Geotechnical Assessment - Longwall S7A

Tahmoor Coal

PSM5522-013R Rev 01 01 October 2025

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1. Introduction

PSM was engaged by Tahmoor Coal Pty Ltd (TC) contains our geotechnical assessment of the potential impacts on nominated land features due to mining subsidence arising from planned longwall LW S7A. LW S7A is part of the Tahmoor South Project underneath Bargo, NSW.

This report has been prepared at your request and in accordance with our proposal PSM3522-010L Rev2 dated 29 July 2025. TCs acceptance of this proposal was provided on 8 August 2025 based on provision of a purchase order and initial payment .

The purpose for this assessment is to create an addendum to Douglas Partners (DP) *Geotechnical Assessment for LW S1A to LW S6A* reference 210597.00.R.002.Rev1 dated June 2024, (DP 2024b). This addendum is to consider the impact of an additional longwall (LW S7A) on land features within the Study Area, this would include both:

- features previously considered in DP report that will see an incremental effects due to the addition of LW S7A, and
- new features that will become impacted by the addition of LW S7A.

2. Scope of Works

The agreed scope of work was as follows:

- Review of:
  - Longwall S7A modification report and the MSEC subsidence predictions for at-risk features
  - Douglas Partners LW S1A to LW S6A Geotechnical Assessment.
- Develop a list of features to be targeted for more detailed assessment based on this initial review.
- Conduct field inspections to develop a general understanding of targeted site features. These inspections were to focus on collecting key parameters, assessing general conditions, and documenting findings with photographic evidence including drone footage where beneficial. Particular attention was to be given to identifying characteristics that may increase the susceptibility of features to subsidence impacts.
- Inspections were to include or target:
  - Selected locations of the cliffline along Hornes Creek
  - Rock shelters
  - Farm dams
  - Road embankments and cuttings.
- Assess the performance and condition of the above features during previous subsidence events associated with the extraction of LW S1A to S3A, based on both the observations during inspections and monitoring data.
- Identify features at risk from future subsidence and carry out a risk assessment to evaluate the potential level of impact on each feature. Review any update (if required) any previous assessments for features that have already been assessed/inspected. Provide recommendations for any additional detailed assessments or studies (e.g. dam break analysis) that may be required as part of any additional assessments.
- Update the geotechnical assessment of the impact mine subsidence to include LW S7A based on review, inspections and assessments outlined above.
- Update these related documents based on this updated assessment:
  - Relevant sections of the LW S1A to LW S6A Land Management Plan
  - The Trigger Action Response Plan (TARP).

3. Background

3.1 Proposed Mining

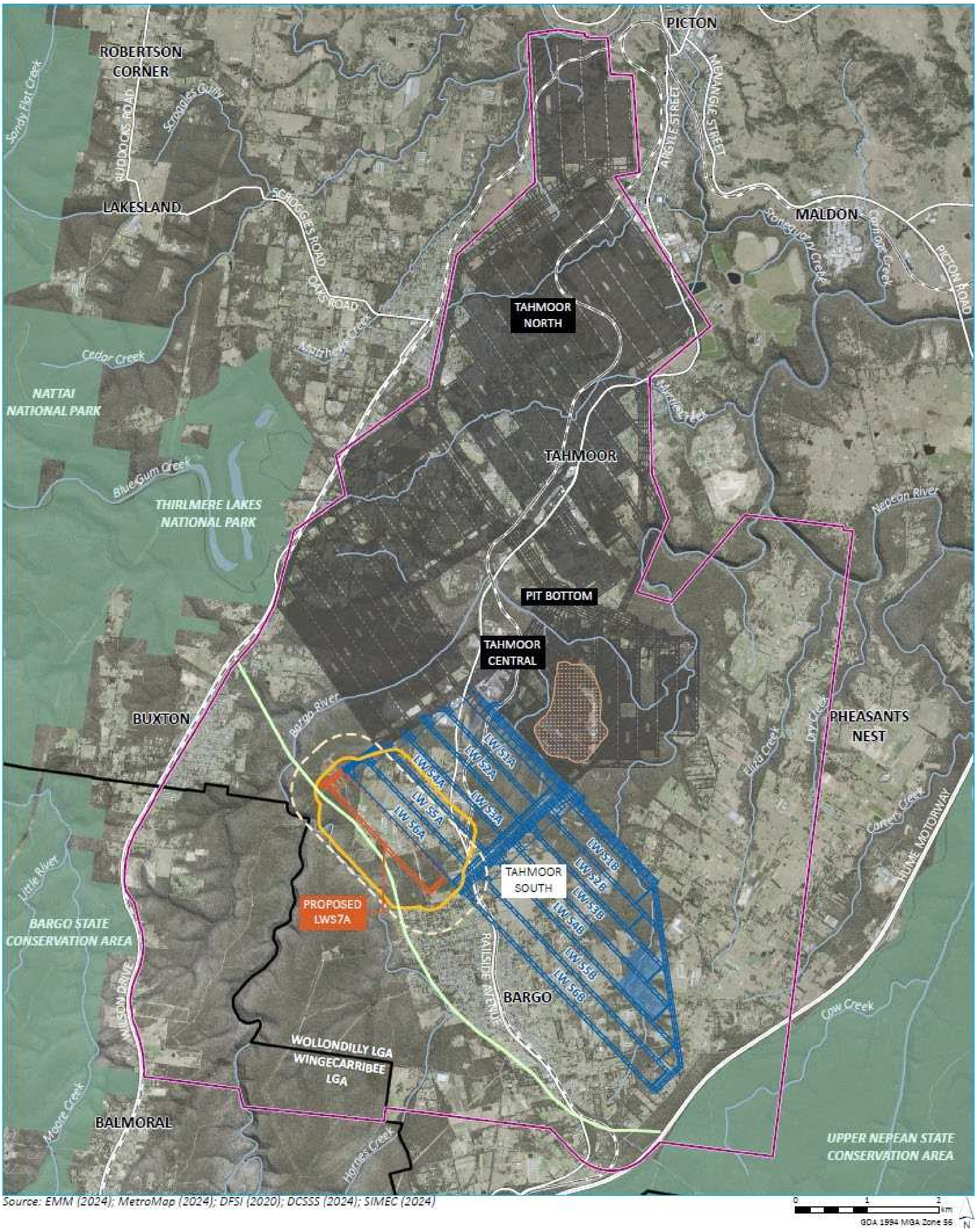
Tahmoor Coal Mine is an underground coal mine within the Southern Coalfield and located near the township of Tahmoor in NSW around 80 km south-west of Sydney. The mine commenced operations in 1979.

The Tahmoor South Project received approval in September 2022 and started in October 2022. The Tahmoor South Domain is presented in Inset 1. It includes an A series of longwall panels (LW S1A-S6A) and a B series of longwall panels (LW S1B-S6B). Tahmoor South is targeting an extraction height ranging from 2.1 to 2.6 m within the Bulli Seam; this seam being approximately 350 m below ground level.

Longwalls S1A to S3A extraction has been recently completed and Longwall S4A is due to start within the next few months. With longwall extraction is from Southeast to Northwest.

The project has undergone two (2) modifications regarding the water treatment for the mining process. Modification 3 is for the addition of an additional Longwall (LW S7A) to the south of the A series of longwall panels. The LW S7A was proposed following the revision of the Central Fault interpretated location, which is located to the south west of the Tahmoor South Project. Inset 1 presents the location of LW S7A within the mine development and Figure 1 presents the Tahmoor South Project.

LW S7A is planned to be 1918 m long and 285 m wide, similar in size to previous longwalls. Subsidence predictions provided by MSEC are expected to be within similar magnitude as the approved longwalls. Further details on the seam is presented in Section 5.4.1.



Source: EMM (2024); MetroMap (2024); DFSI (2020); DCSSS (2024); SIMEC (2024)

Inset 1: Location of the Proposed LW S7A within the Tahmoor Coal Mine.

3.2 Previous Assessments

Douglas Partners have previously undertaken a geotechnical assessment of selected features potentially impacted by longwalls S1A to S6A (DP 2024). This report in conjunction with MSEC (2024) report assisted in the selection of specific features targeted for additional assessment as part of this study.

Our review of this report found the methodology used in the assessments were reasonable and generally well founded. In some cases some minor discrepancies were noted in some of the assessed impacts or consequences, some slightly increasing some slightly decreasing risks to features. However, such discrepancies are expected due to the somewhat subjective nature of these assessments.

Given our review we used the data provided in the DP (2024) including inspections reports as a basis upon which to base this assessment of the incremental impacts due to proposed longwall LW S7A.

3.3 Geology

3.3.1 Stratigraphy

The stratigraphy of the Southern Coalfield of Tahmoor is part of the Sydney basin sedimentary sequence.

In the area of the Southern coalfield of Tahmoor, the Wianamatta group and Hawkesbury sandstone outcrop at the surface. The Wianamatta group comprising shales and sandstones overlays the Hawkesbury Sandstone along the Tahmoor Coal Northern region (SIMEC, 2022). In the study area of the Picton Weir only Hawkesbury Sandstone was expected to outcrop which was subsequently confirmed by field mapping.

Beneath the Wianamatta formation lie two, thick, massive sandstone intervals of Hawkesbury and Bulgo stratigraphic units, each underlain by shale and claystone units of lower strength. The Hawkesbury sandstone varies in thickness from a maximum of 160 m, generally reduced in areas of erosion and incision. Inset 2 shows the typical stratigraphy section of the Southern Coalfields (a) and an example of the sandstone outcropping within the Bargo River gorge (b).

Inset 2: (a) Southern Coalfields stratigraphic sequence (Russell, 2018) and example of Hawkesbury Sandstone exposure along the Bargo River (b).

Beneath the Hawkesbury Sandstone, the Narrabeen Group comprises pelletal claystone to coarse conglomeratic units underlain by the Illawarra Coal Measures formed by layers of interbedded coal seams (e.g., Bulli, Balgownie, Wongawilli) and predominantly fine-grained units ranging from claystone to less common sandstone and conglomerate.

Post-Permian igneous dykes and sills around the coal measures have been encountered throughout works in the Tahmoor Coal Mining and site investigations prior to this study.

3.3.2 Folding

The Southern Coalfield is bisected by the N-S to N-W Camden syncline, with associated N-S to N-NW trending anticlines and synclines. At the regional scale the stratigraphy above the Bulli seam gently dips N-NE with measurements generally around 5°. Typically, bedding dips recorded during PSM's field mapping ranged between less than 10° and 15° dipping towards the NE and cross-beds showed steeper angles (max 30°) and wider spread of dip directions between N and E.

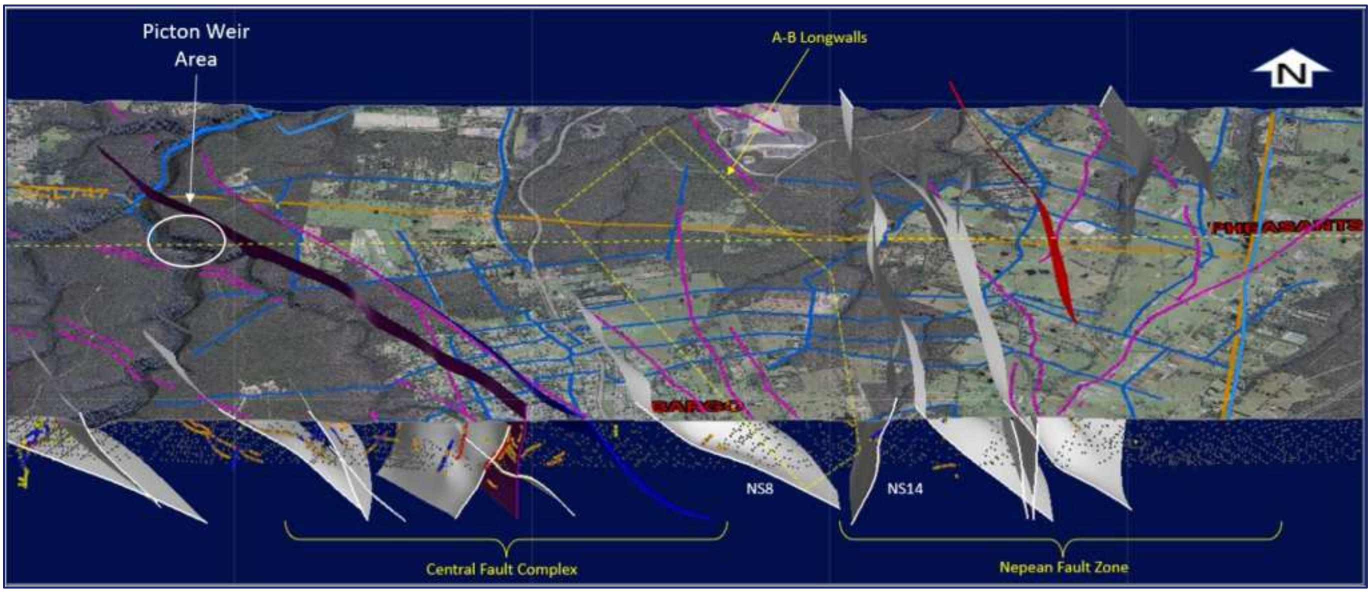
The area surrounding Picton Weir is primarily influenced by the Camden Syncline and by the Mt Tomah Monocline, the two primary folding events result of the current compressional regime. The two large scale folds are known to be plunging to N-NE, consistently with the measures of the bedding planes in the area.

3.3.3 Faulting

The Southern Coalfield is regionally controlled by the 3 major structural domains of high-angle normal faults striking sub-parallel to the fold axes of the Camden syncline and the Mt Tomah Monocline.

The three structural domains consist of the Eastern, Central and Western fault zones. Longwall S7A is in the direct vicinity of the latest interpreted location of the NW striking normal fault corridor named the Central Fault Complex.

The Central Fault Complex is known to be similar in orientation to the Nepean Fault zone striking to the West at about 15° to 20°. The regional scale faults within the corridor include projections in the study area comprising smaller conjugating, antithetic and synthetic structures such as faults, shears and joints. These structures were mainly mapped during underground longwall excavation at Tahmoor Coal and interpreted from geophysics surveys prior to this study. Figure 3 and Inset 3 presents the interpreted Central Fault Complex within the area.



Inset 3: Regional cross section extracted from the 3D model provided by SIMEC showing the relation between the NNW-striking structures interpreted as the Central Fault Complex.

The vertical displacement offsets measured within the Central Fault Complex is believed to be up to 20 m, with the east side laying over the west side (SIMEC, 2022). No faults were observed during the geological field mapping and borehole logging undertaken for this study.

The overall orientation and location of Hornes Creek generally aligns with the inferred Central Fault Complex. The double kink in the river to the east of the Weir is potentially attributable to conjugated lineaments sub-perpendicular to the Central Fault Complex responsible to displace the main creek axis.

