	410	4	2.2	4.2	2.9	6.3	45.5	2.5	89	0	0	0	0	C1	10.4	6.30	2.52	1.76
74	24	430	4.5	2.75	2.4	2.6	9.0	51.7	2.5	88	0	0	0	0	C1	12.45	8.99	3.60	1.70
75	24	430	2.4	2.5	3.2	3.7	9.5	11.8	2.5	90	0	0	0	0	C1	12.3	9.50	3.80	1.11
76	24	430	2.5	4.2	2.6	3	8.1	11.1	2.5	90	0	0	0	0	C1	10.65	8.10	3.24	1.16
77	24	420	2.3	3.85	2.4	2	6.2	12.0	2.5	91	0	0	0	0	C1	8.55	6.20	2.48	1.32
78	24	410	5.5	3.95	2.4	0	9.3	11.7	2.5	90	0	0	0	0	C1	13.25	9.30	3.72	1.11
79	24	320	5	2.25	4.6	2	9.2	94.7	2.5	90	0	0	0	0	C1	14	9.20	3.68	1.82
80	24	340	4.3	1.5	4.3	2	10.2	104.0	2.5	92	0	0	0	0	C1	14.5	10.19	4.08	1.82
81	24	340	4.8	2	4.9	2.2	10.1	52.2	2.5	90	0	0	0	0	C1	14.95	10.10	4.04	1.68
82	24	355	4.5	1.7	5.1	2.2	9.9	10.9	2.5	90	0	0	0	0	C1	14.7	9.90	3.96	1.05
83	24	365	5.3	1.5	4.6	2.1	8.8	58.0	2.5	90	0	0	0	0	C1	13.75	8.80	3.52	1.74
84	24	365	4.9	2.1	4.2	1.5	9.8	54.3	2.5	90	0	0	0	0	C1	14.35	9.80	3.92	1.69
85	24	380	4.6	1.7	4.5	3.3	9.8	113.0	2.5	88	0	0	0	0	C1	14.35	9.79	3.92	1.84
86	24	395	4.5	3.9	4.4	2.3	10.5	55.6	2.5	94	0	0	0	0	C1	14.95	10.47	4.19	1.68
87	24	405	4.7	2.3	4.9	2.2	9.8	55.0	2.5	90	0	0	0	0	C1	14.6	9.80	3.92	1.70
88	24	420	5	2.1	5	2.1	9.1	48.0	2.5	85	0	0	0	0	C1	14.1	9.07	3.63	1.68
89	24	420	5	2.3	1.9	3.5	3.0	63.5	2.5	91	0	0	0	0	C1	6.45	3.00	1.20	1.91
90	24	420	4.5	4.2	2.2	2.3	18.5	62.0	2.5	89	0	0	0	0	C1	21.85	18.50	7.40	1.54
91	24	430	1.8	3.7	3.1	3	5.0	67.7	2.5	90	0	0	0	0	C1	7.45	5.00	2.00	1.86
92	24	430	2.8	2.5	2.8	1.9	4.8	35.7	2.5	89	0	0	0	0	C1	7.6	4.80	1.92	1.76
93	24	430	2.4	3.7	2.7	1.9	4.9	20.9	2.5	89	0	0	0	0	C2	23.7	4.85	1.94	1.62
																		Av. W/H	
																		3.85	

