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SUBSIDENCE MONITORING PLAN – TAHMOOR SOUTH DOMAIN – LONGWALLS SOUTH 1A – SOUTH 7A

Tahmoor Coal Pty Ltd

Document Control

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Drawing No.	*Description*	*Revision*
MSEC1193-01-01	Subsidence Monitoring Plan	D
MSEC1193-02-01	Surface Water Monitoring Plan	01
MSEC1193-02-02	Groundwater Monitoring Plan	01
MSEC1193-02-03	Biodiversity Monitoring Plan	01
MSEC1193-11-02	Wollondilly Anglican College Monitoring Plan	A
MSEC1074-07	Australian Wildlife Sanctuary Monitoring Plan	02
MSEC1201-03	Main Southern Railway Monitoring Plan	C
MSEC1201-05	Culvert & Embankment 98.445 km Monitoring Plan	B
MSEC1201-06	Culvert & Embankment 98.739 km Monitoring Plan	B
MSEC1201-07	Culvert & Embankment 99.035 km Monitoring Plan	B
MSEC1201-08	Culvert & Embankment 99.388 km Monitoring Plan	B
MSEC1201-09	Cutting 99.690 km Monitoring Plan	B
MSEC1210-10	Culvert & Embankment 100.121 km Monitoring Plan	B
MSEC1210-11	Culvert & Embankment 100.425 km Monitoring Plan	B
MSEC1210-12	Embankment 101.00 km & Cutting 101.162 km at Wellers Road Overbridge Monitoring Plan	B
MSEC1247-01	Tahmoor Mine Monitoring Plan	02

1 Introduction

1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing underground coal mine located approximately 80 kilometres (km) south-west of Sydney in the Southern Coalfields of New South Wales (NSW). Tahmoor Mine surface facilities are situated between the towns of Tahmoor and Bargo within the Wollondilly Local Government Area (LGA). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

The location of Tahmoor Mine in the regional context is shown in **Figure 1.**

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to gain approval for the Tahmoor South Coal Project, which involves use of the existing surface infrastructure and the expansion of underground longwall mining to the south of the existing workings (referred to as the Tahmoor South Domain). Tahmoor Coal subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020). In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) for the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 35 Mt of ROM coal proposed to be extracted over a 10-year period.

The Tahmoor South Domain is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Thirteen longwalls are proposed in this domain which are divided into a series of seven northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 7A (LW S1A-S7A), are the focus of the current Extraction Plan.

1.2 Updates to the Subsidence Monitoring Plan

This Subsidence Monitoring Plan was first developed prior to the commencement of LW S1A and completion of detailed Subsidence Management Plans. Additional monitoring measures were developed in consultation with infrastructure and property owners during the development of the detailed Subsidence Management Plans and Revision 7 of this Subsidence Monitoring Plan has been updated to include them.

Tahmoor Coal has shortened LW S3A by approximately 104 metres at the commencing end following approval by DPHI on 27 March 2024. The extraction of LW S3A was completed on 17 December 2024. LWS4A is shortened by 104m as approved by DPHI on 11 November 2024. The extraction of Longwall S4A is scheduled to commence in January 2026. The effect of the change is to very slightly reduce the amount and extent of subsidence that will be experienced along the Tributary to Teatree Hollow, Remembrance Drive, Charlies Point Road and the Main Southern Railway. The planned change in the commencing length of extraction also effectively brought forward the planned timing of surveys and inspections.

Tahmoor Coal was granted approval (Modification 3) to include an additional longwall panel, Longwall South 7A (LW S7A) on 26 May 2025. Detailed Subsidence Management Plans were updated to reflect the inclusion of LW S7A and this Subsidence Monitoring Plan has been updated accordingly.

The location of LW S1A-S7A and associated Study Area are illustrated in **Figure 2.**

1.3 Purpose

This Subsidence Monitoring Plan (SMP) has been prepared to support an Extraction Plan for the secondary extraction of coal from LW S1A-S7A. The SMP is required to be included with the Extraction Plan in accordance with Development Consent (SDD 8445) (the Consent) Condition C8.

The purpose of this management plan is to:

- Describe the ongoing conventional and non-conventional subsidence monitoring program;
- Provide data to assist with the management of risks associated with conventional and non-conventional subsidence;
- Validate the conventional and non-conventional subsidence predictions;
- Analyse the relationship between the predicted and resulting conventional and non-conventional subsidence effects and predicted and resulting impacts under the plan and any ensuing environmental consequences; and
- Inform the adaptive management process.

1.4 Scope

This Subsidence Monitoring Plan describes the inspection regimes, layout of monitoring points, parameters to be measured, monitoring methods and accuracy, timing and frequencies of surveys and inspections, and recording and reporting of monitoring results.

The Subsidence Monitoring Plan is consistent with the monitoring commitments that are described in the following plans (refer **Section 4.2**), which are submitted as part of the Extraction Plan for LW S1A-S7A:

- LW S1A-S7A Water Management Plan for LW S1A-S7A (TAH-HSEC-00361);
- LW S1A-S7A Land Management Plan for LW S1A-S7A (TAH-HSEC-00362);
- LW S1A-S7A Biodiversity Management Plan for LW S1A-S7A (TAH-HSEC-00363);
- LW S1A-S7A Heritage Management Plan for LW S1A-S7A (TAH-HSEC-00364);
- LW S1A-S7A Built Features Management Plan for LW S1A-S7A (TAH-HSEC-00366); and
- LW S1A-S7A Public Safety Management Plan for LW S1A-S7A (TAH-HSEC-00365).

The Subsidence Monitoring Plan is consistent with, or will be consistent with, detailed Subsidence Management Plans for built features, which have been or will be developed by Tahmoor Coal in consultation with stakeholders prior to the influence of subsidence on each relevant feature. Each of these management plans describes measures that will be undertaken to monitor subsidence movements and physical changes and/or impacts that occur during mining. The management plans are listed in **Table 1**.

Table 1 Natural and Built Surface Features within the Study Area and Associated Management Plans

Feature	Management and Monitoring
Surface water and groundwater	LW S1A-S7A Water Management Plan
Landscape features and agricultural land	LW S1A-S7A Land Management Plan
Aquatic and terrestrial biodiversity	LW S1A-S7A Biodiversity Management Plan
Aboriginal and historical heritage	LW S1A-S7A Heritage Management Plan

Feature	Management and Monitoring
Public safety	LW S1A-S7A Public Safety Management Plan
Main Southern Railway	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Main Southern Railway, Report No. MSEC1201, Revision D, August 2025.
Wellers Road Overbridge	Tahmoor Coal – Management Plan for LW S4A-S7A adjacent to Wellers Road Overbridge, Report No. MSEC1193-19, Revision B, March 2025 (under review by Transport for NSW).
Tahmoor Mine Rail Loop	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Mine Site, Report No. MSEC1247, 2023.
Public roads, bridges and culverts	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Wollondilly Shire Council Infrastructure, Report No. MSEC1193-03, Revision D, August 2025.
Potable water infrastructure	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Sydney Water Potable Water Infrastructure, Report No. MSEC1193-04, Revision C, August 2025.
Sewer infrastructure	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Sydney Water Sewer Infrastructure, Report No. MSEC1193-05, Revision B, August 2025.
Gas infrastructure	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Jemena Gas Infrastructure, Report No. MSEC1193-06, Revision B, 2024 and Amendment No.1 for LWS 4A in November 2024.
Electrical infrastructure	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Endeavour Energy Infrastructure, Report No. MSEC1193-07, Revision C, August 2025.
Telecommunications infrastructure	Telecommunications Management Plan – Tahmoor South Domain –Revision of Telstra, NBN Co and TPG Management Plans for LW S1A-S7A, Tahmoor Coal, June 2024.
Public amenities	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Built Structures, Report No. MSEC1193-09, Revision C, August 2025
Structures and farm dams	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Built Structures, Report No. MSEC1193-09, Revision C, August 2025
Bargo Cemetery	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to Wollondilly Shire Council Infrastructure, Report No. MSEC1193-03, Revision D, August 2025
Wollondilly Anglican College	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Wollondilly Anglican College, Report No. MSEC1193-11, 2023.
Tahmoor Mine Site	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Mine Site, Report No. MSEC1247, 2023.
Australian Wildlife Sanctuary	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Australian Wildlife Sanctuary, Report No. MSEC1074, 2023 (Revision D).
Picton Weir	Tahmoor Coal – LW S3A-S7A Management Plan for Potential Impacts to Picton Weir, Report No. MSEC1193-12, Revision C, April 2024 (awaiting feedback from Crown Lands)
Bargo Petroleum and Hill Top Pit Stop (private ownership)	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Bargo Petroleum and Hill Top Pit Stop, Report No. MSEC1193-13, 2023 and Amendment No. 1 for LW S3A in May 2024.
Inghams Bargo Breeder Farm and Turkey Farm (Inghams)	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Inghams Bargo Chicken Breeder Production Complex, Report No. MSEC1193-14, 2023. Tahmoor Coal – LW S5A-S7A Management Plan for Potential Impacts to Inghams Turkey Farm, Report No. MSEC1193-20 (planned to complete prior to LW S5A).
Tahmoor Garden Centre (private ownership)	Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Garden Centre, Report No. MSEC1193-15, 2023, Amendment No. 1 for LW S3A in May 2024 and Amendment No.2 for LW S4A in November 2024

Feature	Management and Monitoring
MKD Machinery (private ownership)	Tahmoor Coal – LW S1A-S7A Management Plan for Potential Impacts to MKD Machinery, Report No. MSEC1193-16, Revision D, August 2025.
Bargo Valley Produce (Bargo Valley Produce Pty Limited)	Tahmoor Coal – LW S5A-S7A Management Plan for Potential Impacts to Bargo Valley Produce, Report No. MSEC1193-17 (planned to complete prior to LW S5A).
Canine Country Club (private ownership)	Tahmoor Coal – LW S5A-S7A Management Plan for Potential Impacts to Canine Country Club, Report No. MSEC1193-18 (planned to complete prior to LW S6A).

These Subsidence Management Plans will be completed prior to the influence of LW S1A-S7A on each feature.

1.5 Definition of Study Area

The Study Area is the surface area within which natural surface features and items of infrastructure have been identified and assessed for their potential to experience mine subsidence impacts as a result of the proposed extraction of LW S1A-S7A.

The extent of the Study Area has been conservatively defined by combining the areas bounded by the following limits:

- A 35° angle of draw from the extents of LW S1A-S7A;
- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour, resulting from the extraction of LW S1A-S7A;
- Features that could experience far-field or valley-related movements and could be sensitive to such movements; and
- For natural features, the Subsidence Study Area has been extended to a minimum of 600 metres from the extents of LW S1A-S7A, as recommended in the independent inquiry report titled "Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield – Strategic Review" (NSW Department of Planning (DoP), 2008).

The depths of cover contours for the Bulli Seam above LW S1A-S7A vary between 365 m and 410 m. The 35° angle of draw, therefore, has been determined by drawing a line that is a horizontal distance varying between 255 m and 290 m around the extent of the longwall mining area.

The features that could experience far-field or valley-related movements and could be sensitive to such movements are listed below:

- The Main Southern Railway viaduct over the Bargo River, located 1,755 metres from LW S1A;
- The Remembrance Drive Bridge over the Bargo River and Main Southern Railway, located 1,690 metres from LW S1A;
- The Picton Weir, (or Bargo Weir), on Bargo River, located 620 metres from LW S7A;
- Streams, within the predicted limits of 20 mm total upsidence and 20 mm total closure;
- Groundwater bores; and
- Survey control marks.

The Study Area is shown in **Figure 2**.

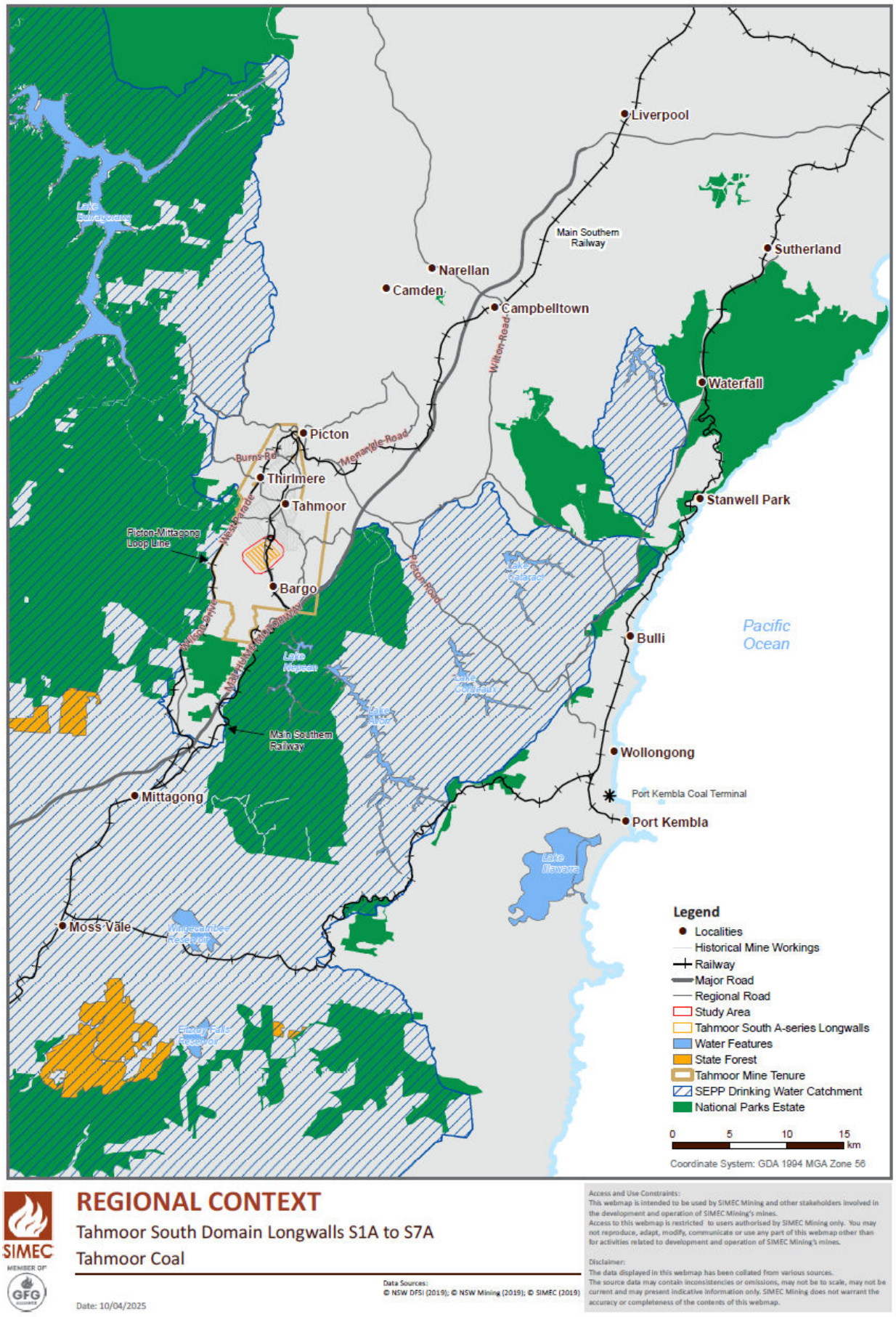

Figure 1 Regional Context

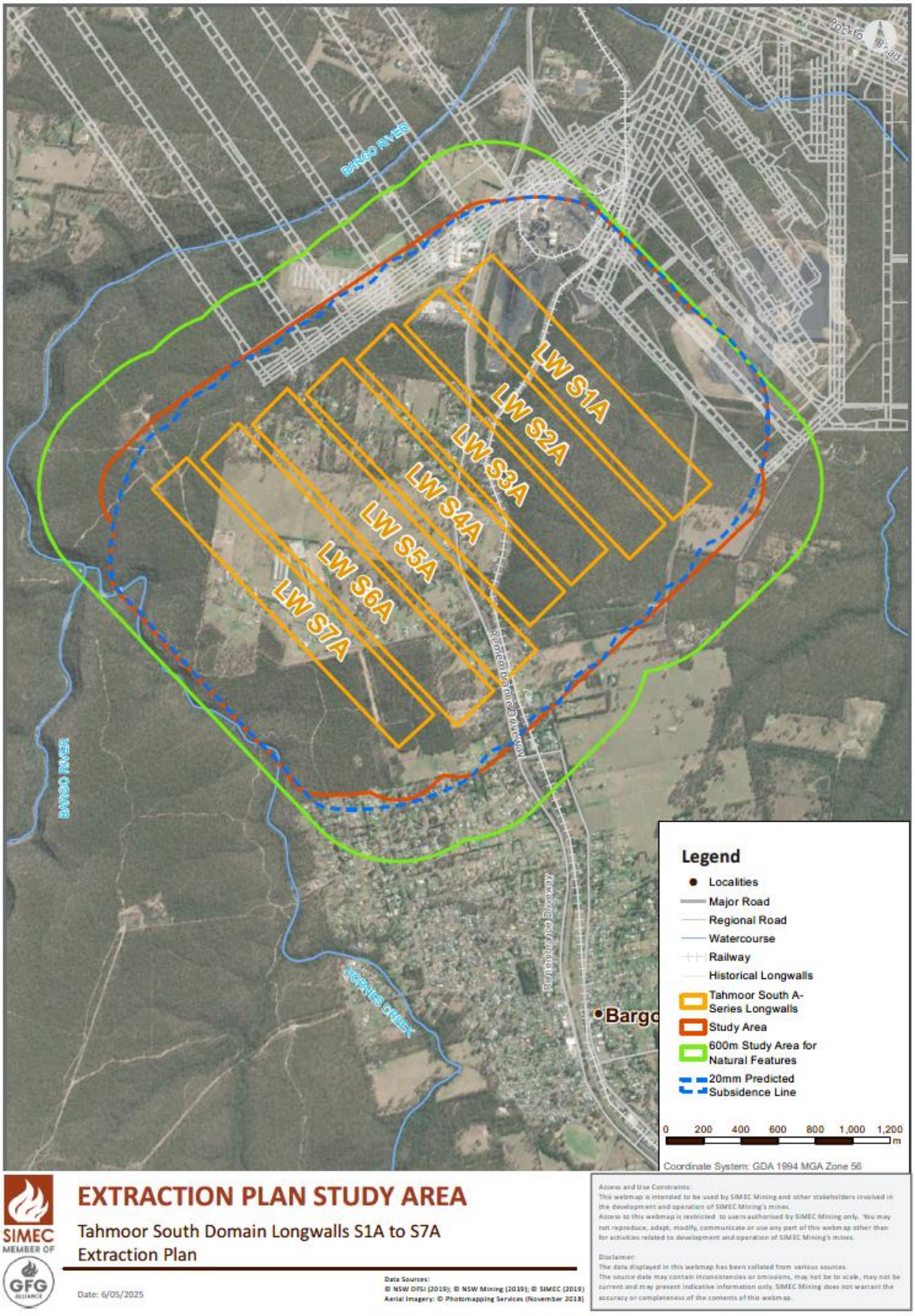

Figure 2 Extraction Plan Study Area

1.6 Definition of Active Subsidence Zone

As a longwall progresses, subsidence begins to develop at a point in front of the longwall face and continues to develop after the longwall passes. The majority of subsidence movement typically occurs within an area 150 m in front of the longwall face to an area 450 m behind the longwall face.