3.3.4 Intrusions

Regional intrusions have been identified as part of post Permian igneous events resulting in dykes, diatremes, and sills. The southern section of the Bargo area is known to contain sills. Numerous dykes were encountered during the works conducted at Tahmoor (drilling and underground excavations). Within the Bulli and Wongawilli seams, micro syenite intrusions of variable character are common (Xstrata Coal, 2012).

No dykes or other intrusion were observed during the geological field mapping and borehole logging carried out for this study.

3.3.5 Geomorphology of the Area

The Bargo River dissects the Hawkesbury Sandstone plateau, forming significant scarps and discrete cliffs on either side of the gorge whose depths range from few metres up to over 100 m.

The cliff line is usually close to the channel where the river trends along the direction of systematic jointing. Cliffs are usually formed under competent sandstone which can contain stratigraphically controlled cavernous zones and ephemeral seeps.

Exposed bedrock is commonly characterised by preferential erosion along open planar defects such as joints and mainly bedding partings and cross bedding partings. This generally leads to incipient undercutting and further dilation of such defects due to gravity, resulting in rockfalls that release blocks of variable size. Additional processes often observed are tafone-type erosion inside the caves generated by the collapse and root jacking in the upper portions of the rock mass where weathering is more advanced, and vegetation is predominant.

Interspersed boulder fields are dominantly located in the base of the gorge and on the alluvial flanks, with minor sand deposits along the banks and, to a much lesser degree, within the river. The riverbed exhibits exposed rock bars which are generally shallow in height (max 1 to 2 m).

4. Project Regulatory Requirements

4.1 Project Definition

The Project definition adopted in this report is based on the definition provided by Douglas Partners (2024):

"Tahmoor Coal received development consent for the Tahmoor South Project on 23 April 2021. Definitions from the development consent for cliffs and slopes have been adopted for this project and are summarised below. Definitions have also been provided for the Study Area for man-made and natural features referred to in the development consent. The details given in Table 1 are based on the precedents in other coal fields with similar mining and surface conditions."

The development consent was updated on 26 May 2025 (Mod 3) to include the latest modification which is the inclusion of Longwall S7A.

Definitions used to describe cliffs, steep slopes and study areas are provided in Table 1 are based on the development consent.

Table 1 - Definitions

Terms	Definition
Cliff	A continuous rock face, including overhangs, with at minima: • length of 20 m • height of 10 m • slope of 1:2 (H:V, >63.4°)
Steep Slope	An area of land having a gradient between 3:1 and 1:2 (H:V, 18.3° ≤ X ≤ 63.4°)
Study Area (SA)	The greater areal extent of either the 20 mm subsidence line and the 35° angle of draw. The Study Area is applicable for man-made landscape features, which comprise road cuttings, road embankments and farm dams.
Study Area for Natural Features (SANF)	A 600 m zone around the footprint of the proposed longwalls (i.e. LW S7A). The study area for natural features comprises cliffs and steep slopes

4.2 Development Consent

There are a number of impact performance measures contained within the Tahmoor South Project development consent. Performance measures relevant to this study are provided in Table 2.

Table 2 – Relevant Impact Performance Measures as per the Development Consent Table 7

Feature	Performance Measures	Relevant item [1]
Natural Features		
Any cliff located directly above longwalls	Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face area of the cliff within any longwall mining domain)	None
Any cliff within Subsidence Area beyond the extent of longwalls	Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within Subsidence Area)	Cliffs features
All land within the Subsidence Area	No greater subsidence impacts or environmental consequences than predicted in the EIS	All
All land outside the Subsidence Area	Negligible subsidence impacts or environmental consequences	All
Built Features		
Key public infrastructure: • Main Southern Railway • Remembrance Drive • M31 Motorway • Moomba to Sydney Gas Pipeline • Gorodok Ethane Pipeline • Bargo Waste Management Centre	• Always safe and serviceable • Damage that does not affect safety or serviceability must be fully repairable, and must be fully investigated and repaired at the cost of the Applicant	Cutting and embankment along Remembrance Drive
All other public infrastructure including roads, culverts, bridges, viaducts, water supply pipelines, sewerage mains, gas pipelines, electrical and telecommunication infrastructure and survey control marks	• Always safe • Serviceability should be maintained wherever practicable • Loss of serviceability must be fully compensated • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant	None
• Public amenities including schools, churches and community centres • Industrial, commercial and business premises • Bargo Cemetery • Wirrimbirra Sanctuary • Privately-owned residences • Other privately-owned built features and improvements, including petrol stations, sheds, garages, farm dams, tanks, swimming pools, tennis courts, roads, tracks and fence	• Always safe • Serviceability should be maintained wherever practicable • Loss of serviceability must be fully compensated • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant	Farm Dams

(1) Only items within the scope of the present report are mentioned.

5. Information Review

5.1 Documents Provided for this Review

Table 3 and Table 4 below provide a summary of the documents provided by TC to PSM for this review. TC also provided PSM with LiDAR and Aerial Imagery for the area and relevant shapefiles for the location of sensitive features.

Table 3 – List of Provided Information

ID	Name	Reference	Author	Date
EMM 2024	*Longwall S7A Modification Report*	SSD 8445 Mod 3	EMM	May 2024
MSEC 2024	*The effects of the proposed addition of LW S7A on previous subsidence predictions and impact assessments*	MSEC1348 RevB	MSEC	Mar 2024
DP 2022	*Detailed Slope Stability Assessment – Longwalls S1A to S6A*	210597.02.R.001.Rev0	DP	Sep 2022
DP 2023	*Detailed Assessment of Farm Dams FD8 and FD13 – Longwalls S1A to S3A*	210597.03.R.001.Rev1	DP	May 2023
DP 2024a	*Report on Preliminary Stability and Dam Break Assessment – Longwalls S4A to S6A*	210597.08.R.001.Rev0	DP	May 2024
DP 2024b	*Geotechnical Assessment Longwalls S1A to S6A*	210597.00.R.002.Rev1	DP	Jun 2024

Table 4 – List of Provided Monitoring Inspection Report by Douglas Partners

Name	Reference	Date
LW S1A		
Geotechnical Subsidence Impact Inspection		
Baseline Inspection – FD1	210597.04.R.001.FD1.Rev0	Oct 2022
LW S1A	210597.04.R.001.Rev1	Oct 2022
LW S1A	210597.04.R.002.Cov.Rev1	Nov 2022
Geotechnical Mine Subsidence Impact Monitoring		
Steep Slope and Farm Dams – December 2022	210597.04.R.003.Rev0	Dec 2022
Steep Slope and Farm Dams – January 2023	210597.04.R.004.Rev0	Jan 2023
Steep Slope and Farm Dams – February 2023	210597.04.R.005.Rev1	Mar 2023
Steep Slope and Farm Dams – March 2023	210597.04.R.006.Rev0	Mar 2023
Steep Slope and Farm Dams – April 2023	210597.04.R.006.Rev0	Apr 2023
Steep Slope and Farm Dams – May 2023	210597.04.R.008.Rev1	May 2023
Steep Slope and Farm Dams – June 2023	210597.04.R.009.Rev0	Jun 2023
Steep Slope and Farm Dams – July 2023	210597.07.R.001.Rev0	Jul 2023
LW S2A		
Geotechnical Mine Subsidence Impact Monitoring		
Steep Slopes and Farm Dams – August 2023	210597.07.R.002.Rev0	Aug 2023
Steep Slopes and Farm Dams – September 2023	210597.07.R.003.Rev0	Sep 2023
Steep Slopes and Farm Dams – October 2023	210597.07.R.004.Rev0	Oct 2023
Subsidence Impacts	210597.07.R.005.Rev0	Dec 2023
Subsidence Impact – December 2023	210597.07.R.006.Rev0	Dec 2023
Subsidence Impact – January 2024	210597.07.R.007.Rev0	Jan 2024
Subsidence Impact – February 2024	210597.07.R.008.Rev0	Feb 2024
Subsidence Impact – March 2024	210597.07.R.009.Rev0	Mar 2024

Name	Reference	Date
Subsidence Impact – April 2024	210597.07.R.010.Rev0	Apr 2024
LW S3A		
Geotechnical Monitoring Mine Subsidence Impact	210597.09.R.001.Rev0	May 2024
Geotechnical Monitoring Mine Subsidence Impact	210597.09.R.002.Rev0	Jun 2024
Geotechnical Monitoring Mine Subsidence Impact	210597.09.R.003.Rev0	Jul 2024
Geotechnical Monitoring Mine Subsidence Impact	210597.09.R.004.Rev0	Aug 2024
Geotechnical Monitoring Mine Subsidence Impact – September 2024	210597.09.R.005.Rev0	Sep 2024
Geotechnical Monitoring Mine Subsidence Impact – October 2024	210597.09.R.006.Rev0	Oct 2024
Geotechnical Monitoring Mine Subsidence Impact – November 2024	210597.09.R.007.Rev1	Nov 2024
Geotechnical Monitoring Mine Subsidence Impact – December 2024	210597.09.R.008.Rev0	Dec 2024
LW S4A		
Geotechnical Monitoring Mine Subsidence Impact – February 2025	210597.09.R.009.Rev2	Mar 2025
Geotechnical Monitoring Mine Subsidence Impact – March 2025	210597.09.R.011.Rev1	May 2025
Geotechnical Monitoring Mine Subsidence Impact – April 2025	210597.09.R.012.Rev0	May 2025
Geotechnical Monitoring Mine Subsidence Impact – June 2025	210597.09.R.013.Rev1	Jul 2025

5.2 Longwalls S1A to S6A – Approved Layout

5.2.1 Geotechnical Assessment

DP (2024a) provides a geotechnical assessment for multiple site features for natural and anthropogenic features that may be affects by subsidence due to longwalls S1A to S6A. Features included in DP (2024a) are summarised in Table 5. The location of features summarised in Table 5 are shown in Figure 1.

Table 5 – DP (2024b) Geotechnical Assessment

Features	DP Assessment	Feature ID
Cliff Lines	2	BC1, BC2
Steep Slopes	3	WC1, WC2, WC3
Road Embankment and Cutting	4 embankments 1 cutting	RE1 to RE4 RC1
Farm Dams	45	FD1 to FD45

5.2.2 Maximum Predicted Conventional Subsidence Effects

Table 6 presents the maximum predicted subsidence impact for LW S1A to LW S6A as modelled by MSEC and presented in MSEC (2024).

Table 6 – MSEC Maximum Predicted Subsidence Main Parameters for LW S1A to LW S6A

Longwall	MSEC Maximum Prediction			
	Conventional Subsidence [mm]	Conventional Tilt [mm/m]	Hogging Curvature [km^{-1}]	Sagging Curvature [km^{-1}]
Incremental				
LW S1A	800	7.0	0.08	0.22
LW S2A	950	7.5	0.08	0.22
LW S3A	950	8.0	0.09	0.22
LW S4A	950	8.0	0.09	0.22
LW S5A	950	8.0	0.10	0.22
LW S6A	975	8.3	0.09	0.23
Total				
After LW S6A	1,350	9.5	0.14	0.24

5.3 Observations of Mine Subsidence at Tahmoor Coal

5.3.1 Previous Predictions

During longwall extraction a substantial increase in subsidence over that predicted was observed over longwalls LW 8, LW 13, LW 24A and above the commencing ends of longwalls LW 24A to 27, LW 32 and LW W4. Strata Control Technology investigated (SCT) the cause of this increase and noted:

- Close proximity to and aligned with the Nepean Fault, and
- Close proximity to the Bargo River Gorge, which is approximately 100 m deep, which permitted groundwater flows to weather the joint and bedding plane properties of the surrounding strata.

MSEC in their May 2022 report on the impacts of longwalls 1A to 6A noted that:

> *"While the proposed LW S1A ‑ S6A are not located near the Nepean Fault, the experiences are a reminder that increased subsidence movements can occur."*

SCT concluded increased subsidence was consistent with localised weathering of joint and bedding planes above a depressed water table adjacent to an incised gorge are likely to both proximity to the Nepean Fault and ability to depressurise. Monitoring in the vicinity if these longwalls showed that the extent of increased subsidence reduced with increasing distance from the Bargo River Gorge.

It is noted that LW S7A is located near a major structure being the Central Fault Complex and adjacent to Bargo Gorge and Hornes Creek. The supplementary MSEC report in 2024 to include longwall S7A as part of the Mod 3 application notes:

> *"It is possible that increased subsidence may develop above LWS7A but this is not certain for the following reasons:*
>
> - *The Central Fault is less defined in the Tahmoor South area compared to the Nepean Fault in the Tahmoor North area, and*
> - *The measured groundwater gradients in the Tahmoor South area are less than those measured near Longwalls 24A to 26."*

In MSECs assessment any exceedance of subsidence predictions, if this occurred, would be small including comparison of the ratio of total subsidence to extraction height being similar to or exceeding conditions for LW 24A.

5.3.2 Longwalls S1A to S2A Monitoring

MSEC (2024) makes the following conclusions regarding the comparison between observed and predicted subsidence during mining:

- Observed incremental subsidence has correlated relatively well with predictions.
- Variation in subsidence magnitude were observed, with a slightly greater than predicted subsidence along Peg V51 (between Teatree Hollow and its Tributary) but remains within the accuracy of the prediction model. All other monitored locations have experienced less than predicted subsidence.

5.4 Proposed Longwall S7A

5.4.1 Bulli Seam along the Longwall S7A

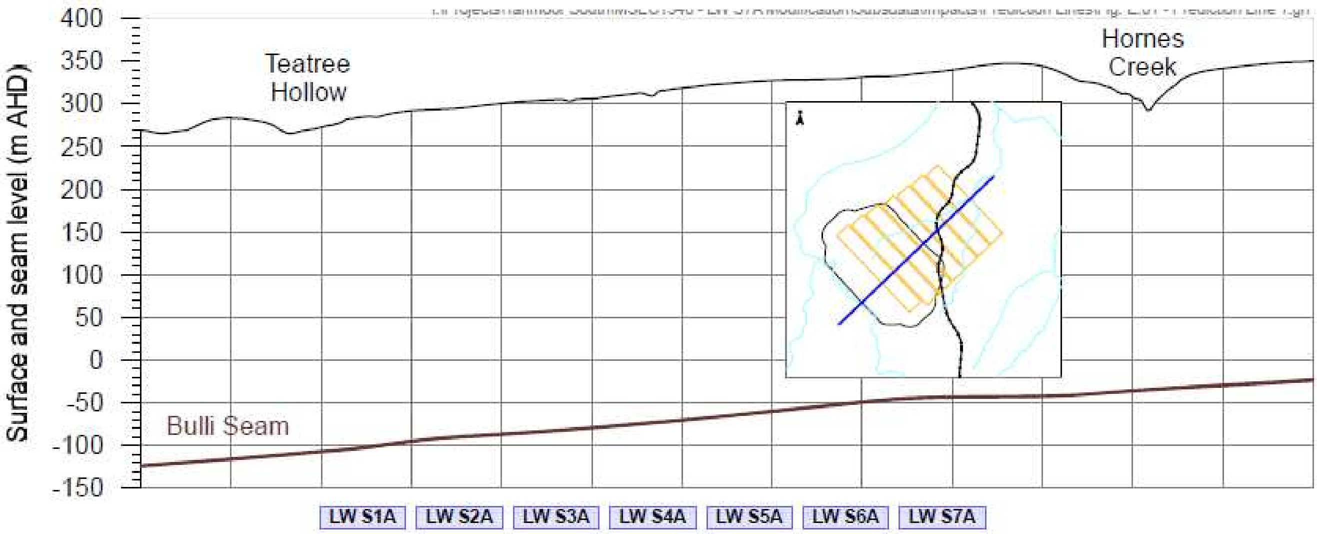
Table 7 presents details of the additional proposed longwall S7A.