Pillar Strength σ_{S2} / **Pillar load (kN)**

Pillar	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
1	1.05	8.57	-	11.91	13.06	11.91	11.25	49.55	5752755	0	5752755	15060.554	15.061	0.79
2	1.07	9.09	-	12.27	13.26	12.27	11.75	49.88	6047843	0	6047843	14979.176	14.979	0.82
3	1.06	8.77	-	12.05	13.14	12.05	11.80	56.03	6822500	0	6822500	15307.039	15.307	0.79
4	1.08	9.06	-	12.26	13.29	12.26	12.80	159.43	20569651	0	20569651	15482.783	15.483	0.79
5	1.00	5.97	-	9.90	12.74	9.90	10.60	95.35	10066672	0	10066672	18016.092	18.016	0.55
6	1.00	5.28	-	9.31	12.88	9.31	9.90	109.75	10821789	0	10821789	19038.200	19.038	0.49
7	1.07	8.95	-	12.18	13.24	12.18	13.15	123.00	15915708	0	15915708	15603.635	15.604	0.78
8	1.05	8.57	-	11.91	13.08	11.91	13.35	69.05	8849448	0	8849448	16146.050	16.146	0.74
9	1.03	8.06	-	11.54	12.88	11.54	13.00	72.65	9066720	0	9066720	16159.263	16.159	0.71
10	1.24	12.92	-	14.69	14.89	14.69	15.85	77.70	11527261	0	11527261	14716.279	14.716	1.00
11	1.00	5.71	-	9.69	12.79	9.69	9.30	14.00	1312416	0	1312416	20759.506	20.760	0.47
12	1.02	10.94	-	13.49	13.59	13.49	14.05	15.15	2145604	0	2145604	16694.706	16.695	0.81
13	1.01	10.05	-	12.92	13.24	12.92	13.30	13.50	1788318	0	1788318	16470.808	16.471	0.78
14	1.02	10.91	-	13.47	13.57	13.47	13.75	14.45	1955085	0	1955085	15270.523	15.271	0.88
15	1.01	10.56	-	13.25	13.40	13.25	13.60	13.55	1769088	0	1769088	15311.477	15.311	0.87
16	1.02	10.92	-	13.48	13.57	13.48	13.55	14.90	1889737	0	1889737	15084.109	15.084	0.89
17	1.20	11.71	-	13.97	14.37	13.97	14.95	87.20	11889197	0	11889197	14323.298	14.323	0.98
18	1.21	11.84	-	14.05	14.45	14.05	14.45	124.85	16020253	0	16020253	13421.344	13.421	1.05
19	1.03	12.51	-	14.45	14.35	14.45	15.65	15.70	2240830	0	2240830	13505.482	13.505	1.07
20	1.01	11.70	-	13.97	13.91	13.97	15.10	13.75	1843710	0	1843710	13186.783	13.187	1.06
21	1.20	11.83	-	14.04	14.41	14.04	14.40	74.85	9571219	0	9571219	13483.819	13.484	1.04
22	1.24	12.67	-	14.54	14.79	14.54	14.70	86.10	10935389	0	10935389	12715.938	12.716	1.14
23	1.04	11.16	-	13.63	13.72	13.63	13.80	15.38	1782270	0	1782270	12892.578	12.893	1.06
24	1.16	12.54	-	14.46	14.54	14.46	15.40	28.40	3673824	0	3673824	13359.360	13.359	1.08
25	1.18	11.34	-	13.74	14.22	13.74	14.10	98.45	11660418	0	11660418	12705.302	12.705	1.08
26	1.00	4.10	-	8.18	13.33	8.18	6.25	10.15	525262.5	0	525263	18044.057	18.044	0.45
27	1.29	17.03	-	16.91	16.81	16.81	16.65	34.00	4687308	0	4687308	11454.809	11.455	1.47
28	1.41	16.02	-	16.39	16.36	16.39	16.15	295.43	38932288	22557034.94	61489323	17936.852	17.937	0.91
29	1.51	21.90	-	19.22	19.34	19.34	15.95	54.35	6969735	9559228.203	16528964	22351.540	22.352	0.87
30	1.53	23.30	-	19.84	20.21	20.21	16.80	52.60	7104787	9261075.064	16365862	21680.228	21.680	0.93
31	1.51	22.00	-	19.27	19.41	19.41	15.85	52.35	6571600	9052263.149	15623863	21317.283	21.317	0.91
32	1.43	19.66	-	18.19	18.16	18.16	15.60	47.15	5648947	7861590.27	13510537	21683.820	21.684	0.84
33	1.36	17.12	-	16.95	16.82	16.82	14.10	48.55	5257382	8081155.384	13338538	22913.725	22.914	0.73
34	1.18	11.61	-	13.91	14.27	13.91	11.35	52.00	4461912	8467235.192	12929147	26119.489	26.119	0.53
35	1.35	14.74	-	15.71	15.77	15.71	14.50	274.00	31466160	26440082.67	57906243	19321.402	19.321	0.81
36	1.15	10.76	-	13.38	13.95	13.38	13.70	70.95	7931642	0	7931642	12152.980	12.153	1.10
37	1.15	10.93	-	13.49	13.99	13.49	14.35	51.75	6237945	0	6237945	13070.876	13.071	1.03
38	1.10	9.47	-	12.53	13.44	12.53	12.90	98.70	11153495	0	11153495	13312.678	13.313	0.94
39	1.22	12.79	-	14.62	14.79	14.62	14.75	52.55	7069026	0	7069026	13305.150	13.305	1.10
40	1.20	12.25	-	14.30	14.55	14.30	13.75	52.35	6737445	0	6737445	13105.830	13.106	1.09
41	1.14	10.65	-	13.31	13.87	13.31	13.35	48.30	6035375	0	6035375	13988.260	13.988	0.95
42	1.18	11.31	-	13.72	14.20	13.72	13.80	94.70	12545856	0	12545856	14205.000	14.205	0.97
43	1.26	13.86	-	15.22	15.26	15.22	15.25	51.05	7660563	0	7660563	14102.656	14.103	1.08
44	1.00	7.03	-	10.77	12.67	10.77	10.80	42.20	4594061	0	4594061	16176.270	16.176	0.67
45	1.13	10.32	-	13.10	13.76	13.10	12.55	61.35	7576234	0	7576234	13957.690	13.958	0.94
46	1.13	10.49	-	13.21	13.80	13.21	12.95	49.28	6279015	0	6279015	14213.955	14.214	0.93
47	1.33	14.87	-	15.78	15.78	15.78	15.30	94.63	13898520	0	13898520	13428.522	13.429	1.17
48	1.23	12.41	-	14.39	14.68	14.39	14.70	99.80	13731682	0	13731682	14016.211	14.016	1.03
49	1.22	12.14	-	14.23	14.56	14.23	13.65	98.40	12571978	0	12571978	13095.810	13.096	1.09
50	1.06	8.93	-	12.16	13.19	12.16	12.50	43.50	4959000	0	4959000	14259.834	14.260	0.85
51	1.30	14.17	-	15.40	15.47	15.40	15.50	95.28	13113651	0	13113651	12818.818	12.819	1.20
52	1.22	12.09	-	14.20	14.55	14.20	14.85	104.85	13826360	0	13826360	13329.567	13.330	1.07
53	1.08	9.17	-	12.33	13.31	12.33	13.20	69.05	7875014	0	7875014	13900.559	13.901	0.89
54	1.15	10.69	-	13.34	13.93	13.34	14.60	80.70	9048730	0	9048730	12442.221	12.442	1.07
55	1.20	12.08	-	14.19	14.49	14.19	14.85	54.00	6351048	1891995.707	8243044	15369.924	15.370	0.92
56	1.05	8.50	-	11.86	13.06	11.86	12.95	104.75	11069142	1728538.356	12797680	15459.496	15.459	0.77
57	1.12	10.22	-	13.03	13.72	13.03	13.85	63.00	7329420	1882504.697	9211925	16433.432	16.433	0.79
58	1.10	9.61	-	12.63	13.51	12.63	13.20	114.35	13222519	1901495.448	15124015	15172.567	15.173	0.83
59	1.21	12.34	-	14.35	14.62	14.35	14.93	66.25	9017685	2212562.025	11230247	16938.532	16.939	0.85
60	1.17	11.84	-	14.05	14.34	14.05	14.30	40.25	5249244	1125381.853	6374626	16266.780	16.267	0.86
61	1.32	14.49	-	15.57	15.63	15.57	15.35	124.83	17934357	0	17934357	13094.977	13.095	1.19
62	1.17	11.65	-	13.93	14.28	13.93	13.60	50.23	6557376	0	6557376	13697.155	13.697	1.02
63	1.13	10.50	-	13.21	13.81	13.21	10.80	47.90	3973018	10318380.06	14291398	33773.834	33.774	0.39
64	1.14	10.86	-	13.44	13.95	13.44	11.30	50.45	4378253	10879819.45	15258072	32976.879	32.977	0.41
65	1.33	15.92	-	16.34	16.23	16.34	13.50	52.45	5607954	11838224.07	17446178	29076.963	29.077	0.56
66	1.39	18.21	-	17.50	17.38	17.38	14.50	47.60	5632032	11186808.01	16818840	27910.455	27.910	0.62
67	1.26	14.13	-	15.38	15.38	15.38	13.10	47.10	5034802	11013736.15	16048538	31631.460	31.631	0.49
68	1.19	11.49	-	13.84	14.28	13.84	13.80	93.65	10545739	0	10545739	11914.407	11.914	1.16
69	1.21	11.94	-	14.11	14.47	14.11	14.60	88.35	11144822	0	11144822	12984.310	12.984	1.09
70	1.11	9.93	-	12.84	13.58	12.84	14.20	46.95	5920207	0	5920207	14683.054	14.683	0.87
71	1.10	9.72	-	12.71	13.53	12.71	13.85	73.55	9045767	0	9045767	14477.861	14.478	0.88
72	1.09	9.35	-	12.45	13.38	12.45	13.65	70.88	8823087	0	8823087	14761.732	14.762	0.84
73	1.00	6.30	-	10.18	12.70	10.18	10.40	48.05	4917245	0	4917245	17154.177	17.154	0.59
74	1.11	10.00	-	12.89	13.62	12.89	12.45	54.38	6986318	0	6986318	15014.652	15.015	0.86
75	1.03	9.76	-	12.73	13.21	12.73	12.30	14.90	1891346	0	1891346	16871.957	16.872	0.75
76	1.01	8.19	-	11.64	12.82	11.64	10.65	14.70	1615648	0	1615648	17969.610	17.970	0.65
77	1.00	6.20	-	10.10	12.71	10.10	8.55	14.93	1286296	0	1286296	17288.927	17.289	0.58
78	1.03	9.54	-	12.59	13.15	12.59	13.25	13.68	1782947	0	1782947	16385.870	16.386	0.77
79	1.15	10.54	-	13.24	13.88	13.24	14.00	96.83	10410624	0	10410624	11949.203	11.949	1.11
80	1.24	12.64	-	14.53	14.79	14.53	14.50	105.75	12512340	0	12512340	11795.192	11.795	1.23
81	1.20	12.08	-	14.19	14.48	14.19	14.95	54.30	6624166	0	6624166	12564.329	12.564	1.13
82	1.01	10.04	-	12.92	13.25	12.92	14.70	12.81	1604376	0	1604376	14922.481	14.922	0.87
83	1.10	9.68	-	12.68	13.50	12.68	13.75	59.80	7202910	0	7202910	14112.284	14.112	0.90
84	1.18	11.52	-	13.85	14.25	13.85	14.35	56.10	7052107	0	7052107	13252.352	13.252	1.05
85	1.21	11.80	-	14.03	14.43	14.03	14.35	115.50	15115716	0	15115716	13649.735	13.650	1.03
86	1.23	12.87	-	14.66	14.84	14.66	14.95	58.70	8319316	0	8319316	14250.285	14.250	1.03
87	1.18	11.53	-	13.86	14.25	13.86	14.60	57.25	8124462	0	8124462	15073.213	15.073	0.92
88	1.11	10.10	-	12.96	13.65	12.96	14.10	50.10	7120613	0	7120613	16301.769	16.302	0.79
89	1.00	3.00	-	6.97	14.09	6.97	6.45	66.40	4317062	0	4317062	22661.745	22.662	0.31
90	1.54	28.49	-	21.99	24.30	24.30	21.85	65.25	14371182	0	14371182	12529.365	12.529	1.94
91	1.00	5.00	-	9.05	12.96	9.05	7.45	71.05	5462608	0	5462608	16137.690	16.138	0.56
92	1.00	4.80	-	8.86	13.03	8.86	7.60	37.90	2972573	0	2972573	17346.947	17.347	0.51
93	1.00	4.85	-	8.91	13.01	8.91	7.40	23.70	1809922	0	1809922	17855.489	17.855	0.50
														Av. FOS
														0.88