This is termed the “active subsidence zone” for the purposes of this Subsidence Monitoring Plan, where surface monitoring is generally conducted. The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 millimetres (mm) subsidence contour for the active longwall and a distance of 150 m in front of and 450 m behind the active longwall face, as shown by **Figure 3.**

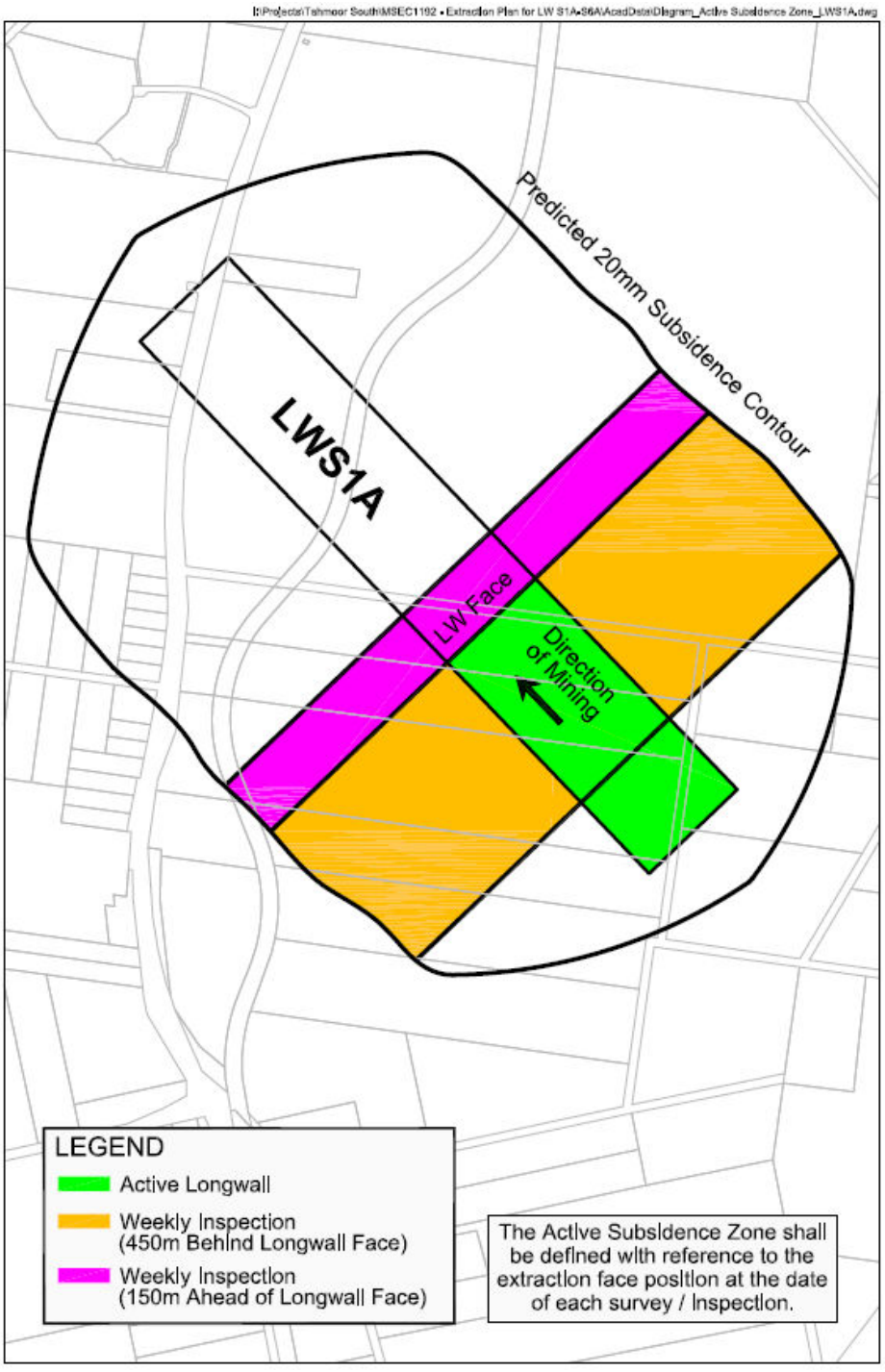

Figure 3 Diagrammatic Representation of Active Subsidence Zone

1.7 Maximum Predicted Conventional Subsidence Parameters

Predicted mining-induced conventional subsidence movements were provided in **Report No. MSEC1192**, which was prepared in support of Tahmoor Coal's Extraction Plan Application for LW S1A-S6A. Tahmoor Coal has revised its forecast extraction heights since the previous predictions were provided in Report No. MSEC1192. The changes are generally minor, in the range of 50 to 100 mm greater than previously forecast.

Revised predicted mining-induced conventional subsidence movements were provided in Report No. MSEC1348, which was prepared in support of Tahmoor Coal's application to extract LW S7A. The predictions do not materially change the assessment of potential impacts on Sydney Water potable water infrastructure (MSEC1348). This Management Plan provides subsidence predictions based on the revised predictions that were provided in Report No. MSEC1348.

A summary of the maximum predicted incremental subsidence parameters due to the extraction of LW S1A-S7A is provided in **Table 2.**

Table 2 Maximum Predicted Incremental Conventional Subsidence Parameters

Longwall	Maximum predicted incremental vertical subsidence (mm)	Maximum predicted incremental tilt (mm/m)	Maximum predicted incremental hogging curvature (km-1)	Maximum predicted incremental sagging curvature (km-1)
LW S1A	825	7.0	0.08	0.23
LW S2A	950	8.0	0.09	0.22
LW S3A	950	8.0	0.09	0.22
LW S4A	975	8.0	0.09	0.22
LW S5A	975	8.0	0.10	0.22
LW S6A	975	8.3	0.09	0.23
LW S7A	1,050	8.9	0.10	0.24

A summary of the maximum predicted total subsidence parameters due to the extraction of LW S1A-S7A is provided in Table 3. The predicted total parameters represent the accumulated movements due to the extraction of all proposed longwalls.

Table 3 Maximum Predicted Total Conventional Subsidence Parameters

Longwall	Maximum predicted total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km-1)	Maximum predicted total sagging curvature (km-1)
LW S1A	825	7.0	0.08	0.23
LW S2A	1,050	8.1	0.10	0.23
LW S3A	1,250	8.3	0.11	0.23
LW S4A	1,300	8.5	0.13	0.22
LW S5A	1,350	9.0	0.14	0.23
LW S6A	1,400	9.5	0.14	0.23
LW S7A	1,400	10.0	0.14	0.25

1.8 Comparison of Measured and Predicted Subsidence during the mining of LWs S1A to S3A

Extensive monitoring has been undertaken by Tahmoor Coal during the mining of LW S1A to S3A. Observed incremental subsidence due to the extraction of LW S1A has correlated reasonably well with predictions, as shown in **Figure 4**.

Subsidence was observed to vary in magnitude along the centreline of LW S1A. Maximum subsidence was measured at Peg V51 on the V-Line, which is located between Teatree Hollow and the Tributary to Teatree Hollow. Observed subsidence was reduced in magnitude over the northern half of the longwall panel at the Main Southern Railway and Tahmoor Mine Site (Pier 2).

As shown in **Figure 4**, observed subsidence at Peg V51 was slightly greater than predicted but within the accuracy of the prediction model of ± 15% (Reports Nos. MSEC1123 and MSEC1192). Observed total subsidence at Peg V51 after the mining of LW S3A is less than predicted, as shown in **Figure 7**. Observed subsidence values at other locations above LW S1A were less than predicted.

Monitoring during the mining of LW S2A measured subsidence movements within predictions, as shown in **Figure 5**. Whilst observed subsidence along Remembrance Drive has been less than predicted, increased compressive strains have been observed at two locations, as shown in **Figure 9**. Tahmoor Coal has managed potential impacts at these two locations in consultation with infrastructure owners.

Monitoring during the mining of LW S3A measured subsidence movements within predictions, as shown in **Figure 6**. Maximum subsidence was measured at Peg MS99500, which is located along the Main Southern Railway and above the centreline of LW S3A. Whilst observed subsidence along the Main Southern Railway has been less than predicted, a bump was observed in the subsidence profile along with a corresponding increased compressive strain at one location, as shown in **Figure 8**.

As recommended in Report Nos. MSEC1192 and MSEC1348, Tahmoor Coal is monitoring during mining to compare observations with predictions. Tahmoor Coal has extensive experience in successfully managing potential subsidence impacts on surface features, even when actual subsidence is substantially greater than the magnitudes that have been predicted above LW S1A-S7A. Subsidence management plans have been developed to manage potential impacts that could occur if greater than predicted subsidence occurs.

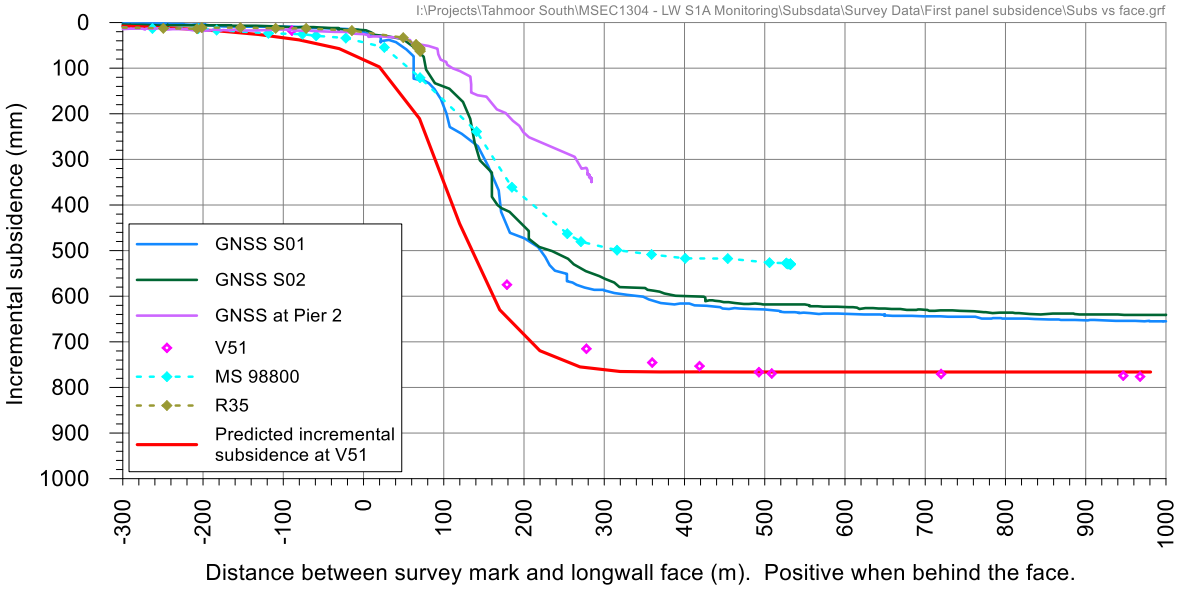

Figure 4 Comparison between predicted and observed subsidence above centreline of LW S1A

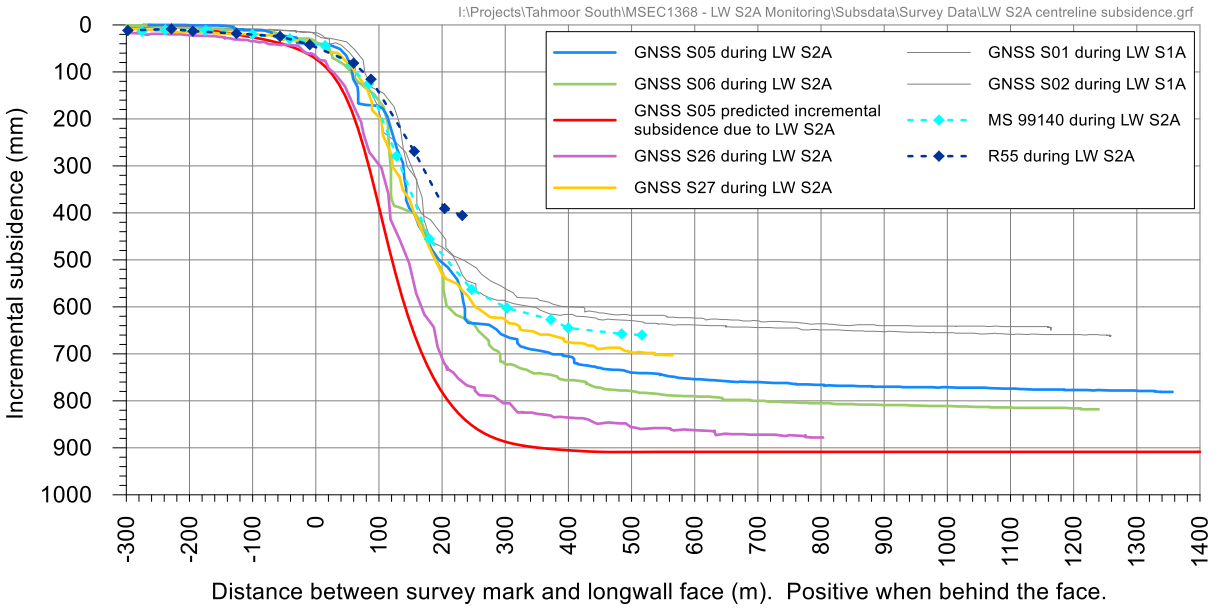

Figure 5 Comparison between predicted and observed subsidence above centreline of LW S2A

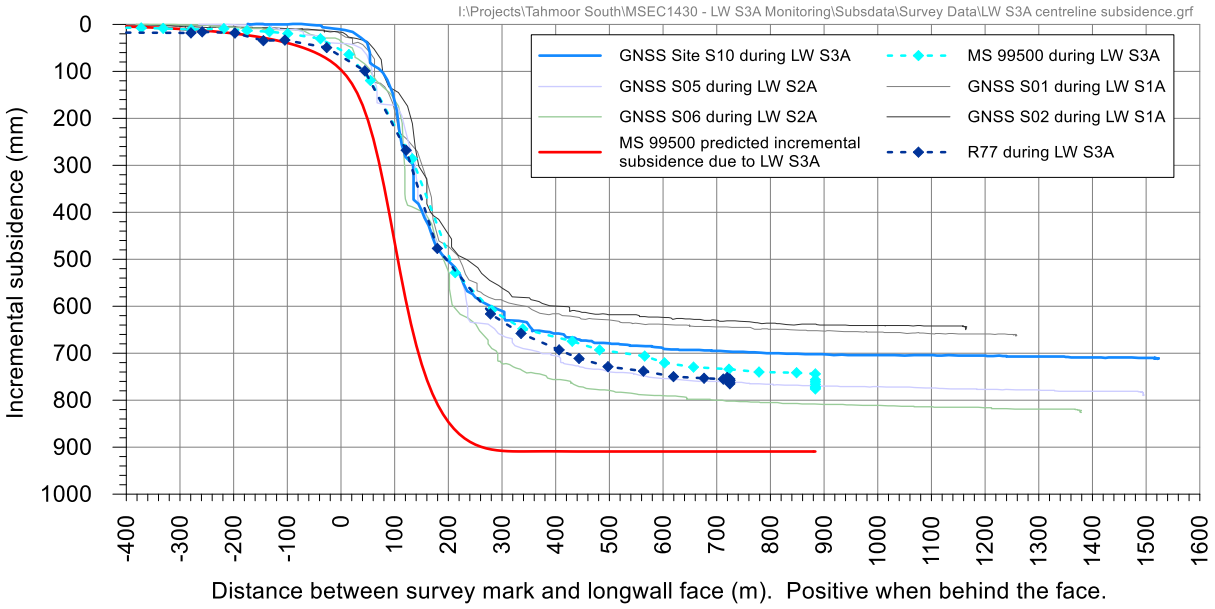

Figure 6 Comparison between predicted and observed subsidence above centreline of LW S3A

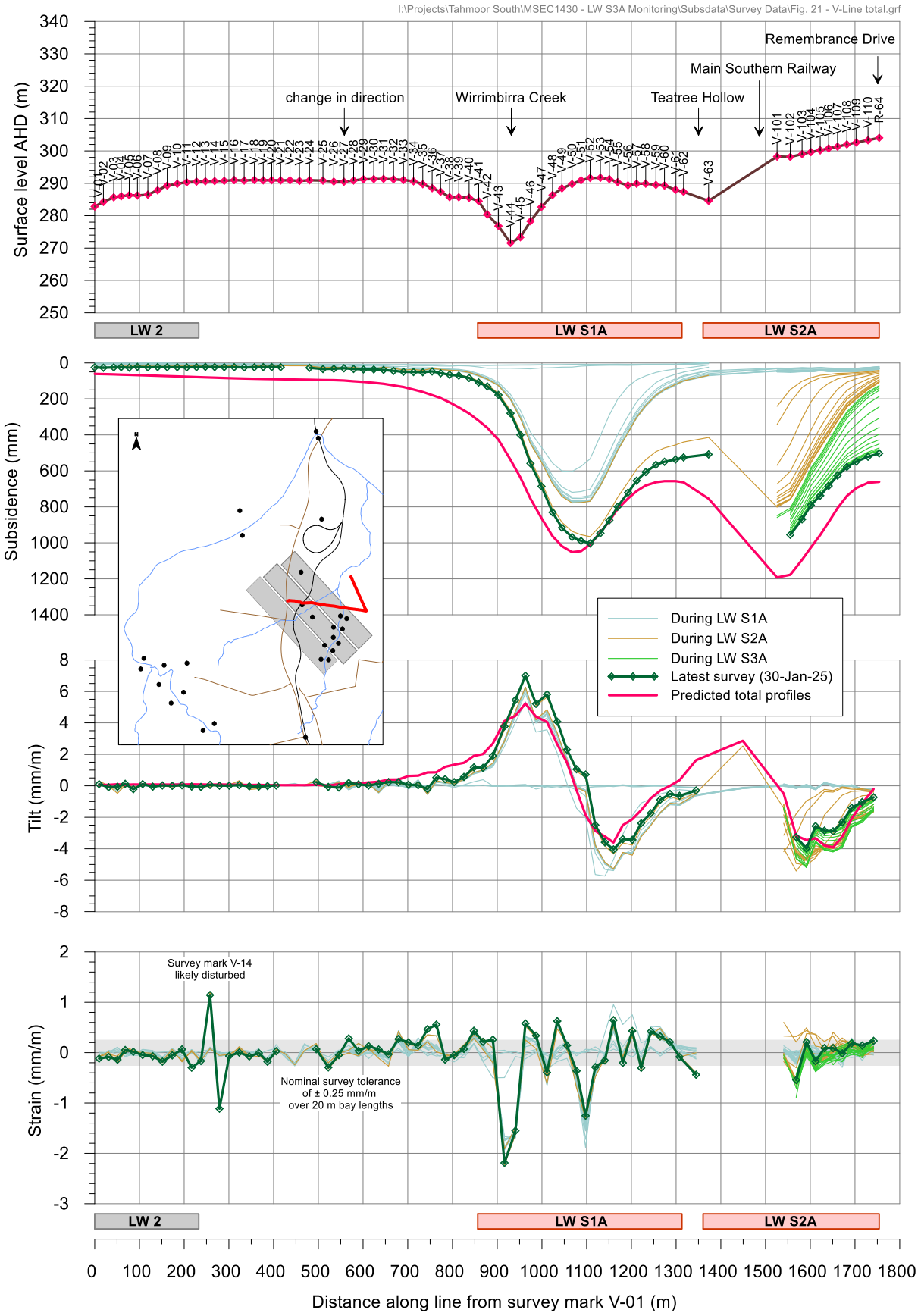

Figure 7 Observed subsidence along V Line during the mining of LW S1A-S3A

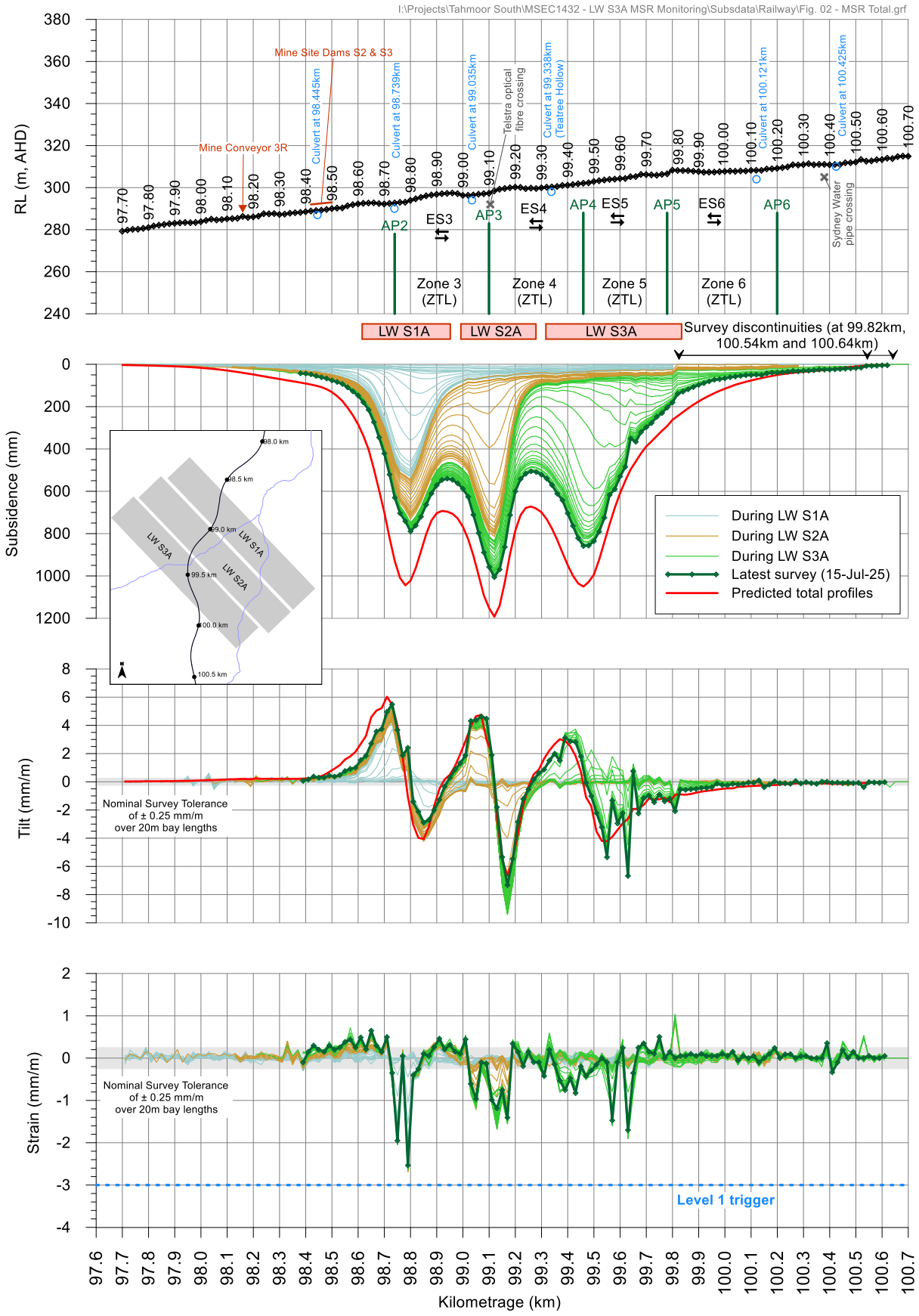

Figure 8 Observed subsidence along Main Southern Railway during the mining of LW S1A-S3A