Table 7 – LW S7A details

Longwall	Overall longwall length including installation heading [m]	Longwall width including first working [m]	Tailgate chain pillar width [m]
LW S7A	1,918	285	36

Details of the Bulli seam in relation to the topography is as follows:

- Terrain directly above the Bulli seam is relatively flat, with variation between 320 m AHD to 350 m AHD
- The Bulli seam generally dips from the southwest towards the northeast with an average gradient of 5% across the mining area, as shown in Inset 1
- The depth of cover directly above LW S7A varies between approx. 375 m and 385 m
- Extraction height for LW S7A range from 2.1 to 2.6 m.



Inset 4: Surface and Seam Levels along the Prediction Line across LWs S1A to S7A.

5.4.2 Maximum Predicted Conventional Subsidence Effects

A summary of the subsidence predictions undertaken by MSEC is provided in Table 8. Predictions are slightly higher than corresponding predictions by MSEC for the approved longwalls S1A to S6A (provided in Section 5.3.2) except for hogging curvature which is unchanged.

Table 8 – MSEC Maximum Predicted Subsidence Main Parameters for LW S7A

Longwall	MSEC Maximum Prediction			
	Conventional Subsidence [mm]	Conventional Tilt [mm/m]	Hogging Curvature [km^{-1}]	Sagging Curvature [km^{-1}]
Incremental				
LW S7A	1,050	8.9	0.10	0.24
Total				
After LW S7A	1,400	10.0	0.14	0.25

5.4.3 Updated Geotechnical Assessment

PSM have undertaken an assessment of additional features that have been included in the increase study area footprint that has been expanded to include the proposed LW S7A. These additional features are included in Table 5. The location of features summarised in Table 5 are shown in Figure 1.

The updated assessment included inspections of these additional features.

Table 9 – Features Included in this Expanded Geotechnical Assessment

Features	PSM Assessment	Feature ID
Cliff Lines	19	**BC1**, BC3 to BC20
Steep Slopes	7 Rock Shelters	RS1 to RS7
Road Embankment and Cutting	2 embankments 1 cutting	**RE2 and RE3** **RC1**
Farm Dams	20	FD

(2) Items in **bold** were included in the DP assessment

6. Inspections

PSM Engineering Geologist Letizia Brusadelli undertook two site visits with the assistance from Ross Barber from Tahmoor Coal incorporating inspection of 18 selected sites. The inspections were carried out on the following dates:

- 21 August 2025
- 3 September 2025.

A site assessment of the inspected cliff lines and rock shelters is presented in Appendix A. The inspection was supplemented by drone imagery to enable access and observation from different perspectives.

It is important to note the following limits regarding the assessment:

- Some cliff areas could not be thoroughly inspected at this stage due to inability to access
- Some known rock shelters could not be located during the assessment, even with the presence of Tahmoor Coal personnel.

7. Subsidence Assessment for LW S7A

7.1 General

Subsidence impacts due to longwall LW S7A may result in surface cracking, heaving, buckling and stepping which can influence steep slopes. DOP (2008) provides a detailed summary of the range of potential mine subsidence effects and the environmental management techniques.

The DOP (2008) recommends the definition of a risk management zone. A Study Area for Natural Features (SANF) for the site was defined by MSEC as subsidence study area expanded to include a 600 m boundary for the natural features.

The assessment of natural features provided in this study was undertaken using the following guidelines:

- Cliff Lines and Rock Shelters:
  - ACARP (2002) Impacts of Mine Subsidence on the Strata & Hydrology of River Valleys/Management Guidelines for Undermining Cliffs Gorges & River Systems (Ref. C9067).
- Road embankments and cuttings:
  - TfNSW (2014) Guide to Slope Risk Analysis, Version 4.
- Farm Dams:
  - Dam Safety NSW (2022), Declared dams consequence category assessment and determination methodology published in NSW Gazette No. 113 dated March 2022.

7.2 Cliff Lines

7.2.1 Methodology

The ACARP (2002) guidelines provide an assessment method for the mining impacts on cliff lines based on 3 categories:

- Extent of mining-induced ground movements
- Aesthetic quality and degree of public exposure
- Natural instability.

A classification ranging from insignificant to extremely high was given for each of the categories presented based on several factors and specific weighting for each as detailed in Appendix A. An overall impact assessment was then derived for each location based on the combined classifications.

ACARP 2002 also provides an estimation of the likelihood of rock falls based on the natural cliff instability and the mining induced ground movement. The method presents an upper bound estimate of the percentage of cliff line likely to be damaged. It is important to note that ACARP 2002 mentions that: *"The likelihood of a particular cliff collapse or rock fall is impossible to predict since the stability of the cliff cannot be fully determined from the appearance of the rock face."*

The mining induced ground movement, aesthetic quality and public exposure, and the cliff natural instability were ranked based on a score derived from a number of parameters. The scores based on the ACARP 2002 approach are presented in Appendix A. The aesthetic and natural instability scores were based on field observations while the mining induced ground movement were based on MSEC predictions for each location.

7.2.1.1 Mining Induced Ground Movement

Generally, cliff lines were located at least 275 m from the proposed Longwall S7A. BC01 is the closest cliff line while the majority of cliff lines were located close to or on the boundary of the SANF. Consequently, mining induced movements at cliff lines are expected to be small and none of the cliffs are to be undermined.

Table 10 – Cliff Lines Predicted Movements as per MSEC (2024)

Reference		Cliff Length [m]	MSEC Prediction of Maximum Impact			
Study	MSEC		Total Subsidence [mm]	Maximum tilt [mm/m]	Total hogging curvature [km^{-1}]	Total sagging curvature [km^{-1}]
BC01	C_00130	122	60	< 0.5	< 0.01	< 0.01
BC03	C_01280	27	< 20			
BC04	C_00800	283	< 20			
BC05	C_03370	62	< 20			
BC06	C_02170	28	< 20			
BC07	C_11150	33	20			
BC08	C_02060	76	40			
BC09	C_07220	30	30			
BC10	C_00710	128	25			
BC11	C_00830	37	< 20			
BC12	C_00920	63	< 20			
BC13	C_05140	51	20			
BC14	C_01160	43	< 20			
BC15	C_02670	39	< 20			
BC16	C_11590	27	< 20			
BC17	C_02240	40	25			
BC18	C_01610	106	30			
BC19	C_02020	43	< 20			
BC20	C_02920	58	< 20			

7.2.2 Assessment

The details for each of the cliff that were inspected are provided in Appendix A. A summary of the ranking is presented in Table 11. For the cliff lines that were not able to be inspected, conservative values were considered in the assessment process.

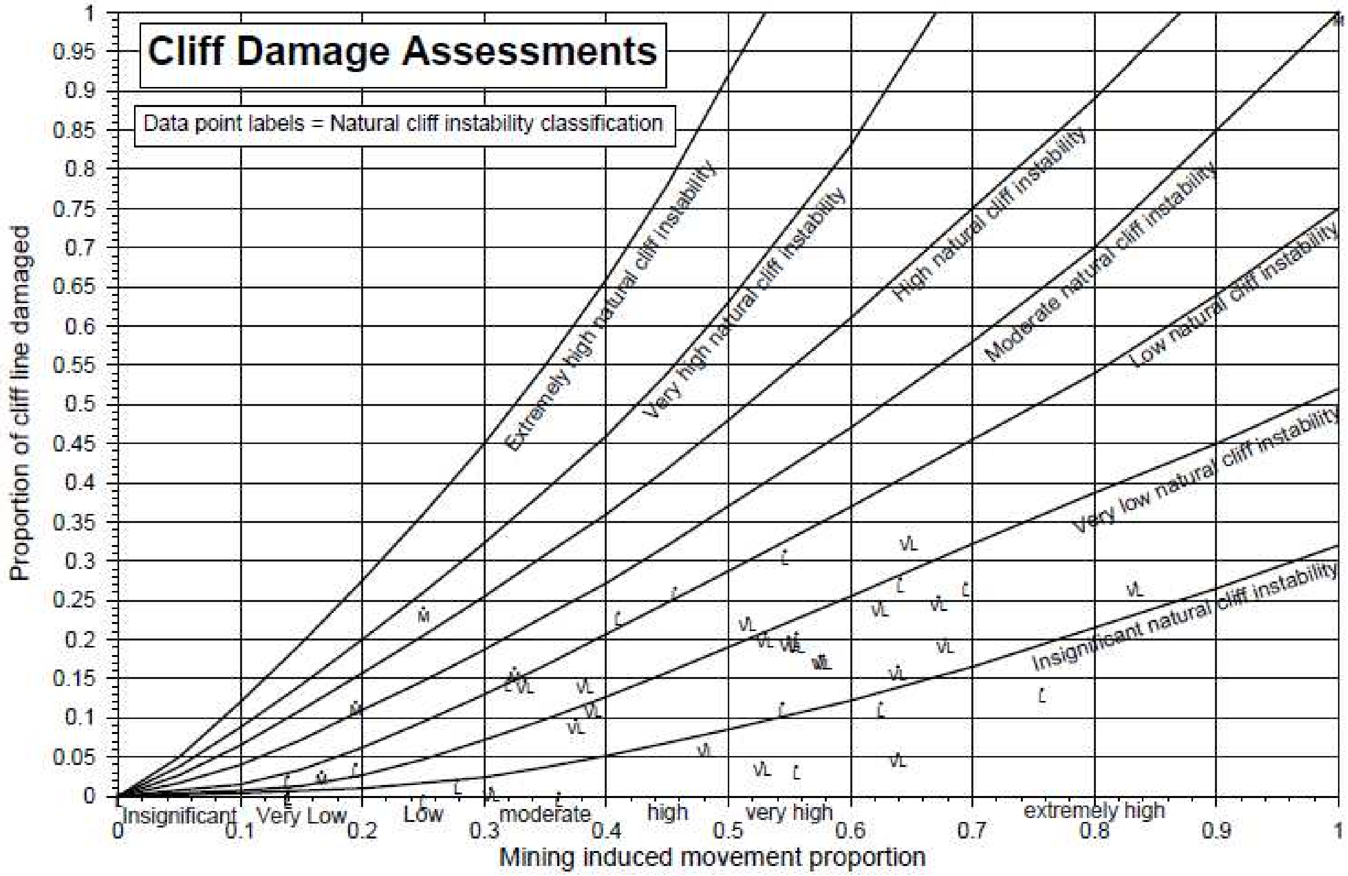
The following assumptions were considered:

- MSEC predictions did not cover some impact matrices for some of the assessed for this study. The following parameters were assumed where such redactions were not available. The choice of these parameters is considered by PSM to be appropriately conservative. These assumed parameters were:
  - mining induced strain at the cliff: < 2 mm/m (low)
  - mining induced horizontal movement at the cliff: 50 to 100 mm (low)
  - in situ horizontal stress at seam level: 20 to 30 MPa (moderate)
- The presence of natural cracks in the cliff crest was often difficult to detect due to access limitations. However, a single crack parallel to the orientation of the cliff face was observed in a single cliff out of six cliffs that were readily accessible. As such consideration for a single crack (low ranking) and a moderate ranking for its orientation was considered.
- There were three cliffs in the SANF that PSM was not able to inspect, these being BC09, BC11 and BC18. These cliffs were assigned an average ranking of "Very Low" for the Aesthetic Quality and "Moderate" Natural Instability based on their location being a considerable distance from LW S7A and their relatively small size.

The rock fall upper bound values are based on ACARP (2002) *cliff assessment damage* chart, presented in Inset 5.

Table 11 – Cliff Lines Assessment

Reference		Mining Impact	Aesthetic Quality	Natural Instability	Overall Assessment	Mining Impact Proportion	Rock Falls (upper bound)
Study	MSEC						
BC01	C_00130	Very Low	Low	High	Low	0.14	< 10%
BC03	C_01280	Very Low	Very Low	High	Low	0.11	< 7%
BC04	C_00800	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC05	C_03370	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC06	C_02170	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC07	C_11150	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC08	C_02060	Very Low	Very Low	High	Low	0.11	< 7%
BC09	C_07220	Very Low	Low	Moderate	Very Low	0.11	< 5%
BC10	C_00710	Very Low	Insignificant	Low	Very Low	0.11	< 2%
BC11	C_00830	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC12	C_00920	Very Low	Insignificant	High	Very Low	0.11	< 7%
BC13	C_05140	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC14	C_01160	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC15	C_02670	Very Low	Insignificant	Moderate	Very Low	0.11	< 5%
BC16	C_11590	Very Low	Insignificant	Moderate	Very Low	0.11	< 5%
BC17	C_02240	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC18	C_01610	Very Low	Very Low	Moderate	Very Low	0.11	< 5%
BC19	C_02020	Very Low	Insignificant	Moderate	Very Low	0.11	< 5%
BC20	C_02920	Very Low	Insignificant	Moderate	Very Low	0.11	< 5%



Inset 5: **Cliff Damage Assessment Chart (ACARP, 2002): Graph showing the likely incidence of rock falls for different levels of mining impact and different levels of cliff line instability.**

7.2.3 Conclusions

Using the ACARP (2002) risk assessment method, cliff lines described above have been assessed to have a Very Low to Low overall risk level. Additionally, around 2% and 10% of the length of cliff lines are predicted to be affected by slope instability during mining. This is somewhat smaller than that predicted by MSEC who based their estimated impact on total face area of cliffs rather than length of cliff line:

> *"Based on this previous experience of mining at Tahmoor, Appin and Tower Collieries, it is unlikely that cliffs beyond the extent of the longwall panels will experience large instabilities. It is possible that isolated rock falls could occur during the mining period due to natural weathering processes. Any impacts are expected to represent less than 0.5 % of the total face area of the cliffs."*

Although there is a discrepancy between the quantum affected there is agreement that impacts to cliff lines due to mining is possible but likely relatively small.

7.3 Natural Steep Slopes

7.3.1 General

As per the scope of works PSM was commissioned to include these features in our assessment:

- Steep slopes on the sides of valleys
- Rock shelters
- Batters of road and railway embankments and cuttings (addressed in Section 7.4)
- Slopes on farm dams (addressed in Section 7.5)

The focus of our assessment was mainly on where steep slopes occurred in these features. The definition of a steep slopes used for this assessment is provided in Table 1. The location of the steep slopes is presented in Figure 3.