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)

PILLAR STABILITY CALCULATIONS - TOP SEAM - RT422
EXTRACTION - 6.8 m

Angle of Draw 26.50 deg 18

	General Inputs								Abutment Loading Input and Calcs												Pillar Strength σ_{S2}				Pillar load (kN)						
Pillar	Rock unit weight (kN/m^3)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m^3/m width	c/c dimension over which abutment load is applied	Abutment	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	Θ_o = ($2*w_2/(w_1+w_2)$)	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
T1	24	315	3.5	4.5	3.6	2.1	10.5	57.9	6.8	86	0	0	0	0	C1	14.05	10.47	1.54	1.69	1.00	10.47	-	5.69	9.68	5.69	14.05	61.20	6500542	0	6500542	10692.560	10.693	0.53
T2	24	315	3.3	2.1	3.6	2.2	10.5	46.4	6.8	83	0	0	0	0	C1	13.95	10.42	1.53	1.63	1.00	10.42	-	5.68	9.69	5.68	13.95	48.55	5120180	0	5120180	10509.401	10.509	0.54
T3	24	315	3.2	2.2	3.5	2	10.5	52.3	6.8	80	0	0	0	0	C1	13.85	10.34	1.52	1.67	1.00	10.34	-	5.66	9.70	5.66	13.85	54.40	5696006	0	5696006	10372.405	10.372	0.55
T4	24	315	3.1	1.6	3.8	4.5	10.6	13.1	6.8	82	0	0	0	0	C1	14.05	10.50	1.54	1.11	1.00	10.50	-	5.70	9.68	5.70	14.05	16.15	1715421	0	1715421	12353.599	12.354	0.46
T5	24	305	2	2.8	3	4.4	9.5	13.1	6.8	86	0	0	0	0	C1	12	9.48	1.39	1.16	1.00	9.48	-	5.41	9.85	5.41	12.00	16.70	1466928	0	1466928	11787.288	11.787	0.46
T6	24	305	4.2	2.1	3.6	4.4	8.7	112.5	6.8	104	0	0	0	0	C1	12.6	8.44	1.24	1.86	1.00	8.44	-	5.10	10.06	5.10	12.60	115.75	10675854	0	10675854	10907.641	10.908	0.47
T7	24	300	3.9	2.1	3.6	2.1	8.7	105.8	6.8	93	0	0	0	0	C1	12.45	8.69	1.28	1.85	1.00	8.69	-	5.18	10.01	5.18	12.45	107.90	9672156	0	9672156	10507.959	10.508	0.49
T8	24	300	3.8	2.1	2.9	2.2	9.0	45.1	6.8	85	0	0	0	0	C1	12.35	8.97	1.32	1.67	1.00	8.97	-	5.26	9.95	5.26	12.35	47.25	4201470	0	4201470	10350.998	10.351	0.51
T9	24	310	3.5	1.9	2.3	2.3	9.4	54.7	6.8	78	0	0	0	0	C1	12.3	9.19	1.35	1.71	1.00	9.19	-	5.33	9.90	5.33	12.30	56.80	5197882	0	5197882	10109.070	10.109	0.53
T10	24	310	3.7	2.3	3.4	2.1	9.3	47.3	6.8	88	0	0	0	0	C1	12.85	9.29	1.37	1.67	1.00	9.29	-	5.36	9.88	5.36	12.85	49.50	4732398	0	4732398	10758.140	10.758	0.50
T11	24	290	3.9	2.1	3.5	2.1	8.1	100.8	6.8	91	0	0	0	0	C1	11.8	8.10	1.19	1.85	1.00	8.10	-	4.99	10.14	4.99	11.80	102.90	8450971	0	8450971	10350.494	10.350	0.48
T12	24	290	3.4	2.2	4.1	2.1	8.1	96.5	6.8	87	0	0	0	0	C1	11.85	8.09	1.19	1.85	1.00	8.09	-	4.99	10.14	4.99	11.85	98.65	8136257	0	8136257	10409.080	10.409	0.48
T13	24	295	3.3	4	3.8	2.2	8.8	62.0	6.8	83	0	0	0	0	C1	12.35	8.73	1.28	1.75	1.00	8.73	-	5.19	10.00	5.19	12.35	65.10	5692214	0	5692214	10432.943	10.433	0.50
T14	24	295	2	4.3	1.9	2.85	11.5	12.5	6.8	83	0	0	0	0	C1	13.45	11.41	1.68	1.04	1.00	11.41	-	5.95	9.55	5.95	13.45	16.08	1530758	0	1530758	10648.751	10.649	0.56
T15	24	285	2.3	2.9	2.2	4.1	10.9	12.0	6.8	87	0	0	0	0	C1	13.15	10.89	1.60	1.05	1.00	10.89	-	5.81	9.62	5.81	13.15	15.50	1394163	0	1394163	10658.739	10.659	0.54
T16	24	285	3.5	3.3	3.5	4.1	9.3	106.8	6.8	88	0	0	0	0	C1	12.75	9.24	1.36	1.84	1.00	9.24	-	5.34	9.89	5.34	12.75	110.45	9632345	0	9632345	9754.890	9.755	0.55
T17	24	280	3.6	2.5	3.5	3.2	8.4	108.5	6.8	89	0	0	0	0	C1	11.95	8.40	1.24	1.86	1.00	8.40	-	5.09	10.07	5.09	11.95	111.35	8941850	0	8941850	9811.115	9.811	0.52
T18	24	280	3.1	2	3.7	2.1	8.6	45.3	6.8	87	0	0	0	0	C1	12	8.59	1.26	1.68	1.00	8.59	-	5.15	10.03	5.15	12.00	47.35	3818304	0	3818304	9801.078	9.801	0.53
T19	24	275	2.5	2.9	2.3	4.2	10.9	12.0	6.8	85	0	0	0	0	C1	13.3	10.86	1.60	1.05	1.00	10.86	-	5.80	9.62	5.80	13.30	15.55	1364979	0	1364979	10435.619	10.436	0.56
T20	24	270	3.6	2.2	3.3	4.1	9.0	66.7	6.8	90	0	0	0	0	C1	12.45	9.00	1.32	1.76	1.00	9.00	-	5.27	9.94	5.27	12.45	69.85	5635219	0	5635219	9387.337	9.387	0.56
T21	24	270	3.8	2.3	3.4	2.2	9.0	98.4	6.8	81	0	0	0	0	C1	12.6	8.89	1.31	1.83	1.00	8.89	-	5.24	9.96	5.24	12.60	100.65	8217871	0	8217871	9279.439	9.279	0.56
T22	24	270	2.9	1.8	3.6	2.1	8.5	97.1	6.8	99	0	0	0	0	C1	11.75	8.40	1.23	1.84	1.00	8.40	-	5.09	10.07	5.09	11.75	99.05	7541667	0	7541667	9137.538	9.138	0.56
T23	24	260	2.2	4.5	2.5	3.2	9.3	12.2	6.8	87	0	0	0	0	C1	11.65	9.29	1.37	1.13	1.00	9.29	-	5.36	9.89	5.36	11.65	16.05	1166771	0	1166771	10283.543	10.284	0.52
T24	24	260	3.9	2.1	3.6	4.4	10.5	110.5	6.8	86	0	0	0	0	C1	14.25	10.47	1.54	1.83	1.00	10.47	-	5.69	9.68	5.69	14.25	113.75	10114650	0	10114650	8717.647	8.718	0.65
T25	24	260	3.5	2.3	3.7	2.1	10.0	106.5	6.8	92	0	0	0	0	C1	13.6	9.99	1.47	1.83	1.00	9.99	-	5.56	9.76	5.56	13.60	108.70	9224717	0	9224717	8661.706	8.662	0.64
