EXTRACTION PLAN – MAIN DOCUMENT – TAHMOOR SOUTH DOMAIN – LONGWALLS SOUTH 1A – SOUTH 6A

Tahmoor Coal Pty Ltd



Document Control

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Prepared By:	April Hudson Approvals Specialist Tahmoor Coal – SIMEC Mining
Approved by:	Zina Ainsworth Environment and Community Manager Tahmoor Coal – SIMEC Mining Signature: Zina Ainsworth Date: 9 September 2022
	Malcolm Waterfall Mining Engineering Manager Tahmoor Coal – SIMEC Mining Signature: Malcolm Waterfall Date: 09 Sept 2022
	Peter Vale Executive General Manager Coal Operations Tahmoor Coal – SIMEC Mining Signature: Peter Vale Date: 9 September 2022

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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) from NSW Department of Planning and Environment (DPE, formerly NSW Department of Planning, Industry and Environment (DPIE)) for the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

In addition to the SSD 8445 approval Tahmoor Coal also received conditions of approval (EPBC 2017/8084) under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) in October 2021.

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. Twelve longwalls are proposed in this domain which are divided into a series of six northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 6A (LW S1A-S6A), are the focus of the current Extraction Plan application.

The location of LW S1A-S6A and associated Study Area are illustrated in **Figure 2.**

1.2 Purpose

This Extraction Plan has been prepared to seek approval for secondary extraction of coal from LW S1A-S6A, in accordance with condition C8 of the Development Consent (SSD 8445). This Extraction Plan has also been prepared to comply with the following relevant approvals, legislation and guidelines:

- CCL 716 and CCL 747 issued under the *Mining Act 1992*;
- Department of Planning, Industry and Environment's *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015);
- *Work Health and Safety Regulation 2017* (WHS Regulation) and *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022* (WHSMP Regulation); and
- NSW Resources Regulator's *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (Department of Industry – Resources Regulator, 2017).

A compliance register showing how the Extraction Plan complies with the relevant approvals, legislation and guidelines has been included in **Section 3.2** of this Extraction Plan.

The key purpose of this Extraction Plan is to outline the monitoring and management measures to be implemented to manage potential subsidence related impacts to ensure the protection of all surface / subsurface natural and built features and the protection of public safety within the Extraction Plan Study Area during extraction of LW S1A-S6A. This Study Area is defined in **Section 3.1** of this Extraction Plan.

Full details of the proposed monitoring and management measures are provided in the supporting component management plans for the Extraction Plan, and summarised in **Section 4** of this document.

1.3 Scope

The Study Area applicable to this Extraction Plan is defined in **Section 3.1**.

This Extraction Plan Main Document has the following structure:

- Section 1: Introduction - This section provides background to the Extraction Plan, the purpose and scope of this Extraction Plan Main Document, and the document structure of the Extraction Plan;
- Section 2: Development - This section outlines stakeholders consulted as part of the preparation of this Extraction Plan, outlines the process of updating subsidence predictions, and outlines the Extraction Plan team;
- Section 3: Overview - This section provides an introduction to the LW S1A-S6A Extraction Plan:
  - Describes the Study Area covered by the Extraction Plan and the environmental and built features in the Study Area;
  - Addresses specific requirements set by SSD 8445 Condition C8, including detailed performance indicators for subsidence performance measures;
  - Addresses Work Health and Safety legislation specifically in relation to subsidence as a principal mining hazard in relation to the safety of 'other persons';
  - Addresses other regulatory requirements, approvals, leases, licences and guidelines relevant to the preparation of the Extraction Plan;
  - Describes all key proposed and existing mining parameters, and any special features;
  - Outlines potential subsidence effects, subsidence impacts and environmental consequences of LW S1A-S6A;
  - Describes the subsidence management measures that will be implemented to ensure compliance;
  - Outlines the adaptive management approach and contingency plans in the event of exceedances of performance measures and predicted environmental consequences;
- Section 4: Key Component Plans - This section outlines the individual management plans intended to manage particular environmental or built features within the Extraction Plan Study Area;
- Section 5: Subsidence Monitoring Plan - This section details the Subsidence Monitoring Plan for potential subsidence impacts and environmental consequences;
- Section 6: Graphical Plans – This section lists the graphical plans that have been prepared for the LW S1A-S6A Extraction Plan Study Area, which include detailed mine plans of LW S1A-S6A;
- Section 7: Implementation - This section describes the key elements of implementation, including reporting requirements, reviews and key responsibilities; and
- Section 8: Document Information - This section provides a compiled list of references, related documents, terms, and abbreviations used in this document. In addition, this section provides the change information for this document, and a summary of the distribution of this document to stakeholders.

1.4 Extraction Plan Structure

This Extraction Plan for LW S1A-S6A comprises a main document, supporting management plans, graphical plans, and technical studies, as outlined in **Table 1**.

Table 1 Extraction Plan Structure

Key Component Plans	Appendixed / Contributing Reports
Extraction Plan Main Document (this document)	Appendix A – Subsidence Predictions and Impact Assessment Report (MSEC, 2022) Appendix B – Master Trigger Action Response Plan Appendix C – Letters of Consultation
Water Management Plan	Appendix A – Trigger Action Response Plan Appendix B – Surface Water Monitoring Plan Appendix C – Surface Water level Monitoring Data Plots Appendix D – Surface Water Quality Summary Tables Appendix E – Groundwater Technical Report (SLR, 2022a)

Key Component Plans	Appendixed / Contributing Reports
	Appendix F – Myrtle Creek and Redbank Creek Remediation Progress Review (ATC Williams, 2022)
Land Management Plan	Appendix A – Trigger Action Response Plan Appendix B – Geotechnical Assessment (Douglas Partners, 2022a) Appendix C – Land and Agricultural Resource Assessment (SLR, 2022) Appendix D – Detailed Slope Stability Assessment (Douglas Partners, 2022b)
Biodiversity Management Plan	Appendix A – Trigger Action Response Plan Appendix B – Detailed Aquatic Monitoring Maps Appendix C – Detailed Riparian and Amphibian Monitoring Maps
Heritage Management Plan	Appendix A – Trigger Action Response Plan Appendix B – Aboriginal Consultation Appendix C – Teatree Hollow 2013.1: Test Excavation Methodology Appendix D – Bargo Cemetery: Site overview and plan Appendix E – Archival record of rockshelter Teatree Hollow 2013.1 Appendix F – Archaeological Research Design – Teatree Hollow Rockshelter
Built Features Management Plan	(None)
Public Safety Management Plan	Appendix A – Risk Assessment Report (Tahmoor Coal, 2022)
Subsidence Monitoring Plan	Appendix A – Drawings Appendix B – Survey Specifications by SMEC Appendix C – Survey Specifications by Southern Rail Surveys
Graphical Plans	(None)

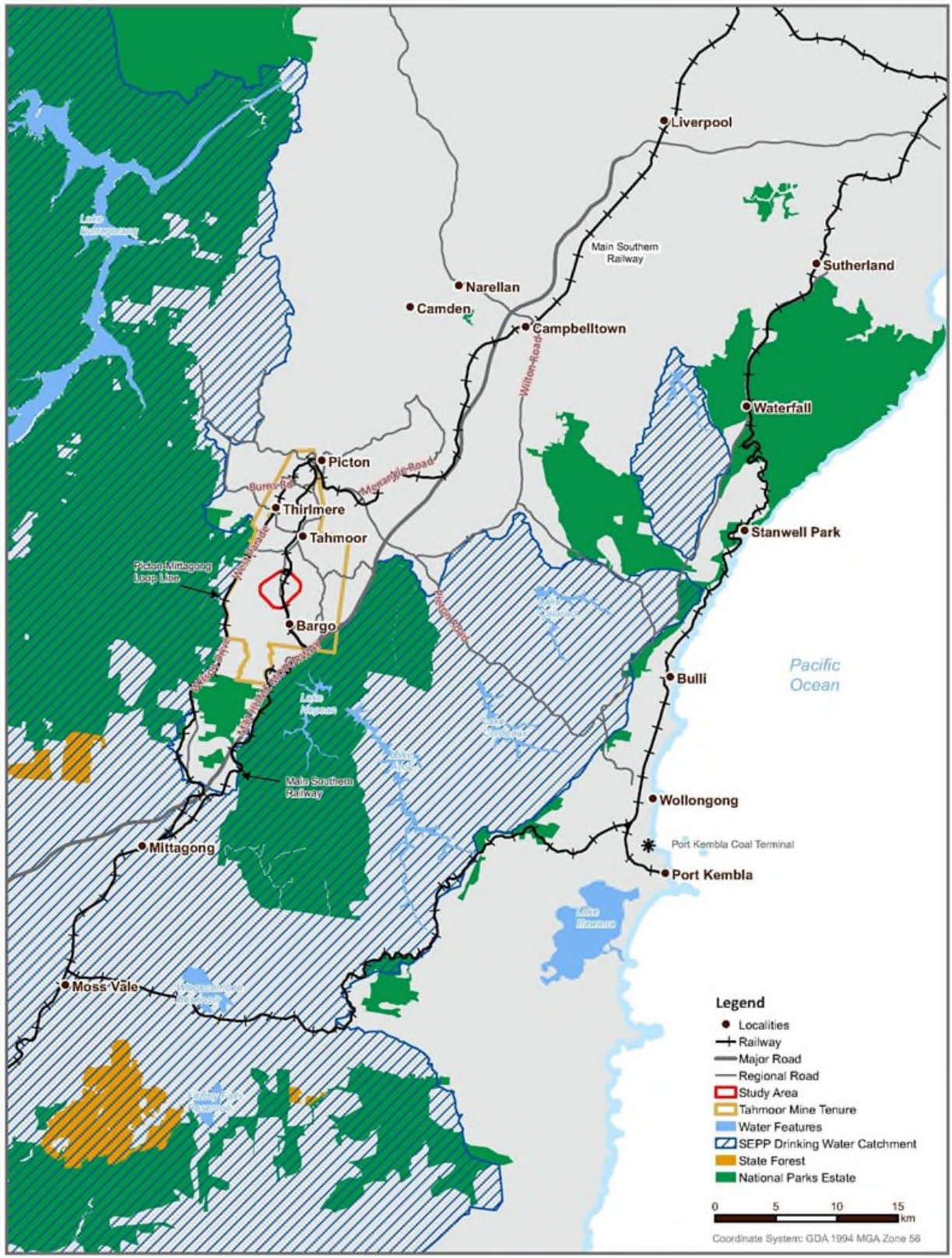


Figure 1 Regional Context

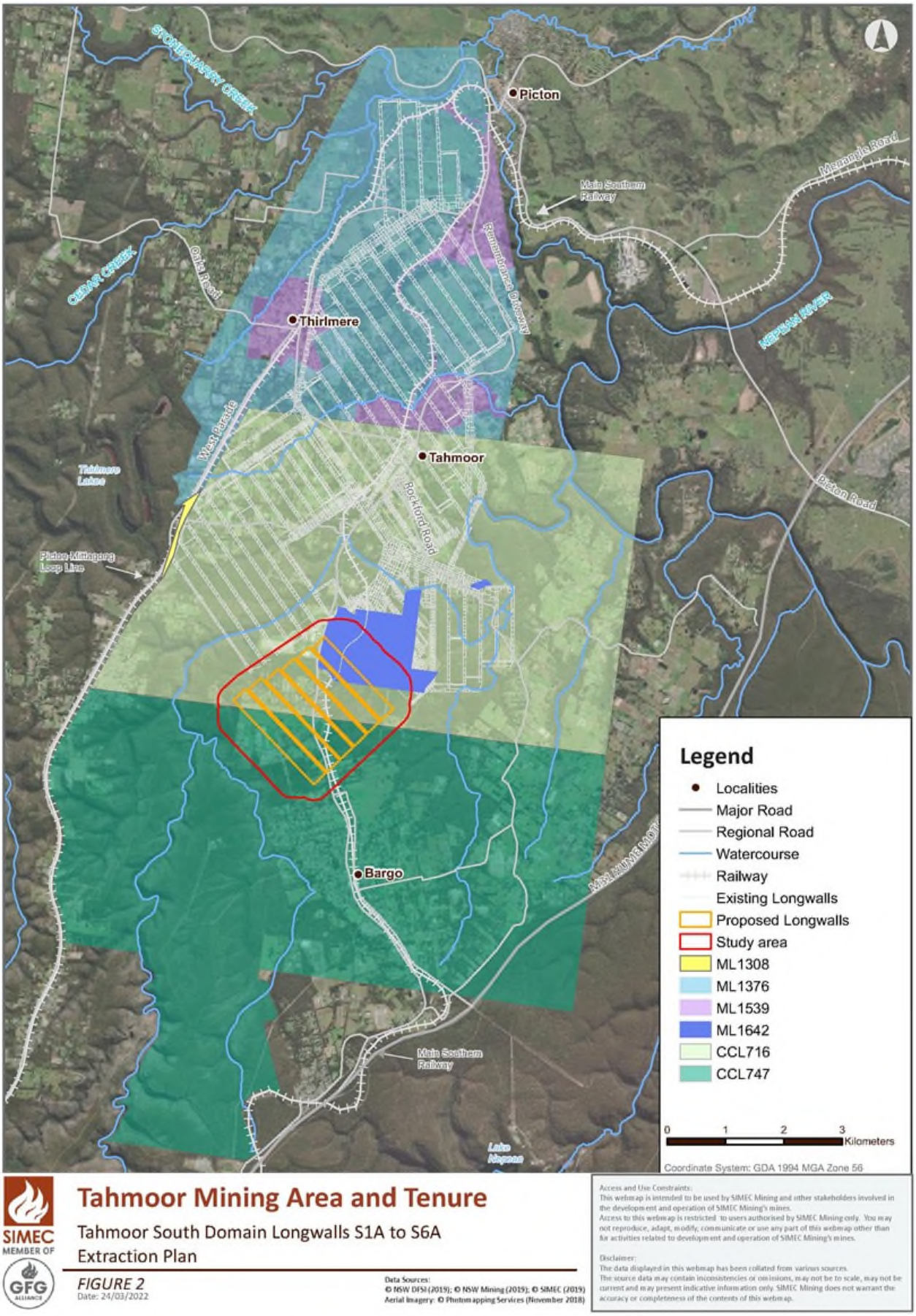


Figure 2 **Tahmoor Mining Areas and Tenure**

2 Extraction Plan Development

2.1 Stakeholder Identification and Engagement

This section provides an overview of the stakeholder engagement process with government agencies and the community, the various engagement activities undertaken, a summary of findings from these activities, and references to where these findings have been incorporated and addressed in this Extraction Plan.

2.1.1 Community Consultation

Tahmoor Coal has a long history of successful engagement with the local community in which it operates, striving to sustain positive relationships through a process of ongoing consultation and interaction. Stakeholder communication is undertaken in accordance with the *TAH-HSEC-00031- Community Development Plan* and the *TAH-HSEC-00039– Stakeholder Engagement Plan*. These guidelines have been used as a basis for the development of the *TAH-HSEC-00119- Communication and Engagement Procedure*.

A number of community consultation mechanisms are utilised throughout each phase of mining for current and future mining (including LW S1A-S6A and the Tahmoor South Domain, past mining areas, exploration activities, and general enquiries). These consultation mechanisms include:

- Written correspondence (e.g. Resident Information Packs, letters, newsletters, emails);
- Display of newsletters at local shopping centre;
- Meetings (face to face or phone);
- Door knocking;
- Periodic Community drop-in sessions;
- 24hr call line for enquiries;
- Provision of contact details for Tahmoor Coal Representatives;
- Publication of information on the Tahmoor Coal Website; and
- Provision of information at the Tahmoor Colliery Community Consultative Committee (TCCCC) (quarterly meetings).

2.1.2 Identification of Key Stakeholders

Consultation has been completed in accordance with Condition C8 of SSD 8445, which outlines relevant stakeholders to be consulted in the development of the Extraction Plan and key component plans. The purpose of this consultation was to provide stakeholders with an overview of the proposed development and to seek input during the development of key component plans and other documents prepared in support of the LW S1A-S6A Extraction Plan described in **Section 4** of this document.

Table 2 provides an overview of stakeholders that have been consulted with during the preparation of this Extraction Plan primarily in accordance with the consultation requirements of SSD 8445.

Table 2 Stakeholders Consulted during the preparation of the LW S1A-S6A Extraction Plan

SSD 8445 Condition	Component	SSD 8445 Consultation Requirements	Additional Stakeholders Consulted
C8(b)	Preparation of Extraction Plan	• Department of Regional NSW - Resources Regulator (Resources Regulator (Subsidence)) • DPE – Water (DPE Water) • Subsidence Advisory NSW (SA NSW)	• DPE (Resource Assessments) • Department of Regional NSW - Resources Regulator (Resources Regulator) (Mining Act Inspectorate) • Department of Regional NSW – Mining Exploration and Geoscience (MEG)
C8(d)	Consultation for mine planning (in relation to mine roof and floor conditions)	• Resources Regulator (Subsidence)	-
C8(g)(i)	Preparation of Subsidence Monitoring Plan	• Resources Regulator (Subsidence)	-

SSD 8445 Condition	Component	SSD 8445 Consultation Requirements	Additional Stakeholders Consulted
C8(g)(ii)	Preparation of Built Features Management Plan	• Resources Regulator (Subsidence) • NSW Environment Protection Authority (EPA) • Owners of potentially affected features	• Dams Safety NSW (DSNSW) • SA NSW • Wollondilly Shire Council (WSC) • Transport for NSW (TfNSW) • Australian Rail Track Corporation (ARTC) • Office of the National Rail Safety Regulator (ONRSR)
C8(g)(iii)	Preparation of Water Management Plan	• DPE Water • DPE - Environment, Energy and Science (EES) Group (part of Biodiversity, Conservation and Science (BCS) within the Department)	• NSW Industry – Land & Water – Natural Resources Access Regulator – East (NRAR) • WaterNSW • DSC • EPA
C8(g)(iv)	Preparation of Biodiversity Management Plan	• EES	-
C8(g)(v)	Preparation of Land Management Plan	• Affected public authorities	• NSW Department of Primary Industries – Agriculture (DPI Agriculture) • WSC • DPE - Crown Lands Division (Crown Lands)
C8(g)(vi)	Preparation of Heritage Management Plan	• Heritage NSW • WSC • Relevant stakeholders for heritage items (Aboriginal and non-Aboriginal heritage items)	• Registered Aboriginal Parties (RAPs)
C8(g)(vii)	Preparation of Public Safety Management Plan	• Resources Regulator (Subsidence)	-
C9	Approval of Extraction Plan	• DPE (Resource Assessments)	-

In addition, consultation with the following stakeholders was also undertaken

- Resource Regulator in accordance with WHS legislation; and
- TCCCC, in accordance with Condition A25 of SSD 8445.

It is noted that the following stakeholders were not consulted with for the preparation of this Extraction Plan:

- Technical Committee required under condition C14: The Bargo Waste Management Centre is not included in the Study Area.
- NSW Department regulating the *Pipelines Act 1976* (DPE - Division of Energy, Climate Change and Sustainability): The Moomba to Sydney gas pipeline is not in the Study Area. Jemena have been and will continue to be consulted for the management of potential subsidence impacts to local gas pipelines within the Study Area.

A number of requests for information and comments from DPE, the Independent Advisory Panel for Underground Mining (IAPUM), and key Government Agencies were received during the post-submission review stage of the Extraction Plan. This correspondence included:

- DPE letters with comments dated 12 July 2022, 28 July 2022, and 30 August 2022;
- IAPUM final report dated August 2022;
- DPI Agriculture letter with comments dated 3 June 2022;
- Heritage NSW letter with comments dated 6 June 2022;
- DPE Crown Lands letter with comments dated 7 June 2022;
- MEG letter with comments dated 10 June 2022;
- SA NSW email with comments dated 15 June 2022;

- Resources Regulator letter with comments dated 29 June 2022;
- DPE Water letter with comments dated 1 July 2022;
- WSC letter with comments dated 12 July 2022; and
- DPE BCS letter with comments dated 20 July 2022.

Comments were provided by Tahmoor Coal and reviewed by DPE as part of the assessment process, and have not been included in this Extraction Plan document.

2.1.3 Results and Outcomes of Consultation

Stakeholder engagement has been undertaken with local and State Governments, industry regulators, the local Aboriginal community, affected landowners, and the wider local community during the preparation of this Extraction Plan.

A summary of preliminary consultation with government agencies and stakeholders to date during the preparation of this Extraction Plan is provided in **Table 3**. An additional round of consultation has been completed with government agencies and stakeholders following the submission of the Extraction Plan documents, as facilitated by DPE. This consultation provided an opportunity for detailed comments to be submitted by government agencies and stakeholders regarding the documents, to which Tahmoor Coal has provided a response. This consultation has not been discussed further in the Extraction Plan document.

Following the preparation of draft management plans for the various built features in the Study Area, relevant owners with built features located in or near the Study Area will be consulted to review and endorse the relevant Subsidence Management Plans that outline the management of their built features during LW S1A-S6A extraction. Tahmoor Coal has completed such consultation with built feature owners as part of previous longwalls and has well-established relationships with built feature owners in the local area, who are familiar with the process and structure of the management plans.

The following built feature owners have been / will be consulted regarding the corresponding management plans for built features in or near the Study Area:

- Endeavour Energy for the management of electrical infrastructure;
- Jemena for the management of gas infrastructure;
- Sydney Water for the management of potable water infrastructure and sewer infrastructure;
- Telstra for management of Telstra-managed telecommunications infrastructure;
- NBNCo for management of NBN-managed telecommunications infrastructure;
- TPG for management of TPG-managed telecommunications infrastructure;
- Australian Rail Track Corporation (ARTC) for the management of the Main Southern Railway and associated infrastructure;
- Wollondilly Shire Council (WSC) for management of public roads, culverts and bridges, and the Bargo Cemetery;
- Dams Safety NSW for management of Picton Weir;
- Tahmoor Coal for the management of the Tahmoor Mine Site and associated built structures and infrastructure at 2975 Remembrance Driveway, Bargo;
- Wollondilly Anglican College for the management of the school at 3000 Remembrance Driveway, Bargo;
- Bargo Petroleum and Hill Top Pit Stop for the management of the automotive centre and wreckers yard at 3030 Remembrance Driveway, Bargo;
- Inghams for the management of the Inghams Bargo Breeder Farm (chickens) at 3030 Remembrance Driveway, Bargo and the Inghams Turkey Farm at 100-110 Yarran Road, Bargo;
- Tahmoor Garden Centre for the management of the property at 3070 Remembrance Driveway, Bargo;
- National Trust for management of the Australian Wildlife Sanctuary property and structures at 3105 Remembrance Driveway, Bargo;
- MKD Machinery for the management of built structures at 3165 Remembrance Driveway, Bargo;
- Pamak Hobbies for the management of the garden railway at 40 Great Southern Road, Bargo;
- Canine Country Club for the management of built structures at 85 Yarran Road, Bargo; and
- Bargo Valley Product Pty Limited for the management of built structures at 80-90 Yarran Road, Bargo.

In addition, a Built Structures Management Plan has been / will be prepared for the management of privately-owned built structures in the Study Area.

Table 3 Summary of Key Issues Raised and Outcomes of Consultation Undertaken for LW S1A-S6A Extraction Plan

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
NSW Department of Planning and Environment (DPE) – Resource Assessments	A letter seeking approval of suitably qualified and experienced persons to prepare the Extraction Plan was sent on 14 September 2021.	Approval of suitably qualified and experienced persons to prepare the Extraction Plan was received from DPE on 26 November 2021.	Noted.
	A meeting was held between representatives of DPE (Jessie Evans and Gabrielle Allan) and Tahmoor Coal via teleconference on 20 December 2021. This meeting was an opportunity to outline the proposed LW S1A-S6A Extraction Plan, the key features in the Study Area to be monitored and managed, and stakeholder consultation currently in progress.	DPE noted that Jessie Evans is taking over as point of contact for Tahmoor Coal from Stephen O'Donoghue.	Noted.
		DPE asked how the proposed impact to the Aboriginal heritage item (AHIMS Site #52-2-4471, rockshelter) compares to the performance measures.	Tahmoor Coal advised that this would be addressed in the Heritage Management Plan as part of the Extraction Plan. Tahmoor Coal noted that there may be indirect harm and a partial loss of value for the item.
		DPE interested in management of the petrol station during subsidence.	Tahmoor Coal noted that petrol stations have been successfully undermined by previous longwalls at Tahmoor Mine. A subsidence management plan for this property will be prepared to manage impacts from subsidence.
		DPE enquired how many landowners are above the A longwall series.	Tahmoor Coal noted that the number is less than that for the B longwall series and most are situated along Caloola Road and nearby streets. Tahmoor Coal noted that consultation with all residents within the Study Area has started, including the provision of the resident information packs, and offering of Pre-Mining Inspections for those residents within the 20 mm subsidence contour for the first few longwalls. Tahmoor Coal noted that the next round of landholder consultation will be provided early 2022.
		DPIE advised that a meeting with DPE and other government agencies should coincide with lodgement of the Extraction Plan. The meeting should be an overview only to prepare agencies for their review of the Extraction Plan. A site visit should also be included.	Tahmoor Coal will liaise with DPE to set up this meeting and site visit at the time of lodgement of the Extraction Plan.
		DPE advised that there are no set criteria to determine the involvement of the Independent Advisory Panel for Underground Mining (IAPUM), and the decision is made once government agency comments are received and reviewed.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
	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.	As of 18 May 2022, no response to the letter of consultation has been received from DPE Resource Assessments, however two meetings have been held to discuss the proposal.	Noted.
	A meeting was held between representatives of DPE (Jessie Evans and Gabrielle Allan) and Tahmoor Coal via teleconference on 10 February 2022. This meeting was an opportunity to discuss further the involvement of the Independent Advisory Panel for Underground Mining (IAPUM) for the assessment of the proposed LW S1A-S6A Extraction Plan.	Jessie Evans taking lead on assessment going forward.	Noted.
		Six longwalls of approximately four years for the Extraction Plan assessment has been done previously, and ok to proceed.	Noted.
		Extraction Plans over the last 5 years are getting more complex, as well as underground mining in general, hence the introduction of IAPUM. IAPUM is likely to be involved, however will depend on agency advice and DPE ability / expertise to deal with the matter. IAPUM focus can be broad or narrow, depending on the issues at hand.	Tahmoor Coal asked if it more likely that IAPUM will be involved, can they be involved earlier on? DPE responded that there is no value in having them involved prior to the submission of the Extraction Plan. The Department can brief them earlier. It is an evolving space as to when to involve them. IAPUM receive all the agency advice and DPE briefing.
		Key considerations for the Extraction Plan: • Do the predictions meet the Performance Measures • Details of the TARPs • Sufficient and robust baseline monitoring • Adaptive management planning. Approval will depend on surface features and adaptive management proposed.	Noted.
		How will Wirrimbirra / Australian Wildlife Sanctuary be covered?	Tahmoor Coal responded that an individual subsidence management plan will be prepared, and submitted prior to the start of Longwall South 1A. Tahmoor Coal also noted that there is a good relationship with Wirrimbirra / National Trust and a Land Access Agreement is in place.
		DPE suggested a one hour briefing around the time of lodgement of the Extraction Plan.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
NSW Department of Planning and Environment – Environment, Energy and Science (EES) Group	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 3 February 2022.	Noted.
		It is recommended that consideration be given to subsidence impacts to Hornes Creek which currently has good water quality and feeds into the Bargo River near Picton Weir and re-opening of fractures in the Bargo River caused by extraction of longwalls 14 – 19. In both instances, this will require an appropriate water monitoring program and a clear commitment to undertake the necessary remediation actions, should impacts occur.	Section 5 of the Water Management Plan demonstrates that monitoring locations in the Hornes Creek and Bargo River have been included in the monitoring program for this Extraction Plan. The Water Management Plan TARPs include a commitment for remediation should impacts to these systems occur as a result of longwall mining.
		It is suggested that an update is provided on the progress of the remediation of Myrtle and Redbank Creek which outlines the outcomes of an inspection of Redbank Creek remediation works and data that demonstrates 'success' of this work.	A report on the remediation progress of Myrtle and Redbank Creek is provided in Appendix F of the Water Management Plan.
NSW Department of Planning and Environment – Water (DPE Water)	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 1 March 2022 stating there are no preliminary comments at this stage.	Noted.
	The over-arching Tahmoor South Surface Water Management Plan was sent to DPE Water for review on 14 December 2021. Comments were received on 19 January 2022, and one comment was relevant to this Extraction Plan.	DPE Water requested that a record of pre- and post-subsidence state of key rock bars and pools be maintained for review of impact predictions reporting.	Pre-mining and post-mining monitoring of rockbars and pools is included in the monitoring program, as discussed in Section 5 of the Water Management Plan. This will include photographic record of these features for future reference.
NSW Department of Planning and Environment – Crown Lands Division (Crown Lands)	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 2 February 2022.	Noted.
		It is envisaged that the purpose of the "Study Area" and "600m Study Area for Natural Features" outlined in the Extraction Plan, attached to your letter, will best be further explained in the plan.	The definition and purpose of the Study Area and 600 m Study Area for Natural Features is discussed in **Section 3.1.1** of this document.
		Mitigation of impacts on the Bargo River and other watercourses, as a consequence of the longwall extraction works will need to be addressed in the plan.	The Water Management Plan TARPs include a commitment for remediation of watercourses, should impacts to these systems occur as a result of longwall mining.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
		Within the Longwall area, there is a substantial amount of Crown Land. This Crown Land includes Dedication 500432 managed by The National Trust of Australia for Conservation of Native Flora, Fauna (45.03 ha) including Lot 33 DP 751250, Lot 18 DP 751250, Lot 19 DP 751250, all on the eastern side of Remembrance Drive.	Land associated with the Australian Wildlife Sanctuary (managed by The National Trust of Australia) will be managed in accordance with the Australian Wildlife Sanctuary Management Plan. This land includes the three land parcels noted in the comment from Crown Land. This management plan will be prepared in consultation with The National Trust, and will be finalised prior to the commencement of Longwall South 1A extraction. Further information on management plans to be prepared for infrastructure and structures is provided in **Section 2.1.2** and **Table 5**.
		This reserve is adjoined by other Crown reserves e.g. R751250 (1784 ha), a Parish reserve for Bargo, Camden with purpose of future public requirements, environmental studies and training purposes.	There are numerous lots for DP751250, however they do not appear to contain any structures. Any waterways or dams contained within these reserve lots will be managed in accordance with the Water Management Plan. The management of flora and fauna within the Study Area will be in accordance with the Biodiversity Management Plan.
		Within the 600 m Study Area for Natural Features, identified in the Extraction plan, the Wingecarribee Shire Council holds Licence No 625498 (a Section 2.20 licence – Short Term Licence Type 1a – Combined) with Crown lands for Environmental Protection, which includes Lot 7311 DP 11410250. The account area for this licence is 9397 ha of Crown Land, so extends well beyond the Study Areas identified.	The land mentioned does not appear to contain any structures. Any waterways or dams contained within these reserve lots will be managed in accordance with the Water Management Plan. The management of flora and fauna within the Study Area will be in accordance with the Biodiversity Management Plan.
		The Crown Land area between Bargo and Tahmoor is understood to support numerous Endangered Ecological Communities and Threatened Species of Flora and Fauna. The Extraction Plan will need to address mitigation of adverse impacts of the extraction operation on flora and fauna within the Study Areas.	The Biodiversity Management Plan confirms the presence of any Endangered Ecological Communities and Threatened Species (flora and fauna) in the Study Area, as well as outlining the proposed management of ecology during mining of LW S1A-S6A.
		Further, access arrangements to be made by Tahmoor Coal Pty Ltd are not to adversely impact any Crown Land within the Study Areas.	Access to Crown Land for the purpose of monitoring will be arranged by Tahmoor Coal, and will be rehabilitated following the completion of monitoring.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
			As per condition A39 of SSD 8445, Tahmoor Coal will consult with Crown Land and enter into a compensation agreement prior to undertaking any new development on Crown Land or Crown Roads.
		Surface disposal areas for material from the underground longwall sites will likely be documented in the plan. It is desirable that arrangements for disposal of spoil do not adversely impact on public land (including Crown land) in the environs.	This Extraction Plan discusses the management of potential impact from the extraction of LW S1A-S6A only. Details on the REA and any proposed changes as a result of proposed longwall extraction in the Tahmoor South Domain are documented in the EIS and two Amendment Reports, which were reviewed as part of the approval of SSD 8445. As per condition A39 of SSD 8445, Tahmoor Coal will consult with Crown Land and enter into a compensation agreement prior to undertaking any development on Crown Land or Crown Roads.
Department of Regional NSW - Resources Regulator (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 provided a copy of the Subsidence Monitoring Plan on 14 May 2022 to Resources Regulator for review. Tahmoor Coal recognised that Far Field assets would form part of the monitoring plan.
	As part of operational approvals for first workings in the Tahmoor South Domain, Tahmoor Coal has submitted notification of various High-Risk Activities which refer to the geological conditions including the roof and floor and comparison to existing conditions in Tahmoor North which are well understood by the Resource Regulator.	All of these notifications have been accepted without objection by the Resource Regulator.	Operations have been conducted in Tahmoor South for over thirty years with the knowledge and approval of the Resources Regulator. The area Tahmoor operations is conducting first workings in currently (referred to as Tahmoor South) is bounded on two sides to the north -east and southeast by old workings and as such the geology of this area is well understood on a macro level. This knowledge is compounded by the fact that no significant geological structures have been encountered within these workings or identified in exploration boreholes, the roof and floor geology throughout the longwall blocks laid out throughout Tahmoor South is therefore well understood.
Department of Regional NSW - Resources Regulator (Mining Act Inspectorate)	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 25 January 2022 stating there are no specific comments at this stage.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
Department of Regional NSW – Mining Exploration and Geoscience (MEG)	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 27 January 2022 stating that comments will be provided on review of the submitted Extraction Plan documents.	Noted.
NSW Infrastructure - Land & Water - Natural Resources Access Regulator (NRAR)	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.	As of 18 May 2022, no response to the letter of consultation has been received from NRAR.	Noted.
WaterNSW	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 10 January 2022.	Noted.
		WaterNSW confirmed that the Study Area is located outside the Sydney Drinking Water Catchment (SDWC) and Special Areas.	Noted.
		WaterNSW recommends that the proposed LW S1A-S6A Extraction Plan, including the Surface Water Management Plan, confirm the WaterNSW's assessment on the SDWC and detail relevant monitoring and management measures. This assessment concluded that the impact on SDWC would be insignificant due to 4 assumptions listed in the consultation letter.	Impacts to the Sydney Drinking Water Catchment and Special Areas are not predicted to occur. Monitoring and management measures for surface water features are detailed in the Water Management Plan.
		WaterNSW recommends that the Extraction Plan considers WaterNSW Mining Principles and Water Monitoring Guidelines for Underground Mining Activities even though the application area is located outside the SDWC and Special Areas. These documents are part of current accepted Best Recommended Practice for managing mining impacts in NSW.	These guidelines are considered in Section 5 of the Water Management Plan.
Heritage NSW	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 13 March 2022 stating there are no specific comments on the proposed extraction.	Noted.
Dams Safety NSW (DSNSW)	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 11 March 2022 stating, as there are no declared dams or notification areas in the area, DSNSW has no further comments on the proposed extraction.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
NSW Environment Protection Authority (EPA)	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 11 January 2022 stating there are no specific comments on the proposed extraction.	Noted.
NSW Department of Primary Industries – Agriculture (DPI Agriculture)	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 4 February 2022.	Noted.
		A full assessment of the agricultural land uses in the area that may be potentially impacted so any agricultural developments and associated enterprises in the area are considered in terms of identified risks and economic disruption particularly with subsidence.	An Agricultural Impact Statement was prepared for the first Amendment Report for SSD 8445 approval. For this Extraction Plan, a Land and Agricultural Resource Assessment (SLR, 2022c) has been prepared to complement the information from the Agricultural Impact Statement, and provide any updates on agricultural development impacts from the proposed longwalls.
		Consult with the owners / managers of affected and adjoining neighbours and agricultural operations in a timely and appropriate manner about: the proposal, the likely impacts and suitable mitigation measures or compensation.	Consultation with owners of agricultural businesses in the Study Area has commenced. Tahmoor Coal will continue to consult with the owners during the preparation of a subsidence management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans. Further information on management plans to be prepared for built features is provided in **Section 2.1.2** and **Table 5**. In addition, all landowners in the Study Area have been informed by an information packaged delivered by mail of the proposed development and the subsidence impact claims process in the event that their property is damaged by mining.
		Consider possible cumulative effects to agricultural enterprises and landholders from subsidence/ other impacting events.	Given the described impacts are of a minor nature and readily managed through application of appropriate mitigation measures and management strategies, any resulting cumulative impacts on agricultural resources and enterprises are also expected to be minor and readily mitigated.
		An assessment of the monitoring regime that will identify any changes as a result of the effects of the longwall mining, especially subsidence. This may include impacts of farm infrastructure i.e. buildings, fences, slope changes, water supply infrastructure.	Tahmoor Coal will consult with the agricultural business owners during the preparation of subsidence management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
			Further information on management plans to be prepared for built features is provided in **Section 2.1.2** and **Table 5**.
		In relation to the poultry enterprises that exist in the area, that these owner / managers as well as the processors / owners of the birds be consulted to ensure that production plans can be adjusted if required. This should have at least for 12 month period of mining activity.	Tahmoor Coal will consult with the agricultural business owners during the preparation of subsidence management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans. Further information on management plans to be prepared for built features is provided in **Section 2.1.2** and **Table 5**.
		For protected cropping enterprises (glasshouses) located in the impacted area, the slope of the glasshouses is critical for efficient irrigation so subsidence may be a potential issue. This may also be an issue for other open horticultural enterprises e.g. olives if they are irrigated with a dripper system.	Tahmoor Coal will consult with the agricultural business owners during the preparation of management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties (including hothouses and greenhouses) in accordance with these management plans. Further information on management plans to be prepared for built features is provided in **Section 2.1.2** and **Table 5**.
		Dust can also be an issue for greenhouse / glasshouse light transmission so this needs to be addressed if dust levels are an issue above ground.	The extraction of LW S1A-S6A involves the extraction of six underground longwall panels and as such there will be no impact to air quality resulting from this extraction activity. All other activities associated with the Tahmoor South Project that have the potential to create dust will be undertaken in accordance with the approved Air and Greenhouse Gas Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.
		With water quality any increase in the total dissolved salts (TDS) or an increase in sodium level will be a limitation to any horticultural system relying on hydroponics or fertigation.	There is no predicted increase in total dissolved salts or sodium in groundwater bores associated with LW S1A-S6A. This is discussed further in the Land and Agricultural Resource Assessment (SLR, 2022c).
Subsidence Advisory NSW (SA NSW)	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 2 February 2022 stating that specific feedback on the proposed application will be provided when supporting documentation has been finalised.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
		It is noted that the proposed layout includes panels that are located further to the south and southwest and of greater length than those shown in the layout submitted as part of SIMEC's project approval. Supporting documentation should include a comparison between extraction and project approval regarding predicted impacts to residential dwellings.	Tahmoor Coal confirms that the longwall layout has been straightened up, resulting in lengthening of the A series longwalls and shortening of the B series longwalls in the Tahmoor South Domain. However, as discussed in the Subsidence Predictions and Impact Assessment Report by MSEC (2022; **Appendix A**), there is no real net effect in subsidence impact to residential dwellings as a result of this change. Refer to Section 1.1 of **Appendix A** for further information.
Transport for NSW (TfNSW)	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 8 March 2022 from TfNSW (Southern Region) requesting a map showing the proposed longwalls in relation to Picton Road, Hume Highway and Victoria Bridge.	MSEC provided the requested map on 9 March 2022.
		Following a review of the closest distances from the mining area to TfNSW assets, TfNSW (Southern Region) responded on 11 March 2022 that, as TfNSW assets are more than five times the depth of cover, there are no further comments for the Extraction Plan.	Noted.
		A response was received on 9 March 2022 from TfNSW (Sydney Region) stating that there are no further requirements are recommended.	Noted.
		It was noted by TfNSW (Sydney Region) that consent under Section 138 of the *Roads Act 1993* would be required for any proposed longwall extension adjacent to or under the Hume Highway, or any road/rail within the TfNSW network, as well as any works within the classified reserve. If any such work was to occur, the proponent would also need to enter into a Deed of Agreement.	As confirmed by TfNSW (Southern Region), Tahmoor Coal are more than five times the depth of cover from TfNSW assets. Therefore, these requirements are not applicable to the proposed longwalls.
		TfNSW (Sydney Region) advised that consideration should be given to the impacts of any additional traffic generated by the proposed extension of longwall mining operations.	Tahmoor Coal confirm that there will be a negligible increase in traffic generated as a result of the proposed longwalls.
		Further comments may be provided when the LW S1A-S6A Built Features Management Plan is made available as these works may impact Remembrance Driveway and the nearby school zone associated with Wollondilly Anglican College.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
		TfNSW has previously resumed and dedicated a strip of land as road along the Remembrance Driveway frontage of the subject property.	Noted.
		No objections are raised to the development proposal on property grounds provided all buildings and structures, together with any improvements integral to the future use of the site are wholly within the freehold property (unlimited in height or depth) along the Remembrance Drive boundary.	Noted.
Office of the National Rail Safety Regulator (ONRSR)	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 23 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls.	A response was received on 12 January 2022 from Resources Regulator requesting the draft plan for the proposed longwalls.	Tahmoor Coal advised that the Tahmoor South Rail Management Plan is scheduled for delivery by 500 metres of extraction of Longwall South 1A (estimated January 2023), and will be provided to ONRSR at this time. ONRSR have been involved in discussions regarding the Tahmoor South Rail Risk Assessment on 28 August 2021.
Australian Rail Track Corporation (ARTC)	A letter introducing the Extraction Plan for LW S1A-S6A was sent on 23 December 2021. Tahmoor Coal provided a figure of the Extraction Plan Study Area, and an overview of the longwalls.	As of 1 May 2022, no response to the letter of consultation has been received from ARTC.	Noted. ARTC have been involved in discussions regarding the Tahmoor South Rail Risk Assessment completed on 28 August 2021.
Wollondilly Shire Council (WSC)	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 from Council's Assets and Transport Team was received on 21 January 2022.	Noted.
		Council noted that they can only effect repairs to road pavement in the event of an emergency. All other repairs are required to be carried out by Tahmoor Coal to the satisfaction of Wollondilly Shire Council's Construction Specifications. Suitably qualified civil contractors employed by Tahmoor Coal must be available to complete temporary restoration works as required, and after to complete the final restoration works. All cracks/damage to kerb and gutter, footpaths, drainage structure and property entrances are the responsibility of Tahmoor Coal and must be managed throughout the length of the mining activity, and permanent repairs carried out to the satisfaction of the property owner (either Council or a private party) upon the completion of any subsidence activity.	Noted. The Wollondilly Shire Council Management Plan outlines the requirements for road mitigation works in the event of damage to public roads, kerbs, gutters, footpaths or property entrances as a result of longwall subsidence.
		A response from Council's Waste and Environmental Services Team was also received on 14 February 2022.	Noted.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
		It is understood that the longwalls covered by the Extraction Plan are at a sufficient distance to not result in any subsidence induced impacts to the operation of the Bargo Waste Management Centre. However, clarification by SIMEC of this understanding would be appreciated.	The Bargo Waste Management Centre is located more than 1 kilometre from the proposed LW S1A-S6A and is situated outside of the 20 mm subsidence impact area (and Study Area). Therefore, it is unlikely that the proposed longwalls will result in any subsidence induced impacts to the operation of this facility.
		Council would expect in this regard that the Extraction Plan involve a detailed consultation program as well as identification to the greatest accuracy possible likely subsidence-related impacts to dwellings over the full duration of a particular longwall.	A Social Impact Management Plan is being prepared which will include a detailed community engagement plan. A Built Features Management Plan will also be prepared covering the predicted subsidence-related impacts and risk management to dwellings located over LW S1A-S6A.
		The Independent Planning Commission is noted to have included a condition in the Determination "for the voluntary acquisition rights for properties affected by certain types of damage that are impacted by more than one longwall". It is requested to be noted Council does not have a formal position over such acquisition. However, the offering of this process as an alternative and detailed explanation of its potential negative and positive implications to landowners would be expected.	Tahmoor Coal offers weekly visual inspections to landowners during the active subsidence periods. Should any damage be assessed that meets the voluntary acquisition requirements, Tahmoor will assess this on a case-by-case basis and liaise with government agency, Subsidence Advisory NSW who administers the *Coal Mine Subsidence Compensation Act 2017* and has guidelines for property acquisition for subsidence damage.
		An assessment of impacts to surface and groundwaters be consistent with all current scientific research that includes the Characterisation and Modelling of Geological Fault Zones Guideline publication available on the Commonwealth Independent Expert Scientific Committee (IESC) website.	An assessment of potential impacts for surface water and groundwater, as presented in Section 4 of the Water Management Plan, has been complete in accordance with current scientific research.
		A detailed geological model that identifies the likely interaction of subsidence induced fractures with the modelled groundwater environment as part of complying with the IESC publication.	The Tahmoor South Geological Model has been updated, as discussed in the Groundwater Technical Report in Appendix E of the Water Management Plan.
		A scientific based investigation over the establishment of Risk Management Zones for third order watercourses for the purposes of identifying and managing impacts associated with subsidence to the ecological health of waterways within a catchment context.	Management of watercourses in the Study Area, including those of third order, is provided in Sections 4, 5 and 6 of the Water Management Plan.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
		An assessment of potential impacts of mining activities to the operation of private bores and mitigation measures to address any identified potential adverse implications.	Potential impacts to privately owned bores and the monitoring and management measures proposed is provided in Sections 4.3.3, 5 and 6.2.1 of the Water Management Plan.
		Trigger Response Action Plans and related monitoring programs that are developed as part of the Extraction Plan and Water Plan are to be scientifically based, supported by commensurate data. They are requested in this regard to include appropriate ecological focussed indicators to monitor any impacts to the ecological health of waterways at a suitable timeframe that would restrict the need for Creek Management Action Plans.	TARPs for surface water and groundwater that meet these requirements are provided in **Appendix B**, as well as Appendix A of the Water Management Plan.
Tahmoor Colliery Community Consultative Committee (TCCCC)	Quarterly meetings are held with the Tahmoor Colliery Community Consultative Committee (TCCCC) and representatives of Tahmoor Coal at the Tahmoor Mine or via teleconference. These meetings are an opportunity to provide the TCCCC with an update of activities at Tahmoor Mine, as well as details of the proposed LW S1A-S6A Extraction Plan. The LW S1A-S6A Extraction Plan was introduced at the TCCCC meeting on 2 December 2021.	A TCCCC Committee Member asked if Picton Weir was within the LW S1A-S6A Extraction Plan Study Area and if it would be impacted.	Tahmoor Coal responded that the Picton Weir was not within the Study Area, however in accordance with the precautionary approach, a management plan for the structure would be prepared as part of the Extraction Plan.
	The LW S1A-S6A Extraction Plan was introduced at the TCCCC meeting on 3 March 2022.	A TCCCC Committee Member asked if the quality of coal to be extracted from the Tahmoor South longwalls would be similar to that which is currently being extracted.	Tahmoor Coal responded that yes, the coal quality is similar, as is evident from old longwalls near the proposed Tahmoor South Longwalls.
		David Henry (Wollondilly Shire Council Representative) advised that the Thirlmere Lakes Research Program report has been delayed and will be ready in 3-4 weeks pending ministerial approval. Martin Krogh (DPE) will notify Council once the report is approved, and it will be circulated to TCCCC.	Noted.
Registered Aboriginal Parties	EMM Heritage Consultants, on behalf of Tahmoor Coal, sent a letter via email on 17 January 2022 to 29 Registered Aboriginal Parties (RAPs) (refer to the Heritage Management Plan for a list of RAPs) to inform them of the upcoming Heritage Management Plan scope.	The Kamilaroi Yankuntjatjara Working Group provided interim feedback stating that the rockshelter Teatree Hollow 2013.1 was of high cultural value, further investigation of the site was needed, and options for protective measures be considered. Cubbitch Barta also responded during this period reiterating the high cultural value of the rockshelter and advocated for the site's protection.	EMM and Tahmoor considered options to address this feedback through developing site management measures with a focus on archaeologically investigating the rockshelter. This was done with the aim to provide a positive cultural heritage output by contributing to Aboriginal archaeology of the local area.

Stakeholder	Description of Consultation	Summary of Comments	Tahmoor Coal Response
	On 1 April 2022, EMM provided the draft Heritage Management Plan for RAP review and feedback. This version included options for ochre pigmentation sampling and test excavation in the draft Heritage Management Plan. A further draft of the Heritage Management Plan, along with details of a test excavation methodology for the rockshelter with art and stone artefacts was also provided to RAPs on 19 April 2022.	Through further consultation during the draft HMP period, it was determined that archaeological test excavation was the most appropriate method to pursue to wholistically address RAP feedback gathered during the HMP consultation process.	The Heritage Management Plan provide details about the proposed test excavation, as well as further detail regarding consultation with RAPs during the preparation of this Extraction Plan.
Landowners of private property within the LW S1A-S6A Study Area	Letters of consultation were sent to all landowners of private property within the LW S1A-S6A Study Area on 24 August 2021 informing residents of upcoming first and second workings. These letters included a Resident Information Pack and information about LW S1A-S6A, as well as an offer to landowners for the completion of a Pre-Mining Inspection.	Responses to this correspondence have been received with requests for PMIs.	PMIs have been scheduled where requested. Going forward, Tahmoor Coal will conduct regular consultation with landowners / occupiers in the Study Area as LW S1A commences and during extraction of LW S1A-S6A. This will include consultation via letter box drops and door knocking. Community Drop-In sessions have will be scheduled in mid-2022 (Covid-19 restrictions allowing). Tahmoor Coal is currently in the process of consulting with built feature owners in the Study Area for the preparation of management plans for each individual built feature and will monitor and manage potential impacts to built features in accordance with these management plans.

2.2 Subsidence Background

2.2.1 History of Mine Plan Changes for the Tahmoor South Domain

The Tahmoor South Domain mine plan has undergone a series of amendments since the issue of the first EIS for the Tahmoor South Project in 2014. These mine plan revisions are summarised below:

- EIS Submission (2014): Original EIS submission, which was placed on hold and subsequently withdrawn in late 2015.
- EIS Submission (January 2019): Updated EIS submission based on revised Planning Secretary's Environmental Assessment Requirements (SEARs) issued in June 2018.
- Project Amendment Report (February 2020): The mine design was modified to reduce potential environmental impacts of the Project through the reduction in the extent of longwall mining. This was achieved by the following modifications:
- Removal of LW 109, which was located directly beneath Dog Trap Creek. This would result in elimination of direct impacts to Aboriginal heritage items;
- Configuration of the longwall layout to comprise two series of shorter longwall panels;
- Reduction in the proposed longwall width, from approximately 305 m to approximately 285 m; and
- Reduction in the height of extraction within the longwall panels from up to 2.85 m to up to 2.6 m.
- Second Amendment Report (August 2020): The mine design was again modified to further reduce potential environmental impacts. This included the removal of two longwalls in the southern part of the mine near the township of Bargo (LW 107B and LW108B), which would result in a reduction in magnitude of subsidence impacts.

The numerous modifications of the Tahmoor South Domain mine plan have resulted in a reduction of the magnitude and extent of subsidence impacts, as well as avoidance of significant impact to sensitive surface features of the environment, including Aboriginal heritage items.

The current mine plan proposes to complete underground mining with access to the Tahmoor South Domain provided from the existing pit top facilities. This mine design consideration minimises surface impacts from mining through the avoidance of establishing new surface facilities.

A number of minor changes have been made to the mine layout since development consent was received. A summary of these minor changes is provided below (MSEC, 2022):

- The layout for LW S1A-S6A has been shifted approximately 35 m to the south-west;
- LW S2A to LW S6A have been widened by 2 m (the width of LW S1A is unchanged);
- Chain pillar widths for the tailgates for LW S3A to LW S6A have been reduced by 2 m (the chain pillar between LW S1A and LW S2A was unchanged);
- The commencing ends of LW S1A-S6A have been aligned, compared to the previous staggered layout. The outcome of the change is that LW S2A to LW S6A have been extended in length. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted for development consent; and
- The planned sequence has been amended, such that the A series longwalls are proposed to be extracted in sequence. During the application for development consent, it was planned that Longwalls 101A to 103A (now renamed Longwalls S1A to S3A) would be extracted first, followed by the B series longwalls, and then the extraction of Longwalls 104A to 106A (now renamed Longwalls S4A to S6A).

2.2.2 Revised Subsidence Predictions

To support this Extraction Plan, MSEC have revised the subsidence predictions for the proposed longwalls and prepared the report *MSEC1192 Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A, Subsidence ground movement predictions and subsidence impact assessments for natural features and surface infrastructure* (hereafter referred to as the 'Subsidence Predictions and Impact Assessment Report') (MSEC, 2022; refer to **Appendix A**).

Tahmoor Coal considers that these current subsidence predictions are acceptable, and that the current mine plan appropriately balances the requirements of resource recovery, minimisation of environmental impact, and consideration of community and Government agency concerns.

If the measured mining induced movements were to be in excess of the predicted values, a review of the model will be undertaken and would include the review of subsidence values and impacts to any surface features within the Extraction Plan Study Area.

2.2.3 Current Methods and Models used by MSEC

The following sections outline the methods and models used by MSEC to provide revised subsidence predictions for the proposed LW S1A-S6A (MSEC, 2022; refer to **Appendix A**). Particular note has been made regarding the process of review of the methods and models used to make predictions of subsidence effects, subsidence impacts and environmental consequences.

2.2.3.1 Incremental Profile Method

The predicted conventional subsidence parameters for the proposed longwalls have been determined using the Incremental Profile Method (IPM), which has been developed by MSEC in 1994. The method is an empirical model based on a large database of observed monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW and the Bowen Basin in Queensland. This IPM subsidence prediction model has been continually developed, revised and updated since 1994, as the new additional monitoring data became available, to suite specific local geology and conditions (MSEC, 2022).

For the Tahmoor South Project, the IPM has been based on the Southern Coalfields predictive curves with calibrations for the local conditions, based on the extensive ground monitoring data from Tahmoor Mine. A discussion on the calibration of the IPM is provided in Section 3.7 of **Appendix A**, while Section 3.8 of **Appendix A** discusses areas where increased subsidence have been observed in comparison with the predictions generated from the IPM**.**

2.2.3.2 2002 ACARP Method

The predicted upsidence and closure movements for the longwalls at Tahmoor Mine have been obtained using the empirical method outlined in Australian Coal Association Research Program (ACARP) Research Project No. C9067 (Waddington and Kay, 2002), referred to as the 2002 ACARP method. A comparison between the measured and predicted valley related effects for previously extracted longwalls at Tahmoor Mine has been provided in Section 3.9 of **Appendix A**.

2.2.3.3 Prediction of Strains

A linear relationship between curvature and strain provides a reasonable prediction for conventional tensile and compressive strains. In the Southern Coalfields, it has been found that a factor of 15 provides a reasonable relationship between the predicted maximum curvature and the predicted maximum conventional strains. This method is effective for predicting typical values when the ground subsides regularly with no localised or elevated strains due to near-surface geological structures or valley closure effects. The maximum strains can be much greater than these typical values and there can be considerable variation from the linear relationship.

The Subsidence Predictions and Impact Assessment Report (MSEC, 2022) therefore provided a statistical approach to account for the variability, instead of just providing a single predicted conventional strain. The range of potential strains above the proposed LW S1A-S6A has been determined using monitoring data from the previously extracted longwalls at the mine. The range of strains measured during the extraction of these longwalls should, therefore, provide a reasonable indication of the range of potential strains for the proposed LW S1A-S6A. The data used in the analysis of observed strains included those resulting from both conventional and nonconventional anomalous movements, however did not include those resulting from valley related effects.

2.2.3.4 Ground Stain

Ground strain comprises two components, being normal strain and shear strain, which can be interrelated using Mohr's Circle. The magnitudes of the normal strain and shear strain components are, therefore, dependent on the orientation in which they are measured. The maximum normal strains (i.e. principal strains) are those in the direction where the corresponding shear strain is zero.

Normal strains along monitoring lines can be measured using 2D and 3D techniques, by taking the change in horizontal distance between two points on the ground and dividing by the original horizontal distance between them. This provides the magnitude of normal strain along the orientation of the monitoring line and, therefore, this strain may not necessarily be the maximum (i.e. principal) strain.

Shear deformations are more difficult to measure, as they are the relative horizontal movements perpendicular to the direction of measurement. However, 3D monitoring techniques provide data on the direction and the absolute displacement of survey marks and, therefore, the shear deformations perpendicular to the monitoring line can be determined. Shear deformations perpendicular to monitoring lines can be described using various parameters, including horizontal tilt, horizontal curvature, horizontal mid-ordinate deviation, angular distortion and shear index.

Horizontal mid-ordinate deviation has been used as the measure for shear deformation, which is defined as the differential horizontal movement of each survey mark, perpendicular to a line drawn between two adjacent survey marks.

2.3 Extraction Plan Team

In accordance with condition C8(a) of SSD 8445, Tahmoor Coal sought the endorsement of qualified and experienced persons to prepare the Extraction Plan from the Planning Secretary. On 26 November 2021, the Director of Resource Assessments (as nominated by the Planning Secretary) endorsed the appointment of the experts listed in **Table 4**.

A copy of the letter of endorsement from DPE is provided in **Appendix C**.

Table 4 Extraction Plan Team

SSD 8445 Condition	Management Plan and Supporting Documents	Company	Team Member
C8	Extraction Plan Main Document	Tahmoor Coal	April Hudson Zina Ainsworth
C8(c)	Graphical Plans	Tahmoor Coal	Zachary Burley
C8(e)	Subsidence Predictions and Impact Assessment Report	MSEC	Daryl Kay
C8(g)(i)	Subsidence Monitoring Plan	MSEC	Daryl Kay
C8(g)(ii)	Built Features Management Plan and associated Subsidence Management Plans for individual built features	MSEC	Daryl Kay
C8(g)(iii)	Water Management Plan	HEC / ATC Williams	Anthony Marszalek Camilla West
	Supporting surface water documents for the Water Management Plan	HEC / ATC Williams	Anthony Marszalek Camilla West
	Supporting groundwater documents for the Water Management Plan	SLR	Sharon Hulbert Maxime Philbert
		Watershed Hydrogeo	Will Minchin
C8(g)(v)	Land Management Plan and supporting documents	Tahmoor Coal	April Hudson
		Douglas Partners	Roderick Haselden Sean Little
		SLR	Murray Fraser
C8(g)(iv)	Biodiversity Management Plan	Niche Environment and Heritage	Matthew Russell Jessie Bear Sian Griffiths
C8(g)(vi)	Heritage Management Plan	EMM Consulting	Susan Lampart Ryan Desic Anthony Dakhoul Pamela Chauvel
C8(g)(vii)	Public Safety Management Plan	Tahmoor Coal	April Hudson Zina Ainsworth

3 Extraction Plan Overview

3.1 Extraction Plan Study Area

3.1.1 Definition of Study Area

The Extraction Plan Study Area is defined as the surface area that is likely to be affected by the extraction of LW S1A-S6A from the Bulli Coal Seam. This Study Area has been calculated by combining the areas bound by the following limits:

- The predicted limit of vertical subsidence, taken as the 20 millimetre (mm) subsidence contour resulting from the extraction of LW S1A-S6A; and
- A 35^{o} angle of draw line from the limit of proposed extraction for LW S1A-S6A.

The Study Area is illustrated in **Figure 3**.

An expansion of the Study Area to 600 m from extraction has also been defined by MSEC (20221) (refer to **Figure 3**). Relevant features within this 600 m buffer could be susceptible to far-field or valley related movements have been included for consideration in the Subsidence Predictions and Impact Assessment Report (MSEC, 2022) and within this Extraction Plan and associated documents. The 600 m buffer for natural features has been included based on recommendations in the independent inquiry report titled *Impacts of Underground Coal Mining on Natural Features in the Southern Coalfields – Strategic Review* (NSW Department of Planning (DoP), 2008).

3.1.2 Environmental Features in the Study Area

Topography within the Study Area is generally undulating with a fall from the south-west to the north-east. The major topographical feature in and near the Study Area are Teatree Hollow and Bargo River valley, the latter which is located to the north of the Study Area. The surface levels near the Study Area vary from a low point of approximately 265 m AHD in the base of Teatree Hollow downstream from LW S1A, to the high point of approximately 345 m AHD to the south-west of LW S6A.

Teatree Hollow is located directly above the proposed LW S1A to LW S6A, while the tributary of Teatree Hollow (Wirrimbirra Creek) is located directly above the proposed LW S1A to LW S4A. These are located in the catchment of the Hawkesbury-Nepean River.

The Study Area is located predominantly within the Teatree Hollow catchment which is a sub-catchment of the Bargo River. Small portions of the Study Area and 600 m buffer are also located within the Hornes Creek, Dogtrap Creek and Bargo River catchments. The lower reaches of Teatree Hollow, Dogtrap Creek and the Bargo River have, to varying degrees, experienced subsidence-related effects due to historical mining operations at the Tahmoor Mine.

The surface lithology above the proposed LW S1A-S6A generally comprises the Wianamatta Group, with the Hawkesbury Sandstone exposed in the river gorges and creek alignments within the Study Area (MSEC, 2022). The landscape of the Study Area includes a number of steep slopes.

The Study Area is generally cleared for small scale rural production, while native vegetation is present predominantly in the riparian zones and steep slopes of the Study Area.

The Study Area does not include any Drinking Water Catchment Areas, Declared Special Areas, springs, sea, lake, shoreline, natural dams, escarpments, swamps, wetlands or water related ecosystems, National Parks, State Forests, State Conservation Areas, or areas of significant geological interest (MSEC, 2022).

Table 5 provides a summary of the environmental features within the Extraction Plan Study Area and the Key Component Plans and associated documents that discuss and manage these features.