7.3.2 Steep Slopes on Valleys Sides

The steep slopes on the sides of valleys are located around Hornes Creek and a small tributary to the Bargo River. These slopes are proposed to be undermined and are generally located near the edge of the study area. The small tributary is effectively in line with LW S5A, at the edge of the LW S7A Study Area and outside of the 600 m SANF boundary. The sides of valleys are predominantly found in Hawkesbury Sandstone and consist of a mixture of cliffs and rock outcrops, screed slopes with rocky soils and loose rock fragments. The majority of slopes are stabilised, to some extent, by natural vegetation.

No natural steep slopes are located in the vicinity or upslope of a targeted features. As such no specific assessment was deemed necessary.

MSEC (2024) provide a good discussion around the stability of steep slopes in the Southern Coalfield as follows:

> *"There has been extensive experience of mining beneath steep slopes in the Southern Coalfield. These include steep slopes along the Cataract, Nepean, Bargo and Georges Rivers and streams such as Myrtle Creek and Redbank Creek above Tahmoor Mine Longwalls 22 to 32, slopes on Redback Range above Tahmoor Mine Longwalls 26 and 27 and slopes along ridges and valleys above Tahmoor LWs W1-W4. No large-scale slope failures have been observed along these slopes, even where longwalls have been mined directly beneath them. Surface cracking and minor rock falls along clifflines or rock outcrops have been observed, for example, during the mining of Appin Longwalls 301 and 302 adjacent to the Cataract River, however, no large-scale slope failures have been observed.*
>
> *Potential impacts on steep slopes would generally result from the movement of soils, causing tension cracks to appear at the tops of the slopes and compression ridges to form at the bottoms of the slopes. These movements are consistent with observations of upsidence and closure of creek valleys where compression is developed at the bottoms of the valleys and tension is developed at the tops of the valleys. If tension cracks were left untreated it is possible that soil erosion could occur.*
>
> *It is possible, therefore, that some remediation might be required to ensure that mining-induced surface cracking does not result in the formation of soil erosion channels. In some cases, erosion protection measures may be needed, such as the planting of additional vegetation in order to stabilise the slopes in the longer term.*

While in most cases impacts to slopes are likely to consist of surface cracking, there remains a low probability of large-scale slope slippage. The probability is assessed to be very low for slopes that will not be directly mined beneath by the longwalls. Experience indicates that the probability of mining induced large-scale slippages is extremely low due to the substantial depths of cover within the Study Area. While the risk is extremely low, some risk remains and attention must therefore be paid to any structures or roads that may be located in the vicinity of steep slopes.

There are no structures or roads located along natural steep slopes within the Study Area."

7.3.3 Rock Shelters

7.3.3.1 Rock Shelters Details

All identified rock shelters were located along the Hornes Creek. RS2 to RS7 are within study area, while RS1 is located just outside of the area and within the natural boundary. The details about the rock shelters provided by EMM (2024) are presented in Table 12.

Table 12 – Rock Shelter details

Site Name		Site Type	Description	Landform
AHIMS No.	ID			
52-2-4974	RS1	Rock shelter with deposit	West facing rock shelter near the confluence of Hornes Creek and the Bargo River. Shelter is quite shallow with a rock base and a limited area of PAD.	Upper scarp
52-2-4975	RS2	Rock shelter with deposit and artifact	High, shallow rock shelter with deposit and artefacts. Overhang extends for approximately 80 m along the upper scarp. Artefacts were identified under the dripline within a 1 m^2 area. Artefacts included a mudstone flake, a quartz flake piece and a silcrete flake.	Upper scarp
52-2-4976	RS3	Rock shelter with deposit	Cavernous, open shelter facing west on the upper scarp. Rock shelter has a rock platform base overlaid with 10–20 cm depth of sandy PAD and a large area of PAD below the drip line.	Upper scarp
52-2-4977	RS4	Rock shelter with deposit and artifact	Large, west facing rock shelter with good amenity and area of PAD (6 x 4 m). Charcoal graffiti and disturbance from recent campfires in the shelter. Indeterminate charcoal markings, partly covered in lichen may represent earlier artworks. One silcrete debitage flake.	Upper scarp
52-2-4978	RS5	Rock shelter	Low shelter (1.7 m high) charcoal graffiti and some indeterminate charcoal markings. No PAD.	Upper scarp
52-2-4982	RS6	Rock shelter with deposit and artifact	Large rock shelter formed by cavernous weathering, facing north above Hornes Creek. A small micro-debitage mudstone flake was found within the dripline. The shelter contains an area of PAD approximately 6 x 3 m.	Upper scarp
52-2-4981	RS7	Rock shelter with deposit	Small rock shelter with PAD (approximately 1 x 3 m) beside Hornes Creek.	Footslope

7.3.3.2 Mine Subsidence Effect on Rock Shelters

Streams and valleys are often sensitive to subsidence movements due to effects such as closure and upsidence (reduced subsidence). Identified rock shelters are located along the sides of the valley and therefore could experience these effects. Rock shelters are particularly susceptible to subsidence-induced damage as they are typically located along cliff lines (DoP 2008). Some fracturing was observed in the Southern Coalfield, with increased fracturing typically occurring near the bases of rivers, creeks and valleys, as the result of valley related movements (MSEC 2024).

Subsidence predictions for each Aboriginal heritage site are provided in Table 6.12. While some mining induced movement is expected, the overall likelihood of this causing an impact on the newly recorded Aboriginal sites is considered low (MSEC 2024).

The cliffs which contain the newly recorded rock shelters are considered unlikely to experience any major instabilities due to the proposed extraction of LW S7A as the proposed modification does not involve mining directly beneath any identified cliffs within the study area.

A summary of the predicted probability of impact from the extraction of LW S7A on each Aboriginal site is presented in Table 6.13.

Table 13 – Rock Shelter Subsidence Prediction

Site Name		Significance	MSEC Subsidence Prediction			
AHIMS No.	ID		Total Subsidence [mm]	Maximum tilt [mm/m]	Total hogging curvature [km^{-1}]	Total sagging curvature [km^{-1}]
52-2-4974	RS1	Low	20	<0.5	<0.01	<0.01
52-2-4975	RS2	High	40			
52-2-4976	RS3	Low	40			
52-2-4977	RS4	Moderate	40			
52-2-4978	RS5	Low	50			
52-2-4982	RS6	High	20			
52-2-4981	RS7	Low	30			

7.3.4 Rock Shelter Assessment

Identified rock shelters were found to be generally located within cliff lines and as such considered be more appropriate to be assessed using the Cliff Lines methodology as per ACARP (2002). The Cliff Lines approach was specially developed for considering heritage significance as part of their qualitative subsidence impact assessment. The methodology is outlined in Section7.2.1.

Table 14 provides a summary of the rock shelter assessment, with further details available in Appendix A. A discussion on the expected impacts to the cliff face can be found in Section 7.2.3.

As noted in Section 5.4.3, accurately locating the exact position of some known rock shelters proved challenging. Consequently, assumptions were made based on the characteristics of adjacent cliff faces regarding natural stability. Additionally, conservative parameters were adopted for aesthetic significance, taking into account the enhanced heritage value.

The impact classification rating are "Very Low", similar to previous Cliff Line overall assessment.

Table 14 – Rock Shelter Assessment

Reference		Mining Impact	Aesthetic Quality	Natural Instability	Overall Assessment
AHIMS No.	ID				
52-2-4974	RS1	Very Low	Very Low	Moderate	Very Low
52-2-4975	RS2	Very Low	Low	High	**Very Low**
52-2-4976	RS3	Very Low	Very Low	High	Very Low
52-2-4977	RS4	Very Low	Very Low	High	Very Low
52-2-4978	RS5	Very Low	Very Low	High	Very Low
52-2-4982	RS6	Very Low	Low	Moderate	Very Low
52-2-4981	RS7	Very Low	Very Low	Moderate	Very Low

7.4 Road Embankments and Cuttings

7.4.1 LW S7A Predicted Subsidence Impact

Remembrance Drive is supported by 2 road embankments both located within the Study Area; one north of Yarran Road (identified as RE3) and one South of Yarran Road (RE2). Additionally, approximately half of a road cutting situated between Caloola Road and Yarran Road (RC1) is located within the Study Area. Both road embankments are located directly over LW S5A and the cutting is located directly over LW S4A. No embankments are to be directly undermined during the extraction of LW S7A.

Remembrance Drive does not cross directly above LW S7A and only a small amount of additional subsidence due to LW S7A is expected following the prior extraction of LWs S1A to S6A. A summary of the predicted subsidence for Remembrance Drive is presented in Table 15. The following assessment has been undertaken only considering incremental effect of mine subsidence on the Remembrance Drive.

Table 15 – MSEC (2024) Maximum Predicted Conventional Subsidence Parameters for Remembrance Drive

Longwall	Maximum Total Prediction				
	Subsidence [mm]	Tilt along alignment [mm/m]	Tilt across alignment [mm/m]	Hogging curvature in any direction [km^{-1}]	Sagging curvature in any direction [km^{-1}]
Previous Assessment (LW S1A to LW S6A layout)					
LW S1A	200	1.5	4.0	0.06	0.03
LW S2A	975	5.0	5.5	0.08	0.20
LW S3A	1150	7.0	4.5	0.10	0.20
LW S4A	1300	6.0	5.5	0.12	0.20
LW S5A	1350	5.5	6.0	0.13	0.20
LW S6A	1350	6.5	5.5	0.13	0.25
Current Assessment (LW S1A to LW S7A layout)					
LW S7A (1)	1400 (60)	7.0 (<0.5)	5.0 (<0.5)	0.13 (<0.01)	0.25 (<0.01)

(3) Maximum predicted incremental parameters presented in brackets

7.4.2 Remembrance Drive Details

Remembrance Drive is single lane and bi-directional with an asphalt and a speed limit of 80 km/h. Table 16 presents the relevant embankment and cuttings details.

Table 16 – Remembrance Drive embankment and cuttings details

ID	Type	Length [m]	Maximum Height [m]	Minimum Distance [m] from Toe or Crest to	
				Asphalt	Carriageway
RE2	Embankment	230	8	0	2.5
RE3		150	3.5	0	2.75
RC1	Cutting	460	6.5	2	2.5

7.4.3 TfNSW Risk Assessment

7.4.3.1 General

We note that the incremental subsidence impacts on these features due to LW S7A is very small (around about 60 additional subsidence and a slightly increased tilt as per Table 15). We have adopted the same approach used in DP (2024b) to assess the additional impacts (if any) on road embankments and cuttings. This method is prescribed by TfNSW and is summarised below.

The TfNSW method provides the ability to assess the potential slope instability for the NSW road network. The method requires these steps:

- Identify the hazards
- Assess the hazards by attributing them with:
  - Likelihood, based on:
    - Probability of occurrence, $P_{(d)}$, the probability of rockfall for cuttings or landslide both embankments and cuttings to occur
    - Probability of Travel, $P_{(t)}$, the probability of the risk impacting the road.
  - Consequence, based on:
    - Temporal Spatial Probability, T, the probability of a road user to be impacted by the hazard, this is mainly based on road traffic
    - Vulnerability, V, the probability of the event causing loss of life, assuming that a vehicle impacts the debris (cutting) or is lost into a void caused by the failure (embankment).
- Evaluate the risk based on the above assessment, providing a ranking. This would allow for the proper management of the hazards, either by mitigation or control.

7.4.3.2 Probability of Occurrence, $P_{(d)}$

DP (2022) presented Factors of Safety (FoS) corresponding to different slope instability hazards. DP (2024b) did not detail the methodology around their derivation of probability of occurrence (meaning embankment failure in this instance) from those results. Our methodology of deriving probability of occurrence relied upon DP (2022) factors for safety in combination with the relationship presented in Silva, Lambe and Marr (2008). We have considered the embankment to be a facility classification between Category II and Category III where:

- Category II: *"facilities designed, built, and operated using standard engineering practice. Many ordinary facilities fall into this category"*
- Category III: *"Facilities without site-specific design and sub-standard construction or operation. Temporary facilities and those with low failure consequences often fall into this category."*

Table 17 – Annual Probability of Failure based on FoS

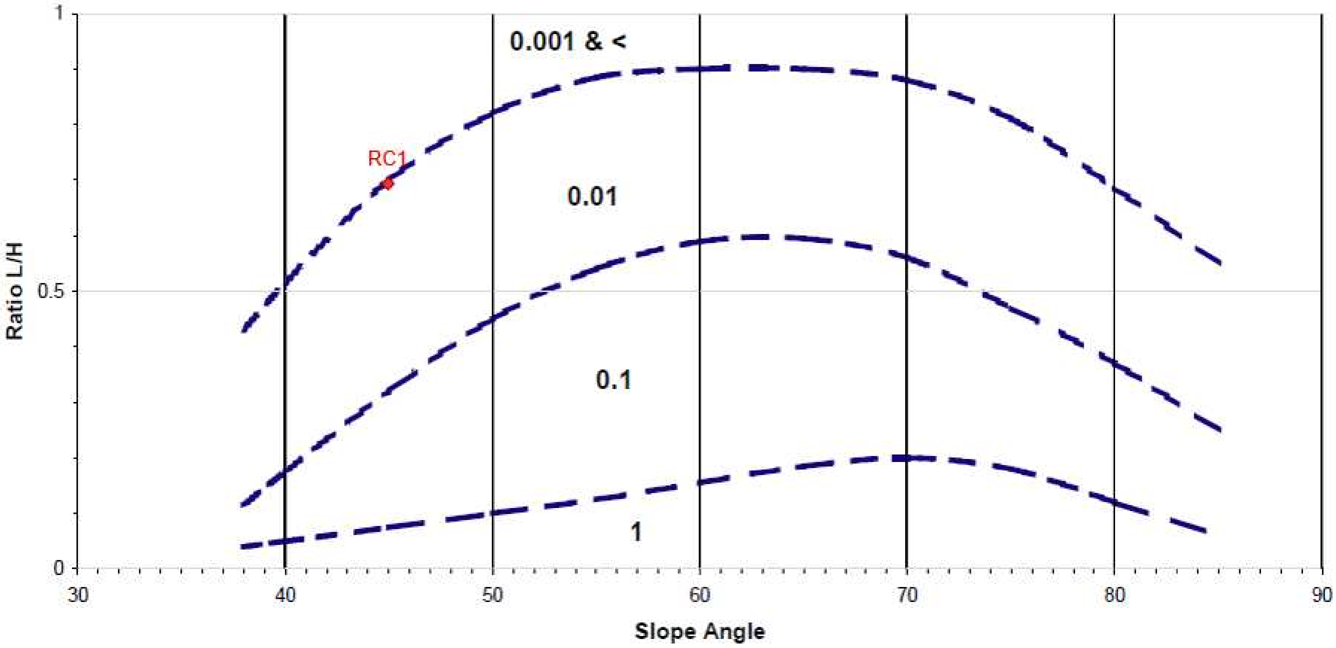
Embankment	FoS for 1% AEP flood		Annual Probability of Failure	
	North bound	South bound	North bound	South bound
RE2	1.27	1.78	0.01	0.00001
RE3	3.8	1.71	< 0.00001	0.0001

7.4.3.3 Travel Distance / impact reaching road users, $P_{(t)}$

Estimates were developed using the methodology outlined by TFNSW (2014), which provides a simplified chart-based approach for estimating the likelihood of rockfalls reaching certain distances.