T26	24	250	3.1	1.8	3.8	2.3	8.0	101.8	6.8	86	0	0	0	0	C1	11.45	7.98	1.17	1.85	1.00	7.98	-	4.96	10.17	4.96	11.45	103.85	7134495	0	7134495	8760.431	8.760	0.57
T27	24	250	3.8	1.8	3.8	4.1	10.5	61.0	6.8	93	0	0	0	0	C1	14.3	10.49	1.54	1.71	1.00	10.49	-	5.70	9.68	5.70	14.30	63.95	5486910	0	5486910	8566.604	8.567	0.67
T28	24	250	2.5	4.1	2.4	2.8	11.0	12.1	6.8	85	0	0	0	0	C2	15.55	10.96	1.61	1.05	1.00	10.96	-	5.83	9.61	5.83	13.45	15.55	1254885	0	1254885	9428.137	9.428	0.62
T29	24	250	2	4.1	2.5	2.6	10.2	12.3	6.8	85	0	0	0	0	C2	15.65	10.16	1.49	1.09	1.00	10.16	-	5.61	9.73	5.61	12.45	15.65	1169055	0	1169055	9318.149	9.318	0.60
T30	24	240	3	4.1	3.8	2.1	8.5	97.0	6.8	91	0	0	0	0	C2	100.1	8.50	1.25	1.84	1.00	8.50	-	5.12	10.05	5.12	11.90	100.10	6861254	0	6861254	8321.715	8.322	0.62
T31	24	240	3.6	2.1	3.6	2	7.2	110.5	6.8	90	0	0	0	0	C2	112.55	7.20	1.06	1.88	1.00	7.20	-	4.70	10.38	4.70	10.80	112.55	7001510	0	7001510	8800.290	8.800	0.53
T32	24	230	3.4	2.1	3.7	2.6	6.3	73.5	6.8	82	0	0	0	0	C2	75.85	6.24	0.92	1.84	1.00	6.24	-	4.37	10.68	4.37	9.85	75.85	4124116	0	4124116	8906.417	8.906	0.49
T33	24	230	3.2	2.6	3	4.1	6.8	50.3	6.8	97	0	0	0	0	C2	53.65	6.75	0.99	1.76	1.00	6.75	-	4.55	10.51	4.55	9.90	53.65	2931865	0	2931865	8571.703	8.572	0.53
T34	24	230	2.1	2.5	2.2	4	11.7	12.3	6.8	85	0	0	0	0	C2	15.55	11.66	1.71	1.03	1.00	11.66	-	6.01	9.52	6.01	13.85	15.55	1188829	0	1188829	8260.917	8.261	0.73
T35	24	320	4.5	1.9	3.5	2.2	9.8	42.0	6.8	83	0	0	0	0	C2	44.05	9.73	1.43	1.62	1.00	9.73	-	5.48	9.80	5.48	13.80	44.05	4668595	0	4668595	11342.554	11.343	0.48
T36	24	320	4.3	2.3	3.3	2.1	9.2	48.5	6.8	90	0	0	0	0	C1	13	9.20	1.35	1.68	1.00	9.20	-	5.33	9.90	5.33	13.00	50.70	5061888	0	5061888	11344.437	11.344	0.47
T37	24	315	3.2	1.9	3.7	2	9.0	46.7	6.8	90	0	0	0	0	C1	12.45	9.00	1.32	1.68	1.00	9.00	-	5.27	9.94	5.27	12.45	48.65	4579035	0	4579035	10894.683	10.895	0.48
T38	24	315	3.2	1.9	3.3	1.9	9.1	46.0	6.8	86	0	0	0	0	C1	12.35	9.08	1.33	1.67	1.00	9.08	-	5.29	9.93	5.29	12.35	47.90	4472231	0	4472231	10683.783	10.684	0.50
T39	24	305	3.9	2.4	3.2	1.9	9.1	94.2	6.8	83	0	0	0	0	C1	12.65	9.03	1.33	1.82	1.00	9.03	-	5.28	9.94	5.28	12.65	96.35	8921817	0	8921817	10407.850	10.408	0.51
T40	24	300	4.2	2.7	4.1	2.4	8.3	97.8	6.8	89	0	0	0	0	C1	12.45	8.30	1.22	1.84	1.00	8.30	-	5.06	10.09	5.06	12.45	100.35	8995374	0	8995374	11081.595	11.082	0.46
T41	24	295	4	2.9	3.4	2	10.3	43.2	6.8	81	0	0	0	0	C1	14	10.17	1.50	1.61	1.00	10.17	-	5.61	9.73	5.61	14.00	45.65	4524828	0	4524828	10169.067	10.169	0.55
T42	24	290	3.8	2.75	3.9	2	11.0	100.5	6.8	75	0	0	0	0	C1	14.85	10.63	1.56	1.80	1.00	10.63	-	5.74	9.66	5.74	14.85	102.88	10632749	0	10632749	9618.045	9.618	0.60
T43	24	280	3.7	2.9	4.3	2.4	8.5	97.0	6.8	90	0	0	0	0	C1	12.5	8.50	1.25	1.84	1.00	8.50	-	5.12	10.05	5.12	12.50	99.65	8370600	0	8370600	10152.335	10.152	0.50
T44	24	280	3.8	1.9	3.8	2.4	9.5	97.6	6.8	94	0	0	0	0	C1	13.3	9.48	1.39	1.82	1.00	9.48	-	5.41	9.85	5.41	13.30	99.75	8915256	0	8915256	9615.246	9.615	0.56
T45	24	270	4.1	2	3.8	2.2	8.8	93.1	6.8	79	0	0	0	0	C1	12.75	8.64	1.27	1.83	1.00	8.64	-	5.16	10.02	5.16	12.75	95.20	7865424	0	7865424	9600.410	9.600	0.54
T46	24	270	4.5	2.1	4.3	2.9	8.5	49.1	6.8	84	0	0	0	0	C1	12.9	8.45	1.24	1.70	1.00	8.45	-	5.10	10.06	5.10	12.90	51.60	4313347	0	4313347	10335.084	10.335	0.49
T47	24	260	3.5	3	4.5	1.5	8.1	103.4	6.8	90	0	0	0	0	C1	12.1	8.10	1.19	1.85	1.00	8.10	-	4.99	10.14	4.99	12.10	105.65	7976998	0	7976998	9524.318	9.524	0.52
T48	24	260	3.5	1.33	4.1	2.3	10.1	86.7	6.8	93	0	0	0	0	C1	13.9	10.09	1.48	1.79	1.00	10.09	-	5.59	9.74	5.59	13.90	88.52	7677437	0	7677437	8767.500	8.768	0.64
T49	24	250	4.5	2.9	3.9	2.3	9.6	49.8	6.8	83	0	0	0	0	C1	13.8	9.53	1.40	1.68	1.00	9.53	-	5.43	9.84	5.43	13.80	52.40	4338720	0	4338720	9075.301	9.075	0.60
T50	24	250	4.6	2.3	2.5	1.9	9.5	100.5	6.8	86	0	0	0	0	C1	13.05	9.48	1.39	1.83	1.00	9.48	-	5.41	9.85	5.41	13.05	102.60	8033580	0	8033580	8414.328	8.414	0.64
T51	24	240	4.5	2.1	5	1.5	8.7	56.0	6.8	95	0	0	0	0	C1	13.45	8.67	1.27	1.73	1.00	8.67	-	5.17	10.01	5.17	13.45	57.80	4477882	0	4477882	9191.054	9.191	0.56
T52	24	240	4.8	2.3	4.7	3	7.8	47.7	6.8	91	0	0	0	0	C1	12.55	7.80	1.15	1.72	1.00	7.80	-	4.90	10.22	4.90	12.55	50.35	3639701	0	3639701	9782.564	9.783	0.50
T53	24	230	4.6	2	4.3	1.8	2.5	64.6	6.8	87	0	0	0	0	C1	6.95	2.50	0.37	1.93	1.00	2.50	-	2.74	13.00	2.74	6.95	66.50	2551206	0	2551206	15796.941	15.797	0.17
																		Av. W/H													Av. FOS
																		1.34													0.54