Table 5 Environmental and Built Features within the LW S1A-S6A Extraction Plan Area and Management Plans

Feature	Investigation and Assessment	Management and Monitoring
Natural and Aboriginal Heritage Features		
Waterways	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • Water Management Plan (WMP) • Myrtle Creek and Redbank Creek Remediation Progress Review (ATC Williams, 2022)	• WMP • Subsidence Monitoring Plan
Flood-prone land	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • WMP	• WMP • Subsidence Monitoring Plan

Feature	Investigation and Assessment	Management and Monitoring
Groundwater	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • WMP • Groundwater Technical Report (SLR, 2022a) • Baseline Private Bore Assessment Report (SLR, 2022b)	• WMP • Subsidence Monitoring Plan
Steep slopes and cliffs	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • Land Management Plan (LMP) • Detailed Slope Stability Assessment	• LMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Main Southern Railway, Report No. MSEC1201, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Mine Site, Report No. MSEC1247, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Wollondilly Shire Council Infrastructure, Report No. MSEC1193-03, 2022
Land and soil capability	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • LMP • Geotechnical Assessment (Douglas Partners, 2022) • Land and Agricultural Resource Assessment (SLR, 2022c)	• LMP • Subsidence Monitoring Plan
Aquatic ecology (e.g. threatened or protected species, aquatic habitat)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • Biodiversity Management Plan (BMP)	• BMP • Subsidence Monitoring Plan
Terrestrial ecology (e.g. threatened or protected species, natural vegetation)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BMP	• BMP • Subsidence Monitoring Plan
Aboriginal heritage	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • Heritage Management Plan (HMP)	• HMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Australian Wildlife Sanctuary, Report No. MSEC1074, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Bargo Cemetery, Report No. MSEC1193-10, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Main Southern Railway, Report No. MSEC1201, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Picton Weir, Report No. MSEC1193-12, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Mine Site, Report No. MSEC1247, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Wollondilly Shire Council Infrastructure, Report No. MSEC1193-03, 2022
Built Features (infrastructure owner in brackets)		
Electrical infrastructure (Endeavour Energy)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • Built Features Management Plan (BFMP)	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Endeavour Energy Infrastructure, Report No. MSEC1193-07, 2022

Feature	Investigation and Assessment	Management and Monitoring
Gas infrastructure (Jemena)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Jemena Gas Infrastructure, Report No. MSEC1193-06, 2022
Potable water infrastructure (Sydney Water)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Sydney Water Potable Water Infrastructure, Report No. MSEC1193-04, 2022
Sewer infrastructure (Sydney Water)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Sydney Water Sewer Infrastructure, Report No. MSEC1193-05, 2022
Telecommunications infrastructure (Telstra, NBNCo and TPG)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Telstra Infrastructure, Comms Network Solutions, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for NBN Co Infrastructure, Comms Network Solutions, 2022 • Tahmoor Coal – LW S1A-S6A Management Plan for TPG Infrastructure, Comms Network Solutions, 2022
Main Southern Railway (ARTC)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Main Southern Railway, Report No. MSEC1201, 2022
Public roads, bridges and culverts (Wollondilly Shire Council)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Wollondilly Shire Council Infrastructure, Report No. MSEC1193-03, 2022
Picton Weir (Dams Safety NSW)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Picton Weir, Report No. MSEC1193-12, 2022
Farm dams (privately owned)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • LMP • BFMP	• LMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Built Structures, Report No. MSEC1193-09, 2022
Groundwater bores (privately owned)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • WMP • Groundwater Technical Report (SLR, 2022a)	• WMP • BFMP • Subsidence Monitoring Plan

Feature	Investigation and Assessment	Management and Monitoring
	• Baseline Private Bore Assessment (SLR, 2022b) • BFMP	
Permanent survey control marks (Spatial Services)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan
Built Features (property / structure owner in brackets)		
Bargo Cemetery (Wollondilly Shire Council)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Bargo Cemetery, Report No. MSEC1193-10, 2022
Tahmoor Mine Site (Tahmoor Coal)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Mine Site, Report No. MSEC1247, 2022
Wollondilly Anglican College (Anglican Diocese)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Wollondilly Anglican College, Report No. MSEC1193-11, 2022
Bargo Petroleum and Hill Top Pit Stop (private ownership)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Bargo Petroleum and Hill Top Pit Stop, Report No. MSEC1193-13, 2022
Inghams Bargo Breeder Farm (Inghams)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Inghams Bargo Breeder Farm and Turkey Farm, Report No. MSEC1193-14, 2022
Inghams Turkey Farm (Inghams)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Inghams Bargo Breeder Farm and Turkey Farm, Report No. MSEC1193-14, 2022
Tahmoor Garden Centre (private ownership)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Tahmoor Garden Centre, Report No. MSEC1193-15, 2022
Australian Wildlife Sanctuary (National Trust)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • HMP • BFMP	• HMP • BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Australian Wildlife Sanctuary, Report No. MSEC1074, 2022
MKD Machinery (private ownership)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan

Feature	Investigation and Assessment	Management and Monitoring
		• Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to MKD Machinery, Report No. MSEC1193-16 (planned to complete prior to LW S3A)
Pamak Hobbies (private ownership)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Pamak Hobbies, Report No. MSEC1193-19 (planned to complete prior to LW S5A)
Canine Country Club (private ownership)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Canine Country Club, Report No. MSEC1193-18 (planned to complete prior to LW S6A)
Bargo Valley Produce (Bargo Valley Product Pty Limited)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Bargo Valley Produce, Report No. MSEC1193-17 (planned to complete prior to LW S5A)
Public amenities	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Built Structures, Report No. MSEC1193-09, 2022
Dwellings, driveways, pools, rural structures (privately owned)	• Subsidence Prediction and Impact Assessment Report (MSEC, 2022) • BFMP	• BFMP • Subsidence Monitoring Plan • Tahmoor Coal – LW S1A-S6A Management Plan for Potential Impacts to Built Structures, Report No. MSEC1193-09, 2022

3.1.3 Land Use and Built Features in the Study Area

The Study Area is located within the Wollondilly Shire Council Local Government Area, and the predominant land uses within the Study Area include rural residential, small-scale cattle and horse grazing. The main agricultural enterprise within or adjacent to the Study Area is poultry farming, and numerous horticultural enterprises (managed by irrigation systems, greenhouses, hothouses and hydroponic systems) are also present in the Study Area (SLR, 2022c).

A number of infrastructure are located within the vicinity of the proposed longwalls, including:

- Main Southern Railway, including the Wellers Road Overbridge;
- Public roads, drainage culverts, and bridges;
- Potable water infrastructure;
- Sewer infrastructure;
- Gas infrastructure;
- Electrical infrastructure;
- Telecommunications infrastructure;
- Picton Wier;
- Groundwater bores; and
- Survey control marks.

A number of properties with built features have been identified within the vicinity of the proposed longwalls, including:

- 105 private properties, with a total of 65 houses located directly above the proposed longwalls. These properties include built structures, driveways, pools, septic tanks, farm dams, and water tanks;

- Wollondilly Anglican College (including church, sewerage treatment plant, oval, tennis courts);
- Farm land and facilities (farm buildings and sheds, tanks, gas and fuel storages, poultry sheds, hydroponic systems, irrigation systems, fences, farm dams, bores). This included the businesses Inghams Bargo Breeder Farm, Inghams Turkey Farm, and Bargo Valley Produce;
- Bargo Cemetery;
- Australian Wildlife Sanctuary;
- Tahmoor Mine Site;
- Bargo Petroleum and Hill Top Pit Stop;
- Tahmoor Garden Centre;
- MKD Machinery;
- Pamak Hobbies; and
- Canine Country Club.

The Study Area does not include tunnels, liquid fuel pipelines, air strips, hospitals, shopping centres, community centres, office buildings, swimming pools, bowling greens, racecourses, golf courses, glass houses, factories, buildings equipment or operations that are sensitive to surface movements, surface mining voids or rehabilitation areas, items of architectural significance, retirement or age care villages (MSEC, 2022).

The Study Area encompasses three Aboriginal heritage sites and four historical heritage sites (refer to **Figure 11**):

- Aboriginal heritage sites:
  - Isolated find: TC14-2-19 (AHIMS 48-2-0275);
  - Artefact scatter: Remembrance Drive 2013.1 (AHIMS 52-2-3968);
  - Rockshelter: Teatree Hollow 2013.1 (AHIMS 52-2-4471);
- Historical heritage sites:
  - Wirrimbirra Sanctuary (known as the Australian Wildlife Sanctuary) [State Heritage Register (SHR) and Wollondilly local environment plan (WLEP)];
  - Bargo Cemetery (WLEP);
  - Part of the Great Southern Road (non-statutory listed); and
  - Tahmoor Colliery (known as the Tahmoor Mine Site) (non-statutory listed).

One locally listed heritage item, Railway Bridge North (also known as Wellers Road Overbridge), is located within the 600 m buffer from extraction that could be susceptible to far-field or valley related movements. In addition, a locally listed heritage item, Picton Weir, and the State and locally listed heritage item, Bargo Railway Viaduct, are outside the 600 m buffer but could also be susceptible to far-field or valley related movements.

Table 5 provides a summary of the built features within the Extraction Plan Study Area and the Key Component Plans and associated documents that discuss and manage these features.

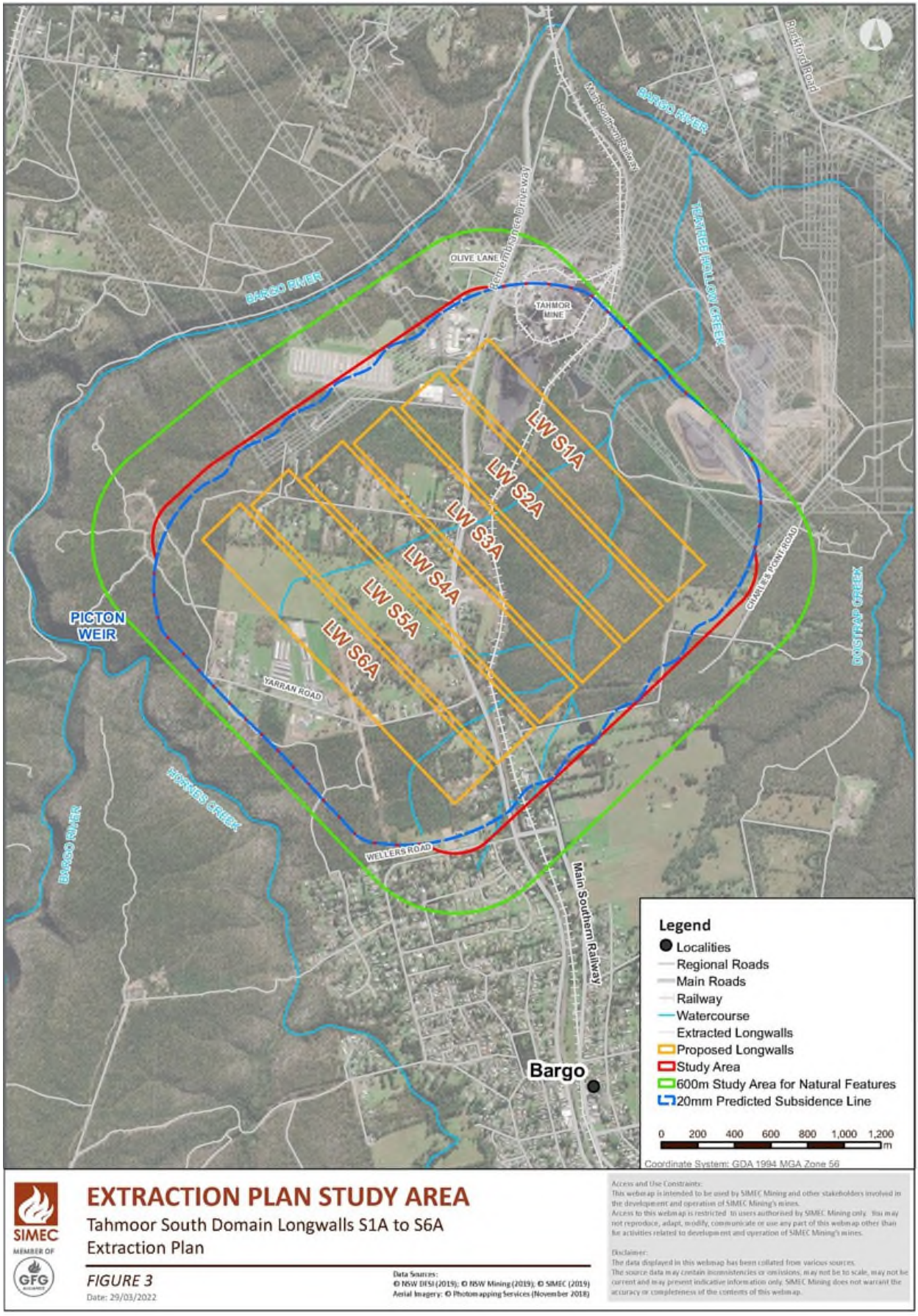


Figure 3 **Extraction Plan Study Area**

3.2 Approvals and Licensing 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 (including development consents, leases, licences, and other relevant approvals) is maintained by Tahmoor Coal in a compliance database.

Tahmoor Mine currently operates under a number of approvals, including:

- Development Consent (7105/47) granted in 1975 by Wollondilly Shire Council for the development of a mine and associated mine infrastructure;
- Development Consent (76/20188) granted in 1979 by NSW Planning and Environment Commission (and subsequent minor modifications approved by NSW Planning and Environment Commission and NSW Department of Planning) for a CHPP and reject emplacement, coal transportation, upgrade of surface facilities for longwall mining, and extension of the CHPP.
- Development Consent (190/85) granted in 1985 by Wollondilly Shire Council for surface civil and mechanical work for gas extraction;
- Development Consent (DA 57/93) (and subsequent minor modification) granted by the Land and Environment Court in 1994 for an expansion of underground coal mining into the Tahmoor North area, continued operation of the existing Tahmoor Mine surface facilities including the coal preparation plant and the reject emplacement area;
- Development Consent (DA 67/98) (and subsequent minor modification) granted by the Minister for Urban Affairs and Planning in 1999 for the expansion of underground mining into those areas of Tahmoor North in which mining was classified as prohibited development;
- Development Consent (SSD 8445) granted in 2021 by DPIE for the Tahmoor South Project, including the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period;
- Approval (EPBC 2017/8084) granted in 2021 by Department of Agriculture, Water and the Environment (DAWE) for the Tahmoor South Project under sections 130(1) and 133(1) of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act);
- CCL 716, CCL 747, ML 1376, ML 1308, ML 1539, and ML 1642;
- Tahmoor Mining Operations Plan (MOP); and
- Environmental Protection Licence (EPL) 1389 under the *Protection of the Environment Operations Act 1997*.

It is noted that development consents 7105/47, 76/20188, 190/85 and 57/93 will be surrendered in accordance with Consent A21 (SSD 8445) following the completion of current mining activities and mine closure/rehabilitation activities required by these consents.

These approvals constitute Tahmoor Coal's licences to conduct underground mining operations by longwall and bord and pillar mining methods within the Bulli Coal Seam.

Applicable conditions relevant to the proposed extraction of LW S1A-S6A from development consent SSD 8445, EPBC 2017/8084, Leases CCL 716 and CCL 747, EPL 1389 and relevant Work Health and Safety Legislation (WHS Legislation) are outlined in the following sections. Each component management plan prepared in support of the Extraction Plan also includes these details as well as where each plan addresses the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (NSW Department of Planning & Environment, 2015) and WHS Legislation.

Statutory approvals areas and mining tenement boundaries applicable to the LW S1A-S6A Extraction Plan Study Area are detailed on **Figure 2** and Graphical Plan 5.

3.2.1 Project Approval

3.2.1.1 Development Consent Conditions for Extraction Plan

LW S1A-S6A will be extracted in the Tahmoor South mining area in accordance with Development Consent SSD 8445. 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 6**.

Table 6 SSD 8445 Condition Requirements for Extraction Plans

<table>
<tr><th>Condition Reference</th><th>Condition Requirement</th><th>Tahmoor Coal Response / Section Addressed</th></tr>
<tr><td>C1</td><td>SUBSIDENCE
Performance Measures – Natural and Heritage Features etc.
The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 7.</td><td rowspan="2">Section 3.4.2, Section 3.5, Section 3.6, Section 4, Section 5
Appendix B – Master TARP
Key Component Plans and Supporting Documents</td></tr>
<tr><td>Excerpt from Table 7</td><td>Table 7: Subsidence impact performance measures - natural and heritage features etc
<table>
<tr><th>Feature</th><th>Performance Measures</th></tr>
<tr><td colspan="2">Water Resources</td></tr>
<tr><td>All watercourses within the Subsidence Area</td><td>- No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS</td></tr>
<tr><td>Other watercourses</td><td>- Negligible environmental consequences including beyond those predicted in the EIS, including:
- negligible diversion of flows or changes in the natural drainage behaviour of pools;
- negligible decline in baseline channel stability;
- negligible gas releases and iron staining; and
- negligible increase in water turbidity</td></tr>
<tr><td>GDEs including Thirlmere Lakes</td><td>- Negligible impacts including:
- negligible change in groundwater levels; and
- negligible change in groundwater quality.</td></tr>
<tr><td colspan="2">Land</td></tr>
<tr><td>Any cliff located directly above longwalls</td><td>- Minor environmental consequences (that is occasional rockwalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 5% of the total face area of the cliff within any longwall mining domain)</td></tr>
<tr><td>Any cliff within Subsidence Area beyond the extent of longwalls</td><td>- Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within Subsidence Area)</td></tr>
<tr><td>All land within the Subsidence Area</td><td>- No greater subsidence impacts or environmental consequences than predicted in the EIS</td></tr>
<tr><td>All land outside the Subsidence Area</td><td>- Negligible subsidence impacts or environmental consequences</td></tr>
<tr><td colspan="2">Biodiversity</td></tr>
<tr><td>Threatened species, threatened populations, or endangered ecological communities</td><td>- No greater subsidence impacts or environmental consequences than predicted in the EIS
- Negligible impacts on threatened species, populations or communities due to remediation of subsidence cracking</td></tr>
<tr><td>Aquatic habitat</td><td>- Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS</td></tr>
<tr><td colspan="2">Heritage</td></tr>
<tr><td>Aboriginal cultural heritage sites listed in Appendix 4</td><td>- No greater subsidence impacts or loss of heritage values than predicted in the EIS</td></tr>
<tr><td>Historic heritage sites listed in Appendix 4</td><td>- No greater subsidence impacts or loss of heritage values than predicted in the EIS</td></tr>
<tr><td colspan="2">Mine workings</td></tr>
<tr><td>First workings</td><td>- To remain long term stable and non-subsiding</td></tr>
<tr><td>Second workings</td><td>- To be carried out only within the approved mine plan, in accordance with an approved Extraction Plan</td></tr>
</table>
Notes for Table 7 (C1):
Notes:
• These performance measures apply to all mining taking place after the date of this consent.
• The Applicant is required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent (see condition C8).</td></tr>
</table>

<table>
<tr><th>Condition Reference</th><th>Condition Requirement</th><th>Tahmoor Coal Response / Section Addressed</th></tr>
<tr><td>C2</td><td>Performance Measures – Natural and Heritage Features etc.
Measurement and monitoring of compliance with performance measures and performance indicators in this consent is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans and monitoring programs. In the event of a dispute over the appropriateness of proposed methods, the Planning Secretary will be the final arbiter.</td><td>Section 2.2.3, Section 3.6, Section 5
Appendix B – Master TARP
Key Component Plans and Supporting Documents</td></tr>
<tr><td>C5</td><td>Performance Measures - Built Features
The Applicant must ensure that the development meets the performance measures in Table 8.
Table 8: Subsidence impact performance measures – built features
<table>
<tr><th>Feature</th><th>Performance Measures</th></tr>
<tr><td colspan="2">Public Infrastructure</td></tr>
<tr><td>Key public infrastructure:
• Main Southern Railway
• Remembrance Drive
• M31 Motorway
• Moomba to Sydney Gas Pipeline
• Gorodok Ethane Pipeline
• Bargo Waste Management Centre</td><td>- Always safe and serviceable
- Damage that does not affect safety or serviceability must be fully repairable, and must be fully investigated and repaired at the cost of the Applicant</td></tr>
<tr><td>• All other public infrastructure including roads, culverts, bridges, viaducts, water supply pipelines, sewerage mains, gas pipelines, electrical and telecommunication infrastructure and survey control marks</td><td>- Always safe
- Serviceability should be maintained wherever practicable
- Loss of serviceability must be fully compensated
- Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant</td></tr>
<tr><td colspan="2">Other Built Features</td></tr>
<tr><td>• Public amenities including schools, churches and community centres
• Industrial, commercial and business premises
• Bargo Cemetery
• Wirrimbirra Sanctuary
• Privately-owned residences
• Other privately-owned built features and improvements, including petrol stations, sheds, garages, farm dams, tanks, swimming pools, tennis courts, roads, tracks and fences</td><td>- Always safe
- Serviceability should be maintained wherever practicable
- Loss of serviceability must be fully compensated
- Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant</td></tr>
<tr><td colspan="2">Public Safety</td></tr>
<tr><td>- Public safety</td><td>- Negligible additional risk</td></tr>
</table>
Notes for Table 8 (C5)
Notes:
• These performance measures apply to all mining taking place after the date of this consent.
• The Applicant is required to define more detailed performance measures in the Built Features Management Plans or Public Safety Management Plan (see condition C8).
• Requirements regarding safety or serviceability do not prevent preventative or mitigatory actions being taken prior to or during mining.
• Requirements under this condition may be met by measures undertaken in undertaken in accordance with the Coal Mine Subsidence Compensation Act 2017.</td><td>Section 3.5, Section 3.6, Section 5
Appendix B – Master TARP
Key Component Plans and Supporting Documents</td></tr>
<tr><td>C6</td><td>Performance Measures - Built Features
Any dispute between the Applicant and the owner of any built feature over the interpretation, application or implementation of the performance measures in Table 8 is to be settled by the Planning Secretary, following consultation with the Resources Regulator. Any decision by the Planning Secretary shall be final.</td><td>Noted.</td></tr>
<tr><td>C8</td><td>Extraction Plan
The Applicant must prepare an Extraction Plan for all second workings on the site of the development to the satisfaction of the Planning Secretary. Each Extraction Plan must:</td><td>This document.</td></tr>
<tr><td>C8(a)</td><td>Be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;</td><td>Section 2.3
Appendix C – Consultation for evidence of endorsement</td></tr>
</table>

Condition Reference	Condition Requirement	Tahmoor Coal Response / Section Addressed
C8(b)	Be prepared in consultation with the Resources Regulator, DPIE Water and SANSW;	**Section 2.1, Section 2.2** **Appendix C** – Consultation for evidence of endorsement
C8(c)	Include detailed plans of existing and proposed first and second workings and overlying surface features, including any applicable adaptive management measures;	**Section 6** Graphical Plans
C8(d)	Include adequate consideration of mine roof and floor conditions which has been undertaken in consultation with the Resources Regulator;	**Section 2.1.3, Section 3.3.4, Section 3.4.2**
C8(e)	provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent;	**Section 3.4** **Appendix A** – Subsidence Prediction and Impact Assessment Report
C8(f)	describe in detail the performance indicators to be implemented to ensure compliance with the performance measures in Table 7 and Table 8, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition B56;	**Section 3.4.2, Section 3.5, Section 3.6, Section 5** **Appendix B** – Master TARP Key Component Plans and Supporting Documents
C8(g)	Including a:	See below
C8(g)(i)	Subsidence Monitoring Plan which has been prepared in consultation with the Resources Regulator to:	**Section 5** Subsidence Monitoring Plan
	• describe the ongoing conventional and non-conventional Subsidence Monitoring Plan;	
	• 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;	
C8(g)(ii)	Built Features Management Plan which has been prepared in consultation with the Resources Regulator, to manage the potential subsidence impacts of the proposed underground workings on built features, and which:	**Section 4.6** Built Features Management Plan Subsidence Management Plans for built features
	• has also been prepared in consultation with: - the owners of potentially affected features; - the Technical Committee required under condition C14; - the EPA in relation to the Bargo Waste Management Centre; and - the NSW Department regulating the Pipelines Act 1967 in relation to the licensed gas pipelines;	
	• addresses in appropriate detail all items of key public infrastructure (with particular consideration of public roads and rail lines, including any associates bridges and culverts, gas pipelines and waste facilities), other public infrastructure and all classes of other built features;	
	• recommends appropriate pre-mining mitigation measures to reduce subsidence impacts;	
	• recommends appropriate remedial measures and includes commitments to mitigate, repair, replace or compensate predicted impacts on potentially affected built features in a timely manner; and	
	• in the case of all key public infrastructure, and other public infrastructure except roads, trails and associated structures, reports external auditing for compliance with ISO 31000 (or an alternative standard agreed with the infrastructure owner), and provides for annual auditing of compliance and effectiveness during extraction which may impact the infrastructure;	
C8(g)(iii)	Water Management Plan which has been prepared in consultation with DPIE Water and BCS and is consistent with the Water Management Plan required under condition B34, which provides for the management of potential impacts and environmental consequences of the proposed underground workings on watercourses and aquifers, including:	**Section 4.2** Water Management Plan
	• detailed baseline data on: - surface water flows, quality and geomorphic conditions of watercourses and/or water bodies that could be affected by subsidence; and - groundwater levels, yield and quality in the region, including for privately-owned licensed bores;	
	• detailed surface and groundwater impact assessment criteria, including specific trigger levels for:	

Condition Reference	Condition Requirement	Tahmoor Coal Response / Section Addressed
	- investigating any potentially adverse impacts on water resources or water quality; - active remediation of geomorphic and erosional impacts (including supporting justification for the selected triggers); and - providing compensatory water supply to affected water users under condition B26 of this Schedule;	
	• a surface water monitoring program to monitor and report on: - stream flows and quality; - stream and riparian vegetation; - channel and bank stability; and - the effectiveness of remediation measures in controlling geomorphic and erosional impacts;	
	• a groundwater monitoring program to monitor and report on: - groundwater inflows to the underground mining operations; - the height of groundwater depressurisation; - height of fracturing above indicative longwall panels following mining; - background changes in groundwater yield/quality against mine-induced changes, in particular, on privately-owned groundwater bores in the vicinity of the site; - permeability, hydraulic gradient, flow direction and connectivity of the deep and shallow groundwater aquifers; and - impacts of the development on GDEs (including Thirlmere Lakes);	
	• a description of any adaptive management practices implemented to guide future mining activities in the event of greater than predicted impacts on aquatic habitat;	
	• a program to validate the surface water and groundwater models for the development and compare monitoring results with modelled predictions; and	
	• a plan to respond to any exceedances of the surface water and groundwater assessment criteria, including a Watercourse Corrective Action Management Plan as detailed in Condition C12.	
C8(g)(iv)	Biodiversity Management Plan which is consistent with the Biodiversity Management Plan required under condition B38:	**Section 4.4** Biodiversity Management Plan
	• has been prepared in consultation with BCS;	
	• establishes baseline data for existing habitat within the subsidence area, including water table depth, vegetation condition, stream morphology, key fish habitat and threatened species habitat; and	
	• provides for the adaptive management of potential impacts and environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats, EECs/CEECs and water dependent ecosystems;	
C8(g)(v)	Land Management Plan which:	**Section 4.3** Land Management Plan
	• has been prepared in consultation with any affected public authorities;	
	• provides for the management of potential impacts and/or environmental consequences of the proposed underground workings on land in general, with a specific focus on steep slopes; and	
	• is informed by a detailed slope stability assessment prepared by a suitably qualified and experienced person/s;	
C8(g)(vi)	Heritage Management Plan which is consistent with the requirements of conditions B42 to B47:	**Section 4.5** Heritage Management Plan
	• has been prepared in consultation with Heritage NSW, Council and relevant stakeholders for both Aboriginal heritage and non-Aboriginal heritage items;	
	• includes a pre-mining assessment of the condition and structure of local and State significant heritage items within the subsidence area;	
	• describes the measures to be implemented to: - protect, monitor and manage potential environmental consequences of the proposed second workings on identified Aboriginal objects and Aboriginal places and local and State significant heritage items, in accordance with the commitments made in the EIS; - manage the discovery of suspected human remains and any new Aboriginal objects or Aboriginal places, including provisions for burials, over the life of the development; - ensure compliance with the requirements under conditions B41 to B46 inclusive and the subsidence impact performance measures in Table 7; and - facilitate ongoing consultation and involvement of Registered Aboriginal Parties in the conservation and management of Aboriginal cultural heritage sites within the subsidence area;	

Condition Reference	Condition Requirement	Tahmoor Coal Response / Section Addressed
C8(g)(vii)	Public Safety Management Plan which has been prepared in consultation with the Resources Regulator, which ensures public safety and manages access on the site;	**Section 4.7** Public Safety Management Plan
C8(g)(viii)	Trigger Action Response Plans addressing all features in Table 7 and Table 8, which contain:	**Section 3.6.2** Appendix B – Master TARP
	• appropriate triggers to warn of increased risk of exceedance of any performance measure;	**Section 3.6.2** Appendix B – Master TARP
	• specific actions to respond to high risk of exceedance of any performance measure to ensure that the measure is not exceeded;	**Section 3.6.3** Appendix B – Master TARP
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement the measures; and	**Section 3.6.3**
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measures in Table 7 and/or Table 8, or where any such exceedance appears likely; and	**Section 3.6.4**
C8(g)(ix)	Contingency Plan that expressly provides for:	**Section 3.6.3** Appendix B – Master TARP
	• adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Table 7 and/or Table 8, or where any such exceedance appears likely;	**Section 3.6.4**
	• an assessment of remediation measures that may be required if exceedances occur and the capacity to implement those measures;	**Section 3.6.3**
C8(h)	Propose appropriate revisions to the Rehabilitation Management Plan required under Condition B60; and	The Rehabilitation Management Plan, required under Condition B60, is currently in preparation. This document will be submitted to DPE for approval prior to the 2 July 2022 deadline for large mines in accordance with the new regulations for mining rehabilitation under the *Mining Act 1992*. Following this approval, the plan will be revised every 3 years unless site conditions changes.
C8(i)	include a program to collect sufficient baseline data for future Extraction Plans.	**Section 5.4** Subsidence Monitoring Plan
C9	The Applicant must not undertake second workings until the relevant Extraction Plan is approved by the Planning Secretary.	Noted.
C10	The Applicant must implement the Extraction Plan as approved by the Planning Secretary.	Noted.
C11	**Payment of Reasonable Costs** The Applicant must pay all reasonable costs incurred by the Department to engage a suitably qualified, experienced and independent person/s to review the adequacy of any aspect of an Extraction Plan.	Noted.

3.2.1.2 Additional Consent Conditions Relevant to Extraction Plan

In addition to the requirements in SSD 8445 specific to the preparation of this Extraction Plan, **Table 7** provides a summary of additional requirements listed in SSD 8445 that are applicable to this Extraction Plan.

It is noted that, while DA 1975 (7105/47) is applicable to the first portion of first workings (refer to response to Condition C7 in the table below), there are no conditions from DA 1975 that are relevant to this Extraction Plan. In addition, DA 1975 will be surrendered in accordance with Consent A21 (SSD 8445) following the completion of current mining activities and mine closure/rehabilitation activities required by these consents.

Table 7 Additional Development Consent Requirements for this Extraction Plan

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
SSD 8445		
A1	**Obligation to minimise harm to the environment** In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of this development, and any rehabilitation required under this consent.	**Section 3.6** The management measures discussed in this Extraction Plan have been proposed to meet the requirements of this condition.
A2	**Terms of consent** The development may only be carried out: (a) in compliance with conditions of this consent; (b) in accordance with all written directions of the Planning Secretary; (c) generally in accordance with the EIS; and (d) generally in accordance with the Development Layout in Appendix 2.	**Section 3.2.1** This Extraction Plan has been developed in compliance with the listed conditions and commitments as discussed in Condition A2, which is required in Condition E5.
A5	**Mining operations** First workings and second workings may only be carried out within the area covered by the approved mine plan, subject to Condition A7 requiring shortening of Longwall 103B (LW 103B) and Longwall 104B (LW 104B).	**Appendix A** – Subsidence Predictions and Impact Assessment shows the 'Extent of Longwalls' as defined in the Tahmoor South Project EIS, and illustrates that the proposed longwalls are within this area. LW 103B and LW 104B are not relevant to this Extraction plan.
A19	**Mining operations** The proposed downcast ventilation shaft TSC2 must be constructed on the same site as TSC1. Disturbance must not occur at the proposed TSC2 site. Construction of shafts TSC1 and TSC2 must not be commenced until a revised layout and design has been submitted to and approved by the Planning Secretary. This Condition does not remove the need for the Applicant to pursue micro-siting of surface infrastructure to avoid biodiversity impacts as required under condition B38(e)(i).	**Section 7.8** This Extraction Plan will be reviewed within three months following a notification of a change in the development phase relevant to this condition, as required by Condition E7.
A25	**Community Consultative Committee** Within three months of the commencement of the development, a Community Consultative Committee (CCC) must be established for the development in accordance with the Department's Community Consultative Committee Guidelines: State Significant Projects (2019). The CCC must meet at a minimum frequency of once every six months. The CCC must continue to operate during the life of the development, or other timeframe agreed by the Planning Secretary. The Committee must comprise an independent chair and appropriate representation from the Applicant, Council, affected stakeholder groups and the local community.	**Section 2.1, Section 2.1.3** The TCCCC was established in 2003 in response to the requirement for DA 67/98 Condition 47 to establish and operate a Community Consultative Committee in general accordance with DPE Community Consultative

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
		Committee Guidelines: State Significant Projects (2016). DPE have approved the existing TCCCC as meeting the requirements for this condition. This Extraction Plan has been discussed at recent TCCCC meetings.
A36	**Compliance** The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development.	**Section 7.9.1** Tahmoor Coal provides Environmental Awareness Training for all on-site employees on an annual basis. This training includes information on all relevant environmental aspects, including relevant information included in this Extraction Plan.
A39	**Crown Land** The Applicant must consult with DPIE - Crown Lands prior to undertaking any development on Crown Land or Crown Roads. Notes: • Under section 265 of the Mining Act 1992, the Applicant is required to enter into a compensation agreement with DPIE - Crown Lands prior to undertaking any mining operations or related activities on Crown land or Crown roads within a mining lease. • Under section 141 of the Mining Act 1992, the Applicant is required to enter into an access arrangement with DPIE - Crown Lands prior to undertaking any prospecting operations on Crown land or Crown roads within an exploration licence.	**Section 2.1.3** Tahmoor Coal will consult with Crown Land and enter into a compensation agreement prior to undertaking any new development on Crown Land or Crown Roads. This condition was mentioned during consultation with Crown Lands.
B25	Prior to the commencement of second workings under this consent, the Applicant must complete a bore census for all licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 metres as a result of the development providing: (a) notification of bore owners, including an indication of the level of risk of impact to their water supply; (b) ongoing engagement and consultation with bore owners in accordance with the Make Good Strategy contained in the EIS; (c) detailed baseline data regarding groundwater levels, yield and quality for privately-owned groundwater bores; and (d) a condition assessment of existing groundwater bores and monitoring equipment; to the satisfaction of the Planning Secretary.	A Baseline Private Bore Assessment Report is included as an appendices to the Water Management Plan, and includes a review of all licensed privately-owned groundwater bores that are predicted to have a drawdown of greater than 2 metres by the proposed development.
B26	**Compensatory Water Supply** The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with NRAR and DPIE Water, and to the satisfaction of the Planning Secretary	Water Management Plan includes the compensation management plan to be implemented if water supply is impacted by the extraction of LW S1A-S6A.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
B27	The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply should be provided (at least on an interim basis) as soon as practicable after the loss is identified, unless otherwise agreed with the landowner. The burden of proof that any loss of water supply is not due to mining impacts rests with the Applicant.	Water Management Plan includes the compensation management plan to be implemented if water supply is impacted by the extraction of LW S1A-S6A.
B34	**Water Management Plan** Prior to the commencement of construction activities, the Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. (Refer to the SSD 8445 Consent Conditions for full condition)	A Water Management Plan for the Tahmoor South Project has been approved by DPE. Relevant sections from this management plan have been included in the LW S1A-S6A Water Management Plan.
B38	**Biodiversity Management Plan** The Applicant must prepare a Biodiversity Management Plan for all areas of the development to the satisfaction of the Planning Secretary. (Refer to the SSD 8445 Consent Conditions for full condition)	A Biodiversity Management Plan for the Tahmoor South Project has been approved by DPE. Relevant sections from this management plan have been included in the LW S1A-S6A Biodiversity Management Plan.
B41	**Heritage** The Applicant must ensure that the development does not cause any direct or indirect impact on any identified heritage item, beyond those predicted in the EIS. Note: Identified heritage items are listed in Appendix 4.	The Heritage Management Plan includes management measures to address this condition.
B42	**Protection of Aboriginal Heritage** If any previously unknown Aboriginal object is discovered on the site, or suspected to be on the site: (a) all work in the immediate vicinity of the object or place must cease immediately; (b) a 10 m buffer area around the object or place must be cordoned off; and (c) Heritage NSW must be contacted immediately.	Managements measures have been included in the Heritage Management Plan if potential or actual archaeological objects or sites are identified.
B43	**Protection of Aboriginal Heritage** Work in the immediate vicinity may only recommence if: (a) the potential Aboriginal object is confirmed by Heritage NSW, in consultation with the Registered Aboriginal Parties, not to be an Aboriginal object or Aboriginal place; or (b) the Planning Secretary is satisfied with the measures to be implemented in respect of the Aboriginal object and makes a written direction in that regard.	Managements measures have been included in the Heritage Management Plan if potential or actual archaeological objects or sites are identified.
B44	**Protection of Aboriginal Heritage** If suspected human remains are discovered on the site, then all work surrounding the area must cease, and the area must be secured. The Applicant must immediately notify NSW Police Force and Heritage NSW, and work must not recommence in the area until authorised by NSW Police Force and Heritage NSW.	Managements measures have been included in the Heritage Management Plan if potential or actual archaeological objects or sites are identified.
B45	**Protection of Aboriginal Heritage** The Applicant must ensure that all known Aboriginal objects or Aboriginal places on the site and within any offset areas are properly recorded, and those records are kept up to date, in the Aboriginal Heritage Information Management System (AHIMS) Register.	The Heritage Management Plan includes management measures to address this condition.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
B46	**Protection of Historic Cultural Heritage** The Applicant must not commence second workings until the Historic Heritage Plan required under condition C8 is approved by the Planning Secretary. The Applicant must implement the Historic Heritage Plan as approved by the Planning Secretary.	Noted. The Heritage Management Plan is included as part of this Extraction Plan application, in accordance with condition C8.
B47	**Visual Amenity and Lighting** The Applicant must: Take all reasonable steps to minimise the visual and off-site lighting impacts of the development; take all reasonable steps to shield views of mining operations and associated equipment from users of public roads and privately-owned residences; ensure no fixed outdoor lights shine directly above the horizontal or above the building line or any illuminated structure; ensure mobile lighting rigs do not shine directly above the horizontal (except where required for emergency safety purposes); ensure that all external lighting associated with the development complies with relevant Australian Standards including the latest version of Australian Standard AS4282 (INT) 2019 - Control of Obtrusive Effects of Outdoor Lighting; and ensure that the visual appearance of any new buildings, structures, facilities or works (including paint colours and specifications) is aimed at blending as far as possible with the surrounding landscape.	Considered in each individual Construction Environmental Management Plan for surface construction works. This condition is not relevant to the Heritage Management Plan (as indicated in Condition C8(g)(vi)) as the extraction of LW S1A-S6A does not include any of these surface construction works.
B56	**Rehabilitation Objectives** The Applicant must rehabilitate the site in accordance with the conditions imposed on the mining lease(s) associated with the development under the Mining Act 1992. This rehabilitation must be generally consistent with the proposed rehabilitation activities described in the EIS (and shown conceptually in the Rehabilitation Plan in Appendix 5), and must comply with the objectives in Table 6. Table 6: Rehabilitation Objectives Feature: Community Objective: • Ensure public safety • Minimise adverse socio-economic effects associated with mine closure	The rehabilitation objectives of this condition are required to be met in Condition C8(f). **Section 3.4.2, Section 3.5, Section 3.6, Section 5** **Appendix B** – Master TARP Key Component Plans and Supporting Documents
B60	**Rehabilitation Management Plan** The Applicant must prepare a Rehabilitation Management Plan for the development, in accordance with the conditions imposed on the mining lease(s) associated with the development under the Mining Act 1992. (Refer to the SSD 8445 Consent Conditions for full condition)	The Rehabilitation Management Plan as specified in this condition is required to be revised to be met in Condition C8(h). The Rehabilitation Management Plan, required under Condition B60, is currently in preparation. This document will be submitted to DPE for approval prior to the 2 July 2022 deadline for large mines in accordance with the new regulations for mining rehabilitation under the Mining Act 1992.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
		Following this approval, the plan will be revised every 3 years unless site conditions changes.
C3	**Additional Offsets** If the Applicant exceeds the performance measures in Table 7 and the Planning Secretary determines that: it is not reasonable or feasible to remediate the subsidence impact or environmental consequences; or remediation measures implemented by the Applicant have failed to satisfactorily remediate the subsidence impact or environmental consequence, then the Applicant must provide an offset to compensate for the subsidence impact or environmental consequence, that is proportionate to the significance of the subsidence impact or environmental consequence, following consultation with BCS and/or Heritage NSW and to the satisfaction of the Planning Secretary.	Noted. Performance measures in Table 7 of SSD 8445 are not anticipated to be exceeded.
C4	The offset required under condition C3 must give priority to like-for-like physical environmental offsets, but may also consider other offsets under the Biodiversity Offsets Scheme of the BC Act, such as the Biodiversity Conservation Fund established by BCT, or funding or implementing supplementary measures, such as: actions outlined in threatened species recovery programs; actions that contribute to threat abatement programs; biodiversity research and survey programs; and/or rehabilitating degraded habitat.	Noted. Performance measures in Table 7 of SSD 8445 are not anticipated to be exceeded.
C7	**First Workings** The Applicant may carry out first workings within the area of the approved mine plan, other than in accordance with an approved Extraction Plan, provided that the Resources Regulator is satisfied that the first workings are designed to remain stable and non-subsiding in the long term, and do not generate more than 20 mm of vertical subsidence, except insofar as they may be impacted by approved second workings. Note: The intent of this condition is to ensure that first workings are built to geotechnical and engineering standards sufficient to ensure long term stability, with negligible direct subsidence impacts.	**Section 3.4.2** First workings for LW S1A remain within the Tahmoor North Lease, for which DA 1975 (applies. Under this development consent there are no requirements for first workings notifications. Requirements for first workings notifications under the Tahmoor South development consent commences when LW S1A extraction starts (approximately September 2022). A letter will be sent to the Resources Regulator prior to this commencement with information on the first workings as required under this condition.
C12	**Watercourse Corrective Action Management Plan(s)** The Applicant must prepare a Watercourse Corrective Action Management Plan(s) for watercourses damaged by subsidence impacts associated by the development, to the satisfaction of the Planning Secretary. (Refer to the SSD 8445 Consent Conditions for full condition)	In accordance with Condition C8(g)(iii), the Water Management Plan will include a plan to respond to any exceedances of the surface water and groundwater assessment criteria, in the event that exceedances occur.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
		This includes references to Watercourse Corrective Action Management Plan(s), if required.
C14	**Technical Committee for the Bargo Waste Management Centre** Prior to commencing second workings, the Applicant must establish a Technical Committee for the Bargo Waste Management Centre, comprising engineering and geotechnical specialists and a representative of Council, whose appointment has been endorsed by the Planning Secretary; the Applicant and Council. The Technical Committee must continue to operate during the life of the development, or other timeframe agreed by the Planning Secretary. The role of the Technical Committee is to: (a) provide input into the preparation and implementation of the Built Features Management Plan; (b) consult with relevant statutory agencies, including the EPA and SA NSW; (c) identify all potential mechanisms for impacts of the development on the Bargo Waste Management Centre, including from non-conventional subsidence; (d) undertake a risk assessment to identify the level of subsidence induced risks; (e) recommend appropriate pre-mining mitigation measures required to reduce subsidence impacts; (f) recommend appropriate remedial measures and measures to investigate, mitigate, repair, replace or compensate predicted impacts and associated cost sharing responsibilities; and (g) recommend monitoring programs, trigger action response plan(s) and communication plans, to ensure the development meets the performance measures in Table 8. Note: • Technical Committees may also be established for other public infrastructure assets listed in Table 10.	Consultation with this technical committee is required under Condition C8(g)(ii). However, the Bargo Waste Management Centre is not included in the Study Area. A Technical Committee for the Bargo Waste Management Centre will be established prior to the commencement of second workings.
E4	**Adaptive Management** The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and performance measures in this consent. Any exceedance of these criteria or performance measures constitutes a breach of this consent and may be subject to offset or other provisions as specified in this consent and/or penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria or performance measures has occurred, the Applicant must, at the earliest opportunity: (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; (c) within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures or other course of action; and (d) implement reasonable remediation measures as directed by the Planning Secretary.	**Section 3.6, Section 7.4**
E5	**Management Plan Requirements** Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	This main document and all management plans under this Extraction Plan have been prepared in accordance with this condition.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
	(a) a summary of relevant background or baseline data;	**Section 2.2, Section 3.1** Key Component Plans and Supporting Documents
	(b) details of:	NA
	(b)(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Section 3.2** Key Component Plans and Supporting Documents
	(b)(ii) any relevant limits or performance measures and criteria; and	**Section 3.5.1** Key Component Plans and Supporting Documents
	(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;	**Section 3.5.2** Key Component Plans and Supporting Documents
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 3.2.1.3** Key Component Plans and Supporting Documents
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 3.6** Key Component Plans and Supporting Documents
	(e) a program to monitor and report on the:	NA
	(e)(i) impacts and environmental performance of the development; and	**Section 5** Key Component Plans and Supporting Documents
	(e)(ii) effectiveness of the management measures set out pursuant to condition E5(d);	**Section 3.6.5** Key Component Plans and Supporting Documents
	(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;	**Section 3.6.3** Key Component Plans and Supporting Documents
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 3.6.4** Key Component Plans and Supporting Documents
	(h) a protocol for managing and reporting any:	NA
	(h)(i) incident, non-compliance or exceedance of any impact assessment criterion or performance criterion;	**Section 7.2, Section 7.3, Section 7.4**
	(h)(ii) complaint; or	**Section 7.5**
	(h)(iii) failure to comply with other statutory requirements;	**Section 7.1**
	(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development; and	**Section 7.10**
	(j) a protocol for periodic review of the plan.	**Section 7.8**

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
E6	**Management Plan Requirements** The Applicant must ensure that management plans prepared for the development are consistent with the conditions of this consent and any EPL issued for the site.	**Section 3.2** All known conditions and environmental licensing requirements are dealt with in this Extraction Plan and Key Component Plans.
E7	**Revision of Strategies, Plans and Programs** Within three months of: (a) the submission of an incident report under condition E9; (b) the submission of an Annual Review under condition E13; (c) the submission of an Independent Environmental Audit under condition E15; (d) the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or (e) notification of a change in development phase under condition A19; The suitability of existing strategies, plans and programs required under this consent must be reviewed by the Applicant.	**Section 7.8**
E9	**Incident Notification** The Planning Secretary must be notified in writing via the Major Projects website immediately after the Applicant becomes aware of an incident. The notification must identify the development (including the development application number and the name of the development if it has one) and set out the location and nature of the incident. Subsequent notification requirements must be given, and reports submitted in accordance with the requirements set out in Appendix 8.	**Section 7.2**
E10	**Non-Compliance Notification** The Planning Secretary must be notified in writing via the Major Projects website within seven days after the Applicant becomes aware of any non-compliance.	**Section 7.3**
E13	**Annual Review** By the end of March in each year after the commencement of the development, or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. (Refer to the SSD 8445 Consent Conditions for full condition)	**Section 7.1.3**
E15	**Independent Environmental Audit** Independent Audits of the development must be conducted and carried out in accordance with the Independent Audit Post Approval Requirements (2020).	**Section 7.7.2**
E23	**Monitoring and Environmental Audits** Before the commencement of construction until the completion of all rehabilitation required under this consent, the Applicant must: (a) make the following information and documents (as they are obtained, approved or as otherwise stipulated within the conditions of this consent) publicly available on its website: (i) the EIS; (ii) all current statutory approvals for the development; (iii) all approved strategies, plans and programs required under the conditions of this consent; (iv) the proposed staging plans for the development if the construction, operation or decommissioning of the development is to be staged; (v) minutes of CCC meetings;	**Section 7.10.1**

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
	(vi) regular reporting on the environmental performance of the development in accordance with the reporting requirements in any plans or programs approved under the conditions of this consent; (vii) a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs; (viii) a summary of the current phase and progress of the development; (ix) contact details to enquire about the development or to make a complaint; (x) a complaints register, updated monthly; (xi) a register of incident and non-compliance notifications made to the Planning Secretary, updated monthly; (xii) the Annual Reviews of the development; (xiii) audit reports prepared as part of any Independent Environmental Audit of the development and the Applicant's response to the recommendations in any audit report; (xiv) annual returns made under the National Greenhouse and Energy Reporting legislation (xv) any other matter required by the Planning Secretary; and (b) keep such information up to date, to the satisfaction of the Planning Secretary.	

3.2.1.3 EIS Commitments Relevant to Extraction Plan and Supporting Documents

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.

EIS commitments relevant to this management plan are outlined in **Table 8**. These EIS commitments do not include commitments that are covered by the SSD 8445 Conditions of Consent.

Table 8 EIS Commitments

EIS Reference	Commitment	Tahmoor Coal Response / Section Addressed
GE-1	**Geomorphology** Potential impact: Impacts to geomorphological features in the Project Area from mining-induced subsidence Management and mitigation measures: - Pre-, during- and post-mining photographic surveys and visual inspections of geomorphological features for each longwall. Results would be documented in the Extraction Plan and Annual Review. - Annual catchment survey at 10 headwater photographic sampling locations to monitor mining-induced subsidence impacts of the Project over time. - A geomorphology survey (baseline and post mining) of waterways overlying each longwall to complement monitoring of subsidence at each longwall. - Installation of subsidence monitoring points before mining of secondary workings for all longwalls. The adaptive management plan for the Project would include re-evaluation of the monitoring	Water Management Plan

EIS Reference	Commitment	Tahmoor Coal Response / Section Addressed
	techniques for subsidence and biodiversity after mining of each longwall. This would then inform monitoring for subsequent longwall panels. - Monitoring of knickpoint formation during mining of each longwall, and implementation of appropriate controls to prevent knickpoint formation. - Reporting of monitoring results within the Annual Review.	
SW-1	Surface water Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Monitoring would be undertaken before mining commences to assess the baseline conditions above each longwall, and would include: - Geomorphological conditions, including creek mapping and high-resolution photography (before, during and after mining beneath each longwall) of rock bars, shallow alluvium (i.e. less than 2 m deep) and permanent or semi-permanent pools within the subsidence impact area. - Water quality - Stream flow Monitoring sites will include: - Ongoing streamflow monitoring at Hornes Creek, Dog Trap Creek, Eliza Creek and Carters Creek in order to expand baseline data of these waterways up to the period of mining within these catchments; - An additional stream flow gauging station would be installed at Tea Tree Hollow, downstream of the edge of the longwall and upstream of Licensed Discharge Point (LDP) 1. - Additional water level monitoring at Hornes Creek, Dog Trap Creek, Tea Tree Hollow and Eliza Creek to establish baseline water level data to enable the assessment of potential impacts to pool water levels; - Streamflow gauging activities would be continued. Enhanced low flow control weirs would be established at the existing gauging station at Dog Trap Creek downstream and the proposed new gauging station at Tea Tree Hollow to support the generation of reliable continuous flow data (including reliable low flow data) at the stations. Routine water level and water quality monitoring at the stations would also be continued. Monitoring results would be reported in the Annual Review.	Water Management Plan
SW-2	**Surface water** Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Monitoring of waterways within 200 m of active longwall mining, including weekly photographic recording and monthly water quality sampling upstream and downstream of potentially affected areas. Results would be analysed in relation to action response triggers, as detailed in the surface water management plan. Monitoring to be reported in the Annual Review and six-monthly subsidence impact reports.	Water Management Plan
SW-5	**Surface water** Potential impact: Impacts to surface water from mining-induced subsidence Management and mitigation measures: Update the monitoring and management plans and the groundwater/ surface water model in relation to impacts to the Thirlmere Lakes as findings from the OEH research project become available to guide ongoing management of impacts.	Water Management Plan

EIS Reference	Commitment	Tahmoor Coal Response / Section Addressed
SW-6	**Surface water** Potential impact: Water quality impacts due to discharge of treated water from LDP1. Management and mitigation measures: Monitoring and management of water quality downstream of LDP1 would include: - A new water quality monitoring site would be established on the Bargo River downstream of the confluence with Tea Tree Hollow and upstream of SW14 to increase the spatial representation of water quality sites downstream of LDP1. - Establishment of a TARP for water quality exceedances which incorporate both baseline and control monitoring data. - The pit top water management system performance would be assessed annually against its predicted performance range. - Revision to the water management plan would be undertaken if the performance review indicates the water management system has, or is likely to be, unable to meet its regulatory performance requirements. - The discharge monitoring would include: - A full suite of metals; - Sulfate, total dissolved solids and electrical conductivity, major ions; - Total suspended solids and turbidity; - Any residual settling agent risks (flocculants or coagulants); and - Volume and frequency of controlled discharges and frequency of managed overflows.	Water Management Plan
SW-7	**Surface water** Potential impact: Surface water entitlement Management and mitigation measures: Obtain the necessary authorised entitlement to account for the maximum take of water from both surface water and groundwater sources in accordance with the Aquifer Interference Policy.	Water Management Plan
PAR #6	**Surface water** - Prior to the commencement of longwall mining, an adaptive monitoring and TARP would be developed. The following surface water elements would be incorporated into the plan: - TARPs for water quality exceedances which incorporate both baseline and control monitoring data. Site specific trigger values have been developed in accordance with ANZECC (2000) and ANZG (2018) for baseline sites which may potentially be affected by the Project – refer HEC (2019). - TARPs for unexpected flow loss based on analysis of baseline (i.e. pre-subsidence) streamflow data, post-subsidence streamflow data and contemporaneous data from control sites. Catchment flow modelling would also be used in the analysis. - TARPs for unexpected loss of pool water holding capacity based on analysis of baseline (i.e. pre-subsidence) pool water level data, post-subsidence pool water level data and contemporaneous data from control pool sites. Pool water balance modelling would also be used in the analysis particularly during unusual climatic/hydrological conditions.	Water Management Plan
PAR #9	**Surface water** - Monitoring of streamflow, pool water levels and water quality would continue for two years following cessation of longwall subsidence related movement in a watercourse or following completion of any stream/pool remediation.	Water Management Plan

EIS Reference	Commitment	Tahmoor Coal Response / Section Addressed
GW-3	**Groundwater** Potential impact: Impacts to groundwater as a result of mining induced subsidence Management and mitigation measures: Update and maintain regional groundwater monitoring network, with monitoring results reported annually within the Annual Review. This would include replacement of failed bores around Tahmoor North and Tahmoor South, as well as establishing new bores. Monitoring of groundwater levels would include: - A condition assessment of bores and monitoring equipment (VMPs) of new bores around Tahmoor South, with a specific update of the GWMP. - Geophysical logging of boreholes that allow changes in groundwater storage and fracture apertures to be quantified and depth of rock deformation to be identified (i.e. observations of non-deformed ground which could be at least 10- 30 m below surface). - Re-install at least one bore in the footprint of a Tahmoor North longwall (e.g. at TNC029) to monitor post-mining groundwater level and groundwater quality. - Monitoring in longwall centre-lines of pre- and post-mining conditions Tahmoor South. This would be undertaken for the longwall (101A), and then every two or three after that. Packer testing would also be undertaken, followed by installing VMPs at four elevations in the Hawkesbury Sandstone and then two in the Bulgo Sandstone to assist in defining a profile of fracturing and depressurisation above longwalls. Results from monitoring would be compared to those from groundwater monitoring of reference sites including upstream and outside the predicted subsidence impact zone where relevant	Water Management Plan
GW-5	**Groundwater** Potential impact: Impacts to groundwater as a result of mining induced subsidence Management and mitigation measures: Revision of the groundwater model to: - Take further advantage of unstructured mesh capabilities; - Incorporate conceptual developments from the OEH Thirlmere Lakes Research Program (once complete); and - Incorporate the results of mine inflow monitoring; - Incorporate monitoring data from groundwater bores in the Western Domain of Tahmoor North.	Water Management Plan
AE-2	**Aquatic ecology** Potential impact: Impacts to aquatic ecology as a result of longwall mining and mining induced subsidence Management and mitigation measures: Undertake monitoring of macroinvertebrates for a baseline of two years prior to longwall extraction. The monitoring program may require adding or relocating sites according to the final mine plan and using the same sampling methods as used in the aquatic monitoring conducted to date.	Biodiversity Management Plan
AE-3	**Aquatic ecology (existing commitment)** Potential impact: Impacts to aquatic ecology as a result of longwall mining and mining induced subsidence Management and mitigation measures: Implement a BACI (Before After Control Impact) designed monitoring program to compliment the baseline information collected and to assess monitoring impacts in an adaptive management framework.	Biodiversity Management Plan

EIS Reference	Commitment	Tahmoor Coal Response / Section Addressed
358/SAR	**Terrestrial ecology** Transmission lines - the proposed transmission lines has been revised to maximise the existing cleared land, road and existing easement as much as practical. Clearing is therefore only required where vegetation encroaches on the proposed transmission line easement. The installation of the transmission line has also been designed to avoid direct impact to threatened flora by: Engaging a suitably qualified ecologist to be present during clearing associated with the transmission line easement to: clearly mark the threatened plants to ensure that the contractors avoid impacts during clearing event; and be present during the installation of the power poles to safeguard against direct impacts to the threatened plants. The transmission line will require on-going maintenance, such as slashing of vegetation within the easement to a height of 2 m. Given the plants will not grow above 2 m in height, the long-term maintenance slashing is unlikely to impact the threatened plants."	Biodiversity Management Plan
LUR-3	**Land use and resources** Potential impact: Impacts of the surface aspects of the Project on land use Management and mitigation measures: Develop a Land Management Plan to manage land use and agricultural land within the Project Area	Land Management Plan
HH-3	**Non-Aboriginal Heritage** Potential impact: Impacts to items of non-Aboriginal Cultural Heritage Significance as a result of longwall mining and mining-induced subsidence. Management and mitigation measures: Develop a site-specific Heritage Property Subsidence Management Plan for Wirrimbirra Sanctuary prior to commencement of mining, including a detailed site inspection. The outcomes of the assessment would be provided in an additional Statement of Heritage Impact in consultation with the National Trust and NSW Heritage Council, or its delegate.	Heritage Management Plan Built Features Management Plan

3.2.1.4 EPBC Act Approval Conditions

Conditions relevant to the Extraction Plan from the approval (EPBC 2017/8084) granted by DAWE for the Tahmoor South Project are outlined in **Table 9**.

Table 9 EPBC Act Approval Conditions

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
1	The approval holder must not impact any listed threatened species and ecological communities outside the Development Application Area. Within the Development Application Area, the approval holder must not impact more than: a. 7.3 hectares of the Shale Sandstone Transition Forest in Sydney Basin Bioregion. b.0 individuals of Small-flower Grevillea; c. 0 individuals of Bargo Geebung; d. 0 individuals of Rufous Pomaderris e. 1.3 hectares of Koala habitat	The Biodiversity Management Plan outline the proposed ecology monitoring program and management measures for the management of ecology (including threatened species and ecological communities) during mining of LW S1A-S6A.
2	The approval holder must comply with the State development consent conditions A9, B37, B38, B39, B40, B56, B58, B59, B60, C1, C2, C3, C4, C8, C9 and C10	Relevant conditions applicable to this Extraction Plan are discussed in **Section 3.2.1.1** and **Section 3.2.1.2.**

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
		Condition A9 of SSD 8445 is not considered relevant to this Extraction Plan. Conditions B37, B38, B39, B40, B58 and B59 of SSD 8445 are covered by the generic Biodiversity Management Plan for the Tahmoor South Domain, which has been approved by DPE.
3	For the protection of water resources, the approval holder must comply with State development consent conditions A7, B23, B24, B30, B31, B32, B33, B34, B35, B36, C1, C2, C8, C9 and C10	Relevant conditions applicable to this Extraction Plan are discussed in **Section 3.2.1.1** and **Section 3.2.1.2.** Condition A7 of SSD 8445 is not considered relevant to this Extraction Plan. Conditions B30, B31, B32, B33, B34, B35 and B36 of SSD 8445 are covered by the generic Water Management Plan for the Tahmoor South Domain, which has been approved by DPE. Conditions B23 and B24 of SSD 8445 will be reported on in the Annual Review.
4	The approval holder must ensure there is no adverse effect on the function of a water resource as a result of the action.	Water Management Plan
8	The approval holder must submit to Department each approved Extraction Plan for second workings within 2 business days of its approval by the NSW Planning Secretary.	Noted.
9	The approval holder must notify the Department within 5 business days of any proposed changes to any approved Extraction Plan. If the NSW Planning Secretary approves a revised version of an Extraction Plan, the approval holder must provide the Department with the approved revised Extraction Plan within 5 business days of its approval by the NSW Planning Secretary, accompanies by a detailed explanation of what changes have been made and any implications the changes could have for protected matters.	Noted.
10	If the approval holder detects or predicts an exceedance of a performance measure, the approval holder must notify the Department of the exceedance within 2 business days.	Noted.
11	If the approval holder detects an exceedance as described in condition 10, the approval holder must submit to the Department for approval an Impact Response Plan that has been peer reviewed. Each Impact Response Plan must at a minimum: a. be prepared by a suitably qualified person; b. describe all potential and actual impacts to water resources arising from the exceedance; c. include conceptual modelling, as well as a review of all historical monitoring data to determine the stressor-response relationships for any potential GDEs and consideration of potential contributing activities; d. consider and where appropriate include local scale numerical modelling with consideration of potential contributing activities;	**Section 7.4.3** Tahmoor Coal will also observe Conditions 12-16 of this approval.