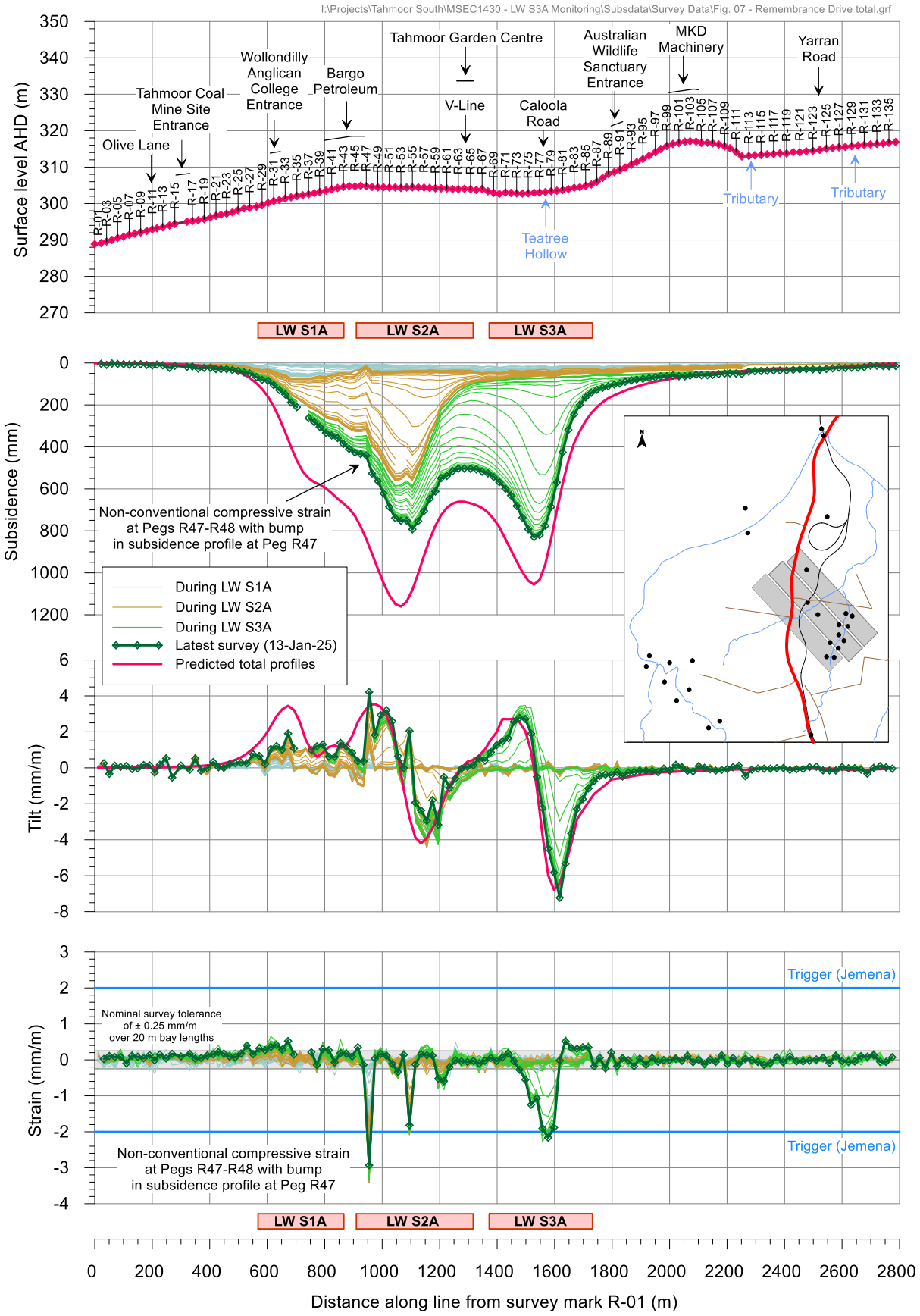

Figure 9 Observed subsidence along Remembrance Drive during the mining of LW S1A-S3A

While reasonable correlations have generally been observed at Tahmoor Mine, substantially increased subsidence was observed over the predicted subsidence levels during the mining of LW 24A and then similar increased subsidence movements were also observed above the southern ends of LWs 25 to 27 and the commencing end of LW 32. This was a very unusual event for the Southern Coalfield and are linked to the presence of the Nepean Fault. Further details are provided in **Report Nos. MSEC1192 and MSEC1348.**

Whilst increased subsidence has not been observed during the mining of LWs S1A to S3A, LW S7A runs adjacent and approximately parallel to the Central Fault complex, which is located on the western side of the mining area. As discussed in **Report No. MSEC1348**, it is possible that increased subsidence may develop above LW S7A 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.

If greater than predicted subsidence was to occur above the proposed longwalls, it is unlikely that the magnitude of this increased subsidence will be much greater than the predictions for the following reasons:

- Predicted maximum incremental subsidence is 1,150 mm, which represents approximately 45 % to 52 % of the proposed extraction height. Maximum observed incremental subsidence above Longwalls 24A to 27 was approximately 55 % of the extraction height.
- Predicted maximum total subsidence is 1,650 mm, which represents approximately 63 % of the proposed extraction height. Maximum observed total subsidence above Longwalls 24A to 27 was approximately 62 % of the extraction height.
- The higher levels of predicted subsidence at Tahmoor South are due to a combination of greater extraction heights and slightly shallower depths of cover. They are comparable to or just less than the observed increased subsidence above Longwalls 24A to 27 when expressed as a proportion of extraction height.
- In the cases of Longwalls 24A and 25, the observed maximum subsidence was greater than predictions by between 2 to 2.3 times. This was partly because the panels were the first and second in a series of longwalls where reduced subsidence would normally have been expected to develop. Increasing the predicted levels of subsidence by factors of 2 to 2.3 would result in subsidence much greater than the proposed extraction height, which is extremely unlikely to occur.

While the potential exists for increased subsidence to occur above LW S7A adjacent to the Central Fault, it is important to note that the potential impacts on surface infrastructure from this extra subsidence can be managed, as it was managed over Longwalls 24A to 27, Longwall 32 and Longwall W4, so that they remain safe and serviceable during and after the mining period with the implementation of effective management measures.

This Subsidence Monitoring Plan, therefore, includes monitoring to measure the development of subsidence during the early stages of extraction to confirm that subsidence is developing within predictions. Subsidence management plans for built features and natural features will be, or have been, developed to manage potential impacts that could occur even if greater than predicted subsidence occurs. The plans include regular reviews of observed subsidence movements to ensure that planned measures to manage potential subsidence impacts on natural and built features are adequate and effective.

1.9 Preparation of this Plan

This Plan has been prepared by Mine Subsidence Engineering Consultants (MSEC) on behalf of Tahmoor Coal. Daryl Kay (Subsidence Specialist) has been endorsed by the Department of Planning, Industry and Environment (DPIE, previously the Department of Planning and Environment (DPE), now NSW

Department of Planning, Housing and Infrastructure (DPHI)) as a suitably qualified subsidence engineer to prepare this plan.

2 Regulatory Requirements

2.1 Project Approval

2.1.1 Development Consent Conditions

2.1.1.1 Extraction Plan Requirements

Tahmoor Coal's operations are conducted in accordance with applicable Commonwealth and State environmental, planning, mining safety, and natural resource legislation. A register of relevant environmental legislative and regulatory requirements is maintained by Tahmoor Coal in a compliance database.

LW S1A-S7A will be extracted in the Tahmoor South mining area under Development Consent SSD 8445, as discussed further in Section 3.2.1 of the Extraction Plan Main Document. SSD 8445 provides the conditional planning approval framework for mining activities in the Tahmoor South Domain to be addressed within an Extraction Plan and supporting management plans. Conditions relevant to this management plan from SSD 8445 are detailed in **Table 4.**

SSD 8445 has been modified on three occasions relating to:

- Modification 1 - Extension of time to commission the Tahmoor Coal Water Treatment Plant, approved on 19 July 2022; and
- Modification 2 - Underground brine disposal and transfer of mine water, approved on 13 June 2023.
- Modification 3 - Inclusion of an additional longwall panel (Longwall South 7A (LW S7A)) to the existing approved mine plan, approved on 26 May 20265.

Approval (EPBC 2017/8084) was also granted in 2021 by the then Department of Agriculture, Water and the Environment (DAWE) (now Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW)) for the Tahmoor South Project under sections 130(1) and 133(1) of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act).

It is noted that LW S3A has been shortened by 104 m, as approved by DPHI on 27 March 2024 and LW S4A is shortened by 104m as approved by DPHI on 11 November 2024.

Table 4 Key Conditions from SSD 8445 regarding Subsidence Monitoring Plan

Condition Reference	Condition Requirement	Where Addressed
C8(g)(i)	Subsidence Monitoring Plan which has been prepared in consultation with the Resources Regulator to:	This plan. **Section 2.2**
	• describe the ongoing conventional and non-conventional subsidence monitoring program;	**Section 3**
	• provide data to assist with the management of risks associated with conventional and non-conventional subsidence;	
	• validate the conventional and non-conventional subsidence predictions;	
	• analyse the relationship between the predicted and resulting conventional and non-conventional subsidence effects and predicted and resulting impacts under the plan and any ensuing environmental consequences; and	
	• inform the adaptive management process;	

2.1.1.2 Management Plan Requirements

Condition E5 of the Consent outlines the general requirements for all management plans. **Table 5** outlines the requirements under this condition and notes that these requirements are not relevant to this Plan.

Table 5 Management Plan Requirements

Condition Reference	Condition Requirement	Where Addressed
E5	Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	Noted.
(a)	a summary of relevant background or baseline data;	Not relevant to SMP
(b)	details of:	NA
(b)(i)	the relevant statutory requirements (including any relevant approval, licence or lease conditions);	Not relevant to SMP
(b)(ii)	any relevant limits or performance measures and criteria; and	Not relevant to SMP
(b)(iii)	the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Not relevant to SMP
(c)	any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	Not relevant to SMP
(d)	a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	Not relevant to SMP
(e)	a program to monitor and report on the:	NA
(e)(i)	impacts and environmental performance of the development; and	Not relevant to SMP
(e)(ii)	effectiveness of the management measures set out pursuant to condition E5(d);	Not relevant to SMP
(f)	a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	Not relevant to SMP
(g)	a program to investigate and implement ways to improve the environmental performance of the development over time;	Not relevant to SMP
(h)	a protocol for managing and reporting any:	NA
(h)(i)	incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	Not relevant to SMP
(h)(ii)	complaint; or	Not relevant to SMP
(h)(iii)	failure to comply with other statutory requirements;	Not relevant to SMP
(i)	public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	Not relevant to SMP
(j)	a protocol for periodic review of the plan.	Not relevant to SMP

2.1.2 EIS Commitments

Condition A2(g) of the Consent states that the development may only be carried out generally in accordance with the EIS. The relevant EIS documents include:

- Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019;
- Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020;
- Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020; and
- Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

This Subsidence Monitoring Plan describes Tahmoor Coal's planned monitoring activities in undertaking these commitments.

2.1.3 Extraction Plan Guideline

This Subsidence Monitoring Plan has been updated in accordance with the DPE *Extraction Plan Guideline* (DPE, 2022), as detailed in **Table 6.**

Table 6 Extraction Plan Guideline Requirements for Subsidence Monitoring Program

Extraction Plan Guideline Content Requirements	Where Addressed
The subsidence monitoring program should have clearly stated objectives and include:	**Section 3**
• Proposed subsidence monitoring activities, including the use of land-based and/or satellite and other remote survey techniques and the accuracy of proposed techniques;	**Section 3**
• Information on subsidence parameters to be obtained from each monitoring activity;	**Section 3**
• Proposed locations and/or extents where each monitoring activity will take place – in particular, the proposed layout and/or locations of instrumentation, monitoring points or inspections (including plans);	**Section 3, Appendix A**
• Proposed timing, frequency and duration of each monitoring activity;	**Section 3**
• Proposed monitoring methods and technologies and industry standards or codes of practice to be applied;	**Appendix B, Appendix C**
• Proposed measures and procedures for quality assurance and competence of personnel undertaking monitoring activities;	**Section 3.2, Appendix B, Appendix C**
• Proposed procedures to record monitoring results;	**Section 3.3, Appendix B, Appendix C**
• Proposed reporting of monitoring results, including the frequency of reporting, which will depend on the nature of the risk;	**Section 3.3, Appendix B, Appendix C**
• Capacity of the program to detect early warning of deviations from the defined performance measures and associated performance indicators.	**Section 3.3, Appendix A**

2.2 Consultation

2.2.1 Consultation to Date

The NSW Department of Regional NSW – Resources Regulator (Resources Regulator) were consulted during the preparation of this management plan.

The feedback provided by this stakeholder is summarised within **Table 7** below. It is noted that this consultation table does not include consultation completed during and after the Extraction Plan review stage post submission to DPE (now DPHI). A summary of all consultation undertaken for this extraction plan is provided in Section 2.1.2 of the Extraction Plan Main Document, and a copy of the incoming correspondence is also provided in Appendix C of the Extraction Plan Main Document.

Table 7 Consultation to Date

Consulted Stakeholder	Consultation Conducted	Outcomes of Consultation
Resources Regulator	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 22 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls. A response was received on 23 December 2021 from Resources Regulator requesting a subsidence monitoring plan for the proposed longwalls.	Tahmoor Coal submitted v2 of the Subsidence Monitoring Program on 9 September 2022, which was implemented prior to and during the extraction of LW S1A.

3 Subsidence Monitoring Program

3.1 Layout of Monitoring Points

The layout of monitoring points is provided in Drawing No. MSEC1193-01-01, which is included in **Appendix A**. Due to the density of survey marks, detailed layouts of monitoring points for Wollondilly Anglican College and the Tahmoor Mine Site are shown in separate monitoring plans.

3.2 Monitoring Methods and Accuracy

With the exception of surveys undertaken within the railway corridor, the monitoring methods and accuracy are described in the report entitled *Specifications for Subsidence Monitoring for Longwalls S1A-S6A* by SMEC. This specification is appended to this Subsidence Monitoring Plan in **Appendix B**. The specification will also be applied during the extraction of LW S7A.

With respect to surveys undertaken within the railway corridor, the monitoring methods and accuracy are described in the reports entitled *Main South Line- Survey Monitoring Plan for LW's S1A to S6A* by Southern Rail Surveys. This specification is appended to this Subsidence Monitoring Plan in **Appendix C**. The specification will also be applied during the extraction of LW S7A.

Occasionally survey pegs become disturbed or lost. Tahmoor Coal will replace the lost pegs unless approval for not replacing the pegs is provided by the Resources Regulator.

Tahmoor Coal will conduct monitoring in accordance with the Tahmoor Coal Environmental Management Strategy Framework, which is aligned with ISO 14001 Environmental Management System.

Monitoring will be supervised by the Tahmoor Coal Environment and Community Team, the members of which are professional and competent scientists and engineers.

3.3 Recording and Reporting of Monitoring Results

The recording and reporting of monitoring results is described in the report entitled *Specifications for Subsidence Monitoring for Longwalls S1A-S6A* by SMEC and in the report entitled *Main South Line- Survey Monitoring Plan for LW's S1A to S6A* by Southern Rail Surveys. These specifications are appended to this Subsidence Monitoring Plan in **Appendix B** and **Appendix C**.

3.4 Inspection Regimes, Parameters to be Measured, Timing and Frequencies of Surveys and Inspections

An overview of inspection regimes, parameters to be measured, timing and frequencies of surveys and inspections are outlined in **Table 8.** The information is sorted by features that are being monitored.

To clarify, where the timing of the monitoring or inspection frequency is described as "*Monthly after x metres of extraction*", or "*Every 200 metres of extraction after x metres of extraction*", this means that the first survey will commence within one week of the longwall face passing "*x metres of extraction*".

3.5 Continuous GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time.

The locations of planned GNSS units are shown in Drawings No. MSEC1193-01-01 and are summarised below:

- Centrelines of LW S1A to S3A - The GNSS units are located in bushland within the Australian Wildlife Sanctuary. The units are proposed to track the development of subsidence and horizontal movements above the commencing ends of the longwalls. The monitoring data will provide the first subsidence results for each panel to compare against subsidence predictions. Conventional survey lines are not possible in this area due to thick vegetation, preventing lines of sight;
- Valley closure across Tributary to Teatree Hollow - Pairs of GNSS units are be located across the Tributary to Teatree Hollow to measure valley closure. Conventional survey lines are not possible in this area due to thick vegetation, preventing lines of sight across the sides of the valley. Two pairs of GNSS units are planned to be located across rockbars controlling pools along the creek. A site of archaeological significance is located near one these rockbars. The results will be cross-checked by manual surveys across the rockbars in the base of the valley;
- Valley closure across Teatree Hollow – A pair of GNSS units have been installed across the Teatree Hollow to measure valley closure above LW S2A. Conventional survey lines are not possible in this area due to thick vegetation, preventing lines of sight across the sides of the valley.
- Bargo River – Two GNSS units were installed across the Bargo River to monitor for valley closure and whether the existing goaf above previously extracted LWs 14B to 19 subsides during the extraction of LWs S1A to S7A. The locations are shown in Drawing No. MSEC1193-01-01, subject to approval by landowners;
- Railway Viaduct across Bargo River - Two GNSS units are located within the Main Southern Railway corridor to measure far field movements, if any, between the abutments of the Viaduct. The two GNSS units will also allow valley closure, if any, to be detected. The results will be cross-checked by manual surveys across the Viaduct if they exceed trigger levels;
- Main Southern Railway above LW S5A – One GNSS unit is located within the Main Southern Railway corridor above the commencing end of LW S5A The GNSS unit will provide early detection of subsidence within the rail corridor and the results may trigger earlier than planned commencement of weekly surveys along the railway. ;
- Picton Weir - Two GNSS units are located at the tops of the valley on either side of the Picton Weir to measure far field movements, if any, across the valley. The two GNSS units will also allow valley closure, if any, to be detected. An additional GNSS unit has been installed between the Picton Weir and LW S7A. The results can be cross-checked by manual surveys across the Weir if they exceed trigger levels;
- Hornes Creek – Three pairs of GNSS units were installed at the tops of the valley on either side of Hornes Creek to measure far field movements, if any, across the valley.
- Wellers Road Overbridge - A GNSS unit has been installed at the Wellers Road Overbridge. to measure far field movements. The results will trigger surveys of the Bridge if they exceed trigger levels; and
- Tahmoor Mine base station site - A GNSS unit has been installed at Tahmoor Mine's survey base station. The surveys will assist Tahmoor Mine's underground survey team to establish survey control, as required.

3.6 Streams

Survey lines have been installed across Teatree Hollow, the Tributary to Teatree Hollow and the Bargo River. Whilst it would be preferred to install ground survey lines between the tops of the valleys, vegetation regrowth since the bushfires in 2019 has significantly restricted lines of sight across the creeks.

3.6.1 Tributary to Teatree Hollow

As discussed in **Section 3.5**, GNSS units were installed to track the development of valley closure across the Tributary to Teatree Hollow as installing conventional survey lines are not possible in this area due to thick vegetation, preventing lines of sight across the sides of the valley.