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)

PILLAR STABILITY CALCULATIONS - TOP SEAM - RT422
SENSITIVITY ANALYSIS - EXTRACTION - 5.3 m

Angle of Draw 26.50 deg 18

	General Inputs								Abutment Loading Input and Calcs											Pillar Strength σ_{S2}				Pillar load (kN)							
Pillar	Rock unit weight (kN/m^3)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m^3/m width	c/c dimension over which abutment load is applied	Abutment	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	Θ_o = ($2*w_2/(w_1+w_2)$)	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
T1	24	315	3.5	4.5	3.6	2.1	10.5	57.9	5.3	86	0	0	0	0	C1	14.05	10.47	1.98	1.69	1.00	10.47	-	7.02	10.13	7.02	14.05	61.20	6500542	0	6500542	10692.560	10.693	0.66
T2	24	315	3.3	2.1	3.6	2.2	10.5	46.4	5.3	83	0	0	0	0	C1	13.95	10.42	1.97	1.63	1.00	10.42	-	7.00	10.14	7.00	13.95	48.55	5120180	0	5120180	10509.401	10.509	0.67
T3	24	315	3.2	2.2	3.5	2	10.5	52.3	5.3	80	0	0	0	0	C1	13.85	10.34	1.95	1.67	1.00	10.34	-	6.97	10.15	6.97	13.85	54.40	5696006	0	5696006	10372.405	10.372	0.67
T4	24	315	3.1	1.6	3.8	4.5	10.6	13.1	5.3	82	0	0	0	0	C1	14.05	10.50	1.98	1.11	1.00	10.50	-	7.03	10.13	7.03	14.05	16.15	1715421	0	1715421	12353.599	12.354	0.57
T5	24	305	2	2.8	3	4.4	9.5	13.1	5.3	86	0	0	0	0	C1	12	9.48	1.79	1.16	1.00	9.48	-	6.67	10.27	6.67	12.00	16.70	1466928	0	1466928	11787.288	11.787	0.57
T6	24	305	4.2	2.1	3.6	4.4	8.7	112.5	5.3	104	0	0	0	0	C1	12.6	8.44	1.59	1.86	1.00	8.44	-	6.29	10.45	6.29	12.60	115.75	10675854	0	10675854	10907.641	10.908	0.58
T7	24	300	3.9	2.1	3.6	2.1	8.7	105.8	5.3	93	0	0	0	0	C1	12.45	8.69	1.64	1.85	1.00	8.69	-	6.38	10.40	6.38	12.45	107.90	9672156	0	9672156	10507.959	10.508	0.61
T8	24	300	3.8	2.1	2.9	2.2	9.0	45.1	5.3	85	0	0	0	0	C1	12.35	8.97	1.69	1.67	1.00	8.97	-	6.49	10.35	6.49	12.35	47.25	4201470	0	4201470	10350.998	10.351	0.63
T9	24	310	3.5	1.9	2.3	2.3	9.4	54.7	5.3	78	0	0	0	0	C1	12.3	9.19	1.73	1.71	1.00	9.19	-	6.57	10.31	6.57	12.30	56.80	5197882	0	5197882	10109.070	10.109	0.65
T10	24	310	3.7	2.3	3.4	2.1	9.3	47.3	5.3	88	0	0	0	0	C1	12.85	9.29	1.75	1.67	1.00	9.29	-	6.61	10.30	6.61	12.85	49.50	4732398	0	4732398	10758.140	10.758	0.61
T11	24	290	3.9	2.1	3.5	2.1	8.1	100.8	5.3	91	0	0	0	0	C1	11.8	8.10	1.53	1.85	1.00	8.10	-	6.16	10.52	6.16	11.80	102.90	8450971	0	8450971	10350.494	10.350	0.59
T12	24	290	3.4	2.2	4.1	2.1	8.1	96.5	5.3	87	0	0	0	0	C1	11.85	8.09	1.53	1.85	1.00	8.09	-	6.15	10.53	6.15	11.85	98.65	8136257	0	8136257	10409.080	10.409	0.59
T13	24	295	3.3	4	3.8	2.2	8.8	62.0	5.3	83	0	0	0	0	C1	12.35	8.73	1.65	1.75	1.00	8.73	-	6.40	10.39	6.40	12.35	65.10	5692214	0	5692214	10432.943	10.433	0.61
T14	24	295	2	4.3	1.9	2.85	11.5	12.5	5.3	83	0	0	0	0	C1	13.45	11.41	2.15	1.04	1.00	11.41	-	7.34	10.03	7.34	13.45	16.08	1530758	0	1530758	10648.751	10.649	0.69
T15	24	285	2.3	2.9	2.2	4.1	10.9	12.0	5.3	87	0	0	0	0	C1	13.15	10.89	2.05	1.05	1.00	10.89	-	7.16	10.08	7.16	13.15	15.50	1394163	0	1394163	10658.739	10.659	0.67
T16	24	285	3.5	3.3	3.5	4.1	9.3	106.8	5.3	88	0	0	0	0	C1	12.75	9.24	1.74	1.84	1.00	9.24	-	6.59	10.30	6.59	12.75	110.45	9632345	0	9632345	9754.890	9.755	0.68
T17	24	280	3.6	2.5	3.5	3.2	8.4	108.5	5.3	89	0	0	0	0	C1	11.95	8.40	1.58	1.86	1.00	8.40	-	6.27	10.46	6.27	11.95	111.35	8941850	0	8941850	9811.115	9.811	0.64
T18	24	280	3.1	2	3.7	2.1	8.6	45.3	5.3	87	0	0	0	0	C1	12	8.59	1.62	1.68	1.00	8.59	-	6.34	10.42	6.34	12.00	47.35	3818304	0	3818304	9801.078	9.801	0.65
T19	24	275	2.5	2.9	2.3	4.2	10.9	12.0	5.3	85	0	0	0	0	C1	13.3	10.86	2.05	1.05	1.00	10.86	-	7.15	10.09	7.15	13.30	15.55	1364979	0	1364979	10435.619	10.436	0.69
T20	24	270	3.6	2.2	3.3	4.1	9.0	66.7	5.3	90	0	0	0	0	C1	12.45	9.00	1.70	1.76	1.00	9.00	-	6.50	10.35	6.50	12.45	69.85	5635219	0	5635219	9387.337	9.387	0.69
T21	24	270	3.8	2.3	3.4	2.2	9.0	98.4	5.3	81	0	0	0	0	C1	12.6	8.89	1.68	1.83	1.00	8.89	-	6.46	10.37	6.46	12.60	100.65	8217871	0	8217871	9279.439	9.279	0.70
T22	24	270	2.9	1.8	3.6	2.1	8.5	97.1	5.3	99	0	0	0	0	C1	11.75	8.40	1.58	1.84	1.00	8.40	-	6.27	10.46	6.27	11.75	99.05	7541667	0	7541667	9137.538	9.138	0.69
T23	24	260	2.2	4.5	2.5	3.2	9.3	12.2	5.3	87	0	0	0	0	C1	11.65	9.29	1.75	1.13	1.00	9.29	-	6.60	10.30	6.60	11.65	16.05	1166771	0	1166771	10283.543	10.284	0.64
T24	24	260	3.9	2.1	3.6	4.4	10.5	110.5	5.3	86	0	0	0	0	C1	14.25	10.47	1.98	1.83	1.00	10.47	-	7.02	10.13	7.02	14.25	113.75	10114650	0	10114650	8717.647	8.718	0.81
T25	24	260	3.5	2.3	3.7	2.1	10.0	106.5	5.3	92	0	0	0	0	C1	13.6	9.99	1.89	1.83	1.00	9.99	-	6.85	10.19	6.85	13.60	108.70	9224717	0	9224717	8661.706	8.662	0.79