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
	e. derive a scientifically-robust rectification strategy based on multiple lines of evidence and field data to support the assessment of the environmental values of water resources (including the groundwater-dependence of any potential GDEs) within the Development Application Area. f. identify if any further investigations are required to determine the cause of, and/or corrective actions, for the exceedance; g. include the mitigation and management measures that the approval holder has taken and/or proposes to take to reverse the exceedance, including data demonstrating the effectiveness of the mitigation and management measures; h. provide justification for how the proposed mitigation and management measures will achieve and maintain the requirements of condition 4; and i. include a peer review and details of how the approval holder has addressed any inadequacies raised in the peer review. The approved Impact Response Plan must be implemented.	
21	The approval holder must: a. submit plans electronically to the Department; b. unless otherwise agreed to in writing by the Minister, publish each plan on the website within 20 business days of the date: i. of this approval, if the version of the plan to be implemented is specified in these conditions; or ii. that the plan is submitted to the Minister or the Department if the plan does not require the approval of the Minister but was not finalised before the date of this approval; or iii. that the plan was approved in writing by the Minister or by the NSW Planning Secretary, if the plan requires the approval of the Minister or by the NSW Planning Secretary; c. exclude or redact sensitive ecological data from plans that are to be published on the website or provided to a member of the public; and d. keep plans published on the website for the period this approval has effect.	**Section 7.10** Noted.
22	The approval holder must prepare a compliance report for each 12 month period following the date of commencement of the action, or otherwise as agreed in writing by the Minister. The approval holder must: a. publish each compliance report on a website within 60 business days following the relevant 12 month period; b. notify the Department by email that a compliance report has been published on the website and provide the website's link for the compliance report within five business days of the date of publication; c. keep all compliance reports publicly available on the website until this approval expires; d. exclude or redact sensitive ecological data from compliance reports published on the website; and e. where any sensitive ecological data has been excluded from the version published, submit the full compliance report to the Department within 5 business days of publication.	**Section 7.1.3** Tahmoor Coal have obtained DAWE approval to submit this annual compliance report in the form of the Annual Review, which is submitted on 31 March annually.
23	The approval holder must notify the Department in writing of any: incident, or non-compliance with the conditions, or non-compliance with the commitments made in plans. The notification must be given as soon as practicable, and no later than two business days after becoming aware of the incident or non-compliance. The notification must specify: a. any condition which is in breach; b. a short description of the incident and/or non-compliance; and c. the location (including co-ordinates), date, and time of the incident and/or non-compliance. In the event the exact information cannot be provided, provide the best information available.	**Section 7.2.3, Section 7.3.3**

Condition	Condition Requirement	Tahmoor Coal Response / Section Addressed
24	The approval holder must provide to the Department the details of any incident or non-compliance with the conditions or commitments made in plans as soon as practicable and no later than 10 business days after becoming aware of the incident or non-compliance, specifying: a. any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future; b. the potential impacts of the incident or non-compliance; and c. the method and timing of any remedial action that will be undertaken by the approval holder.	**Section 7.2.3, Section 7.3.3**
28	The approval holder must comply with condition A6 in Schedule 2 of the State Development Consent.	The extraction of LW S1A-S6A will be completed by 31 December 2033 and within 10 years of commencement of second workings.

3.2.2 Mining Lease Conditions

The LW S1A-S6A Extraction Plan Study Area is associated with two approved CCLs held by Tahmoor Coal -CCL 716 and CCL 747 (refer to **Figure 2**).

CCL 716 is the original Tahmoor Lease and was granted on 15 June 1990 and expired on 13 March 2021. A request for renewal was submitted on 3 March 2020, and this CCL remains current until the new CCL is issued.

CCL 747 is the Bargo Mining Lease and was granted on 23 May 1990 and expires on 6 November 2025.

Table 10 outlines the mining lease conditions relating directly to subsidence management from CCL 716 and CCL 747.

Table 10 Mining Lease Conditions Relevant to this Extraction Plan

Mining Lease	Condition Number	Condition Requirement	Tahmoor Coal Response / Section Addressed
Methods of Operation / Extraction of Coal			
CCL 716	1	The lease holder shall extract as large a percentage of the coal in the subject areas as is practicable consistent with the provisions of the Coal Mines Regulations Act 1982 and the Regulations thereunder and shall comply with any direction given or which may be given in this regard by the Minister.	**Section 3.3.7** The maximum amount of coal will be extracted as allowed by safety, geological, financial and Extraction Plan constraints.
CCL 747	23	(a) Notwithstanding any description of mining methods and their sequence or of proposed resource recovery contained within the Mining Operations Plan, if at any time the Director-General is of the opinion that minerals which the lease entitles the lease holder to mine and which are economically recoverable at the time are not being recovered from the lease area, or that any such minerals which are being recovered are not being recovered to the extent which should be economically possible or which for environmental reasons are necessary to be recovered, he may give notice in writing to the lease holder requiring the holder to recover such minerals.	

Barriers			
CCL 716	9	The lease holder shall not work or cause to be worked any seam of coal within the subject area without leaving, if the Minister, so directs, a barrier of such width or a protective pillar or pillars of such size or sizes against any surface improvements of any feature whether natural or artificial.	Coal barriers will be maintained in accordance with Minister's directions.
Management and Rehabilitation of Lands (General)			
CCL 716	19	The lease holder shall observe any instruction given or which may be given by the Minister with a view to minimising or prevent public inconvenience or damage to public or private property.	Instructions can be given through the Extraction Plan process and will be complied with. Addressed in the BFMP and the LMP.
CCL 716	20	If required to do so by the Minister and within such time as may be stipulated by the Minister the lease holder shall carry out to the satisfaction of the Minister surveys of structures, buildings and pipelines on adjacent landholdings to determine the effect of operations on any such structures, buildings and pipelines.	Instructions can be given through the Extraction Plan process and will be complied with. Addressed in the BFMP and the Subsidence Monitoring Plan.
CCL 716	21	If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister any lands within the subject area which may have been disturbed by the lease holder.	Such a direction can be given through the Extraction Plan process. Addressed in the BFMP, WMP, LMP, BMP, and the HMP.
CCL 716	23	If so directed by the Minister the lease holder shall rehabilitate to the satisfaction of the Minister and within such time as may be allowed by the Minister any lands within the subject area which may have been disturbed by mining or prospecting operations whether such operations were or were not carried out by the lease holder	Such a direction can be given through the Extraction Plan process. Addressed in the BFMP, WMP, LMP, BMP, and the HMP.
CCL 747	13	(a) Land disturbed must be rehabilitated to a stable and permanent form suitable for a subsequent land use acceptable to the Director-General and in accordance with the Mining Operations Plan so that:- • there is no adverse environmental effect outside the disturbed area and that the land is properly drained and protected from soil erosion. • the state of the land is compatible with the surrounding land and land use requirements. • the landforms, soils, hydrology and flora require no greater maintenance than that in the surrounding land. • in cases where revegetation is required and native vegetation has been removed or damaged, the original species must be re-established with close reference to the flora survey included in the Mining Operations Plan. If the original vegetation was not native, any re-established vegetation must be appropriate to the area and at an acceptable density. • the land does not pose a threat to public safety. (b) Any topsoil that is removed must be stored and maintained in a manner acceptable to the Director-General.	Rehabilitation of land that has been disturbed by the extraction of LW S1A-S6A is discussed in the WMP and LMP.

Environmental Management			
CCL 716	25	The lease holder shall provide and maintain to the satisfaction of the Minister efficient means to prevent contamination, pollution, erosion or situation of any river, stream, creek, tributary, lake, dam, reservoir, watercourse or catchment area or any undue interference to fish or their environment and shall observe any instruction given or which may be given by the Minister with a view to preventing or minimising the contamination, pollution, erosion or siltation of any river, stream, creek, tributary, lake, dam, reservoir, watercourse or catchment area or any undue interference to fish or their environment.	The WMP provides for the management of creeks, tributaries, dams, and catchment areas in the Study Area. The BMP provides for the management of fish habitat in the Study Area.
CCL 747	35	c) The lease holder shall provide and maintain to the satisfaction of the Minister efficient means to prevent contaminated waters discharging or escaping from the subject area onto surrounding areas and shall comply with any direction given or which may be given by the Minister in this regard.	
CCL 747	16	Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution (including sedimentation) or soil contamination or erosion, unless otherwise authorised by a relevant approval, and in accordance with an accepted Mining Operations Plan. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters. The lease holder must observe and perform any instructions given by the Director-General in this regard.	The WMP provides for the management of creeks, tributaries, dams, and catchment areas in the Study Area. The LMP provides for the management of soils and steep slopes.
CCL 716	27	If so directed by the Minister, the lease holder shall ensure that operations are carried out in such manner so as to minimise disturbance to flora and fauna within the subject area.	Such a direction can be given through the Extraction Plan process. Addressed in the WMP and BMP.
CCL 716	30	The lease holder shall conduct operations in such a manner as not to cause or aggravate soil erosion and the lease holder shall observe and perform any instructions given or which may be given by the Minister with a view to minimising or preventing soil erosion.	The LMP provides for the management of soils and steep slopes.
CCL 747	4	(a) The lease holder shall prepare a Subsidence Management Plan prior to commencing any underground mining operations which will potentially lead to subsidence of the land surface. (b) Underground mining operations which will potentially lead to subsidence include secondary extraction panels such as longwalls or miniwalls, associated first workings (gateroads, installation roads and associated main headings, etc), and pillar extractions, and are otherwise defined by the Guideline for Applications for Subsidence Management Approvals.	This Extraction Plan includes all information that has been included in Subsidence Management Plans in the past.

		(c) The lease holder must not commence or undertake underground mining operations that will potentially lead to subsidence other than in accordance with a Subsidence Management Plan approved by the Director-General, an approval under the Goa/ Mines Regulation Act 1982, or the document New Subsidence Management Plan Approval Process - Transitional Provisions. (d) Subsidence Management Plans are to be prepared in accordance with the Guideline for Applications for Subsidence Management Approvals. (e) Subsidence Management Plans as approved shall form part of the Mining Operations Plan required under Condition 2 and will be subject to the Annual Environmental Management Report process as set out under Condition 3. The SMP is also subject to the requirements for subsidence monitoring and reporting set out in the document New Approval Process for Management of Coal Mining Subsidence - Policy.	
Roads			
CCL 716	31	The lease holder shall pay to Wollondilly Shire Council, Department of Land and Water Conservation or the Chief Executive, Roads and Traffic Authority the cost incurred by such Council or Department or Chief Executive of making good any damage caused by operations carried on by or under the authority of the lease holder to any road adjoining or traversing the surface or the expected surface, as the case may be of the subject area.	All man-made surface improvements are covered by Tahmoor Coal and will be repaired as required. Tahmoor Coal will cover financial losses such as business interruption, vegetation replacement, soil erosion, road repair etc as part of the Mining Act's compensable loss provisions. Addressed in the BFMP.
CCL 747	19	(a) Operations must not affect any road unless in accordance with an accepted Mining Operations Plan or with the prior written approval of the Director-General and subject to any conditions he may stipulate. (b) The lease holder must pay to the designated authority in control of the road (generally the local council or the Roads and Traffic Authority) the cost incurred in fixing any damage to roads caused by operations carried out under the lease, less any amount paid or payable from the Mine Subsidence Compensation Fund.	
Transmission Lines, Communication Lines and Pipelines			
CCL 716	41	The lease holder shall as far as is practicable so conduct operations as not to interfere with or impair the stability or efficiency of any transmission line, communication line or pipeline traversing the surface or the excepted surface of the subject area and shall comply with any direction given or which may be given by the Minister in this regard.	The BFMP provides for the management of electrical infrastructure, telecommunications infrastructure, gas infrastructure, potable water infrastructure, and sewerage infrastructure.
CCL 747	17		
CCL 747	35	e) The lease holder shall comply with any direction given or which may be given by the Minister in respect of operations hereby authorised within that part traversed by, or within the vicinity of, the natural gas pipeline traversing the subject area.	Such a direction can be given through the Extraction Plan process. Addressed in the BFMP.

Aboriginal Place or Relic			
CCL 716	43	The lease holder shall not knowingly destroy, deface or damage any aboriginal place or relic within the subject area, except in accordance with an authority issued under the *National Parks and Wildlife Act 1974,* and shall take every precaution in drilling, excavating or disturbing the land against any such destruction, defacement or damage.	Addressed in the HMP.
CCL 747	35	a) The lease holder shall observe and perform any instruction given to which may be given by the Minister regarding any aboriginal relics within the subject area.	Such a direction can be given through the Extraction Plan process. Addressed in the HMP.

3.2.3 Environmental Licences

Tahmoor Mine operates under EPL 1389, which authorises carrying out of scheduled activities associated with coal works, mining for coal and sewage treatment processing by small plants.

An Annual Return stating Tahmoor Mine's compliance with the conditions of EPL 1389 and summarising monitoring results and complaints is completed and submitted to the EPA by 28 February of each year. Each Annual Review is lodged via the EPL portal.

Tahmoor Coal holds four Water Access Licences – WAL 36442, WAL 25777, WAL 43656, and WAL 43572. Further details of these licences and Tahmoor Coal's compliance with the licences are discussed in the Water Management Plan.

3.2.4 Work, Health and Safety Legislations

Tahmoor Coal has developed a Health and Safety Management Plan (TAH-HSEC-00189) that integrates plans, policies and procedures that enables a systematic approach to establishing and maintaining effective systems to manage health and safety consistent with WHS legislation.

Tahmoor Mine has been planned so that LW S1A-S6A will meet all the requirements of the following Work Health and Safety (WHS) Legislation:

- *Work Health and Safety Act 2011* (WHS Act);
- *Work Health and Safety Regulation 2017* (WHS Regulation);
- *Work Health and Safety (Mines and Petroleum Sites) Act 2013* (WHSMP Act); and
- *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022* (WHSMP Regulation).

The WHS Act and WHS Regulations came into force on 1 January 2012. The WHS Act, is the primary piece of legislation dealing with the health and safety of workers in NSW. The WHSMP Act and WHSMP Regulations apply to all mining workplaces in NSW commenced on 1 February 2015 and updated on 1 September 2022. These laws support the WHS Act and WHS Regulation and provide additional provisions for work health and safety issues unique to mines and petroleum sites.

This Extraction Plan has been prepared to address the relevant requirements of the WHS legislation, principally within the context of subsidence related risks to public safety with regards to private property and public infrastructure.

Details regarding the compliance with the relevant requirements of the WHS Regulations and WHSMP Regulations are provided in **Table 14**, as well as being discussed in the Public Safety Management Plan (PSMP).

3.2.4.1 WHS Requirements for Persons Conducting a Business or Undertaking

In accordance with Section 19 of the WHS Act, all persons conducting a business or undertaking (PCBUs), including mine operators and contractors, have a primary duty of care to ensure the health and safety of workers they engage, or whose work activities they influence or direct, so far as is reasonably practicable. PCBUs must also ensure, so far as is reasonably practicable, the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.

Under Clause 14(1) of the WHSMP Regulation, a PCBU at a mine, including the Mine Operator, must manage risks to health and safety associated with the mining operations in accordance with Part 3.1 of the WHS Regulation. Specifically, Clause 70(1) of the WHSMP Regulation requires the operator of an underground coal mine to (in complying with Clause 14) manage risks to health and safety associated with subsidence at the mine. Clause 70(2) of the WHSMP Regulation outlines specific requirements regarding subsidence including monitoring, investigation and reporting.

The Mine Operator's responsibilities include developing and implementing the Health and Safety Management Plan (TAH-HSEC-00189) that is used as the primary means of ensuring, so far as is reasonably practicable that the above discussed PCBU duty of care.

Details regarding the compliance with the relevant requirements of the WHS Regulations and WHSMP Regulations are provided in **Table 11**, as well as being discussed in the PSMP.

3.2.4.2 Subsidence as a Principal Hazard

According to Clause 4 of the WHSMP Regulation provides the definition of a principal hazard as:

> *"…an activity, process, procedure, plant, structure, substance, situation or other circumstance relating to the carrying out of mining operations or petroleum operations that has a reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents in relation to*
>
> *(vi) subsidence,"*

In accordance with Table 7 in Condition C1 and Condition C7 of SSD 8445, all first workings in the Tahmoor South Domain are required to be designed to remain stable and non-subsiding in the long-term, except insofar as they may be impacted by approved second workings. While it is not considered that there is reasonable potential for a subsidence incident to cause multiple fatalities, Tahmoor Coal has prepared this Extraction Plan generally in accordance with the relevant WHS legislation and guidelines as outlined further below and detailed in **Table 11** and the PSMP.

Under Clauses 27(1) and 27(2) of the WHSMP Regulation, the Mine Operator must identify all principal mining hazards associated with mining operations and conduct a risk assessment in relation to each principal hazard identified that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with each principal hazard. Tahmoor Coal has prepared a risk assessment to identify and assess principal hazards and controls in relation to subsidence as discussed further in **Section 7.6**, **Table 11**, and the PSMP.

Table 11 Work Health and Safety Legislation Compliance

WHS Legislation and Clause	Section Addressed	WHS Legislation and Clause
WHS Regulations		
Clause 34	**Duty to identify hazards** A duty holder, in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.	**Section 7.6** PSMP
Clause 35	**Managing risks to health and safety** A duty holder, in managing risks to health and safety, must: (a) eliminate risks to health and safety so far as is reasonably practicable, and (b) if it is not reasonably practicable to eliminate risks to health and safety, minimise those risks so far as is reasonably practicable.	**Section 3.6** Section 6 of WMP, LMP, BMP and HMP.
Clause 36	**Hierarchy of control measures** (1) This clause applies if it is not reasonably practicable for a duty holder to eliminate risks to health and safety. (2) A duty holder, in minimising risks to health and safety, must implement risk control measures in accordance with this clause. (3) The duty holder must minimise risks, so far as is reasonably practicable, by doing 1 or more of the following: (a) substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk, (b) isolating the hazard from any person exposed to it, (c) implementing engineering controls. (4) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls. (5) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by ensuring the provision and use of suitable personal protective equipment.	**Section 3.6, Section 7.6** PSMP Section 6 of WMP, LMP, BMP and HMP.

	Note. A combination of the controls set out in this clause may be used to minimise risks, so far as is reasonably practicable, if a single control is not sufficient for the purpose.	
Clause 37	**Maintenance of control measures** A duty holder who implements a control measure to eliminate or minimise risks to health and safety must ensure that the control measure is, and is maintained so that it remains, effective, including by ensuring that the control measure is and remains: (a) fit for purpose, and (b) suitable for the nature and duration of the work, and (c) installed, set up and used correctly.	**Section 3.6** Section 6 of WMP, LMP, BMP and HMP.
Clause 38	**Review of control measures** (1) A duty holder must review and as necessary revise control measures implemented under this Regulation so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety. (2) Without limiting subclause (1), the duty holder must review and as necessary revise a control measure in the following circumstances: (a) the control measure does not control the risk it was implemented to control so far as is reasonably practicable, (b) before a change at the workplace that is likely to give rise to a new or different risk to health or safety that the measure may not effectively control, (c) a new relevant hazard or risk is identified, (d) the results of consultation by the duty holder under the Act or this Regulation indicate that a review is necessary, (e) a health and safety representative requests a review under subclause (4). (3) Without limiting subclause (2) (b), a change at the workplace includes: (a) a change to the workplace itself or any aspect of the work environment, or (b) a change to a system of work, a process or a procedure. (4) A health and safety representative for workers at a workplace may request a review of a control measure if the representative reasonably believes that: (a) a circumstance referred to in subclause (2) (a), (b), (c) or (d) affects or may affect the health and safety of a member of the work group represented by the health and safety representative, and (b) the duty holder has not adequately reviewed the control measure in response to the circumstance.	**Section 3.6, Section 7.6** PSMP Section 6 of WMP, LMP, BMP and HMP.
WHSMP Regulations		
Clause 14	**Management of risks to health and safety** (1) A person conducting a business or undertaking at a mine or petroleum site must manage risks to health and safety associated with mining operations or petroleum operations at the mine or petroleum site in accordance with the WHS Regulations, Part 3.1. (2) A person conducting a business or undertaking at a mine or petroleum site must ensure a risk assessment is conducted in accordance with this section by a person who is competent to conduct the risk assessment having regard to the nature of the hazard. (3) In conducting a risk assessment, the person must have regard to the following— (a) the nature of the hazard,	**Section 7.6** PSMP

	(b) the likelihood of the hazard affecting the health or safety of a person, (c) the severity of the potential health and safety consequences. (4) Subsection (3) does not limit the operation of another requirement to conduct a risk assessment under this Regulation. (5) A person conducting a business or undertaking at a mine or petroleum site, who is the operator of the mine or petroleum site or who is a contractor, must keep a record of the following— (a) each risk assessment conducted under this section and the name and competency of the person who conducted the risk assessment, (b) the control measures implemented to eliminate or minimise a risk that was identified by the risk assessment. (6) A person conducting a business or undertaking at a mine or petroleum site is not required to keep a record of a risk assessment if— (a) the risk assessment is required to be carried out by an individual before the worker commences a task that forms part of an activity, and (b) the person keeps a record of risk assessments that addresses the overall activity being undertaken, of which the task forms a part. (7) A record kept under subsection (5) by an operator of a mine or petroleum site forms part of— (a) the safety management system of the mine or petroleum site, and (b) the records of the mine or petroleum site. (8) A record, kept under subsection (5) by a contractor who has prepared a contractor health and safety management plan, forms part of the plan.	
Clause 15	**Review of control measures** (1) A person conducting a business or undertaking at a mine or petroleum site must review and as necessary revise control measures implemented under section 14(5)(b) in the following circumstances— (a) an audit of the effectiveness of the safety management system for the mine or petroleum site indicates a deficiency in a control measure, (b) a worker is moved from a hazard or assigned to different work in response to a recommendation contained in a health monitoring report provided under Part 4, (c) an incident referred to in section 124 occurs, (d) another incident occurs that is required to be notified to the regulator under the WHS laws. (2) The operator of a mine or petroleum site must ensure a control measure the subject of a request under the WHS Regulations, clause 38(4) is reviewed and as necessary revised, whether the request is made— (a) to the operator by a health and safety representative, or (b) notified to the operator under subsection (3). (3) A person conducting a business or undertaking at the mine or petroleum site who is not the operator of the mine or petroleum site must immediately notify the operator of a request made to the person under the WHS Regulations, clause 38(4). (4) A health and safety representative for workers at a mine or petroleum site may request a review of a control measure under the WHS Regulations, clause 38(4) as if the circumstances referred to in subsection (1) were included as a circumstance in the WHS Regulations, clause 38(4)(a).	**Section 7.2, Section 7.6, Section 7.7, Section 7.8** PSMP

Clause 27	**Identification of Principal Mining Hazard Management Plan** (1) The operator of a mine or petroleum site must identify all principal hazards associated with mining operations or petroleum operations at the mine or petroleum site. (2) The operator must conduct, in relation to each principal hazard identified, a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal hazard. (3) The operator, in conducting a risk assessment under subsection (2), must— (a) use investigation and analysis methods appropriate to the principal hazard being considered, and (b) consider the principal hazard individually and also cumulatively with other hazards at the mine or petroleum site.	**Section 7.6** PSMP
Clause 28	**Preparation of Principal Mining Hazard Management Plan** (1) The operator of a mine or petroleum site must prepare a principal hazard management plan for each principal hazard associated with mining operations or petroleum operations at the mine or petroleum site in accordance with this section and Schedule 1. (2) A principal hazard management plan must— (a) provide for the management of all aspects of risk control in relation to the principal hazard, and (b) as far as reasonably practicable, be set out and expressed in a way that is readily understandable by persons who use it. (3) A principal hazard management plan must— (a) describe the nature of the principal hazard, and (b) describe how the principal hazard relates to other hazards associated with mining operations or petroleum operations at the mine or petroleum site, and (c) describe the analysis methods used in identifying the principal hazard, and (d) include a record of the most recent risk assessment conducted in relation to the principal hazard, and (e) describe the investigation and analysis methods used in determining the control measures to be implemented, and (f) describe all control measures to be implemented to manage risks to health and safety associated with the principal hazard, and (g) describe the arrangements in place for providing the information, training and instruction required by the WHS Regulations, clause 39 in relation to the principal hazard, and (h) refer to the design principles, engineering standards and technical standards relied on for control measures for the principal hazard, and (i) set out the reasons for adopting or rejecting each control measure considered. (4) The operator of a mine or petroleum site must consider the following when preparing a principal hazard management plan for a principal hazard at the mine or petroleum site— (a) the matters set out in Schedule 1 for the principal hazard, (b) other matters relevant to managing the risks associated with the principal hazard.	The Principal Mining Hazard Management Plan for subsidence will be revised and updated to include LW S1A-S6A prior to the commencement of extraction.

	(5) The operator of a mine or petroleum site at which there is a principal hazard must ensure no mining operations or petroleum operations are carried out at the mine or petroleum site that may give rise to the hazard before the principal hazard management plan for the hazard has been prepared in accordance with this section.	
Clause 70	**Subsidence** (1) In complying with section 14, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine. (2) Without limiting subsection (1), the mine operator must ensure— (a) as far as reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of a person at risk from subsidence, and (b) monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and (c) an investigation of subsidence and an interpretation of subsidence information is carried out only by a competent person, and (d) all subsidence monitoring data is provided to the regulator— (i) in the approved way and form, and (ii) at the times required by the regulator, and (e) as far as reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action in relation to subsidence between the mine operator and relevant persons conducting business or an undertaking that is, or is likely to be, affected by subsidence.	**Section 3.3, Section 5, Section 7.6**, Master TARP (**Appendix B**) PSMP
Clause 124	Duty to notify regulator of certain incidents (1) The operator of a mine or petroleum site must take all reasonable steps to ensure the regulator is notified in accordance with this section after becoming aware of an incident, other than a notifiable incident, arising out of the carrying out of mining operations or petroleum operations at the mine or petroleum site, but only if the incident— (a) results in an illness or injury that requires medical treatment within the meaning of Schedule 9, section 12, or (b) is a high potential incident. (5) In this clause. High potential incident means any indication from monitoring data of the development of subsidence which may result in any incident referred to in clause: • 190 (a) (p) – a failure of ground, or of slope stability control measures, or • 190 (a) (q) – rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence, or • 190 (a) (p) and (q) These clauses are relevant only if a person could reasonably be expected to be present.	**Section 7.2,** Master TARP (**Appendix B**) PSMP

Schedule 1 Subsidence Clause 6	**Principal Hazard Management Plans – additional matters to be considered** **Subsidence** The following matters must be considered in developing the control measures to manage the risks of subsidence— (a) the characteristics of all relevant surface and subsurface features, (b) the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, (c) the characteristics of a previously excavated or abandoned workings that may interact with a proposed or existing mine workings, (d) the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within an old pillar workings that may interact with a proposed or existing mine workings, (e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence, (f) the rate, method, layout, schedule and sequence of mining operations	Subsidence Predictions and Impact Assessment Report (**Appendix A**) Master TARP (**Appendix B**)
Schedule 3 Clause 17	**High Risk Activities** (1) Secondary extraction is identified as a high risk activity. (2) The waiting period for the activity is 3 months. (3) The information and documents that must be provided in relation to the activity are as follows— (a) details of the authoritative sources used in determining that the proposed method of work can be done safely, (b) engineering plans showing the method and sequence of extraction, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine, (c) information about the land above or near the proposed activity including land use and details of who owns or occupies land that may be affected by subsidence, (d) for a pillar extraction, details of the procedures for the recovery of buried and immobile mining plant in or around a goaf, (e) details of how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed.	A High Risk Activity Notification, as required by WHS Regulation, will be submitted separately to this Extraction Plan, prior to the commencement of secondary extraction.

3.2.4.3 Principal Hazard Management Plan

Under Clause 28 of the WHSMP Regulation, the Mine Operator must prepare a Principal Hazard Management Plan for each principal hazard associated with mining operations in accordance with Clause 28 and Schedule 1. The Principal Hazard Management Plan for subsidence will be revised and updated to include LW S1A-S6A prior to the commencement of secondary extraction of LW S1A.

3.2.4.4 High Risk Activity

A Mine Operator must give notice of a High Risk Activity to the regulator and ensure that the requirements of Clause 35 and Schedule 3 of the WHSMP Regulation are complied with. In Schedule 3 of the WHSMP Regulation, there are three High Risk Activities that relate to subsidence:

- Clause 17 – Secondary extraction;
- Clause 18 – Shallow depth of cover mining; and
- Clause 30 – Highwall mining.

Mining of LW S1A-S6A involves secondary extraction, therefore it is considered a High Risk Activity under Schedule 3, Clause 17 of the WHSMP Regulation. A High Risk Activity Notification, as required by WHS Regulation, will be submitted separately to this Extraction Plan, prior to the commencement of secondary extraction of LW S1A.

It is noted that Clause 18 and Clause 19 do not apply to the extraction of LW S1A-S6A.

3.2.4.5 Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation

To assist Mine Operators in complying with their obligations under the WHS laws relevant to subsidence, the Resources Regulator released the document *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (Resources Regulator, 2017). This Extraction Plan has been prepared in accordance with the requirements of the Guideline.

Section 2.2.2 of the *Managing Risks of Subsidence Guideline* lists the surface and subsurface features which could give rise to risks to health and safety, if the features are affected by subsidence. The surface and subsurface features include:

- Public utilities (e.g. highways, railways, tunnels, bridges, air strips, electrical transmission infrastructure or pressurised gas pipelines);
- Public amenities (e.g. shopping centres, hospitals, churches, sport facilities, child care centres or schools);
- Built features other than public utilities and amenities (e.g. dwellings, factories, workshops, privately owned gas storages or surface mining voids or facilities); and
- Natural features (e.g. cliffs, steep slopes, natural caves or dams or surface of land), where subsidence may result in hazardous conditions due to instability of rock or soil masses, rock falls, landslide, fractures, sinkholes, inundation, gas release or pollution of drinking water.

A summary of the relevant natural and built features that may pose a risk to public safety, the WHS risk assessment undertaken, and the management and monitoring of subsidence in relation to public safety is addressed in the PSMP.

3.2.5 Extraction Plan Guidelines

This Extraction Plan has been prepared in accordance with the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), as summarised in **Table 12**.

Table 12 Extraction Plan Guideline Requirements

Extraction Plan Guideline	Section Detail	Section Addressed
1. Title block	A title block should be included at the beginning of the Extraction Plan, which contains the: • name of the applicant company; • name of mine; • development consent and mining lease reference numbers; • Extraction Plan title, date and reference number; and the signature(s) of person(s) taking responsibility for the accuracy and comprehensiveness of the information contained within the plan, including an authorised representative of the lease holder and the mine manager (for the purposes of relevant safety legislation).	Page 2
2. Development of the Plan	The process of development of the Extraction Plan should be described. Most importantly, this section should address consultation undertaken by the Applicant with affected agencies and other key stakeholders, such as the owners and/or operators of both publicly and privately-owned land and infrastructure and the mine's Community Consultative Committee. This section should also describe the process of reviewing and updating the predictions of subsidence effects, subsidence impacts and environmental consequences used in previous environmental impact assessment or environmental management plan documentation relied upon by the Applicant (eg the predictions in any previous Environmental Impact Statement and/or the predictions in any previous Extraction Plan or SMP Application).	**Section 2**

Extraction Plan Guideline	Section Detail	Section Addressed
3. Overview	The overview section is an essential introduction to the Extraction Plan. It should accurately describe: • Mine planning and design; • Subsidence predictions; • Performance objectives and other regulatory requirements; and Subsidence management strategies and measures.	**Section 3**
4. Key component plans:	The main body of the Extraction Plan primarily comprises a set of six key component plans. It is appropriate that these are presented in a particular order, even if some of the later plans deserve a particular priority due to local circumstances (eg the Built Features or Heritage Management Plans). The preferred order for these component plans is as follows: • Water Management Plan; • Land Management Plan; • Biodiversity Management Plan; • Heritage Management Plan; • Built Features Management Plan; and • Public Safety Management Plan. All six key component plans should give appropriate consideration to risk assessment and risk management.	**Section 4** Key Component Plans and Supporting Documents
5. Subsidence Monitoring Plan	The key component plans should be followed by a Subsidence Monitoring Plan. This program should address two purposes. The first is to set out the program for monitoring the *subsidence effects* associated with the proposed coal extraction. The second is to summarise and consolidate the various environmental monitoring programs presented in each of the key component plans. These environmental monitoring programs should be directed towards monitoring the *subsidence impacts* and environmental consequences of mine subsidence.	**Section 5** Subsidence Monitoring Plan
6. Implementation	This section of the Extraction Plan should address all key elements of how the plan is going to be implemented, including reporting, regular review and key responsibilities. This section should follow the structure set out below: • Reporting Framework; • Review of the Extraction Plan; • Review of other Management Plans; and Key Responsibilities.	**Section 7**
7. Graphical Plans	The following plans are required as part of the application: • Plan 1 • Plan 2 • Plan 3 • Plan 4 (not required) • Plan 5 • Plan 6 • Plan 7 Plan with aerial photography	**Section 6** Graphical Plans
8. Attachments to the Extraction Plan	All other material necessary to support the Extraction Plan should be included as Attachments or Appendices.	Appendices A-C

3.3 Mine Planning and Design

3.3.1 Geology

3.3.1.1 Sydney Basin

The Sydney Basin is a large sedimentary basin on the east coast of Australia covering almost 50,000 km^2, whereby approximately 44,000 km^2 is located onshore and another 5,000 km^2 located offshore extending to the edge of the continental shelf. The basin forms part of the larger Sydney Gunnedah-Bowen Basin system, as outlined on **Figure 4**, which extends 1,700 km north from coastal southern NSW to Townsville.

The Sydney Basin is sedimentary in origin, with deposition of sediments occurring from the early Permian (290 million years ago) through to the latter part of the Triassic (200 million years ago). The Sydney Basin on-laps the Lachlan Fold Belt to the west and south, with basin depth increasing to the north and east.

The geological strata of the Sydney Basin can be summarised (from youngest to oldest) as following:

- Unconsolidated alluvial deposits along the major rivers and dune/beach deposits along the coast (Tertiary and Quaternary in age);
- Fractured volcanic intrusive and flows (and associate dyke swarms and occasional sills) within the Sydney Basin (Jurassic and Tertiary in age);
- Sedimentary rocks (including substantial coal measures at depth) of the Sydney Basin (Permian and Triassic age); and
- Fractured basement rocks below the Sydney Basin (Palaeozoic age).

3.3.1.2 Local Geology

The stratigraphy of the local geology (from youngest to oldest) can be summarised as below (and illustrated in **Figure 5**):

- Alluvial sediments – sediments consisting of sand, gravel, silt and clay overlie the Wianamatta Shales and Hawkesbury Sandstone along the major rivers and creeks. These sediments are rarely more than 20 m thick;
- Wianamatta Group – the Triassic Wianamatta Group comprises the surficial geology over most of the area. It can be very thin to more than 100m thick in some of the more elevated areas. The Wianamatta Group primarily comprises shales, with occasional calcareous claystone, laminate and coal. The Ashfield Shale is the most widespread rock type, at surface, across the area;
- Hawkesbury Sandstone:
  - Mittagong Formation – separates the Ashfield Shale from the underlying Hawkesbury Sandstone. It is a thin layer (generally less than 10 m thick) comprising dark grey to grey alternating beds of shale laminate, siltstone and quartzose sandstone;
  - Hawkesbury Sandstone – alluvial in origin, with a thickness of approximately 170 m in the region. Sandstone thicknesses increase to the north. The Triassic Hawkesbury Sandstone is generally medium to coarse grained quartz sandstone, with interbedded siltstone, finer grained sandstone and shale lenses. Shale lenses are common within this formation;
- Narrabeen Group – the total thickness of these Triassic rocks is approximately 450 m across the area and consists of the following subgroups:
- Gosford Sub-group:
  - Newport Formation – medium grained, light to dark grey, quartzose sandstone interbedded with siltstone;
  - Garie Formation – a thin, cream kaolinite claystone, which grades upwards to grey;
- Clifton Sub-group:
  - Bald Hill Claystone – grey to red/brown claystones and mudstones, occasional siderite nodules and generally softer than the overlying Garie Formation;
  - Bulgo Sandstone – white to grey coarse grained sandstone, fining upwards to coarse pebbly sandstone, with interbedded siltstone;
  - Stanwell Park Claystone – alternating light grey/green to brown sandstone and claystone intervals, with minor conglomerate;
  - Scarborough Sandstone – fine to very coarse grained, white to grey sandstone, with occasional siltstone and conglomerate laminae;

- Wombarra Claystone – light grey/green to dark grey claystone, siltstone, mudstone with minor quartz lithic sandstone and conglomerate;

- Illawarra Coal Measures – the sedimentary thickness is approximately 300 m in the central area of the Southern Coalfield. The upper sections of the Permian Illawarra Coal Measures (Sydney Sub-group) contain the major coal seams including the Bulli, Balgownie and Wongawilli Coal seams. The underlying Cumberland Sub-group generally contains thin coal seam development;
- Shoalhaven Group – The Permian Budgong Sandstone is shallow marine to littoral, typically comprising fine and course grained sandstone;
- Talateran Group – basal Permian coal-bearing sequences including the Clyde Coal Measures and the Wasp Head Formation; and
- Basement geology – The Southern Sydney Basin Permian and Triassic rocks have been deposited upon early to middle Palaeozoic basement rocks of the Lachlan Fold Belt. These rocks consist of intensely folded and faulted slates, phyllites, quartzite sandstones and minor limestones of Ordovician to Silurian age.

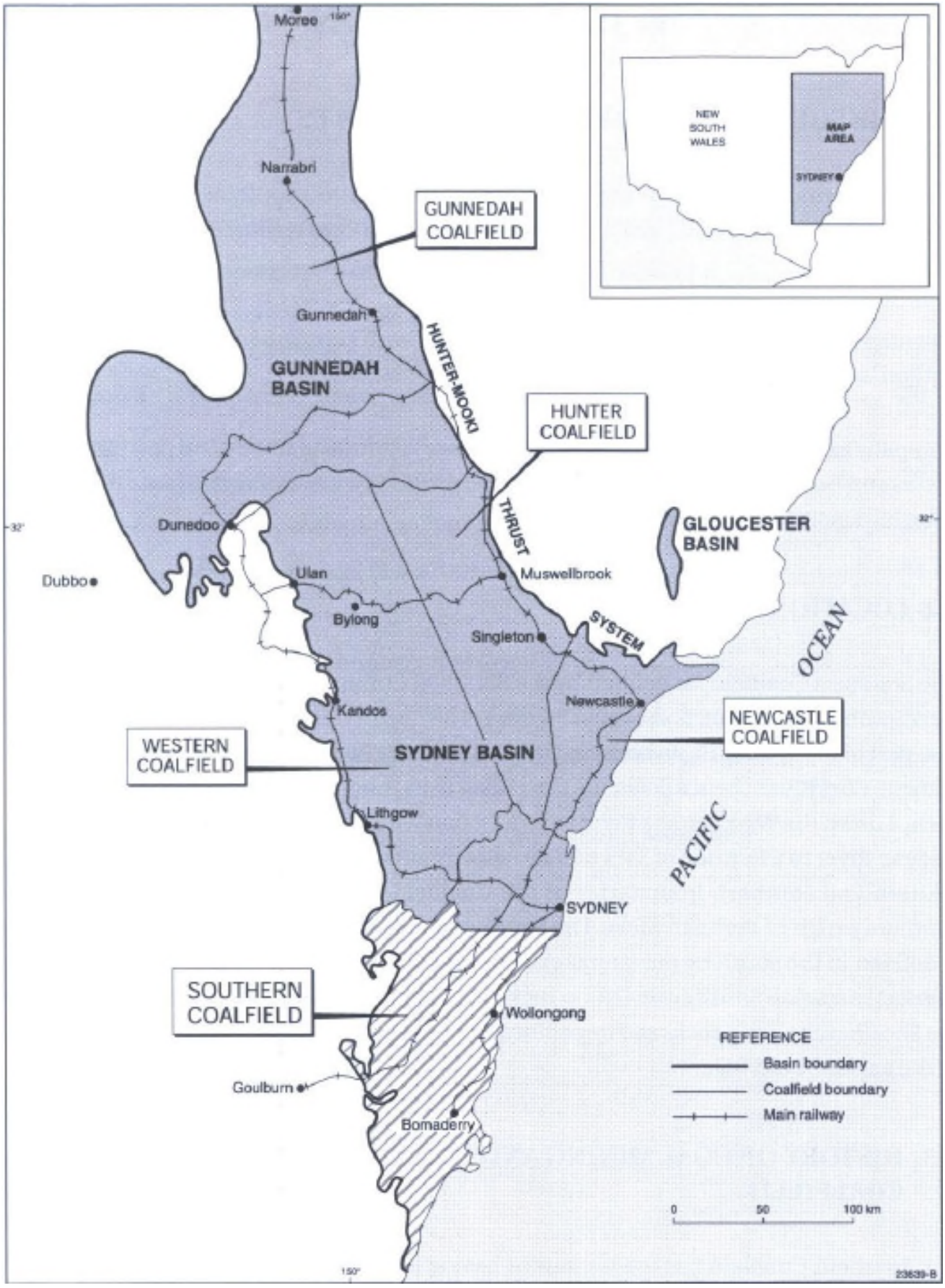


Figure 4 Sydney Basin and the Southern Coalfields

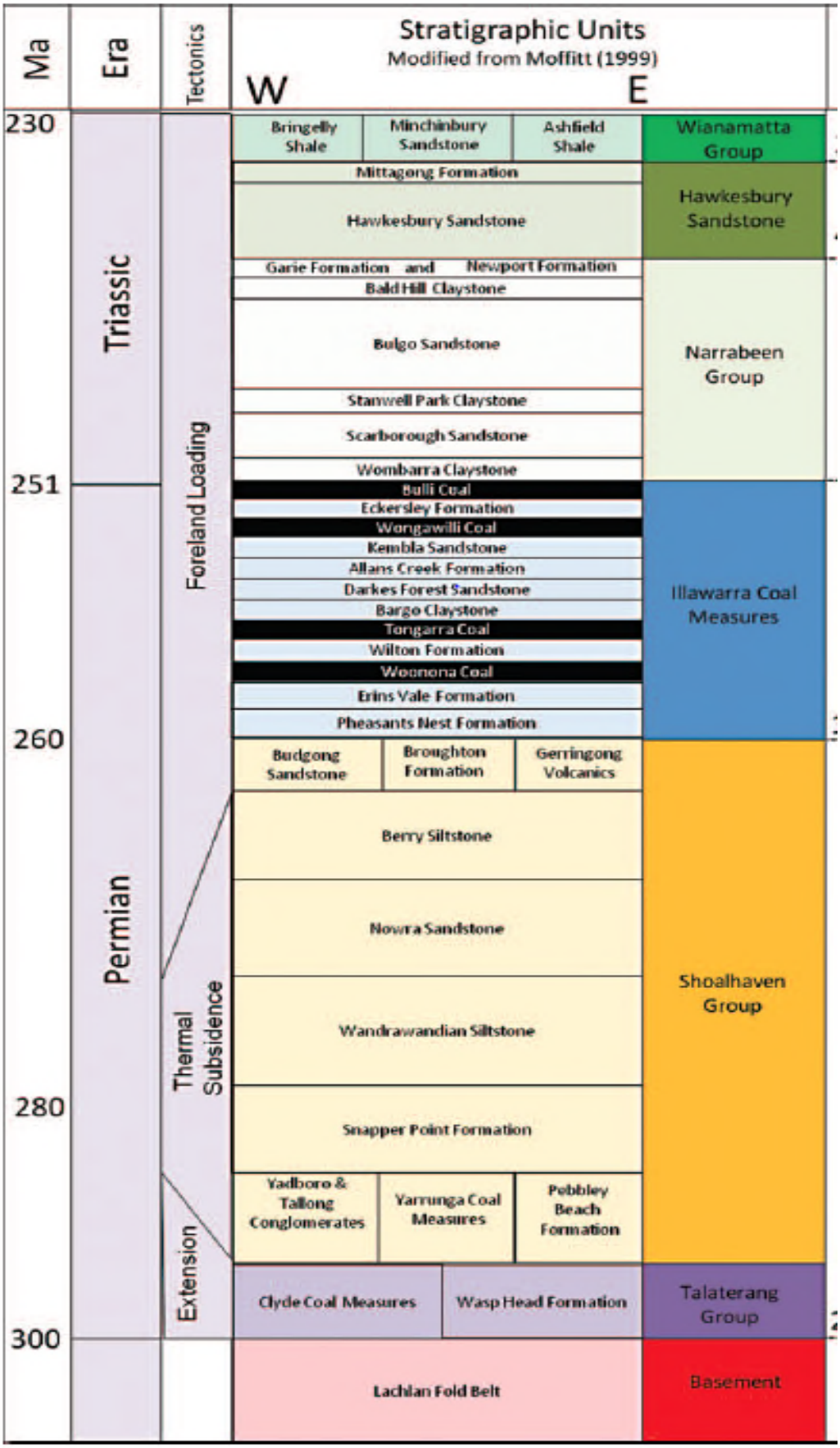


Figure 5 Southern Coalfield Stratigraphy

3.3.1.3 Southern Coalfield

The Southern Coalfield comprises the southern portion of the Sydney Basin, as outlined in **Figure 4**, covering an area south of Sydney almost to Batemans Bay, bounded in the west by the towns of Camden and Mittagong, and Helensburgh and Wollongong in the east.

The geological units of major economic significance in the Southern Coalfield are the late Permian Illawarra Coal Measures, a 240 m thick deltaic sequence that occurs above the Shoalhaven Group and beneath the Hawkesbury Sandstone and Narrabeen Group. The Illawarra Coal Measures are divided into two subgroups - the basal Cumberland Subgroup containing both the Pheasants Nest Formation and Erins Vale Formation, and the Sydney Subgroup containing the economic coal seams that are the Bulli, Balgownie, Wongawilli, and Tongarra seams.

The coal measures outcrop above sea level approximately 20 km to the north of Wollongong. The Illawarra Coal Measures dip at approximately four degrees to the north-west in the Illawarra that creates the outcrop pattern that extends from sea level about 20 km north of Wollongong before turning westward to track the northern side of the Shoalhaven River valleys.

The coal in the Southern Coalfield differs in rank from the other coalfields of the Sydney Basin. It is generally low to high volatility bituminous coal, in contrast to the medium to high volatility bituminous coal which predominates in other regions. The coal is buried at depths of greater than 300 m.

3.3.1.4 Bulli Coal Seam

The Bulli Coal Seam is stratigraphically the top seam in the Illawarra Coal Measures and represents the majority of the coal reserves. The seam reaches depths of up to 800 m in the central north of the coalfield and is situated at more than 850 m below the surface in the north-west. To the north of the coalfield, the Bulli Coal Seam is 5 m at its thickest and in other regions varies in thickness between 2 to 3 m. The thicker sections of the Bulli Coal Seam occur in synclines and down-thrown fault blocks.

The Bulli Coal Seam consists of interbanded coal seams composed of dull and bright plies. In addition to the coal, minor claystone and siderite is present in the seam. The Bulli Coal Seam contains 8-9% ash, 21.5-27.5% volatile matter, 30-55% vitrinite, a high inertinite percentage (up to 55%) and a relatively low sulphur content.

The Bulli Coal Seam is a prime quality coking coal with medium to high ash and low to medium volatiles, with an average raw yield ranging from 70-85% and average of approximately 76%. The regional dip of the Bulli Coal Seam towards the north-west is about 2.5 degrees. Where igneous intrusive bodies occur near the Bulli Coal Seam, the economic potential has been decreased due to thermal alteration of the coal.

3.3.2 Existing Workings

Tahmoor Coal has extracted coal from the Bulli Coal Seam through the operation of Tahmoor Mine since 1979. Tahmoor Mine has included the following longwall series:

- Longwalls 1 to 9 – mined from 1987 to 1992, with widths from 170 m to 200 m (void width) and length up to 1640 m;
- Longwalls 10 to 21 – mined from 1992 to 2004, with widths from 230 m to 235 m (void width) and lengths up to 2675 m;
- Longwalls 22 to 32 – mined from 2005 to 2019, with widths from 283 m to 285 m (void width) and lengths up to 3580 m. This longwall series was orientated in a north-west to south-east direction, and progressively mined from west to east; and
- Longwalls West 1 to West 4 – mined from 2019 to present, with widths of 283 to 285 m (void width) and lengths up to 1875 m. These longwalls are located in the Western Domain and are orientated in a north to south direction, and progressively mined from west to east.

The existing workings typically comprise of a five heading mains development configuration and numerous two heading gate road developments to establish the main and tailgates for the corresponding headwalls. Long-term mains development pillars are designed to be long-term stable and not cause subsidence, resulting in serviceable roads for the life of the mine. Gate road pillars are designed to exceed one-tenth of the overburden depth and are serviceable up until extraction.

Existing workings for both development and secondary extraction are identified in **Figure 2** and the Graphical Plans as part of this Extraction Plan application.

LW S1A-S6A are located in the Tahmoor South Domain. The new series of longwall exist to the south of the previously mined Longwalls 14-19 and to the west of Longwall 2 at Tahmoor Mine.

Tahmoor Mine shares the Southern coalfield with numerous operating and discontinued coal mines that also target the Bulli Coal Seam, although no workings are immediately adjacent to the Tahmoor leases. These mines include South32's Bulli Seam Operations, Russell Vale Mine, and Cordeaux Mine. South32's Dendrobium Mine is situated to the south-east of Tahmoor Mine and targets the deeper Wongawilli Coal Seam.

3.3.3 Proposed Mining Method

First workings (primary extraction or development mining) for LW S1A-S6A utilises continuous miners and shuttle cars to develop roadways that form the longwall panels. The two heading development roadways for LW S1A-S6A are typically extracted at 5.2 m wide and 2.7-2.8 m high by single pass continuous miners.

Development mining equipment required for first workings includes, but is not limited to:

- Continuous miners;
- Shuttle cars;
- Breaker feeders;
- Auxiliary fans;
- Graders;
- Underground personnel transporters; and
- Underground load haul dumps.

Second workings (secondary extraction or longwall mining) for LW S1A-S6A will utilise longwall retreat mining method to extract coal from the Bulli Coal Seam. Longwall mining is supported by continuous miner development operations. Each longwall panel will retreat in a direction away from the Central Mains Headings towards the 500 Mains Headings, nominally extracting from south to north.

Longwall mining equipment required for second workings includes, but is not limited to:

- Longwall shearer – to cut coal from the face of the seam;
- Face conveyor – to collect sheared coal and carry it to a coal sizer and stage loader;
- Panel conveyor – to transfer the coal to a trunk conveyor in one of the main headings; and
- Hydraulic roof supports – to temporarily hold up the roof strata to provide a working space for the shearing machinery and face conveyor. After each slice of coal is removed, the hydraulic roof supports, face conveyor and shearing machinery are moved forward and the roof immediately above the seam is allowed to collapse into the void that is left as the face retreats (the goaf).

ROM coal from Tahmoor Mine is conveyed to the surface via a series of conveyor belts and discharged to the ROM Stockpile area, where the coal is reclaimed and transferred to the Coal Handling Preparation Plant. At the plant, the ROM coal is processed by crushing, washing, sizing and dewatered and then transferred to the product coal stockpile by conveyor. Product Coal is reclaimed and transferred by conveyors to the Rail Load Out Bin, and then loaded into rail coal wagons for transport to either Port Kembla or the Port of Newcastle by rail.

Coal is mined from within the Bulli Coal Seam, producing hard coking coal for steel production. Product coal is marketed to Australian domestic, and export customers.

3.3.4 Mine Geotechnical Overview

3.3.4.1 Depth of Cover

The depth of cover over LW S1A-S6A ranges from between a minimum of approximately 365 m to a maximum of approximately 405 m (**Figure 6** (in masl)).

3.3.4.2 Roof Stata Characteristics

The immediate Bulli Coal Seam roof consists of an interbedded sandstone, siltstone and mudstone sequence of varying thickness, stratigraphically named the Wombarra Claystone. This sequence is overlain by the more thickly bedded Scarborough Sandstone.

Generally, the overburden for the 50 m of roof above the Bulli Coal Seam averages 60-80 Mpa. Roof strengths range typically 40-80 Mpa. The immediate 0.5 m roof strength is typically in the range 40-70 Mpa. The average strength of the 0-2 m horizon is generally stronger, ranging between 50-80 Mpa. The 2-8 m roof horizon ranges in strength from 60-90 Mpa.

Roof conditions vary with both the roof lithology and local stress conditions. Tahmoor Coal undertakes extensive roof monitoring, including roof sampling at specified locations.

3.3.4.3 Floor Strata Characteristics

The Bulli Coal Seam floor typically consists of carbonaceous mudstone grading into the coarser Loddon Sandstone sediments below. Floor strengths range typically 40-70 Mpa. In the current Tahmoor mining area, the immediate floor 0.2-0.5 m below the Bulli Coal Seam averages 50-80 Mpa.

Floor heave is commonly observed during development at Tahmoor Mine. Floor brushing is carried out, usually at least once, to provide adequate clearance within the first two weeks of mining. Typically, 0.5 m of floor is brushed in development roadways.

A laboratory strength range for the coal of the Bulli Coal Seam is about 15-20 Mpa.

3.3.4.4 Seam Dip

The Bulli Coal Seam has a gentle dip to the northeast, averaging 1.7°, although can range with dips up to 4° being recorded. This northeast dip is consistent to being positioned on the western arm of the Camden Syncline and western edge of the Sydney Basin.

The Bulli Coal Seam average gradient is 3-5% (i.e. 1 in 20) or from 8-15 m across the proposed longwall face width within the mining area of LW S1A-S6A.

3.3.4.5 Seam Thickness and Working Section

The main part of the Bulli Coal Seam at Tahmoor Mine is a consistent seam of bright and dull coal. The thickness of the Bulli Coal Seam section ranges from 1.7-2 m thick in LW S1A-S6A.

The Bulli seam geology (full) consists of a main Bulli Coal portion, underlain by a stone band (bedding parting) that typically varies in thickness between 0.05-0.2 m, which is further underlain by a poorer quality coal split which ranges in thickness from 0.1-0.3 m. The longwall working section in LW S1A-S6A plans to extract all three stratigraphic layers. Product yield is primarily driven by the proportionality of the aforementioned layers within the working section.

3.3.4.6 Faulting

Faults and seam continuity have been interpreted from exploration drilling, extensive seismic surveys and underground mapping.

No faults have been identified within the LW S1A-S6A from underground workings by Tahmoor Coal.

Tahmoor south mining area is bounded by the Nepean fault to the east and the Central fault zone to the west (refer to **Figure 6**).

This system is the southern extension of the Lapstone Monocline, and at Tahmoor Mine, it consists of closely spaced sub-vertical en-echelon faults in a zone up to 400 m wide. The net displacement of the faults is approximately 30 m at Picton, diminishing to 10 m at Tahmoor North, and 3m in Tahmoor South. The Nepean Fault Zone is the only hydraulically charged geological structure encountered during mining to date.

3.3.4.7 Igneous Intrusions

Igneous intrusions are present throughout the broader Tahmoor Mine area and are typically identified to be north-west to south-east orientated when intersected in the workings. These bodies have presented as dykes with associated sill material, ranging from very strong fresh material to weak highly altered rock. In the eastern part of the mining leasehold, a plug, which is exposed at the surface, is considered to be present at Bulli Coal Seam level. This feature is external to current mine plans.

Within the southern mining domain, a small-scale igneous intrusion has been mapped and projected within the South 2 Mains Headings, immediately to the East of LW S1A. No further intrusions have been encountered through extensive inseam drilling conducted to date.

Regionally, to the south-east of the Tahmoor Mine leases, the Bulli Coal Seam is extensively intruded and/or cindered to the east of Bargo. The north-western limits of this intrusion partly encroach on the south-eastern part of the Tahmoor South Lease.

3.3.4.8 Seam Splitting

Seam splitting has been observed within underground workings, exploration drilling, gas drainage drilling and roadway development, and is described in **Section 3.3.4.5**.

3.3.4.9 Geotechnical Design Parameters

Chain pillars at Tahmoor Mine typically range between 35-40 m wide (solid), varying slightly with depth of cover. Pillar dimensions are consistent with double abutment chain pillar widths in the local mining district. Narrower chain pillars down to 25 m have been adopted where single sided abutment is planned. Similar dimensions have been adopted in the new mining domain of S1A-S6A.

Specific details of the proposed design parameters are provided in **Table 13.**

3.3.4.10 Stability of Underground Workings

The Coal Mine Roof Rating is routinely measured at Tahmoor Mine to characterise the immediate roof strata, and ranges between 40-55 in the Tahmoor South Domain.

Due to the laminated immediate roof, goafing is typically observed directly behind the shields. Large en-masse roof falls are not a feature of longwalling in the Bulli Coal Seam at Tahmoor Mine.

The Tahmoor Mine Hazard Plan summarises the main features affecting the longwall stability as:

- Roadway stability due to stress notching;
- Cross grades across the face; and
- Minor strike slip faulting.

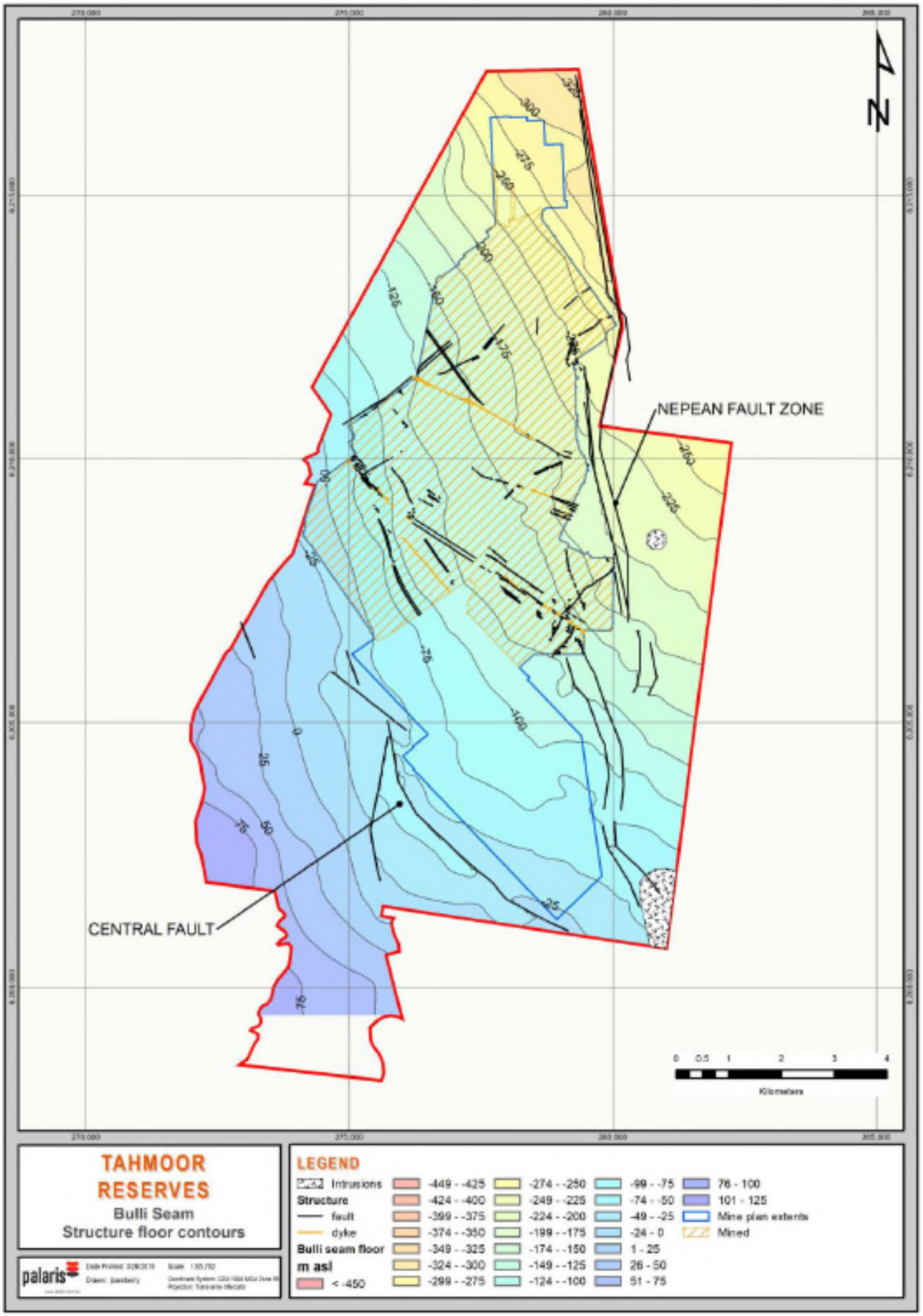


Figure 6 Structure of the Bulli Coal Seam in the Tahmoor Mine Lease Areas (Palaris, 2019)

3.3.5 Mine Geometry

3.3.5.1 Variations to the Original Mine Plan

As discussed in **Section 2.2.1,** the Tahmoor South Domain mine plan has been modified over time since the EIS submission in 2019, including modifications for each of the two amendment development applications.

Since development approval in April 2021, modifications to the Tahmoor South Domain mine plan have been applied to optimise development drivage and sequencing, and to maximise resource recovery within the constraints of available longwall equipment, features and boundaries. These minor adjustments include:

- Minor increases of longwall panel widths;
- Minor amendments to chain pillar widths;
- 'Squaring up' the headings to the south of the A series; and
- Minor adjustment to the commencement ends of the A series panels as a result of modification to the headings.

3.3.5.2 Current proposed Mine Plan

The current proposed mine plan for the Tahmoor South Domain is shown on **Figure 3**.

LW S1A-S6A are to be developed south of the 500 Mains Headings in an approximate north-south orientation and will be extracted from south to north. LW S1A will be mined first, followed by LW S2A to LW S6A in a western progression. The proposed layout for LW S1A-S6A is within the footprint of the Amended Extent of Longwalls as approved under the 2021 Development Consent (MSEC, 2022).

The proposed dimensions of LW S1A-S6A are outlined in **Table 13**. Detailed mine layout drawings are provided in the Graphical Plans that form part of this Extraction Plan application.

The LW S1A-S6A panels will be 283 m (LW S1A) and 285 m (LW S2A–S6A) in width. The length of the longwalls will vary between 1,706 m for LW S1A and 1,994 m for LW S6A (excluding first workings). The overall void length is approximately 8 m greater than the longwall extraction length, owing to the installation headings. The mining height of the longwalls is anticipated to be between 2.1 m to 2.2 m.

Table 13 LW S1A-S6A Design Parameters

Longwall Panel Parameters	Units	LW S1A	LW S2A	LW S3A	LW S4A	LW S5A	LW S6A
ROM Coal Extracted	Tonnes	1,555,032	1,601,165	1,652,936	1,749,809	1,844,764	1,901,748
Gate Road Width	m	5.2	5.2	5.2	5.2	5.2	5.2
Gate Road Height	m	2.75	2.75	2.75	2.75	2.75	2.75
Maingate (MG) Chain Pillar Width	m	37.8	36	36	36	36	36
Tailgate (TG) Chain Pillar Width	m	90.4	37.8	36	36	36	36
Pillar Width/Height Ratio		13.7	13.1	13.1	13.1	13.1	13.1
Tailgate (TG) Chain Pillar Length	m	119.8	119.8	119.8	119.8	119.8	119.8
Longwall Void Width	m	283	285	285	285	285	285
Longwall Extraction Width	m	272.6	274.6	274.6	274.6	274.6	274.6
Longwall Void Length	m	1714	1771	1811	1862	1952	2002
Longwall Extraction Length	m	1706	1763	1803	1854	1944	1994
Longwall Extraction Height	m	2.1-2.2	2.1-2.2	2.1	2.1	2.1	2.1-2.2
Coal Seam thickness	m	1.98	2.01	1.93	1.82	1.85	1.92
Minimum Depth of Cover	m	380	380	375	375	365	380

Longwall Panel Parameters	Units	LW S1A	LW S2A	LW S3A	LW S4A	LW S5A	LW S6A
Maximum Depth of Cover	m	405	395	395	390	385	390

3.3.5.3 Mining Considerations and Hazards

A number of criteria and potential mining hazards have been taken into account during the design of the Tahmoor South mine plan. These items were:

- Seam access;
- Geological information and level of certainty;
- Access to shaft locations;
- Seam dip;
- Alignment with geological structure;
- Major horizontal stress;
- Depth of cover;
- Subsidence limits;
- Ventilation and gas drainage;
- Timing of government approvals;
- Number of development units required to support a highly productive longwall;
- Mains development requirement;
- Scoping accurate productivity levels;
- Frequency of longwall and development relocations; and
- Mine planning effectiveness.