TfNSW (2014) includes a chart for the provisional assessment of the travel distance probability of small rock falls and slides. A conservative geometry was considered for RC1, based on the maximum cutting height, minimum distance to carriageway presented in Table 16 and a 45° slope angle (steepest slope estimated based on LiDAR data).

The result for RC1 is presented in Inset 6 plotting on the line for travel distance of 0.001 and below. A $P_{(t)}$ of 0.001 was deemed appropriate given that values have been chosen considering a worst case scenario (maximum height, maximum slope angle and minimum distance).



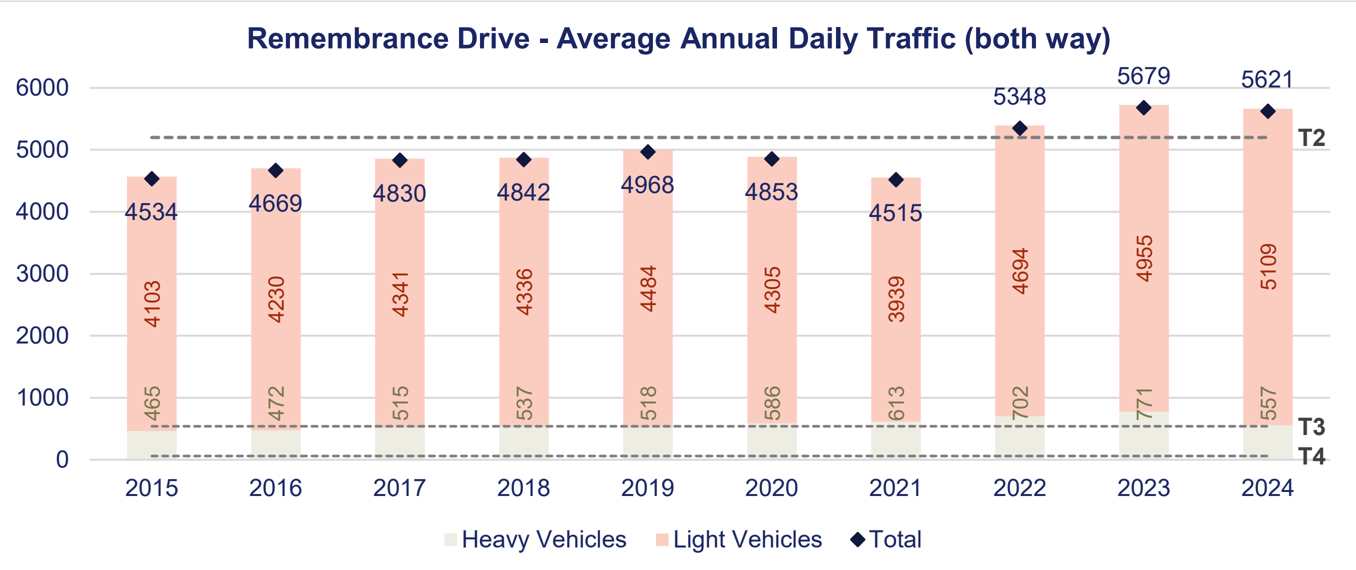
Inset 6: Figure 8 from TfNSW (2014) Estimating travel distance probability for small rock falls/slides

7.4.3.4 Temporal Spatial Probability, T, Based on Remembrance Drive Traffic

A traffic station (ID T0492) is present on the remembrance drive, around 4.8 km south of our southern road embankment (RE1). Traffic movement data available between April 2015 and June 2024, the results are presented in Inset 7.

The public data indicates an average annual daily traffic (two ways) of 5621 for 2024, with a 90% / 10% split between light vehicles and heavy vehicles.

Traffic has seen a 25% increase over the monitoring period with a fairly constant annual increase around 2.5% between 2015 and 2020, followed by a 7% decrease in 2021 then a sharp rebound in 2022 (+18%) followed by a more gradual increase similar to the initial annual increase. The split between light and heavy vehicles staid relatively constant with numbered varying between 87 to 91% light vehicles and 10 to 14% of heavy vehicles with a potential small increase in heavy vehicles in recent years (apart from 2024).



Inset 7: NSW Traffic Volume Viewer for Station T0492 from 2015 to 2024

The threshold for the allocation of temporal probability based on the traffic volume is shown in Inset 7. The current traffic volume results in a T2 temporal spatial probability. Given the difference between the T2 and T1 threshold this is unlikely to be reached within 50 years except if a significant change in nearby development, despite an increasing trend in road traffic movements.

The sight distance is above 100 m in all cases and thus suitable for the 80 km/h speed limit. Therefore, there is no need to adjust the temporal spatial probability.

In the case of debris directly impacting a moving vehicle (cutting RC1), this would reduce the temporal probability by one rating and be of a lesser magnitude compared to the risk of a vehicle impacting debris on the road. Given the cutting geometry, the wide distance between the toe of the cutting and the carriageway, it is unlikely that a significant amount of debris would exceed the height of the vehicle windows. As such no consideration was given for the direct impact by rockfall.

7.4.3.5 Vulnerability

For this application vulnerability is based on the consequence of the impact of a vehicle with an obstruction (block), a step or (at the extreme) a void. Tables18 and Table 20 from TfNSW (2014) are summarized in Table 18 below.

The block size was taken as the range of likely block sizes observed in RC1. DP (2024b) has considered the following regarding the embankment stability:

- Shallow soil slump leading to “irregular surface”
- Intermediate depth failure corresponding to “stepped surface”, and
- Deep seated failure resulting in “shallow void”.

We have adopted DP (2024b) vulnerability ratings in our assessment but have not undertaken a detailed review of their derivation.

Table 18 – Vulnerability based on TfNSW table and urban speed (60 to 80 km/h)

Vehicles Impacting Single Rock Block		Vehicle Interaction with Irregularity at 80 km/h	
Block Size (minimum dimension)	Vulnerability Rating, V	Void or Surface Type	Vulnerability Rating, V
> 1 m	V2	Deep, narrow void	V2
0.5 – 1 m	V3	Shallow void (0.2 – 0.5 m steps)	V3
0.2 – 0.5 m	V4	Stepped surface (0.1 – 0.2 m steps)	V4
~ 0.2 m	V5	Irregular surface (steps < 0.1 m)	V5 (1)
~ 0.1 m	V5 (1)		

(1) *For the purposes of risk analysis , a vulnerability rating of V5 is allocated. In some cases this may lead to an excessively conservative risk outcome* (TfNSW, 2014).

7.4.3.6 Assessed Risk Level

Compared to DP (2024b) previous assessment, we don’t see any way for shallow failure in RC1 to be able to reach the carriageway, as such, RC1 was removed from the list of shallow soil slumps.

Table 19 – TfNSW Risk Assessment Summary Table

<table>
<tr><th colspan="2" rowspan="2">Hazard</th><th rowspan="2">Location</th><th colspan="2">Likelihood Rating, L</th><th colspan="2">Consequence Rating, C</th><th rowspan="2">Assessed Risk Level</th></tr>
<tr><th>$P_{(d)}$</th><th>$P_{(t)}$</th><th>T</th><th>V</th></tr>
<tr><td rowspan="6">Slump</td><td rowspan="2">Shallow</td><td rowspan="2">RE2 – RE3</td><td>0.1</td><td>0.01</td><td>T2</td><td>V5</td><td rowspan="2">ARL5</td></tr>
<tr><td colspan="2">L4</td><td colspan="2">C4</td></tr>
<tr><td rowspan="4">Intermediate depth</td><td rowspan="2">RE2</td><td>0.01</td><td>0.1</td><td>T2</td><td>V4</td><td rowspan="2">ARL4</td></tr>
<tr><td colspan="2">L4</td><td colspan="2">C3</td></tr>
<tr><td rowspan="2">RE3</td><td>0.001</td><td>0.1</td><td>T2</td><td>V4</td><td rowspan="2">ARL5</td></tr>
<tr><td colspan="2">L5</td><td colspan="2">C3</td></tr>
</table>

Hazard		Location	Likelihood Rating, L		Consequence Rating, C		Assessed Risk Level
			$P_{(d)}$	$P_{(t)}$	T	V	
	Deep-seated	RE2	0.001	1.0	T2	V3	ARL3
			L4		C2		
		RE3	0.0001	1.0	T2	V3	ARL4
			L5		C2		
Detached Blocks	0.1 - 0.2 m	RC1	1.0	0.001	T2	V5	ARL5
			L4		C4		
	0.2 – 0.5 m		1.0	0.001	T2	V4	ARL4
			L4		C3		
	0.5 – 1.0 m		0.1	0.001	T2	V3	ARL4
			L5		C2		

7.4.3.7 Discussion

We have revised the likelihood rating for the embankment failure based on established relationship between FoS and annual probability of Failure. This did not lead to a significant change for Embankment RE3 however there was an assessed increase in risk for embankment RE2 to ARL3 due to the revised temporal probability. The other assessed risks ranged between ARL 4 and ARL 5. The increase in risk is largely due to the consideration of increased traffioc volume compared to DP (2024b).

ARL 4 and ARL 5 are generally considered as tolerable under most circumstances, while ARL 3 is considered as medium risk, is usually considered as tolerable for the short term but likely to require regular monitoring and may be acceptable in the long-term depending on cost benefit analysis, Lester et al. (2015).

It is important to note that the subsidence impact relative to LW S7A are minor with subsidence incremental impact less than 4% compared to the impact due to the LW S1A to LW S6A. The two road embankments and one cutting are to be directly undermined by cutting LW S4A and LW S5A.

As noted above, these elevated risks are primarily related in increased traffic numbers. PSM anticipate any elevated risk can be accommodated by a review of the Wollondilly Shire Council Management Plan.

7.5 Farm Dams

7.5.1 General

A total of 20 farm dams are located within the LW S7A study area, key details regarding their size and predicted subsidence are presented in Table 20.

It is to note that the incremental subsidence for most of the farm dams are:

- Typically, less than 25% of the total subsidence:
  - Five (5) between 3 and 8%
  - Ten (10) between 14 and 20%
  - Three (3) between 20 and 25%
  - Two (2) above 75%.
- The ones above 75% are:
  - FD44 located in between LW S6A and LW S7A
  - FD45 that is directly above LW S7A.

Table 20 – Farm Dams Details

Dam ID		Estimates of Key Metrics [1]			Subsidence Prediction by MSEC					
		Maximum Embankment Height	Surface Area	Dam Volume	Incremental due to LW S7A only		Total after LW S1A to S7A			Ratio LW S7A
DP	MSEC				Subsidence	Tilt	Subsidence	Tilt	Change in Freeboard	Subsidence
		[m]	[m^2]	[ML]	[mm]	[mm/m]	[mm]	[mm/m]	[mm]	[%]
FD20	BRE_090_d02	1.5	464	0.4	30	< 0.5	975	2.5	100	3%
FD23	BCA_110_d01	2.5	664	0.7	30	< 0.5	625	6.5	350	5%
FD27	BRE_167_d01	3.0	3130	**3.8**	175	1.5	1075	4.0	300	16%
FD28	BRE_167_d02	1.0	193	0.2	225	2.0	1300	4.0	200	17%
FD29	BRE_154_d01	1.5	2616	**3.8**	70	< 0.5	1375	6.5	200	5%
FD30	BRE_154_d02	3.0	1666	**2.0**	100	0.5	1325	7.0	500	8%
FD31	BYR_005_d02	2.0	1714	**1.7**	175	1.0	1050	3.5	200	17%
FD32	BYR_005_d01	1.5	612	0.5	250	1.0	1275	4.0	250	20%
FD33	BYR_015_d01	2.0	1556	**1.6**	250	1.0	1325	4.0	300	19%
FD34	BRE_143_d01	2.0	800	0.8	125	0.5	925	3.5	50	14%
FD35	BRE_148_d01	1.5	908	**1.0**	225	1.0	1200	3.5	250	19%
FD36	BRE_148_d02	1.0	347	0.2	225	1.0	1225	3.5	200	18%
FD37	BRE_090_d01	3.5	2091	**3.1**	150	0.5	975	4.5	100	15%
FD38	BRE_090_d03	2.0	1965	**2.0**	225	1.0	1200	3.5	300	19%
FD39	BCA_015_d01	2.0	506	0.5	60	< 0.5	1250	5.0	250	5%
FD40	BCA_010_d01	2.5	422	0.4	150	0.5	875	3.5	100	17%
FD41	BCA_001_d01	1.5	394	0.4	250	1.0	1175	5.5	300	21%
FD42	BRE_090_d04	2.0	489	0.5	300	1.0	1275	6.5	250	24%
FD44	BYR_065_d01	1.0	830	0.9	650	3.0	825	2.0	50	79%
FD45	BYR_095_d01	1.5	1136	**1.4**	950	8.0	1100	8.5	350	86%

(1) Estimates based on LiDAR and aerial imagery
(2) Colors highlight the Dam for which LW S7A will have additional subsidence, with Blue above 10%, yellow above 20% and red above 50%

7.5.2 DP (2024b) Assessment

DP (2024b) previously undertook the inspection of farm dams FD27, FD30 to FD33, FD35 to FD36, FD39 to FD41 and FD44 to FD45. This covered 11 out of 19 known to lie within the LW S7A Study Area with access not available for the remaining 8 at the time of their inspections.

DP (2024b) undertook a preliminary consequence screening for farm dams that were estimated to be larger than 1 ML. Based on ANCOLD (2012) they obtained consequence category for these structures ranging from Very Low to Significant. DP (2024b) noted that structures located downstream of FD29 was at risk of inundation in case of dam break. And that the remembrance drive was downstream of 2 different series of dams.

DP (2024b) also noted the potential for cascading failure for some of the dams. However, they mentioned that based on the low storage capacity of the dam and that the dam break is likely to be incremental and not a sudden release, the potential for loss of life is unlikely, however some risk to property and/or services could be expected.

Additionally, DP (2023) carried out preliminary stability and dam break assessments for FD29 to FD31, FD35, FD37 and FD38. It is important to note that DP (2023) assessment led to an increase of the Consequence Category to High B and High A for some dams under dam break during floods.