Survey marks were installed across the base of the creek at the GNSS locations, including rockbars controlling water levels in Pools TT2 and TT3/TT11 where surface water level monitoring is being conducted. The selection of peg locations was determined on site with a target spacing between 5 and 10 metres where access was possible. The purpose of the surveys is to measure potential valley closure and upsidence movements at these locations. Given the dense vegetation, a baseline survey was conducted prior to mining and it is planned to then repeat the survey at the end of each longwall. Additional surveys can be conducted during mining if required.

Subsidence movements will also be surveyed where roads, railways and other services infrastructure cross the Tributary to Teatree Hollow and its associated first order drainage lines, as shown in Drawing No. MSEC1192-01-01. The installed LW S1A Tahmoor Mine Boundary Line also crosses the Tributary to Teatree Hollow, as shown in Drawing No. MSEC1193-01-01.

3.6.2 Teatree Hollow

Survey marks were installed across the base of Teatree Hollow at the rockbars controlling water levels in Pools TT9 and TT12. Tahmoor Mine has constructed a dry weather access road across Teatree Hollow immediately downstream of the junction between Teatree Hollow and the Tributary to Teatree Hollow. A survey line has been installed across Teatree Hollow along the access road crossing. The selection of peg locations was determined on site with a target spacing between 5 and 10 metres where access was possible.

Given the dense vegetation, a baseline survey was completed prior to mining and it is planned to then repeat the survey at the end of each longwall. Additional surveys can be conducted during mining if required.

Subsidence movements will also be surveyed where roads, railways and other services infrastructure cross the Teatree Hollow and its associated first and second order drainage lines, as shown in Drawing No. MSEC1193-01-01.

3.6.3 Bargo River

Negligible mining-induced changes are expected to occur along the Bargo River during the extraction of LWs S1A to S7A. Monitoring will be conducted to confirm expectations.

Two GNSS units were installed across the Bargo River valley. The units are located directly above previously extracted LW 16 and will continuously monitor changes during mining.

A series of ground survey marks have been installed along both sides of the Bargo River above previously extracted LWs 14B to 19. Their locations are shown in Drawing No. MSEC1193-01-01. The surveys measure changes in horizontal distances between each pair of pegs to measure potential closure across the Bargo River stream. A baseline survey was conducted prior to the commencement of LW S1A, with additional surveys after the completion of each longwall panel. Additional surveys can be conducted if valley closure is detected by the GNSS units.

3.7 LW S1A Tahmoor Mine Boundary Line and REA Line (V Line)

The V Line is a survey line that was installed along the southern boundary of Tahmoor Mine's property and the western side of Tahmoor Mine's Reject Emplacement Area (REA), as shown in Drawing No. MSEC1192-01-01. The survey line was installed with pegs spaced nominally 20 metres apart.

The purpose of the V Line along the southern boundary of Tahmoor Mine's property was to measure the subsidence profile across the width of LW S1A prior to experiencing significant subsidence along the Main Southern Railway.

The survey line commenced at the south-eastern end at the end of an unsealed road that is accessed from Charlies Point Road. The line terminated at the top of Teatree Hollow due to thick vegetation and then continued along the southern boundary of the Tahmoor Mine site, which followed the path of Telstra's optical fibre cable.

The V line continued along the western side of Tahmoor Mine's Reject Emplacement Area (REA). This section of the V Line was installed with pegs spaced nominally 20 metres apart and followed the path of Endeavour Energy's 66 kV line. The survey line commenced at the southern end at the intersection with the LW S1A Tahmoor Mine Boundary Line and terminated at the top of Teatree Hollow due to thick vegetation, beyond the REA area. The survey line was located approximately 200 metres to 350 metres from LW S1A.

The purpose of this section of the V line was to inform Tahmoor Mine about observed subsidence adjacent to the REA. The REA was inspected at least once a week by Tahmoor Mine during mining.

The full extent of the V Line was surveyed monthly during the mining of LW S1A. The section of the V Line along the southern boundary of the Tahmoor Mine Site has been surveyed on a weekly basis during the mining of LWs S1A to S3A whilst it experienced active subsidence to assist with monitoring along Telstra's optical fibre cable. Additional surveys can be conducted, if required.

3.8 Local roads and main services infrastructure

Survey lines have been installed along Remembrance Drive, Caloola Road, Yarran Road, Charlies Point Road and Great Southern Road, as shown in Drawing No. MSEC1193-01-01.

The survey lines along the local roads and optical fibre cables follow the alignments of Wollondilly Shire Council infrastructure, and services infrastructure including Sydney Water potable water and sewerage pipelines, Jemena gas pipelines, Endeavour Energy electrical infrastructure, and telecommunications infrastructure (Telstra, NBN and TPG). A survey line (V Line) also follows the path of one of Telstra's optical fibre cables along the southern boundary of the Tahmoor Mine site.

The survey lines consist of pegs spaced nominally every 20 m. Surveys will measure levels and horizontal distances between adjacent pegs. Visual inspections will also be conducted along the local roads during the proposed extraction of LW S1A-S7A.

3.9 Main Southern Railway

3.9.1 Surveys along the rail corridor

A survey line was established along the MSR from 97.7 km to 99.8 km prior to the influence of LW S1A on the railway. It has been progressively extended to the south to 101.16 km as each longwall is extracted to include sections of track that are within the predicted limit of subsidence or an angle of draw of 35 degrees, whichever is greater, for each successive LW S2A-S7A.

The survey line consists of pegs spaced nominally 20 m apart along the line. The survey pegs will be measured in absolute 3D on a monthly basis and 2D (levels and horizontal distances between adjacent pegs) on a weekly basis within the periods of active subsidence for each longwall. The extent of the survey will follow the zone of active subsidence as it migrates down each longwall panel.

During the extraction of each longwall, the travelling subsidence wave is expected to migrate slightly south to north as each longwall face approaches and then mines directly beneath the track. The extent of ground surveys, track geometry surveys and track inspections along the rail corridor will, therefore, grow to the north with the advancing longwall face during the mining of LW S1A-S7A. This has been described in the Railway Management Plan (Report No. MSEC1201) and is consistent with previously developed Management Plans for the Tahmoor North longwalls.

The frequencies and extents are summarised as follows:

Stage 1 – Early subsidence period

- Monthly ground surveys are undertaken at survey marks nominally when each longwall face approaches to within 400 metres of each section of railway track.

Stage 2 – Active subsidence period

- Weekly ground surveys are undertaken at survey marks nominally when each longwall face approaches to within 200 metres of each section of railway track.

Stage 3 – Post active subsidence period

- Progressive reduction in monitoring and inspection frequencies and extents for the railway track, embankments, culverts and cuttings, in accordance with the Railway Management Plan.
- Progressive reduction does not commence until each longwall face has passed each section of track by more than 400 metres, and subject to a review of actual monitoring data and approval by ARTC via the governance meeting.

As mining progresses, monitoring measures for each section of track or associated rail infrastructure will progressively migrate from Stage 1 to Stage 2 and, subject to approval by ARTC, Stage 3. An example of the staged monitoring process is provided in **Figure 10** and **Figure 11**.

In the case of the Main Southern Railway, when Stage 3 is reached for each section of track or item of infrastructure, Tahmoor Coal will not reduce monitoring frequencies or stop monitoring until agreed by ARTC (via recommendation by the Rail Management Group). ARTC can agree to the proposed reduction during an ARTC / Tahmoor Coal governance meeting as recorded by minutes of the meeting and reconfirmed separately in writing or email.

The Resources Regulator and the Office of the National Rail Safety Regulator (ONRSR) will be informed of the change separately in writing. This procedure will apply to any change to the monitoring frequencies specified for the Main Southern Railway in the Subsidence Monitoring Plan.

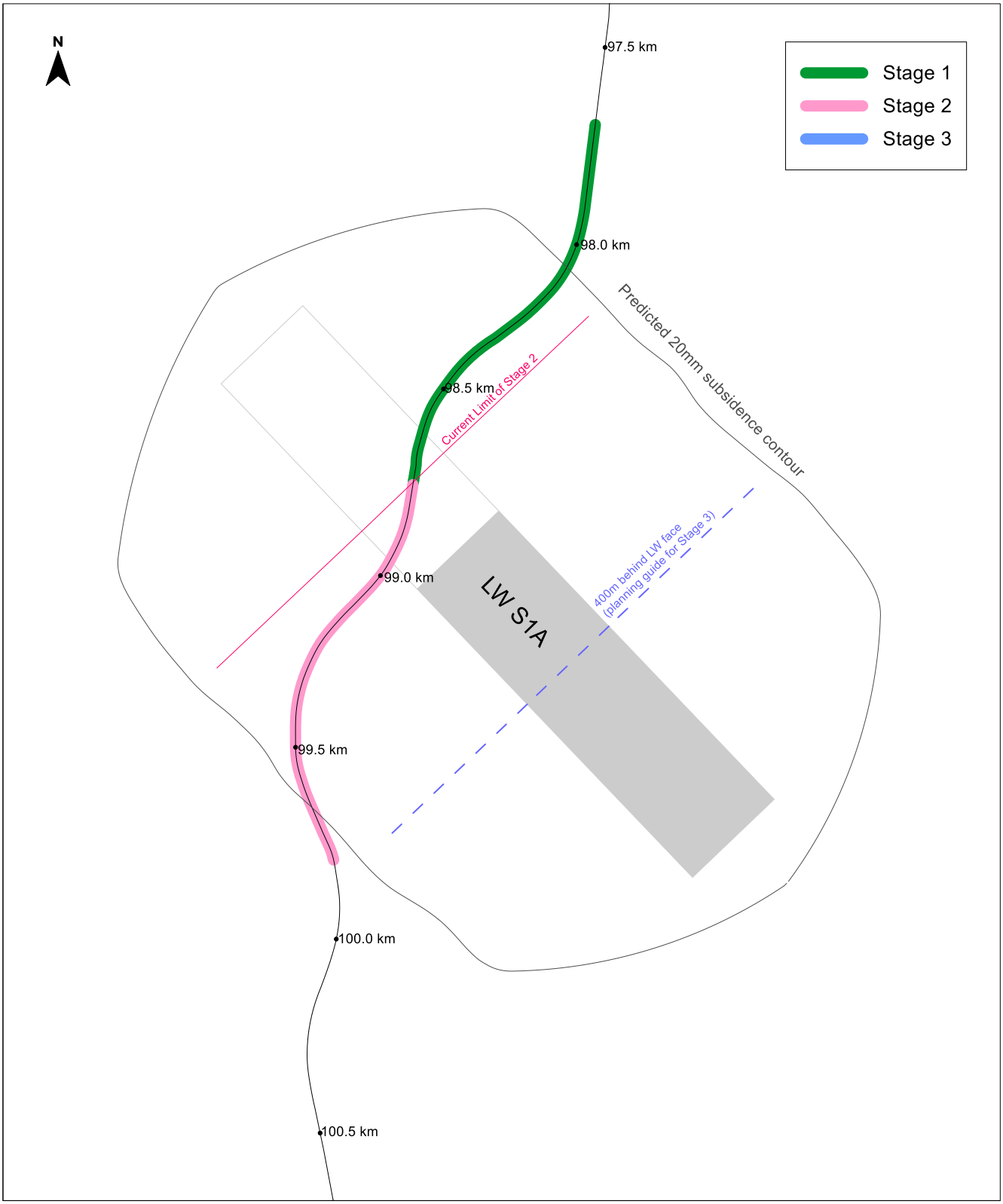

Figure 10 Conceptual diagram showing stages of management during mining of LW S1A at 1000 metres of extraction

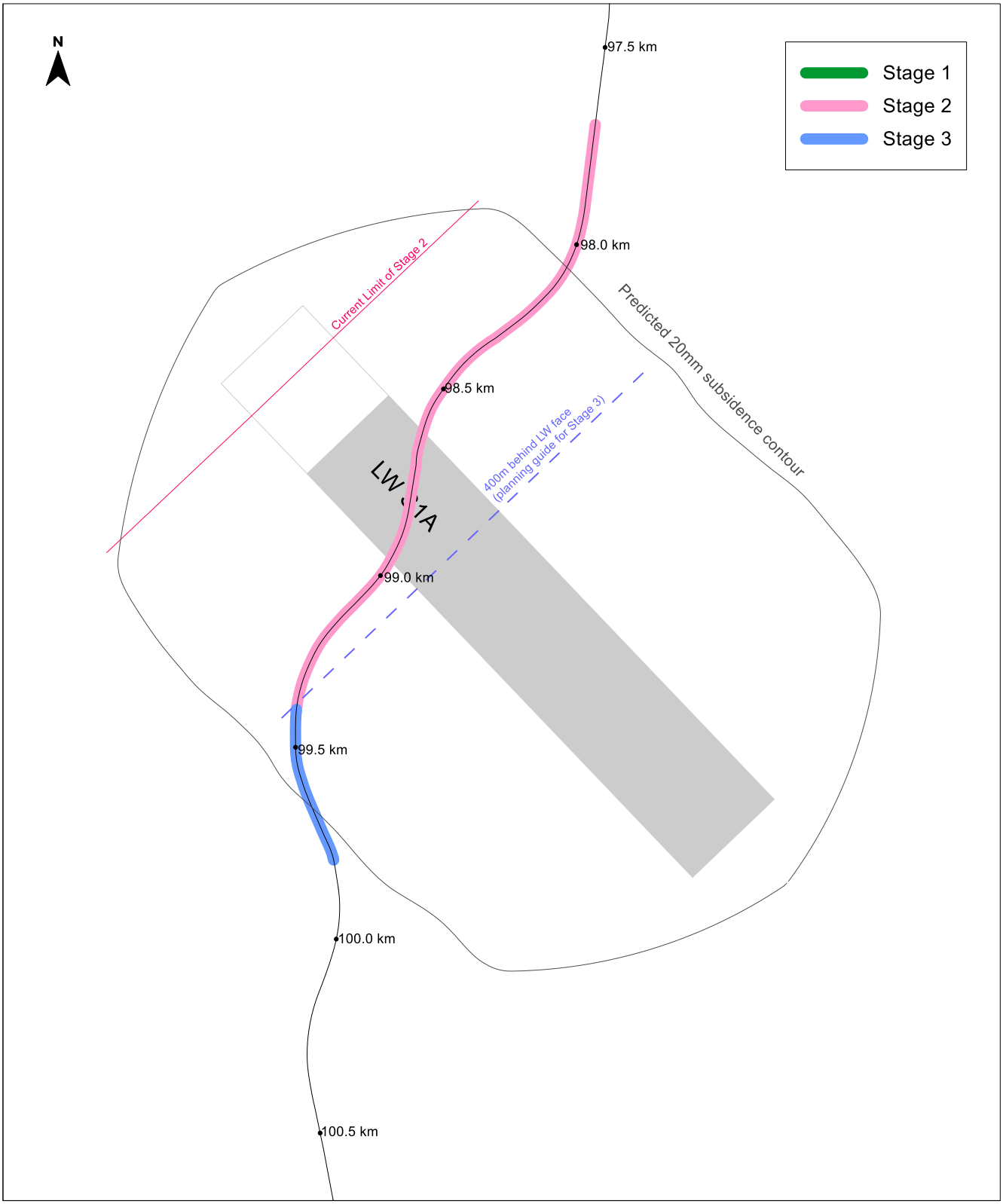

Figure 11 Conceptual diagram showing stages of management during mining of LW S1A at 1400 metres of extraction

3.9.2 Track Geometry Monitoring

The track geometry along the MSR is being monitored by a track recording trolley on a weekly basis during the periods of active subsidence for each longwall. Further details are provided in the MSR Management Plan.

3.9.3 Rail Stress Monitoring

A track expansion system has been installed along MSR to manage potential impacts on rail stress during the mining of LW S1A-S7A.

Rail stress and temperature gauges were initially installed on both rails of each track, spaced every 60 metres along the MSR from 97.780 km to 99.780 km prior to the influence of LW S1A. The rail stress monitoring system has been progressively extended to the south to 101.110 km to include sections of track that are located within the predicted limit of subsidence, an angle of draw of 35 degrees or within 200 metres of the last anchor point, whichever is greater, for each successive LW S2A-S7A.

3.9.4 Expansion Switch Monitoring

Displacement transducers have been installed on all four switch blades for each expansion switch along the MSR prior to the changeover of full toe load clips to zero toe load clips. The changeover of clips is documented in the Railway Management Plan (Report No. MSEC1201).

The switch displacement monitoring system has been progressively extended to the south to monitor changes in displacement of expansion switches that are planned to manage potential impacts on rail stress for each successive LW S2A-S7A.

3.9.5 Visual Inspections

Visual inspections are being conducted along the MSR by a Track Certifier on a daily basis along the railway corridor during the periods of active subsidence for each longwall.

Detailed visual inspections of culverts, embankments and cuttings will be conducted by a geotechnical engineer on a weekly basis when each site is located within the zone of active subsidence.

Further details will be provided in the MSR Management Plan.

3.9.6 Monitoring of railway embankments

3.9.6.1 Ground surveys

In addition to the measures described above, additional ground survey lines have been or will be established along the crests and toes of the MSR embankments. The ground survey lines have been or will be installed prior to the influence of each longwall on each embankment. Survey marks will also be placed at the inlet and outlet of each culvert.

The survey pegs will be measured in absolute 3D on a monthly basis and local 3D on a weekly basis within the periods of active subsidence for each longwall.

Embankment ground surveys have been installed along the Embankments at 98.445 km, 98.739 km, 99.035 km, 99.388 km, 100.121 km and 100.425 km. Batter slopes are shallow along the Up side of the Embankments at 98.445 km, 98.739 km, 99.035 km.

Embankment ground surveys will be progressively extended to the south to include embankments that are within the predicted limit of subsidence or an angle of draw of 35 degrees, whichever is greater, for each successive LW S2A-S7A.

3.9.6.2 Crest extensometers

An automated, continuous extensometer was placed across the crest of the Embankment at 99.388 km prior to the influence of LW S2A.

Extensometers were progressively installed to the south to include Embankments at 100.121 km and 100.425 km when the embankments were within the predicted limit of subsidence or an angle of draw of 35 degrees, whichever was greater, for each successive LW S2A-S7A.

Extensometer monitoring will be reviewed following completion of geotechnical assessments of the railway embankments.

3.9.6.3 Inclinometers

An inclinometer borehole was installed for the Embankment at 99.388 km so that potential deflections in the borehole can be monitored by manual inclinometers during mining. The inclinometer will be surveyed on a weekly basis within the periods of active subsidence for each longwall.

Inclinometer boreholes were progressively installed and monitored to the south to include Embankments at 100.121 km and 100.425 km when these embankments were within the predicted limit of subsidence or an angle of draw of 35 degrees, whichever was greater, for each successive LW S2A-S7A.

Inclinometer monitoring will be reviewed following completion of geotechnical assessments of the railway embankments.

3.9.6.4 Piezometers

A piezometer was installed in the inclinometer borehole for the Embankment at 99.388 km. Piezometers were also installed at the culvert inlet at 100.121 km and 100.425 km. The piezometers measure changes in water pressure during mining.

Piezometer monitoring will be reviewed following completion of geotechnical assessments of the railway embankments.

3.9.6.5 Visual inspections

The embankments are also being inspected by a geotechnical engineer on a weekly basis during the periods of active subsidence for each longwall. Additional inspections can be conducted if adverse changes are observed from daily inspections by Track Certifier, weekly surveys along the rail corridor or continuous readings from extensometers. Further details are provided in the MSR Management Plan.

3.9.7 Monitoring of railway cuttings

There are no substantial cuttings located directly above or immediately adjacent to LW S1A. Following a geotechnical assessment, a cutting that is located directly above LW S3A at 99.690 km and survey marks have been installed along it. The survey pegs are being measured in absolute 3D on a monthly basis and local 3D on a weekly basis within the periods of active subsidence for each longwall.

Cutting ground surveys are being progressively extended to the south to include cuttings that are within the predicted limit of subsidence or an angle of draw of 35 degrees, whichever is greater, for each successive LW S4A-S7A. Survey pegs have been installed at the Cutting at 100.700 km prior to the commencement of LW S4A. Survey marks will be installed at the Cutting at 101.162 km prior to the commencement of LW S5A.

3.9.8 Monitoring of Bargo River Railway Viaduct and Remembrance Drive Bridge over the Main Southern Railway

Two GNSS units are located within the Main Southern Railway corridor to measure far field movements, if any, between the abutments of the Viaduct. The two GNSS units also allowed valley closure, if any, to be detected.

Survey marks were placed on the abutments of the Bargo River Viaduct and the Remembrance Drive Bridge over the MSR prior to the commencement of LW S1A. The marks were re-surveyed at the completion of LW S1A to S3A.