Tahmoor Mine prepares mining and geotechnical hazard plan for each longwall in advance of mining.

3.3.6 Mine Schedule

An indicative mining schedule for development and secondary extraction of LW S1A-S6A is provided in **Table 14**.

Mining of LW S1A is scheduled to commence in October 2022, with LW S6A scheduled for completion in July 2026. It is estimated that each longwall will be extracted in approximately 6 to 8 months.

The rate of longwall retreat is anticipated to range from 50-80 m per week, depending on geological conditions and support regime. Tahmoor Coal operates seven days a week, 24 hours a day on a roster basis.

Table 14 Mine Schedule for LW S1A-S6A

Longwall Panel	Estimated Start Date	Estimated Completion Date	Estimated Duration
Longwalls South 1A (LW S1A)	3/10/2022	6/04/2023	185 days (6.2 months)
Longwalls South 2A (LW S2A)	13/06/2023	17/01/2024	218 days (7.3 months)
Longwalls South 3A (LW S3A)	19/02/2024	31/08/2024	194 days (6.5 months)
Longwalls South 4A (LW S4A)	6/10/2024	23/04/2025	199 days (6.6 months)
Longwalls South 5A (LW S5A)	25/05/2025	17/12/2025	206 days (6.9 months)
Longwalls South 6A (LW S6A)	20/01/2026	25/08/2026	217 days (7.2 months)

3.3.7 Resource Recovery

3.3.7.1 Coal Quality

Tahmoor Mine is a well-established and consistent metallurgical coal brand in the global marketplace that borders on being a hard coking coal. The Tahmoor Mine sells coking coal products to steel producers in Australian domestic market and export markets to European, Indian and Asian customers.

High quality coking coal is the primary product of the Tahmoor Mine. This product has a target ash of an average 9.3% with 8% product moisture. A higher ash coal is produced as a secondary product, which is washed to a target ash of 25% with a product moisture of 6%.

The geological definition of Tahmoor South coal has primarily been determined by the TBC series of boreholes from 2008-2010. Near term geological data is gained by a longwall block strip sampling regime and selective input of inseam exploration/gas drainage drill holes.

Coal Reserve for the Tahmoor South Domain mining area has been reported in accordance with the JORC Code, 2012. The reserves are estimated as of 31 December 2019 and generally reflect the mine design currently used for the Tahmoor South with the exception of minor alterations as described in **Section 3.3.5**, and are outlined in **Table 15**.

Table 15 Coal Reserve Estimates

Reserve	Domain	Proved (Mt)
ROM Reserve	Tahmoor South Domain – LW S1A-S6A Bulli Coal Seam (5% M_{ROM})	10.4
Marketable Reserve	Coking Coal (8.5% M_{Prod}, 10% Ash)	6.3
	Secondary Coking Coal (6% M_{Prod}, 20% Ash)	0.4
	Total Product	6.6

3.3.7.2 Resource Recovery

The full seam ranges in thickness from 1.70 m - 2.01 m for LW S1A-S6A. Longwall equipment is able to cut at height of 2.15 m up to 2.6 m, therefore the full seam thickness will be mined. The total recoverable reserve from the extraction area is 6,292 394 tonnes for LW S1A-S6A.

Expected longwall resource recovery from LW S1A-S6A is presented in **Table 16**.

Table 16 Estimated Individual Panel Tonnages and Recovery

Longwall	ROM tonnes (t)	Coking Coal Product tonnes (t)	High Ash Secondary product tonnes (t)	Reject tonnes (t)	Yield (%)
LW S1A	1,572,027	1,008,346	65,319	498,362	68.3
LW S2A	1,618,664	1,004,247	71,720	542,697	66.5
LW S3A	1,671,001	1,021,598	62,130	587,273	64.9
LW S4A	1,768,933	1,033,279	53,152	682,502	61.4
LW S5A	1,864,925	1,096,971	61,103	706,851	62.1
LW S6A	1,922,532	1,127,953	66,707	727,873	62.1

3.3.7.3 Justification Statement

There are no significant environmental impacts anticipated, given the mine plan avoidance of sensitive areas and the ability for ongoing adaptive management, which will preclude longwall mining within the Extraction Plan Study Area. In addition, there are no significant subsidence impacts anticipated to surface infrastructure that cannot be mitigated prior to mining that will preclude longwall mining within the Extraction Plan Study Area.

The subsidence monitoring plan forming part of this Extraction Plan summaries the overall monitoring of mining impacts on both the natural environment and built features, with management actions and controls detailed within the relevant key component plans and subsidence management plans for built features.

Tahmoor Coal considers that the mine layout of LW S1A-S6A provides the most efficient resource recovery given the environmental and surface features constraints to mining. The extraction of the proposed longwalls has no detrimental impact on the potential to mine economically recoverable coal in the remainder of the lease areas.

3.4 Subsidence Predictions and Observations

3.4.1 Overview

Key parameters used in the description, prediction and assessment of surface movements resulting from underground mining are subsidence, tilt, strain, curvature, valley closure, and upsidence. A glossary of subsidence terms is provided in **Section 8.3** of this Extraction Plan Main Document.

As discussed in **Section 2.2.1**, the Tahmoor South Domain mine plan has undergone a series of changes since the original EIS submission was prepared in 2014.

Subsidence predictions for the extraction of LW S1A-S6A have been presented in the Subsidence Predictions and Impact Assessment Report by MSEC (2022; refer to **Appendix A**). The following sections provide a summary of the information contained in the report (MSEC, 2022) to provide the maximum predicted conventional subsidence parameters resulting from the extraction of the proposed LW S1A-S6A in the Bulli Coal Seam.

The predicted subsidence, tilt and curvature have been obtained using the Incremental Profile Method, which has been calibrated for local conditions. The predicted strains have been determined by analysing the strains measured at Tahmoor Mine and other mines in the NSW Coalfields where the longwall width-to-depth ratios and extraction heights are similar to those for the proposed longwalls. A summary of subsidence predictions methods used to predict subsidence parameters for the extraction of LW S1A-S6A is provided in **Section 2.2.3**, and are discussed in further detail in the Subsidence Predictions and Impact Assessment Report (MSEC, 2022; **Appendix A**).

The maximum predicted subsidence parameters and the predicted subsidence contours describe and show the conventional movements. These predicted subsidence parameters do not include non-conventional movements such as valley related upsidence and closure movements, nor the effects of faults and other geological structures. Such effects have been addressed separately in the Subsidence Predictions and Impact Assessment Report for each environmental and built feature provided in Chapters 5 to 11 of **Appendix A**.

Subsidence impact predictions have been used in the various Key Component Plans and associated documents to determine the appropriate management of the relevant environmental and built features. **Table 5** provides a summary of the environmental and built features considered and the relevant Key Component Plans and associated documents that discuss and manage these features.

3.4.2 First Workings

The underground workings proposed are consistent with the proven success of the pillar geometries previously employed at Tahmoor Mine over a period of 35 years. Roof stratigraphy and floor conditions are well understood and controlled by the established roadway reinforcement systems. Coal strength, from the pillar stability point of view, is expected to be undiminished in the Extraction Plan Study Area and is complemented by rib bolting where necessary.

The parameters used for first workings at Tahmoor Coal Mine are width of 5.2 m and height of 2.7-2.8 m. The design parameters for first workings utilised at Tahmoor Mine are below the criteria for a High Risk Activity notification, as outlined within Schedule 3, Part 2, Clause 14 of the WHSMP Regulations.

The first workings for LW S1A-S6A are expected to be long term stable and non-subsiding in accordance with the requirements of Table 7 in Condition C1 and Condition C7 of SSD 8445. **Section 3.3.3** provides more details regarding first workings methodology.

First workings for LW S1A remain within the Tahmoor North Lease, for which DA 1975 applies. Under this development consent there are no requirements for first workings notifications. First workings for LW S1A commenced in April 2021.

Requirements for first workings notifications under the Tahmoor South development consent commences when LW S1A extraction starts (estimated around October 2022). A letter will be sent prior to this commencement to the Resources Regulator with information on the first workings as required under Condition C7 of the Development Consent.

3.4.3 Subsidence Prediction

A summary of the maximum predicted values of incremental vertical subsidence, tilt and curvature resulting from the proposed LW S1A-S6A are provided in **Table 17**. The incremental parameters represent the additional movements due to the extraction of each of the proposed longwalls.

Table 17 Maximum Predicted Increment Conventional Subsidence, Tilt and Curvature for the Proposed LW S1A-S6A

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	800	7.0	0.08	0.22
LW S2A	950	7.5	0.08	0.22
LW S3A	950	8.0	0.09	0.22
LW S4A	950	8.0	0.09	0.22
LW S5A	950	8.0	0.10	0.22
LW S6A	975	8.3	0.09	0.23

A summary of the maximum predicted values of total vertical subsidence, tilt and curvature resulting from the extraction of the proposed longwalls is provided in **Table 18**. The predicted total parameters represent the accumulated movements due to the extraction of all proposed longwalls within each of the mining areas. The predicted total vertical subsidence contours are shown in Drawing Nos. MSEC1192-22 of **Appendix A**.

Table 18 Maximum Predicted Total Conventional Subsidence, Tilt and Curvature for the Proposed LW S1A-S6A

Longwall	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km^{-1})	Maximum Predicted Total Conventional Sagging Curvature (km^{-1})
LW S1A	800	7.0	0.08	0.22
LW S2A	1,000	8.0	0.10	0.22
LW S3A	1,200	8.0	0.10	0.22
LW S4A	1,250	8.5	0.13	0.22
LW S5A	1,350	9.0	0.14	0.22
LW S6A	1,350	9.5	0.14	0.24

The maximum predicted total vertical subsidence of 1350 mm represents 61 % of the proposed mining height. The maximum predicted total tilt is 9.5 mm/m (i.e. 0.955 %, or 1 in 95). The maximum predicted total curvatures are 0.14 km^{-1} hogging and 0.24 km^{-1} sagging, which represent minimum radii of curvature of 7.1 km and 4.2 km, respectively.

The predicted conventional subsidence parameters vary across the mining area. To illustrate this variation, the predicted profiles of conventional subsidence, tilt and curvature have been prepared along a prediction line, which are located as shown in Drawings Nos. MSEC1192-22 in **Appendix A**.

3.4.4 Strain Prediction

For features that are in discrete locations, such as building structures, farm dams and archaeological sites, it is appropriate to assess the frequency of the maximum strains measured in individual survey bays.

3.4.4.1 Strain Measured in Survey Bays

The survey database has been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located directly above goaf or the chain pillars that are located between the extracted longwalls, which has been referred to as "above goaf".

The 95 % confidence levels for the maximum total strains that the individual survey bays above goaf experienced at any time during mining were 0.9 mm/m tensile and 1.6 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays above goaf experienced at any time during mining were 1.4 mm/m tensile and 3.1 mm/m compressive.

The survey database has also been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located outside and within 200 m of the nearest longwall goaf edge, which has been referred to as "above solid coal".

The 95 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 0.6 mm/m tensile and 0.5 mm/m compressive. The 99 % confidence levels for the maximum total strains that the individual survey bays above solid coal experienced at any time during mining were 0.0 mm/m tensile and 1.5 mm/m compressive.

3.4.4.2 Strain Measured along Whole Monitoring Lines

For linear features such as roads, cables and pipelines, it is more appropriate to assess the frequency of the maximum strains measured along whole monitoring lines, rather than for individual survey bays. That is, an analysis of the maximum strains measured anywhere along the monitoring lines, regardless of where the strain occurs.

A total of 42 of the 52 monitoring lines (i.e. 92 %) at Tahmoor, Appin and West Cliff Collieries had recorded maximum total tensile strains of 2.0 mm/m, or less. A total of 45 of the 52 monitoring lines (i.e. 87 %) at the mines had recorded maximum total compressive strains of 4.0 mm/m, or less.

3.4.4.3 Shear Strains

The 95 % and 99 % confidence levels for the maximum total horizontal mid-ordinate deviation that the individual survey marks located above goaf experienced at any time during mining were 20 mm and 35 mm, respectively.

3.5 Performance Measures and Indicators

3.5.1 Performance Measures

Performance objectives in relation to the subsidence impacts are outlined in SSD 8445. Performance measures relating to natural and heritage features are provided in Table 7 of SSD 8445 Condition C1, and are presented in **Table 6**. Performance measures relating to built features are provided in Table 8 of SSD 8445 Condition C3, and are also presented in **Table 6.** These objectives have been used when developing the management strategies incorporated in this Extraction Plan.

With regards to the subsidence performance measure discussed in **Table 6**, 'negligible' is defined as being 'so small and insignificant as to not be worth considering'.

3.5.2 Performance Indicators

To establish compliance with the performance measures outlined in **Table 6**, Tahmoor Coal has developed subsidence and environmental monitoring programs in consultation with stakeholders as detailed in **Section 5** of this Extraction Plan, and within the key component plans.

Trigger Action Response Plans (TARP) have been developed as part of the monitoring of performance indicators for the relevant management plans to establish an appropriate response if a performance measure is triggered. A 'Normal Condition' section is provided in each TARP to indicate that the environment is performing within normal levels or natural variability. Deviation from baseline or expected conditions triggers an increased level of risk to the environment (Level 1 or higher based on escalating corresponding risk). Each TARP provides a number of trigger levels based on the feature under observation, and each trigger is clearly defined with an appropriate action and response assigned for each risk level.

The TARPs are discussed further in **Section 3.6.2** and a Master TARP consolidating all the aspects is provided in **Appendix B**. TARPs associated with individual Subsidence Management Plans for built features will be developed separately as part of their individual management plan, and incorporated into the Master TARP once completed.

3.6 Subsidence Management Strategies

Subsidence management at Tahmoor Mine follows the risk hierarchy approach of risk elimination (impact avoidance), substitution and mitigation, engineering controls, management and monitoring.

Subsidence management and mitigation strategies for each relevant environmental and built feature are described within the relevant management plans developed in support of the Extraction Plan outlined in **Section 4**. Further to detailed discussion in mine design (refer **Section 2.2**), the following sections provide addition discussion on impact avoidance measures, adaptive management processes, and contingency management using TARPs.

3.6.1 Avoidance

Impact avoidance (risk elimination) is the highest level of risk management control under the risk hierarchy and is the starting point for mine design wherever practicable.

There are two management strategies for avoiding or minimising the impacts to sensitive surface features as a result of mining. These are:

- Avoid mining under sensitive surface features; and/or
- Mine design under the sensitive surface features with a sub-critical void width.

As discussed in **Section 2.2**, the mine plan for LW S1A-S6A has been modified since the 2014 Original EIS submission. The numerous modifications of the Tahmoor South Domain mine plan have resulted in a reduction of the magnitude and extent of subsidence impacts, as well as avoidance of significant impact to sensitive surface features of the environment, including Aboriginal heritage items. This included the removal of LW 109 in February 2020, which was located directly beneath Dogtrap Creek and would have resulted in direct impacts to Aboriginal heritage items.

The current mine plan proposes to complete underground mining with access to the Tahmoor South Domain provided from the existing pit top facilities. This mine design consideration minimises surface impacts from mining through the avoidance of establishing new surface facilities.

3.6.2 Trigger Action Response Plans

Tahmoor Coal has developed TARPs for each relevant component management plan prepared to support the LW S1A-S6A Extraction Plan (refer to key component plans discussed in **Section 4** of this Extraction Plan). A Master TARP consolidating all aspects from the management plans is provided in **Appendix B**, and will be added to with TARPs from individual Subsidence Management Plans for built features once completed.

The TARPs have been developed using the performance indicators for subsidence impacts relevant to each component management plan. The TARPs outline the assigned level of risk for each performance measure. The 'Normal Condition' Level of each TARP indicates that, based on monitoring results, the environment is performing within normal levels. Where performance indicators indicate that a level of risk has been triggered greater than a normal level (Levels 1 or higher with escalating corresponding risk), a response in the form of management / corrective management actions is required to be implemented as outlined in the TARP.

3.6.2.1 Implementation of Monitoring Program and TARP Requirements

Tahmoor Coal's standard approach for all monitoring, reporting, investigation and remediation is to commence all tasks as soon as practicable. The following sections provide more information on this standard approach to be adopted during the LW S1A-S6A pre-mining, mining and post-mining phases:

- All monitoring commitments will be tracked on a weekly basis so that tasks are completed as required, taking into consideration land access and environmental factors. Post-mining monitoring will typically be completed within one month of the completion of the relevant longwall and prior to the influence from the active subsidence zone on the feature from the next longwall.
- Following the receipt of monitoring data and laboratory results, specialist consultants will review the data against the relevant TARPs as soon as practicable. If any TARP trigger has occurred, specialist consultants will notify Tahmoor Coal as soon as practicable. Monitoring results and TARP triggers will also be discussed during the monthly Environmental Response Group meetings, and any relevant information from other disciplines will be shared within the group. It is noted that discussions amongst specialists from different disciplines will not be restricted to ERG meetings, and relevant specialists will be included at any time to discuss results and assist with the completion of required actions and responses, as required.
- In the event of a TARP trigger occurrence, Tahmoor Coal will initiate all requirements (actions and responses) in accordance with the relevant TARP (i.e. investigation, report, negotiation, CMA determination, or similar) as soon as practicable and endeavour to commence actions and responses within one month of the exceedance being recorded. This timeframe is noted to be subject to issues outside of Tahmoor Coal's control such as land access constraints, inclement weather, extended timeframes where further monitoring is required, and inability to communicate with a third party / landholder.
- Tahmoor Coal will complete the required actions and responses relating to the TARP trigger as soon as practicable and will endeavour to finalise these requirements, subject to issues outside of Tahmoor Coal's control, as follows:
  - Level 1 and Level 2 TARP trigger actions and responses within three months of the exceedance being recorded;
  - Level 3 and Level 4 TARP trigger actions and responses within six months of the exceedance being recorded; and

- Exceeds Performance Measures actions and responses in accordance with the timeframes provided in the relevant TARPs.

The contingency plan in the event of an exceedance of performance indicators may include:

- Management actions;
- Corrective management actions;
- Preventative actions;
- Further investigations;
- Implementation of a Rehabilitation Management Plan; and/or
- Implementation of a Corrective Action Management Plan (CAMP).

If a CAMP is required in accordance with the TARP, this document will be prepared in consultation with key Government agencies. The CAMP will include the following key elements:

- Investigation of the impact and root cause analysis;
- Review of monitoring data and extent of environmental consequences;
- Technical review into remediation methodology options;
- Establishment of remediation success criteria;
- Development of remediation strategy;
- Development of post-remediation review; and
- Project management administration, controls, scheduling and reporting.

The success of remediation measures that has been implemented for any TARP exceedance would be reviewed as part of any CAMP, the Six Monthly Subsidence Impact Reports (refer to **Section 7.1.1**) and the Annual Review (refer to **Section 7.1.2**).

3.6.3 Adaptive Management Strategies

3.6.3.1 Continuous Improvement

Tahmoor Coal have adopted the "Plan-Do-Check-Act" model as shown in **Figure 7**. This model will be applied to all aspects of Tahmoor Coal's environmental management and is utilised to embed the continuous improvement process in all system documents.

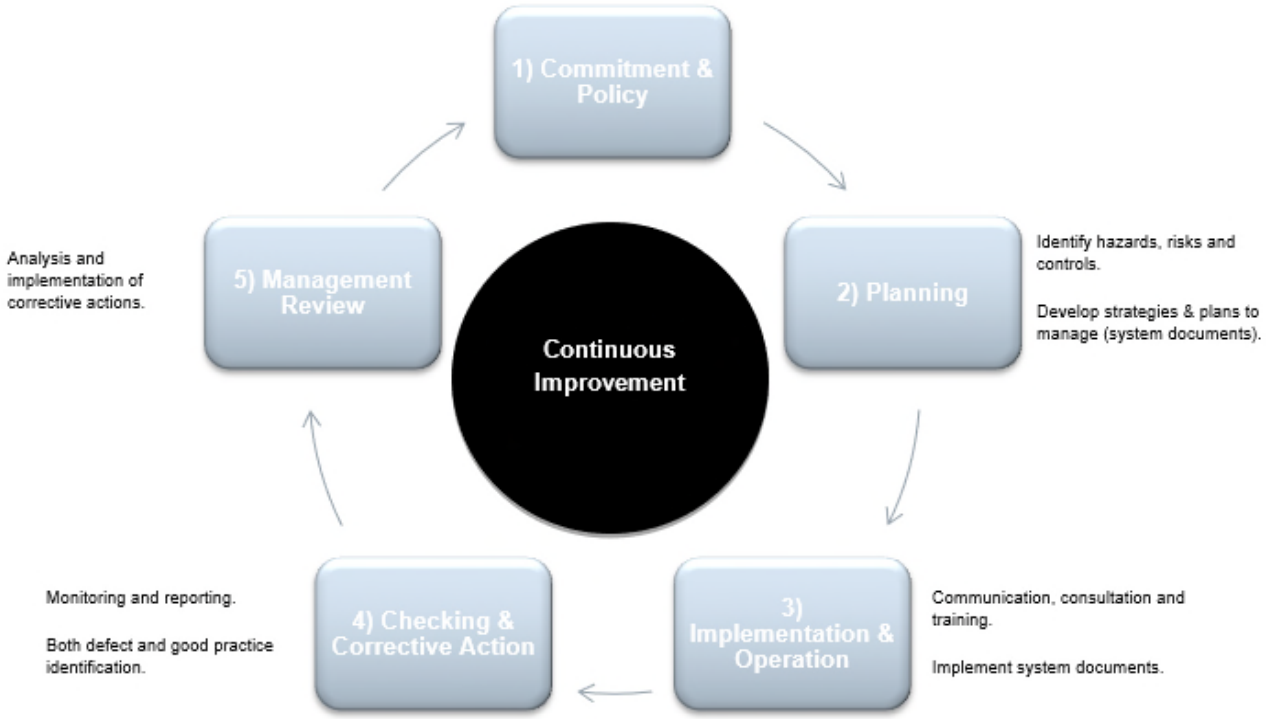


Figure 7 Continuous Improvement Model

3.6.3.2 Effectiveness of Management Measures

The effectiveness of the management measures presented in each of the key component plans will be validated periodically via comparison of monitoring results with modelled predictions. Re-calibration will occur as necessary, and an independent review of the model will occur every three years.

3.6.3.3 Adaptive Management Strategy - Review of Mine Plan for Built Features

Adaptive management measures for the reduction of impact to environmental features is not proposed for the extraction of LW S1A-S6A. However, a number of built features may benefit from adaptive management strategies, as discussed below.

An Adaptive Management Strategy is proposed to review mining-induced ground movements, subsidence impacts and environmental consequences to three properties / infrastructure during the mining of the following longwalls:

- Wollondilly Anglican College - In the extremely unlikely event that severe impacts develop, it would be possible to pause longwall extraction as it approaches the school to ensure that the school remains safe, serviceable and operational during and after the proposed mining;
- Picton Weir - As Tahmoor Mine will progressively approach the Picton Weir, it will be possible to review observations during the mining of each longwall and adjust the mine plan, if necessary to reduce the potential for impacts on Picton Weir. Picton Weir is also located beyond the finishing ends of the longwalls and it will be possible to stop the longwall during mining, if necessary based on actual observations during mining; and
- Wellers Road Bridge - As Tahmoor Mine will progressively approach the Wellers Road Bridge, it will be possible to review observations during the mining of each longwall and adjust the mine plan, if necessary to reduce the potential for impacts on the Overbridge.

According to the Adaptive Management Strategy, if impacts to built features listed above were greater than anticipated, Tahmoor Coal would review amending the commencing / finishing positions of the longwalls in question to reduce the potential for impacts on these built features.

If it was determined that the current start / finishing positions of these longwalls is likely to result in an exceedance of the subsidence impact performance measure for these built features, detailed analysis would be undertaken to determine if a modification of the longwall(s) is likely to result in an exceedance of the subsidence performance measures. If a setback is likely to reduce the likelihood of an exceedance occurring, modification of the longwall(s) would be determined. This process would be completed by re-generating the subsidence model for the relevant longwall to include observed subsidence measurements, and generating potential subsidence predictions for defined incremental changes to future longwall(s) from the built feature in question.

3.6.3.4 Adaptive Management Strategy - Review of Mine Plan for Heritage Features

If extraction of LW S1A-S6A indicates that an environmental consequence has occurred to the heritage significance of Rockshelter Site 52-2-4471 (and a Level 2 of TARP HMP1 has been triggered), Tahmoor Coal would review the impacts that occurred to the rockshelter site and also review the experiences that were observed at other non-heritage rockshelters during the mining of LW S1A-S6A. If the review indicates that impacts on Aboriginal sites above the B Series longwalls are likely to be greater than predicted in the EIS, Tahmoor Coal will review the mine design and determine whether some longwall panels should be setback further to avoid directly mining beneath other rockshelter sites.

3.6.4 Strategy for Continuous Improvement to the Aquatic Monitoring Program

The BACI designed aquatic monitoring program will be evaluated each season and adapted where required to account for prevailing environmental conditions. To date, the baseline aquatic monitoring program has been adapted to account for consistently dry creek beds at sampling locations and to avoid collecting data where other environmental variables would confound results. Monitoring reports will identify any limitations and improvements that could be made to the program including additional sites and analyses that could be incorporated.

3.6.5 Strategy for Continuous Improvement to the Riparian and Amphibian Monitoring Program

The BACI designed terrestrial monitoring program will be evaluated each season and adapted where required to account for prevailing environmental conditions. To date, the baseline amphibian monitoring program has been adapted to account for the potential decline in amphibian populations within watercourses of the Study Area. The program currently collects watercourse parameters associated with sensitive amphibian habitat areas and accounts for total frog species richness and abundance.

Riparian monitoring focuses on signs of riparian vegetation dieback. To date, the program obtains data on flora species richness, floristic cover, prevalence of exotic species, and other anecdotal information (e.g., visual shifts in vegetation assemblages, evidence of post-fire recovery, stochastic events [flooding], and above surface human disturbance). Monitoring reports will identify any limitations and improvements that could be made to the program including additional sites and analyses that could incorporated.

4 Key Component Plans

4.1 Overview of Environmental Management

4.1.1 Environmental Management Strategy Framework

The Tahmoor Environmental Management System (EMS) Framework provides the strategic context for the environmental management of Tahmoor Coal and forms part of the broader Health, Safety, Environment and Community (HSEC) management systems at Tahmoor Coal. The EMS outlines how Tahmoor Coal manages environment and community (E&C) aspects, impacts and performance. It provides a framework for the standards, plans and procedures implemented to ensure operations are managed in accordance with the ISO:14001 principles.

The objectives of the EMS are:

- To provide an overall framework for environmental management at Tahmoor Mine utilising the principles of ISO:14001;
- To ensure compliance with all development consent, licences and approvals at Tahmoor Mine;
- To detail the relationship and interactions between various operational and environmental components at Tahmoor Mine;
- To provide effective mechanisms for external communications, maintaining a relationship with the local community; and
- To assist Tahmoor Coal employees and contractors in administering their responsibilities regarding environmental management.

This Extraction Plan will be implemented in conjunction with the EMS framework. **Figure 8** provides an overview of the EMSF and the documents which are part of the strategic framework for environmental management at Tahmoor Mine.

4.1.2 Overview of Key Component Plans of this Extraction Plan

The overall framework for subsidence monitoring and management of impacts of this Extraction Plan is provided in the Subsidence Monitoring Plan for this Extraction Plan. This document outlines the monitoring program for the measurement of actual subsidence, and the inspection program for environmental consequences of subsidence to compare against predicted impacts to determine if actions have been triggered.

The Extraction Plan is supported by a set of individual management plans intended to manage particular environmental or built features within the Extraction Plan Study Area. The individual management plans, which have been prepared to specifically address Condition C8 of SSD 8445, include:

- Water Management Plan – to manage potential environmental consequences to surface water and groundwater as a result of secondary extraction;
- Land Management Plan – to manage potential environmental consequences to landscape features and agricultural enterprises as a result of secondary extraction;
- Biodiversity Management Plan – to manage potential environmental consequences to aquatic and terrestrial biodiversity as a result of secondary extraction;
- Heritage Management Plan – to manage potential environmental consequences to Aboriginal and historical heritage as a result of secondary extraction;
- Built Features Management Plan – to manage potential environmental consequences to built feature as a result of secondary extraction. A number of sub-plans are currently in preparation to manage potential environmental consequences to built features as a result of secondary extraction; and
- Public Safety Management Plan – to ensure public safety in the Extraction Plan Study Area.

If a subsidence impact or environmental consequence occurs, the required action(s) are provided in the master TARP in **Appendix B** or the individual management plan to which the trigger refers to.

Figure 8 provides an overview of the environmental management plans and other environmental management documents that have been prepared to manage environmental impact resulting from LW S1A-S6A extraction.

Table 5 provides a summary of environment and built features within the Extraction Plan Study Area and in which key component plans they are managed. The location of these features is illustrated in Appendix F of the Subsidence Predictions and Impact Assessment Report (MSEC, 2022) (**Appendix A**).

It should be noted that:

- All environmental and built features are discussed in the Subsidence Prediction and Impact Assessment Report (MSEC, 2022; **Appendix A**);
- All monitoring measures for these features are summarised in the Subsidence Monitoring Plan; and
- The Built Features Management Plan is an umbrella document for the management of built features, and a number of sub-plans are currently in preparation to manage potential environmental consequences to built features as a result of secondary extraction.

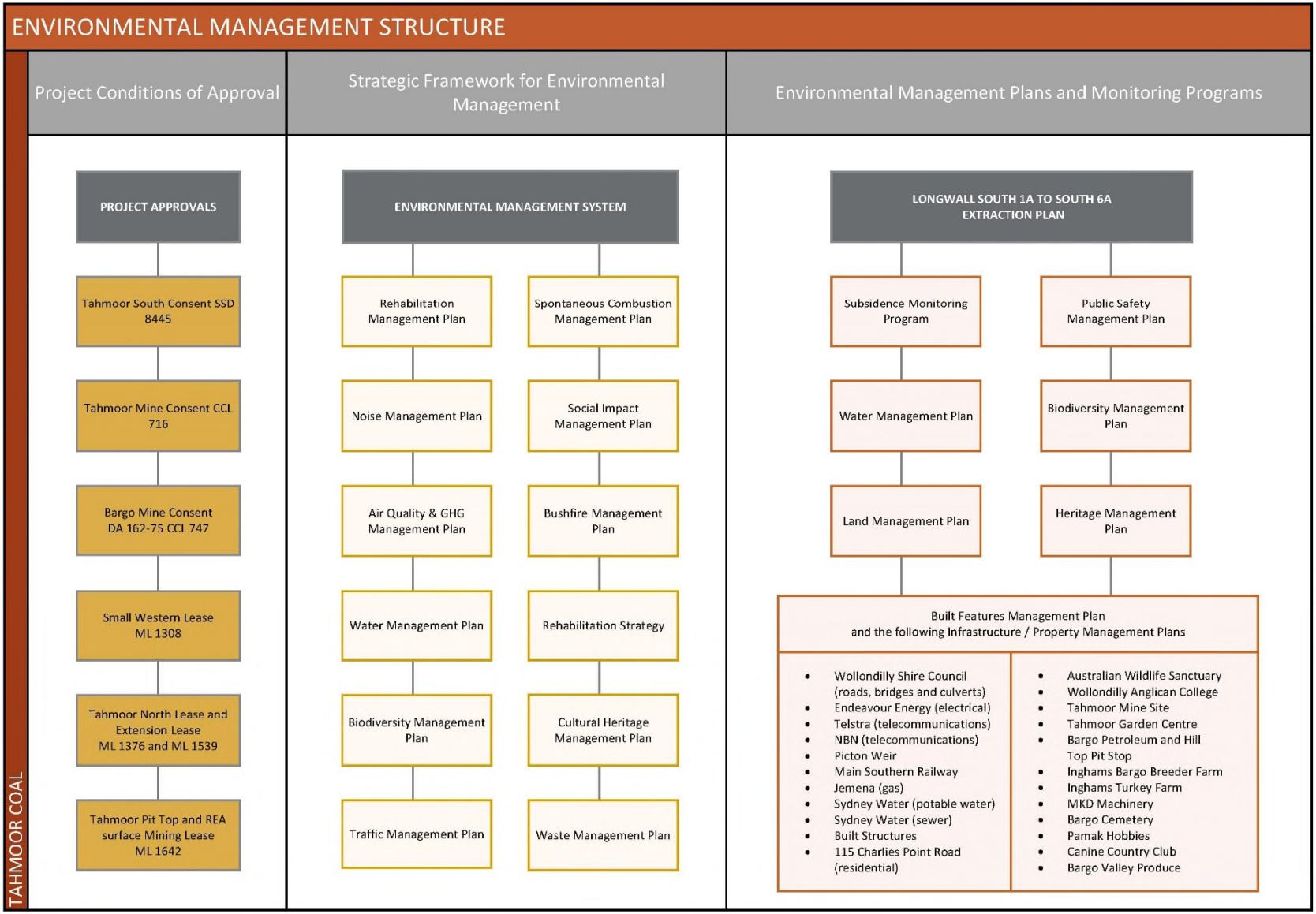


Figure 8 Overview of Environmental Management Structure for Tahmoor Coal

4.2 Water Management Plan

A WMP for LW S1A-S6A has been prepared to identify the monitoring and management measures for surface water and groundwater resources within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved. The WMP focused on watercourses and groundwater. The Study Area is located predominantly within the Teatree Hollow catchment, which is a sub-catchment of the Bargo River. Small portions of the Study Area and 600 m buffer are also located within the Hornes Creek, Dogtrap Creek and Bargo River catchments.

The WMP was prepared to address the requirements listed in Condition C8(g)(iii) of SSD 8445 (refer to Table 1 of the WMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), and regulatory requirements (refer to Section 2.2 of the WMP). The WMP was prepared in consultation with the EES, DPE Water, Crown Lands, WaterNSW, and WSC (refer to **Section 2.1.3**).

The WMP provides information on (but not limited to) the following:

- Baseline data for surface water (water level, streamflow and water quality), and groundwater levels (Section 3 of the WMP);
- Predicted subsidence impacts and environmental consequences to surface water and groundwater resources (Section 4 of the WMP);
- Performance measures and performance criteria for surface water and groundwater (Section 5.1 of the WMP);
- Surface water monitoring measures relating to pool water level, streamflow, stream water quality, and channel and bank stability (Section 5.2 of the WMP);
- Groundwater monitoring measures relating to groundwater level and water quality (Section 5.2 of the WMP);
- Water management measures for surface water and groundwater resources (Section 6.2 of the WMP); and
- TARPs to be implemented to manage and protect surface water and groundwater resources (Appendix A of the WMP).

Watercourses within the LW S1A-S6A Study Area are identified on **Figure 9**. A summary of water monitoring measures is provided in **Section 5.3**, and surface water and groundwater TARP actions are consolidated in **Appendix B**.

The following documents were prepared to support the WMP:

- Groundwater Technical Report (SLR, 2022a) – provides details of baseline data, monitoring and management measures, and TARPs for groundwater resources in the LW S1A-S6A Study Area; and
- Baseline Private Bore Assessment (SLR, 2022b) – provides a description of existing private groundwater bores in the Study Area, bore yields and serviceability of accessible bores, groundwater quality from accessible bores.

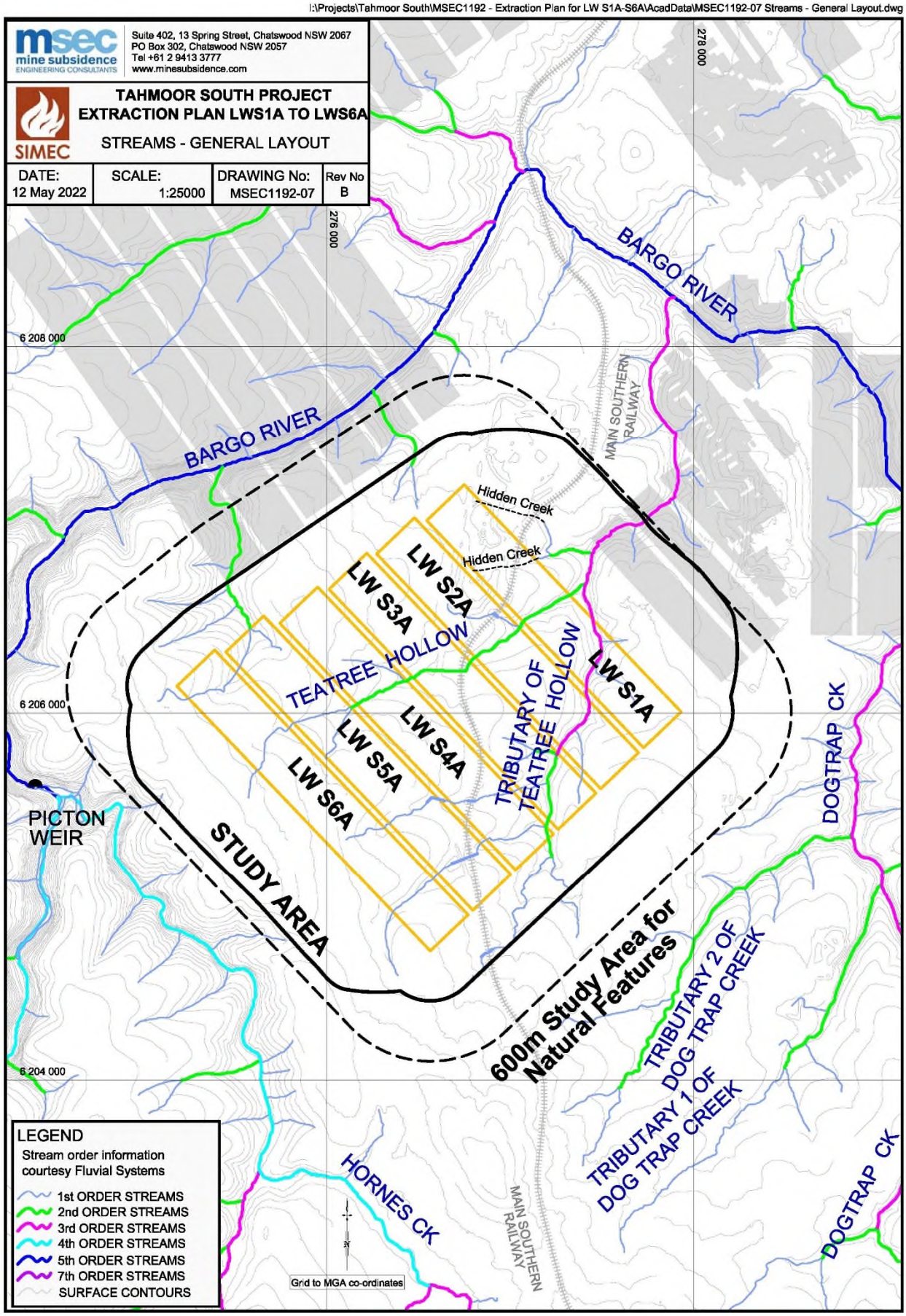


Figure 9 **Streams in the LW S1A-S6A Study Area (MSEC, 2022)**

4.3 Land Management Plan

A LMP for LW S1A-S6A has been prepared to identify the monitoring and management measures for landscape features and agricultural resources within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved. The LMP focused on cliffs, steep slopes, farm dams and agricultural enterprises.

The LMP was prepared to address the requirements listed in Condition C8(g)(v) of SSD 8445 (refer to Table 2 of the LMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), and other regulatory requirements (refer to Section 2 of the LMP). The LMP was prepared in consultation with the DPI Agriculture and DPE Crown Lands (refer to **Section 2.1.3**).

The LMP provides information on (but not limited to) the following:

- Baseline data for landscape features and agricultural enterprises (Section 3 of the LMP);
- Predicted subsidence impacts and environmental consequences to landscape features and agricultural enterprises (Section 4 of the LMP);
- Performance measures and performance criteria for landscape features (Section 5.1 of the LMP);
- Monitoring measures for landscape features (Section 5.2 of the LMP);
- Management measures for landscape features (Section 6.2 of the LMP); and
- TARPs to be implemented to manage landscape features (Appendix A of the LMP).

Cliffs and steep slopes within the LW S1A-S6A Study Area are identified on **Figure 10**. A summary of landscape and agricultural monitoring measures is provided in **Section 5.3**, and landscape TARP actions are consolidated in **Appendix B**.

The following document was prepared to support the LMP:

- Geotechnical Assessment (Douglas Partners, 2022) – provides an overview of steep slopes and dams in the Study Area, as well as an assessment of likely impacts to these features and impacts to built features as a result of LW S1A-S6A extraction; and
- Land and Agricultural Resource Assessment (SLR, 2022c) – provides an overview of the landscape, land and soil capability, and agricultural enterprises in the Study Area, as well as an assessment of likely impacts to these features as a result of LW S1A-S6A extraction.

Potential risks to constructed steep slopes along road embankments and cuttings are managed separately in accordance with the Wollondilly Shire Council Management Plan. Potential risks to constructed steep slopes along railway embankments and cuttings are managed separately in accordance with the Main Southern Railway Management Plan. Potential risks to constructed steep slopes and dams at the Tahmoor Mine site are managed in accordance separately with the Tahmoor Mine Site Management Plan.

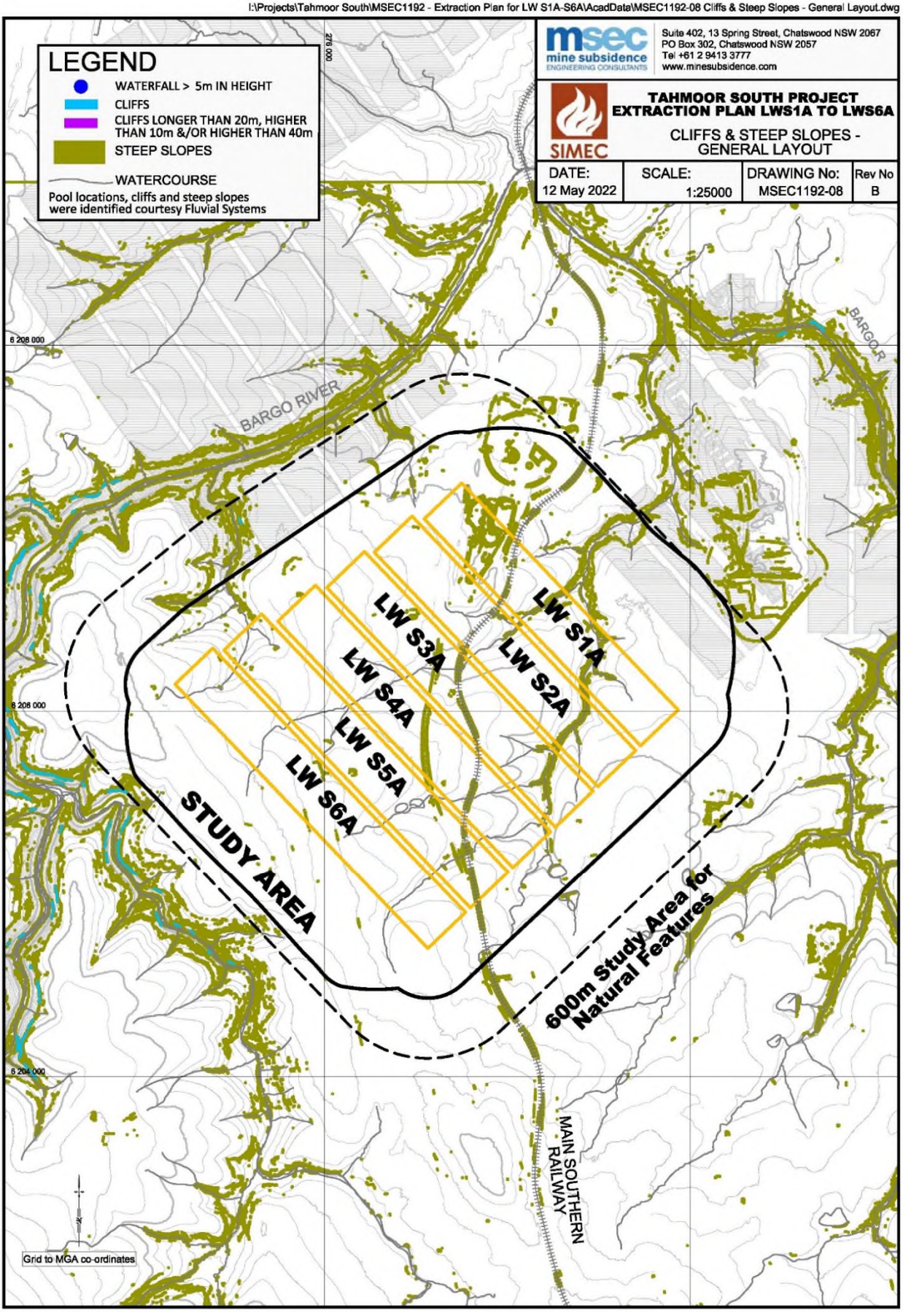


Figure 10 **Cliffs and Steep Slopes in the LW S1A-S6A Study Area (MSEC, 2022)**

4.4 Biodiversity Management Plan

A BMP for LW S1A-S6A has been prepared to identify the monitoring and management measures for aquatic and terrestrial biodiversity within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved. The BMP focused on aquatic and terrestrial biodiversity, with particular focus on threatened species, populations and their habitats, and Endangered Ecological Communities (EECs) and water dependent ecosystems.

The BMP was prepared to address the requirements listed in Condition C8(g)(iv) of SSD 8445 (refer to Table 2 of the BMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), and regulatory requirements (refer to Section 2 of the BMP). The BMP was prepared in consultation with the EES, Crown Lands, and Wollondilly Shire Council (refer to **Section 2.1.3**).

The BMP provides information on (but not limited to) the following:

- Baseline data for terrestrial vegetation communities (including threatened ecological communities, riparian vegetation, and vegetation condition), threatened flora and fauna and communities, watercourses and stream morphology, aquatic biodiversity (Section 3 of the BMP);
- Predicted subsidence impacts and environmental consequences to aquatic and terrestrial biodiversity (Section 4 of the BMP);
- Performance measures and performance criteria for aquatic and terrestrial biodiversity (Section 5.1 of the BMP);
- Biodiversity monitoring measures relating to aquatic biodiversity (water quality, aquatic habitats, macroinvertebrates) and terrestrial biodiversity (amphibian and riparian vegetation) (Section 5.2 of the BMP);
- Biodiversity management measures for aquatic and terrestrial biodiversity (Section 6.2 of the BMP); and
- TARPs to be implemented to manage and protect aquatic and terrestrial biodiversity (Appendix A of the BMP).

A summary of biodiversity monitoring measures is provided in **Section 5.3**, and biodiversity TARP actions are consolidated in **Appendix B**.

A number of threatened species and one EEC were recorded, or potentially recorded, within the Study Area during the monitoring surveys:

- *Pomaderris brunnea (*Brown Pomaderris), *Grevillea parviflora* subsp. *parviflora*, and *Persoonia bargoensis* – Threatened flora species in the Study Area;
- Twelve threatened fauna species recorded within or near the Study Area, as well as the Giant Burrowing Frog and Red-crowned Toadlet recorded at Cow Creek and Hornes Creek. However, no threatened amphibian species have been detected during the baseline monitoring; and
- Shale Sandstone Transition Forest in the Sydney Basin Bioregion – Threatened Ecological Community confirmed in the Study Area.

4.5 Heritage Management Plan

A HMP for LW S1A-S6A has been prepared to identify the monitoring and management measures for Aboriginal and historical heritage items within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved. The HMP focused on Aboriginal and historical heritage items listed on heritage databases, and Aboriginal and historical heritage items identified in the Study Area during site investigations.

The HMP was prepared to address the requirements listed in Condition C8(g)(vi) of SSD 8445 (refer to Table 1 of the HMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), and regulatory requirements (refer to Section 2 of the HMP). The HMP was prepared in consultation with the DPE, EES, Heritage NSW, Wollondilly Shire Council, and RAPs (refer to **Section 2.1.3**).

The HMP provides information on (but not limited to) the following:

- Baseline data for Aboriginal and historical heritage items (Section 3 of the HMP);
- Predicted subsidence impacts and environmental consequences to Aboriginal and historical heritage items (Section 4 of the HMP);
- Performance measures and performance criteria for Aboriginal and historical heritage items (Section 5.1 of the HMP);
- Aboriginal and historical heritage monitoring measures (Section 5.2 of the HMP);
- Management measures for Aboriginal and historical heritage items (Section 6.2 of the HMP); and
- TARPs to be implemented to manage and protect Aboriginal and historical heritage (Appendix A of the HMP).

Aboriginal and historical heritage items located within the LW S1A-S6A Study Area are identified on **Figure 11**. A summary of heritage monitoring measures is provided in **Section 5.3**, and heritage TARP actions are consolidated in **Appendix B**.

The Study Area encompasses three Aboriginal heritage sites and four historical heritage sites (refer to **Figure 11**):

- Aboriginal heritage sites:
  - Isolated find: TC14-2-19 (AHIMS 48-2-0275);
  - Artefact scatter: Remembrance Drive 2013.1 (AHIMS 52-2-3968);
  - Rockshelter: Teatree Hollow 2013.1 (AHIMS 52-2-4471);
- Historical heritage sites:
  - Wirrimbirra Sanctuary (known as the Australian Wildlife Sanctuary) [SHR and WLEP];
  - Bargo Cemetery (WLEP);
  - Part of the Great Southern Road (non-statutory listed); and
  - Tahmoor Colliery (known as the Tahmoor Mine Site) (non-statutory listed).

One locally listed heritage item, Railway Bridge North (also known as Wellers Road Overbridge), is located within the 600 m buffer from extraction that could be susceptible to far-field or valley related movements. In addition, a locally listed heritage item, Picton Weir, and the State and locally listed heritage item, Bargo Railway Viaduct, are located outside the 600 m buffer but could also be

susceptible to far-field or valley related movements.

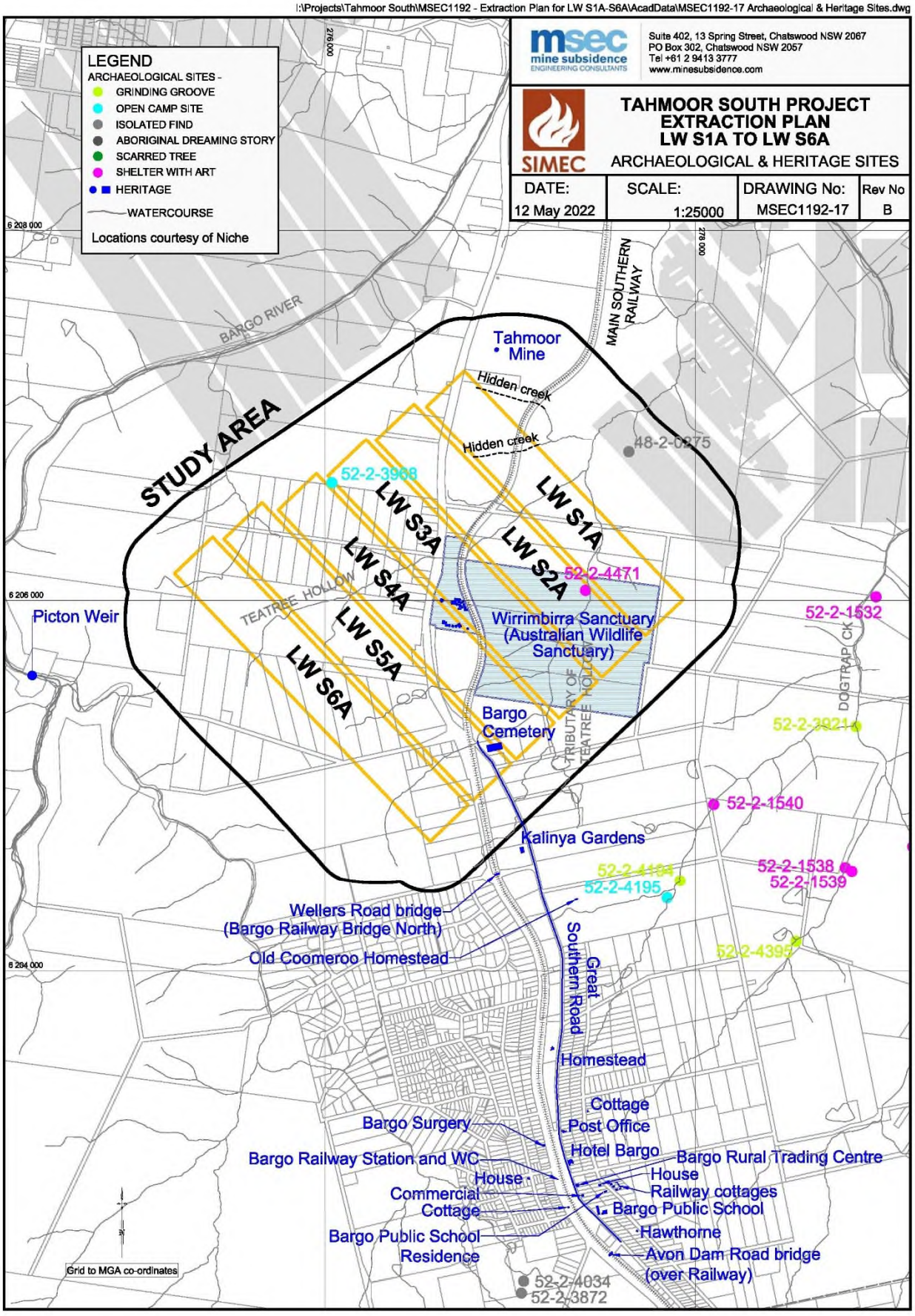


Figure 11 Aboriginal and Historical Heritage Sites in the LW S1A-S6A Study Area (MSEC, 2022)

4.6 Built Features Management Plan

A Built Features Management Plan (BFMP) for LW S1A-S6A has been prepared to identify the monitoring and management measures for all built features within the Extraction Plan Study Area that are required to be implemented to demonstrate that the relevant performance measures are achieved. The BFMP focused on the management of infrastructure (electrical, potable water, sewer, gas, telecommunications, roads, culverts, bridges, rail, Picton Weir, and survey control marks), structures for industrial, commercial and business, rural properties and structures (built structures, pools, septic tanks, and farm dams), and historical heritage (e.g. Bargo Cemetery, Australian Wildlife Sanctuary, Wellers Road Bridge).

The BFMP provides information on the key built features within the Study Area and which Subsidence Management Plan to refer to with regards to monitoring and management of potential subsidence-related impacts for each built feature resulting from the extraction of LW S1A-S6A. Built features within the LW S1A-S6A Study Area are also identified in Sections 6-11 of the Subsidence Predictions and Impact Assessment Report (MSEC, 2022; refer to **Appendix A** of this document).

The BFMP was prepared to address the requirements listed in Condition C8(g)(ii) of SSD 8445 (refer to Table 1 of the BFMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), the *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (Resources Regulator, 2017), and other regulatory requirements (refer to Section 2 of the BFMP). The BFMP was prepared in consultation with the Resources Regulator, TfNSW, and WSC (refer to **Section 2.1.3**).

A number of sub-plans for individual built features (Subsidence Management Plans), as summarised in **Table 5,** are currently being prepared. Each sub-plan will include a summary of potential risks, impact predictions and assessment, appropriate management and monitoring measures, and a detailed TARP for the built feature. The contents of each sub-plan will be prepared in consultation with the built feature owners and other relevant stakeholders. Following approval and signature by the built feature owner, each sub-plan will be submitted to DPE and Resources Regulator.

4.7 Public Safety Management Plan

A PSMP for LW S1A-S6A has been prepared to address all potential safety hazards to the public through the provision of management strategies, controls and monitoring programs to be implemented to manage potential risks from subsidence related impacts as a result of LW S1A-S6A secondary extraction. Features located within the Extraction Plan Study Area that could pose a hazard to public safety are summarised in **Table 5.**

The PSMP was prepared to address the requirements listed in Condition C8(g)(vii) of SSD 8445 (refer to Table 1 of the PSMP), the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015), the *Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation* (Department of Industry – Resources Regulator, 2017), requirements of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 (Clause 27 and Clause 28) and other regulatory requirements (refer to Section 2 of the PSMP). Regulatory requirements applicable to the PSMP to manage subsidence related risks to public safety are outlined further in Section 2.2 of the PSMP.

Risk assessments undertaken in support of the development of the PSMP are detailed in Section 4.3 of this Extraction Plan Main Document. The PSMP was prepared in consultation with the Resources Regulator (refer to **Section 2.1.3**).

The PSMP provides information on (but not limited to) the following:

- Potential subsidence-related public safety hazards (Section 3.2 of the PSMP); and
- Performance measures for public safety (Section 7.2 of the PSMP).

Features identified within the Extraction Plan Study Area relevant to public safety are managed under a number of supporting plans in addition to the PSMP, as noted in **Table 5**.

The following documents were prepared to support the PSMP:

- Built Features Management Plan;
- Land Management Plan; and
- Subsidence Prediction and Impact Assessment Report (MSEC, 2022).

5 Subsidence Monitoring Plan

5.1 Monitoring Strategy and Approach

5.1.1 Subsidence Monitoring Plan for LW S1A-S6A

An integrated Subsidence Monitoring Plan has been developed for LW S1A-S6A as a component of this Extraction Plan in accordance with Condition C8(g)(i) of SSD 8445. The Subsidence Monitoring Plan sets out the program for the monitoring of subsidence movements and effects associated with second workings of LW S1A-S6A and provides consolidated summaries for the monitoring of subsidence impacts and environmental consequences to environmental and built features.

The purpose of the Subsidence Monitoring Plan is to:

- Demonstrate mine development and extraction are undertaken as per the mine design;
- Provide information to demonstrate that statutory performance measures are met;
- Target monitoring of environmental and built features within the Extraction Plan Study Area;
- Meet stakeholder monitoring requirements for environmental features;
- Meet built feature owners monitoring requirements for built features;
- Provide appropriate information required to assess against triggers within the relevant TARPs, including data for trend analysis to inform adaptive management; and
- Provide a suitable basis for future Extraction Plans and associated monitoring programs required as part of Tahmoor Mine operations.

The Subsidence Monitoring Plan is designed to ensure that a clear and concise monitoring program of all subsidence related effects, impacts and environmental consequences is implemented. The Subsidence Monitoring Plan includes:

- A detailed program for subsidence movement and effects monitoring for LW S1A-S6A using subsidence monitoring lines to measure both conventional and non-conventional vertical subsidence, tile and strain (tensile and compressive);
- A consolidated summary of built features monitoring as detailed within the BFMP and supporting sub-plans; and
- A consolidated summary of environmental monitoring for management of water (surface and groundwater), landscape features, biodiversity, and heritage (Aboriginal and historical) as detailed in the management plans for this Extraction Plan.

The Subsidence Monitoring Plan is scheduled and tracked by Tahmoor Coal according to longwall distance and/or scheduled dates. Tahmoor Coal will carry out surveys, inspections and notifications as scheduled, and the required actions will be assigned to the relevant role to ensure the Subsidence Monitoring Plan is achieved.

5.1.2 Summary of Monitoring in this Extraction Plan

The following sections provide a summary and re-presentation of monitoring details from the Subsidence Monitoring Plan and other relevant management plans and sub-plans for the monitoring of subsidence effects (**Section 5.2**), subsidence impacts and environmental consequences (**Section 5.3**) associated with the extraction of LW S1A-S6A.

Full detail pertaining to subsidence monitoring methodology can be found in the Subsidence Monitoring Plan and the relevant management plans and sub-plans discussed in the sections below.

5.2 Subsidence Effects Monitoring

The Subsidence Monitoring Plan includes a monitoring program to evaluate subsidence effects as a result of LW S1A-S6A extraction has been prepared in accordance with Condition C8(g)(i) of SSD 8445 and the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015).

As a longwall progresses, subsidence begins to develop at a point in front of the active longwall face and continues to develop after the longwall passes. This is termed the 'active subsidence zone' for the purposes of this Extraction Plan. The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 m in front of the active longwall face and 450 m behind the active longwall face. The active subsidence zone is illustrated in **Figure 12**.

Tahmoor Coal has established a monitoring network to monitor subsidence movements as a result of LW S1A-S6A. The layout of monitoring lines and points is illustrated in **Figure 13** as well as on Graphical Plan 7, and is discussed further in the Subsidence Monitoring Plan.

The combined monitoring network will consist of the following:

- Global Navigation Satellite System (GNSS) units to be placed in the following locations:
  - Centrelines of LW S1A to LW S3A located in bushland within the Australian Wildlife Sanctuary;
  - Pairs of GNSS units to be placed across the Tributary to Teatree Hollow to measure valley closure;
  - Two GNSS units placed across the Bargo River to monitor for valley closure;
  - Two GNSS units placed at the Railway Viaduct across Bargo River to measure far field movements;
  - Two GNSS units to be placed on either side of the Picton Weir to measure far field movements, as well as an additional GNSS unit between the Picton Weir and LW S6A;
  - A GNSS unit at the Wellers Road Overbridge to measure far field movements; and
  - A GNSS unit at Tahmoor Mine's survey base station.
- Survey lines and survey marks in association with Teatree Hollow and the tributary to Teatree Hollow. This would include survey marks across the base of the creek along Tributary of Teatree Hollow, and where roads, railways and other infrastructure services cross the tributary and associated first order drainage lines. Survey marks are also planned across the base of Teatree Hollow, and a survey line across the road crossing that intersects Teatree Hollow;
- Survey lines across the southern boundary of Tahmoor Mine's property and along the western side of the REA;
- Survey lines have been or will be installed along Remembrance Drive, Caloola Road, Yarran Road, Charlies Point Road and Great Southern Road;
- Survey line along the Main Southern Railway from 97.7 km to 99.8 km, and monitoring points for key items along the railway;
- Survey points at the Tahmoor Mine site to allow monitoring of the Main Southern Railway, Remembrance Drive, Rail Loop and road bridge, stockpile area and conveyors, the drift, winder house, building structures, dams, and associated services infrastructure;
- Survey points at the Wollondilly Anglican College and Australian Wildlife Sanctuary, as well as other commercial, industrial and business establishments in the Study Area; and
- Survey points at private properties, dwellings, buildings and dams.