T26	24	250	3.1	1.8	3.8	2.3	8.0	101.8	5.3	86	0	0	0	0	C1	11.45	7.98	1.51	1.85	1.00	7.98	-	6.11	10.55	6.11	11.45	103.85	7134495	0	7134495	8760.431	8.760	0.70
T27	24	250	3.8	1.8	3.8	4.1	10.5	61.0	5.3	93	0	0	0	0	C1	14.3	10.49	1.98	1.71	1.00	10.49	-	7.02	10.13	7.02	14.30	63.95	5486910	0	5486910	8566.604	8.567	0.82
T28	24	250	2.5	4.1	2.4	2.8	11.0	12.1	5.3	85	0	0	0	0	C2	15.55	10.96	2.07	1.05	1.00	10.96	-	7.18	10.08	7.18	13.45	15.55	1254885	0	1254885	9428.137	9.428	0.76
T29	24	250	2	4.1	2.5	2.6	10.2	12.3	5.3	85	0	0	0	0	C2	15.65	10.16	1.92	1.09	1.00	10.16	-	6.91	10.17	6.91	12.45	15.65	1169055	0	1169055	9318.149	9.318	0.74
T30	24	240	3	4.1	3.8	2.1	8.5	97.0	5.3	91	0	0	0	0	C2	100.1	8.50	1.60	1.84	1.00	8.50	-	6.31	10.44	6.31	11.90	100.10	6861254	0	6861254	8321.715	8.322	0.76
T31	24	240	3.6	2.1	3.6	2	7.2	110.5	5.3	90	0	0	0	0	C2	112.55	7.20	1.36	1.88	1.00	7.20	-	5.80	10.74	5.80	10.80	112.55	7001510	0	7001510	8800.290	8.800	0.66
T32	24	230	3.4	2.1	3.7	2.6	6.3	73.5	5.3	82	0	0	0	0	C2	75.85	6.24	1.18	1.84	1.00	6.24	-	5.39	11.04	5.39	9.85	75.85	4124116	0	4124116	8906.417	8.906	0.61
T33	24	230	3.2	2.6	3	4.1	6.8	50.3	5.3	97	0	0	0	0	C2	53.65	6.75	1.27	1.76	1.00	6.75	-	5.61	10.87	5.61	9.90	53.65	2931865	0	2931865	8571.703	8.572	0.65
T34	24	230	2.1	2.5	2.2	4	11.7	12.3	5.3	85	0	0	0	0	C2	15.55	11.66	2.20	1.03	1.00	11.66	-	7.41	10.01	7.41	13.85	15.55	1188829	0	1188829	8260.917	8.261	0.90
T35	24	320	4.5	1.9	3.5	2.2	9.8	42.0	5.3	83	0	0	0	0	C2	44.05	9.73	1.84	1.62	1.00	9.73	-	6.76	10.23	6.76	13.80	44.05	4668595	0	4668595	11342.554	11.343	0.60
T36	24	320	4.3	2.3	3.3	2.1	9.2	48.5	5.3	90	0	0	0	0	C1	13	9.20	1.74	1.68	1.00	9.20	-	6.57	10.31	6.57	13.00	50.70	5061888	0	5061888	11344.437	11.344	0.58
T37	24	315	3.2	1.9	3.7	2	9.0	46.7	5.3	90	0	0	0	0	C1	12.45	9.00	1.70	1.68	1.00	9.00	-	6.50	10.35	6.50	12.45	48.65	4579035	0	4579035	10894.683	10.895	0.60
T38	24	315	3.2	1.9	3.3	1.9	9.1	46.0	5.3	86	0	0	0	0	C1	12.35	9.08	1.71	1.67	1.00	9.08	-	6.53	10.33	6.53	12.35	47.90	4472231	0	4472231	10683.783	10.684	0.61
T39	24	305	3.9	2.4	3.2	1.9	9.1	94.2	5.3	83	0	0	0	0	C1	12.65	9.03	1.70	1.82	1.00	9.03	-	6.51	10.34	6.51	12.65	96.35	8921817	0	8921817	10407.850	10.408	0.63
T40	24	300	4.2	2.7	4.1	2.4	8.3	97.8	5.3	89	0	0	0	0	C1	12.45	8.30	1.57	1.84	1.00	8.30	-	6.23	10.48	6.23	12.45	100.35	8995374	0	8995374	11081.595	11.082	0.56
T41	24	295	4	2.9	3.4	2	10.3	43.2	5.3	81	0	0	0	0	C1	14	10.17	1.92	1.61	1.00	10.17	-	6.92	10.17	6.92	14.00	45.65	4524828	0	4524828	10169.067	10.169	0.68
T42	24	290	3.8	2.75	3.9	2	11.0	100.5	5.3	75	0	0	0	0	C1	14.85	10.63	2.00	1.80	1.00	10.63	-	7.07	10.11	7.07	14.85	102.88	10632749	0	10632749	9618.045	9.618	0.74
T43	24	280	3.7	2.9	4.3	2.4	8.5	97.0	5.3	90	0	0	0	0	C1	12.5	8.50	1.60	1.84	1.00	8.50	-	6.31	10.44	6.31	12.50	99.65	8370600	0	8370600	10152.335	10.152	0.62
T44	24	280	3.8	1.9	3.8	2.4	9.5	97.6	5.3	94	0	0	0	0	C1	13.3	9.48	1.79	1.82	1.00	9.48	-	6.67	10.27	6.67	13.30	99.75	8915256	0	8915256	9615.246	9.615	0.69
T45	24	270	4.1	2	3.8	2.2	8.8	93.1	5.3	79	0	0	0	0	C1	12.75	8.64	1.63	1.83	1.00	8.64	-	6.36	10.41	6.36	12.75	95.20	7865424	0	7865424	9600.410	9.600	0.66
T46	24	270	4.5	2.1	4.3	2.9	8.5	49.1	5.3	84	0	0	0	0	C1	12.9	8.45	1.59	1.70	1.00	8.45	-	6.29	10.45	6.29	12.90	51.60	4313347	0	4313347	10335.084	10.335	0.61
T47	24	260	3.5	3	4.5	1.5	8.1	103.4	5.3	90	0	0	0	0	C1	12.1	8.10	1.53	1.85	1.00	8.10	-	6.16	10.52	6.16	12.10	105.65	7976998	0	7976998	9524.318	9.524	0.65
T48	24	260	3.5	1.33	4.1	2.3	10.1	86.7	5.3	93	0	0	0	0	C1	13.9	10.09	1.90	1.79	1.00	10.09	-	6.89	10.18	6.89	13.90	88.52	7677437	0	7677437	8767.500	8.768	0.79
T49	24	250	4.5	2.9	3.9	2.3	9.6	49.8	5.3	83	0	0	0	0	C1	13.8	9.53	1.80	1.68	1.00	9.53	-	6.69	10.26	6.69	13.80	52.40	4338720	0	4338720	9075.301	9.075	0.74
T50	24	250	4.6	2.3	2.5	1.9	9.5	100.5	5.3	86	0	0	0	0	C1	13.05	9.48	1.79	1.83	1.00	9.48	-	6.67	10.27	6.67	13.05	102.60	8033580	0	8033580	8414.328	8.414	0.79
T51	24	240	4.5	2.1	5	1.5	8.7	56.0	5.3	95	0	0	0	0	C1	13.45	8.67	1.64	1.73	1.00	8.67	-	6.37	10.41	6.37	13.45	57.80	4477882	0	4477882	9191.054	9.191	0.69
T52	24	240	4.8	2.3	4.7	3	7.8	47.7	5.3	91	0	0	0	0	C1	12.55	7.80	1.47	1.72	1.00	7.80	-	6.04	10.59	6.04	12.55	50.35	3639701	0	3639701	9782.564	9.783	0.62
T53	24	230	4.6	2	4.3	1.8	2.5	64.6	5.3	87	0	0	0	0	C1	6.95	2.50	0.47	1.93	1.00	2.50	-	3.38	13.37	3.38	6.95	66.50	2551206	0	2551206	15796.941	15.797	0.21
																		Av. W/H													Av. FOS
																		1.72													0.66