No impacts were recorded to the Viaduct or the Remembrance Drive Bridge over the MSR during the extraction of LWs S1A to S3A. Observed changes in distances between the Viaduct and Bridge abutments were within survey tolerances and less than trigger levels. Whilst GNSS monitoring will continue at the Viaduct, other monitoring and inspections at the Viaduct and Bridge have ceased, in accordance with the risk control procedures for LWs S1A to S3A of the MSR Management Plan. Additional surveys can be conducted if triggered by GNSS results.

3.9.9 Wellers Road Overbridge

A GNSS unit was installed at the Wellers Road Overbridge to measure far field movements.

Continuous, automated laser distancemeters and draw wire displacement sensors were installed at the Bridge during the mining of LW S3A.

Survey marks were placed at the base of the arch and base of abutments on both sides of Wellers Road Overbridge prior to the mining of LW S1A. Survey marks were also be placed at the ends of the spandrel walls at the bridge approaches on both sides of the Overbridge.

The marks will be re-surveyed at the completion of LW S1A to S7A and on a monthly basis during the extraction of Longwalls S4A to S7A. Additional surveys can be conducted if triggered by GNSS results or monitoring results from laser distancemeters and draw wire displacements sensors.

3.10 Tahmoor Mine Site

Surface facilities at Tahmoor Mine, including a total of 142 building structures, tanks and dams are located within the Study Area. The majority of the facilities were not directly mined beneath but a number of structures and other infrastructure will experience mine subsidence movements due to the extraction of the proposed LW S1A-S3A. These included:

- Rail loop line;
- The coal stockpile area;
- Overhead coal conveyors;
- Underground coal conveyors and associated tunnels;
- Plant associated with the coal conveyors;
- The drift portal;
- The winder;
- Building structures, including the coal bins, mine office, bath houses, the washery, workshops and the administration building;
- Overhead gantry crane and monorail within the washery;
- The road bridge over the Rail Loop;
- Associated services infrastructure;
- Dams; and
- Unsealed access roads.

There are also surface facilities just outside the Study Area, including the No. 3 Shaft that is the second entry and egress from the mine, the gas plant and the power generation plant.

The monitoring plan for the Tahmoor Mine Site is shown in Drawing No. MSEC1247-01 and monitoring was conducted during the mining of LWs S1A to S3A in accordance with the Tahmoor Mine Site Management Plan. The monitoring strategy is summarised below:

- Conduct weekly surveys and visual inspections around and within the Mine Site, including along the Rail Loop and overhead conveyors;
- Baseline relative 3D surveys will be conducted around the key building structures. Additional surveys can be conducted if triggered by the survey results or visual inspections; and
- Continuous, automated monitoring at targeted locations.

While impacts were observed, the Tahmoor Mine Site remained safe and serviceable during the mining of LWs S1A to LW S3A and monitoring has ceased in accordance with the Tahmoor Mine Site Management Plan. The planned monitoring was in addition to routine maintenance and monitoring conducted by Tahmoor Mine. Details are provided below.

3.10.1 Ground surveys

As discussed previously in this Subsidence Monitoring Plan, survey lines were installed along the Main Southern Railway, Remembrance Drive and along the Rail Loop within the mine site, prior to the influence of LW S1A. The survey lines were measured in absolute 3D on a monthly basis and 2D (levels and horizontal distances between adjacent pegs) on a weekly basis within the periods of active subsidence for each longwall.

3.10.2 Stockpile Area – Conveyors 5C and 6C

The overhead Conveyor 5C and Underground Conveyor 6C are located within the Stockpile area of the mine site, which have been mined directly beneath by LW S1A.

The following monitoring was conducted in the Stockpile Area:

- Weekly local 3D survey along the Reclaim Tunnel supporting Underground Conveyor 6C during the periods of active subsidence;
- Weekly local 3D survey along the tops of the trestles and the concrete piers supporting Overhead Conveyor 5C during the periods of active subsidence;
- Weekly monitoring of the structural gap in the superstructure frame supporting the Overhead Conveyor 5C;
- Baseline survey of the alignment of Conveyors 5C and 6C; and
- Visual inspections of the Stockpile Area, including the conveyors, trestles and piers, superstructures, Reclaim Tunnel and stockpiles during the periods of active subsidence.

Tahmoor Coal has monitored changes in stress on the steel trestles due to changes in pressure from the stockpile material to confirm assumptions in the structural assessments.

3.10.3 Other Overhead Conveyors on the Mine Site

The following monitoring was conducted along the overhead conveyors on the Mine Site:

- Weekly local 3D survey along the bases of the trestles and other supporting structures for the overhead conveyors, as shown in Drawing No. MSEC1247-01 during the periods of active subsidence;
- Weekly survey across the span supporting Conveyor 3R across the Main Southern Railway;
- Baseline survey of the tops of the trestles and other supporting structures for the overhead conveyors;
- Baseline survey of the alignment of Conveyors 5C and 6C; and
- Visual inspections of the Overhead Conveyors, including the conveyors, trestles and piers, superstructures, and underground tunnels during the periods of active subsidence.

3.10.4 Drift

The predicted limit of subsidence due to the extraction of LW S1A-S7A intersects the Drift approximately 40 metres inside the Portal.

Whilst the potential for impacts on the Drift and the Portal was considered to be low, additional monitoring measures was conducted during active subsidence.

The following monitoring was conducted at the Drift:

- Weekly local survey across the width of the Drift Portal and at locations that are nominally 20 and 40 metres from the Portal, as shown in Drawing No. MSEC1247-01. The survey consisted of survey prisms on the side walls measured subsidence and convergence or opening across the drift. The survey was conducted from the Drift Portal; and
- Routine daily inspections of the Drift, the overhead conveyor mounted on the roof and the jointed rails, as per current procedures.

3.10.5 Winder House

The Winder equipment is sensitive to twist and is mounted on a rigid ground slab. The following monitoring was conducted at the Winder House:

- Baseline relative 3D survey around the Winder House, as shown in Drawing No. MSEC1247-01;
- Continuous, automated monitoring for twist by bi-directional tiltmeters mounted on the machinery or supporting ground slab; and
- Weekly visual inspections of the Winder during the periods of active subsidence.

Tahmoor Mine also conducted real time condition based monitoring of the drive system, for the purposes of planning maintenance cycles.

3.10.6 Building structures

Many structures are located on the Mine Site, including coal bins, the mine office, bath houses, the washery, workshops and the administration building.

While the majority of the structures have been constructed with flexible steel frames, the coal bins are constructed with circular reinforced concrete walls on a heavy duty ground slab. Structural frames are constructed within the 6000 t Bin.

The following monitoring was conducted at the building structures:

- Baseline relative 3D survey around the 6000 t Bin, the two Raw Coal Bins, the Washery and associated elevated hoppers and thickeners, as shown in Drawing No. MSEC1247-01;
- Weekly relative 3D surveys of the supports for the overhead crane rails inside the Washery during the periods of active subsidence;
- Baseline alignment survey of the overhead crane rails within the Washery;
- Monthly crane inspections during periods of active subsidence; and
- Weekly visual inspections of the building structures on the Mine Site during the periods of active subsidence.

3.10.7 Road bridge over the Rail Loop

The road bridge over the Rail Loop consists of an Armco culvert with a compacted earth embankment fill.

The following monitoring was conducted at the road bridge over the Rail Loop:

- Weekly surveys along the Rail Loop during the periods of active subsidence;
- Weekly relative 3D survey of marks on entry and exit of the culvert, as shown in Drawing No. MSEC1247-01; and
- Weekly visual inspections of the road bridge over the Rail Loop including the embankment during the periods of active subsidence.

3.10.8 Dams

A number of dams are located around the Mine Site. Survey marks were placed along the dam walls, as shown in Drawing No. MSEC1247-01.

The following monitoring was conducted at the dams:

- Baseline relative 3D survey of marks around the dams, as shown in Drawing No. MSEC1247-01; and
- Weekly visual inspections of the dams during the periods of active subsidence.

3.10.9 Associated services infrastructure

Tahmoor Coal has an extensive network of services infrastructure, including water pipework, sewer pipework, gas pipework, electrical and telecommunications cabling.

The following monitoring was conducted for services infrastructure at the Mine Site:

- Weekly surveys along the Rail Loop, overhead conveyors and reclaim tunnel during the periods of active subsidence;
- Baseline relative 3D surveys of marks around the main building structures and dams, as shown in Drawing No. MSEC1247-01; and
- Weekly visual inspections of the Mine Site during the periods of active subsidence.

3.11 Wollondilly Anglican College

The monitoring plan for the Wollondilly Anglican College is shown in Drawing No. MSEC1193-11-02. The final positions of the survey marks were coordinated with Wollondilly Anglican College.

A pre-mining hazard identification inspection was completed by John Matheson of JMA Solutions in January 2022. The buildings are a mixture of single and double storey structures. The majority of the structures are steel framed with brick veneer walls. Newer double storey structures have been constructed as reinforced concrete frames with brick veneer walls. The oldest building, Sturt Cottage, is a single storey, double brick structure. The structures were found to be in serviceable condition.

The following monitoring was conducted during the mining of LW S1A to S3A as summarised below:

- Weekly surveys and visual inspections along Remembrance Drive during periods of active subsidence;
- Weekly 2D surveys along lines along and across the College, as shown in Drawing No. MSEC1193-11-02;
- Baseline relative 3D surveys around the College buildings, as shown in Drawing No. MSEC1193-11-02. Additional surveys were conducted when triggered by the survey results or visual inspections; and
- Weekly visual inspections of the College during periods of active subsidence.

While impacts were observed, the Wollondilly Anglican College remained safe and serviceable during the mining of LWs S1A to LW S3A. A final survey and inspection is planned to be conducted at the completion of LW S4A, in accordance with the Wollondilly Anglican College Management Plan.

3.12 Australian Wildlife Sanctuary (Wirrimbirra Sanctuary)

The Australian Wildlife Sanctuary is located on Remembrance Drive and covers an area of approximately 95 ha. The site is also known as Wirrimbirra Sanctuary, which is the name that is listed as an item of heritage on the State Heritage Register (01508). The Sanctuary contains rich and diverse plantings of native plants in formalised gardens, which were developed to provide areas of representative native plants for education and research purposes.

The Australian Wildlife Sanctuary includes a visitor centre, a glass house and other shade structures, along with established gardens and walks. A dingo sanctuary is located on the property. Two cottages are located next to the visitor centre. Some structures were destroyed by bushfires in late 2019 but the main structures within the sanctuary, and the dingo sanctuary were successfully protected. It is planned to replace the lost buildings in the future.

A pre-mining hazard identification inspection was completed by John Matheson of JMA Solutions in January 2020. The structures generally comprise timber-framed structures with metal-clad timber-framed roofs on reinforced concrete ground slabs. The structures were found to be in serviceable condition.

The monitoring plan for the Australian Wildlife Sanctuary (Wirrimbirra Sanctuary) is shown in Drawing No. MSEC1074-07. The following monitoring measures are planned:

- Conduct weekly surveys and visual inspections along Remembrance Drive, Main Southern Railway and Charlies Point Road during periods of active subsidence;
- Conduct weekly relative 3D surveys around the Sanctuary buildings during periods of active subsidence;
- Conduct GNSS monitoring, as discussed in Section 3.5;
- Conduct ground surveys across the Tributary to Teatree Hollow on Australian Wildlife Sanctuary, as discussed in Section 3.6;
- Conduct weekly visual inspections of the Sanctuary buildings, including the Dingo Sanctuary and the farm dams during periods of active subsidence;
- Conduct asbestos air monitoring during periods of active subsidence; and
- Conduct surface water level and water quality monitoring, as discussed in **Section 3.18**.

3.13 Commercial, Industrial and Business Establishments

A total of 143 structures are located within the Study Area that are used for industrial, commercial or business purposes. The establishments include the Bargo Petroleum and Hill Top Pit Stop (petrol station and automotive repair workshop and a wreckers yard), MKD Machinery (a concrete plant), Inghams poultry farms, Bargo Valley Produce facilities, the Canine Country Club and Cattery, and the Tahmoor Garden Centre. They also include mine infrastructure owned and operated by Tahmoor Mine, which were discussed in **Section 3.10**.

Tahmoor Coal will develop Property Safety Management Plans (PSMPs) in consultation with landowners prior to the influence of LW S1A-S7A on each property.

The properties have been inspected prior to the development of the PSMPs by a structural engineer.

The monitoring plan for the establishments is shown in Drawing No. MSEC1193-01-01. The final positions of the survey marks will be coordinated with the landowners. The monitoring strategy is summarised below, subject to agreements with the landowners:

- Conduct weekly surveys and visual inspections along Remembrance Drive during periods of active subsidence (many of the establishments are located along Remembrance Drive);
- Conduct weekly relative 3D surveys will be conducted around the establishments;
- Conduct weekly visual inspections of the establishments during periods of active subsidence; and
- Conduct specialist monitoring, where required following detailed consultation with landowners. This includes:
- Monitoring the integrity of the fuel tanks at the petrol station; and
- Baseline monitoring of the verticality of the vehicle hoist at the mechanic's workshop.

3.14 Residential structures

Survey lines have been installed along Remembrance Drive, Caloola Road, Yarran Road, Charlies Point Road and Great Southern Road, as shown in Drawing No. MSEC1193-01-01.

The survey lines along the local roads pass the majority of the residential structures. The survey lines consist of pegs spaced nominally every 20 m. Surveys will measure levels and horizontal distances between adjacent pegs.

Visual inspections are also being conducted along the local roads during periods of active subsidence during the proposed extraction of LW S1A-S7A.

In accordance with the Built Structures Management Plan, the following surveys and inspections will be conducted as required:

- Conduct weekly surveys and visual inspections along local streets during periods of active subsidence;
- Tahmoor Coal will offer to install ground survey marks around residential structures that are located directly above LW S1A-S67, particularly for semi-rural and rural structures that are remote from streets where survey lines are installed. Tahmoor Coal will particularly encourage landowners to agree to install survey pegs for selected properties, where recommended by the geotechnical engineer or structural engineer due to their proximity to steep slopes or pre-existing condition. Where landowners have agreed to install survey marks, Tahmoor Coal will offer to conduct at least one survey when the properties are experiencing active subsidence during the extraction of each relevant longwall. The locations of installed survey marks around houses to date are shown in Drawing No. MSEC1193-01-01;
- Visual inspections of residential structures during periods of active subsidence that are either: located on or adjacent to steep slopes, are in poor existing condition (based on the hazard identification inspections), or where recommended by the Structures Response Group; and
- Visual inspections of pool fences and gates during periods of active subsidence.

3.15 Optical fibre cables

A network of optical fibre cables owned by Telstra, NBN Co. and TPG are located directly above and adjacent to the proposed LW S1A-S7A.

In addition to ground surveys and visual inspections along the local roads, Optical Time Domain Reflectometer (OTDR) monitoring will be conducted on potentially affected optical fibre cables during the extraction of proposed LW S1A-S7A. OTDR monitoring has been used extensively by Tahmoor Coal's telecommunications consultant Comms Network Solutions during the mining of previously extracted longwalls.

Following the retirement of Colin Dove, OTDR monitoring will be conducted by the asset owners, with Telstra testing its cable during the mining of LW S3A. Baseline monitoring has been conducted prior to mining and infrastructure owners will conduct routine real time monitoring of optic fibre performance as per their existing maintenance monitoring plans. The frequency of targeted OTDR monitoring can be conducted if alerted from the real time monitoring system or triggered by observations of non-conventional subsidence movements. The losses in attenuation can be identified early and located by the OTDR monitoring system to a sufficient accuracy to allow the affected cable(s) to be locally exposed by excavation and relieved of deformations.

The NBN telecommunications tower is located at No. 3166 Remembrance Drive, with access from Yarran Road. The tower is located directly above LW S6A. Tahmoor Coal has consulted with NBN regarding the tower to manage potential impacts on the tower and its operations. This Subsidence Monitoring Plan has been updated prior to the influence of LW S4A-S7A on the tower. Tiltmeters have been installed to

continuously monitor tilts at the Tower. It is also planned to conduct visual inspections on a weekly basis during periods of active subsidence.

3.16 Electrical infrastructure

A network of overhead and buried electrical infrastructure owned by Endeavour Energy is located directly above and adjacent to proposed LW S1A-S7A.

An inspection of power poles located directly above and adjacent to LW S1A-S7A was conducted by Endeavour Energy prior to the commencement of LW S1A. Experience has shown that power poles have remained safe and serviceable during and after mining.

In addition to ground surveys and visual inspections along local roads, Endeavour Energy has recommend individual power poles for monthly monitoring by survey when each pole is experiencing active subsidence.

3.17 Potable water, sewerage and gas infrastructure

A network of potable water, sewerage and gas pipelines are located within the Study Area. The main pipelines are located along Remembrance Drive and the Main Southern Railway. They include Sydney Water's Cast Iron Cement Lined (CICL) 450 mm diameter watermain, Sydney Water's 180 mm diameter welded PE sewer pressure main and Jemena's 150 mm diameter steel gas main.

The watermain supplies potable water along Caloola Road and Yarran Road within the Study Area. The sewer pressure main and gas main travel straight through the Study Area without branching off to connect to local properties.

The following monitoring is planned to be conducted as summarised below:

- Conduct weekly 2D surveys along local streets, including Remembrance Drive, Caloola Road and Yarran Road during periods of active subsidence;
- Conduct monthly 3D surveys along Remembrance Drive during periods of active subsidence;
- Continuously monitor displacements of Gibault joints on the watermain, which have been installed at selected creek crossings;
- Conduct visual inspections along local streets during periods of active subsidence; and
- Conduct baseline gas detection survey along Jemena's steel main and additional gas detection surveys at the completion of each longwall. Additional gas detection surveys can be undertaken if triggered by ground survey results or visual inspections.

3.18 Picton Weir

The Picton Weir is located on the Bargo River just downstream of the confluence with Hornes Creek. The weir was constructed in the late 19th century and it was built to provide water to the surrounding townships. It is now heavily silted and is not used for water supply. Water retained by the weir is released at its base through a seized open valve and outlet pipe.

The Picton Weir is listed on Wollondilly Shire Council's Wollondilly Local Environmental Plan 2011 (Listing Number 141). As described on the NSW government heritage inventory, Picton Weir has local significance as evidence of the attempts by State and Local governments to provide reliable potable water sources to towns and regional areas in the late 19th century.

The following monitoring is planned to be conducted as summarised below:

- GNSS monitoring at both ends of Picton Weir (Sites S13 and S14, both installed);
- GNSS monitoring at a location between LWs S1A to S7A and the Picton Weir (Site S19, installed);
- GNSS monitoring at three pairs across Hornes Creek (Sites S20 to S25, installed);

- Survey marks on rockfaces on both sides of the Picton Weir (installed and baseline surveyed);
- Survey marks on the Picton Weir (to be installed prior to start of LW S3A);
- Laser distancemeter monitoring across the Picton Weir near the crest and base of the Weir (to be installed prior to start of LW S4A);
- Photogrammetric survey of shape of dam wall and surrounding rockfaces on both sides of the Picton Weir (baseline survey completed);
- Vertical inclinometers in borehole BH01 at northern side of the Picton Weir (boreholes drilled, inclinometer tubing installed and baseline surveyed prior to start of LW S3A);
- Groundwater level monitoring in borehole BH01 at northern side of the Picton Weir (installed);
- Surface water level monitoring upstream of Picton Weir (to be installed prior to start of LW S4A);
- Detailed visual inspection of Picton Weir and surrounding rockfaces by UAV (baseline inspection completed); and
- Visual inspections during mining.

3.19 Surface Water monitoring

Surface water monitoring points have been established along Teatree Hollow and Tributary to Teatree Hollow.

There are 2 sites on Teatree Hollow, and 2 sites on Tributary to Teatree Hollow, as shown in Drawing No. MSEC1193-02-01.

The monitoring sites measure changes in water level and quality.

Further details are provided in the Water Management Plan.

3.20 Groundwater monitoring

A groundwater monitoring plan has been developed by Tahmoor Coal and it is described in the Water Management Plan. The locations of groundwater monitoring sites around proposed LW S1A-S7A are shown in Drawing No. MSEC1193-02-02. Groundwater monitoring includes monitoring of groundwater levels and quality.

3.21 Biodiversity monitoring

A biodiversity monitoring plan has been developed by Tahmoor Coal and it is described in the Biodiversity Management Plan. The locations of riparian monitoring sites and aquatic biodiversity monitoring sites are shown in Drawing No. MSEC1193-02-03.

3.22 Aboriginal heritage sites

A plan has been developed by Tahmoor Coal to monitor changes at Aboriginal heritage sites during the extraction of proposed LW S1A-S7A and it is described in the Heritage Management Plan.