The purpose of the proposed survey lines is to measure the general magnitude and shape of surface subsidence. The observed subsidence movements will be used to provide early subsidence information to inform Tahmoor Coal and affected stakeholders. The information would assist Tahmoor Coal and affected stakeholders in considering whether any additional measures are required to manage potential impacts on the built features. In addition, survey lines in the creek systems will measure potential valley closure and upsidence movements at these locations.

The information will also be used by Tahmoor Coal as part of its ongoing review of subsidence effects on natural features.

Survey lines will consist of pegs spaced nominally every 20 m, where possible. Surveys will measure levels and horizontal distances between adjacent pegs. Baseline surveys will be completed prior to the commencement of mining of LW S1A.

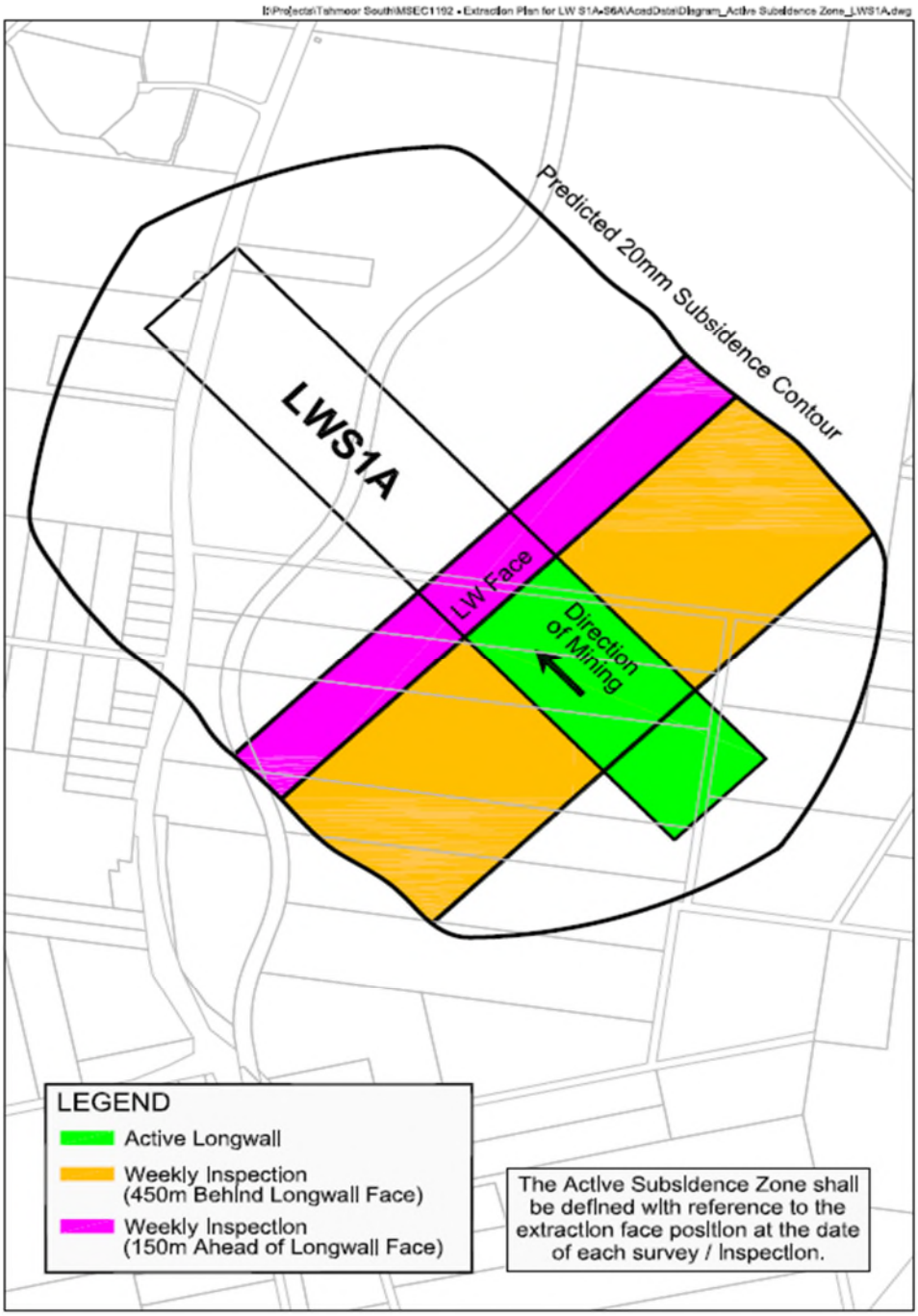


Figure 12 Diagrammatic representation of Active Subsidence Zone

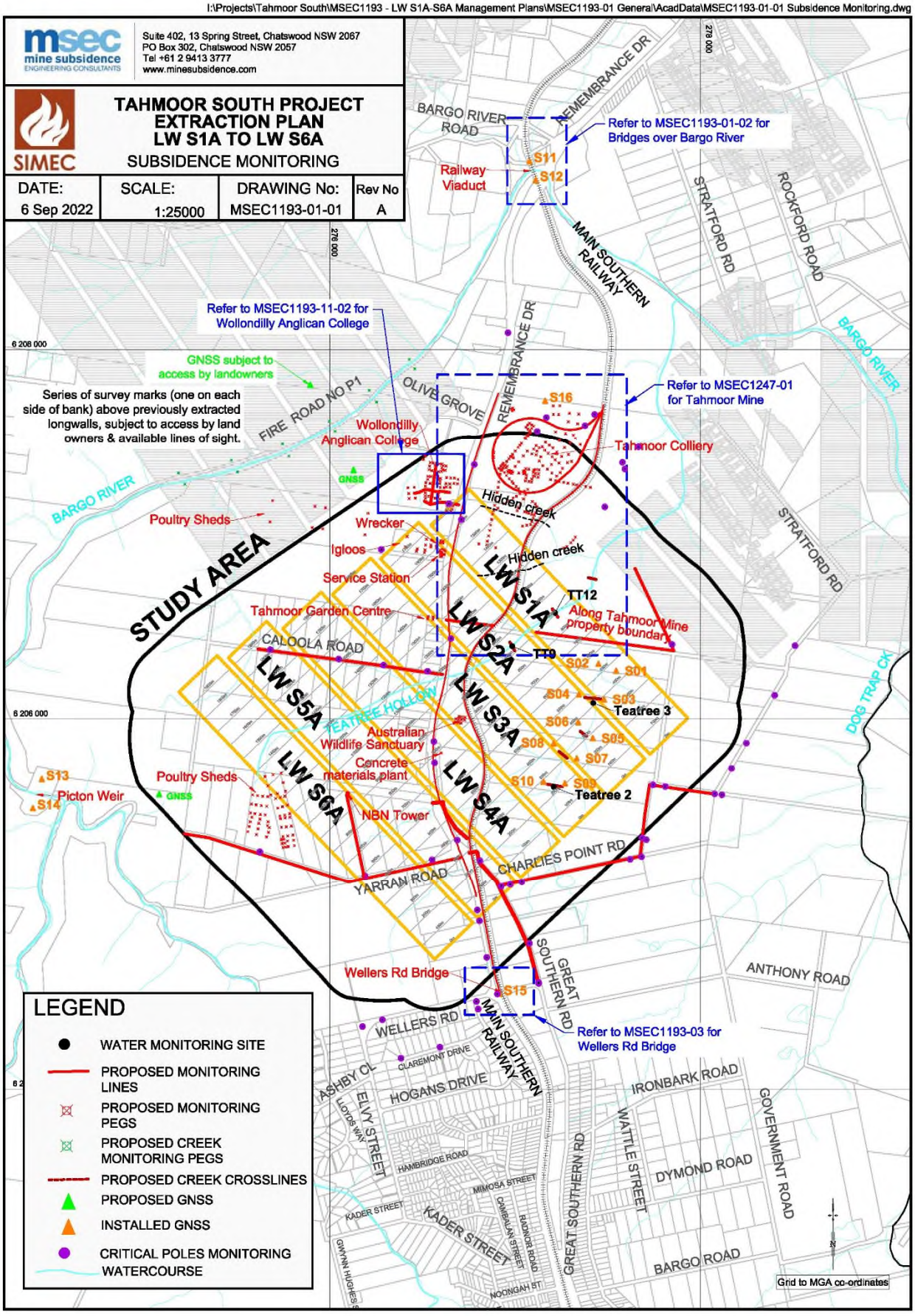


Figure 13 **Proposed Monitoring Locations for LW S1A-S6A Extraction Plan Study Area (from Subsidence Monitoring Plan)**

5.3 Subsidence Impacts and Environmental Consequences Monitoring

A monitoring program to evaluate subsidence impacts and environmental consequences as a result of LW S1A-S6A extraction has been prepared in accordance with Condition C8(g)(i) of SSD 8445 and the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015).

5.3.1 Monitoring of Built Features

Built features in the Study Area, as described in **Section 4.6** of this Extraction Plan, are monitored and managed in accordance with dedicated supporting Subsidence Management Plans (sub-plans) developed for each type of built feature specifically in consultation with the relevant stakeholders. The sub-plans for built features are managed collectively by the over-arching BFMP.

Monitoring of built features will include (in addition to subsidence effects monitoring discussed in **Section 5.2**):

- Public roads and main infrastructure - Ground surveys along public roads, visual inspection along public roads, gas detection surveys, power pole surveys, Optical Time Domain Reflectometer (OTDR) monitoring for optical fibre cables;
- Picton Weir- Continuous GNSS monitoring, ground survey, visual inspections;
- Wollondilly Anglican College - ground surveys, alignment survey of sensitive classroom equipment, visual inspections;
- Australian Wildlife Sanctuary - ground survey, asbestos air monitoring, visual inspections;
- Structures - ground surveys, visual inspections of specific structures including pools;
- Farm dams - visual inspection;
- Commercial, industrial and business establishments - ground surveys, visual inspections;
- Tahmoor Mine Site Infrastructure - Monitoring at key items of infrastructure, which includes absolute 3D and 2D surveys, continuous GNSS monitoring, and baseline surveys and visual inspections as defined in the Tahmoor Mine Site Management Plan; and
- Main Southern Railway and Tahmoor Mine Rail Loop - Monitoring at key items of railway infrastructure, which will include absolute 3D surveys, continuous GNSS monitoring, and baseline structural surveys and additional monitoring as defined in the Main Southern Railway Management plan.

A consolidated summary of the monitoring of built features is presented in Section 3 of the Subsidence Monitoring Plan, and location of built features monitoring is illustrated in **Figure 13**.

5.3.2 Monitoring of Environmental Features

Monitoring and evaluation of subsidence performance measures and potential mining related impacts on surface water, groundwater, surface water, landscape features, flora and fauna, Aboriginal and European heritage, are described in detail in the Section 5.2 of each of the WMP, LMP, BMP and HMP.

Monitoring of environmental features will include (in addition to subsidence effect monitoring discussed in **Section 5.2**):

- Creeks:
  - Streamflow monitoring, continuous water level monitoring, manual water level monitoring and water quality sampling at locations show in **Figure 16**;
  - Visual inspections of pools and geomorphology survey of stream reaches in Teatree Hollow, Teatree Hollow tributary and the Bargo River tributary;
  - Catchment survey of 10 headwater sites;
- Groundwater - Monitoring of groundwater levels and quality in shallow bores, private bores, NSW Government monitoring bores and deep groundwater pressure monitoring bores;
- Cliffs and natural steep slopes - Visual monitoring by a geotechnical engineer;
- Agricultural land - Visual inspection;
- Biodiversity - Bi-annual monitoring of amphibians, riparian vegetation, and aquatic biodiversity;
- Aboriginal heritage sites - Visual inspection; and
- Historical heritage sites - Monitoring as per built features monitoring, and visual inspection by an archaeologist.

The location of the biodiversity monitoring is illustrated in **Figure 14** and **Figure 15**, and the location of surface water monitoring and groundwater monitoring is illustrated in **Figure 16** and **Figure 17**, respectively.

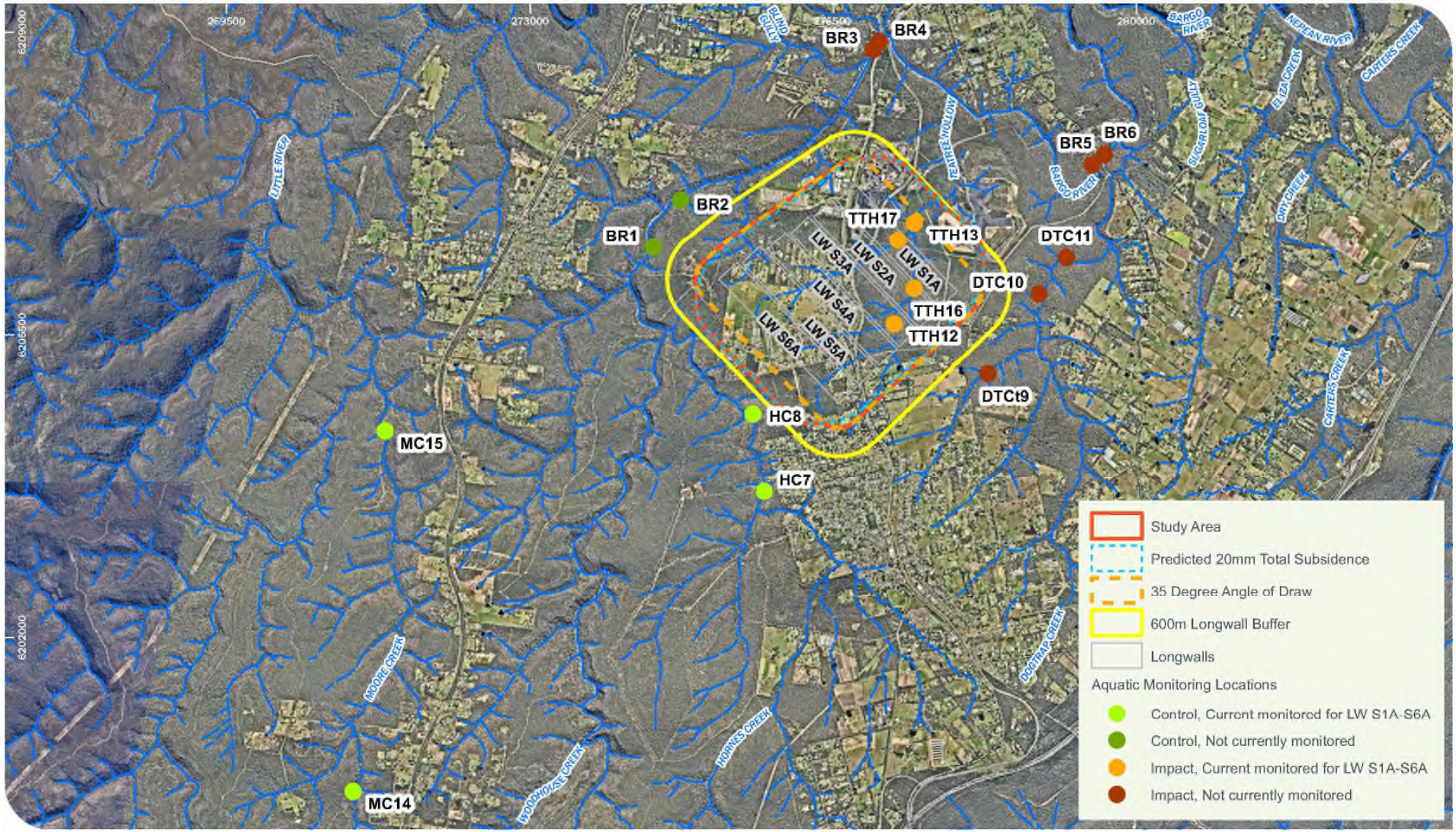


Figure 14 **Aquatic Biodiversity Monitoring Program (from Biodiversity Management Plan)**

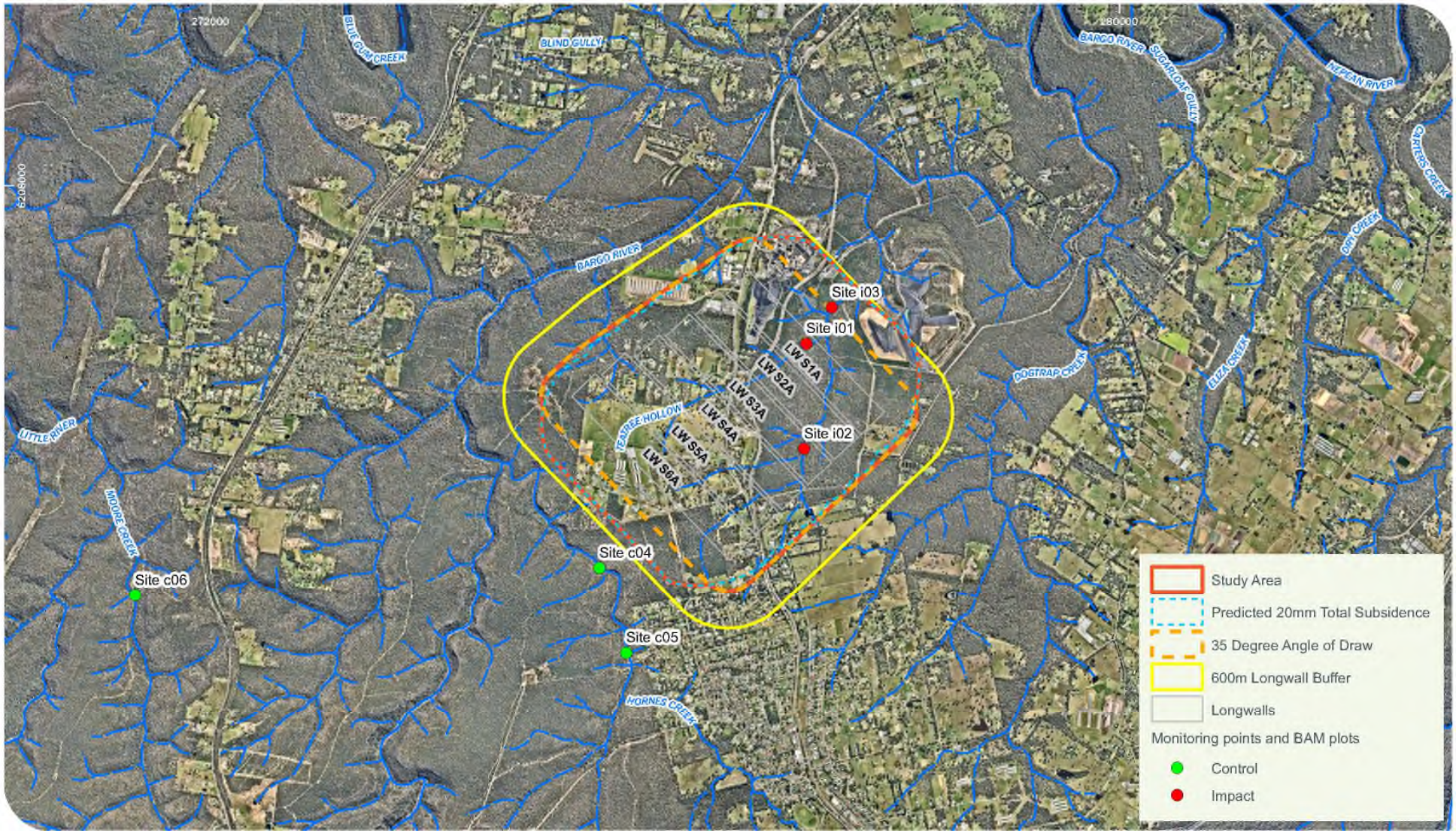


Figure 15 **Terrestrial Biodiversity Monitoring Program (from Biodiversity Management Plan)**

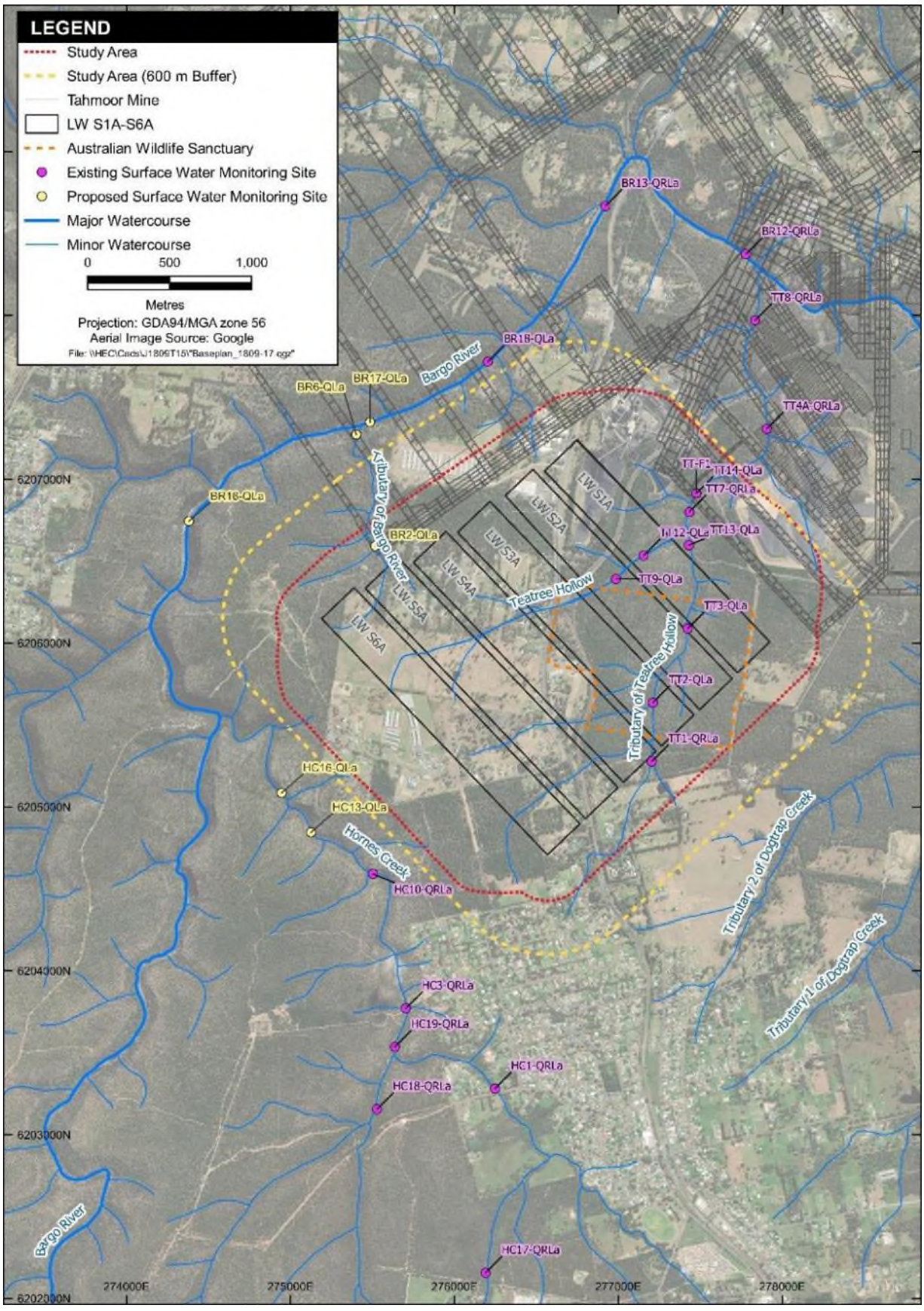


Figure 16 **Existing and Proposed Surface Water Monitoring Program (from Water Management Plan)**

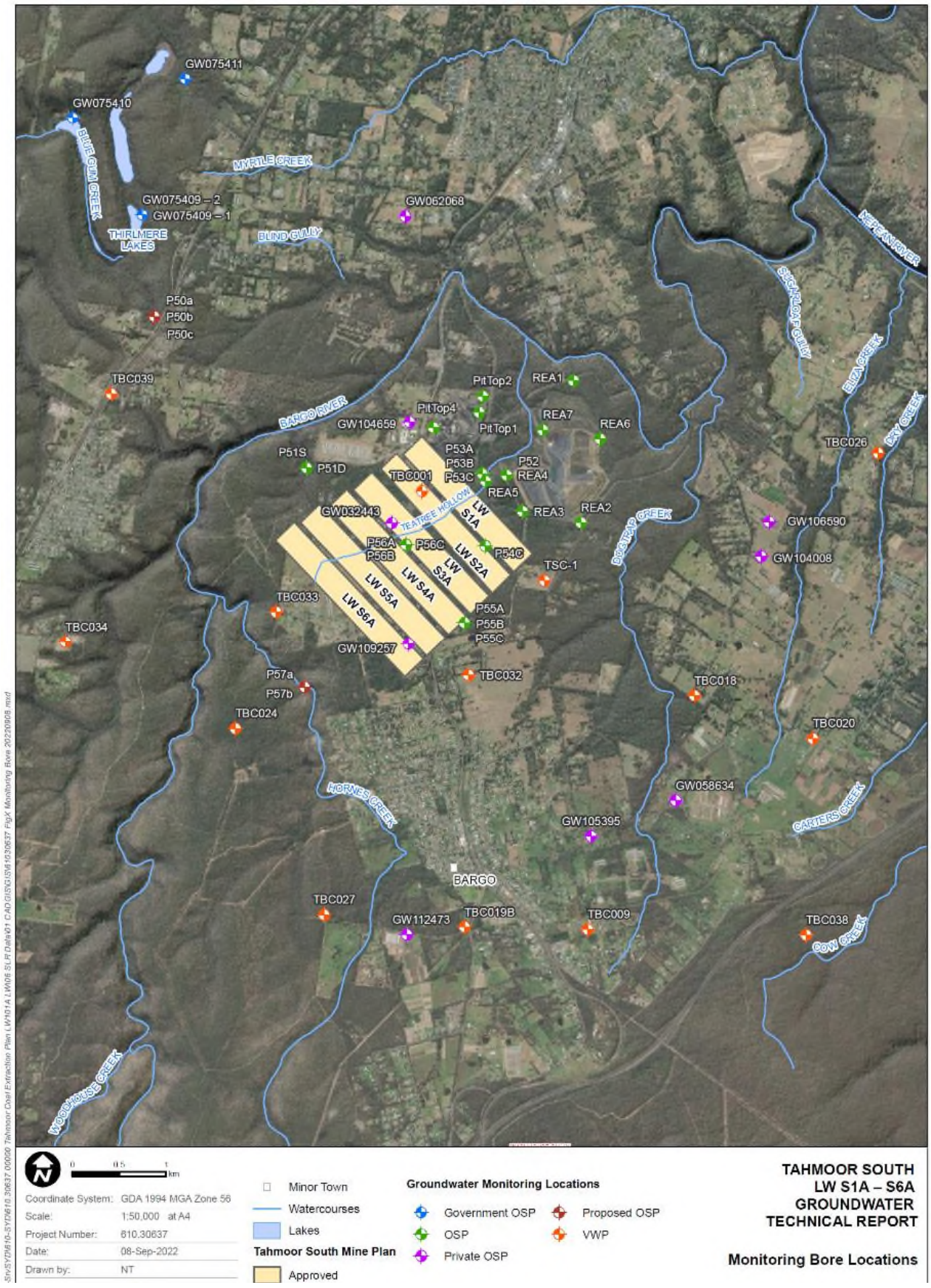


Figure 17 **Existing and Proposed Groundwater Monitoring Sites (from Water Management Plan)**

5.4 Baseline Monitoring to Support Future Extraction Plans

Tahmoor Coal has approval for the extraction of an addition six longwalls (Longwalls South 1B to South 6B, or the Tahmoor South 'B Series') in the Tahmoor South Domain. Monitoring data collected during the extraction of LW S1A-S6A will be used as baseline data to support these future longwalls. An extraction plan for LW S1B-S6B will be lodged in accordance with the relevant conditions of consent.

A monitoring program to collect sufficient baseline data for future extraction plans is summarized in **Table 19**, in accordance with Condition C8(i) of SSD 8445 and the DPE *Draft Guidelines for the Preparation of Extraction Plans* V5 (DPE, 2015). This monitoring program has been consolidated from the various key component plans and this monitoring program will be used as reference site data for future longwalls. In addition, monitoring data collected during the mining of LW S1A-S6A would be used in the review of observed subsidence impacts and environmental consequences for future extraction plans.

Table 19 Baseline Monitoring Program to Support Future Extraction Plans

Aspect of Future Extraction Plans	Existing and Proposed Monitoring Programs	Tahmoor Coal Document Reference
Subsidence	• Subsidence monitoring undertaken in accordance with the Subsidence Monitoring Plan. • A significant amount of baseline data has been collected during the extraction of the previous longwall panels in the Tahmoor North Domain, which includes the most recently mined Western Domain as well as longwalls mined directly to the north and east of the proposed longwalls.	Subsidence Monitoring Plan
Surface Water	• Surface water monitoring (flow and quality) will be undertaken in accordance with the WMP. • A significant amount of baseline surface water data has been collected during the extraction of the previous longwall panels in the Western Domain and to the south of the Western Domain, as well as baseline data from the Tahmoor South Domain. • A monitoring program for future longwalls would be implemented at least two years in advance of mining.	WMP
Groundwater	• Groundwater monitoring (groundwater level and quality) undertaken in accordance with the WMP. • A significant amount of baseline groundwater data has been collected during the extraction of the previous longwall panels in the Western Domain and to the south of the Western Domain, as well as baseline data from the Tahmoor South Domain. • A monitoring program for future longwalls would be implemented at least two years in advance of mining.	WMP
Landscape	• Monitoring of impacts to steep slopes and agricultural land in accordance with the LMP. • A significant amount of baseline landscape feature data for cliffs, steep slopes and agricultural land has been collected during the extraction of the previous longwall panels in the Western Domain.	LMP
Biodiversity	• Biodiversity monitoring of aquatic habitat, macroinvertebrates, riparian vegetation, and amphibians in accordance with the BMP. • A significant amount of baseline ecology data has been collected during 2019-2022 in the Tahmoor South Domain. • A significant amount of baseline ecology data for aquatic and terrestrial biodiversity has been collected during the extraction of the previous longwall panels in the Western Domain.	BMP
Heritage	• Monitoring of Aboriginal and historical heritage items in accordance with the HMP would be used in the review of observed subsidence impacts to inform future Extraction Plans for the Tahmoor South Domain. • A significant amount of baseline Aboriginal heritage data has also been collected during the extraction of the previous longwall panels in the Tahmoor South and Western Domains, as well as baseline data from the Tahmoor South Domain.	HMP

6 Graphical Plans

Graphical plans have been prepared for the LW S1A-S6A Extraction Plan Study Area in accordance with the *Draft Guidelines for the Preparation of Extraction Plans V5 (*DPE, 2015) are listed in **Table 20**.

It is noted that given there are no existing or proposed workings in other seams above or below the proposed working seam, Plan 4 is not required.

Table 20 Graphical Plans

Plan Number	Plan Title	Plan Reference Number
Plan 1	Workings and Dimensions	TCC00656-1
Plan 2	Surface Features	TCC00656-2
Plan 3	Bulli Seam Geological Data	TCC00656-3
Plan 4	Existing and Proposed Workings in Seams Above and/or Below	Not required
Plan 5	Mining Titles and Land Ownership	TCC00656-5
Plan 6	Geological Sections	TCC00656-6
Plan 7	Subsidence Monitoring	TCC00656-7
Plan 8	Aerial Photography	TCC00656-8

7 Implementation

7.1 General Reporting

Reporting for the Extraction Plan is undertaken in accordance with the specific requirements from the Consent, relevant licences, and generally in accordance with the DPE *Draft Guidelines for the Preparation of Extraction Plans* V5 (DPE, 2015), and the requirements of the WHSMP Regulation.

Details of the regular reporting requirements are provided in the following sections.

7.1.1 Six-monthly Subsidence Impact Reporting

In accordance with the DPE *Draft Guidelines for the Preparation of Extraction Plans* V5 (DPE, 2015), Tahmoor Coal will undertake six-monthly subsidence impact reporting. This reporting will form the basis for inclusion in annual review reporting and will include a discussion of all impacts and environmental monitoring results during extraction of LW S1A-S6A. In addition, details included in the reporting will include:

- A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s);
- Any proposed actions resulting from triggers being met in the TARP, or other actions;
- An assessment of compliance with all relevant performance measures and indicators; and
- A comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and level data, piezometer readings.

Six Monthly Subsidence Impact Reports are lodged on the DPE Planning Portal and a copy is submitted to relevant agencies (e.g. Resources Regulator (Subsidence), Resources Regulator (Mining Act Inspectorate), MEG, SA NSW, NRAR, EPA, and WSC) and the Tahmoor Colliery Community Consultative Committee (TCCCC). The reports are also made publicly available on the Tahmoor Coal website.

7.1.2 Annual Review

In accordance with Consent Condition E13, an Annual Review is required to be submitted by 31 March each year. The Annual Review will:

- Describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;
- Include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, including a comparison of these results against the:
  - Relevant statutory requirements, limits or performance measures/criteria;
  - Requirements of any plan or program required under this consent;
  - Monitoring results of previous years; and
  - Relevant predictions in the EIS (or updated and contemporary modelling, as required by agencies).
- Identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence;
- Evaluate and report on:
  - The effectiveness of the noise and air quality management systems; and
  - Compliance with the performance measures, criteria and operating conditions of this consent.
- Identify any trends in the monitoring data over the life of the development and provide any raw monitoring data as requested by the Planning Secretary;
- Identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
- Describe what measures will be implemented over the next calendar year to improve the environmental performance of the development.

The Annual Review is completed in accordance with the post-approval requirements for State significant mining developments and incorporates reporting requirements of the Resources Regulator. In addition, the Annual Review will also include a summary of environmental effects monitoring as described in the previous Six Monthly Subsidence Impact Reports, as per the DPE *Draft Guidelines for the Preparation of Extraction Plans* V5 (DPE, 2015).

Annual Reports are lodged on the DPE Planning Portal and a copy is submitted to relevant agencies (e.g. Resources Regulator (Subsidence), Resources Regulator (Mining Act Inspectorate), EPA, Water NSW, SA NSW, and Wollondilly Shire Council), TCCCC, and any interested person upon request. The reports are also made publicly available on the Tahmoor Coal website.

7.1.3 Annual Return

An Annual Return stating Tahmoor Mine's compliance with the conditions of EPL 1389 is completed and submitted to the EPA via the EPL portal by 28 February of each year. In addition to a statement of compliance with the conditions of EPL 1389, the report also includes a summary of monitoring results and complaints received for the 12-month period.

7.2 Incidents

7.2.1 Incident Definition

The Consent defines an incident as '*an occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance*'.

Material Harm is defined within the Consent as "harm to the environment that:

- Involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or results in actual or potential loss or property damage of an amount, or
- Amounts in aggregate, exceeding $10,000, (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)".

This definition excludes "harm" that is authorised under either this Consent or any other statutory approval.

As per the WHS Regulations (Mining and Petroleum Sites) 2022, a 'high potential incident' means any indication from monitoring data of the development of subsidence which may result in any incident referred to in:

- Clause 190 (a) (p) – a failure of ground, or of slope stability control measures; or
- Clause 190 (a) (q) – rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence; or
- Clause 190 (a) (p) and (q).

7.2.2 Incident Management

Tahmoor Coal manages and responds to incidents in accordance with the following plans:

- Emergency and Incident Manual (TAH-HSEC-232);
- Pollution Incident Response Management Plan (TAH-HSEC-00155); and
- Notification of Environmental Pollution Incidents (TAH-HSEC-00224).

These plans have been developed to manage preparation, incident response and reporting requirements under the NSW *Protection of the Environment Operations Act 1997*.

The management plans provide roles and responsibilities, management strategies, action and response plans and record management protocols for incidents and emergencies.

7.2.3 Incident Reporting

A Written Incident Notification will be submitted to the Planning Secretary via the Major Projects website, and any other relevant agencies, within seven days after Tahmoor Coal becomes aware of an incident.

Written Incident Notifications will include:

- The development and application number;
- Details of the incident (date, time, location, a brief description of what occurred and why it is classified as an incident);
- How the incident was detected;
- When Tahmoor Coal became aware of the incident;
- Any actual or potential non-compliance with conditions of consent;
- Describe what immediate steps were taken in relation to the incident;
- Identify further action(s) that will be taken in relation to the incident; and
- Identify a project contact for further communication regarding the incident.

Within 30 days of the date on which the incident occurred or as otherwise agreed to by the Planning Secretary, Tahmoor Coal will provide the Planning Secretary and any relevant public authorities (as determined by the Planning Secretary) with a Detailed Incident Report.

Detailed Incident Reports will include:

- A summary of the incident;
- Outcomes of an incident investigation, including identification of the cause of the incident;
- Details of the corrective and preventative actions that have been, or will be, implemented to address the incident and prevent recurrence; and
- Details of any communication with other stakeholders regarding the incident.

All incidents will be reported in the Annual Review and the Six Monthly Subsidence Impact Report, and a record maintained in Tahmoor Coal's Compliance Management System, Cority.

In addition, in accordance with the DAWE approval conditions 23 and 24 for the Tahmoor South Project, Tahmoor Coal will notify the Department in writing of any incident. Notification of this occurrence will be given as soon as practicable, and no later than two business days after becoming aware of the incident.

The notification will specify:

- Any condition which is in breach;
- A short description of the incident; and
- The location (including co-ordinates), date, and time of the incident. In the event the exact information cannot be provided, provide the best information available.

Tahmoor Coal will also provide details of any incident as soon as practicable and no later than 10 business days after becoming aware of the incident, specifying:

- Any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future;
- The potential impacts of the incident; and
- The method and timing of any remedial action that will be undertaken by the approval holder.

7.3 Non-Compliances

7.3.1 Non-Compliance Definition

The Consent defines a non-compliance as 'an occurrence, set of circumstances or development that is in breach of the consent'.

7.3.2 Non-Compliance Management

Non-compliances or system defects detected during monitoring, inspections and audits will be managed in accordance with the Tahmoor Coal Environmental Management Framework Document (TAH-HSEC-00173), with corrective action plans developed and implemented to rectify any issues.

7.3.3 Non-Compliance Reporting

The Planning Secretary will be notified in writing via the Major Projects website within seven days after Tahmoor Coal becomes aware of any non-compliance.

If a non-compliance is detected, the following steps will be followed:

- Identify and confirm the non-compliance (i.e. review against approval criteria or condition and confirm that a non-compliance has occurred);
- Complete internal environmental incident reporting documentation including an investigation to capture all relevant information;
- In accordance with the relevant approval, determine what action (i.e. external reporting) is required. Specifically, determine if immediate reporting is required and to which stakeholders, or ensure that the event is captured for future reporting;
- Following the incident investigation, develop a corrective action plan aimed at preventing future re-occurrence; and
- Complete all required reporting and consult with relevant agencies on the corrective action plan to be implemented.

A non-compliance notification will identify the following:

- The development and the application number;
- The condition of consent that the development is non-compliant with;
- The way in which it does not comply and the reasons for the non-compliance (if known); and
- Any actions which have been, or will be, undertaken to address the non-compliance.

In addition, in accordance with the DAWE approval conditions 23 and 24 for the Tahmoor South Project, Tahmoor Coal will notify the Department in writing of any non-compliance with the conditions or commitments made in the Extraction Plan. Notification of this occurrence will be given as soon as practicable, and no later than two business days after becoming aware of the non-compliance. The notification will specify:

- Any condition which is in breach;
- A short description of the non-compliance; and
- The location (including co-ordinates), date, and time of the non-compliance. In the event the exact information cannot be provided, provide the best information available.

Tahmoor Coal will also provide details of any non-compliance with the conditions or commitments made in the Extraction Plan as soon as practicable and no later than 10 business days after becoming aware of the non-compliance, specifying:

- Any corrective action or investigation which the approval holder has already taken or intends to take in the immediate future;
- The potential impacts of the non-compliance; and
- The method and timing of any remedial action that will be undertaken by the approval holder.

A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

All non-compliances will be reported in the Annual Review and the Six Monthly Subsidence Impact Report, and a record maintained in Tahmoor Coal's Compliance Management System, Cority.

7.4 Exceedances

7.4.1 Exceedance Definition

For the purposes of this plan, an exceedance is defined 'any instance where monitoring results show an exceedance of criterion outlined within the Consent or other regulatory instrument'.

7.4.2 Exceedance Management

Exceedances will be managed by Tahmoor Coal through the Contingency Plan and TARP process as outlined in **Section 3.6** and **Appendix B**.

7.4.3 Exceedance Reporting

Exceedance reporting will occur as per the response in the Trigger Actions Response Plans, with reporting to DPE (and other relevant agencies) within 7 days of investigation completion where the highest TARP Level has occurred.

In accordance with Condition E4 of the Consent, where any exceedance of the criteria or performance measures outlined within this document has occurred, Tahmoor Coal will:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures / corrective management actions or other course of action;
- Within 14 days of the exceedance occurring (or other timeframe agreed by the Planning Secretary), submit a report to the Planning Secretary describing these remediation options and any preferred remediation measures / corrective management actions or other course of action; and
- Implement reasonable remediation measures / corrective management actions as directed by the Planning Secretary.

In addition, notification to DAWE is also required of any detection or prediction of an exceedance of a performance measure within 2 business days.

In accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project, if an exceedance of the performance measures is detected, Tahmoor Coal will submit to the Department for approval an Impact Response Plan that has been peer reviewed. Each Impact Response Plan will include, at a minimum:

- Be prepared by a suitably qualified person;
- Describe all potential and actual impacts to water resources arising from the exceedance;
- Include conceptual modelling, as well as a review of all historical monitoring data to determine the stressor-response relationships for any potential GDEs and consideration of potential contributing activities;
- Consider and where appropriate include local scale numerical modelling with consideration of potential contributing activities;
- Derive a scientifically-robust rectification strategy based on multiple lines of evidence and field data to support the assessment of the environmental values of water resources (including the groundwater-dependence of any potential GDEs) within the Development Application Area.
- Identify if any further investigations are required to determine the cause of, and/or corrective actions, for the exceedance;
- Include the mitigation and management measures that the approval holder has taken and/or proposes to take to reverse the exceedance, including data demonstrating the effectiveness of the mitigation and management measures;
- Provide justification for how the proposed mitigation and management measures will achieve and maintain the requirements of condition 4; and
- Include a peer review and details of how the approval holder has addressed any inadequacies raised in the peer review.

The approved Impact Response Plan will be implemented. Conditions 12 to 16 of the DAWE approval of the Tahmoor South Project will also be observed.

All exceedances will be reported in the Annual Review and the Six Monthly Subsidence Impact Report, and a record maintained in Tahmoor Coal's Compliance Management System, Cority.

7.5 Complaints and Disputes

Community Complaints at Tahmoor Coal are managed in accordance with Community Complaints and Enquiry Procedure (TAH-HSEC-00120). Tahmoor Coal operates a 24-hour complaints line (1800 154 415) for receiving community complaints and other stakeholder communications. The general process detailed in the procedure for responding to complaints is:

- Acknowledging all complaints and responding to the complainant within 24 hours where practicable;
- Registering all complaint details in Cority;
- Investigating complaints impartially considering the facts and the circumstances prevailing at the time;
- Implementing corrective actions if required; and
- Reporting to relevant stakeholders of investigation outcomes and corrective actions taken.

A record of all community complaints in relation to activities undertaken by the licensee must be kept in a legible form and be in accordance with Tahmoor Coal's Environmental Protection Licence (EPL) 1389.

The following information will also be kept in the event of a community complaint, as required by Section M4 in Tahmoor Coal's EPL 1389:

- The date and time of the complaint;
- The method by which the complaint was made;
- Any personal details of the complainant which were provided by the complainant or a note to that effect;
- The nature of the complaint;
- The action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
- If no action was taken by the licensee, the reasons why no action was taken.

These records must be kept for at least 4 years after the complaint was made and be able to be produced to any authorised officer who asks to see them.

In the event of a dispute or conflict between Tahmoor Coal personnel and a member of the community, the Tahmoor Coal Environment and Community Manager will facilitate communication between both parties to reach a resolution, which may include a meeting with the complainant to discuss the issue.

Where relevant, negotiations will be initiated in accordance with any relevant Consent conditions. This general process is documented in the Community Complaints and Enquiry Procedure (TAH-HSEC-00120). If a dispute cannot be resolved, the matter will be escalated to involve the site Operations Manager or General Manager as required and may involve consultation with the relevant government agency to assist in reaching a determination on the matter.

7.6 Risk Assessments

7.6.1 Site-wide Risk Assessment

Aspects and impacts at Tahmoor Mine are considered in light of legislative requirements and internal and external stakeholder views. Key aspects and impacts are identified during the annual review of the Tahmoor Coal Environment and Community (E&C) Broad Brush Risk Assessment (BBRA) and the operational Life of Mine (LOM) Risk Assessment and Site Wide Broad-Brush Risk Assessment (Mine BBRA).

7.6.2 General Risk Assessment

Tahmoor Coal completed a risk assessment for the extraction of LW S1A-S6A on 3 November 2021 to determine the major risks relating to built features and environmental features associated with secondary extraction of LW S1A-S6A. The primary objectives of the risk assessment were to:

- Ensure the required approvals for the proposed longwalls are obtained in a timely manner to enable mining to commence;
- Ensure all environmental risks are appropriately eliminated or managed according to environmental legislation requirements;
- Ensure the safe and serviceable operation of all surface built features in the Study Area;
- Ensure that the health and safety of people who may be present in the Study Area are not put at risk due to mine subsidence;
- Assist in the establishment of procedures to measure, monitor, control, mitigate and repair built features in the Study Area; and
- Ensure the required management plans for environmental features and built features are prepared and in place in a timely manner to manage potential impacts to environmental features or built features during mining.

The risk assessment was completed to satisfy Tahmoor Coal's requirements in relation to WHS and in compliance to mining regulations and conditions and is completed in consultation with key stakeholders. The risk assessment for LW S1A-S6A was completed in accordance with:

- Risk Management (TAH-HSEC-00229) standard prepared by Tahmoor Coal, which details the 12 Step Risk Management Process for managing risk and the risk matrix used to categorise risks;
- WRAC Workplace Risk Assessment and Controls (TAH-HSEC-00014) standard prepared by Tahmoor Coal, which details the methodology for use during the risk assessment;
- DPE requirements and DPE Conditions of Approval (SSD 8445);
- *NSW Work Health and Safety (Mines and Petroleum Sites) Regulations 2014* (it is noted that this was updated in 2022);
- AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines; and
- Risk Management Handbook for the Mining Industry (MDG1010).

Risks were identified and assessed through the review of known surface and sub-surface features within the Extraction Plan Study Area. The risk assessment also drew upon the experience and results of previous risk assessments completed for previous longwalls at Tahmoor Mine.

The risk assessment was completed by members of the Tahmoor Coal E&C Department and relevant technical specialists, and was facilitated by a Tahmoor Coal internal facilitator.

The outcomes of the risk assessment are outlined in the PSMP, to which a report for the risk assessment is appended. Treatment plans / tasks identified during the risk assessment have been recorded in in Cority and assigned to responsible personnel for completion within appropriate timeframes.

7.6.3 Built Feature Specific Risk Assessments

Further risk assessments for specific built features in the LW S1A-S6A Study Area will be completed if potential impacts to these features are deemed to be more detailed than the risks assessed in the general LW S1A-S6A Risk Assessment. The results from these risk assessments will be included in the individual management plans for the features, as listed in **Section 2.1.2** and **Table 5**.

7.7 Audits and Reviews of Environment and Community Performance

7.7.1 Internal Audit and Review

In accordance with internal company requirements, Tahmoor Coal has implemented a system for the monitoring and review of E&C performance at the site. Tahmoor Coal is to provide ongoing monitoring and regular management review of E&C performance to:

- Confirm the adequacy and effectiveness of management plans, procedures and standards;
- Address any identified weaknesses;
- Share good performance and lessons learnt with other sites; and
- Ensure ongoing compliance with all leases, licences and approvals.

Process or area specific internal audits are also conducted periodically, generally administered by the E&C Manager, focussing on the following areas:

- Air quality;
- Water management;
- Erosion and sediment control; and
- Statutory approvals.

These audits may be conducted by consultants on behalf of Tahmoor Coal, by Liberty GFG employees or may be self-assessments conducted by Tahmoor Coal personnel. Audit results and corrective actions are recorded in Cority and assigned to responsible personnel for completion within appropriate timeframes.

7.7.2 Independent Environmental Audit

In accordance with Conditions E15 – E20 of the Consent, Tahmoor Coal will complete Independent Environmental Audits of the development at the frequencies determined within DPE's Independent Audit Post Approval Requirements (2020). For extraction, the 'Operational Phase' requirements are relevant, requiring an initial independent audit within 26 weeks of the commencement of operation and ongoing independent audits at intervals no greater than 3 years or as otherwise agreed by the Planning Secretary.

The audits will assess:

- Environmental performance of the Mine;
- Compliance with the requirements of all relevant development consents, mining leases, Exploration Authorisations, and site environmental protection licence.

The audit will also assess:

- Environmental assessments; and
- Plans and programs required by above approvals.

The audit will review the adequacy of the following requirements under the abovementioned approvals:

- Strategies;
- Plans; and
- Programs.

The audit will recommend appropriate measures and corrective actions to improve environmental performance at Tahmoor Coal. Audit results and corrective actions are recorded in Cority and assigned to responsible personnel for completion within appropriate timeframes.

7.7.3 Extraction Plan Audit

Audits of the Extraction Plan are to be conducted in consultation with the Plan owner and nominated individuals and shall focus on the content and implementation.

Audits on the content shall consist of a determination of understanding of the Extraction Plan by the individual's allocated responsibility under this plan.

Audits on the implementation shall consist of reviews of the safe working procedures and risk assessments developed to ensure safe operation of this Extraction Plan, they may also involve discussions with personnel involved in the management plan to determine understanding and compliance.

Should an audit of this Extraction Plan determine that a deficiency is evident in the content or implementation, the results are to be brought to the attention of the E&C Manager that corrective actions can be developed and implemented. Corrective actions are recorded in Cority and assigned to responsible personnel for completion within appropriate timeframes.

Tahmoor Coal is responsible to verify that the nominated corrective action has been implemented by way of a follow up audit.

Any changes to the Extraction Plan are to be managed and communicated to all personnel in accordance with Tahmoor Coal's Document and Record Control (TAH-HSEC-00124) and Change Management Standard (TAH-HSEC-00171) documents.

Additionally, auditing will be undertaken in accordance with:

- Health and Safety Management Plan (TAH-HSEC-00189); and
- Environmental Management System Framework (EMSF) (TAH-HSEC-00173).

7.8 Review of Documents

7.8.1 Review of Extraction Plan

This Extraction Plan Main Document will be reviewed on a time or event basis, as is required:

Time based:

- In accordance with Condition E7 (a) of the Consent, a review will be required within 3 months of:
  - Any incident, event or finding that identifies an inadequacy in the risk assessment or associated documents to continue to effectively manage the identified hazard;
  - A change to the workplace itself or any aspect of the work environment, a change to a system of work, a process or a procedure;
- In accordance with Condition E7 (b-e) of the Consent, this plan will be reviewed within three months of:
  - the submission of an Annual Review under Condition E13;
  - the submission of an Independent Environmental Audit under Condition E15;
  - the approval of any modification of the conditions of this consent (unless the conditions require otherwise); or
  - notification of a change in development phase under Condition A19;

Event based:

- Stakeholders raise issues that necessitate a review;
- Significant change in mine design or layout;
- Unpredicted subsidence impacts or environmental consequences have required implementation of contingency actions;
- Development Consent requirements trigger a review;
- Circumstances in either Clause 15 and/or Clause 124 of the WHSMP Regulation and/or Clause 38 of the WHS Regulation (refer to Section 3.2.4 of this Extraction Plan for further detail); and/or
- Monitoring, incident or audit processes demonstrate that a review is warranted.

If deemed appropriate, relevant stakeholders may be included in the review process. All reviews are to be documented. The process for review of this document will be in according to Tahmoor Coal's Document and Record Control (TAH-HSEC-00124) document.

Following changes (or as otherwise required above) a copy of the amended management plan will be forwarded to the Planning Secretary for approval.

7.8.2 Review of Other Management Plans

The Key Component Plans prepared in support of this Extraction Plan (refer to **Section 4**) are also subject to individual review requirements as detailed within each plan. Amendments to the Key Component Plans will be undertaken in consultation with relevant stakeholders. Following changes (or as otherwise required above) a copy of the amended Key Component Plan(s) will be forwarded to the Planning Secretary for approval.

The review of other management plans that apply more broadly to the whole mine site, such as the Mining Operations Plan 2020-2024 (TAH-HSEC-00359) and the Environmental Management System Framework (TAH-HSEC-00173), may be required following the completion of this Extraction Plan. The process for review of these documents will be in according to Tahmoor Coal's Document and Record Control (TAH-HSEC-00124) document.

7.8.3 Document Control

This Extraction Plan includes Document Control details as part of the document quality assurance and control (QA/QC). This includes the following Document Control information:

- Document details including author(s), revision numbers, dates and status (refer to Document Control table at the start of this Extraction Plan main document, and **Section 8.5**);
- Revision, approval and authorisation details (refer to Document Control table at the start of this Extraction Plan main document, and **Section 8.5**); and
- Distribution details including the provision to external stakeholders (refer to **Section 8.6**).

All revisions of this Extraction Plan are stored on Tahmoor Coal's Document Control Software, Intelex, and are updated in accordance with Tahmoor Coal's Document and Record Control (TAH-HSEC-00124) and Change Management Standard (TAH-HSEC-00171) documents.

7.9 Roles and Responsibilities

7.9.1 General Roles and Responsibilities

E&C management is regarded as part of the responsibilities of all employees and contractors at Tahmoor Coal. Specific information pertaining to the role, responsibility, authority and accountability of key personnel involved in environmental management at Tahmoor Coal is provided in **Table 21** below.

Table 21 Roles and Responsibilities

Position	Responsibilities
Operations Manager	• Approve this management plan and any revised versions as required. • Provide adequate environmental personnel/resources for implementation of this management plan and associated plans. • Ensure underground mining activities are conducted in accordance with this management plan.
Environment & Community Manager	• Approve this management plan and any revised versions as required. • Determine adequate resources and funds are available to ensure the effectiveness of this procedure. • Ensure this management plan is implemented and maintained. • Certify compliance and adherence to this management plan. • Ensure any potential or actual issues, triggers and non-conformances are reported in accordance with this management plan, regulatory requirements and corporate standards. • Liaise with relevant government agencies and built feature owners in relation to regulatory conditions and compliance issues. • Coordinate external audits, corporate reporting and management.
Approvals Specialist	• Develop, implement, review and maintain this management plan and system documents. • Review and assess subsidence monitoring results against predictions. • Coordinate environmental reporting for timely completion in accordance with internal and external requirements. • Investigate and report any exceedances of performance indicators in accordance with the TARPs. • Implement subsidence management actions as required by the TARPs.
Environmental Specialist	• Coordinate environmental compliance on-site including timely completion of monitoring and reporting in accordance with internal and external requirements. • Assist in the development, implementation, review and maintain of this management plan and system documents. • Implement and ensure the completion of audit actions.
Community Liaison Specialist	• Liaise with the community as required and as per the Stakeholder Engagement Plan, including facilitation of Community Consultative Committee meetings. • Consult with relevant stakeholders during the development of management plans relating to their built features. • Liaise with land owners, landholders and land managers to gain access for subsidence monitoring and any remediation works. • Ensure all community complaints are addressed, investigated and appropriately managed as per site procedures, and reported internally as per internal requirements.

Position	Responsibilities
Surveyor	• Coordinate with the Community Liaison Specialist to gain access for subsidence monitoring. • Establish and undertake subsidence monitoring in accordance with this management plan to the required survey standard and within the specified timeframes.
Mine Subsidence Engineer	• Ensure monitoring data are adequately checked, processed and recorded. • Review and assess subsidence monitoring results against predictions. • Provide monitoring results to the E&C Team, relevant agencies and built feature owners. • Notify the Environment and Community Manager of any identified public safety issues.
All Other Employees and Contractors	• Complete activities under their control in accordance with this management plan and associated plans and site procedures. • Ensure environmental controls within their jurisdiction are operated and maintained in a proper and efficient manner. • Report all environmental incidents and complaints in a timely manner.

7.9.2 Employee & Contractor Training

Environmental training for Tahmoor Coal employees and contractors is conducted in accordance with the Environment & Community Training Needs Analysis, which Tahmoor Coal manages through the Scenario Training Database. General environmental awareness training is provided to all employees and contractors annually through a generic visitor induction and the SafeCoal training session scheduled by the Tahmoor Coal Health, Safety & Training Department.

7.9.3 Response Groups

Tahmoor Coal operates three response groups made up of Tahmoor Coal Staff and relevant technical specialists:

- Environmental Response Group (ERG);
- Structural Response Group (SRG); and
- Rail Response Group (RRG).

The response groups are responsible for taking the necessary actions required to manage the risks that are identified from monitoring of natural and built features to ensure that the health and safety of people and the environment are not put at risk due to mine subsidence. Each response group assists in the development and review management plans, collects and analyses monitoring results, determines potential impacts, and provides advice regarding appropriate actions relevant to the area of interest.

Each response group is made up of a group of key members, and the response group may invite other specialist consultants and stakeholders depending on the topic of conversation. Each group meets regularly and outcomes of the meetings are documented.

7.10 Access to Information

7.10.1 Tahmoor Coal Website

In accordance with Condition E23 of the Consent, Tahmoor Coal is required to make publicly available information pertaining to Tahmoor Coal's general environmental performance against internal targets and external approvals criteria. The following information is available on Tahmoor Coal's Website:

- Tahmoor South Project EIS;
- All current statutory approvals for Tahmoor Mine;
- All approved strategies, plans and programs;
- Any proposed staging plans for the Tahmoor South Project;
- Minutes of TCCCC meetings;
- Regular reporting on the environmental performance;
- A comprehensive summary of the monitoring results of Tahmoor Mine;
- A summary of the current phase and progress of development at Tahmoor Mine;
- Contact details to enquire about Tahmoor Mine or to make a complaint;
- A complaints register updated on a monthly basis;

- A record of incidents and non-compliance notifications made to the Planning Secretary updated monthly;
- Annual Review documents;
- Independent Environmental Audits of the Tahmoor Mine, and Tahmoor Coal's response to the recommendations in the audits;
- Annual returns made under the National Greenhouse and Energy Reporting legislation;
- Environmental Protection Licence Annual Return; and
- Any other matter required by the Planning Secretary.

These reports are prepared in accordance with relevant guidelines and are published on Tahmoor Coal's website in accordance with the Tahmoor Website Procedure (TAH-HSEC-00221).

This Extraction Plan will be uploaded to the Tahmoor Coal Website following approval.

7.10.2 Tahmoor Colliery Community Consultative Committee

Information pertaining to Tahmoor Coal's general environmental performance against internal targets and external approvals criteria is reported to the community via the TCCCC.

The TCCCC was established in 2003 in response to the requirement for DA 67/98 Condition 47 to establish and operate a Community Consultative Committee in general accordance with DPE *Community Consultative Committee Guidelines: State Significant Projects (2016)*. The requirement for the TCCCC was renewed for the Tahmoor South Project in Condition A25 of the Consent.

The TCCCC currently meets on a quarterly basis and provides a forum of two-way communication between community representatives and Tahmoor Coal. Some of the information reported at the TCCCC includes:

- Progress at the mine and operational issues;
- Activities, projects and community initiatives;
- Subsidence monitoring and environmental performance; and
- Community complaints and the response to complaints.

As discussed in **Section 7.10.1,** the minutes from the TCCCC meetings is provided on the Tahmoor Coal Website.

8 Document Information

8.1 Referenced Documents

Reference information that is directly related to the development of this document or referenced from within this document is listed in **Table 22** below.

Table 22 Reference Information

Title
ATC Williams (2022), Tahmoor South LW S1A-S6A Water Management Plan – Myrtle Creek and Redbank Creek Remediation Program Review, May 2022, document 121171.17.
Department of Industry – Resources Regulator (2017), Managing Risks of Subsidence Guide: WHS (Mines and Petroleum Sites) Legislation.
Department of Planning (2008), Impacts of Underground Coal Mining on Natural Features in the Southern Coalfields: Strategic Review. NSW Department of Planning, July 2008.
Department of Planning and Environment (DPE) (2015), Draft Guidelines for the Preparation of Extraction Plans V5.
Douglas Partners (2022), Report on Geotechnical Assessment, Longwalls S1A to S6A, Bargo, prepared for Tahmoor Coal, May 2022.
Mine Subsidence Engineering Consultants (2022), Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A: Subsidence ground movement predictions and subsidence impact assessments for natural features and surface infrastructure. Prepared for Tahmoor Coal, May 2022, document MSEC1192.
SLR (2022a), LW S1A-S6A Extraction Plan - Groundwater Technical Report, prepared for Tahmoor Coal, May 2022, document 610.30637.00000.
SLR (2022b), Tahmoor South - Baseline Private Bore Assessment Report, prepared for Tahmoor Coal, May 2022, document 310.30637.00000.
SLR (2022c), Tahmoor Extraction Plan LW S1A-S6A Land and Agricultural Resource Assessment, prepared for Tahmoor Coal, April 2022, document 630.12732.002.
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.
Tahmoor Coal (2022), Tahmoor South Domain, Longwalls South 1A to South 6A, Risk Assessment Report.
Waddington, A.A. and Kay, D.R., (2002). ACARP Management Information Handbook on the Undermining of Cliffs, Gorges and River Systems-Version 1. Developed from ACARP Research Projects C8005 and C9067, September 2002.

8.2 Related Documents

Related documents (internal documents) directly related to or referenced from this document are listed in **Table 23** below.

Table 23 Related Documents

Document Number	Document Title
TAH-HSEC-00173	Environmental Management System Framework
TAH-HSEC-00359	Mining Operations Plan 2020-2024
TAH-HSEC-00124	Document and Record Control
TAH-HSEC-00171	Change Management Standard
TAH-HSEC-00229	Risk Management
TAH-HSEC-00014	WRAC Workplace Risk Assessment and Controls
TAH-HSEC-00189	Health and Safety Management Plan
TAH-HSEC-00155	Emergency and Incident Manual
TAH-HSEC-00155	Pollution Incident Response Management Plan
TAH-HSEC-00224	Notification of Environmental Pollution Incidents
TAH-HSEC-00120	Community Complaints and Enquiry Procedure
TAH-HSEC-00221	Tahmoor Website Procedure

Document Number	Document Title
TAH-HSEC-00365	LW S1A-S6A Extraction Plan Main Document
TAH-HSEC-00361	LW S1A-S6A Water Management Plan
TAH-HSEC-00362	LW S1A-S6A Land Management Plan
TAH-HSEC-00363	LW S1A-S6A Biodiversity Management Plan
TAH-HSEC-00364	LW S1A-S6A Heritage Management Plan
TAH-HSEC-00366	LW S1A-S6A Built Features Management Plan
TAH-HSEC-00365	LW S1A-S6A Public Safety Management Plan
TAH-HSEC-00367	LW S1A-S6A Subsidence Monitoring Plan

8.3 Glossary of Terms

Terms references to this document are provided below in **Table 24**.