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)

PILLAR STABILITY CALCULATIONS - TOP SEAM - RT422
SENSITIVITY ANALYSIS - EXTRACTION - 3.5 m

Angle of Draw 26.50 deg 18

	General Inputs								Abutment Loading Input and Calcs											Pillar Strength σ_{S2}				Pillar load (kN)						
Pillar	Rock unit weight (kN/m^3)	Rock Cover Depth (m)	Bord Width 1 (x_1) (m)	Bord Width 2 (x_2) (m)	Bord Width 3 (x_3) (m)	Bord Width 4 (x_4) (m)	Design min. Pillar Width w_1 (m)	Design min. Pillar Width w_2 (m)	Actual Extraction height, h	θ (deg)	Goaf / Panel Width W (m)	Chain Pillar Width w (m)	% of Abutment Loading Assumed	Additional Abutment volume m^3/m width	c/c dimension over which abutment load is applied	Abutment	w = w_1*sin (θ)	Width to Heigh Ratio = w/h	Θ_o = ($2*w_2/(w_1+w_2)$)	Θ	Actual w_{eff}	Eq. (12)	Eq. (40a) for R<5	Eq. (40b) for R>5	Adopted Strength σ_{S2}	c/c dimension along w1 = c1 (m)	c/c dimension along w2 = c2	Direct	Abutment	Total	Pillar Stress (kPa)	Pillar Stress (MPa)	FOS
T1	24	315	3.5	4.5	3.6	2.1	10.5	57.9	3.5	86	0	0	0	0	C1	14.05	10.47	2.99	1.69	1.00	10.47	-	9.95	11.35	9.95	14.05	61.20	6500542	0	6500542	10692.560	10.693	0.93
T2	24	315	3.3	2.1	3.6	2.2	10.5	46.4	3.5	83	0	0	0	0	C1	13.95	10.42	2.98	1.63	1.00	10.42	-	9.92	11.35	9.92	13.95	48.55	5120180	0	5120180	10509.401	10.509	0.94
T3	24	315	3.2	2.2	3.5	2	10.5	52.3	3.5	80	0	0	0	0	C1	13.85	10.34	2.95	1.67	1.00	10.34	-	9.88	11.34	9.88	13.85	54.40	5696006	0	5696006	10372.405	10.372	0.95
T4	24	315	3.1	1.6	3.8	4.5	10.6	13.1	3.5	82	0	0	0	0	C1	14.05	10.50	3.00	1.11	1.00	10.50	-	9.96	11.35	9.96	14.05	16.15	1715421	0	1715421	12353.599	12.354	0.81
T5	24	305	2	2.8	3	4.4	9.5	13.1	3.5	86	0	0	0	0	C1	12	9.48	2.71	1.16	1.00	9.48	-	9.45	11.34	9.45	12.00	16.70	1466928	0	1466928	11787.288	11.787	0.80
T6	24	305	4.2	2.1	3.6	4.4	8.7	112.5	3.5	104	0	0	0	0	C1	12.6	8.44	2.41	1.86	1.00	8.44	-	8.91	11.40	8.91	12.60	115.75	10675854	0	10675854	10907.641	10.908	0.82
T7	24	300	3.9	2.1	3.6	2.1	8.7	105.8	3.5	93	0	0	0	0	C1	12.45	8.69	2.48	1.85	1.00	8.69	-	9.04	11.38	9.04	12.45	107.90	9672156	0	9672156	10507.959	10.508	0.86
T8	24	300	3.8	2.1	2.9	2.2	9.0	45.1	3.5	85	0	0	0	0	C1	12.35	8.97	2.56	1.67	1.00	8.97	-	9.19	11.36	9.19	12.35	47.25	4201470	0	4201470	10350.998	10.351	0.89
T9	24	310	3.5	1.9	2.3	2.3	9.4	54.7	3.5	78	0	0	0	0	C1	12.3	9.19	2.63	1.71	1.00	9.19	-	9.31	11.35	9.31	12.30	56.80	5197882	0	5197882	10109.070	10.109	0.92
T10	24	310	3.7	2.3	3.4	2.1	9.3	47.3	3.5	88	0	0	0	0	C1	12.85	9.29	2.66	1.67	1.00	9.29	-	9.36	11.34	9.36	12.85	49.50	4732398	0	4732398	10758.140	10.758	0.87
T11	24	290	3.9	2.1	3.5	2.1	8.1	100.8	3.5	91	0	0	0	0	C1	11.8	8.10	2.31	1.85	1.00	8.10	-	8.73	11.43	8.73	11.80	102.90	8450971	0	8450971	10350.494	10.350	0.84
T12	24	290	3.4	2.2	4.1	2.1	8.1	96.5	3.5	87	0	0	0	0	C1	11.85	8.09	2.31	1.85	1.00	8.09	-	8.72	11.43	8.72	11.85	98.65	8136257	0	8136257	10409.080	10.409	0.84
T13	24	295	3.3	4	3.8	2.2	8.8	62.0	3.5	83	0	0	0	0	C1	12.35	8.73	2.50	1.75	1.00	8.73	-	9.07	11.37	9.07	12.35	65.10	5692214	0	5692214	10432.943	10.433	0.87
T14	24	295	2	4.3	1.9	2.85	11.5	12.5	3.5	83	0	0	0	0	C1	13.45	11.41	3.26	1.04	1.00	11.45	-	10.41	11.43	10.41	13.45	16.08	1530758	0	1530758	10648.751	10.649	0.98
T15	24	285	2.3	2.9	2.2	4.1	10.9	12.0	3.5	87	0	0	0	0	C1	13.15	10.89	3.11	1.05	1.00	10.90	-	10.15	11.38	10.15	13.15	15.50	1394163	0	1394163	10658.739	10.659	0.95
T16	24	285	3.5	3.3	3.5	4.1	9.3	106.8	3.5	88	0	0	0	0	C1	12.75	9.24	2.64	1.84	1.00	9.24	-	9.33	11.35	9.33	12.75	110.45	9632345	0	9632345	9754.890	9.755	0.96
T17	24	280	3.6	2.5	3.5	3.2	8.4	108.5	3.5	89	0	0	0	0	C1	11.95	8.40	2.40	1.86	1.00	8.40	-	8.89	11.40	8.89	11.95	111.35	8941850	0	8941850	9811.115	9.811	0.91
T18	24	280	3.1	2	3.7	2.1	8.6	45.3	3.5	87	0	0	0	0	C1	12	8.59	2.45	1.68	1.00	8.59	-	8.99	11.38	8.99	12.00	47.35	3818304	0	3818304	9801.078	9.801	0.92
T19	24	275	2.5	2.9	2.3	4.2	10.9	12.0	3.5	85	0	0	0	0	C1	13.3	10.86	3.10	1.05	1.00	10.88	-	10.14	11.38	10.14	13.30	15.55	1364979	0	1364979	10435.619	10.436	0.97
T20	24	270	3.6	2.2	3.3	4.1	9.0	66.7	3.5	90	0	0	0	0	C1	12.45	9.00	2.57	1.76	1.00	9.00	-	9.21	11.36	9.21	12.45	69.85	5635219	0	5635219	9387.337	9.387	0.98
T21	24	270	3.8	2.3	3.4	2.2	9.0	98.4	3.5	81	0	0	0	0	C1	12.6	8.89	2.54	1.83	1.00	8.89	-	9.15	11.36	9.15	12.60	100.65	8217871	0	8217871	9279.439	9.279	0.99
T22	24	270	2.9	1.8	3.6	2.1	8.5	97.1	3.5	99	0	0	0	0	C1	11.75	8.40	2.40	1.84	1.00	8.40	-	8.89	11.40	8.89	11.75	99.05	7541667	0	7541667	9137.538	9.138	0.97
T23	24	260	2.2	4.5	2.5	3.2	9.3	12.2	3.5	87	0	0	0	0	C1	11.65	9.29	2.65	1.13	1.00	9.29	-	9.36	11.35	9.36	11.65	16.05	1166771	0	1166771	10283.543	10.284	0.91
T24	24	260	3.9	2.1	3.6	4.4	10.5	110.5	3.5	86	0	0	0	0	C1	14.25	10.47	2.99	1.83	1.00	10.47	-	9.95	11.35	9.95	14.25	113.75	10114650	0	10114650	8717.647	8.718	1.14