Monitoring of ground movements at Teatree Hollow and Tributary to Teatree Hollow is described in **Section 3.6**. This includes detailed monitoring of ground movements at a site along Tributary to Teatree Hollow where a rock shelter with art is present.

Visual inspections will be conducted at the Aboriginal heritage sites by an archaeologist at the completion of LW S1A-S7A for sites within the predicted limit of incremental subsidence of each active longwall.

Table 8 Subsidence Monitoring Program for LW S1A-S7A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
General subsidence surveys					
GNSS units as shown in Drawing No. MSEC1193-01-01	Continuous GNSS monitoring	Absolute easting, northing and level (MGA coordinates)	• Units S1 to S28 installed	• Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S7A.	-
LW S1A Tahmoor Mine boundary line (V Line)	2D survey line along Tahmoor Mine property boundary	2D subsidence and distance	• Pegs installed and baseline surveyed	• Monthly within active subsidence zone of LW S1A (complete).	• Survey at end of LW S1A-S4A.
Wollondilly Shire Council infrastructure					
Local roads (Remembrance Drive, Caloola Road, Yarran Road, Charlies Point Road, Great Southern Road)		•	•	•	•
	2D survey along Charlies Point Road	• 2D subsidence and distance	• Pegs installed and baseline surveyed	• Monthly survey during LWs S1A-S5A between 200m and 800m extraction, and continue if ongoing adverse movements are observed	• Full length survey at end of LWs S1A-S7A
	2D / Absolute 3D surveys along Remembrance Drive	• 2D subsidence and distance • RL, Absolute Easting and Northing and 2D distance between pegs along Remembrance Drive	• Pegs installed and baseline surveyed	• Monthly 3D / Weekly 2D surveys for pegs within active subsidence zone commencing as per below: LW S1A: start after 1300m extraction LW S2A: start after 900m extraction LW S3A: start after 500m extraction LW S4A: start after 200m extraction LW S5A: start after GNSS 28 subsides more than 20 mm due to LW S5A or 200m extraction, whichever occurs first LW S6A: start after GNSS 28 subsides more than 20 mm due to LW S5A or 200m extraction, whichever occurs first • Continue surveys until outside active subsidence zone or one month after end of LW and continue further if ongoing adverse movements are observed.	• Full length survey at end of LWs S1A-S7A
	2D surveys along Caloola Road	• 2D subsidence and distance	• Pegs installed and baseline surveyed	• Weekly 2D surveys for pegs within active subsidence zone commencing as per below: LW S2A: start after 900m extraction LW S3A: start after 800m extraction LW S4A: start after 800m extraction LW S5A: start after 900m extraction LW S6A: start after 900m extraction Continue surveys until outside active subsidence zone or one month after end of LW and continue further if ongoing adverse movements are observed.	• Full length survey at end of LWs S1A-S7A
	2D surveys along Yarran Road	• 2D subsidence and distance	• Pegs installed and baseline surveyed	• Weekly 2D surveys for pegs within active subsidence zone commencing as per below: LW S4A: start after 200m extraction LW S5A: start after 200m extraction LW S6A: start after 200m extraction LW S7A: start after 200m extraction	• Full length survey at end of LWs S3A-S7A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
				• Continue if ongoing adverse movements are observed.	
	2D surveys along Great Southern Road	• 2D subsidence and distance	• Pegs installed and baseline surveyed	• Weekly 2D surveys for pegs within active subsidence zone commencing as per below: LW S4A: start after 200m extraction LW S5A: start after 200m extraction LW S6A: start after 200m extraction • Continue if ongoing adverse movements are observed	• Full length survey at end of LWs S3A-S7A
	Visual inspections of streets	-	-	• Detailed inspection once a week within the active subsidence zone of LW S1A-S7A.	-
Remembrance Drive embankment over Teatree Hollow	Ground survey	• RL, Absolute and Local easting and northing	• Pegs installed and baseline surveyed	• Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below: LW S2A: start after 900m extraction LW S3A: start after 800m extraction LW S4A: start after 800m extraction LW S5A: start after 900m extraction • Continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW S2A-S6A
	Visual inspection by building inspector	-	• Baseline inspection complete	• Weekly during periods of active subsidence of LW S2A to S5A and continue if ongoing adverse movements are observed	-
	Visual inspection by geotechnical engineer	-	• Baseline inspection complete	• Monthly during periods of active subsidence of LW S2A to S5A and continue if ongoing adverse movements are observed	-
Remembrance Drive embankment over Tributary to Teatree Hollow (RE3)	Ground survey	• RL, Absolute and Local easting and northing	• Pegs installed and baseline surveyed	• Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below: LW S4A: start after 300m extraction LW S5A: start after 400m extraction LW S6A: start after 400m extraction • Continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW S3A-S7A
	Visual inspection by building inspector	-	• Baseline inspection complete	• Weekly during periods of active subsidence of LW S4A to S6A and continue if ongoing adverse movements are observed	-
	Visual inspection by geotechnical engineer	-	• Baseline inspection complete	• Monthly during periods of active subsidence of LW S4A to S6A and continue if ongoing adverse movements are observed	-
Remembrance Drive embankment over Tributary to Teatree Hollow (RE2)	Ground survey	• RL, Absolute and Local easting and northing	• Pegs installed and baseline surveyed	• Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below: LW S4A: start after 200m extraction	• Absolute 3D survey at end of LW S3A-S7A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
				LW S5A: start after 200m extraction LW S6A: start after 200m extraction • Continue if ongoing adverse movements are observed.	
	Visual inspection by building inspector	-	• Baseline inspection complete	• Weekly during periods of active subsidence of LW S4A to S6A and continue if ongoing adverse movements are observed	-
	Visual inspection by geotechnical engineer	-	• Baseline inspection complete	• Monthly during periods of active subsidence of LW S4A to S6A and continue if ongoing adverse movements are observed	-
Remembrance Drive embankment at Wellers Road (RE1)	Ground survey	• RL, Absolute and Local easting and northing	• Install and baseline survey pegs prior to LW S5A.	• Monthly 3D surveys during LW S6A between 200 m and 800 m and continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW S5A-S7A
	Visual inspection by building inspector	-	• Baseline inspection prior to LW S5A	• Weekly during LW S6A between 200 m and 800 m and continue if ongoing adverse movements are observed	-
	Visual inspection by geotechnical engineer	-	• Baseline inspection prior to LW S5A	• Monthly during LW S6A between 200 m and 800 m and continue if ongoing adverse movements are observed	-
Remembrance Drive cutting (RC1)	Ground survey	RL, Absolute and Local easting and northing	• Pegs installed and baseline surveyed	• Monthly 3D / Weekly 2D surveys within active subsidence zone commencing as per below: LW S3A: start after 500m extraction LW S4A: start after 400m extraction LW S5A: start after 400m extraction LW S6A: start after 500m extraction • Continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW S2A-S7A
	Visual inspection by building inspector	-	• Baseline inspection complete	• Weekly during periods of active subsidence of LW S3A to S6A and continue if ongoing adverse movements are observed	-
	Visual inspection by geotechnical engineer	-	• Baseline inspection complete	• Monthly during periods of active subsidence of LW S3A to S6A and continue if ongoing adverse movements are observed	-
Causeway on Government Road	Ground survey	• 2D subsidence and distance	• Baseline inspection complete	• Monthly 2D surveys during LW S4A to S7A between 200 m and 1000 m and continue if ongoing adverse movements are observed.	• Survey at end of LW S1A-S7A
	Visual inspection	-	• Baseline inspection complete	• Monthly inspections during LW S4A to S7A between 200 m and 1000 m and continue if ongoing adverse movements are observed.	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Bargo Cemetery	Ground survey	RL, Local easting and northing	• Install and baseline survey pegs prior to LW S4A (complete)	• Weekly Relative 3D surveys between 200m and 1000m of extraction of LWs S4A to S6A and continue if ongoing adverse movements are observed	• Survey at end of LW S4A-S7A
	Visual inspection	-	• Baseline inspection complete • Detailed visual inspection immediately prior to start of LW S4A (complete)	• Weekly inspections between 200m and 1000m of extraction of LWs S4A to S6A and continue if ongoing adverse movements are observed	• End of LW S7A
Sydney Water potable water and sewerage infrastructure					
Potable water infrastructure	Ground surveys along streets	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan.		
	Visual inspections of streets	-	As described for Wollondilly Shire Council Management Plan.		
	Continuous Gibault expansion joint monitoring	Distance	• Teatree Hollow crossing at Caloola Rd installed • Tributary to Teatree Hollow crossing north of Remembrance Drive and Yarran Road installed. • Tributary to Teatree Hollow crossing adjacent to Main Southern Railway at 100.425 km - install prior to LW S5A.	• Continuous readings recorded hourly.	-
Gas infrastructure					
Gas infrastructure	Gas detection surveys	-	• Baseline survey prior to LW S1A.	• If triggered by ground surveys and/or visual inspections	• End of LW S1A-S7A
	Ground surveys along streets	• 2D subsidence and distance • RL, Absolute Easting and Northing and 2D distance between pegs along Remembrance Drive	As described for Wollondilly Shire Council Management Plan.		
	Visual inspections of streets	-	As described for Wollondilly Shire Council Management Plan.		
Electrical infrastructure					
Electrical infrastructure	Ground surveys along streets	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan.		
	Visual inspections of streets	-	As described for Wollondilly Shire Council Management Plan.		
Critical power poles	Power pole surveys	Subsidence at base and vertical offset (or tilt)	• Baseline survey of poles identified by Endeavour Energy for poles within the predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 600 metres of pole.	• Monthly for each pole within active subsidence zone, and for following three months thereafter.	• End of LW for all poles within predicted limit of incremental subsidence of each active LW
Telecommunications infrastructure					
Telstra, NBN and TPG infrastructure	Ground surveys along streets and Main Southern Railway	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan and Main Southern Railway.		
	Ground survey along optical fibre cable south of Tahmoor Mine site between Remembrance Drive and Main Southern Railway	2D subsidence and distance	• Install and baseline survey prior to influence of LW S1A	• Weekly during period of active subsidence	• End of LW S1A-S5A.
	Visual inspections of streets	-	As described for Wollondilly Shire Council Management Plan.		
	Detailed visual inspections of pits and streets	-	-	• Weekly inspection of streets when within active subsidence zone. Pits to be	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
				inspected as required when triggered by monitoring results.	
	OTDR monitoring of optical fibre cables	-	-	• As required when triggered by monitoring results for cables located within active subsidence zone.	-
NBN telecommunications tower	Ground surveys		• Baseline survey complete	• Weekly when within active subsidence zone	• End of LWs S4A-S7A.
	Visual inspections	-	-	• Weekly when within active subsidence zone	-
	Continuous tilt monitoring	Tilt	• Tiltmeters installed on NBN Tower	• Continuous readings recorded every 5 minutes.	-
Picton Weir					
Picton Weir	Continuous GNSS monitoring	Absolute easting, northing and level (MGA coordinates)	• Install prior to commencement of LW S1A (Units S13, S14 and S19 to S25 installed.	• Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S7A and continue if ongoing adverse movements are observed.	-
	Ground surveys on both sides of Weir	RL, Local easting and northing	• Pegs installed and baseline surveyed	• Monthly during extraction of LWs S5A-S7A and continue if ongoing adverse movements are observed.	• End of LWs S3A-S7A
	Laser distancemeter monitoring	Distance	• Install and commission prior to start of LW S4A	• Hourly readings until end of LW S7A and continue if ongoing adverse movements are observed	-
	Vertical inclinometer monitoring	Change in tilt	• Installed and baseline surveyed	• Monthly during LWs S5A, S6A and LW S7A and continue if ongoing adverse movements are observed	• End of LWs S3A to S7A
	Groundwater level monitoring	Water level	• Installed and commissioned	• Download monthly during LWs S5A to S7A and continue if ongoing adverse movements are observed	• Download end of LWs S3A to S7A
	Surface water level monitoring	Water level	• Install and commission prior to start of LW S4A	• Hourly readings until end of LW S7A and continue if ongoing adverse movements are observed	-
	Visual inspection by UAV	-	• Baseline inspection complete	• Monthly during LWs S5A to S7A and continue if ongoing adverse movements are observed	• End of LWs S3A to S7A
	Visual inspections	-	• Baseline inspection complete	• Monthly during extraction of LWs S5A-S7A and continue if ongoing adverse movements are observed.	-
	Visual inspections by structural and geotechnical engineers	-	• Inspect prior to 500m extraction of LW S5A to LW S7A	-	-
Wollondilly Anglican College					
Wollondilly Anglican College infrastructure	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys along designated monitoring lines as shown in Drawing No. MSEC1193-11-02	2D subsidence and distance	• Baseline survey complete	• Weekly when within active subsidence zone for LWs S1A and S2A and continue for one month after end of LW	• End of LW S1A-S4A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
				• One survey in August 2024 to track residual subsidence after LW S2A	
	Ground surveys around Clifford Warne Auditorium as shown in Drawing No. MSEC1193-11-02	RL, Local easting and northing	• Baseline survey complete	• Weekly when within active subsidence zone for LWs S1A and S2A and continue for one month after end of LW	• End of LW S1A-S4A
	Ground surveys around structures as shown in Drawing No. MSEC1193-11-02	RL, Local easting and northing	• Baseline survey complete	• One survey around Johnson Cottage, COLA, the Canteen and White Cottage in August 2024 to track residual subsidence after LW S2A • If triggered by ground surveys and/or visual inspections	• End of LW S1A-S4A
	Alignment survey of sensitive classroom equipment	-	• Pre-mining survey	• If triggered by weekly ground surveys and/or visual inspections	• End of LW S1A-S4A
	Visual inspections	-	• Pre-mining structural inspection and assessment (complete)	• Weekly for LWs S1A and S2A when within active subsidence zone • Weekly after 1400m of extraction of LW S3A until the end of LW S3A and continue if adverse movements are observed.	-
Australian Wildlife Sanctuary					
Australian Wildlife Sanctuary	Ground surveys along streets and Main Southern Railway	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan and Main Southern Railway.		
	Ground surveys around perimeter of main buildings as shown in Drawing No. MSEC1074-07	RL, Local easting and northing	• Baseline survey (complete)	• Weekly when within active subsidence zone	• End of LW S2A-S6A.
	Asbestos air monitoring	-	• Baseline air monitoring (complete)	• Weekly when within active subsidence zone	-
	Visual inspections by building inspector	-	• Pre-mining hazard identification inspection (complete)	• Weekly when within active subsidence zone	-
	Visual inspections by heritage consultant	-	• Pre-mining heritage inspection (complete)	• If triggered by ground surveys and/or visual inspections	End of LW S2A-S6A.
Spatial Services					
Permanent survey marks	Ground surveys along streets	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan.		
Structures					
Houses, pools and other residential structures	Ground surveys along streets	2D subsidence and distance	As described for Wollondilly Shire Council Management Plan.		
	Ground surveys for structures as requested by or agreed with landowners	RL, Local easting and northing	• Baseline survey of house prior to each LW approaching within 400 m of property (majority completed).	• One survey per longwall when house is within active subsidence zone, targeted to occur when LW face has passed house between 100 and 200 metres.	• End of LW S1A-S7A.
	Visual inspections of streets	-	As described for Wollondilly Shire Council Management Plan.		
	Visual inspections of specific structures, including pools	Varies depending on structure	Refer Built Structures Management Plan (Weekly when within active subsidence zone or as required by geotechnical or structural engineer).		

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Farm dams	Visual inspection of farm dams	Dam embankment integrity and water level observation	• One observation by a geotechnical consultant prior to undermining using fixed location photo points.	• Monthly observations by a geotechnical consultant during periods of active subsidence using fixed location photo points.	• Quarterly observations by a geotechnical consultant for a minimum of 12 months post mining using fixed location photo points.

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Commercial, Industrial and Business Establishments					
Bargo Petroleum	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around perimeter of main building	RL, Local easting and northing	• Install and baseline survey prior to influence of LW S1A-S6A	• Weekly during LW S3A when within active subsidence zone after 1200 m and continue for one month after end of LW	• End of LW S1A-S6A
	Visual inspections	-	• Pre-mining structural inspection and assessment (complete)	• Weekly during LW S3A when within active subsidence zone after 1200 m and continue for one month after end of LW	-
	Pressure testing of fuel tanks and fuel lines	-	• Pre-mining baseline test (complete)	• If triggered by monitoring results	• End of LW S3A Additional test after end of LW S3A if more than 50 mm additional subsidence develops at the petrol station and for every 50 mm thereafter
	On-site groundwater testing	Visual and hydrocarbon testing	• Pre-mining baseline test (complete)	• Monthly during LW S3A when within active subsidence zone after 1200 m and continue for one month after end of LW	• Additional test after end of LW S3A if more than 50 mm additional subsidence develops at the petrol station and for every 50 mm thereafter
	Fuel balance monitoring			• Monthly as per standard practice • Weekly during LW S3A when within active subsidence zone after 1200 m and continue for one month after end of LW	• End of LW S1A-S3A
Bargo Petroleum mechanic shop	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around perimeter of main building	RL, Local easting and northing	• Install and baseline survey prior to influence of LW S1A-S6A	• Weekly when within active subsidence zone	• End of LW S1A-S4A
	Visual inspections, including car hoist	-	• Pre-mining structural inspection and assessment (complete)	• Weekly when within active subsidence zone	-
Inghams Poultry Sheds on Remembrance Drive	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys along southern perimeter fence	RL, Local easting and northing	• Baseline survey complete	• Weekly when within active subsidence zone	• End of LW S2A-S4A
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S2A (complete)	• Weekly when within active subsidence zone	-
Inghams Poultry Sheds on Yarran Road	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around perimeter of sheds	RL, Local easting and northing	• Install and baseline survey prior to influence of LW S5A	• Weekly when within active subsidence zone	• End of LW S5A-S7A
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S5A	• Weekly when within active subsidence zone	-
Tahmoor Garden Centre	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around perimeter of main buildings	RL, Local easting and northing	• Baseline survey complete	• Weekly when within active subsidence zone after 1000 m for LW S4A, and after 1100 m for LW S5A until end of LW	• End of LW S1A-S6A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S1A (complete)	• Weekly when within active subsidence zone	-
Bargo Valley Produce	Ground surveys along Yarran Rd	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around perimeter of main buildings	RL, Local easting and northing	• Install and baseline survey prior to influence of LW S5A	• Weekly when within active subsidence zone	• End of LW S5A-S7A
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S5A	• Weekly when within active subsidence zone	-
MKD Machinery Concrete Plant	Ground surveys along Remembrance Drive	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Ground surveys around plant structures	RL, Local easting and northing	• Baseline survey complete	• Weekly when within active subsidence zone after 450m for LW S3A and LW S4A, and after 550m for LW S5A	• End of LWs S2A-S7A
	Tiltmeters on silo hopper tower	Tilt	• Installed	• Readings every 2 hours	-
	Alignment survey of sliding gate	-	• Baseline complete	• If triggered by monitoring results	-
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S3A (complete)	• Weekly when within active subsidence zone after 450m for LW S3A and LW S4A, and after 550m for LW S5A and S6A	End of LW S2A-S7A
Canine Country Club	Ground surveys along Yarran Road	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Visual inspections	-	• Pre-mining structural inspection and assessment prior to influence of LW S6A	• Weekly when within active subsidence zone	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Main Southern Railway					
Railway track	Absolute 3D ground survey along rail corridor	Absolute easting, northing and level (MGA coordinates)	• Pegs installed and baseline surveyed for LWs S1A-S7A	• Monthly 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed.	• Full length survey for section of railway within predicted limit of incremental subsidence of each active LW
	Focussed 2D ground survey along rail corridor	2D subsidence and distance	• Pegs installed and baseline surveyed for LWs S1A-S7A	• Focussed weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Full length survey for section of railway within predicted limit of incremental subsidence of each active LW.
	Rail creep surveys of expansion switches, anchor points and CWR track	2D distance	• Baseline survey after installation of zero toe load clips	• Weekly after active LW face approaching within 200 metres of survey line.	-
	Long bay length ground surveys *Extents as per Focussed 2D ground surveys*	2D distances over bay lengths that are nominally 100 m long	• Install and baseline survey pegs for section of railway within predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 600 metres of survey line.	• Focussed weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Full length survey for section of railway within predicted limit of incremental subsidence of each active LW.
	Automated, continuous rail stress, rail temperature and switch displacement monitoring	Rail stress, rail temperature and switch displacement	• Gauges installed for LWs S1A to S7A	• Every 5 minutes.	-
	Track geometry surveys using Amber track mounted device or equivalent *Extents as per Focussed 2D ground surveys*	Superelevation (cant), twist, gauge	• Baseline survey for section of railway within predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 600 metres of railway track.	• Focussed weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Full length survey for section of railway within predicted limit of incremental subsidence of each active LW.
	Track inspection by qualified track certifier. *Extents as per Focussed 2D ground surveys*	The inspection will check infrastructure within the rail corridor, including the track, culverts, cuttings, embankments and fences	• Baseline inspection for section of railway within predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 200 metres of railway track.	• Daily during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Tahmoor Mine Conveyor Crossing	Survey between conveyor trestles on either side of Railway	Distance	• Baseline survey prior to LW S1A face approaching within 600 metres of crossing (complete)	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• End of LW S1A-S2A (complete)