Table 24 Glossary of Terms

Term	Definition
Adaptive management	Monitoring subsidence impacts and subsidence effects and, based on the results, modifying the mine plan as mining proceeds to ensure that the effects, impacts and/or associated environmental consequences remain within the predicted and designated ranges and in compliance with the conditions of the Project Approval.
Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence).
Aquifer	A sub-surface rock formation containing water in recoverable quantities.
Block	A dimensional delineation of the mineral deposit; as in “a block of coal” or a “coal blocked out for extraction”.
Built features	Includes any building or work erected or constructed on land, including dwellings and infrastructure such as a formed road, street, path, walk, or driveway; any pipeline, water sewer, telephone, gas or other infrastructure service main.
Chain pillar	A block of coal left unmined between the longwall extraction panels.
Cliff	A continuous rock faces, including overhangs, having a minimum length of 20 m, a minimum height of 10 m and a minimum slope of 2 to 1, i.e. having minimum angles to the horizontal of 63°.
Closure	The reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of mm, is the greatest reduction in distance between any two points on the opposing valley sides. It should be noted that the observed closure movement across a valley is the total movement resulting from various mechanisms, including conventional mining induced movements, valley closure movements, far-field effects, downhill movements and other possible strata mechanisms.
Coal face	The current working place for coal extraction.
Coal Preparation Plan (CPP)	Processing plant where coal is sized, washed and prepared for the market.
Coal seam	Naturally formed underground layer of coal.
Continuous miner	The electric powered cutting machine used to remove coal from the active mining face and load it into the shuttle car.
Conveyor	The means of transporting coal from the coal face to the underground bin or surface. It consists of a belt being driven by a motor over a roller assembly.
Cover depth (H)	The depth of coal seam from the ground surface in m. Cover depth is normally provided as an average over the area of the panel.
Critical area	The area of extraction at which the maximum possible subsidence of one point on the surface occurs.

Term	Definition
Curvature	Second derivative of subsidence, or the rate of change of tilt, and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the Radius of Curvature with the units of 1/km (km^{-1}), but the value of curvature can be inverted, if required, to obtain the radius of curvature, which is usually in km. Curvature can be either hogging (i.e. convex) or sagging (e.g. concave).
Development	The operations involved in preparing the coal seam for extraction.
Downcast	A shaft or other mine opening down to the underground workings in which fresh air from the surface passes.
Drift	An inclined access opening from the surface to the coal seam.
Exploration	The search for mineral deposits and the work done to prove or establish the extent of a mineral deposit.
Extracted seam	The thickness of coal that is extracted. The extracted seam thickness is thickness normally given as an average over the area of the panel.
Effective extracted seam thickness (T)	The extracted seam thickness modified to account for the percentage of coal left as pillars within the panel.
Face length	The width of the coalface measured across the longwall panel.
Far-field movements	The measured horizontal movements at pegs that are located beyond the longwall panel edges and over solid unmined coal areas. Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain.
First workings	The driving of headings (underground roadways) into the solid coal seam prior to the commencement of extraction. First workings do not result in surface subsidence.
Gate road	An underground roadway leading to a working place in longwall mining.
Goaf	The void created by the extraction of the coal into which the immediate roof layers collapse.
Goaf end factor	A factor applied to reduce the predicted incremental subsidence at points lying close to the commencing or finishing ribs of a panel.
Headings	An underground roadway formed in the direction of a development panel.
Horizontal displacement	The horizontal movement of a point on the surface of the ground as it settles above an extracted panel. Displacement is described by various parameters including horizontal tilt, horizontal curvature, mid-ordinate deviation, angular distortion and shear index.
Incremental subsidence	The difference between the subsidence at a point before and after a panel is mined. It is therefore the additional subsidence at a point resulting from the excavation of a panel.
Inflection point	The point on the subsidence profile where the profile changes from a convex curvature to a concave curvature. At this point the strain changes sign and subsidence is approximately one half of S max.
Longwall	A system of mining coal in which the seam is extracted on a broad front or long face using a coal shearer and the roof is supported by hydraulic roof supports.
Minor cliff	A continuous rock face, including overhangs, having a: • Minimum length of 20 metres and a height between 5 metres and 10 metres or maximum length of 20 metres and a minimum height of 20 metres; and • A minimum slope of 2 in 1 (>63.4°)
Mitigation measures	Subsidence management measures which aim to reduce subsidence impacts, usually implemented prior to or during mining.
Overlap adjustment factor	A factor that defines the ratio between the maximum incremental subsidence of a panel and the maximum incremental subsidence of the panel if it were the first panel in a series.
Panel or longwall panel	The plan area of coal extraction, or a block of coal to be mined by longwalls defined by gate roads and coal seam thickness.
Panel length (L)	The longitudinal distance along a panel measured in the direction of mining from the commencing rib to the finishing rib.

Term	Definition
Panel width (Wv)	The transverse distance across a panel, usually equal to the face length plus the widths of the roadways on each side.
Panel centre line	An imaginary line drawn down the middle of the panel.
Pillar	A block of coal left unmined.
Pillar width (Wpl)	The shortest dimension of a pillar measured from the vertical edges of the coal pillar, i.e. from rib to rib.
Remediation measures	Subsidence management measures which aim to repair any adverse effects of subsidence, usually implemented after mining.
Risk	The chance of something happening that will have an impact on objectives. It is measures in terms of consequence and likelihood.
Rock face feature	A rock face having a: • Minimum length of 20 metres and heights between 3 metres and 5 metres, or maximum length of 20 metres and a minimum height of 5 metres; and • A minimum slope of 2 in 1 (>63.4°).
Run of mine (ROM)	Raw coal production, or the unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock.
Safe, serviceable and Repairable	Safe means no danger to users who are present; serviceable means available for its intended use; repairable means damaged components can be repaired economically.
Second workings	Extraction of coal by longwall mining that may result in surface subsidence.
Shaft	A vertical opening connecting the surface with the underground workings.
Shear deformations	The horizontal displacements that are measured across monitoring lines and these can be described by various parameters including; horizontal tilt, horizontal curvature, mid-ordinate deviation, angular distortion and shear index.
Steep slopes	An area of land having a gradient between 1 in 3 (33% or 18.3°) and 2 in 1 (200% or 63.4°).
Strain	The change in the horizontal distance between two points divided by the original horizontal distance between the points, i.e. strain is the relative differential displacement of the ground along or across a subsidence monitoring line. Strain is dimensionless and can be expressed as a decimal, a percentage or in parts per notation. Tensile Strains are measured where the distance between two points or survey pegs increases and Compressive Strains where the distance between two points decreases. Whilst mining induced strains are measured along monitoring lines, ground shearing can occur both vertically, and horizontally across the directions of the monitoring lines.
Sub-critical area	An area of panel smaller than the critical area.
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel, but, 'subsidence of the ground' in some references can include both a vertical and horizontal movement component. The vertical component of subsidence is measured by determining the change in surface level of a peg that is fixed in the ground before mining commenced and this vertical subsidence is usually expressed in units of mm. Sometimes the horizontal component of a peg's movement is not measured, but in these cases, the horizontal distances between a particular peg and the adjacent pegs are measured.
Subsidence effects	The deformations of the ground mass surrounding a mine, sometimes referred to as 'components' or 'parameters' of mine subsidence induced ground movements, including vertical and horizontal displacements, tilts, curvatures, strains, upsidence and closure.

Term	Definition
Subsidence impacts	The physical changes or damage to the fabric or structure of the ground, its surface and environmental features, or built structures that are caused by the subsidence effects. These impacts considerations can include tensile and shear cracking of the rock mass, localised buckling of strata, bed separation, rock falls, collapse of overhangs, failure of pillars, failure of pillar floors, dilation, slumping and also include subsidence depressions or troughs.
Subsidence consequences	The knock-on results of subsidence impacts, i.e. any change in the amenity or function of a natural feature or built structure that arises from subsidence impacts. Consequence considerations include public safety, loss of flows, reduction in water quality, damage to artwork, flooding, draining of aquifers, the environment, community, land use, loss of profits, surface improvements and infrastructure. Consequences related to environmental features are referred to as environmental consequences.
Super-critical area	An area of panel greater than the critical area.
Tilt	The change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the horizontal distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of mm/m. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %, or 1 in 1000.
Total subsidence, tilts, curvatures and strains	Accumulated parameters after the completion of each longwall.
Travelling subsidence, tilts, curvatures and strains	Transient movements as the longwall extraction face mines directly beneath a given point.
Upcast	A shaft or other mine opening through which air returns to the surface after ventilating the underground workings.
Uplift	An increase in the level of a point relative to its original position.
Upsidence	Upsidence results from the dilation or buckling of near-surface strata at or near the base of the valley. The term uplift is used for the cases where the ground level is raised above the pre-mining level, i.e. when the upsidence is greater than the subsidence. The magnitude of upsidence, which is typically expressed in the units of mm, is the difference between the observed subsidence profile within the valley and the conventional subsidence profile which would have otherwise been expected in flat terrain.
Vertical displacement	Vertical downward movements of the ground surface caused by underground coal mining.
Valley related movements	Valley bulging movements are a natural phenomenon, resulting from the formation and ongoing development of the valley. The potential for these natural movements are influenced by the geomorphology of the valley. Valley related movements can be caused by or accelerated by mine subsidence as the result of a number of factors, including the redistribution of horizontal in situ stresses and down slope movements. Valley related movements are normally described by the parameters upsidence, closure, compressive strains and tensile strains.

8.4 Abbreviations

Abbreviations used in this document are provided below in **Table 25.**

Table 25 Abbreviations

Abbreviation	Definition
ACARP	Australian Coal Association Research Program
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ARTC	Australian Rail Track Corporation
BCS	Department of Planning and Environment - Biodiversity, Conservation and Science
BFMP	LW S1A-S6A Built Features Management Plan
BMP	LW S1A-S6A Biodiversity Management Plan

Abbreviation	Definition
CAMP	Corrective Action Management Plan
CCL	Consolidated coal lease
CHPP	Coal handling and preparation plant
Crown Lands	NSW Department of Planning and Environment – Crown Lands Division
DA	Development Application
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DPE	NSW Department of Planning and Environment Formerly known as NSW Department of Planning, Industry and Environment (DPIE)
DPIE	NSW Department of Planning, Industry and Environment (former) Now known as NSW Department of Planning and Environment
DPE Crown Lands	NSW Department of Planning and Environment – Crown Lands
DPE Water	NSW Department of Planning and Environment - Water
DPI	NSW Department of Primary Industries
DPI Agriculture	NSW Department of Primary Industries – Agriculture
DSNSW	Dams Safety NSW
E&C	Environment and community
EEC	Endangered Ecological Community
EES	NSW Department of Planning and Environment – Environment, Energy and Science Group
EIS	Environmental Impact Statement
EMS	Environmental Management System
EMSF	Environmental Management System Framework
EPA	NSW Environment Protection Authority
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ERG	Tahmoor Coal Environmental Response Group
Ha	Hectares
HMP	LW S1A-S6A Heritage Management Plan
HSEC	Health, Safety, Environment and Community
IAPUM	Independent Advisory Panel for Underground Mining
IESC	Commonwealth Independent Expert Scientific Committee
IPM	Incremental Profile Method
km	Kilometre/s
LGA	Local Government Area
LMP	LW S1A-S6A Land Management Plan
LW	Longwall
LW S1A-S6A	Longwalls South 1A to South 6A
m	Metre/s
MEG	Department of Regional NSW – Mining Exploration and Geoscience

Abbreviation	Definition
Masl	Metres above sea level
MG	Main Gate
mm	Millimetre
ML	Mining Lease
MOP	Mining Operations Plan 2020-2024 (TAH-HSEC-00026)
MSEC	Mine Subsidence Engineering Consultants
NRAR	NSW Industry – Land & Water – Natural Resources Access Regulator – East
NSW	New South Wales
OEH	NSW Office of Environment and Heritage Now known as DPE – Environment, Energy and Science (EES) Group
PCBCs	Persons conducting a business or undertaking
PSMP	LW W3-W4 Public Safety Management Plan
ONRSR	NSW Office of the National Rail Safety Regulator
QA/QC	Quality assurance and control
RAPs	Registered Aboriginal Parties
Resources Regulator	Department of Regional NSW – Resources Regulator
ROM	Run of Mine
RRG	Rail Response Group
SA NSW	Subsidence Advisory NSW (formerly the Mine Subsidence Board)
SHR	State Heritage Register
SIMEC	SIMEC Mining Division
Spatial Services	NSW Department of Finance, Services and Innovation – Spatial Services
SRG	Structural Response Group
SSD 8445	Tahmoor South Project Development Consent
SDWC	Sydney Drinking Water Catchment
T	Tonnes
Tahmoor Mine	Tahmoor Coal Mine
Tahmoor Coal	Tahmoor Coal Pty Ltd
TARP	Trigger Action Response Plan
TCCCC	Tahmoor Colliery Community Consultative Committee
TDS	Total dissolved salts
TfNSW	Transport for NSW
TG	Tailgate
Western Domain	The area to the north-west of the Main Southern Rail within ML 1376 and ML 1539
WHS	Work Health and Safety
WHS Act	*Work Health and Safety Act 2011*
WHS Regulation	*Work Health and Safety Regulation 2017*
WHSMP Act	*Work Health and Safety (Mines and Petroleum Sites) Act 2013*

Abbreviation	Definition
WHSMP Regulation	*Work Health and Safety (Mines and Petroleum Sites) Regulation 2022*
WLEP	*Wollondilly Local Environment Plan 2011*
WMP	LW S1A-S6A Water Management Plan
WSC	Wollondilly Shire Council

8.5 Change Information

Full details of the document history are recorded below in **Table 26**.

Table 26 Document History

Version	Date Reviewed	Reviewed By	Change Summary
1.0	May 2022	Zina Ainsworth, Charlie Wheatley Malcolm Waterfall, Peter Vale	New Document
1.1	May 2022	Zina Ainsworth, Charlie Wheatley Malcolm Waterfall, Peter Vale	Minor formatting changes made to document and TARP.
2.0	September 2022	Charlie Wheatley, Zina Ainsworth	Updated document following consultation with DPE, government agencies and the Independent Advisory Panel for Underground Mining

8.6 Document Distribution

This Extraction Plan and associated document have been distributed according to **Table 27**.

Table 27 Distribution List for Extraction Plan

Agency	Contact Person	Position	Email Address / Portal
DPE - Resource Assessments	(Planning Portal)	(Planning Portal)	(https://www.planningportal.nsw.gov.au/major-projects)
	Jessie Evans	Director – Resource Assessments	Jessie.Evans@planning.nsw.gov.au
	Gabrielle Allan	Principal Planning Officer	Gabrielle.Allan@planning.nsw.gov.au
DPE - EES	Liza Schaeper	Senior Team Leader	liza.schaeper@environment.nsw.gov.au
	Martin Krogh	Principal Scientist Major Assessments	martin.krogh@environment.nsw.gov.au
	Meagan Hinds	Senior Threatened Species Officer, Ecosystems and Threatened Species	meagan.hinds@envirnment.nsw.gov.au
DPE - Water	(General email)	(General email)	water.assessments@dpie.nsw.gov.au
	Fabienne Boudoux d'Hautefeuille	Manager of Water Assessments	fabienne.d'hautefeuille@dpie.nsw.gov.au
	Liz Rogers	Manager Assessments	Liz.rogers@dpie.nsw.gov.au
DPIE - Crown Lands Division	(General email)	(General email)	cl.enquiries@crownland.nsw.gov.au
Resources Regulator (Subsidence)	(General email)	(General email)	subsidence.monitoring@planning.nsw.gov.au nswresourcesregulator@service-now.com
	Dr. Gang Li	Principal Subsidence Engineer	gang.li@planning.nsw.gov.au
	Ray Ramage	Senior Mine Safety Officer - Subsidence	ray.ramage@planning.nsw.gov.au
Resources Regulator (Mining Act Inspectorate)	(General email)	(General email)	nswresourcesregulator@service-now.com
	Greg Kininmonth	Manager Environmental Operations (Southern)	greg.kininmonth@planning.nsw.gov.au
Department of Regional NSW - MEG	(General email)	(General email)	Resource.operations@planning.nsw.gov.au assessment.coordination@planning.nsw.gov.au

Agency	Contact Person	Position	Email Address / Portal
NRAR	(General email)	(General email)	nrar.servicedesk@dpie.nsw.gov.au
WaterNSW	(General email)	(General email)	environmental.assessments@waternsw.com.au
Heritage NSW	(General email)	(General email)	heritagemailbox@environment.nsw.gov.au
DSNSW	(General email)	(General email)	mining@damsafety.nsw.gov.au
	Heather Middleton	Manager Mining Impacts	heather.middleton@damsafety.nsw.gov.au
EPA	(General email)	(General email)	epa.illawarra@epa.nsw.gov.au
	Andrew Couldridge	Senior Operations Officer - Metropolitan Illawarra	andrew.couldridge@epa.nsw.gov.au
DPI Agriculture	(General email)	(General email)	landuse.ag@dpi.nsw.gov.au
Subsidence Advisory NSW	(General email)	(General email)	subsidencetechnical@customerservice.nsw.gov.au
	John Johnston	Technical Manager	John.Johnston@customerservice.nsw.gov.au
TfNSW	(General email)	(General email)	Development.Sydney@transport.nsw.gov.au
ONRSR	Ian Cochran	Technical Specialist – Bridges & Structures	ian.Cockran@onrsr.com.au
ARTC	Michael Irons	Prooperty Manager Wagga Wagga	mirons@ARTC.com.au
Wollondilly Shire Council	(General email)	(General email)	council@wollondilly.nsw.gov.au
	David Henry	Acting Team Leader Environmental Services	david.henry@wollondilly.nsw.gov.au

APPENDIX A – Subsidence Predictions and Impact Assessment Report (MSEC, 2022)

msec
mine subsidence
ENGINEERING CONSULTANTS

SIMEC

SIMEC Mining:

Tahmoor South Project – Extraction Plan for Longwalls S1A to S6A

Subsidence ground movement predictions and subsidence impact assessments for natural features and surface infrastructure

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
A	Final	DJK	TC	May-22

Report produced to:- Support the Tahmoor South Project Extraction Plan, prepared by Tahmoor Coal for submission to the NSW Department of Planning, Industry and Environment (DPIE).

Background reports available at *www.minesubsidence.com*:-

Introduction to Longwall Mining and Subsidence (Revision A)

General Discussion of Mine Subsidence Ground Movements (Revision A)

Mine Subsidence Damage to Building Structures (Revision A)

EXECUTIVE SUMMARY

Tahmoor Coal Pty Ltd, (Tahmoor Coal), owns and operates Tahmoor Mine, an existing underground coal mine that is located approximately 80 km south-west of Sydney in the Southern Coalfield of New South Wales (NSW). Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

Tahmoor Coal received development consent in April 2021 for the Tahmoor South Project, which is an extension of the current Tahmoor Mine underground coal mining within the Bulli seam towards the south of the existing Tahmoor Mine.

Tahmoor Coal is submitting an Extraction Plan for Longwalls S1A to S6A (LWs S1A to S6A), which will be the first longwall panels to be extracted in the Tahmoor South domain. The proposed longwalls are located between Tahmoor's surface facilities to the north and the township of Bargo to the south.

The proposed mine layout for LWs S1A to S6A lies within the approved Extent of Longwalls. Minor changes have been made to the mine layout since development consent was received (approved EIS Layout), as foreshadowed by Tahmoor Coal when it applied for development consent.

MSEC has been commissioned to prepare a subsidence prediction and impact assessment report to provide subsidence predictions and assessments based on the proposed mine layout.

This report should be read in conjunction with the Extraction Plan being prepared by Tahmoor Coal and in conjunction with the reports from the other specialist consultants engaged by the Tahmoor South Project.

MSEC has been commissioned by Tahmoor Coal to:-

- Identify the natural features and items of surface infrastructure that are in the vicinity of the proposed longwalls,
- Provide subsidence predictions at each of these natural features and items of surface infrastructure,
- Provide impact assessments, in conjunction with other specialist consultants, for each of these natural features and items of surface infrastructure, and to
- Provide information on the measures that can be implemented to manage potential impacts.

The proposed mining will affect a broad range of natural features and built infrastructure.

Chapter 1	provides an introduction, outlines the Project, presents the purpose of the report, and provides the base information on the mine layout, surface topography, seam and geological information.
Chapter 2	defines the *Subsidence Study Area* and provides a list of the natural features and items of surface infrastructure that have been identified within the *Subsidence Study Area*.
Chapter 3	includes an overview of conventional and non-conventional subsidence movements and the methods that have been used to predict these movements resulting from the extraction of the proposed longwalls.
Chapter 4	provides the maximum predicted subsidence parameters resulting from the extraction of the proposed longwalls.
Chapters 5 to 11	provide descriptions, predictions and impact assessments for each of the natural features and items of surface infrastructure that have been identified within the *Subsidence Study Area*. Recommendations for each of these features are also provided, which have been based on the predictions and impact assessments.

The overall findings of the assessments undertaken by MSEC are that the levels of impact and damage to all identified natural features and built infrastructure are manageable and can be controlled by the preparation and implementation of Subsidence Management Plans (or Extraction Plans), many of which have been successfully implemented during previous mining at Tahmoor Mine.

These management plans are developed in consultation with the owners of infrastructure and are approved by relevant government agencies. The findings in this report should be read in conjunction with all other associated consultant reports.

Recommended management measures generally include monitoring of ground movements and the condition of surface features. Some mitigation measures are recommended to mitigate or avoid the risk of serious consequences should impacts occur to some critical surface features.

It is recommended that Tahmoor Coal continues to develop management plans to manage the potential impacts for the surface features due to the extraction of the proposed longwalls.

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Drawings

Drawings referred to in this report are included in Appendix F at the end of this report.

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MSEC1192-01	General layout	A
MSEC1192-02	Surface level contours	A
MSEC1192-03	Seam roof contours	A
MSEC1192-04	Extraction height	A
MSEC1192-05	Depth of cover contours	A
MSEC1192-06	Geological structures at seam level	A
MSEC1192-07	Streams – general layout	A
MSEC1192-08	Cliffs and steep slopes – general layout	A
MSEC1192-09	Natural features detail map	A
MSEC1192-10	Railway and associated infrastructure	A
MSEC1192-11	Roads and associated infrastructure	A
MSEC1192-12	Water infrastructure	A
MSEC1192-13	Sewer infrastructure	A
MSEC1192-14	Gas infrastructure	A
MSEC1192-15	Electrical infrastructure	A
MSEC1192-16	Telecommunications infrastructure	A
MSEC1192-17	Archaeological and heritage sites	A
MSEC1192-18	Building structures and dams	A
MSEC1192-19	Public amenities and commercial establishments	A
MSEC1192-20	Tahmoor Mine infrastructure	A
MSEC1192-21	Groundwater bores and survey control marks	A
MSEC1192-22	Predicted total subsidence contours	A
MSEC1192-23	Proposed monitoring plan	A

1.1. Background

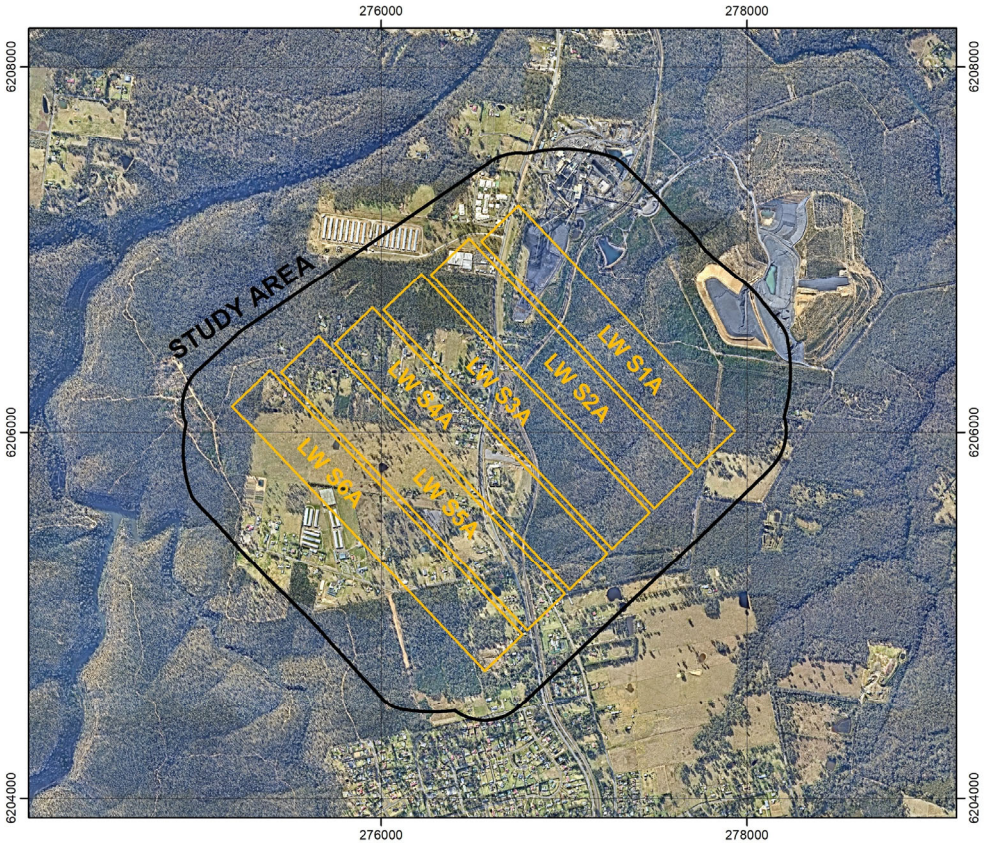
Tahmoor Coal Pty Ltd, (Tahmoor Coal), owns and operates Tahmoor Mine, an existing underground coal mine that is located approximately 80 km south-west of Sydney in the Southern Coalfield of New South Wales (NSW). Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

Tahmoor Coal received development consent in April 2021 for the Tahmoor South Project, which is an extension of the current Tahmoor Mine underground coal mining within the Bulli seam towards the south of the existing Tahmoor Mine.

Tahmoor Coal is submitting an Extraction Plan for Longwalls S1A to S6A (LWs S1A to S6A), which will be the first longwall panels to be extracted in the Tahmoor South domain. The proposed longwalls are located between Tahmoor's surface facilities to the north and the township of Bargo to the south. The locations of LWs S1A to S6A are shown in Fig. 1.1 and Drawing No. MSEC1192-01, which, together with all other drawings, are included in Appendix F.

The proposed mine layout for LWs S1A to S6A lies within the approved Extent of Longwalls. Minor changes have been made to the mine layout since development consent was received (approved EIS Layout), as foreshadowed by Tahmoor Coal when it applied for development consent. A comparison between mine layouts is shown in Fig. 1.2.

- The layout for LWs S1A to S6A has been shifted approximately 35 metres to the south-west;
- LWs S2A to S6A have been widened by 2 metres (the width of LW S1A is unchanged);
- Chain pillar widths for the tailgates of LWs S3A to S6A have been reduced by 2 metres (the chain pillar between LWs S1A and S2A is unchanged);
- The commencing ends of LWs S1A to S6A have been aligned compared to the previous staggered layout. The outcome of the change is that LWs S2A to S6A have been extended in length. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted for development consent; and
- The planned sequence has been amended, such that the A series longwalls are proposed to be extracted in sequence. When Tahmoor Coal applied for development consent, it had been planned to extract LWs 101A to 103A first, then the B series longwalls and return to extract LWs 104A to 106A. The longwalls have renamed S1A to S6A since the EIS was approved.



Photograph courtesy Nearmap

Fig. 1.1 Proposed longwalls and the Study Area

The Study Area comprises an area adjacent to, and to the south of, the existing Tahmoor Approved Mining Area. The *Subsidence Study Area* for the purposes of this report is defined in Section 2.1 and is shown in Drawing No. 1192-01.

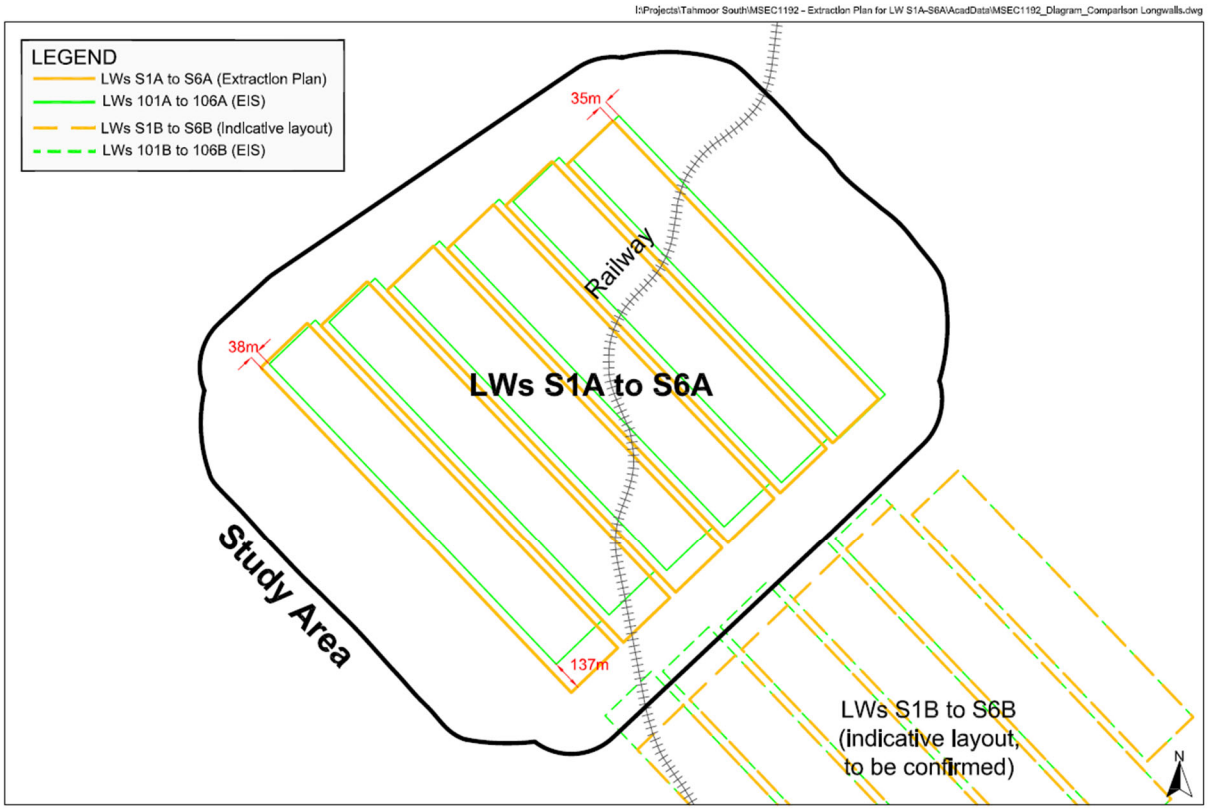


Fig. 1.2 Comparison between mine layouts for LWs S1A to S6A (2022 Extraction Plan) and LWs 101A to 106A (2021 approved EIS Layout)

1.2. Purpose of the report

1.2.1. Scope of Work and Report structure

MSEC has been commissioned by Tahmoor Coal to:-

- Identify the natural features and items of surface infrastructure that are in the vicinity of the proposed longwalls;
- Provide subsidence predictions at each of these natural features and items of surface infrastructure;
- Provide impact assessments, in conjunction with other specialist consultants, for each of these natural features and items of surface infrastructure; and to
- Provide information on the measures that can be implemented to manage potential impacts.

This report is structured as follows:

Chapter 1 provides an introduction, outlines the Project, presents the purpose of the report, and provides the base information on the mine layout, surface topography, seam and geological information.

Chapter 2 defines the *Subsidence Study Area* and provides a list of the natural features and items of surface infrastructure that have been identified within the *Subsidence Study Area*.

Chapter 3 includes an overview of conventional and non-conventional subsidence movements and the methods that have been used to predict these movements resulting from the extraction of the proposed longwalls.

Chapter 4 provides the maximum predicted subsidence parameters resulting from the extraction of the proposed longwalls.

Chapters 5 to 11 provide descriptions, predictions and impact assessments for each of the natural features and items of surface infrastructure that have been identified within the *Subsidence Study Area*. Recommendations for each of these features are also provided, which have been based on the predictions and impact assessments.

1.3. Mining Geometry

The proposed LWs S1A to S6A are shown in Drawing No. MSEC1192-01. A summary of the proposed longwall dimensions is provided in Table 1.1.

Table 1.1 Geometry of the proposed Longwalls S1A to S6A compared to EIS Layout

Layout	Longwall	Overall void length including installation heading (m)	Overall void width including first workings (m)	Overall tailgate chain pillar width (m)
Extraction Plan LWs S1A to S6A	LW S1A	1,711	283	-
	LW S2A	1,768	285	38
	LW S3A	1,808	285	36
	LW S4A	1,860	285	36
	LW S5A	1,949	285	36
	LW S6A	1,999	285	36
EIS Layout (MSEC1123)	LW101A	1,715	283	-
	LW102A	1,730	283	38
	LW103A	1,745	283	38
	LW104A	1,760	283	38
	LW105A	1,800	283	38
	LW106A	1,845	283	38

Table 1.1 also compares the proposed mining geometries with the geometries provided in the EIS. The minor changes in panel and pillar widths result in minor changes in predicted subsidence movements, which are discussed in Section 4.2 of this report.

The commencing ends of LWs S1A to S6A have been aligned compared to the previous staggered layout. The outcome of the change is that LWs S2A to S6A have been extended in length by up to 154 metres. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted in the EIS layout.

1.4. Surface topography

The surface level contours in the vicinity of the proposed longwalls are shown in Drawing No. MSEC1192-02. They were generated from 2012 and 2013 airborne laser scans of the area.

The ground surface within the *Subsidence Study Area*, as is defined in Section 2.1, is generally undulating with a fall from the south-west to the north-east. The major topographical feature within the *Subsidence Study Area* is Teatree Hollow. The major topographical feature near the *Subsidence Study Area* is the Bargo River valley, which is located to the north of the *Subsidence Study Area*.

The surface levels near the Subsidence Study Area vary from a low point of approximately 265 metres AHD, in the base of Teatree Hollow, downstream from of the proposed Longwall S1A, to a high point of approximately 345 metres AHD, at the south-western end of the *Subsidence Study Area* to the south-west of the proposed LW S6A.

1.5. Seam information

The seam roof contours, seam thickness contours and depth of cover contours, for the Bulli seam, have been provided by Tahmoor Coal and are shown in Drawing Nos. MSEC1192-03, MSEC1192-04 and MSEC1192-05, respectively.

Fig. 1.3 shows the surface, Bulli seam levels and proposed extraction heights across the proposed mining area along Cross-Section 1. The location of this section is shown in Drawings Nos. MSEC1192-02 and MSEC1192-03.

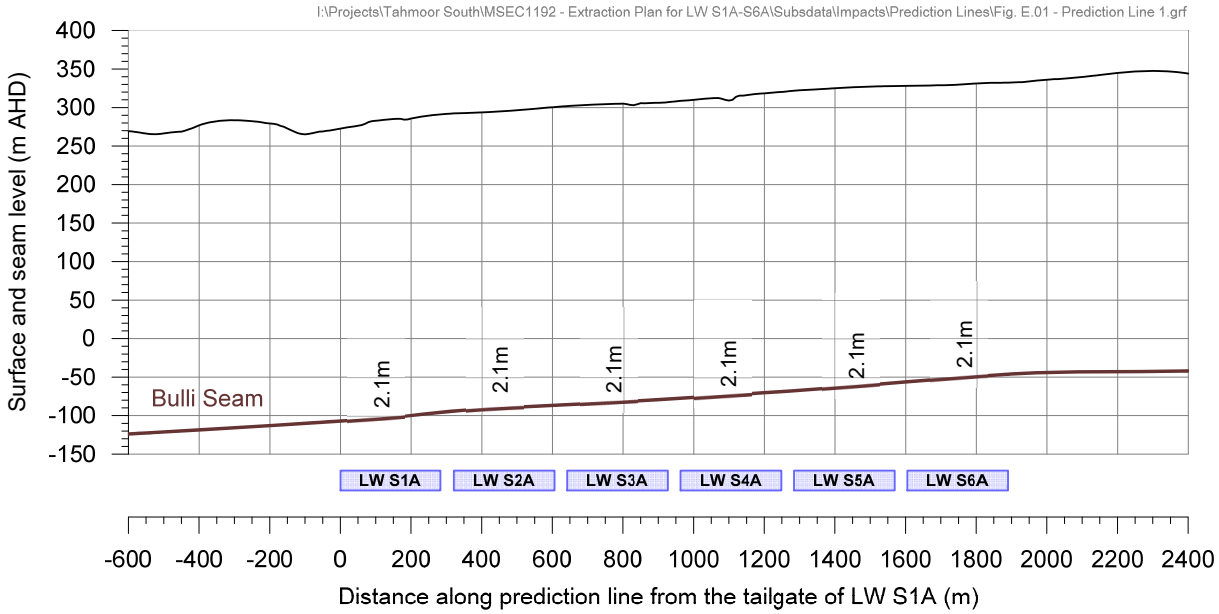


Fig. 1.3 Cross-section 1 through LWs S1A to S6A

The Bulli seam within the Subsidence Study Area generally dips from the south-west to the north-east, as shown by the seam roof contours in Drawing No. MSEC1192-03. The seam roof contours show the presence of several major faults which are discussed further in the next section of this report.

The planned Bulli seam extraction heights, i.e. the height of the Bulli seam that is to be mined, vary from a minimum extraction height of 2.1 metres to a maximum extraction height of 2.2 metres, as is shown in Drawing No. MSEC1192-04. Depending on the strength of floor under the longwall chocks, these extraction heights are planned to include parts of the stone roof, a stone band, a shaly coal layer and some stone floor and, as a result, the subsidence calculations in this report have assumed that these stone partings in both the floor and the roof will be extracted. This planned working section, including the stone partings in the floor and roof, is also shown in Fig. 1.4.

The depth of cover contours to the Bulli seam vary from a minimum of approximately 365 metres beneath a tributary to the Bargo River directly above the proposed LW S5A to a maximum of approximately 410 metres above proposed LW S1A as shown in Drawing No. MSEC1192-05.

1.6. Geological details

Tahmoor Mine lies in the southern part of the Permo-Triassic Sydney Basin, within which the main coal bearing sequence is the Illawarra Coal Measures, of Late Permian age. The Illawarra Coal Measures contain four workable seams, the uppermost of which is the Bulli seam, and it is this seam from which coal is proposed to be extracted as part of the proposed development.

The sediments that form the overburden to the Bulli seam belong to the Hawkesbury Tectonic Stage, which comprises three stratigraphic divisions. The lowest division is the Narrabeen Group, which is subdivided into a series of interbedded sandstone and claystone units. It ranges in age from Lower to Middle Triassic and varies in thickness up to 310 metres. Overlying the Narrabeen Group is the Hawkesbury Sandstone Group, which is a series of bedded sandstone units which dates from the Middle Triassic and has a thickness of up to 185 metres. Above the Hawkesbury is the Wianamatta Group, which consists of shales and siltstones and is poorly represented in this region, having a thickness of only a few tens of metres.

A typical stratigraphic section for the Southern Coalfield area is shown in Fig. 1.4, courtesy of McElroy Bryan Geological Services, (MBGS, 2013) and a west to east stratigraphic geological section is shown in Fig. 1.5 below, which is also available courtesy of MBGS.

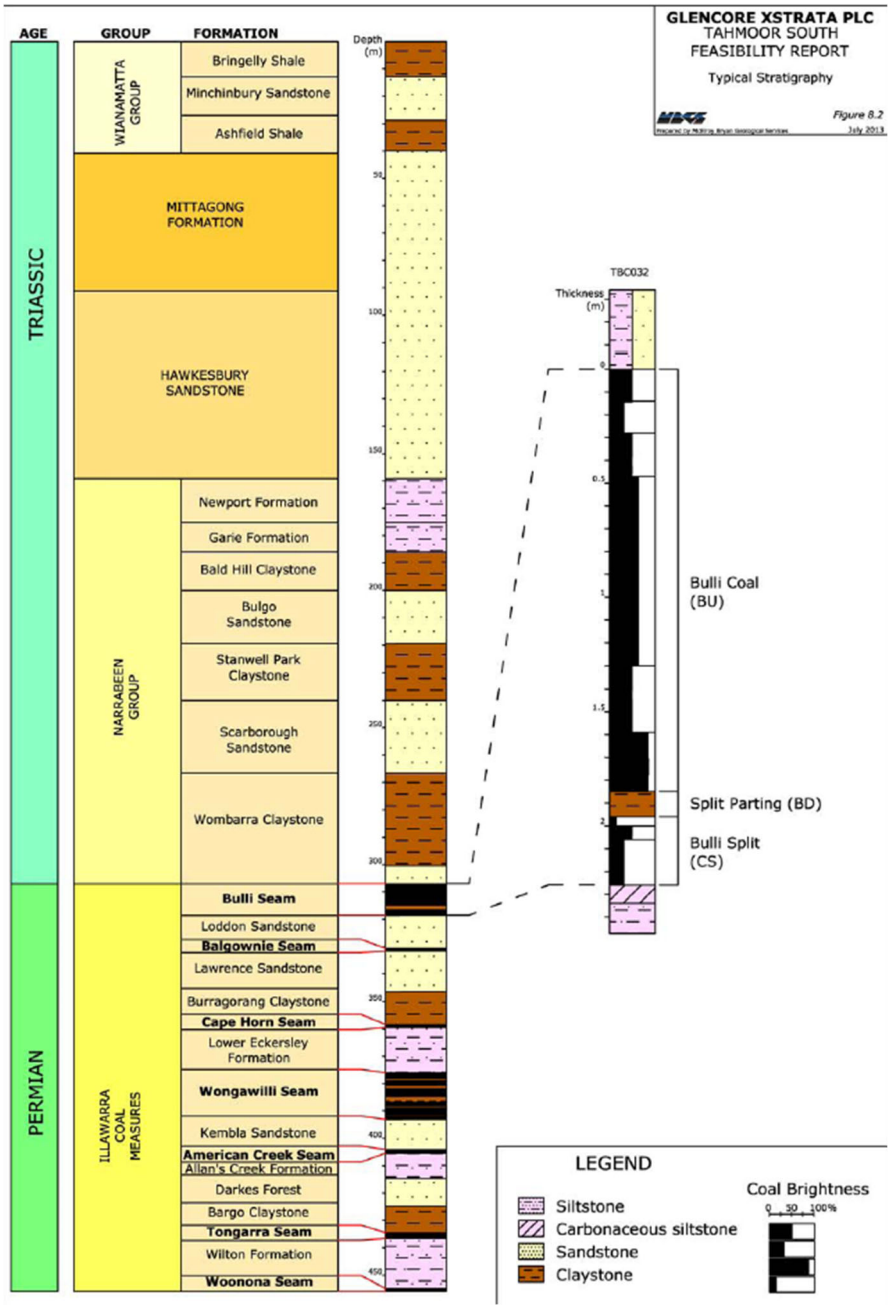


Fig. 1.4 Typical stratigraphic section – Southern Coalfield (MBGS, 2013)

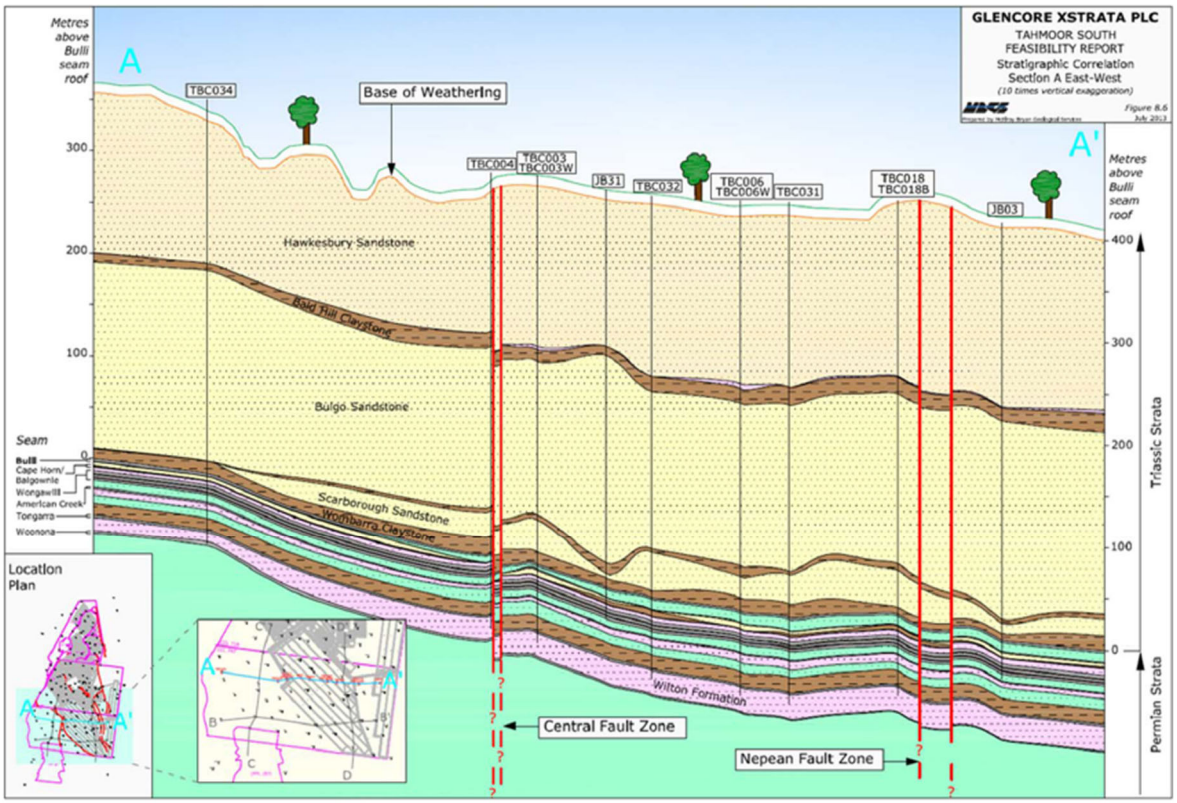


Fig. 1.5 West to east geological cross-section through western, central and eastern domains

The major sandstone units are interbedded with other rocks and, though shales and claystones are quite extensive in places, the sandstone predominates. The major sandstone units are the Scarborough (Narrabeen Group), the Bulgo (Narrabeen Group) and the Hawkesbury Sandstones (Hawkesbury Sandstone Group) and these units vary in thickness from a few metres to as much as 200 metres. The rocks exposed in the river gorges and creek alignments within the *Subsidence Study Area* belong to the Hawkesbury Sandstone Group. The other rocks generally exist in discrete but thinner beds of less than 15 metres thickness or are interbedded as thin bands within the sandstone.

The major claystone unit is the Bald Hill Claystone, which lies above the Bulgo Sandstone and at the base of the Hawkesbury Sandstone. As shown in Fig. 1.5 above, the base of the Bald Hill Claystone is between 180 metres to 220 metres above the Bulli Seam. This claystone unit varies in thickness and is, in some places, more than 25 metres thick. The Bald Hill Claystone has been described in the literature as an aquitard (e.g. the Independent Inquiry report entitled "*Strategic Review of Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield*", (Southern Coalfield Inquiry Report), which was published in July 2008, (NSW DPIE, 2008), and detailed information on this claystone and other claystone and siltstone units within the overburden are provided in the reports by SCT (2013a) and SLR (2022a).

1.7. Geological structures

Tahmoor Mine has undertaken comprehensive geological exploration of the overburden and the Illawarra Coal Measures within the *Subsidence Study Area* using several geological and geotechnical consultants (MBGS, 2013; Gordon Geotechniques, 2013; SCT, 2013a) and a number of geological structures have been identified.

Several fault structures were identified and the two main structures that separate the mining domains are the Nepean Fault zone and the Central Fault zone. These and other identified faults and igneous intrusions are shown in Drawing No. MSEC1192-06. MBGS (2013) reviewed 205 drill holes in the Tahmoor area for Tahmoor Coal of which 72 drill holes were in Tahmoor South. Additionally, an extensive array of seismic survey lines (140 km) were completed over recent years and combined this data provides sufficient data to have a sound understanding of overall deposit geometry, structural features likely to impact on mining, seam gas and raw coal quality characteristics within the Bulli Seam.

The Nepean Fault zone is the major structural feature in the Tahmoor complex and it marks the eastern boundary to the existing mining operations at Tahmoor Mine. The MBGS (2013) advises that the Nepean Fault zone runs in an approximate North-South direction and is a normal fault system which appears to exhibit en echelon style. Seismic surveys indicate the fault zone within the Tahmoor South area comprises many near vertical faults with overall displacement in the order of 10 metres to 15 metres and has a varying width of approximately 350 metres wide. A report by Gordon Geotechniques (2013), quoted two other reports, Lohe, et al., (1992), advising that the Nepean Fault was a high angle westerly dipping reverse fault and SEA, (2002), advising that the Nepean Fault was a series of reverse and normal faults. Gordon Geotechniques noted that the Nepean Fault zone was up to 200 metres wide with the western side of the fault being more disturbed than the eastern side. The proposed LWs S1A to S6A are not located near the Nepean Fault complex.

The Central Fault zone, which lies to the west and south of the proposed longwalls, was described by MBGS as a normal fault trending northwest with vertical displacement up to 20 metres, east side up. This fault was identified in the 2D seismic lines and was also intercepted in one drill hole (JB06) where the Wongawilli Seam has been displaced. The Gordon Geotechniques report advised that this Central Fault zone was associated with a number of features including a change in Bulli Seam fluidity and thinning of the Balgownie to Bulli Seam interburden. The Central Fault has a surface expression which affects Hornes Creek as it flows into the Bargo River.

It is noted that while comprehensive drilling and seismic exploration has been carried out, further in-seam drilling is planned to be undertaken and additional smaller geological structures may be discovered at that time. Further discussion on the influence of faulting on mining induced subsidence movements is presented in Chapters 3, 4 and 6.

The surface geology within the Study Area, as is defined in Section 2.1, is shown in Fig. 1.6, which presents the proposed longwalls overlaid on Geological Series Sheet 9029, (Geological Survey of NSW, NSW Government, 1999).

It can be seen from Fig. 1.6 that the majority of surface geology within the Study Area comprises the Hawkesbury Sandstone Group (Rh), with the Wianamatta Group, (Rw) located near the finishing ends of LWs S1A and S2A.

Hawkesbury Sandstone Group (Rh) is exposed along the majority of streams within the *Subsidence Study Area*.

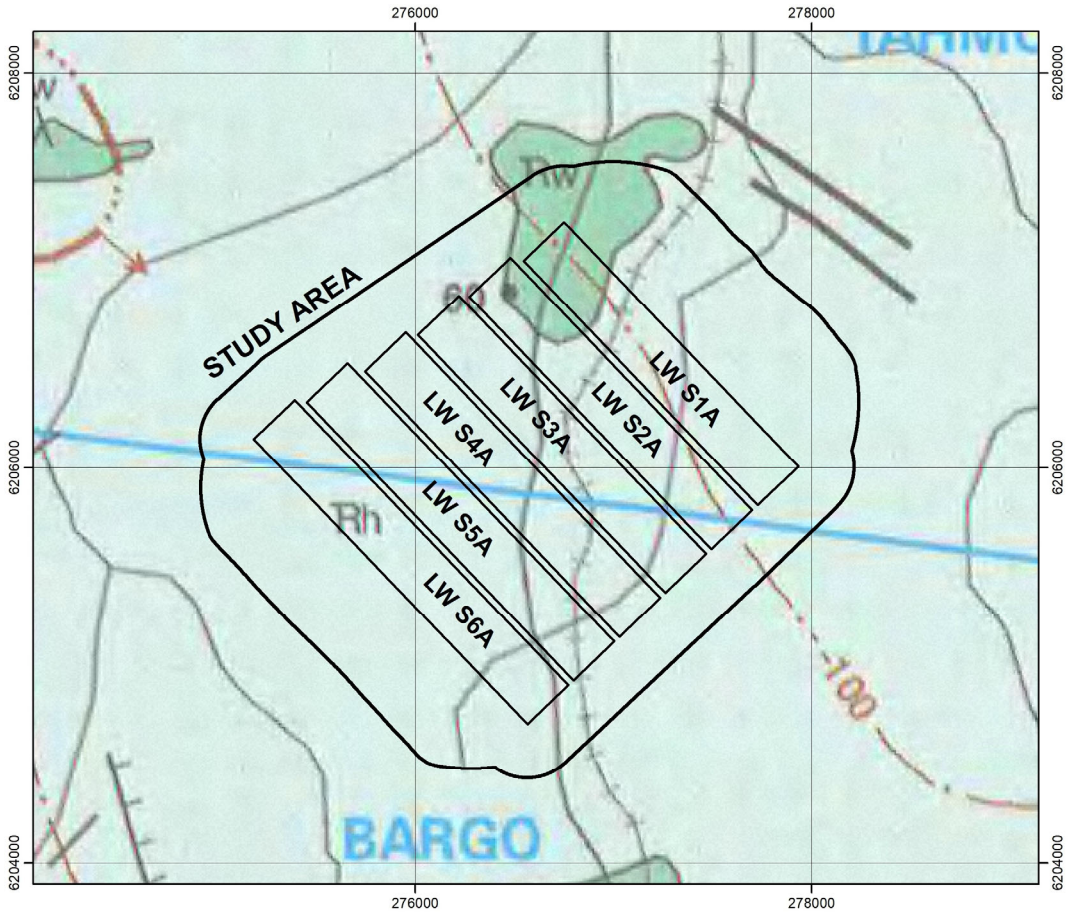


Fig. 1.6 Surface geology within the Study Area (DTIRIS, Geological Series Sheet 9029-9129)

2.1. Definition of the Subsidence Study Area

The *Subsidence 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 LWs S1A to S6A.

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

- A 35° angle of draw from the extents of LWs S1A to S6A;
- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour, resulting from the extraction of LWs S1A to S6A; and
- Features that could experience far-field or valley-related movements and could be sensitive to such movements.
- For natural features, the *Subsidence Study Area* has been extended to a minimum of 600 metres from the extents of LWs S1A to S6A, 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 are shown in Drawing No. MSEC1192-05. The depths of cover directly above LWs S1A to S6A vary between 375 m and 410 m. The 35° angle of draw, therefore, has been determined by drawing a line that is a horizontal distance varying between 260 m and 290 m around the extent of the longwall mining area.

The predicted limit of vertical subsidence, taken as the predicted total 20 mm subsidence contour, has been determined using the Incremental Profile Method, which is described in Chapter 3. The predicted 20 mm subsidence contour has been calibrated to account for measured subsidence in the northern areas of the existing Tahmoor Mine and the measured values were based on detailed ground surveys that were carried out using remote stable datum points. In some cases, the predicted 20 mm subsidence contour extends to 600 metres from the nearest edge of longwalls.

The extent of the *Subsidence Study Area* has therefore been drawn with a line around the longwalls based on whichever of the above limits extended the furthest from the proposed mining area. The extent of the *Subsidence Study Area* is shown in Drawings MSEC1192-01.

Additionally, it was found that there may be areas that are outside this line showing the extent of the *Subsidence Study Area* that could experience either far-field movements, or valley-related upsidence and closure movements. Some surface features have been identified that may be sensitive to such movements and, hence, impact assessments have been provided in this report for all the surface features or items of infrastructure that are outside the *Subsidence Study Area* and could be impacted by these far-field movements, or valley-related upsidence and closure movements.

The features that are located beyond the *Subsidence Study Area* for LWs S1A to S6A that could be sensitive to impacts from such movements are shown in Drawing MSEC1192-01 and are listed below. The descriptions and impact assessments for each of these natural features or items of infrastructure are provided in later sections of the report:-

- 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 940 metres from LW S6A;
- Streams, within the predicted limits of 20 mm total upsidence and 20 mm total closure;
- Groundwater bores; and
- Survey control marks.

2.2. Natural Features and items of surface infrastructure within the Subsidence Study Area

The major natural features and items of surface infrastructure within the *Subsidence Study Area* can be seen in the 1:25,000 Topographic Maps of the area, published by the Central Mapping Authority (CMA), numbered PICTON 9029-4-S and BARGO 9029-3-N. The proposed longwalls and the *Subsidence Study Area* have been overlaid on an extract of this CMA map in Fig. 2.1.

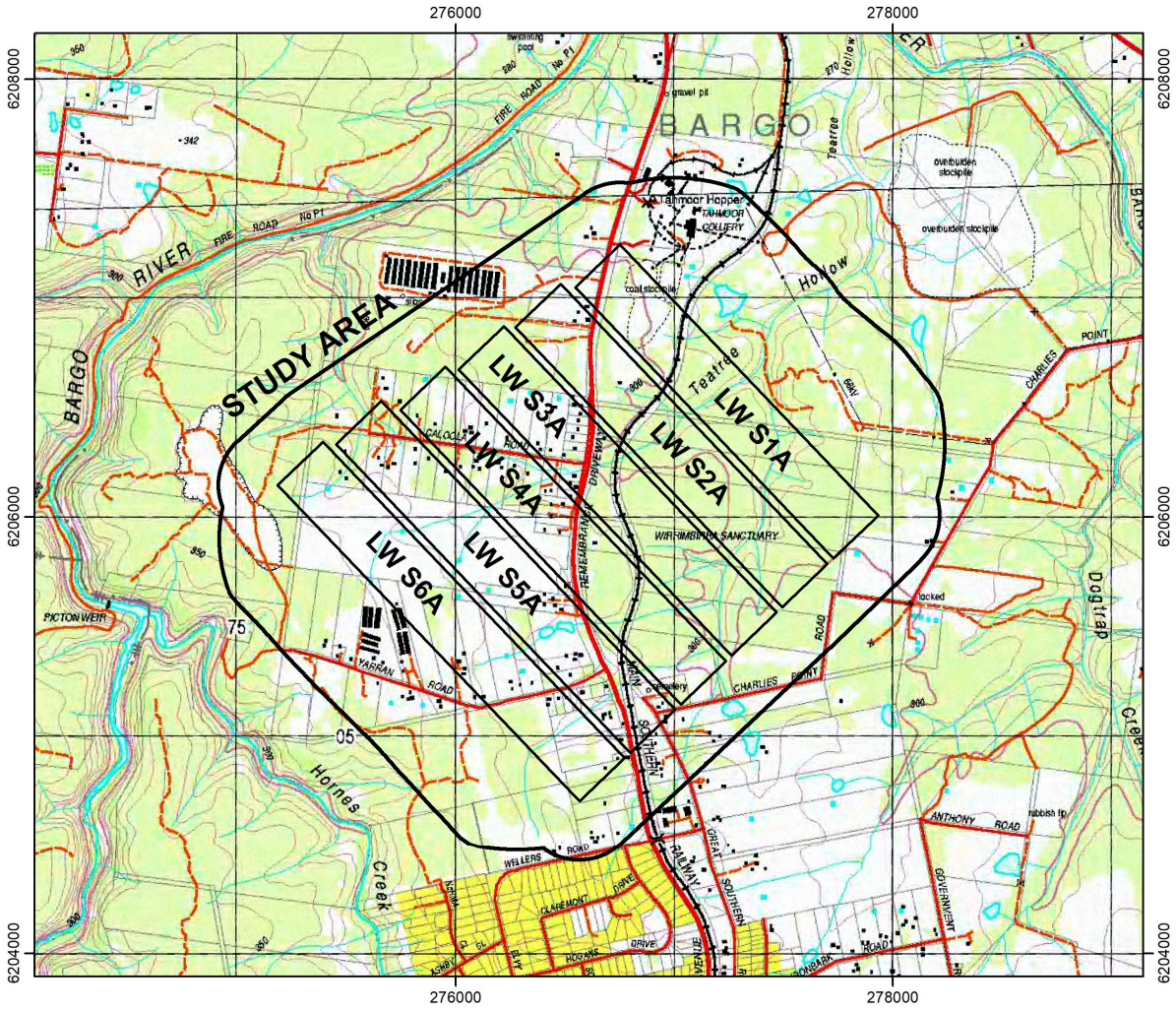


Fig. 2.1 The proposed longwalls and the Subsidence Study Area overlaid on CMA Map No. Bargo 9029-3-N

A summary of the natural features and items of surface infrastructure within the *Subsidence Study Area* is provided in Table 2.1. The locations of these features are shown in Drawing Nos. MSEC1192-07 to MSEC1192-21, in Appendix F.

Descriptions, predictions and impact assessments for the natural features and items of surface infrastructure are provided in Chapters 5 though to 11. The relevant chapter and section number references in this report that address these features and items are provided in Table 2.1.

Table 2.1 Natural features and surface infrastructure

Item	Within *Study Area*	Section Number Reference
NATURAL FEATURES		
Catchment Areas or Declared Special Areas	×	
Rivers or Creeks	✓	5.2 & 5.3
Aquifers or Known Groundwater Resources	✓	8.11
Springs	×	
Sea or Lake	×	
Shorelines	×	
Natural Dams	×	
Cliffs or Pagodas	✓	5.4
Steep Slopes	✓	5.5
Escarpments	×	
Land Prone to Flooding or Inundation	✓	5.7
Swamps, Wetlands or Water Related Ecosystems	×	
Threatened or Protected Species	✓	5.9
National Parks	×	
State Forests	×	
State Conservation Areas	×	
Natural Vegetation	✓	5.12
Areas of Significant Geological Interest	×	
Any Other Natural Features Considered Significant	✓	5.14
PUBLIC UTILITIES		
Railways	✓	6.1
Roads (All Types)	✓	0
Bridges	✓	6.4
Tunnels	×	
Culverts	✓	6.1 & 0
Water, Gas or Sewerage Infrastructure	✓	0, 6.7 & 6.8
Liquid Fuel Pipelines	×	
Electricity Transmission Lines or Associated Plants	✓	6.9
Telecommunication Lines or Associated Plants	✓	6.10
Water Tanks, Water or Sewage Treatment Works	✓	0
Dams, Reservoirs or Associated Works	✓	6.11
Air Strips	×	
Any Other Public Utilities	×	
PUBLIC AMENITIES		
Hospitals	×	
Places of Worship	✓	7.4
Schools	✓	0
Shopping Centres	×	
Community Centres	×	
Office Buildings	×	
Swimming Pools	×	
Bowling Greens	×	
Ovals or Cricket Grounds	✓	7.11
Race Courses	×	
Golf Courses	×	
Tennis Courts	✓	7.14
Any Other Public Amenities	✓	7.15

Item	Within *Study Area*	Section Number Reference
FARM LAND AND FACILITIES		
Agricultural Utilisation or Agricultural Suitability of Farm Land	✓	8.1
Farm Buildings or Sheds	✓	8.2
Tanks	✓	8.3
Gas or Fuel Storages	✓	8.4
Poultry Sheds	✓	0
Glass Houses	×	
Hydroponic Systems	✓	8.7
Irrigation Systems	✓	8.8
Fences	✓	8.9
Farm Dams	✓	8.10
Wells or Bores	✓	8.11
Any Other Farm Features	×	
INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS	×	
Factories	×	
Workshops	✓	9.1
Business or Commercial Establishments or Improvements	✓	9.1
Gas or Fuel Storages or Associated Plants	✓	9.2
Waste Storages or Associated Plants	×	
Buildings, Equipment or Operations that are Sensitive to Surface Movements	×	
Surface Mining (Open Cut) Voids or Rehabilitated Areas	×	
Mine Infrastructure Including Tailings Dams or Emplacement Areas	✓	9.3
Any Other Industrial, Commercial or Business Features	×	
AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE	✓	10.1 & 0
ITEMS OF ARCHITECTURAL SIGNIFICANCE	×	
PERMANENT SURVEY CONTROL MARKS	✓	6.12
RESIDENTIAL ESTABLISHMENTS		
Houses	✓	11.1
Flats or Units	✓	11.2
Caravan Parks	✓	0
Retirement or Aged Care Villages	×	
Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	✓	11.5 11.5.6 9.3 11.5.8
Any Other Residential Features	×	
ANY OTHER ITEM OF SIGNIFICANCE	×	
ANY KNOWN FUTURE DEVELOPMENTS	×	

2.3. Bargo Mine Subsidence District and the role of Subsidence Advisory NSW

The *Subsidence Study Area* is located within the Bargo Mine Subsidence District as proclaimed in 1975 and 1994.