The approach taken by DP (2023) appears to determine Consequence Category based on the total flood impact rather than the incremental flood impact as per as per ANCOLD (2012) guidelines. For this reason, PSM expect that the Consequence Category assessment for dams FD29 to FD31, FD35, FD37 and FD38 by DP (2023) has likely been overestimated. This view is supported by the original dam break report undertaken by Orion (Appendix B of DP 2023) which notes that:

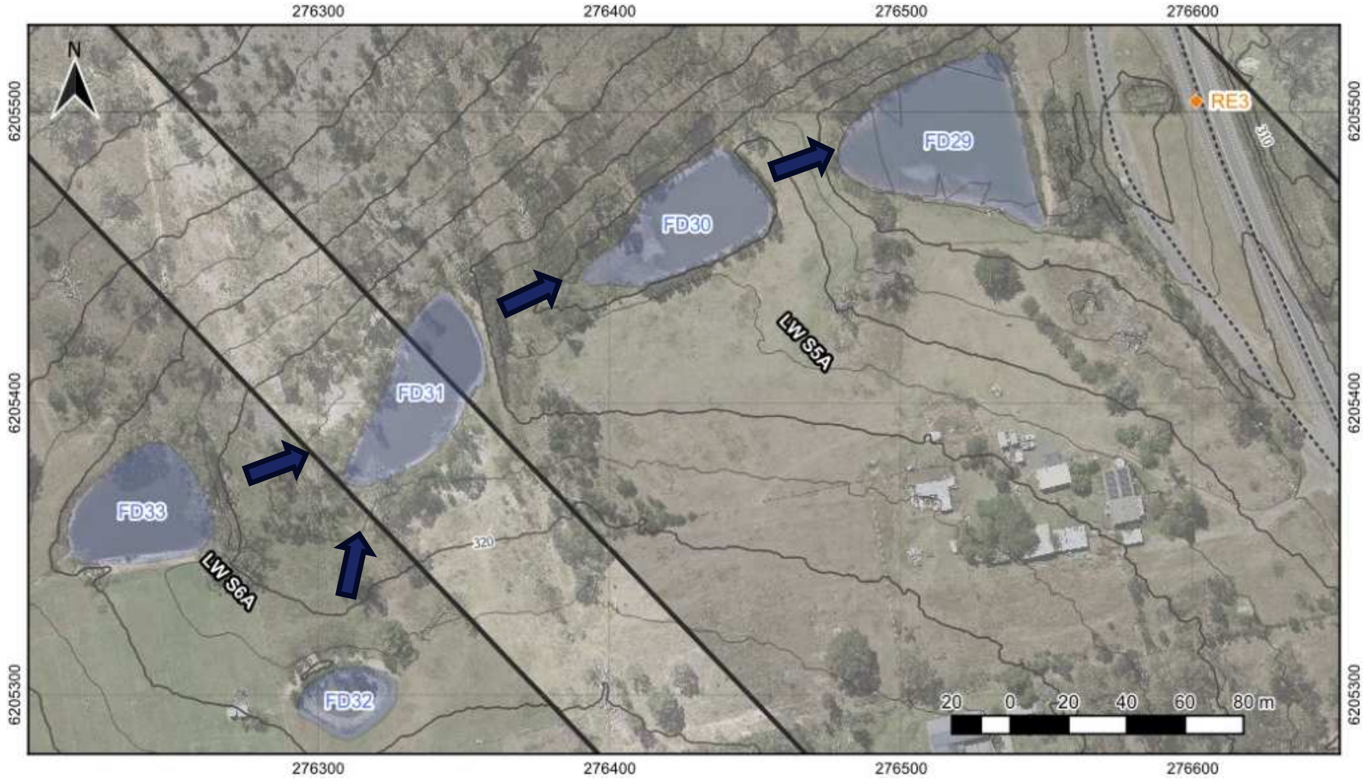
- *"Flooding Impacts of the dam system in a Sunny Day Dam Break event does not encroach on residential structures. These flooding events will flow through existing large rural and rural residential lots though the existing flow paths.*
- *The impacts of the dam break during the 1% AEP event does increase the flood levels within stream directly downstream of the Dams. However, due to the distance of the Dams from the residential areas, the impact of the dam break is limited. From Table 12 in Section 4.6, the flooding impact is less than 40mm at the downstream flow constrictions at Remembrance Drive North and Remembrance Drive South.*
- *The impacts of the dam break during the PMF event does increase the flood levels within stream directly downstream of the Dams. However, due to the distance of the Dams from the residential areas, the impact of the dam break is limited. From Table 12 in Section 4.6, the flooding impact is less than 20mm at the downstream flow constrictions at Remembrance Drive North and Remembrance Drive South."*

7.5.3 PSM Assessment

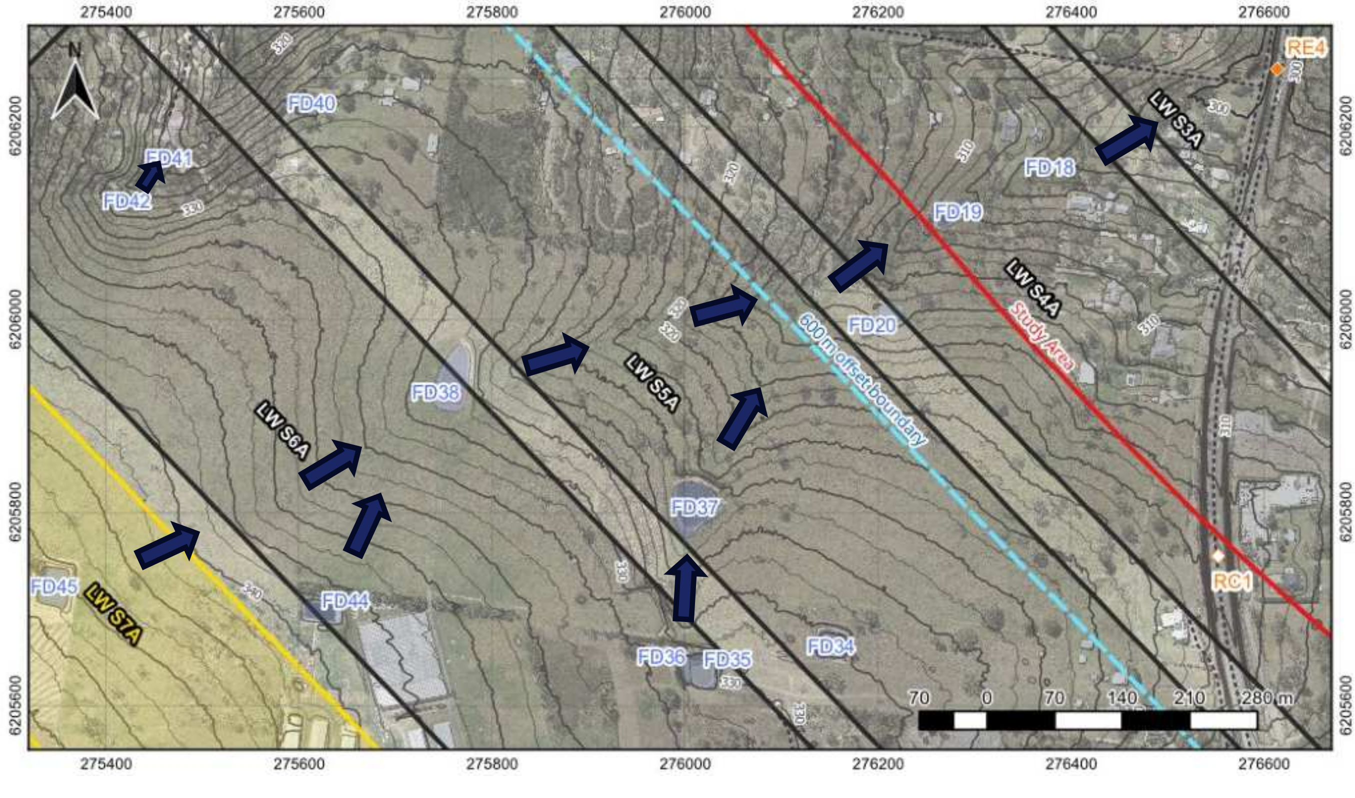
As discussed above, we expected the flood consequence category to not divert significantly the natural flood risk. All the dams from the dam break study are expected to be classified as "Very Low" as per DP (2022) Consequence Category for the Sunny Day dam break.

Most of the farm dams have been placed along valleys and are thus susceptible to cascading failure, as shown in the following insets. It should also be noted that FD42 and FD28 are directly upstream of FD41 and FD27 respectively. FD28 is a very small dam and is likely to have limited if any impact on the stability of FD27, however FD42 is likely to be larger than FD41 and has a higher change of leading to its failure in case of dam break.

The DP (2024b) does not appear to consider the implications of cascading failure for dams FD32-FD33, FD44-FD45 and FD42. Consequently, we propose have the Consequence Category of dams located upstream of other dams to be matched to the Consequence Category of lower dams were necessary to reflect the consequences of a cascading failure. Based on the DP (2024b) dam break assessment for a sunny day failure all dams would be subject to a "Very Low" consequence category including the effects of cascading failure.



Inset 8: **Potential risk for cascading failure between FD29 to FD33.**



Inset 9: **Potential risk for cascading failure between FD18 to FD20, FD34 to FD38 with FD44 to FD45 and RE4; between FD41 and FD42.**

Table 21 – Assessment of Farm Dams Consequence Categories for Dam Storage Larger than 1ML

Dam ID	Volume [ML]	Downstream Topography	Population at Risk	Severity of Damage and Loss	Consequence Category
FD27	3.8	Hilly	< 1	Minor	Very Low
FD29	3.8	Hilly	< 1	Minor	Very Low
FD30	2.0	Hilly	< 1	Minor	Very Low
FD31	1.7	Hilly	< 1	Minor	Very Low
FD33	1.6	Hilly	< 1	Minor	Very Low
FD35	1.0	Hilly	< 1	Minor	Very Low
FD37	3.1	Hilly	< 1	Minor	Very Low
FD38	2.0	Hilly	< 1	Minor	Very Low
FD45	1.4	Gentle	< 1	Minor	Very Low

We understand from the DP (2024b) inspections that the dams range from compacted clayey material to sandy soil and crushed sandstone. Clayey dams would be more able to deal with potential cracks versus the dam made of granular material. The monitoring of those structures should be more thorough.

We agree with the recommendations and monitoring program developed by DP (2024b) to be appropriate for the consequence category of the assets, notably:

- The farm dams may require periodic surveillance with regards to water level and visual inspection for crack development
- Remediation may be required to restore any affected dam
- It may also be necessary to reduce the volume of stored water in some dams during the mine subsidence period
- The farm dams that were not previously inspected should be inspected by a geotechnical engineer when access is given, preferably prior to mining, to confirm the assumptions in the current assessment or to allow for re-assessment where conditions vary from those anticipated.

8. Monitoring Program

The present monitoring program only addresses the monitoring requirements for the features that have been presented in the current report.

To facilitate for the proper detection of signs of distress and related actions as defined in the TARPs, the following is required:

- Establish baseline with photograph records, dilapidation surveys and install monitoring equipment within the study area prior to start of excavation
- Regular task to be undertaken prior, during and after longwall extraction, including:
  - Monitoring and assessment of key subsidence and review of the performance vs the prediction, this should be undertaken prior, during and after longwall extraction
  - Inspections and potential sub surface investigation (as required).

Table 22 presents the recommended monitoring plan in relation to the features presented in this report. It is important to note that the present monitoring will need to be integrated with the current plan developed for LW S1A to S6A. The LW S1A to S6A plan will require some extension of the monitoring duration of the features within the Study Area for LW S1A to S6A (e.g. the farm dams, BC1), until the completion of LW S7A and a full set of monitoring for features that were outside of the LW S1A to S6A Study Area (e.g. Cliff Lines BC3 to BC21 and rock shelters RS1 to RS7).

Inspection of farm dams is limited to areas where access has been granted by the landowner. Similarly, some cliffs or rock shelters located near the creek may have limited access at certain times due to high water levels, dense vegetation, or other hazards. We recommend the use of drones to supplement ground-based inspections and provide access in areas where access is limited.

We recommend that performance monitoring for mine subsidence impacts within the nominated study areas should comprise the following:

- Baseline for the cliff lines and rock shelters would benefit from undertaking a 3D photogrammetric survey prior to the longwalls excavation.
- Visual inspections and field measurements in cliff lines, rock shelters and farm dam embankments including of cracking, bulging, buckling, displacement or dislodgement of boulders or slabs, rockfalls and slope instability potentially related to mine subsidence (e.g. not including natural cracking related to soil shrinkage and swell). The results of visual inspections and measurements will be compared to nearby survey results to assess the potential contribution from mining subsidence and the magnitude of the contribution, where possible.
- Farm dam water levels and seepage through farm dam embankments will be monitored to assess changes from their 'normal operating range' and the potential impacts of mine subsidence. Farm dam water level monitoring will include photo records of dam's levels. Additionally, we recommend the installation of staff gauges for easy water level measurement. Visual inspections of farm dam embankments will be carried out by a geotechnical engineer to assess the potential for seepage through embankments. The results of visual inspections and measurements will be compared to nearby survey results to assess the potential contribution from mining subsidence and the magnitudes of the contribution, where possible.

Table 22 – Recommended Monitoring Plan

Features Type	Features	Monitoring		
		Prior to Mining	During Mining	Prost Mining
Cliff Lines	BC1, BC3 to BC21	Visual Inspection baseline and 3D photogrammetric survey of the cliffs prior to the commencement of mining by a geotechnical engineer.	None required (cliff lines are located near the edge of the natural study area and have only low risk level)	Visual inspection at the completion of longwall panels by a geotechnical engineer
Natural Steep Slopes	RS1 to RS7	Visual Inspection baseline and 3D photogrammetric survey of the cliffs one month prior to the active subsidence period by a geotechnical engineer.	Monthly visual inspection during the active subsidence period by a geotechnical engineer, subject to land access.	Quarterly visual inspection for 12 months following the active subsidence period by a geotechnical engineer, or as required in accordance with a Rehabilitation Management Plan
Farm Dams	FD20, FD23, FD27 to FD42, FD44 and FD45	Dam embankment integrity and water level observation by a geotechnical engineer one month prior to the active subsidence period using fixed location photo points.	Dam embankment integrity and water level observation every month during the active subsidence period by a geotechnical engineer using fixed location photo points.	Dam embankment integrity and water level observation using fixed location photo points on a quarterly basis for 12 months following the completion of active subsidence, by a geotechnical engineer, or as required in accordance with a Rehabilitation Management Plan

9. TARPs

A Trigger Action Response Plan (TARP) has been developed for the extraction of LW S1A to LW S6A. We understand that this plan was developed in collaboration with the mine, various consultant and the mine regulators.

The actions developed within the TARP are to address any potential significant subsidence related impacts related to the elements presented in this report. Overall, the existing TARP was reviewed and only details concerning the monitoring program were updated. Table 23, Table 24 and Table 25 presents the revised TARPs for cliffs, rock shelters and farm dams.

The monitoring program that was used for the revision of the TARPs is presented in Section 7.5.2.