T25	24	260	3.5	2.3	3.7	2.1	10.0	106.5	3.5	92	0	0	0	0	C1	13.6	9.99	2.86	1.83	1.00	9.99	-	9.71	11.34	9.71	13.60	108.70	9224717	0	9224717	8661.706	8.662	1.12
T26	24	250	3.1	1.8	3.8	2.3	8.0	101.8	3.5	86	0	0	0	0	C1	11.45	7.98	2.28	1.85	1.00	7.98	-	8.66	11.44	8.66	11.45	103.85	7134495	0	7134495	8760.431	8.760	0.99
T27	24	250	3.8	1.8	3.8	4.1	10.5	61.0	3.5	93	0	0	0	0	C1	14.3	10.49	3.00	1.71	1.00	10.49	-	9.95	11.35	9.95	14.30	63.95	5486910	0	5486910	8566.604	8.567	1.16
T28	24	250	2.5	4.1	2.4	2.8	11.0	12.1	3.5	85	0	0	0	0	C2	15.55	10.96	3.13	1.05	1.00	10.98	-	10.19	11.38	10.19	13.45	15.55	1254885	0	1254885	9428.137	9.428	1.08
T29	24	250	2	4.1	2.5	2.6	10.2	12.3	3.5	85	0	0	0	0	C2	15.65	10.16	2.90	1.09	1.00	10.16	-	9.80	11.34	9.80	12.45	15.65	1169055	0	1169055	9318.149	9.318	1.05
T30	24	240	3	4.1	3.8	2.1	8.5	97.0	3.5	91	0	0	0	0	C2	100.1	8.50	2.43	1.84	1.00	8.50	-	8.94	11.39	8.94	11.90	100.10	6861254	0	6861254	8321.715	8.322	1.07
T31	24	240	3.6	2.1	3.6	2	7.2	110.5	3.5	90	0	0	0	0	C2	112.55	7.20	2.06	1.88	1.00	7.20	-	8.22	11.56	8.22	10.80	112.55	7001510	0	7001510	8800.290	8.800	0.93
T32	24	230	3.4	2.1	3.7	2.6	6.3	73.5	3.5	82	0	0	0	0	C2	75.85	6.24	1.78	1.84	1.00	6.24	-	7.64	11.78	7.64	9.85	75.85	4124116	0	4124116	8906.417	8.906	0.86
T33	24	230	3.2	2.6	3	4.1	6.8	50.3	3.5	97	0	0	0	0	C2	53.65	6.75	1.93	1.76	1.00	6.75	-	7.95	11.65	7.95	9.90	53.65	2931865	0	2931865	8571.703	8.572	0.93
T34	24	230	2.1	2.5	2.2	4	11.7	12.3	3.5	85	0	0	0	0	C2	15.55	11.66	3.33	1.03	1.00	11.69	-	10.52	11.45	10.52	13.85	15.55	1188829	0	1188829	8260.917	8.261	1.27
T35	24	320	4.5	1.9	3.5	2.2	9.8	42.0	3.5	83	0	0	0	0	C2	44.05	9.73	2.78	1.62	1.00	9.73	-	9.58	11.34	9.58	13.80	44.05	4668595	0	4668595	11342.554	11.343	0.84
T36	24	320	4.3	2.3	3.3	2.1	9.2	48.5	3.5	90	0	0	0	0	C1	13	9.20	2.63	1.68	1.00	9.20	-	9.31	11.35	9.31	13.00	50.70	5061888	0	5061888	11344.437	11.344	0.82
T37	24	315	3.2	1.9	3.7	2	9.0	46.7	3.5	90	0	0	0	0	C1	12.45	9.00	2.57	1.68	1.00	9.00	-	9.21	11.36	9.21	12.45	48.65	4579035	0	4579035	10894.683	10.895	0.85
T38	24	315	3.2	1.9	3.3	1.9	9.1	46.0	3.5	86	0	0	0	0	C1	12.35	9.08	2.59	1.67	1.00	9.08	-	9.25	11.35	9.25	12.35	47.90	4472231	0	4472231	10683.783	10.684	0.87
T39	24	305	3.9	2.4	3.2	1.9	9.1	94.2	3.5	83	0	0	0	0	C1	12.65	9.03	2.58	1.82	1.00	9.03	-	9.22	11.36	9.22	12.65	96.35	8921817	0	8921817	10407.850	10.408	0.89
T40	24	300	4.2	2.7	4.1	2.4	8.3	97.8	3.5	89	0	0	0	0	C1	12.45	8.30	2.37	1.84	1.00	8.30	-	8.83	11.41	8.83	12.45	100.35	8995374	0	8995374	11081.595	11.082	0.80
T41	24	295	4	2.9	3.4	2	10.3	43.2	3.5	81	0	0	0	0	C1	14	10.17	2.91	1.61	1.00	10.17	-	9.80	11.34	9.80	14.00	45.65	4524828	0	4524828	10169.067	10.169	0.96
T42	24	290	3.8	2.75	3.9	2	11.0	100.5	3.5	75	0	0	0	0	C1	14.85	10.63	3.04	1.80	1.01	10.70	-	10.06	11.40	10.06	14.85	102.88	10632749	0	10632749	9618.045	9.618	1.05
T43	24	280	3.7	2.9	4.3	2.4	8.5	97.0	3.5	90	0	0	0	0	C1	12.5	8.50	2.43	1.84	1.00	8.50	-	8.94	11.39	8.94	12.50	99.65	8370600	0	8370600	10152.335	10.152	0.88
T44	24	280	3.8	1.9	3.8	2.4	9.5	97.6	3.5	94	0	0	0	0	C1	13.3	9.48	2.71	1.82	1.00	9.48	-	9.45	11.34	9.45	13.30	99.75	8915256	0	8915256	9615.246	9.615	0.98
T45	24	270	4.1	2	3.8	2.2	8.8	93.1	3.5	79	0	0	0	0	C1	12.75	8.64	2.47	1.83	1.00	8.64	-	9.02	11.38	9.02	12.75	95.20	7865424	0	7865424	9600.410	9.600	0.94
T46	24	270	4.5	2.1	4.3	2.9	8.5	49.1	3.5	84	0	0	0	0	C1	12.9	8.45	2.42	1.70	1.00	8.45	-	8.92	11.39	8.92	12.90	51.60	4313347	0	4313347	10335.084	10.335	0.86
T47	24	260	3.5	3	4.5	1.5	8.1	103.4	3.5	90	0	0	0	0	C1	12.1	8.10	2.31	1.85	1.00	8.10	-	8.73	11.43	8.73	12.10	105.65	7976998	0	7976998	9524.318	9.524	0.92
T48	24	260	3.5	1.33	4.1	2.3	10.1	86.7	3.5	93	0	0	0	0	C1	13.9	10.09	2.88	1.79	1.00	10.09	-	9.76	11.34	9.76	13.90	88.52	7677437	0	7677437	8767.500	8.768	1.11
T49	24	250	4.5	2.9	3.9	2.3	9.6	49.8	3.5	83	0	0	0	0	C1	13.8	9.53	2.72	1.68	1.00	9.53	-	9.48	11.34	9.48	13.80	52.40	4338720	0	4338720	9075.301	9.075	1.04
T50	24	250	4.6	2.3	2.5	1.9	9.5	100.5	3.5	86	0	0	0	0	C1	13.05	9.48	2.71	1.83	1.00	9.48	-	9.45	11.34	9.45	13.05	102.60	8033580	0	8033580	8414.328	8.414	1.12
T51	24	240	4.5	2.1	5	1.5	8.7	56.0	3.5	95	0	0	0	0	C1	13.45	8.67	2.48	1.73	1.00	8.67	-	9.03	11.38	9.03	13.45	57.80	4477882	0	4477882	9191.054	9.191	0.98
T52	24	240	4.8	2.3	4.7	3	7.8	47.7	3.5	91	0	0	0	0	C1	12.55	7.80	2.23	1.72	1.00	7.80	-	8.56	11.47	8.56	12.55	50.35	3639701	0	3639701	9782.564	9.783	0.87
T53	24	230	4.6	2	4.3	1.8	2.5	64.6	3.5	87	0	0	0	0	C1	6.95	2.50	0.71	1.93	1.00	2.50	-	4.79	14.02	4.79	6.95	66.50	2551206	0	2551206	15796.941	15.797	0.30
																	Av. W/H														Av. FOS
																	2.60														0.94

Notes To Table

FoS determined from NSW & Queensland Max Likelihood (Equation 40a / 40b)