Subsidence Advisory NSW (SA NSW) is the NSW Government agency responsible for administering the *Coal Mine Subsidence Compensation Act 2017.* SA NSW has two core functions:

1. To provide compensation or manage the provision of compensation where surface developments are damaged by mine subsidence following extraction of coal or shale in NSW; and
2. To regulate surface development within mine subsidence districts to reduce the risk of mine subsidence damage.

SA NSW provides expert advice to property owners, government departments, councils, community organisations and industries within coal mining areas of NSW. This advice aims to provide compatibility between surface development and underground mining.

The owners of buildings or other surface improvements damaged by mine subsidence can lodge claims for compensation through SA NSW. Currently, under the Coal Mine Subsidence Compensation Act 2017, any claim for mine subsidence damage needs to be lodged with SA NSW. SA NSW staff will arrange for the damage to be assessed by an independent specialist assessor. If the damage is attributable to mine subsidence, a scope of repairs will be prepared and compensation will be determined.

Proposed development in mine subsidence districts requires SA NSW approval. SA NSW sets building and construction requirements to protect buildings and other surface improvements from subsidence damage. These requirements cover the nature and class of improvements, including height, type of building materials used and the construction method.

SA NSW has the power to issue stop work notices to prevent illegal construction in mine subsidence districts, and any improvements erected without SA NSW's approval, or contrary to an approval are not eligible for compensation.

Further information about SA NSW's services is available at www.subsidenceadvisory.nsw.gov.au.

3.1. Introduction

This chapter provides a brief overview of; longwall mining; the development of mine subsidence and the methods that have been used to predict the mine subsidence movements resulting from the extraction of the longwalls. Further details on longwall mining, the development of subsidence and the methods used to predict mine subsidence movements can be obtained in the background reports entitled *Introduction to Longwall Mining and Subsidence* and *General Discussion on Mine Subsidence Ground Movements* which can be obtained from *www.minesubsidence.com*.

3.2. Overview of longwall mining

The proposed development at Tahmoor Mine is to continue mining coal using the longwall mining method. A typical cross-section at a coal face showing a typical longwall shearer and roof supports and showing typical immediate floor and roof strata, is sketched in Fig. 3.1.

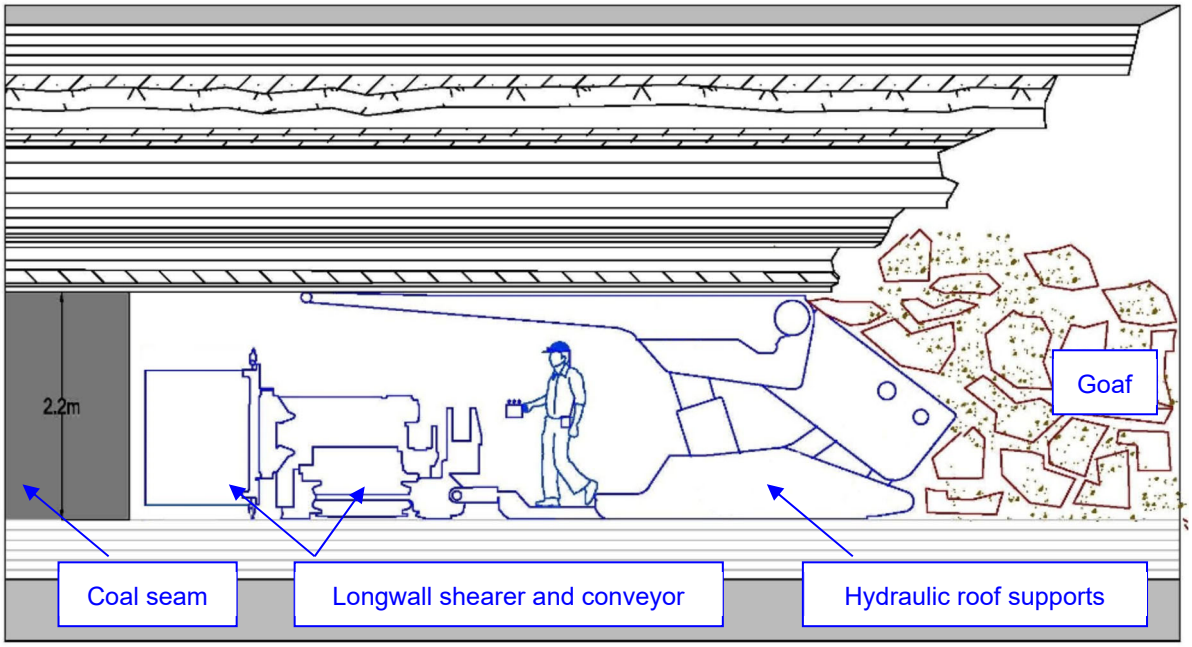


Fig. 3.1 Cross-section along the length of a typical longwall at the coal face

The coal is removed by a shearer, which cuts the coal from the coal face on each pass as it traverses the width of the longwall. The roof at the coal face is supported by a series of hydraulic roof supports, which temporarily hold up the roof strata, and provide a secure working space at the coal face. The coal is then transported by a face conveyor belt which is located behind and beneath the shearer. As the coal is removed from each section of the coal face, the hydraulic supports are stepped forward, and the coal face progresses (retreats) along the length of the longwall.

The strata directly behind the hydraulic supports, immediately above the coal seam, collapses into the void that is left as the coal face retreats. The collapsed zone, often called the goaf, comprises loose blocks and can contain large voids. Immediately above this collapsed zone, the strata remain relatively intact and bends into the goaf, resulting in new vertical factures and the opening up of existing vertical fractures and creation of bed openings or separations. The amount of fracturing, strata sagging and bedding plan separation reduces for the overlying strata that are higher up again that is up towards the surface.

At the surface, the ground subsides vertically and moves horizontally towards the centre of the mined goaf area. The maximum subsidence at the surface varies, depending on a number of factors including longwall geometry, depth of cover, extracted seam thickness, extent and proximity of previously extracted panels and seams and the overburden geology. The maximum subsidence in the Southern Coalfield, within a single seam and for a single panel of supercritical critical width of extraction, that is the panel width is much wider than the depth of cover, is generally about 65 % of the extracted seam thickness.

3.3. Overview of conventional subsidence parameters

The normal ground movements resulting from the extraction of longwalls are referred to as conventional or systematic subsidence movements. These movements are described by the following parameters:-

- **Subsidence** usually refers to vertical displacement of a point, but subsidence of the ground includes both vertical and horizontal displacements. These horizontal displacements in some cases, where the subsidence is small beyond the longwall goaf edges, can be greater than the vertical subsidence.
- Unlike mining induced vertical subsidence, which has a magnitude only, **Horizontal Displacements** have both a magnitude and a direction, i.e. they can be referred to as a vector. Early researchers generally only measured and predicted vertical subsidence and ground strains and rarely measured or predicted the horizontal displacements of points. Subsidence and horizontal movements are usually expressed in units of *millimetres (mm)*.
- **Tilt** is the change in the slope of the ground as a result of differential subsidence and is calculated as the change in subsidence between two points divided by the distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of *millimetres per metre (mm/m)*. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %, or 1 in 1000.
- **Curvature** is the bending of the ground as a result of differential subsidence and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the **Radius of Curvature** with the units of *1/kilometres (km^{-1})*, but the values of curvature can be inverted, if required, to obtain the radius of curvature, which is usually expressed in *kilometres (km)*.
- **Strain** is the relative differential horizontal movements of the ground. **Normal strain** is calculated as the change in horizontal distance between two points on the ground, divided by the original horizontal distance between them. Strain is typically expressed in units of *millimetres per metre (mm/m)*. **Tensile strains** occur where the distance between two points increases and **Compressive strains** occur when the distance between two points decreases. So that ground strains can be compared between different locations, they are typically measured over bay lengths that are equal to the depth of cover between the surface and seam divided by 20. When strains are measured over longer bay lengths lower averaged values are generally observed.

  Whilst mining induced normal strains are measured along monitoring lines, **ground shearing** can also occur both vertically and horizontally across the directions of monitoring lines. Most of the published mine subsidence literature discusses the differential ground movements that are measured along subsidence monitoring lines, however, differential ground movements can also be measured across monitoring lines using 3D survey monitoring techniques.
- **Horizontal shear deformation** across monitoring lines can be described by various parameters including horizontal tilt, horizontal curvature, mid-ordinate deviation, angular distortion and shear index. However, is not possible to determine the horizontal shear strain across a monitoring line using standard 2D or 3D monitoring techniques. High deformations along monitoring lines (i.e. normal strains) are generally measured where high deformations have been measured across the monitoring line (i.e. shear deformations) and vice versa.

High resolution surveying techniques using GPS technology and satellite based differential interferometry are providing far more data and a much better basis for understanding the extent and the mechanics of the mining induced vertical and horizontal ground movements. Modern surveyors now provide the current easting, northing and reduced level of each installed peg from which three-dimensional subsidence and mining induced horizontal movements and directions can be derived for each epoch. Because of these improvements in subsidence surveying our understanding of both the magnitude and direction of mining induced vertical and horizontal ground movements and the lateral extent of these mining induced ground movements has improved substantially.

The **total** subsidence, tilts, curvatures and strains are the accumulated parameters which result from the extraction of a series of longwalls. **Incremental** subsidence, tilts, curvatures and strains are the additional movements due to the extraction of each longwall and are determined from monitored data by subtracting the movements monitored before a longwall was mined from the movements monitored after that longwall was mined. The **travelling** tilts, curvatures and strains are the transient movements as the longwall extraction face mines directly beneath a given point.

Residual subsidence is defined as the additional, time-dependent subsidence that develops after active mining has been completed or has moved sufficiently far enough away from the affected area to no longer have an immediate influence. As the amount of subsidence being measured reduces asymptotically to smaller and smaller levels, the shrinking and swelling of the soil due to changes in moisture content and the survey accuracy can form a large proportion of the measured subsidence.

3.4. Overview of conventional and non-conventional subsidence movements

Some subsidence terms and definitions were first published in an Independent Inquiry report entitled "*Strategic Review of Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield*", (Southern Coalfield Inquiry Report), which was published in July 2008, (NSW DP, 2008). The terms and definitions draw a distinction between subsidence effects, subsidence impacts, environmental consequences, consequences, secondary consequences, conventional effects and non-conventional effects.

Conventional subsidence profiles are typically smooth in shape and can be explained by the expected caving mechanisms associated with overlying strata spanning the extracted void. Normal conventional subsidence movements due to longwall extraction are easy to identify where longwalls are regular in shape, the extracted coal seams are relatively uniform in thickness, the geological conditions are consistent and surface topography is relatively flat.

As a general rule, the smoothness of the profile is governed by the depth of cover and lithology of the overburden, particularly the near surface strata layers. Where the depth of cover is greater than 400 metres, such as the case within the Study Area, the observed subsidence profiles along monitoring survey lines are generally smooth. Where the depth of cover is less than 100 metres, the observed subsidence profiles along monitoring lines are generally irregular. Very irregular subsidence movements are observed with much higher tilts, curvatures and strains at very shallow depths of cover where the collapsed zone above the extracted longwalls extends up to or near to the surface.

Irregular subsidence movements are occasionally observed at the deeper depths of cover along an otherwise smooth subsidence profile. The cause of these irregular subsidence movements can be associated with:-

- sudden or abrupt changes in geological conditions;
- steep topography; and
- valley related mechanisms.

Non-conventional movements due to geological conditions, steep topography and valley related movements are discussed in the following sections.

3.4.1. Non-conventional subsidence movements due to changes in geological conditions

For those sites where the depth of cover is less than 100 metres, the observed subsidence profiles along monitoring lines are generally irregular with much higher tilts, curvatures and strains principally because the collapsed zone has extended up to or near to the surface. Where the depth of cover is around 400 metres, as is the case over most of the *Subsidence Study Area*, the observed subsidence profiles along monitoring survey lines will generally be smooth as is typical in the Southern Coalfields. However, irregular subsidence movements can occasionally be observed at these deeper depths of cover along an otherwise smooth subsidence profile and these localised irregular subsidence movements, that are called non-conventional subsidence movements, are often associated with sudden or abrupt changes in geological conditions, steep topography, and valley related mechanisms.

Accordingly, non-conventional subsidence movements may occur or could be expected within the river and creek valleys, near the major fault zones, near the outcrop of the interface between sandstone and shale strata layers. It is believed that most the unexpected irregular subsidence movements, i.e. the non-conventional ground movements, are a result of the reaction of near surface strata to increased horizontal compressive stresses due to mining operations. Some of the geological conditions that are believed to influence these irregular subsidence movements are the blocky nature of near surface sedimentary strata layers and the possible presence of unknown faults, dykes or other geological structures, cross bedded strata, thin and brittle near surface strata layers and pre-existing natural joints. The presence of these geological features near the surface can result in bumps in an otherwise smooth subsidence profile which are usually accompanied by locally increased tilts, curvatures and strains.

Even though it may be possible to attribute a reason behind many of the observed non-conventional ground movements, there remain some observed irregular ground movements that still cannot be explained with the available geological information. The term "anomaly" is therefore reserved for those non-conventional ground movement cases that were not expected to occur and cannot be explained by any of the above possible causes.

It is not possible to predict the locations and magnitudes of non-conventional anomalous movements. In some cases, approximate predictions for the non-conventional ground movements can be made where the underlying geological or topographic conditions are known in advance. It is expected that these methods will improve as further knowledge is gained through ongoing research and investigation.

In this report, the analyses of non-conventional ground movements have been carried out statistically in the predictions and impact assessments, by basing these on the frequency of past occurrence of both the

conventional and non-conventional ground movements and impacts. The analysis of strains provided in Section 4.3 includes those resulting from both conventional and non-conventional anomalous movements.

An analysis of observations during the mining of Tahmoor Longwalls 22 to 31 provides an indication of the spatial frequency of non-conventional movements, which is discussed in Section 4.7. The impact assessments for the natural features and items of surface infrastructure, which are provided in Chapters 5 through to 11, include a discussion of historical impacts resulting from previous longwall mining which have occurred as the result of both conventional and non-conventional subsidence movements.

3.4.2. Non-conventional subsidence movements due to valley related Movements

Valley bulging movements are a natural phenomenon, resulting from the formation and ongoing weathering, erosion and development of valleys, as illustrated in Fig. 3.2. These naturally occurring valley bulging movements include inward movement of the valley sides and the bulging or upwards movement of the valley floor. The potential for these natural movements are influenced by the geomorphology of valleys.

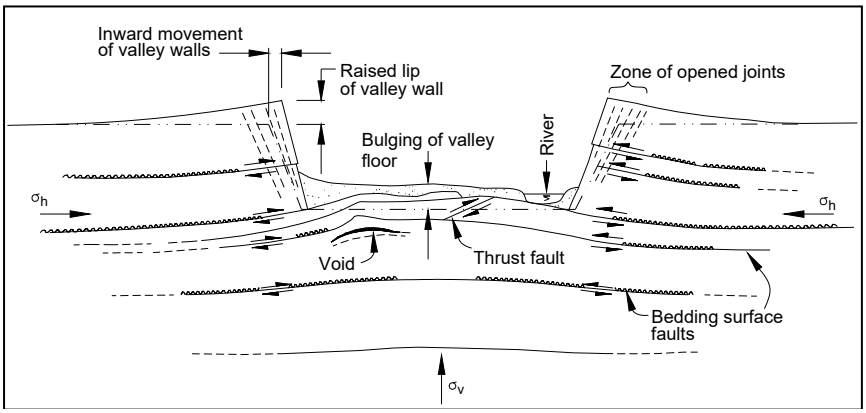


Fig. 3.2 Valley formation in flat-lying sedimentary rocks (after Patton and Hendren 1972)

The streams within the *Subsidence Study Area* may also be subjected to mining induced valley related movements, which result in similar consequences to the naturally occurring valley bulging movements that are discussed above. These mining induced valley closure result in closure movements across the valley and upsidence in the floor of the valley. The potential for these mining induced movements are influenced by the geomorphology of the valleys and the proximity and magnitude of the mining induced subsidence movements. As discussed in Section 3.4 and in the Southern Coalfield Inquiry Report (DPIE 2008), mining induced valley related movements are commonly observed across river and creek alignments in the Southern Coalfield and extensive studies have been carried out to predict the extent of these valley related movements.

As stated in the peer review by SCT (2014), a number of explanations of the mechanics of valley closure have been provided in the literature. Valley related movements are believed to be caused by the mining process through a number of different complex mechanisms and the relative contribution from each mechanism is expected to vary from case to case.

Valley related movements are normally described by the following parameters:-

- **Upsidence** is the reduced subsidence, or the relative uplift within a valley which results from the dilation or buckling of near surface strata at or near the base of the valley. The magnitude of upsidence, which is typically expressed in the units of *millimetres (mm)*, is the difference between the observed subsidence profile within the valley and the conventional subsidence profile which would have otherwise been expected in flat terrain.
- **Closure** is the reduction in the horizontal distances across the valley sides. The magnitude of maximum valley closure, which is typically expressed in the units of *millimetres (mm)* and is defined as the greatest reduction in distance between any two points on the opposing valley sides, is generally measured from pegs located at the top of the sides of the valley, however, sometimes the greatest closure is observed between pegs located in the base of the valley.
- **Compressive valley closure strains** occur within the bases of valleys as a result of valley closure and upsidence movements. **Tensile strains** tend occur in the sides and near the tops of the valleys as a result of valley closure movements. The magnitudes of these strains, which are typically expressed in the units of *millimetres per metre (mm/m)*, are calculated as the changes in horizontal distance over a standard bay length, divided by the original bay length.

The predicted valley related movements resulting from the extraction of the proposed longwalls were made using the empirical method outlined in Australian Coal Association Research Programme (ACARP) Research Project No. C9067 (Waddington and Kay, 2002). Further details can be obtained from the background report entitled *General Discussion on Mine Subsidence Ground Movements* which can be found at *www.minesubsidence.com*.

3.4.3. Non-conventional subsidence movements due to steep topography

Non-conventional movements can also result from slope instability movements where longwalls are extracted beneath steep slopes. In these cases, elevated tensile strains develop near the tops of the steep slopes and elevated compressive strains develop near the bases of the steep slopes. The potential impacts resulting from slope instability movements include the development of tension cracks at the tops and the sides of the steep slopes and compression ridges at the bottoms of the steep slopes. The term 'slope instability movements' is not intended to be confused with horizontal movements in a downslope direction, as correctly raised in the peer review by SCT (2014).

Further discussions on the potential for slope instability movements for the steep slopes within the *Subsidence Study Area* are provided in Section 5.5.

3.5. Far-field movements

The measured horizontal movements at survey marks which are located beyond the longwall goaf edges and over solid unmined coal areas are often much greater than the observed vertical movements at those marks. These movements are often referred to as *far-field movements*.

Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain. These movements generally do not result in impacts on natural features or surface infrastructure, except where they are experienced by large structures which are very sensitive to differential horizontal movements.

These observed far field horizontal movements appear to occur as a result of a number of mechanisms or components, however, the main mechanism thought to be responsible for the observed far-field movements in flat terrain is the partial relief or relaxation of the in situ horizontal stresses of the immediate strata around the goaf towards the goaf areas. For the strata around the goaf to expand towards the collapsed zone there has to be slippage along some bedding planes. It is agreed with the statements in the peer review by SCT (2014) that the shear horizon or horizons on which movement occurs is not necessarily at the level of the coal seam and may occur at one or many horizons within the overburden.

The extent to which a particular stratum can expand into the goaf is dependent on the height of the void formation, the dilation in the neighbouring strata and the elastic properties of each stratum, and hence, the horizontal expansion varies from stratum to stratum with the greatest expansion occurring near, or just above, seam level. The measured far-field horizontal movements on the surface would, therefore, be expected to increase wherever the in situ compressive stresses are higher and where the height and extent of the goaf is more extensive, i.e. where the mining activity is more extensive.

Where narrow sub-critical panels are being mined and the height of collapse may only extend part of the way up to the surface, the strata that is overlying the collapsed zone may be able accommodate increased horizontal stresses. However, around wide supercritical panels where the cracking and goafing can extend up to the surface, there would be greater disturbance to the strata over the goaf and less stiffness within the collapsed strata to accommodate increased horizontal stresses. It is likely therefore that greater redistribution of in situ horizontal stresses would occur under and around these supercritical panels, greater stress relief and far field movements can occur towards these supercritical panels and these far field movements would extend well beyond a mined area before equilibrium is regained in the rock mass.

An empirical database of observed incremental far-field horizontal movements has been compiled using monitoring data from the NSW Coalfields, but predominately the database includes measurements from the Southern Coalfield. The far-field horizontal movements resulting from longwall mining are generally observed to be orientated towards the extracted longwall. At very low levels of far-field horizontal movements, however, there was a higher scatter in the orientation of the observed movements.

Far-field horizontal movements can be predicted with reasonable accuracy and the method used to predict such movements are described further in Section 4.6.

3.6. The Incremental Profile Method (IPM)

The predicted conventional subsidence parameters due to the extraction of the proposed longwalls were determined using the Incremental Profile Method (IPM), which was developed by MSEC in 1994, when formally known as Waddington Kay and Associates. This method is an empirical model based on a large database of observed subsidence monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of New South Wales and the Bowen Basin in Queensland.

The database of detailed subsidence monitoring data from various coalfields includes data from the following Collieries or Mines: Abel, Angus Place, Appin, Ashton, Awaba, Austar, Baal Bone, Bellambi, Beltana, Blakefield South, Bulga, Bulli, Burwood, Carborough Downs, Chain Valley, Clarence, Coalcliff, Cook, Cooranbong, Cordeaux, Corrimal, Crinum, Cumnock, Dartbrook, Delta, Dendrobium, Donaldson, Eastern Main, Ellalong, Elouera, Fernbrook, Glennies Creek, Grasstree, Gretley, Grosvenor, Invincible, John Darling, Kenmare, Kemira, Kestrel, Lambton, Liddell, Mandalong, Metropolitan, Moranbah North, Mt. Kembla, Munmorah, Narrabri, Nardell, Newpac, Newstan, Newvale, Newvale 2, NRE Wongawilli, Oaky Creek, Ravensworth, South Bulga, South Bulli, Southern, Springvale, Stockton Borehole, Tasman, Teralba, Tahmoor, Tower, Wambo, Wallarah, Western Main, Ulan, United, West Cliff, West Wallsend, and Wyee.

Observed incremental subsidence profiles show the additional subsidence that resulted from the extraction of an individual longwall panel and these can be derived by subtracting the observed subsidence profiles of points along monitoring lines before mining from the observed subsidence profiles after mining. Reviews of the available incremental and total subsidence profiles showed that, whilst the final observed total subsidence profiles measured over a series of longwalls were irregular, the observed incremental subsidence profiles due to the extraction of individual longwalls were more consistent in both shape and magnitude.

The observed incremental subsidence at a point has been shown to vary according to local geology, depth of cover, panel width, the pillar widths, the extracted seam thickness, the extent and proximity of adjacent previously mined panels in the currently mined seam and/or in the overlying or underlying seams, the stability of the chain pillars, the strength of the coal seams and the overburden strata and a time-related subsidence component.

The regularity in shape between observed incremental subsidence profiles was first noticed whilst carrying out an empirical study in the Southern Coalfields of NSW using monitoring data from more than 72 longwall panels. A prediction model was then developed to predict the incremental subsidence at points for each of the longwalls in a series of longwalls and then adding together the appropriate subsidence values to derive the total subsidence at each point. MSEC then developed standard subsidence prediction curves and shapes of predicted incremental subsidence profiles using observed profiles from monitoring lines with similar mining geometry and overburden geology. This IPM subsidence prediction model has been continually developed, revised and updated since 1994, as the new additional monitoring data became available, to suite specific local geology and conditions.

The prediction of subsidence using the IPM is now fully automated and subsidence predictions can be made anywhere above or outside the extracted longwalls, based on the local surface and seam information. Details as to how this model was developed have been outlined in various published papers, which include information that would allow others to use this method to predict mine subsidence ground movements resulting from underground coal mining operations, based on local observed data. MSEC can use the current IPM model to predict subsidence contours over complex underground mine layouts within days of receiving the necessary data.

MSEC has used this IPM for almost 1,000 studies for proposed mines and numerous comparisons have been provided between the predicted subsidence movements and the subsequently monitored ground movements. The results of these comparisons have been included in many prediction reports, government inquiry reports and end of panel monitoring reports, and these comparisons and reviews confirm the use of this IPM subsidence prediction model provides reasonable, if not, slightly conservative predictions for both single seam and multi-seam conditions in NSW and QLD for those cases where the mining geometry and overburden geology are similar to and within the range of the empirical data from which the IPM model was developed. When the mining geometry and overburden geology are outside the ranges of the empirical data from which the IPM model was developed then additional advice is sought from relevant mathematical models.

For this Tahmoor South Project, the IPM has been based on the Southern Coalfield predictive curves with calibrations for the local conditions, based on the extensive ground monitoring data from Tahmoor Mine as discussed in Section 3.7.

Further details on the IPM are provided in the background report entitled General Discussion on Mine Subsidence Ground Movements which can be obtained from *www.minesubsidence.com*. The following section describes the calibration of the IPM for local single-seam conditions.

3.7. Calibration of Incremental Profile Method, outside the increased subsidence area

The extraction of longwalls at Tahmoor Mine has generally resulted in observed mine subsidence movements that are typical of those observed above other collieries in the Southern Coalfield of NSW at comparable depths of cover. However, during the mining of Longwall 24A at Tahmoor Mine substantially increased subsidence was observed over the predicted subsidence levels and then similar increased subsidence movements were also observed above the southern ends of Longwalls 25 to 27 and Longwall 32. This was a very unusual event for the Southern Coalfield and is discussed further in Section 3.8.

This section of the report describes the calibration and testing of the IPM above the majority of the previously extracted longwalls at Tahmoor Mine and does not include observations in the areas of increased subsidence, which is addressed separately in Section 3.8.

The IPM was previously refined or calibrated using the extensive monitoring data that had been collected during the extraction of Longwalls 22 to 25 at Tahmoor to predict the subsidence parameters for Longwalls 27 to 30 at Tahmoor Mine, and the details of this calibration were provided in Section 3.6 of Report No. MSEC355 (Revision B, July 2009).

The IPM prediction curves from that report are the latest calibration of the IPM and this model was tested against the latest available subsidence data in the Tahmoor North area, plus, the available subsidence data from monitoring lines above the previously extracted Tahmoor Longwalls 1 to 19 since these later longwalls were located closer to the proposed Tahmoor South longwalls.

The reliability of the IPM prediction curves is illustrated by comparing the observed movements with those predicted for the following monitoring lines, which are shown in Appendix G of this report. The results have been extended to include measured subsidence after the mining of Longwall 30, where they have been measured. The locations of the monitoring lines are shown in Fig. 3.3 :-

- Fig. G.01 – 100-Line for Tahmoor Longwalls 1 and 2;
- Fig. G.02 – 200-Line for Tahmoor Longwall 2;
- Fig. G.03 – 300-Line for Tahmoor Longwalls 3 to 7;
- Fig. G.04 – 800-Line for Tahmoor Longwalls 8 to12;
- Fig. G.05 – 900-Line for Tahmoor Longwalls 10A to 13;
- Fig. G.06 – 1000-Line for Tahmoor Longwalls 14B to 19;
- Fig. G.07 – Brundah Road Line for Tahmoor North Longwalls 23B to 28;
- Fig. G.08 – Castlereagh Street Line for Tahmoor North Longwalls 22 to 28;
- Fig. G.09 – Remembrance Drive Line for Tahmoor North Longwalls 23A to 30;
- Fig. G.10 – Thirlmere Way Line for Tahmoor North Longwalls 23A to 27;
- Fig. G.11 – York Street Line for Tahmoor North Longwalls 24A to 28;
- Fig. G.12 – HRF Line for Tahmoor North Longwalls 23 to 26;
- Fig. G.13 – LW25 XS1 Line for Tahmoor North Longwalls 25 to 26;
- Fig. G.14 – LW24A Draw Line for Tahmoor North Longwalls 24A to 26; and
- Fig. G.15 – LW25 Centreline for Tahmoor North Longwalls 25 to 26.

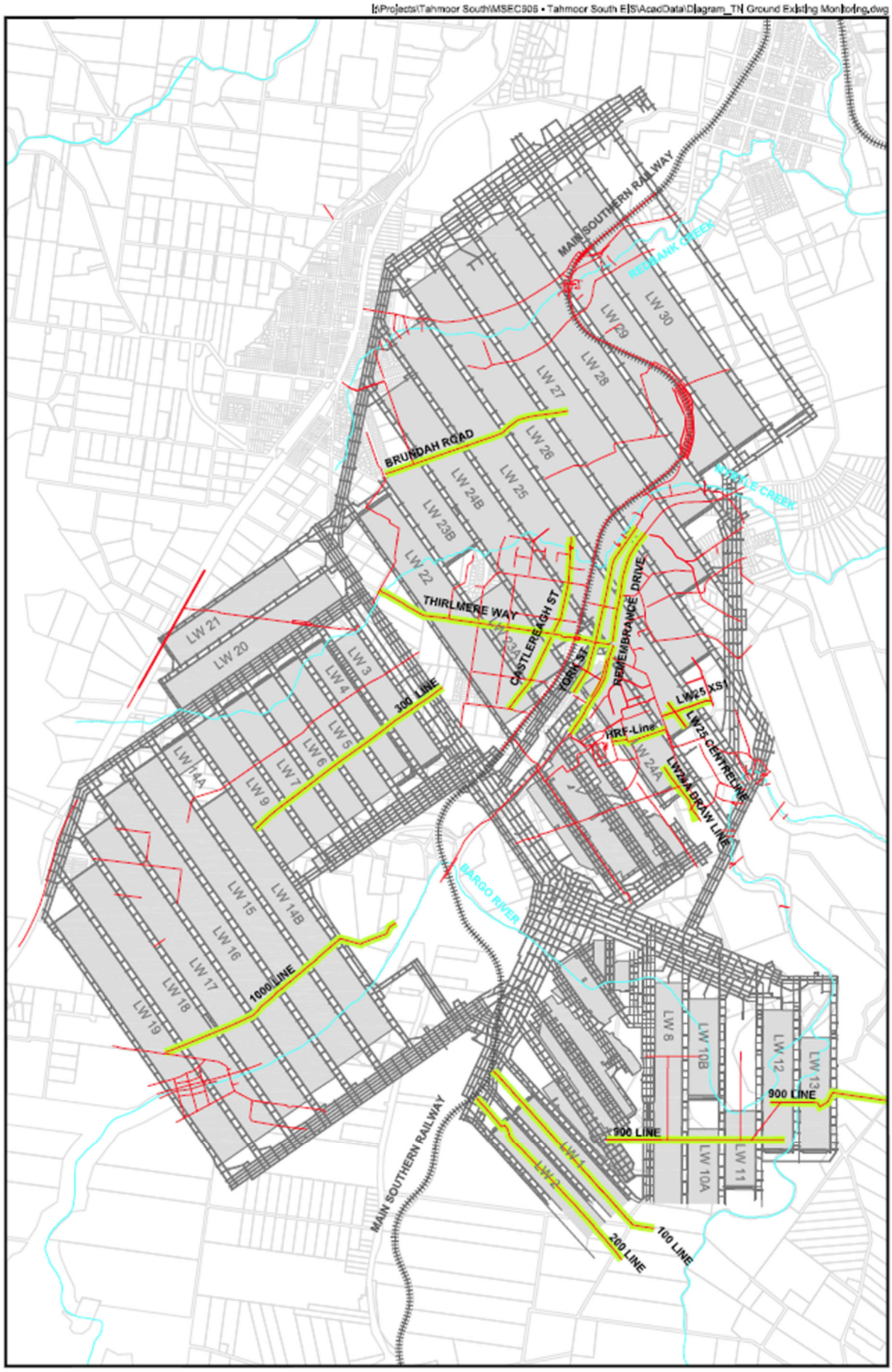


Fig. 3.3 Tahmoor North monitoring lines used in testing calibration of the IPM model

The following observations can be seen from the above figures:

- Predicted maximum subsidence has been greater, for all the monitoring lines over Longwalls 1 to 7, over Longwalls 14 to 23 and over the northern western ends of Longwalls 24B to 26, than the observed maximum subsidence.
- The observed subsidence profiles, for all the monitoring lines over Longwalls 1 to 7, Longwalls 14 to 19, Longwalls 20 to 21 and over Longwalls 21 to 24B, reasonably match those predicted using the calibrated prediction curves with the observed subsidence generally being greater than the observed subsidence. While there is reasonable correlation, it is highlighted that, in some locations away from the points of maxima and, in particular, beyond the longwall goaf edges, the observed subsidence has exceeded that predicted. In these locations beyond the longwall goaf edges, however, the magnitude of subsidence is low and there were very low associated tilts, curvatures and strains.
- Greater maximum subsidence of up to 670 mm has been observed, along some of the lines over Longwalls 24A and above the south eastern ends of Longwalls 25 to 27, than the predicted maximum subsidence as discussed in detail in Section 3.8.
- Greater subsidence was observed compared to predictions along the 800-Line above the centre of Longwall 8 where several small faults and dykes were located. The observed incremental subsidence of 420 mm was 50% greater at that location than the predicted value of 280 mm. The centre of this panel is within 500 metres of the Bargo River, where the valley depth, measured using a one half a depth of cover basis, is 40 metres and this location was within 1,400 m of the Nepean Fault.
- Greater subsidence was observed compared to predictions along the 900-Line above Longwall 13. At this location where the 900-Line crosses Longwall 13 and the Nepean Fault zone, the Nepean Fault zone runs almost parallel to Longwall 13 and the maingate edge of Longwall 13 is within 170 metres of the fault zone. The observed incremental subsidence of 820 mm was approximately 30% greater at that location than the predicted value of 550 mm. The centre of this panel is also within 300 metres of the Bargo River, where the valley depth, measured using a one half a depth of cover basis, is 25 metres and this location was within 300 m of the Nepean Fault.
- Slightly greater subsidence was observed along Castlereagh Street compared to predictions above Longwalls 22 and 23A. This street runs across the south eastern ends of these longwall panels and near the railway corridor.
- Slightly greater subsidence was observed compared to predictions along Remembrance Drive above Longwalls 24A and the southern parts of Longwall 25 and Longwall 26. This area is located on the edge of the zone of increased subsidence.
- Slightly greater subsidence was observed compared to predictions along Thirlmere Way above the southern end of Longwall 24B and the south eastern parts of Longwall 25. This area is located near the zone of increased subsidence.
- Slightly greater subsidence was observed compared to predictions along York Street above Longwalls 24A and the south eastern parts of Longwall 25. This area is located along the edge of the zone of increased subsidence.
- Greater subsidence of up to 600 mm was also observed compared to predictions along the HRF-Line and LW25 XS1 Line, which are within the zone of increased subsidence, as is discussed in more detail in Section 3.8.
- The observed tilt and curvature profiles over all these monitoring lines also reasonably matched the predicted profiles using the calibrated prediction curves. The observed curvatures were derived from the smoothed subsidence profiles, to obtain overall levels of curvature, rather than the localised curvatures at each survey mark. Please see Section 3.7.1 for further discussion on curvature.
- The maximum observed tilts and curvatures were, in most cases, similar to the maximums predicted using the standard Bulli seam prediction curves. The observed tilts and curvatures exceeded those predicted at the tributary crossings, at the locations of the upsidence movements, as the predicted profiles did not include non-conventional valley related movements. There was also some scatter in the observed tilt and curvature profiles.

A comparison between the observed and predicted total subsidence at the individual survey marks from the 100-Line, 200-Line, 300-Line, 800-Line, 900-Line and the 1000-Line after the extraction of Longwalls 1 to 19 at Tahmoor Mine is provided in Fig. 3.4. That is, this analysis includes the occasions when the observed total subsidence exceeded the predicted total subsidence over Longwalls 1 to 19, which were along the 800-Line and 900-Line as shown in Fig. G.04 and Fig. G.05.

The observed subsidence at individual survey pegs, i.e. at a point, for pegs located over Tahmoor Longwalls 1 to 19 exceeded the predicted subsidence by more than +15 % by a small margin at some of the survey marks along the 100-Line, 300-Line, and by much higher margins at surveys marks along the 800-Line and 900-Line. It can be seen from Fig. 3.4 that the observed total subsidence at the other individual survey marks were generally less than the predicted total subsidence plus 15 %, or less than the predicted total subsidence plus 50 mm, which is generally considered acceptable for subsidence prediction methods.

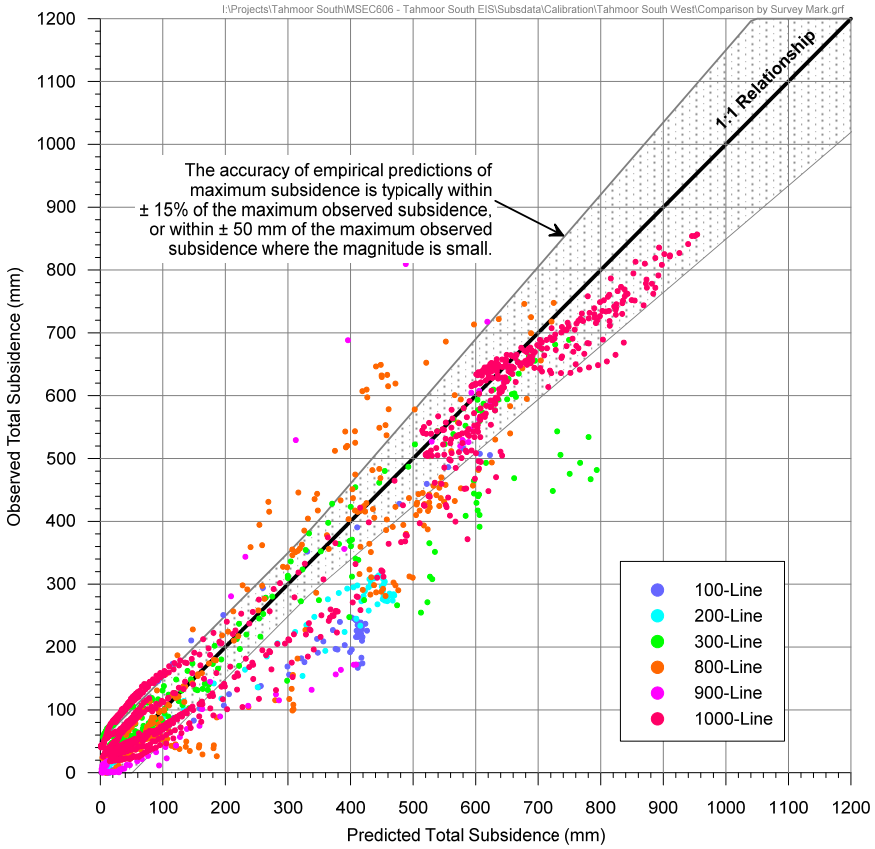


Fig. 3.4 Comparison between observed and predicted total subsidence at individual survey marks for the Tahmoor Longwalls 1 to 19

The further comparison between the observed and predicted total subsidence at all of the individual survey marks over the northern areas of the Tahmoor Mine, at the completion of each of the Longwalls 22 to 26, is provided in Fig. 3.5. These results in Fig. 3.5 have only been provided for the monitoring lines that are located outside the zone of increased subsidence, as is discussed separately in Section 3.8, i.e. these plots do not including pegs located above Longwall 24A and above the south eastern ends of Longwalls 25 and 26. However this analysis does include the monitored data from those parts of Remembrance Drive and Castlereagh Street that are close to or near the zone of increased subsidence, i.e. within a transition zone.

It can be seen from Fig. 3.5, that the observed total subsidence at the individual survey marks at Tahmoor North, due to the extraction of Tahmoor Longwalls 22 to 26, for these monitoring lines that are generally located outside the zone of increased subsidence and outside the transition zone, were generally less than the predicted total subsidence plus 15 %, or less than the predicted total subsidence plus 50 mm, which is generally considered acceptable for subsidence prediction methods. There are several exceedances, however, and these generally occurred along the monitoring lines in those parts of Remembrance Drive and Castlereagh Street that are located close to or near the zone of increased subsidence and from those with lower levels of subsidence.

Instead of plotting the results for all survey marks along a line, a further comparison is provided in Fig. 3.6 between the observed and predicted maximum total subsidence along monitoring lines at the northern parts of the Tahmoor Mine for these monitoring lines that are located outside the zone of increased subsidence, due to the extraction of Tahmoor Longwalls 22 to 26.

It can be seen by comparing Fig. 3.4 and Fig. 3.5 that the maximum observed subsidence values anywhere along the whole monitoring lines are generally less than the predicted total subsidence plus 15 %, or less than the predicted total subsidence plus 50 mm, except where the magnitudes are small. There are some exceedances at the Railway Line (2D) and Larkin St, however, these lines are also located close to or near the zone of increased subsidence and are generally occurred along the monitoring lines with lower levels of subsidence.

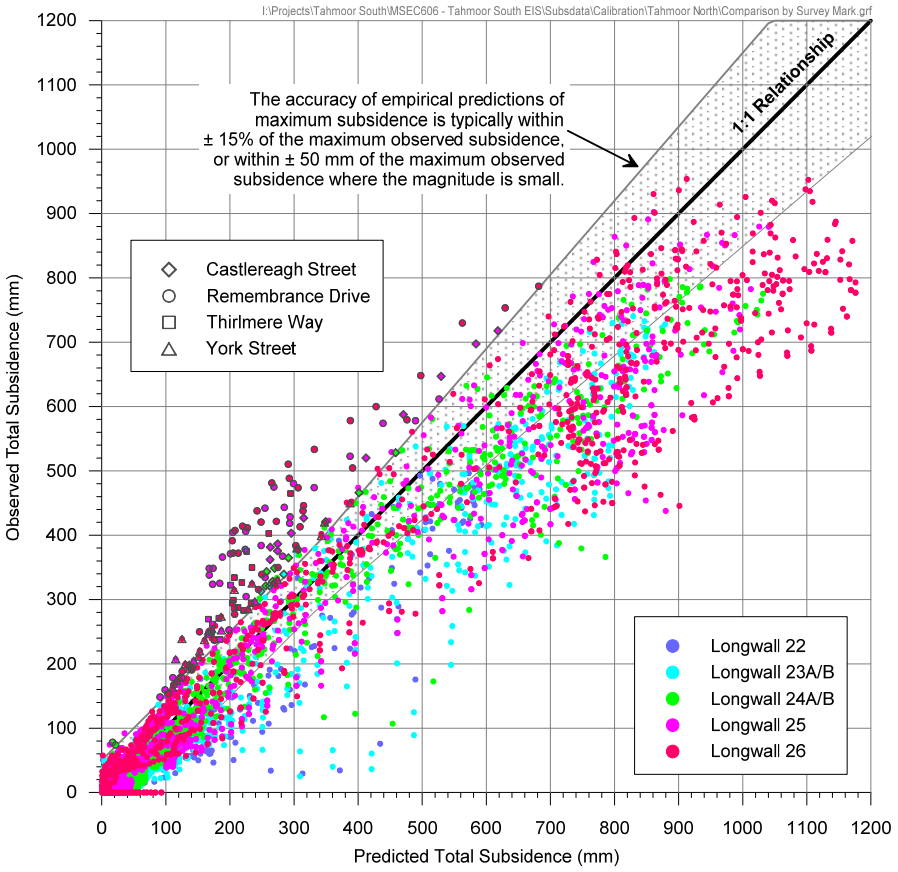


Fig. 3.5 Comparison between observed and predicted total subsidence at individual survey marks for the Tahmoor North longwalls 22 to 26

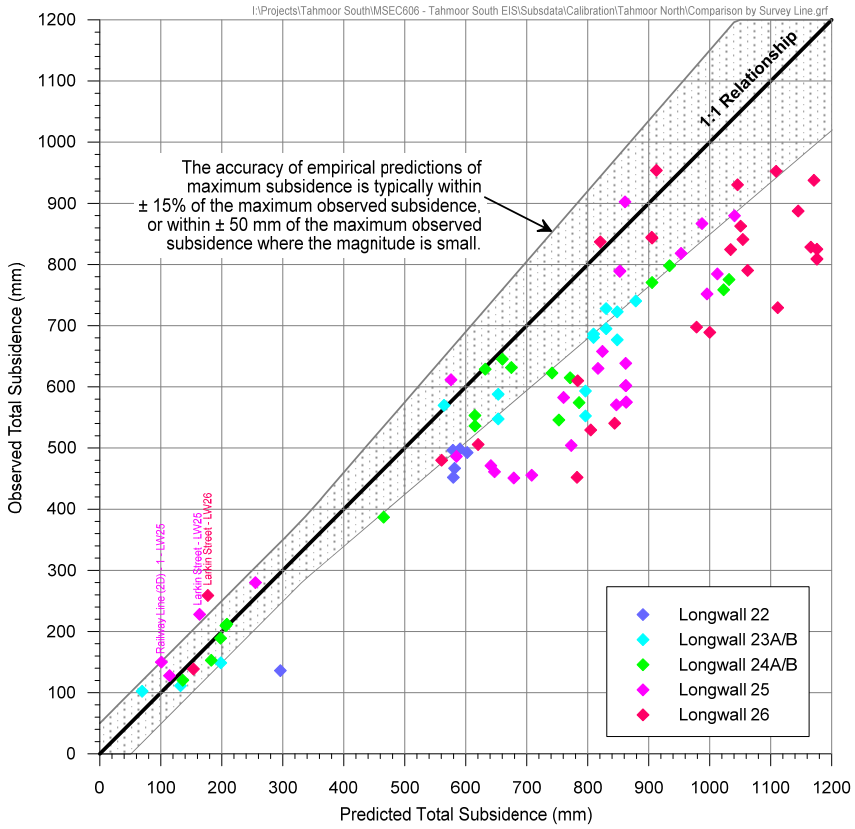


Fig. 3.6 Comparison between observed and predicted maximum total subsidence along whole monitoring lines for the Tahmoor North longwalls 22 to 26

A further statistical review of these maximum subsidence values along monitoring lines has been undertaken. The distribution of the ratio of the maximum observed to maximum predicted total subsidence, for the monitoring lines near Longwalls 22 to 26 located outside the zone of increased subsidence at Tahmoor Mine with maximum values greater than 200 mm, is illustrated in Fig. 3.7 (left). A gamma distribution has been fitted to the results and this is also shown in this figure. The resulting probabilities of exceedance have been determined, based on this gamma distribution, which is shown on the right of Fig. 3.7.

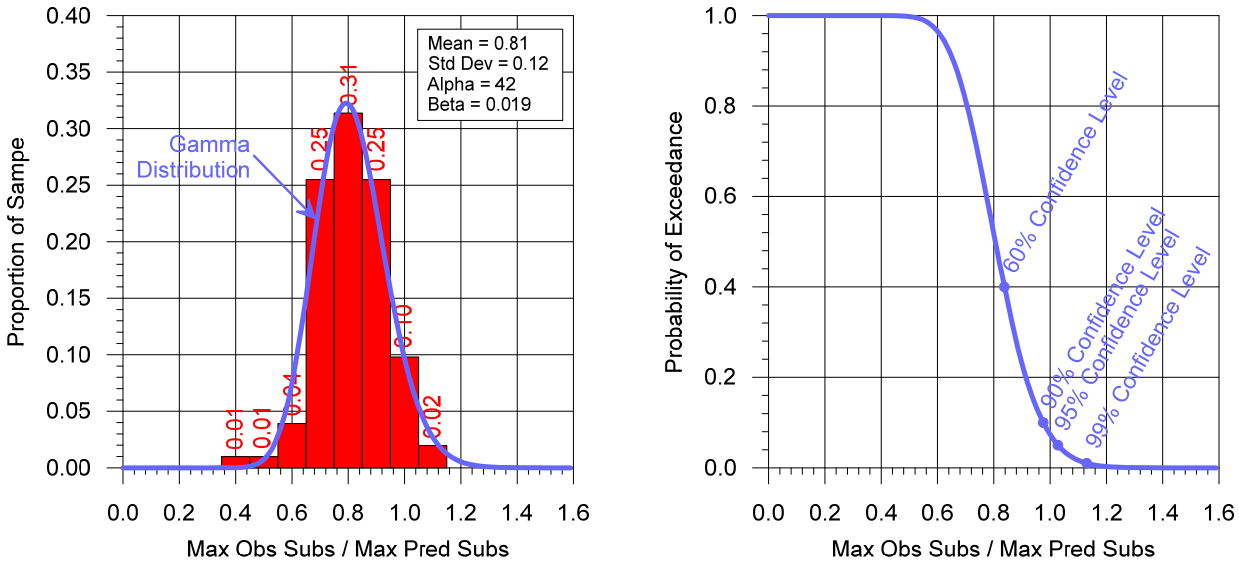


Fig. 3.7 Distribution of the ratio of the maximum observed to maximum predicted total subsidence for monitoring lines at Tahmoor Mine

It can be seen on the left side of the above figure that the maximum observed total subsidence along the monitoring lines at Tahmoor Mine was, on average, 81 % of the maximum predicted total subsidence. The maximum observed total subsidence along the monitoring lines was, at most, 10 % greater than the maximum predicted total subsidence.

It can be seen on the right side of the above figure that, based on the monitoring data, there is approximately a 93 % confidence level that the maximum observed total subsidence would be less than the maximum predicted total subsidence. That is, there is an approximate 7 % probability that the maximum observed total subsidence would exceed the maximum predicted subsidence anywhere along a monitoring line.

The subsidence predictions for the proposed Tahmoor South longwalls using this calibrated IPM model are provided in Section 4.2. Based on the statistical review of the accuracy of this calibrated IPM model, it is expected, therefore, that the calibrated IPM should generally provide reasonable, if not, slightly conservative predictions for conventional subsidence resulting from the extraction of the proposed Tahmoor South longwalls.

However, because of the increased subsidence that has been observed in parts of Tahmoor Mine, consideration should, however, be made for the observed movements exceeding those predicted as the result of anomalous or non-conventional movements, or for increased subsidence which is discussed in Section 3.8.

3.7.1. Comparisons between the observed and predicted tilt and curvature for previously extracted longwalls in the Southern Coalfield

It can be seen from Fig. G.01 to G.11 that there has generally been a reasonable correlation between predicted and observed tilt profiles at Tahmoor Mine. A reasonable correlation has also been found at surrounding collieries in the Southern Coalfield where the depths of cover are similar to those at Tahmoor Mine. Where increased subsidence has been observed at Tahmoor Mine, however, higher than predicted tilts have been observed, and this is discussed further in Section 3.8.

It is difficult to make meaningful comparisons between the profiles of raw observed curvature and predicted conventional curvature. The reason for this is that survey tolerance can be a large proportion of the measured curvatures and hence this can result in very irregular profiles. The survey tolerance for relative vertical movements is typically around ±3 mm, which equates to a survey tolerance for curvature of approximately 0.05 km^{-1} over a 20 metre bay length. This is important when compared to typical magnitudes of curvatures measured in the Southern Coalfield, which are in the order of 0.05 km^{-1} to 0.15 km^{-1}.

To make meaningful curvature comparisons, the observed curvatures have been derived from smoothed observed subsidence profiles, which removes the small deviations resulting from, amongst other things, survey tolerance. The subsidence profile has been smoothed using either the Savitzky-Golay or Loess algorithm, which removes the localised deviations, but does not reduce the overall maxima. This is illustrated in Fig. 3.8 along the Moreton Park Road Line in Area 7, which shows the raw observed subsidence profile, the smoothed subsidence profile, the raw observed curvature profile and the curvature profile derived from the smoothed subsidence.

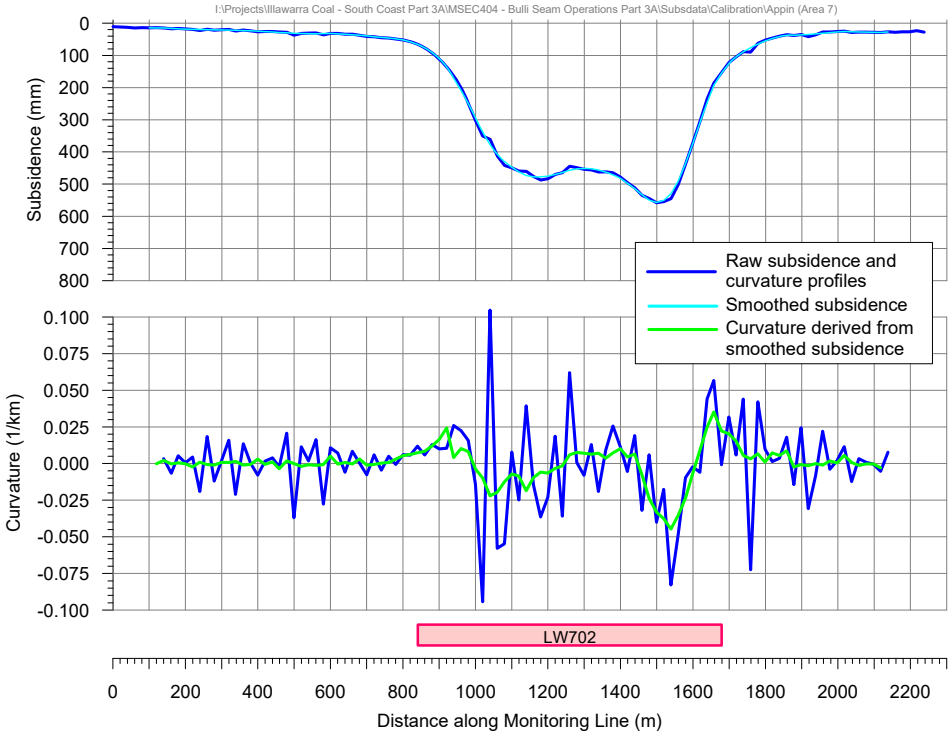


Fig. 3.8 Comparisons of raw observed curvature with curvature derived from smoothed subsidence along the Moreton Park Road line due to Appin Colliery Longwall 702

It can be seen from the above figure, that the smoothed subsidence profile reasonably matches the raw subsidence profile, but the small deviations have been removed. It can also be seen that the raw observed curvatures are very irregular, due to the small deviations in the raw observed subsidence profile. The curvature derived from the smoothed subsidence profile, however, more clearly shows the locations of overall hogging curvature and overall sagging curvature, rather than the localised curvatures at each mark.

Comparisons between the profiles of observed subsidence, tilt and curvature derived from smoothed subsidence profiles with predicted subsidence, tilt and curvature have been provided along the following monitoring lines at Tahmoor Mine:-

- Fig. G.07 – Brundah Road;
- Fig. G.09 – Remembrance Drive; and
- Fig. G.11 – York Street

The comparisons show that when observed curvature has been derived from smoothed subsidence profiles, a reasonable correlation between predicted and observed profiles can be found. A reasonable correlation has also been found at surrounding collieries in the Southern Coalfield where the depths of cover are similar to those at Tahmoor Mine. Where increased subsidence has been observed at Tahmoor Mine, however, higher than predicted curvatures have been observed, and this is discussed further in Section 3.8.

3.8. Areas where increased subsidence, compared to predictions, have been observed

The extraction of longwalls at Tahmoor Mine has generally resulted in mine subsidence movements that were typical of those observed above other collieries in the Southern Coalfield of NSW at comparable depths of cover.

However, the locations where greater subsidence was observed compared to the predicted values were identified, in Section 3.7, were:

- over Longwalls 24A and the southern parts of Longwalls 25 to 27;
- over the commencing end of Longwall 32; and
- over Longwall 8 and along the 800-Line, and over Longwall 13 and along the 900-Line.

It is not a coincidence that there are many faults and dykes at these locations, that these locations are near the Nepean Fault and these locations are near major river valleys or gorges. The extents of these zones of increased subsidence are discussed in detail in Report No. MSEC1123, which was submitted by Tahmoor Coal in support of the EIS application for the Tahmoor South Project.

While the proposed LWs S1A to S6A are not located near the Nepean Fault, the experiences are a reminder that increased subsidence movements can occur. 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 LWs S1A to S6A. It is recommended that subsidence management plans be developed to manage potential impacts that could occur if greater than predicted subsidence occurs.

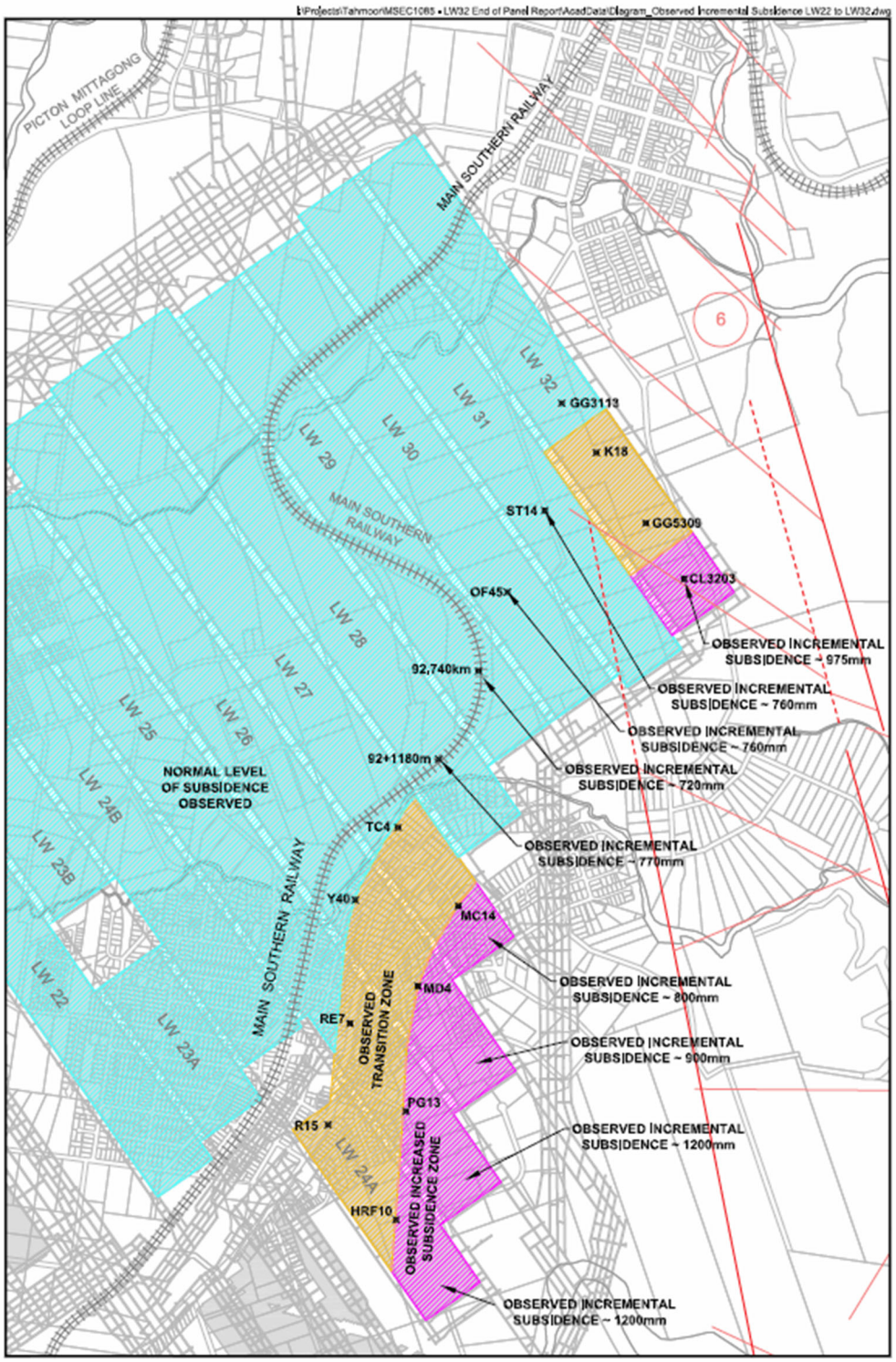


Fig. 3.9 Zones of increased subsidence over Longwalls 22 to 32

3.9. Review of the measured and predicted valley-related effects at Tahmoor

The predicted upsidence and closure movements for the longwalls at Tahmoor Mine have been obtained using the empirical method outlined in Australian Coal Association Research Program (ACARP) Research Project No. C9067 (Waddington and Kay, 2002), referred to as the 2002 ACARP method. Comparisons between the measured and predicted valley-related effects for the previously extracted longwalls at Tahmoor Mine have been provided in the following sections.

3.9.1. Myrtle Creek and the Skew Culvert

Detailed ground monitoring was undertaken where Myrtle Creek and a tributary to this creek (referred to as the Skew Culvert) crosses beneath the Main Southern Railway above Longwalls 26 and 27. A map showing the monitoring lines in these locations is shown in Fig. 3.10.