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Railway culverts and embankments	Absolute 3D surveys and relative 3D surveys along monitoring lines on the crests and/or toes of the embankments on both sides and at spring points of both sides of culverts.	Absolute easting, northing and level (MGA coordinates) Relative easting, northing and level	• Pegs installed and baseline surveyed for LWs S1A-S7A	• Monthly Absolute 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed. • Weekly Relative 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW for embankments within predicted limit of incremental subsidence of each active LW.
	Automated, continuous extensometer across crests of the embankments at 99.338 km, 100.121 km and 100.425 km	Distance	• Installed and commissioned	• Every 15 minutes.	-
	Inclinometer surveys for the Embankments at 99.388 km, 100.121 km and 100.425 km	Change in tilt	• Install and baseline surveyed	• Monthly surveys during periods of active subsidence and continue if ongoing adverse movements are observed.	-
	Piezometer monitoring for the Embankments at 99.388 km, 100.121 km and 100.425 km	Change in water pressure	• Installed and commissioned	• Every 15 minutes.	-
	Inspection by geotechnical engineer	-	• Baseline inspection for embankments within predicted limit of incremental subsidence of each active LW, prior to active LW face approaching within 200 metres of each embankment.	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Railway cuttings	Absolute 3D and relative 3D surveys every 20 metres along the toes and across the crests of the cuttings at 99.690 km, 100.700 km and 101.162 km	Absolute / relative easting, northing and level (MGA coordinates)	• Install and baseline survey for Cutting at 99.690 km (complete) • Install and baseline survey for Cutting at 100.700 km prior to start of LW S4A (complete) • Install and baseline survey for Cutting at 101.162 km prior to start of LW S5A	• Monthly Absolute 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed. • Weekly Relative 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed.	• Absolute 3D survey at end of LW S4A-7A.
	Inspection by geotechnical engineer	-	• Baseline inspection prior to start of each LW.	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Bargo River Railway Viaduct and Remembrance Drive Bridge over the Main Southern Railway	Continuous GNSS monitoring	Absolute easting, northing and level (MGA coordinates)	• Install prior to commencement of LW S1A (Units S11 and S12 installed).	• Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S7A and continue if ongoing adverse movements are observed.	-
	Absolute 3D survey of marks on ground, piers and abutments	Absolute easting, northing and level (MGA coordinates)	• Install and baseline survey prior to start of LW S1A (complete)	-	• Absolute 3D at end of LW S1A-S3A (complete)
	Relative 3D survey of marks	RL, Local easting and northing	• Install and baseline survey prior to start of LW S1A (complete)	-	• Survey at end of LW S1A-S3A (complete)
Wellers Road Overbridge	Continuous GNSS monitoring	Absolute easting, northing and level (MGA coordinates)	• Install prior to commencement of LW S1A (Unit S15 installed).	• Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S7A and continue if ongoing adverse movements are observed.	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
	Absolute 3D survey	Absolute easting, northing and level (MGA coordinates)	• Install and baseline survey prior to start of LW S1A (complete)	-	• Absolute 3D at end of LW S1A-S7A
	Local 3D survey marks at base of arch, base of the abutment walls and at the ends of the spandrel walls	RL, Local easting and northing	• Install and baseline survey prior to start of LW S1A (complete)	• Monthly after 200m extraction for LWs S4A to S7A	• Survey at end of LW S1A-S7A
	Laser distancemeter and draw wire sensor monitoring	Distance	• Installed and commissioned	• Every 15 minutes	-
	Crack gauge monitoring	-	• Installed and commissioned	• Monthly after 200m of extraction of LWs S4A to S7A until 800m of extraction unless ongoing adverse changes observed	• End of LW S1A-S7A
Tahmoor Mine Rail Loop (complete)					
Railway track	Absolute 3D ground survey along rail loop	Absolute easting, northing and level (MGA coordinates)	• Pegs installed and baseline surveyed	• Monthly 3D surveys during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S2A (complete)
	2D ground survey along rail corridor	2D subsidence and distance	• Pegs installed and baseline surveyed	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S2A (complete)
	Long bay length ground surveys	2D distances over bay lengths that are nominally 100 m long	• Pegs installed and baseline surveyed	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S2A (complete)
	Track geometry surveys using Amber track mounted device or equivalent	Superelevation (cant), twist, gauge	• Baseline survey completed	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S2A (complete)
	Track inspection by qualified track certifier.	The inspection will check infrastructure within the rail corridor, including the track, culverts, cuttings, embankments, rail hopper, road and conveyor crossings	• Baseline inspection completed	• Daily during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Road crossing over Rail Loop	Relative 3D survey of marks on entry and exit of the culvert	RL, Local easting and northing	• Baseline survey completed	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S2A (complete)

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Tahmoor Mine Site Infrastructure (complete)					
Mine site in general	Absolute 3D and 2D Ground surveys along Main Southern Railway	• Absolute easting, northing and level (MGA coordinates) • 2D subsidence and distance	• As described for Main Southern Railway.		
	Absolute 3D and 2D Ground surveys along Rail Loop	• Absolute easting, northing and level (MGA coordinates) • 2D subsidence and distance	• As described for Tahmoor Rail Loop.		
	Absolute 3D and 2D Ground surveys along Remembrance Drive	• 2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan.		
	Visual inspections of mine site, including Stockpile Area, overhead conveyors, underground conveyors, building structures, pavements, dams (subsidence inspection in addition to routine inspections by Tahmoor Mine as part of routine operations)	-	• Baseline inspection complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Stockpile Area (Conveyors 5C and 6C)	Relative 3D surveys along Reclaim Tunnel (Conveyor 6C)	RL, Local easting and northing	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A (complete)
	Relative 3D surveys along tops of trestles and concrete piers (Conveyor 5C)	RL, Local easting and northing	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A(complete)
	Monitoring of structural gap in structural frames supporting Conveyor 5C	Distance	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A(complete)
	Baseline survey of alignment of Conveyors 5C and 6C	Vertical and lateral alignment of conveyors	• Baseline survey complete	-	-
Overhead and underground conveyors (other than Conveyors 5C and 6C)	Relative 3D survey along bases of trestles and other supporting structures for the overhead conveyors	RL, Local easting and northing	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A(complete)
	Baseline relative 3D survey of tops of trestles and other supporting structures for the overhead conveyors	RL, Local easting and northing	• Baseline survey complete	-	-
	Baseline relative 3D survey along tunnels	RL, Local easting and northing	• Baseline survey complete	-	-
	Baseline survey of alignment of conveyors	Vertical and lateral alignment of conveyors	• Baseline survey complete	-	-
Drift portal	Relative 3D survey of Drift Portal	RL, Local easting and northing	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A(complete)
	Visual inspections of Drift	-	• Routine daily monitoring activity at Tahmoor Mine		
Winder House	Baseline relative 3D survey around Winder House	RL, Local easting and northing	• Baseline survey complete	-	-
	Continuous, automated monitoring for twist by bi-directional tiltmeters	Tilt	• Installed and commissioned	• Every 15 minutes.	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Building structures	Baseline relative 3D survey around 6000 t Bin, Raw Coal Bins, the Washery incl hoppers and thickeners	RL, Local easting and northing	• Baseline survey complete	-	-
	Relative 3D surveys of rail supports to overhead crane rails inside Washery	RL, Local easting and northing	• Baseline survey complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A (complete)
	Crane inspections	-	• Monthly during periods of active subsidence		
	Baseline alignment survey of overhead crane rails	Vertical and lateral alignment or rails	• Baseline survey complete	-	-
Dams	Relative 3D survey of dams	RL, Local easting and northing	• Baseline survey complete	• Monthly inspections by a geotechnical consultant during periods of active subsidence and continue if ongoing adverse movements are observed.	• Survey after end of LW S1A-S3A (complete)
Reject Emplacement Area	2D survey line along western side of REA within Study Area	2D subsidence and distance	• Install and baseline survey complete	• Monthly within active subsidence zone of LW S1A.	• Survey at end of LW S1A-S3A (complete)
	Visual inspections of REA within Study Area including emplacement area, pavements and drains	-	• Baseline inspection complete	• Weekly during periods of active subsidence and continue if ongoing adverse movements are observed.	-
Environmental monitoring					
Ground surveys across streams	Continuous GNSS monitoring	Absolute easting, northing and level (MGA coordinates)	As described for general subsidence surveys		
Ground surveys across the base of Teatree Hollow and the Tributary to Teatree Hollow, as shown in **Drawing No. MSEC1193-01-01**	Relative 3D survey	RL, Local easting and northing	• Baseline survey prior to start of LW S1A (complete)	-	• Survey at end of LW S1A-S7A
Ground surveys across the Bargo River above previously extracted LWs 14B to 19, as shown in **Drawing No. MSEC1193-01-01**	Closure survey	Horizontal distance between marks	• Baseline survey prior to start of LW S1A (complete)	-	• Survey at end of LW S1A-S7A

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Surface water monitoring, as shown in **Drawing No. MSEC1193-02-01**	Streamflow monitoring	Refer Water Management Plan	• Continuous readings, downloaded monthly. Refer Water Management Plan for further details.	• Continuous readings, downloaded monthly. Refer Water Management Plan for further details.	• Continuous readings, downloaded monthly for 12 months following completion of LW S7A. Refer Water Management Plan for further details.
	Continuous water level monitoring	Water level relative to Cease to Flow level for subject pool	• Continuous readings, downloaded monthly. Refer Water Management Plan for further details.	• Continuous readings, downloaded monthly. Refer Water Management Plan for further details.	• Continuous readings, downloaded monthly for 12 months following completion of LW S7A. Refer Water Management Plan for further details.
	Manual water level monitoring	Water level relative to Cease to Flow level for subject pool	• Monthly. Refer Water Management Plan for further details.	• Monthly. Refer Water Management Plan for further details.	• Monthly for 12 months following completion of LW S7A. Refer Water Management Plan for further details.
	Water quality sampling	Refer Water Management Plan	• Monthly. Refer Water Management Plan for further details.	• Monthly. Refer Water Management Plan for further details.	• Monthly for 12 months following completion of LW S7A. Refer Water Management Plan for further details.
Physical features and natural behaviour of pools	Visual inspections of pools in Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary	-	• Baseline inspection survey (complete) • Observe prior to start of LW S1A (complete)	• Monthly during periods of active subsidence (after 200 m of secondary extraction of relevant longwall)	• Quarterly observations over 12 months for pools no longer within active subsidence zone.
Geomorphology and channel stability	Visual inspections / geomorphology survey of stream reaches of Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary	-	• Baseline inspection survey (complete) • Observe prior to mining of LW S1A S7A (complete). Refer to Water Management Plan for further details.	• Monthly during periods of active subsidence. Refer to Water Management Plan for further details.	• Observe knickpoint formation post-mining of each relevant longwall. • Geomorphology survey following completion of LW S7A. • Refer to Water Management Plan for further details.
	Catchment survey of 10 headwater sites	-	• Pre-mining survey. Refer to Water Management Plan for further details.	• Annually. Refer to Water Management Plan for further details.	• Post-mining survey. Refer to Water Management Plan for further details.
Cliffs and Natural Steep Slopes					
Cliffs	Visual inspections by geotechnical engineer	-	• Site inspection and calculation of face area by March 2023 (complete). Baseline inspections for Cliff BC2 prior to LW S3A (complete) and Cliff BC1 prior to LW S6A	-	• Observation at the completion of mining for Cliff BC2 after LWs S3A to S7A and Cliff BC1 after LW S7A. Refer to Land Management Plan for further details.
Natural steep slopes	Visual inspections by geotechnical engineer	-	• Observation one month prior to active subsidence. Refer to Land Management Plan for further details.	• Monthly during active subsidence. Refer to Land Management Plan for further details.	• Quarterly for 12 months following active subsidence. Refer to Land Management Plan for further details.
Agricultural Land					
Agricultural lands	Visual inspection	-	• Prior to the commencement of mining. Refer to Land Management Plan for further details.	-	• Completion of each longwall. Refer to Land Management Plan for further details.

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Groundwater monitoring					
Groundwater monitoring, as shown in **Drawing No. MSEC1193-02-02**	Groundwater level monitoring of shallow bores (Open Stand Pipes (OSP)) and private bores (OSP)	Water level in borehole (RL)	• Continuous readings, downloaded monthly, and monthly manual measurements. Refer Water Management Plan for further details.	• Continuous readings, downloaded monthly, and monthly manual measurements. Refer Water Management Plan for further details.	• Continuous readings, downloaded quarterly, and quarterly manual measurements for 12 months following the completion of LW S7A. Refer Water Management Plan for further details.
	Continuous shallow and deep groundwater pressure monitoring (vibrating wire piezometers (VWP))	Water pressure	• Continuous readings. Refer Water Management Plan for further details.	• Continuous readings. Refer Water Management Plan for further details.	• Continuous readings for 12 months following the completion of LW S7A. Refer Water Management Plan for further details.
	Groundwater level and quality data download from NSW Government monitoring bores	Water level and quality	• Monthly download of data. Refer Water Management Plan for further details.	• Monthly download of data. Refer Water Management Plan for further details.	• Quarterly download of data for 12 months following the completion of LW S7A. Refer Water Management Plan for further details.
	Groundwater quality sampling	Refer Water Management Plan	• Monthly sampling. Refer Water Management Plan for further details.	• Monthly sampling. Refer Water Management Plan for further details.	• Quarterly sampling for 12 months following the completion of LW S7A. Refer Water Management Plan for further details.
Biodiversity monitoring					
Riparian vegetation, Threatened Ecological Communities, and Threatened flora species monitoring, as shown in **Drawing No. MSEC1193-02-03**	Riparian vegetation, Threatened Ecological Community and Threatened flora health at monitoring and control sites	Refer Biodiversity Management Plan	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn) for 12 months following the completion of LW S7A. Refer Biodiversity Management Plan for further details.
Amphibian monitoring, as shown in **Drawing No. MSEC1193-02-03**	Frog surveys at monitoring and control sites	Refer Biodiversity Management Plan	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn) for 12 months following the completion of LW S7A. Refer Biodiversity Management Plan for further details.
Aquatic sites, as shown in **Drawing No. MSEC1193-02-03**	Aquatic habitat assessment, macroinvertebrate sampling, water quality sampling, fish sampling at monitoring sites and control sites	Refer Biodiversity Management Plan	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn). Refer Biodiversity Management Plan for further details.	• Bi-annually (Spring and Autumn) for 12 months following the completion of LW S7A. Refer Biodiversity Management Plan for further details.
Aboriginal heritage monitoring					
Teatree Hollow 2013.1 (Rock shelter site with art and artefacts)	Visual inspection and condition assessment by archaeologist	Refer Heritage Management Plan	• Baseline visual inspection (completed). • Baseline recording, sampling and photogrammetry (completed). • Refer to Heritage Management Plan for further details.	• Fortnightly (monitoring overall rock shelter stability) during periods of active subsidence. Refer to Heritage Management Plan for further details.	• End of each relevant LW. Refer to Heritage Management Plan for further details.
	Review of monitoring data from GNSS units / survey lines in proximity to the rock shelter.	-	-	• Review monitoring data monthly during periods of active subsidence. Refer to Heritage Management Plan for further details.	-
	Structural geotechnical review of rock shelter.	Refer Heritage Management Plan.	• Complete review prior to commencement of LW S1A (complete).	-	-

Feature	Monitoring Component / Location	Parameters	Timing and Frequency (may be increased if triggered by monitoring results)		
			Pre-mining Monitoring	During Mining Monitoring	Post-mining Monitoring
Items of Heritage Significance					
Australian Wildlife Sanctuary	Ground survey	2D subsidence and distance	• As described for Australian Wildlife Sanctuary Management Plan		
	Structural assessment	-	• As described for Australian Wildlife Sanctuary Management Plan		
	Visual inspection by archaeologist	-	• Baseline visual inspection as part of Statement of Heritage Impact (complete).	-	• Completion of LW S5A
Picton Weir	Refer monitoring measures described for Picton Weir				
Tahmoor Mine	Refer monitoring measures described for Tahmoor Mine				
Great Southern Road	Refer monitoring measures described for Wollondilly Shire Council				
Bargo Cemetery	Ground surveys along Great Southern Road and Charlies Point Road	2D subsidence and distance	• As described for Wollondilly Shire Council Management Plan, including Bargo Cemetery and Main Southern Railway.		
	Visual inspection and condition assessment by archaeologist	-	• Baseline inspection completed.	-	• End of LW S7A
Bargo Railway Bridge North (Wellers Road Overbridge)	Ground and structure surveys	-	• Refer monitoring measures described for Main Southern Railway, including Wellers Road Bridge		
	Visual inspection by archaeologist	-	• Prior to mining.	-	• End of LW S7A.
Bargo Railway Viaduct	Ground and structure surveys	-	• Refer monitoring measures described for Main Southern Railway		
	Visual inspection by archaeologist	-	• Prior to mining.	-	• End of LW S7A.

4 Document Information

4.1 Referenced Documents

Reference information, listed in **Table 9** below, is information that is directly related to the development of this document or referenced from within this document.

Table 9 Reference Information

Title
NSW Department of Planning and Environment (DPE) (2022), Extraction Plan Guideline.
NSW Department of Planning & Environment (2017), Resources Regulator, Mine Safety Operations.
SIMEC (2019) Tahmoor South Project Environmental Impact Statement, Volumes 1 and 7, dated January 2019.
SIMEC (2020a) Tahmoor South Project Amendment Report, including Appendices A to R and response to submissions, dated February 2020.
SIMEC (2020b) Tahmoor South Project Second Amendment Report, Appendices A to O and response to submissions, dated August 2020.
SIMEC (2020c) Additional information responses dated 14 September 2020 (including Appendices A to L), 23 October 2020 and 4 November 2020.

4.2 Related Documents

Related documents, listed in **Table 10** below, are internal documents directly related to or referenced from this document.

Table 10 Related Documents

Number	Title
TAH-HSEC-00365	LW S1A-S7A Extraction Plan Main Document
TAH-HSEC-00361	LW S1A-S7A Water Management Plan
TAH-HSEC-00362	LW S1A-S7A Land Management Plan
TAH-HSEC-00363	LW S1A-S7A Biodiversity Management Plan
TAH-HSEC-00364	LW S1A-S7A Heritage Management Plan
TAH-HSEC-00366	LW S1A-S7A Built Features Management Plan
TAH-HSEC-00365	LW S1A-S7A Public Safety Management Plan
TAH-HSEC-00367	LW S1A-S7A Subsidence Monitoring Plan

4.3 Glossary of Terms

Section 8.3 of the Extraction Plan Main Document provides a compiles Glossary of Terms.

4.4 Abbreviations

Abbreviations used in this document are provided below in **Table 11.**

Table 11 Abbreviations

Abbreviation	Definition
ARTC	Australian Rail Track Corporation
CICL	Cast Iron Concrete Lined
CCL	Consolidated Coal Lease
CHPP	Coal handling and preparation plant
Commonwealth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water Formerly known as Commonwealth Department of Agriculture, Water and the Environment (DAWE)
DAWE	Commonwealth Department of Agriculture, Water and the Environment Now known as Commonwealth Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW)
DPE	NSW Department of Planning and Environment Formerly known as NSW Department of Planning, Industry and Environment (DPIE) Now known as NSW Department of Planning, Housing and Infrastructure (DPHI)
DPHI	NSW Department of Planning, Housing and Infrastructure Formerly known as NSW Department of Planning and Environment (DPE)
DPIE	NSW Department of Planning, Industry and Environment Now known as NSW Department of Planning, Housing and Infrastructure (DPHI)
EIS	Environmental Impact Statement
GNSS	Global Navigation Satellite System
km	Kilometre/s
kV	Kilovolt
LGA	Local Government Area
LW	Longwall
LW S1A-S6A	Longwall South 1A to South 6A
m	Metre/s
mm	Millimetre/s
MSEC	Mine Subsidence Engineering Consultants
NBN Co	National Broadband Network Corporation
MSR	Main Southern Railway
NSW	New South Wales
OTDR	Optical Time Domain Reflectometer
PSMP	Property Subsidence Management Plan
Resources Regulator	NSW Department of Planning and Environment – Resources Regulator
SSD 8445	Tahmoor South Project Development Consent (the Consent)

Study Area	Study Area applicable to this management plan consists of a combination of the predicted 20 millimetre (mm) Total Subsidence Contour and the 35o Angle of Draw Line as shown in **Figure 2.**
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine

4.5 Change Information

Full details of the document history are recorded below in **Table 12**.