It is understood road embankments and road cuttings identified in Figure 3 of the Land Management Plan are to be managed in accordance with the Wollondilly Shire Council Management Plan and as such do not need to be included in the TARP presented here.

Table 23 – TARPs for Cliffs

Performance Measure and Indicator, TARP objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature • Any cliff within Subsidence Area[1] beyond the extent of longwalls[2]. **Performance Measure** • Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within Subsidence Area). **Performance Indicator** • This performance measure will be considered to be triggered if more than 0.5% of the total face area of the cliffs within the 600 m Environmental Features Study Area is impacted by mining (e.g. by occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing). **TARP Objective** • This TARP defines measures to manage potential impacts on cliff lines and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** • Extent of surface cracking, rockfalls, displacement or dislodgement of boulders or slabs observed.	**Locations** • Cliffs (BC1 to BC20) within the 600 m Environmental Features Study Area as illustrated in Figure 3 of the Land Management Plan. **Monitoring Frequency** **Prior to the commencement of each panel** • Visual inspection baseline by a geotechnical engineer, subject to land access • Timing: ○ Cliff BC1 prior to LW S6A and LW S7A, ○ Cliff BC2 prior to LW S3A S4A, S5A and S6A, ○ Cliff BC3 to BC20 prior to LW S7A. **During mining of each panel** • No additional inspections required **At the completion of each panel** • Visual inspection by a geotechnical engineer, subject to land access • Timing: ○ Cliff BC1 prior to LW S6A and LW S7A, ○ Cliff BC2 prior to LW S3A S4A, S5A and S6A, ○ Cliff BC3 to BC20 prior to LW S7A. **Note: inspections can be combined depending in the timing between completion of panels and commencement of new panels**	**Normal Range of Condition**		
		• Surface cracking < 10 mm wide above the cliff line, on the cliff face, or in the underside of overhangs. AND / OR • No rockfalls, displacement or dislodgement of boulders or slabs observed.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Surface cracking > 10 mm wide above the cliff line, on the cliff face, or in the underside of overhangs. AND / OR • No rockfalls, displacement or dislodgement of boulders or slabs observed.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialises (e.g. subsidence monitoring results). If it is concluded that the cliff has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options to support the cliff line, where relevant (e.g. repairing cracks, installation of support (e.g. rockbolts)). • Erect hazard/warning signs and restrict access to areas where necessary. • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential cliff instability and monitoring results relevant to the cliff locations.	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Subsidence Impact Report and Annual Review. • Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. repairing cracks, installation of support). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Subsidence Impact Report and Annual Review.
		Level 2		
		• Rockfalls, collapse of overhang, displacement or dislodgement of boulders or slabs observed.	• *Actions as stated in Level 1.* • Determine the percentage area of impacted area relative to the total face area. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, or the effect is unrelated to mining such as environmental effects, tree root jacking). If it is concluded that cliff line has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential cliff instability and monitoring results relevant to the cliff locations. • Notify and consult with affected landowner(s). • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Land Management Plan and modify if necessary. • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 1.* If it is concluded that cliffs have been damaged by subsidence impacts: • Offer site visit with DPHI and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPHI and key stakeholders if relevant. • Notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure (if relevant) within two business days. • Provide findings of CMA review to DPHI and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPHI and key stakeholders of any required amendments to Land Management Plan.
		Exceeds Performance Measure		
		• More than 0.5% of the total face area of the cliffs within the 600 m Environmental Features Study Area is impacted due to mining (e.g. by occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing).	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan for future longwalls located near cliffs.	• *Responses as stated in Level 2.* • Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPHI) describing remediation options and any preferred remediation measures or other course of action. • Implement reasonable remediation measures as directed by DPHI, subject to land access. • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project).

(1) Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
(2) It is noted that there are no cliff lines located directly above Longwalls S1A-S7A. Therefore, the performance measure for 'Any cliff located directly above longwalls' is not relevant.

Table 24 – TARPs for Rock Shelters

Performance Measure and Indicator, TARP objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Performance Measure Feature • All land within the Subsidence Area[1],[2]. **Performance Measure** • No greater subsidence impact or environmental consequences than predicted in the EIS[3]. **Performance Indicator** • This performance measure will be considered to be triggered if mining results in mine subsidence-induced slope instability, which would be a greater subsidence impact or consequence than predicted in the EIS. **TARP Objective** • This TARP defines measures to manage potential impacts natural sleep slopes [4],[5] and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** • Extent of surface cracking and stepping, ground bulging, buckling and shearing for steep slopes[6].	**Locations** • Natural steep slopes (RS1 to RS7, WC1 to WC3) • Locations of natural steep slopes shown in Figure 3 of the Land Management Plan. **Monitoring Frequency** **Prior to the commencement of each panel** • Visual inspection baseline one month before active subsidence period by a geotechnical engineer, subject to land access. **During mining of each panel** • Monthly visual inspection during active subsidence period by a geotechnical engineer, subject to land access. **At the completion of each panel** • Quarterly visual inspection for 12 months following active subsidence period by a geotechnical engineer, or as required in accordance with a Rehabilitation Management Plan, subject to land access. **Note: inspections can be combined depending in the timing between completion of panels and commencement of new panels**	**Normal Range of Condition**		
		• Discontinuous surface cracking < 10 mm wide on steep slope (e.g. other than natural desiccation cracking). AND / OR • No localised ground bulging, buckling or shearing.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Persistent[6] surface cracking 10 - 20 mm, or stepping (including shearing) across a crack 10 – 20 mm high on steep slope. AND / OR • Localised ground bulging or buckling (between 100 – 200 mm) is observed on steep slope.	• *Actions as required for Normal Condition.* • Geotechnical consultant inspection to assess cause and determine need for further action/investigation. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results). If it is concluded that the cliff has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. backfilling or grout filling of surface cracking, re-profiling of compression humps). • Erect warning signs and restrict access to areas where necessary. • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential slope instability and monitoring results relevant to the steep slope locations. • Consider additional specific monitoring at the impact site and implement if feasible and effective.	• Report trigger exceedance to DPHI and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Subsidence Impact Report and Annual Review. • Provide DPHI and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. backfilling or grout filling of surface cracking, re-profiling of compression humps, re-direct drainage) • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Subsidence Impact Report and Annual Review.
		Level 2		
		• Persistent[6] surface cracking > 20 mm wide or stepping > 20 mm high on slope. AND / OR • Localised ground bulging or buckling > 200 mm is observed on steep slope. AND / OR • Slope instability < 300 m^3 is observed or assessed as likely by a geotechnical engineer based on the extent of surface cracking or deformation.	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced cracking, or the effect is unrelated to mining such as wet weather or other environmental effects). If it is concluded that cliff line has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential slope instability and monitoring results relevant to the steep slope locations. • Assess potential for slope instability (and if an exceedance of the performance measure is possible). • Consider actions to avoid or reduce the likelihood and/or consequence of slope instability and implement if feasible and effective. • Notify and consult with affected landowner(s). • Review CMAs with regards to the findings from further investigations and consider additional remediation options. • Review Land Management Plan and modify if necessary.	• *Responses as stated in Level 1.* If it is concluded that cliffs have been damaged by subsidence impacts: • Offer site visit with DPHI and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPHI and key stakeholders if relevant. • Notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure (if relevant) within two business days. • Provide findings of CMA review to DPHI and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPHI and key stakeholders of any required amendments to Land Management Plan.
		Exceeds Performance Measure		
		• Subsidence-induced impacts or environmental consequences that result in slope instability > 300 m^3.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 2.* • Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed with DPHI) describing temporary protection measures and long-term remediation options and any preferred remediation measures or other course of action. • Implement reasonable remediation measures as directed by DPHI, subject to land access. • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days.

Performance Measure and Indicator, TARP objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
				• Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project).

(1) Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
(2) Steep slopes are defined as greater than 18.4o. There are three steep slopes identified within the 600 m Environmental Features Study Area that are also located within the Subsidence Area1. As no other steep slopes have been identified within the 600 m Environmental Features Study Area, the performance measure for 'all land outside the subsidence area' is not relevant.
(3) EIS predictions are summarised in the Subsidence Predictions and Impact Assessment Report by MSEC (2022), and the relevant predictions for steep slopes is provided in Section 4.2 of the Land Management Plan.
(4) All road embankments and road cutting identified in Figure 3 of the Land Management Plan will be managed in accordance with the Wollondilly Shire Council Management Plan. All railway embankments within the Study Area will be managed in accordance with the Main Southern Railway Management Plan. All steep slopes on the Tahmoor Mine Site will be managed in accordance with the Tahmoor Mine Site Management Plan.
(5) TARPs for the management of constructed steep slopes will be provided as part of the Wollondilly Shire Council Management Plan (road embankments and cuttings), Main Southern Railway Management Plan (rail embankments) and the Tahmoor Mine Site Management Plan (mine site slopes). These yet to be prepared TARPs will be included in Appendix B Master TARP following preparation and approval by the infrastructure owner.
(6) For the purpose of this TARP, persistent cracking is a tension crack/s that combine to form a potential backscarp or failure plane for slope instability. The length is proportional to the size of the failure surface.

Table 25 – TARPs for Farm Dams

Performance Measure and Indicator, TARP objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Performance Measure Feature • Other privately-owned built features and improvements, including… farm dams. **Performance Measure** • Always safe. • Serviceability should be maintained wherever practicable. • Loss of serviceability must be fully compensated. • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant.. **Performance Indicator** • This performance measure will be considered to be triggered if mining results in damage to a farm dam such that the dam is not safe and serviceable and/or any damages cannot be fully repairable and/or compensated. **TARP Objective** • This TARP defines measures to manage potential impacts on farm dams and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** • Dam embankment integrity, water level and seepage observations.	**Locations** • Identified farm dams within the Study Area. Location shown in Figure 8 of the Land Management Plan **Monitoring Frequency** **Prior to the commencement of each panel** • Dam embankment integrity and water level observation by a geotechnical consultant one month before active subsidence period using fixed location photo points. **During mining of each panel** • Dam embankment integrity and water level observation every month during the active subsidence period by a geotechnical consultant, using fixed location photo points, subject to land access. **At the completion of each panel** • Dam embankment integrity and water level observation using fixed location photo points, on a quarterly basis for 12 months following completion of active subsidence by a geotechnical consultant, or as required in accordance with a Rehabilitation Management Plan	**Normal Range of Condition**		
		• No cracks develop within dam embankment (e.g. other than natural desiccation cracking).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Development of isolated cracks (> 10 mm wide) within the dam wall (e.g. other than natural desiccation cracking). AND / OR • Development of isolated seepage without suspended solids (e.g. clear water) from the face or toe of the farm dam embankment.	• *Actions as required for Normal Condition.* • Geotechnical consultant inspection to assess cause and determine need for further action/investigation. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results).If it is concluded that the cliff has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. backfilling surface cracking, reinstatement). • Notify and consult with affected landowner. • Erect warning signs and restrict access to areas where necessary and permitted by the landowner.	• Report trigger exceedance to DPHI, SA NSW and key stakeholders. • Report trigger exceedance and investigation outcomes in Annual Subsidence Impact Report and Annual Review. • Provide DPHI, SA NSW and landowner with proposed corrective management actions (CMAs) for consultation (e.g. backfilling surface cracking, reinstatement). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Annual Subsidence Impact Report and Annual Review.
		Level 2		
		• Development of persistent longitudinal or arcuate cracking within dam wall > 20 mm. AND • Development of seepage with suspended solids (e.g. turbid water) from the face or toe of the farm dam embankment.	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequence of potential dam break, and monitoring results relevant to the dam locations. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Land Management Plan and modify if necessary. • Geotechnical Consultant to advise on the need for a reduction in the dam water level (e.g. half dam volume) to reduce the risk of a dam break failure.	• *Responses as stated in Level 1.* • Advise DPHI, SA NSW and key stakeholders of any required amendments to Land Management Plan. • Provide findings of CMA review to DPHI, SA NSW and landowner for consultation. • Implement additional CMAs, subject to land access.
		Level 3		
		• Development of persistent longitudinal or arcuate cracking within dam wall > 20 mm. AND • Subsidence monitoring identifies subsidence-induced impacts or environmental consequences that result in any slope instability to the farm dam embankment.	• *Actions as stated in Level 2.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, or the effect is unrelated to mining such as environmental effects). If it is concluded that cliff line has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 3 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequence of potential dam break, and monitoring results relevant to the dam locations.	• *Responses as stated in Level 2.* If it is concluded that cliffs have been damaged by subsidence impacts: • Offer site visit with DPHI and key stakeholders. • Repair or replace farm dam in consultation with DPHI and SA NSW and landowner. • Provide alternate water supply for landowner, if required. • Notify Commonwealth DCCEEW of any predictions of an exceedance of a performance measure (if relevant) within two business days.

Performance Measure and Indicator, TARP objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
			• Reduction of dam water level in accordance with advice from Geotechnical Consultant. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Assess potential for the safety and serviceability of the dam to be lost (and if an exceedance of the performance measure is possible).	
		Exceeds Performance Measure		
		• Mining results in damage to a farm dam such that the dam is not safe and serviceable and/or any damages cannot be fully repairable and/or compensated.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPHI (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed with DPHI) describing temporary protection measures and long-term remediation options and any preferred remediation measures or other course of action. • Implement reasonable remediation measures as directed by DPHI, subject to land access. • Notify Commonwealth DCCEEW of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to Commonwealth DCCEEW (in accordance with Condition 11 of the DAWE (now Commonwealth DCCEEW) Consent for the Tahmoor South Project).

10. Conclusions

A high-level geotechnical assessment has been conducted on the land features within the study areas of proposed longwall LW S7A to supplement the existing geotechnical assessment of proposed longwalls LW S1A to LW S6A prepared by Douglas Partners (DP 2024a). This report should be read in conjunction with DP (2024a).

This geotechnical assessment relies upon on subsidence prediction by MSEC and the inspections, assessments and findings provided in DP (2024a). The assessment was supported by site inspections for the new feature. The report also includes a review and update of the monitoring program and TARPs.

The cliff lines and the rock shelters are at the edge of the study areas well away from proposed mining and consequently not expected to experience any significant impact due to proposed mining. Our risk assessment for the cliff is indicating a Very Low risk for all cliff line. Similarly, our risk assessment for the rock shelter generally indicates a Very Low risk.

The steep slopes relating to road embankments and cuttings saw a slight increase regarding the slope instability scenarios. This is due to expected increase in traffic volume over time and not related to an increased risk due to mine related impacts. The proposed LW S7A does not undermine any of these features and therefor the incremental impact by this longwall is expected to be negligible.

The consequence categories of the farm dams assessed by DP (2024a) was reviewed by PSM in accordance with the requirements of Dam Safety NSW (2022). With the exception of dams FD 44 and FD45, most farm dams are not directly undermined by the proposed footprint of LW S7A and therefore expected to experience only limited additional impacts from mine subsidence. Consequently, the incremental effects of LW S7A extraction are unlikely to be significant enough to result in an increased risk of failure.

FD45 is to be directly undermined by the extraction of LW S7A while FD44 is located between LW S6A and LW S7A. These two dams have the potential to trigger cascading failures involving other farm dams located directly downstream. However, based on a previous dam break study of the downstream dams, their consequence category has been assessed as Very Low. It is recommended that a detailed inspection be carried out to confirm the current condition of the dams and ensure there are no signs of distress that could lead to failure with only minor changes in conditions.

It is recommended that a monitoring program be undertaken to facilitate the early detection of signs of distress and the implementation of remedial works (if any). A monitoring program has been provided as part of the updated TARP in the report. In the event that monitoring indicates that the measured parameters are exceeding predicted values, the TARP escalates the monitoring requirements and the need for remedial or precautionary measures to be implemented. It is considered that with periodic inspections, visual observations and timely actions, it will be possible to manage the identified risks and to keep them with tolerable levels.

Yours Sincerely

JOSSELIN RIBOT
SENIOR GEOTECHNICAL ENGINEER

GARETH SWARBRICK
PRINCIPAL GEOTECHNICAL ENGINEER

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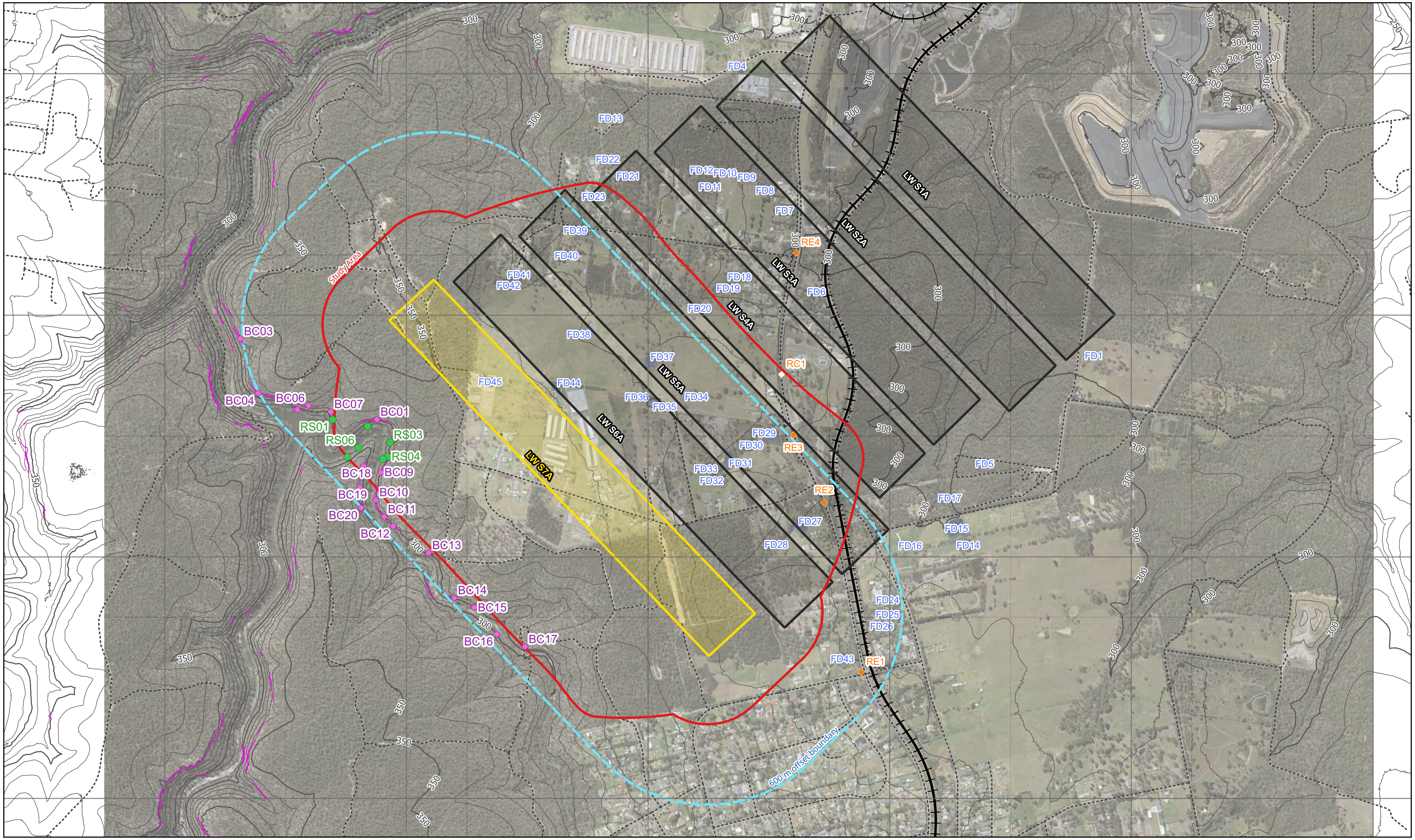

Legend

Long walls - A Series
- Long Walls S1A to S6A
- Long Wall S7A
- Study Area LW S7A
- 600m Offset Boundary LW S7A

Topo

Contours 2022-07
- 10 m Contours
- 50 m Contours

Infrastructures
- Road
- Railway

Features
- Cliff
- Rock Shelter

Assets
- Farm_dams_PSM interp

Road Cuts and Embankments
- Road Cut
- Road Embankment

Scale 1:15,000

N

200 0 200 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

PSM

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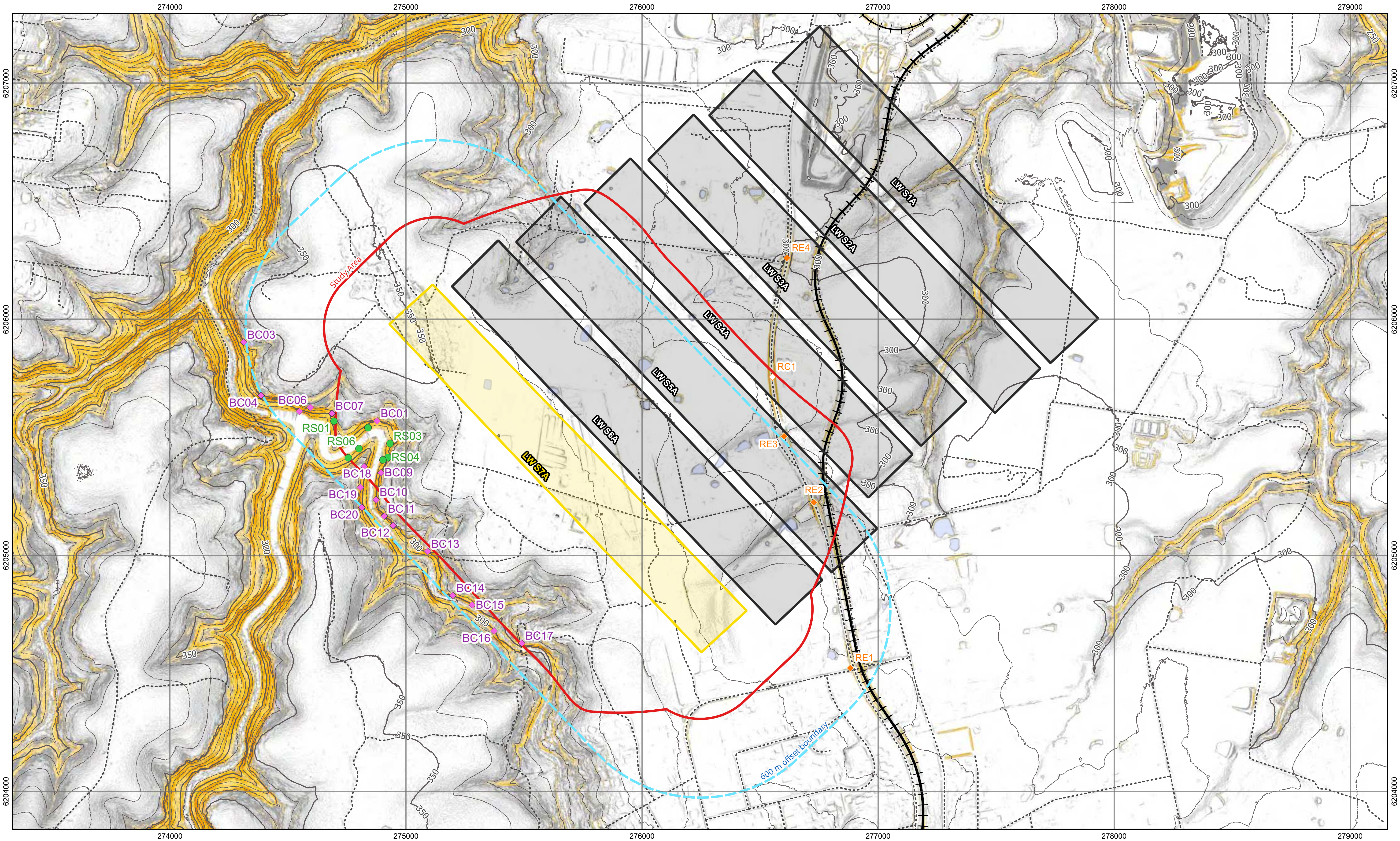
SIMEC Mining
Tahmoor Coking Coal
Bargo, NSW

LONGWALL S7A
GEOTECHNICAL ASSESSMENT
FEATURE LOCATIONS

PSM5522-12R | Figure 1

C:\Users\Joselin Ribot\Pells Sullivan Meynink\GIS - ArcGIS\PSM5522_TahmoorCoal\02_WorkSpace\01_Projects\PSM5522-TahmoorCoal_Geotech Assessment.qgz Layout: PSM5522-013R Figure 1 - Assets



Legend

Long walls - A Series
- Long Walls S1A to S6A
- Long Wall S7A
- Study Area LW S7A
- 600m Offset Boundary

Slopes
- 0 - 5°
- 5 - 10°
- 10 - 18°
- 18 - 25°
- 25 - 32°
- 32 - 45°
- > 45°

Features
- Cliff
- Rock Shelter
- Farm dams

Road Cuts and Embankments
- Road Cut
- Road Embankment

Infrastructures
- Road
- Railway

Scale 1:15,000

N 200 0 200 400 600 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

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LONGWALL S7A
GEOTECHNICAL ASSESSMENT
STEEP SLOPES

PSM5522-12R

Figure 2

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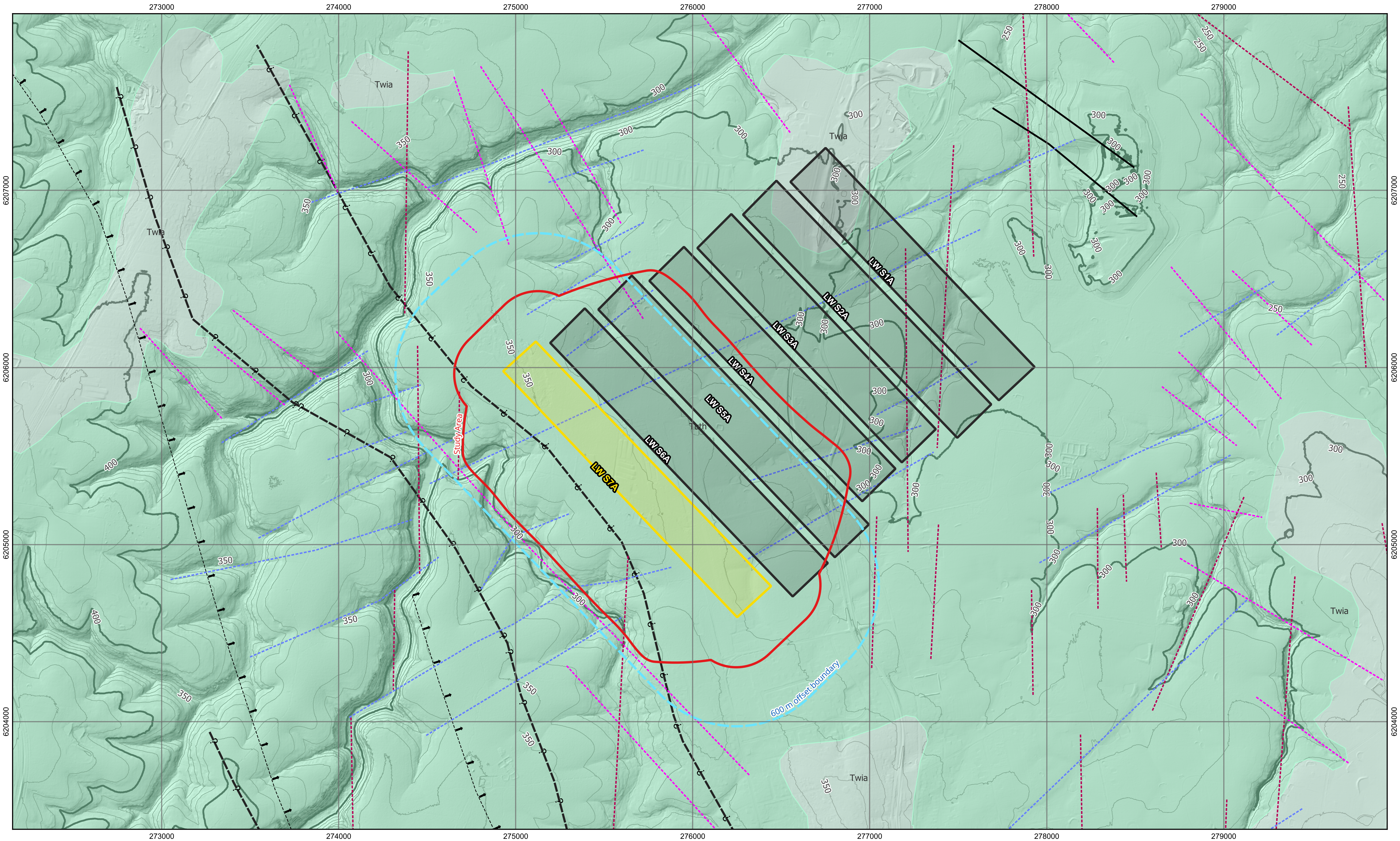

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Legend

Long walls - A Series
- Long Walls S1A to S6A
- Long Wall S7A
- Study Area
- 600m Offset Boundary LW S7A

Topographic Contours
- 10 m Contours
- 100 m Contours

Geology Features

NSW Regional Geology - Rock Unit
- Hawkesbury Sandstone
- Ashfield Shale

- Revised Faults, position approximate

NSW Regional Geology - Structures
- Fault, position accurate
- Monocline, position approximate

PSM Lineament Assessment
- NS Trend
- NW-SE Trend
- SW-NE Trend

Scale 1:20,000

N 250 0 250 500 750 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

PSM

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LONGWALL S7A
GEOTECHNICAL ASSESSMENT
GEOLOGY

PSM5522-12R Figure 3

Appendix A
Cliff Lines Assessment Details