Table 12 Document History

Version	Date Reviewed	Reviewed By	Change Summary
0.1	May 2022	April Hudson, Zina Ainsworth, Charlie Wheatley, Malcolm Waterfall, Peter Vale	New document.
1.0	May 2022	April Hudson, Zina Ainsworth, Charlie Wheatley, Malcolm Waterfall, Peter Vale	Updated document following provision of document to Resources Regulator.
2.0	September 2022	April Hudson, Zina Ainsworth, Charlie Wheatley	Updated document following consultation with DPE (now DPHI), government agencies and the Independent Advisory Panel for Underground Mining.
3.0	January 2023	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(e) following the commencement of first and second workings (18 October 2022) of the Consent SSD 8445.
4.0	June 2023	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(b) following the submission of an Annual Review (31 March 2023), Condition E7(c) following the submission of an Independent Environmental Audit (2 June 2023) and Condition E7 (d) following the approval of any modification (Modification - 13 June 2023) of the Consent SSD 8445.
5.0	June 2024	April Hudson, Zina Ainsworth	Review in accordance with Condition E7(b) following the submission of an Annual Review (28 March 2024).
6.0	February 2025	Daryl Kay, Nick Le Baut, Zina Ainsworth	Review following the approval of Amendment 2 (shortening of LWS4A) to the Tahmoor South LWS1A-S6A Extraction plan (11 November 2024).
7.0	October 2025	Daryl Kay, Nick Le Baut	Review in accordance with Condition E7(d) following the approval of Modification 3 (26 May 2025) and Condition E7(b) following the submission of an annual review (30 September 2025).

APPENDIX A – Drawings

I:\Projects\Tahmoor South\MSEC1193 - LW S1A-S6A Management Plans\MSEC1193-01 General\AcadData\MSEC1193-01-01 Subsidence Monitoring.dwg

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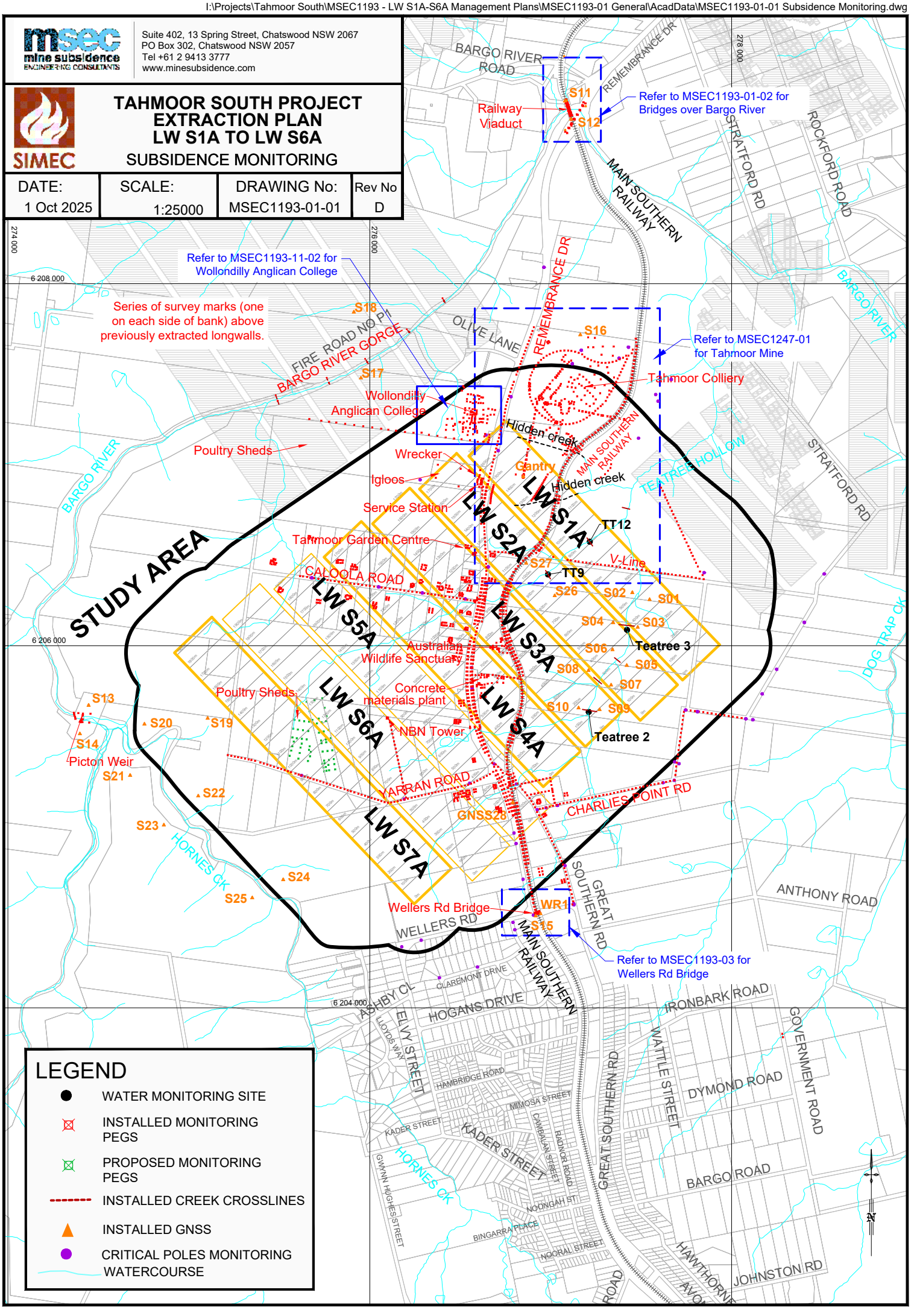
SIMEC

TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

SUBSIDENCE MONITORING

DATE:	SCALE:	DRAWING No:	Rev No
1 Oct 2025	1:25000	MSEC1193-01-01	D



LEGEND

- WATER MONITORING SITE
- INSTALLED MONITORING PEGS
- PROPOSED MONITORING PEGS
- INSTALLED CREEK CROSSLINES
- INSTALLED GNSS
- CRITICAL POLES MONITORING WATERCOURSE

APPENDIX B – Survey Specification by SMEC

SIMEC MINING
Tahmoor Coking Coal

SMEC
Member of the Surbana Jurong Group

SPECIFICATIONS FOR SUBSIDENCE MONITORING FOR LONGWALLS S1A-S6A

1. General Requirements

   1.1. All surveys will be provided to the Tahmoor Colliery Mining Survey as digital Excel file/s.
   1.2. *Survey and Drafting Directions for Mine Surveyors 2020 (NSW - Mines)* in particular *Section 3. (Survey Standards and Procedures)* will be complied with.

2. Required Surveys

   2.1. Levels to Australian Height Datum (AHD) on each station of the subsidence line (in order to obtain subsidence). Some isolated surveys may be carried out to a relative datum where required.
   2.2. Measured distance between each station of the subsidence line (in order to obtain strains).
   2.3. Relative co-ordinates of subsidence line stations where required (in order to obtain relative horizontal & vertical movement).

3. Establishment

   3.1. Each line will be established and initial readings taken prior to the influence of mine subsidence affecting the subsidence line with a minimum distance of 600m from longwall extraction may be used as a guide. This timeframe will be nominated by Tahmoor Coal and installation time frames agreed.
   3.2. Care is to be taken that bench marks and GNSS control stations will be unaffected by ground movement (subsidence & horizontal movement) from future mining or current Longwall extraction. The location of these bench marks and control stations should be confirmed with Tahmoor Coal before use.

4. Surveying Methods

   4.1. ICSM SP1 refers to The Inter-Governmental Committee on Surveying and Mapping Special Publication 1 “Standard for the Australian Survey Control Network” (see https://www.icsm.gov.au/publications/standard-australian-survey-control-network-special-publication-1-sp1)

   4.2. One, or a combination of, the following survey methods may be used and target accuracy must be achieved. Primarily EDM survey methods will be used where possible. Other survey methods are included herein in the event that they are required in specific circumstances.

   4.3. Total Station Survey Methods ~ For both Subsidence & Strain and Three Dimensional Surveys

      4.3.1. Conventional Theodolite/EDM levelling traverse for measuring subsidence & strain.
      4.3.2. Additional survey for three dimensional location of subsidence marks by conventional Theodolite/EDM traverse adjusted between GNSS Baseline(s).
      4.3.3. Height Datum to be carried through traverse by height levelling.
      4.3.4. Maximum traverse line length nominally 150 metres.
      4.3.5. Maximum intermediate line length nominally 80 metres.
      4.3.6. Target at each subsidence station to generally be either a fixed survey prism, a handheld miniprism or a survey prism & fixed pole with dual-support for stability.

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Wollongong NSW 2500
Telephone 02 9900 7128

4.4. GNSS Survey Control for Absolute Three Dimensional Survey of Subsidence Lines:

4.4.1. Connection of absolute three-dimensional surveys, where applicable, to GNSS coordinates resolved using Network RTK methods. Coordinates to be resolved in the current nominated Map Grid of Australia Datum (GDA2020).

4.4.2. Surveyed coordinates for each GNSS position by this method are to be observed in sets using an average of a minimum of three 2-minute occupations measured once and the whole set repeated again at least 30 minutes apart. *Refer to tables 14 & 15 "Technical Specifications for NSW Secondary Control Surveys" NSW Spatial Services (January 2021).*

5. Target Accuracies

5.1. Target Accuracies for monitoring surveys shall be as follows:
Differential Levelling (Digital Level) - 1.5mm per kilometre of double run.
Differential Levelling (Theodolite) to an accuracy of ±5mm.

5.1.1. Strain distances measured to an accuracy of ±5mm (Strain 0.25mm/m over a 20 m bay) for measurement by Total Station.

5.1.2. Traversing shall be minimum Class D or LC as prescribed in ICSM SP1 or better.

5.1.3. Co-ordinates derived from horizontal movement surveys (by traverse &/or GNSS) shall have an absolute accuracy of ± 20mm or better (Relative two dimensional accuracy of ± 5mm).

6. Subsidence Station Placement

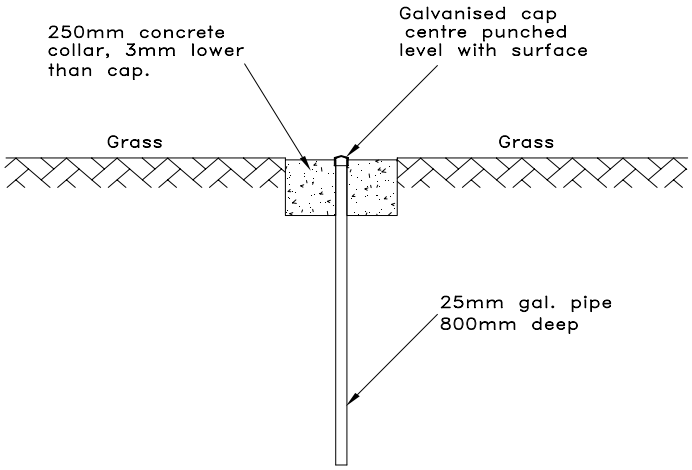
6.1. Installation. Marks are typically either fixed monitoring prisms or standard ground mark subsidence stations. Fixed prisms are either bolted to rock or a solid structure or fixed to a stable star picket. Standard ground mark subsidence marks are to be installed level or below the ground and in such a way so as not to become a danger or hazard (to the public, railway employees, livestock or other persons).

6.2. Location. Subsidence stations are to be installed in locations that will not be damaged or run over by vehicles. Where subsidence stations are located in a position near where vehicles or other equipment may access, the location of the subsidence station should be clearly indicated with an adjacent stake or other warning marker.

6.3. Spacing. All subsidence stations are to be placed at nominal 20 metre intervals and in a straight line where possible.

6.4. Line length. The subsidence line will cover the area affected by mining and shall be specified by Tahmoor Coal.

6.5. Station type. The standard ground mark subsidence stations are to generally be 20mm diameter galvanised pipe, driven into the ground to approximately 800mm length (or to refusal), capped and marked with a centre punch or rivet, together with a concrete collar (as shown below).
Where an area of bitumen or concrete needs to be crossed marks may be installed as a galvanized iron nail, road spike, ramset nail, rivet or drill hole.



6.6. Placement in footpaths and locations of Utility/Service providers. Utilities and services are not to be damaged by the subsidence stations.

6.6.1. Railway Corridor. The location of utilities and services needs to be ascertained from the appropriate rail authority and confirmed prior to installation of the subsidence survey line.

7. Survey Instrument Calibration

7.1. In accordance with NSW Surveyor General Direction No.5 survey instruments associated with this project will be calibrated annually.

7.2. A calibration certificate will be supplied to Tahmoor Colliery.

8. Monitoring frequency

The lines will be established and surveyed initially before subsidence affects the line.

Various timing for resurvey frequency may be requested by the Tahmoor Coal based on the requirements of the Subsidence Management Plans.

Where requested, a final survey will be completed at the end of each longwall before the area is affected by extraction of the next adjacent longwall.

Please refer to Tahmoor Coal Subsidence Management Plans for survey frequencies.

9. Reports

The following information shall be included in the report:

9.1. Date of survey.
9.2. When requested a summary stating maximum values of subsidence, tensile(+ve) strain, compressive(-ve) strain and horizontal movement of the current survey. Reports can also state if any visual subsidence impacts were observed.
9.3. Excel table and XML file showing subsidence results of current survey. Both to be supplied electronically.
9.4. Any other relevant information required by the Surveyor.

10. Additional Information
    Tahmoor Coal will provide an AutoCAD file of the Mine Workings if required.
    Tahmoor Coal will provide an Excel & XML files to be used as templates where required.

Yours faithfully,
SMEC Australia Pty Ltd
per .. **Gary Warren**
Registered Surveyor
Survey Team Leader
Level 2, 6-8 Regent Street
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Gus.Warren@smec.com

Tahmoor Coal Contacts:

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Amanda Fitzgerald
Environment & Community Clerk
Tahmoor Coal
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APPENDIX C – Survey Specification by Southern Rail Surveys

Southern Rail Surveys Pty Ltd

PO Box 990

Wollongong, NSW, 2500

Main South Line- Survey Monitoring Plan for LW's S1A to S6A

1. General Requirements

   1.1. All surveys will be provided to the Tahmoor Colliery Mining Survey as digital Excel file/s.
   1.2. *Survey and Drafting Directions for Mine Surveyors 2020,* in particular *Section 3. (Survey Procedures)* will be complied with (see. www.dpi.nsw.gov.au/minerals and use search).

2. Required Surveys

   2.1. Levels to Australian Height datum (AHD) on each station of the subsidence line. (In order to obtain subsidence.)
   2.2. Measured distance between each station of the subsidence line. (In order to obtain strains.)
   2.3. MGA Co-ordinates of each station of subsidence lines where possible. (In order to obtain horizontal movement).

3. Establishment

   3.1. Each line will be established and initial readings taken prior to the influence of mine subsidence affecting the subsidence line; a minimum distance of 600 m from longwall extraction may be used as a guide. This timeframe will be nominated by Tahmoor Colliery and installation time frames agreed.
   3.2. Care is to be taken that bench marks and control stations (GPS base stations) will be unaffected by ground movement (subsidence & horizontal movement) from future mining or current Longwall extraction. The location of these bench marks and control stations should be confirmed with Tahmoor Colliery before use.

4. Surveying Methods

   4.1. ICSM SP1 refers to The Inter-Governmental Committee on Surveying and Mapping Special Publication 1 "Standards and Practices for Control Surveys".
   (see http://www.icsm.gov.au/icsm/publications/sp1/sp1v2.2)

   4.2. One, or a combination of, the following survey methods may be used and target accuracy must be achieved. Primarily Total Station survey methods will be used where possible. Other survey methods are included herein in the event that they are required in specific circumstances.

   4.3. Totalstation Methods ~ For both Subsidence & Strain and Three Dimensional Survey Traversing

      4.3.1. Conventional Total Station levelling/traverse for measuring subsidence & strain.
      4.3.2. Additional survey for three dimensional location of subsidence marks by conventional Total Station traverse adjusted between GNSS Baseline(s).
      4.3.3. Height Datum to be carried through traverse by height traversing.
      4.3.4. Maximum traverse line length nominally 150 metres.
      4.3.5. Maximum intermediate line length nominally 80 metres.
      4.3.6. Target at each subsidence station to generally be a fixed miniprism.

Southern Rail Surveys Pty Ltd

PO Box 990

Wollongong, NSW, 2500

4.4. GNSS Survey Control for Three Dimensional Survey of Subsidence Lines:

4.4.1. Use of NSW CORSnet GNSS Base Stations. Datum is GDA 2020. This is a NSW wide system of continuously operating GNSS receivers. Procedures in accordance with Surveyors General Direction No. 12 (Sect 10).
4.4.2. CORSnet GNSS Base Stations are monitored daily by the Spatial Services Department of the NSW Government.
4.4.3. GNSS Baselines are to be surveyed relative to NSW CORSnet GNSS Base Stations. Baselines are then used for the adjustment of Total Station traverse lines locating subsidence marks in three dimensions (MGA~AHD).

4.5. Culvert pipe joints:

4.5.1. Culvert pipe joints will be measured by calliper.

5. Target Accuracies

5.1. Target Accuracies for monitoring surveys by total station shall be as follows:
- 1.0 second angular resolution
- ±2mm and 2 ppm distance

5.2. Strain distances measured to an accuracy of ±5mm (Strain 0.25mm/m over a 20 m bay) for measurement by Total Station traverse.
5.3. Traversing shall be minimum Class D or LC as prescribed in ICSM SP1 or better.
5.4. Co-ordinates derived from horizontal movement surveys (by traverse &/or GPS) shall have an absolute accuracy of ± 20mm or better (Relative two dimensional accuracy of ± 5mm).
5.5. Rail creep surveys shall be measured to an accuracy of ±3mm
5.6. Long bay surveys shall be measured to an accuracy of ±3mm
5.7. 2D Bridge surveys across the arches shall be measured to an accuracy of ±3mm

6. Survey Instrument Calibration

6.1. In accordance with the Surveyors Generals Direction No. 5 the survey instruments associated with this project will be calibrated annually.
6.2. A calibration certificate will be supplied to Tahmoor Colliery.

7. Subsidence Station Placement

7.1. Survey marks in the ground are a combination of galvanized pipe/star picket flush with the ground or raised star picket (nominally driven at least 800 mm's into ground or refusal) with fixed prism or steel spigot.
7.2. The culvert survey marks are fixed prisms anchored to structure.
7.3. The overbridge survey marks are fixed prisms attached to the concrete bridge elements as required.
7.4. The toe survey marks within cuttings are steel rod, drilled and epoxy anchored with a fixed prism.

Proposed track kilometrage range and monitoring frequencies are defined in the Tahmoor LW S1A to S6A Railway Subsidence Management Plan.

Southern Rail Surveys Pty Ltd

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Wollongong, NSW, 2500

8. Monitoring frequency

The lines will be established and surveyed initially before subsidence affects the line.
Various timing for resurvey frequency may be requested by the Tahmoor Colliery based on the requirements of the Subsidence Management Plans. The frequency may be 3 monthly, 1 monthly, bi-weekly, weekly or daily.
A final survey will be completed at the end of each longwall before the area is affected by extraction of the next adjacent longwall.
Please refer to Tahmoor LW S1A to S6A Railway Subsidence Management Plan for survey frequencies.

9. Reports

The following information shall be included in the report:

9.1. Date of survey.
9.2. Name, location and RL of bench mark and or GNSS Base station used.
9.3. When requested a summary stating maximum values of subsidence, tensile(+ve) strain, compressive(-ve) strain and horizontal movement of the current survey. Reports can also state if any visual subsidence impacts were observed.
9.4. Excel table and XML file showing subsidence results of current survey. This is to be supplied electronically.
9.5. Any other relevant information required by the Surveyor.

Survey results will nominally be reported within 24 hours of the completion of survey. Results will be forwarded electronically in Excel spreadsheets (.xls and .xml files) to relevant parties.

10. Additional Information
Tahmoor Colliery will provide an AutoCAD file of the Mine Workings if required.
Tahmoor Colliery will provide an Excel & XML files be used as a template.

John Rolles
Registered Surveyor
Southern Rail Surveys Pty Ltd
28 April 2022

Tahmoor Colliery Contacts:

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