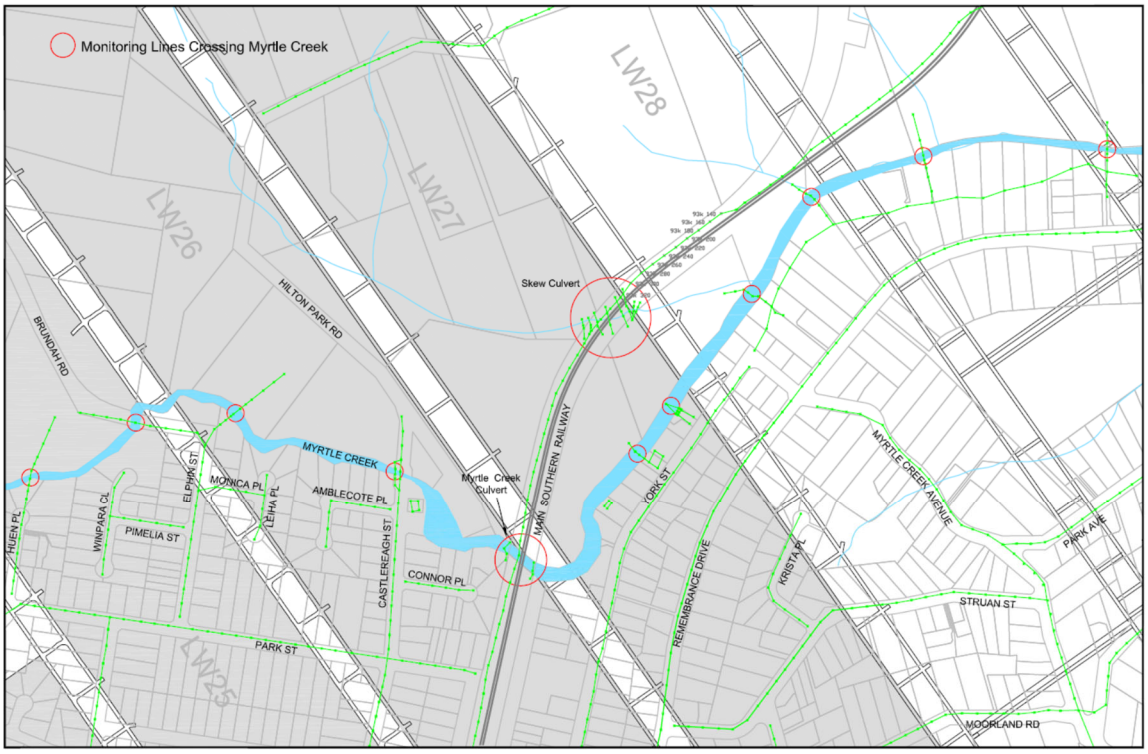


Fig. 3.10 Monitoring lines across Myrtle Creek and the Skew Culvert

The development of valley closure at each of the monitoring lines across the Myrtle Creek, during the extraction of Longwalls 24B to 27, are illustrated in Fig. 3.11.

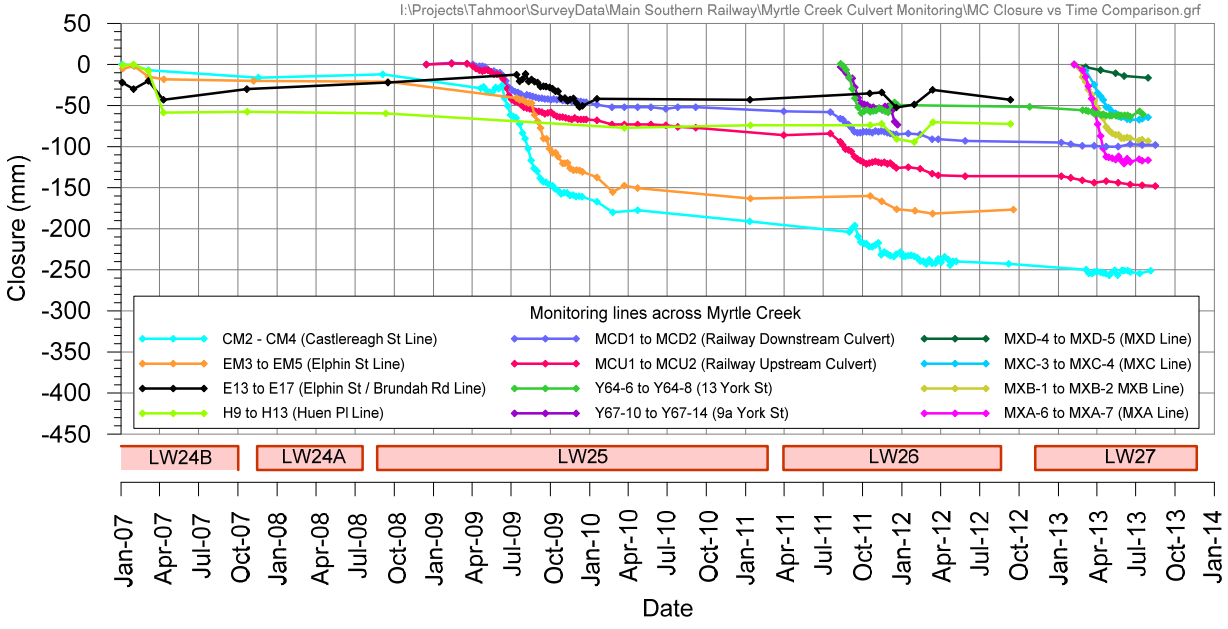


Fig. 3.11 Development of closure across Myrtle Creek during LW24B to LW27

The development of valley closure at each of the monitoring lines across the creek at the Skew Culvert, during the extraction of LW26 and LW27, are shown in Fig. 3.12.

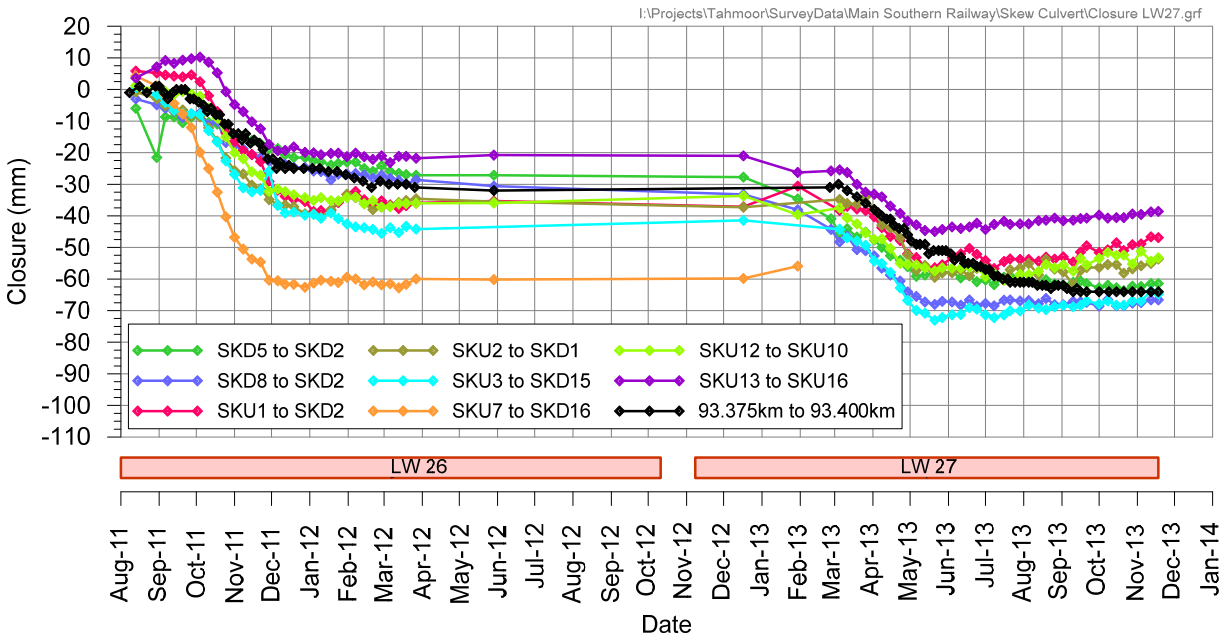


Fig. 3.12 Development of closure across the Skew Culvert during LW26 and LW27

A summary of the predicted and measured incremental closure across Myrtle Creek and the Skew Culvert is provided in Table 3.1. The predictions are consistent with those provided in Report No. MSEC355, which supported the SMP Application for Tahmoor LW27 to LW30.

Table 3.1 Predicted and measured incremental closure at the monitoring lines across Myrtle Creek and the Skew Culvert

Location	Category	Predicted and measured valley closure due to the mining of each longwall (mm)			
		Due to LW24	Due to LW25	Due to LW26	Due to LW27
Castlereagh Street (Pegs CM2 to CM4)	Predicted	30	55	45	25
	Measured	12	179	52	8
Elphin-Myrtle (Pegs EM3 to EM5)	Predicted	60	70	40	-
	Measured	21	142	22	-
Elphin St / Brundah Rd (Pegs E13 to E17)	Predicted	75	75	30	-
	Measured	0	21	6	-
Huen Place (Pegs H9 to H13)	Predicted	60	35	15	-
	Measured	58	15	20	-
Main Southern Railway Upstream (MCU1 to MCU4) Downstream (MCD1 to MCD4)	Predicted	15	30	30	15
	Measured	-	57 (d/s) to 86 (u/s)	36 (d/s) to 50 (u/s)	5 (d/s) to 12 (u/s)
Skew Culvert (8 cross-sections)	Predicted	< 5	10	25	25
	Measured	-	-	21 to 60 (average 36)	8 to 36 (average 21)
13 York Street (Pegs Y64-6 to Y64-8)	Predicted	-	-	65	50
	Measured	-	-	51	9
9a York Street (Pegs Y67-10 to Y67-14)	Predicted	-	-	85	85
	Measured	-	-	73	No access
MXA Line (Pegs MXA-6 to MXA-7)	Predicted	-	-	-	150
	Measured	-	-	-	116
MXB Line (Pegs MXB-1 to MXB-2)	Predicted	-	-	-	170
	Measured	-	-	-	93
MXC Line (Pegs MXC-3 to MXC-4)	Predicted	-	-	-	150
	Measured	-	-	-	64
MXD Line (Pegs MXD-4 to MXD-5)	Predicted	-	-	-	50
	Measured	-	-	-	16

It can be seen from the above table, that the measured valley closure has substantially exceeded predictions at the Castlereagh Street crossing, at the crossing of the Elphin-Myrtle monitoring line and, to a lesser extent, the crossing of the Main Southern Railway during the mining of LW25. It is considered that the reason for the differences in observations may be linked to the change in orientation of Myrtle Creek as the three above-mentioned monitoring lines are located along the same stretch of Myrtle Creek. It is noted, however, that substantially less closure has developed at Castlereagh Street than predicted during the mining of LW27.

The measured valley closure across the creek at the Skew Culvert has also slightly exceeded predictions, where the differences between predicted and measured closure are relatively small for most cross sections.

The measured valley closure across Myrtle Creek where it flows directly above LW27 (MXA to MXC lines) has been less than predicted, but greater in magnitude than that measured across monitoring lines upstream of LW27. This was expected because the valley is deeper compared to sections further upstream.

3.9.2. Redbank Creek

Detailed ground monitoring has been undertaken along Redbank Creek during the extraction of LWs 26 to 31. The ability to survey valley closure across the creek was constrained as access was not provided by some landowners located adjacent to the creek. There was no access to the creek from the northern bank and limited access on the southern bank of the Redbank Creek.

Ground surveys were undertaken in relative 3D from Bridge Street to a monitoring line that is located in cleared pasture land along the top of the valley, as shown in Fig. 3.13. This has provided measurements of total valley closure. Some survey pegs have been installed along a fenceline on the southern side to a point where surveyors can sight a survey peg on Bridge Street. Despite the best efforts of the survey team, the accuracy of the survey is challenged by the lack of cross lines across Redbank Creek. Baseline monitoring indicates that the valley closure measurements were accurate to approximately 20 mm to 30 mm.

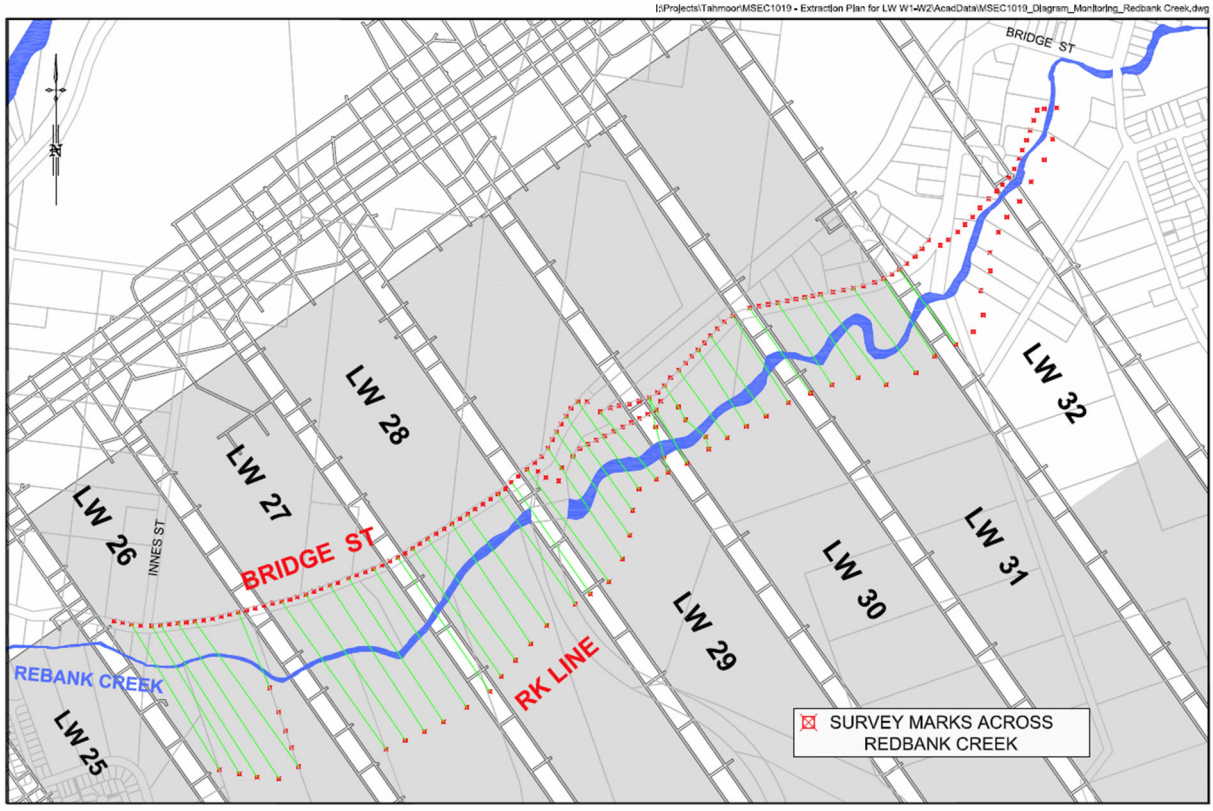


Fig. 3.13 Location of survey marks across Redbank Creek

A comparison between observed and predicted total valley closure along Redbank Creek after the mining of Longwall 31 is shown in Fig. 3.14. A comparison between observed and predicted incremental closure along Redbank Creek is also provided.

The closures are based on calculating changes in horizontal distance between pegs located across the valley in an orientation that is approximately parallel to the longwall panel. This orientation was chosen as Redbank Creek flows approximately at right angles across the panel.

Different results can be derived if the calculations were based on different pairs of pegs, though it is considered that if different pairs were chosen, such calculations would include an additional component of conventional and non-conventional ground shortening that occurs across the panel in both plateau areas or valleys. This is particularly the case if the pegs are located across the width of the longwall panel from each other. When comparing the results against predictions of valley closure, it was considered simpler to choose pegs that are approximately aligned with longwall direction so as not to make allowances for the additional effects of conventional lateral ground closure movements.

A number of observations are made from the monitoring data:

- There has been a reasonable correlation between predicted and observed incremental closure at the completion of Longwall 31. Valley closure was slightly greater for a temporary period of time, when the transient effects of the subsidence travelling wave passed through the valley; and
- Observed total closure from the mining of Longwalls 26 to 31 is less than predicted.

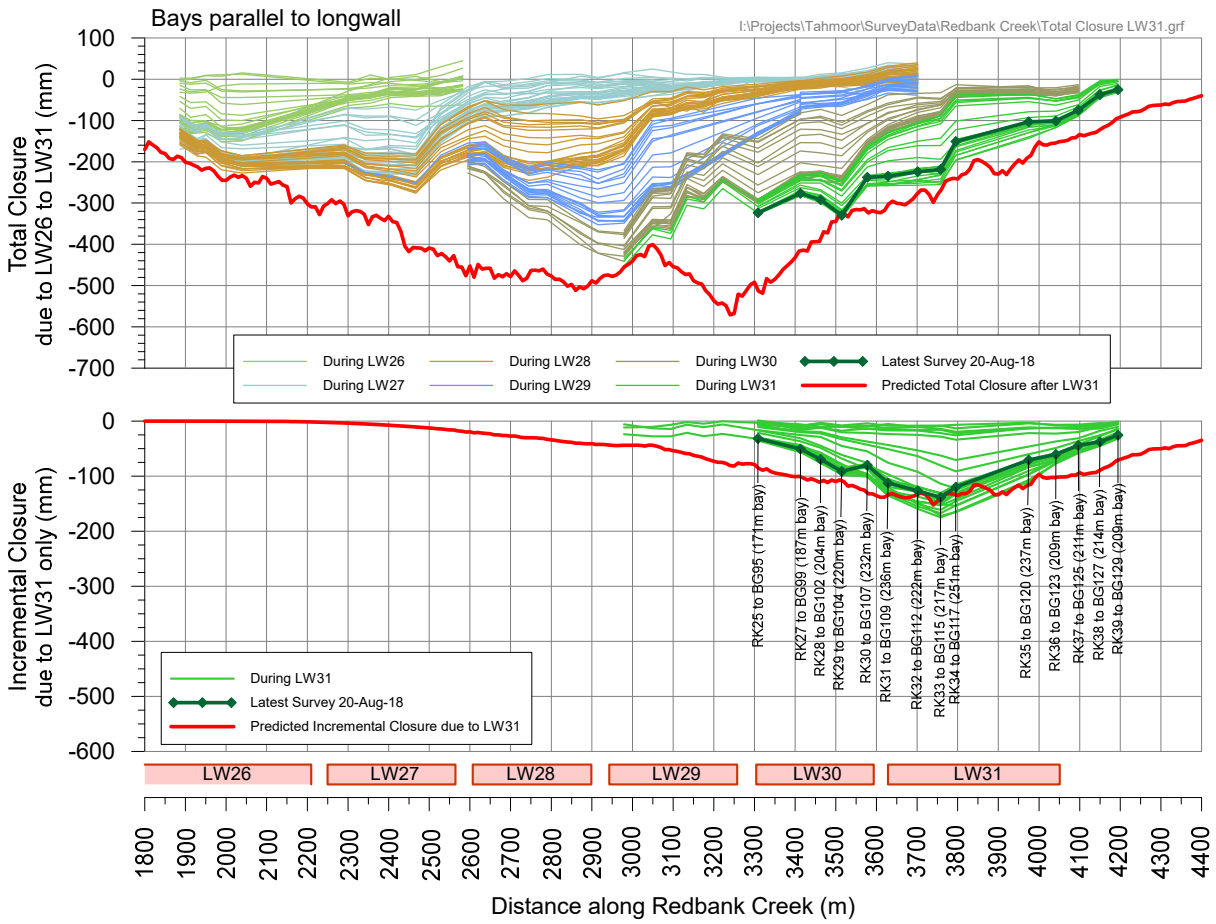


Fig. 3.14 Comparison between observed and predicted valley closure along Redbank Creek

3.9.3. Creek crossings directly above LW W1-W2

Very minor closure of approximately 20 mm was measured across the creek crossing at 88.400 km on the Picton to Mittagong Loop Line during the mining of LW W1, which is less than predicted. Closure is, however, currently developing during the mining of LW W2, with total closure likely to be a similar order of magnitude to the prediction of 125 mm.

Surveys across other creeks above LW W1 have measured very little to no measurable valley closure. As at March 2021, LW W2 has not yet mined directly beneath or adjacent to other creek crossings.

The results show that while the prediction of valley closure is not an exact science, there is a reasonable correlation between measured and predicted subsidence when measured across the width of the valley.

3.9.4. Reliability of the predicted valley-related movements

The review of the observed movements at Myrtle and Redbank Creeks and the observed movements directly above and adjacent to LW W1 indicate that the ACARP Method provides reasonable predictions for valley closure at Tahmoor Mine. It is noted, however, the measured closures substantially exceeded those predicted in three locations along Myrtle Creek, due to the extraction of LW25, but these all occurred along the same section of creek. Elsewhere, the measured closures were typically similar to or less than those predicted.

Whilst the major factors that determine the levels of movement have been identified, there are some factors that are difficult to isolate. One factor that is thought to influence the upsidence and closure movements is the level of in-situ horizontal stress that exists within the strata. In-situ stresses are difficult to obtain and not regularly measured and the limited availability of data makes it impossible to be definitive about the influence of the in-situ stress on the upsidence and closure values. The methods are, however, based predominantly upon the measured data from Tower Colliery in the Southern Coalfield, where the in-situ stresses are high. The methods should, therefore, tend to over-predict the movements in areas of lower stress.

Variations in local geology can affect the way in which the near surface rocks are displaced as subsidence occurs. In the compression zone, the surface strata can buckle upwards or can fail by shearing and sliding over their neighbours. If localised cross bedding exists, this shearing can occur at relatively low values of stress. This can result in fluctuations in the local strains, which can range from tensile to compressive. In

the tensile zone, existing joints can be opened up and new fractures can be formed at random, leading to localised concentrations of tensile strain.

Another factor that is thought to influence the movements is the characteristics of near surface geology, particularly in stream beds. Upsidence in particular is considered to be sensitive to the way in which the bedrock responds, since thin strata layers may respond differently to thicker ones. The location of the point of maximum upsidence is also considered to be strongly influenced by the characteristics of near surface geology.

Another factor that is thought to influence upsidence and closure movements is the presence of geomorphological features. Recent monitoring along a deeper and more incised valley has shown variable measurements around bends. There tended to be less movement at the apex of the bend than in the straight sections.

Notwithstanding the abovementioned limitations, the 2002 ACARP method is the most thoroughly used and tested prediction method for upsidence and closure movements in the Southern Coalfield. It is expected in most cases to provide reasonable, if not, slightly conservative predictions of the valley-related movements for the proposed longwalls.

More recently, the empirical prediction method has been refined based on further research undertaken as part of ACARP Research Project No. 18015 (Kay and Waddington, 2014). The 2014 ACARP method only provides predictions for valley closure and not for upsidence.

The predictions based on the 2002 ACARP method can be directly compared with the predictions provided in previous MSEC subsidence reports for Tahmoor Mine and with other case studies. This method has also been more widely used and tested than the more recent 2014 ACARP method. The assessments provided in this report, therefore, have been based on the predictions obtained using the 2002 ACARP method.

3.10. Rate of subsidence development and timing required for remedial actions

Monitoring of subsidence movements during the mining of previously extracted longwalls at Tahmoor Mine and other surrounding mines in the Southern Coalfield at similar depths of cover have shown that subsidence movements develop gradually over time, with no obvious indication of large and sudden step changes.

The subsidence effect at a point on the surface can be likened to a form of a wave. This wave moves across the ground at approximately the same speed as the longwall face retreats within the longwall panel but the impact of the surface subsidence wave is modified by the depth of cover and the overburden geology.

When the extraction of coal from a panel first commences, there is no immediate surface subsidence, but as the coal within the panel is extracted and the resulting void increases in size, subsidence develops gradually above the goaf area. As mining approaches and before a point is undermined, subsidence movements start to develop and then, after the longwall face passes beyond the point, the maximum value of subsidence is reached and despite further mining occurring within the panel, this level of subsidence is not exceeded except for some small time based residual movements.

An example of the gradual development of subsidence is shown in Fig. 3.15, which shows the development of subsidence of survey pegs that are located along the centreline of Tahmoor Mine's Longwall 27. The development of subsidence is plotted against the distance of each survey peg to the longwall face at the time of each survey. It shows that subsidence at a point above Longwall 27 typically did not commence until the longwall face had approached to within 200 metres of the point and that the majority of the subsidence movements had developed after the longwall face had passed each point by a distance of approximately 400 to 600 metres. The average extraction rate of Longwall 27 was approximately 40 metres per week, so it can be seen that subsidence typically developed over a period of approximately 15 to 20 weeks.

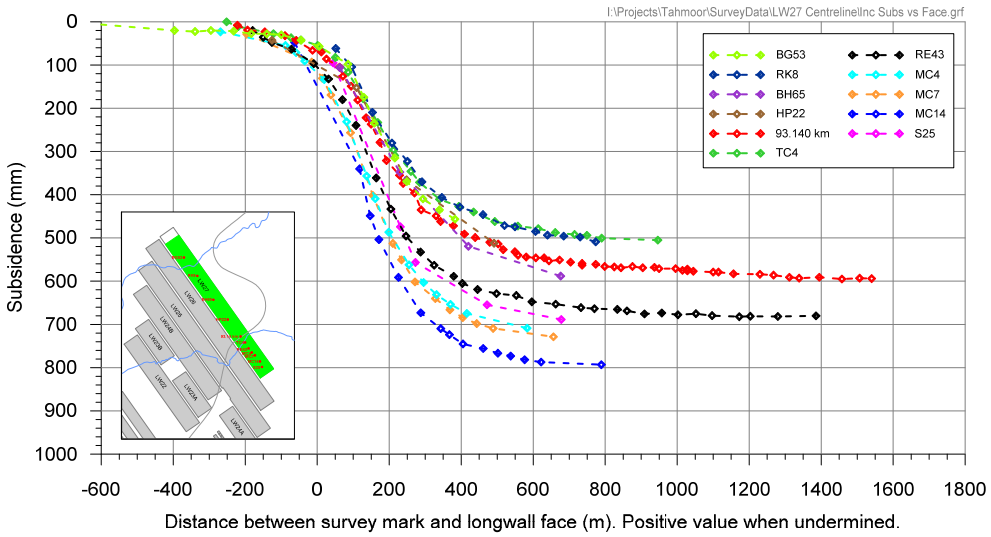


Fig. 3.15 Observed Development of subsidence along Longwall 27 centreline versus distance to longwall face

As further adjacent panels are extracted, additional subsidence can be experienced above the previously mined panel or panels. However, a point is reached where a maximum value of subsidence occurs over the series of panels irrespective of whether more panels are later extracted.

Differential vertical and horizontal subsidence movements, such as tilt, curvature, strain and valley closure and upsidence are also observed to develop gradually as mining progresses.

The gradual development of subsidence movements allows potential impacts on surface features to be managed effectively. This is because with the implementation of an effective monitoring program, unexpected or anomalous subsidence ground movements can be detected early and actions taken in response well before potentially severe impacts occur.

4.1. Introduction

The following sections provide details on the maximum predicted conventional subsidence parameters resulting from the extraction of the proposed mine layout for LWs S1A to S6A using the calibrated IPM model.

The predicted subsidence parameters and the impact assessments for the natural features and surface infrastructure are provided in Chapters 5 through to 11.

The predicted subsidence, tilt and curvature have been obtained using the Incremental Profile Method, which was calibrated for local conditions as described in Section 3.7. The predicted strains have been determined by analysing the strains measured during the previous extraction of longwalls at Tahmoor Mine, as well as at other nearby collieries.

The maximum predicted subsidence parameters and the predicted subsidence contours provided in this Chapter describe and show the conventional movements and do not include the valley-related upsidence and closure movements, nor the effects of faults and other geological structures. Such effects have been addressed separately in the impact assessments for each feature provided in Chapter 5 through to 11.

4.2. Maximum predicted conventional subsidence, tilt and curvature

The maximum predicted conventional subsidence parameters resulting from the extraction of the proposed longwalls were determined using the calibrated Incremental Profile Method, which was described in Chapter 3.

A summary of the maximum predicted values of incremental conventional subsidence, tilt and curvature, due to the extraction of each of the proposed amended longwalls, is provided in Table 4.1. The predicted ground strains are discussed in Section 4.3. The predicted tilts provided in this table are the maxima after the completion of each of the proposed longwalls. The predicted curvatures are the maxima at any time during or after the extraction of each of the proposed longwalls.

Table 4.1 Maximum predicted incremental conventional subsidence, tilt and curvature resulting from the extraction of each of the proposed longwalls

Longwall	Maximum predicted incremental conventional subsidence (mm)	Maximum predicted incremental conventional tilt (mm/m)	Maximum predicted incremental conventional hogging curvature (km^{-1})	Maximum predicted incremental conventional sagging curvature (km^{-1})
LW S1A	800	7.0	0.08	0.22
LW S2A	950	7.5	0.08	0.22
LW S3A	950	8.0	0.09	0.22
LW S4A	950	8.0	0.09	0.22
LW S5A	950	8.0	0.10	0.22
LW S6A	975	8.3	0.09	0.23

The predicted total conventional subsidence contours, using the calibrated IPM model for Tahmoor Mine, resulting from the extraction of the proposed LWs S1A to S6A are shown in Drawing No MSEC1192-22.

A summary of the maximum predicted values of total conventional subsidence, tilt and curvature, after the extraction of each of the proposed amended longwall series, is provided in Table 4.2.

Table 4.2 Maximum predicted total conventional subsidence, tilt and curvature after the extraction of each of the proposed longwalls

Longwalls	Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm/m)	Maximum predicted total conventional hogging curvature (km^{-1})	Maximum predicted total conventional sagging curvature (km^{-1})
LW S1A	800	7.0	0.08	0.22
LW S2A	1,000	8.0	0.10	0.22
LW S3A	1,200	8.0	0.10	0.22
LW S4A	1,250	8.5	0.13	0.22
LW S5A	1,350	9.0	0.14	0.22
LW S6A	1,350	9.5	0.14	0.24

The maximum predicted total subsidence, after the completion of the proposed longwalls, is 1,350 mm which represents around 61 % of the extraction height. The maximum predicted total conventional tilt is 9.5 mm/m (i.e. 0.95 %), which represents a change in grade of 1 in 95. The maximum predicted total conventional curvatures are 0.14 km^{-1} hogging and 0.24 km^{-1} sagging, which represent minimum radii of curvature of 7.1 kilometres and 4.2 kilometres, respectively.

The predicted conventional subsidence parameters vary across the *Subsidence Study Area* as the result of, amongst other factors, variations in the depths of cover, longwall geometry and extraction heights. To illustrate this variation, the predicted profiles of conventional subsidence, tilt and curvature have been prepared along a prediction line, the locations of which is shown in Drawing No. MSEC1192-22.

The predicted profiles of conventional subsidence, tilt and curvature along Prediction Line 1, resulting from the extraction of the proposed LWs S1A to S6A, are shown in Fig. E.01 in Appendix E. The predicted incremental profiles, due to the extraction of each of the proposed longwalls, are shown as dashed black lines. The predicted total profile, after the extraction of each of the proposed amended longwalls, are shown as solid blue lines with the final predicted total profiles being shown in a thicker solid blue line. The range of predicted curvatures in any direction to the prediction lines, at any time during or after the extraction of the proposed longwalls, is shown by the grey shading.

The reliability of the predictions of subsidence, tilt and curvature, obtained using the Incremental Profile Method, is discussed in Section 3.4 to Section 3.8 and Section 4.4 to Section 4.6.

4.2.1. Comparison between predictions based on proposed LWs S1A to S6A with predictions based on the approved EIS layout

Minor changes have been made to the mine layout for proposed LWs S1A to S6A since development consent was received (EIS Layout). The potential for changes was foreshadowed by Tahmoor Coal when it applied for development consent. A comparison between mine layouts was previously shown in Fig. 1.2 and further details are provided.

- The layout for LWs S1A to S6A has been shifted approximately 35 metres to the south-west;
- LWs S2A to S6A have been widened by 2 metres (the width of LW S1A is unchanged);
- Chain pillar widths for the tailgates of LWs S3A to S6A have been reduced by 2 metres (the chain pillar between LWs S1A and S2A is unchanged);
- The commencing ends of LWs S1A to S6A have been aligned compared to the previous staggered layout. The outcome of the change is that LWs S2A to S6A have been extended in length. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted for development consent; and
- The planned sequence has been amended, such that the A series longwalls are proposed to be extracted in sequence. When Tahmoor Coal applied for development consent, it had been planned to extract LWs 101A to 103A first, then the B series longwalls and return to extract LWs 104A to 106A.

A comparison between predictions based on proposed LWs S1A to S6A with predictions based on the approved EIS layout is shown in Fig. 4.1. A comparison between maximum predicted incremental and total conventional subsidence, tilt and curvature between the EIS Layout and the First Amended Layout is shown in Table 4.3 and Table 4.4.

The proposed increases in panel width by 2 metres are very small compared to the overall depth of cover (0.5%) and panel width (0.7%). The chain pillar widths have been reduced by 5%, the 2 metre reduction from 38 metres to 36 metres represents a 0.5% reduction as a proportion of the depth of cover. Both proposed changes are predicted to result in very small increases in predicted maximum subsidence, tilt and curvature, as shown in Fig. 4.1. The predicted changes are within the accuracy of the subsidence prediction model.

The proposed offset in the layout by 35 metres has resulted in a shift of the predicted subsidence profiles across the panels. As shown in Fig. 4.1, some points on the surface are predicted to experience greater subsidence, tilt and curvature as a result of the change, while other points on the surface are predicted to experience greater subsidence, tilt and curvature.

For linear features such as streams, railways, roads and pipelines, the overall predicted maximum subsidence, tilts and curvatures are similar but shifted slightly. For discrete surface features such as building structures, the proposed changes will result in higher predicted values for some features and lower predicted values for other features but the overall spread across the Subsidence Study Area is expected to be similar. It is further noted that subsidence predictions for discrete surface features have been provided in this Extraction Plan report and the previous EIS report as the maximum predicted values within 20 metres of each feature, in recognition of the accuracy of the prediction method. This conservative approach is expected to buffer the effects of the 35 metre shift in mine layout.

The proposed change to the alignment of the central mains between the A and B series longwalls has been proposed to improve efficiencies in resource recovery and mining operations. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted for development consent. Some points on the surface are predicted to experience greater subsidence, tilt and curvature as a result of the change, while other points on the surface are predicted to experience greater subsidence, tilt and curvature as a result of the change.

The proposed changes to the sequencing of longwall extraction is expected to be beneficial to the community in the sense that the effects of extraction of the A series will occur over a shorter duration. Under the previously proposed sequencing in the EIS, the ground surface above LWs S3A and S4A in particular would have experienced a delay in the order of 5 years between active subsidence events while the B series was extracted.

It is also worthwhile noting that the points on the surface where maximum subsidence, tilt and curvatures were predicted for the approved EIS layout are located above the longwall panels in the B series. While the proposed changes to the mine layout in the A series are predicted to result in very small increases in predicted maximum subsidence, tilt and curvature over the A series, the predicted maxima remain less than the maximum subsidence, tilt and curvatures that were predicted for the approved EIS layout.

Specific subsidence predictions have been provided for identified surface and sub-surface features in this report. Comparisons to previously provided predictions for the EIS Layout have generally not been provided for reasons of brevity. Detailed comparisons can be made for each feature by comparing the findings in Report No. MSEC1123 for the EIS Layout.

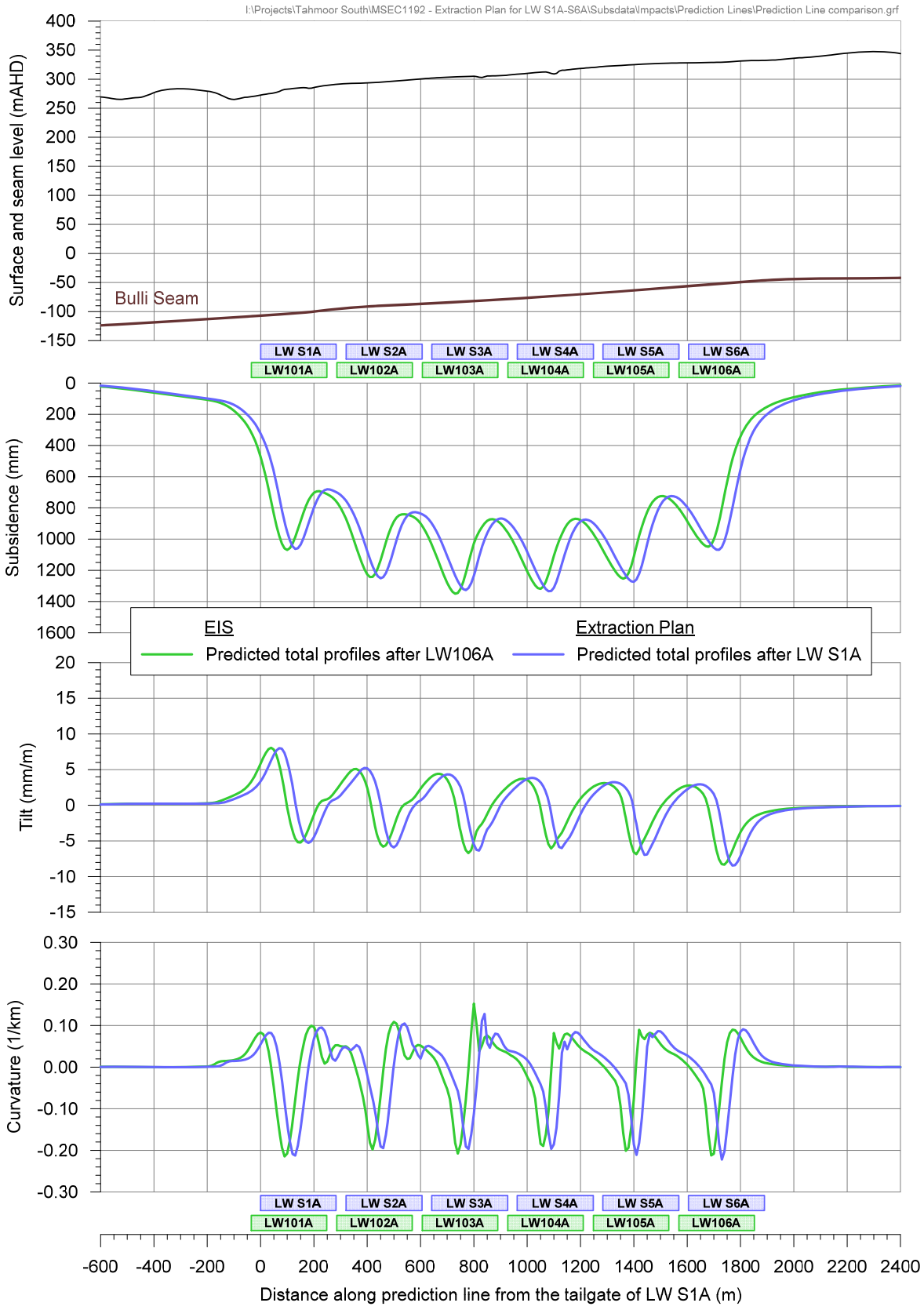


Fig. 4.1 Comparison of predictions between proposed Extraction Layout and approved EIS Layout

Table 4.3 Maximum predicted incremental conventional subsidence, tilt and curvature resulting from the extraction of the Extraction Plan Layout and the EIS Layout

Layout	Longwall	Maximum predicted incremental conventional subsidence (mm)	Maximum predicted incremental conventional tilt (mm/m)	Maximum predicted incremental conventional hogging curvature (km^{-1})	Maximum predicted incremental conventional sagging curvature (km^{-1})
Proposed Extraction Plan LWs S1A to S6A	LW S1A	800	7.0	0.08	0.22
	LW S2A	950	7.5	0.08	0.22
	LW S3A	950	8.0	0.09	0.22
	LW S4A	950	8.0	0.09	0.22
	LW S5A	950	8.0	0.10	0.22
	LW S6A	975	8.3	0.09	0.23
EIS Layout (MSEC1123)	LW101A	800	7.0	0.08	0.22
	LW102A	950	7.5	0.08	0.21
	LW103A	950	7.5	0.08	0.21
	LW104A	950	8.0	0.09	0.21
	LW105A	950	8.0	0.09	0.21
	LW106A	950	8.0	0.09	0.22

Table 4.4 Maximum predicted total conventional subsidence, tilt and curvature resulting from the extraction of the Extraction Plan Layout and the EIS Layout

Layout	Longwall	Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm/m)	Maximum predicted total conventional hogging curvature (km^{-1})	Maximum predicted total conventional sagging curvature (km^{-1})
Proposed Extraction Plan LWs S1A to S6A	LW S1A	800	7.0	0.08	0.22
	LW S2A	1,000	8.0	0.10	0.22
	LW S3A	1,200	8.0	0.10	0.22
	LW S4A	1,250	8.5	0.13	0.22
	LW S5A	1,350	9.0	0.14	0.22
	LW S6A	1,350	9.5	0.14	0.24
EIS Layout (MSEC1123)	LW101A	800	7.0	0.08	0.22
	LW102A	1000	8.0	0.10	0.22
	LW103A	1200	8.5	0.11	0.22
	LW104A	1300	8.5	0.16	0.22
	LW105A	1350	8.5	0.16	0.22
	LW106A	1350	8.7	0.16	0.23

4.3. Predicted strains

It is important to appreciate that the extraction of coal not only results in subsidence, but, it also induces horizontal ground movements and ground strains, and, unlike subsidence, which is measured vertically, it is important to appreciate that these parameters have both a magnitude and a direction. The magnitude of the measured ground strains can be sensitive to the ground distances over which they were measured, and, both the measured ground strains and horizontal movements are very sensitive to the direction in which they were measured. Hence, strain and horizontal movements are more complex, and they are more difficult to predict than subsidence, tilt and curvature.

The profiles of observed strain along monitoring lines, therefore, were often irregular in shape even when the profiles of observed subsidence, tilt and curvature were relatively smooth.

Early researchers noticed the similarity between the observed curvature and strain profiles and the similarity between the observed tilt and horizontal movement profiles. Hence, it was logical that the early strain prediction methods were based on linear relationships with predicted conventional curvature and the early horizontal ground movement prediction methods were based on linear relationships with predicted conventional tilt.

The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones and the locations that are predicted to experience sagging or concave curvature are expected to be net compressive strain zones and adopting a linear relationship between curvature and strain provided a reasonable prediction for the maximum conventional tensile and compressive strains.

In the Southern Coalfield, it was found that a curvature to conventional strain conversion factor of 15 provided a reasonable relationship between the maximum predicted curvatures and the maximum predicted conventional strains. Similarly, a tilt to conventional horizontal movement conversion factor of 15 was found to provide a reasonable relationship between the maximum predicted tilt and the maximum predicted conventional horizontal movement.

However, it was noticed that, whilst these correlations were reasonable for the maximum values of these parameters over some areas of the mined panels, they were not as reliable in many other areas, particularly in those locations that were beyond the edges of the mined panels that were near changes in geological conditions. It was also noted that survey tolerance and valley related movements can represent a high proportion of measured ground strains and horizontal displacements.

The limited accuracy of strain and horizontal movement predictions at locations away from the point of maximum strain and horizontal movement was discussed in later subsidence prediction reports where it was stated that the measured strains and horizontal ground movements at a point can vary considerably from the predicted conventional values. It was noted that the locations that were predicted to experience hogging or convex curvature experienced net tensile strain zones and the locations that were predicted to experience sagging or concave curvature experienced net compressive strain zones, but, it was highlighted that the observed strain and horizontal movement profiles along monitoring lines were irregular in shape, with an occasional spike, compared to the observed subsidence, tilt and curvature profiles which were relatively smooth. Hence, it was concluded that, whilst the prediction of vertical subsidence and tilt at a point could be carried out with reasonable accuracy and reliability, the prediction of mining-induced ground strains and horizontal movements at a point was far less accurate, especially when those predictions used linear conversion factors that were based on predicted conventional curvature and tilt.

Furthermore, the horizontal movement predictions at a point were rarely provided and the predictions of ground strains are usually provided based on statistical basis, as is detailed in Section 4.3.1.

However, strain is one of the most important parameters for assessing the likelihood of mine subsidence damage to natural features and built features on the surface. Recent research has resulted in some improved understanding and methods for predicting ground strains and relative horizontal movements in zones across mined panels at the surface, (Barbato, 2016, 2017). These new methods for predicting strain have been developed dependent on the mining geometry, surface topography, surface geology and the likelihood of irregular anomalous movements.

The predicted distribution of strains using this new method also provides guidance on the magnitudes of localised spikes and the likelihoods of exceeding strain thresholds based on previously measured ground monitoring data (Barbato et al., 2016 and 2017).

The reasons why ground strains and horizontal movements are more complex and difficult to predict than subsidence, tilt and curvature are partly associated with the observation that, while the strata has only one direction to move,(i.e. vertically downwards), it can be moved in two directions horizontally and it has been observed that the ground will move wherever it is easiest to go. Additionally, studies have noted that ground strains and horizontal movements are influenced/affected by many multiple factors and a complex interaction of many mechanisms, including the:

- magnitude of the vertical subsidence, tilt and the depth of cover;
- steepness and direction of the surface topography;
- steepness and direction of the seam dip;
- direction of mining in relation to both the surface and seam slope;
- geology, geomechanical properties and thicknesses of the near surface strata, as well as, all the overburden strata layers, the seam and the strata layers immediately under the seam;
- presence of geological faults, pre-existing natural joints and igneous intrusions;
- magnitude and principal direction of the in situ horizontal compressive stresses in the strata layers around the mined goaf and the surface strata layers;
- presence and proximity of previously extracted panels in the currently mined seam and previously extracted panels in other seams;
- behaviour of blocky sandstone environments where initial ground movements occur predominantly along pre-existing natural joints, the location of which would not be known;
- limited ability of opened joints to close fully during the following compression phases after the initial shearing and tensile movements;
- reversing component that seems to initially move surveyed surface pegs towards the longwall face as the face approaches and, then, after the face extracts under and away from this peg, the surface is moved back towards its initial position and often it is moved further past that position as it follows the mining face; and
- other contributing factors such as the degree of surface roughness and frictional resistance along the bedding planes, survey accuracy or survey tolerance (especially where the strains are of a low order of magnitude), the presence of groundwater flows along the bedding planes and its influence on the slippage along bedding planes, etc.

Nevertheless, it has been concluded that the curvature to conventional strain conversion factor and the tilt to horizontal movement conversion factor can be used to provide a reasonable indication of the maximum conventional strains and horizontal movements over extracted panels.

Using the maximum predicted conventional curvatures of 0.14 km^{-1} hogging and 0.24 km^{-1} sagging curvature and the conventional strain conversion factor of 15, the maximum predicted conventional strains for the proposed LWs S1A to S6A, are approximately 2.1 mm/m tensile and 3.4 mm/m compressive.

At specific points around the mined panels, however, there can be considerable variation from this linear curvature to conventional strain relationship, resulting from non-conventional movements and a wide range of scatter is observed between the predicted and observed strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. In this report, therefore, MSEC has provided a statistical approach to predict observed strain and hence account for this variability, instead of just providing a single predicted conventional strain.

The range of potential strains above the proposed longwalls has been determined using monitoring data from the previously extracted longwalls at Tahmoor Mine, as well as from other nearby collieries, including Appin and West Cliff, where the regional geology and mining geometries are reasonably similar to that for the proposed longwalls. A summary of the monitoring lines that were used in the strain analysis is provided in Table 4.5 and Table 4.6 shows the mining geometry for the proposed longwalls.

Table 4.5 Monitoring lines used in the strain analysis

Location	Monitoring Lines	Longwall Widths (m)	Depths of Cover (m)	Width-to-Depth Ratios	Extraction Heights (m)
Early longwall areas at Tahmoor Mine	100-Line	190	410	0.47	2.0
	200-Line	190	410	0.46	1.9
	300-Line	190 ~ 240	430	0.47	2.2
	800-Line	235	420	0.56	2.1
	900-Line	235	420	0.56	2.0
	1000-Line	190 ~ 240	400	0.57	1.8
Northern areas over Tahmoor	40 monitoring lines located outside the area of '*increased subsidence*'	285	425 ~ 470 *(440 average)*	0.60 ~ 0.67 *(0.64 average)*	1.7 ~ 2.3 *(2.1 average)*
Appin Area 3	M-Line	260	480 ~ 520 *(500 average)*	0.50 ~ 0.54 *(0.52 average)*	2.6 ~ 3.0 *(2.8 average)*
Appin Area 7	HW2 East, HW2 West, ARTC and Moreton Park Road	305	500 ~ 560 *(530 average)*	0.54 ~ 0.61 *(0.58 average)*	2.8 ~ 3.2 *(3.0 average)*
West Cliff Area 5	B-Line	305	490 ~ 530 *(510 average)*	0.58 ~ 0.62 *(0.60 average)*	2.4 ~ 3.0 *(2.6 average)*

Table 4.6 Mining geometry for the proposed LWs S1A to S6A

Location	Longwall Widths (m)	Depths of Cover (m)	Width-to-Depth Ratios	Extraction Heights (m)
LW S1A to LW S6A	283-285	375 ~ 410 *(390 average)*	0.69 ~ 0.76 *(0.73 average)*	2.1 ~ 2.2 *(2.1 average)*

It can be seen from the above tables, that the extraction heights for the proposed longwalls vary between 2.1 metres and 2.2 metres, which similar to those for the previously extracted longwalls at Tahmoor Mine, which varied between 1.7 metres and 2.3 metres, but is less on average than those for the previously extracted longwalls at Appin and West Cliff Collieries, which varied between 2.4 metres and 3.2 metres. That is, the extraction heights for the proposed longwalls are within the ranges of those for the previously extracted longwalls at Tahmoor, Appin and West Cliff Collieries.

The width-to-depth ratios for the proposed longwalls varies between 0.69 and 0.76, which are slightly greater than those for the previously extracted longwalls at Tahmoor, Appin and West Cliff Collieries, which varied between 0.46 and 0.67. Unfortunately, there is limited available ground monitoring data from previously extracted longwalls in the Southern Coalfield where the width-to-depth ratios are exactly similar to the proposed longwalls.

There is, however, extensive ground monitoring data available from previously extracted longwalls in the Newcastle, Hunter and Western Coalfields where the width-to-depth ratios were similar and much greater than those for the proposed longwalls. This data was not included in the strain analyses, since the overburden geology is different to that in the Southern Coalfield and since the width-to-depth ratios for the proposed longwalls are only slightly higher than the available Southern Coalfields data that has similar overburden geology.

A review of the available data from the Newcastle, Hunter and Western Coalfields indicates that the observed strains for previously extracted longwalls having width-to-depth ratios between 0.70 and 0.85, i.e. slightly greater when compared to the proposed amended longwalls, were on average, around 20 % to 40 % greater than the observed strains for previously extracted longwalls in the Newcastle, Hunter and Western Coalfields having width-to-depth ratios between 0.50 and 0.70, i.e. similar to Tahmoor North, Appin and West Cliff Collieries.

It could be expected, therefore, that the observed strains resulting from the extraction of the proposed longwalls would be, on average, around 20 % to 40 % greater than those previously experienced at Tahmoor, Appin and West Cliff Collieries and, hence, the predicted strains for the proposed longwalls have been determined from the analyses of strain from the previously extracted longwalls at Tahmoor, Appin and West Cliff Collieries, with the magnitudes increased by 20 % to 40 % to account for the higher width-to-depth ratios based on the observations from the Newcastle, Hunter and Western Coalfields.

The data used in the analysis of observed strains included those resulting from both conventional and non-conventional anomalous movements but did not include those resulting from valley related movements, which are addressed separately in this report. The strains resulting from damaged or disturbed survey marks have also been excluded.

A number of probability distribution functions were fitted to the empirical monitored strain data. It was found that a *Generalised Pareto Distribution (GPD)* provided a good fit to the raw strain data. Confidence levels have been determined from the empirical strain data using the fitted GPDs. In the cases where survey bays were measured multiple times during a longwall extraction, the maximum tensile strain and the maximum compressive strain were used in the analysis (i.e. single tensile strain and single compressive strain measurement per survey bay).

4.3.1. Analysis of strains measured in survey bays

For features that are in discrete locations, such as building structures, farm dams and archaeological sites, it is appropriate to assess the frequency of the observed maximum strains for individual survey bays.

Predictions of strain above goaf

The survey database has been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located directly above goaf or the chain pillars that are located between the extracted longwalls, which has been referred to as "*above goaf*".

The histogram of the maximum observed total tensile and compressive strains measured in survey bays above goaf, for monitoring lines at Tahmoor, Appin Area and West Cliff Collieries, is provided in Fig. 4.2. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

The 95 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.9 mm/m tensile and 1.6 mm/m compressive. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 95 % of the strains measured *above goaf* would be less than 1.3 mm/m tensile and 2.2 mm/m compressive.

The 99 % confidence levels for the maximum total strains that the individual survey bays *above goaf* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 1.4 mm/m tensile and 3.1 mm/m compressive. Similarly, it is expected that 99 % of the strains measured *above goaf* for the proposed longwalls would be less than 2.0 mm/m tensile and 4.3 mm/m compressive.

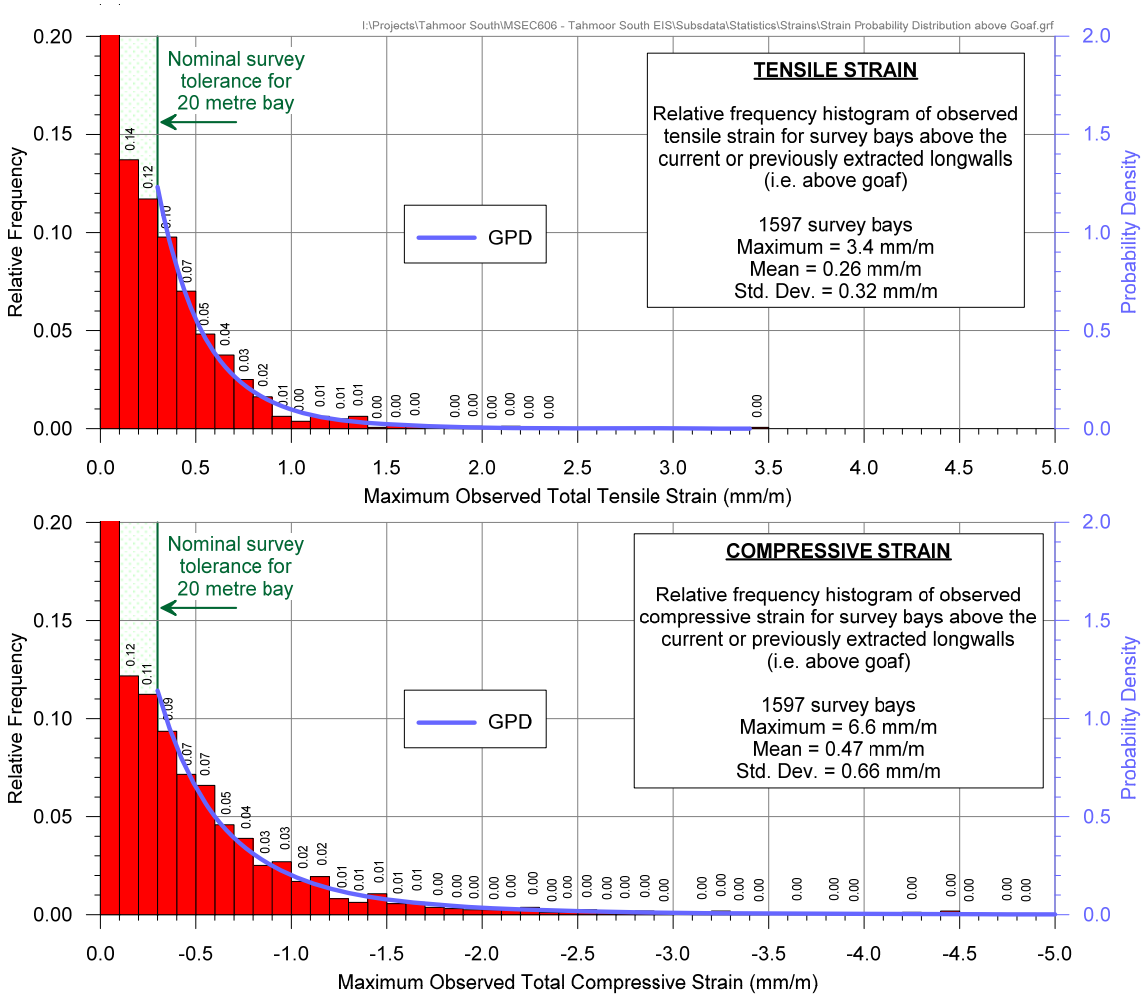


Fig. 4.2 Distributions of the measured maximum tensile and compressive strains for surveys bays located *above goaf* at Tahmoor, Appin and West Cliff Collieries

Predictions of strain above solid coal

The survey database has also been analysed to extract the maximum tensile and compressive strains that have been measured at any time during the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, for survey bays that were located beyond the goaf edges of the mined panels and positioned on unmined areas of coal, i.e. outside panels but within 200 metres of the nearest longwall goaf edge, which has been referred to as "*above solid coal*".

The histogram of the maximum observed tensile and compressive strains measured in survey bays above solid coal, for monitoring lines at Tahmoor, Appin and West Cliff Collieries, is provided in Fig. 4.3. The probability distribution functions, based on the fitted GPDs, have also been shown in this figure.

The 95 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.6 mm/m tensile and 0.5 mm/m compressive. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 95 % of the strains measured *above solid coal* would be less than 1.0 mm/m tensile and compressive.

The 99 % confidence levels for the maximum total strains that the individual survey bays *above solid coal* experienced at any time during mining at Tahmoor, Appin and West Cliff Collieries were 0.9 mm/m tensile and compressive. Similarly, it is expected that 99 % of the strains measured *above solid coal* adjacent to the proposed longwalls would be less than 1.5 mm/m tensile and compressive.

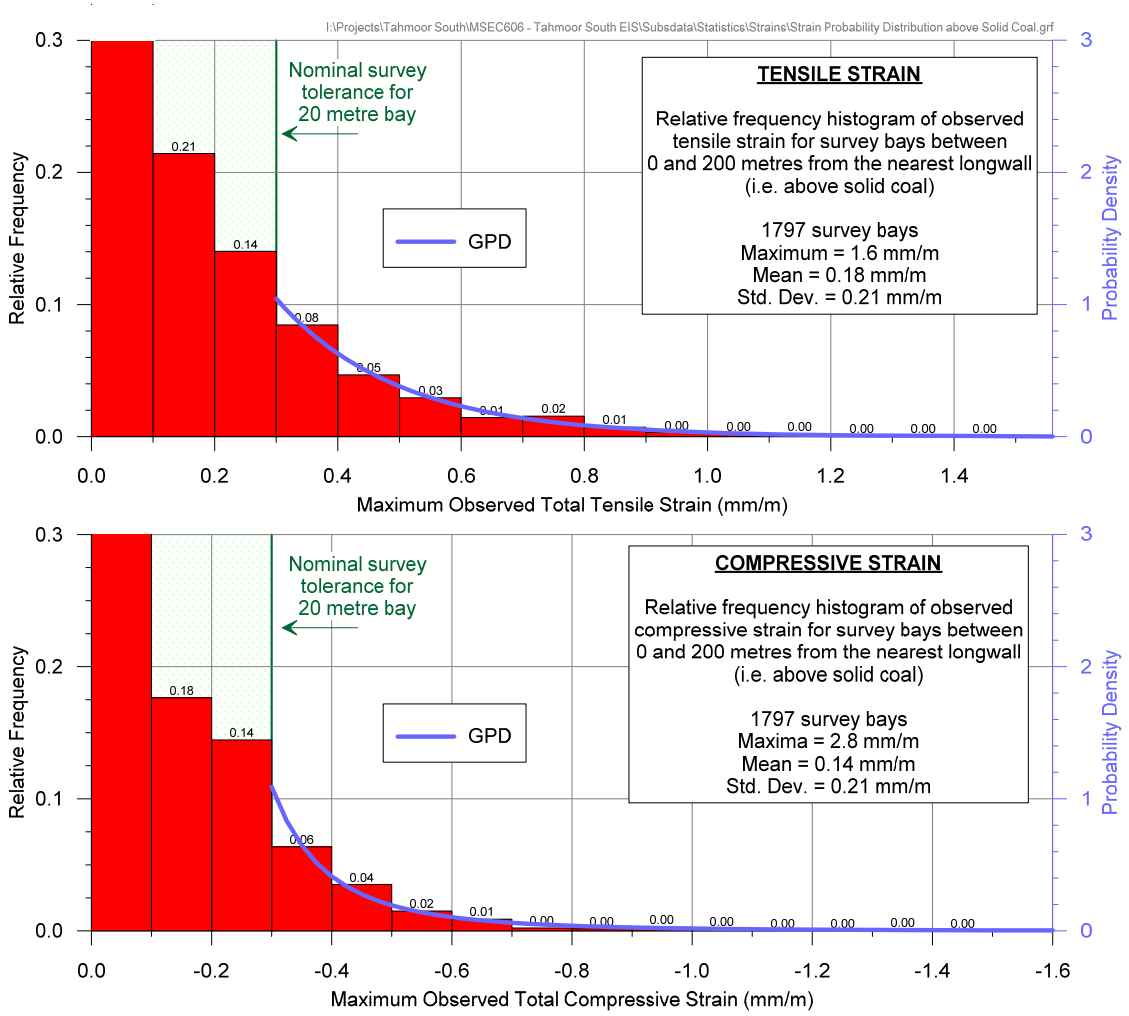


Fig. 4.3 Distributions of the measured maximum tensile and compressive strains for survey bays located *above solid Coal* at Tahmoor, Appin and West Cliff Collieries

4.3.2. Analysis of strains measured along whole monitoring lines

For linear features such as roads, cables and pipelines, it is more appropriate to assess the frequency of the maximum observed strains along whole monitoring lines, rather than for individual survey bays. That is, an analysis of the maximum strains measured anywhere along the monitoring lines, regardless of where the strain actually occurs.

The histogram of maximum observed total tensile and compressive strains measured anywhere along the monitoring lines, at any time during or after the extraction of the previous longwalls at Tahmoor, Appin and West Cliff Collieries, is provided in Fig. 4.4.

It can be seen from Fig. 4.4, that 42 of the 52 monitoring lines (i.e. 92 % of the total) at Tahmoor, Appin and West Cliff Collieries had recorded maximum total tensile strains of 2.0 mm/m, or less. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 92 % of the monitoring lines above the proposed longwalls would experience maximum tensile strains of 3.0 mm/m, or less.

It can also be seen, that 45 of the 52 monitoring lines (i.e. 87 % of the total) at Tahmoor, Appin and West Cliff Collieries had recorded maximum total compressive strains of 4.0 mm/m, or less. The strains for the proposed longwalls are predicted to be 20 % to 40 % greater than those previously observed at these collieries and, therefore, it is expected that 87 % of the monitoring lines above the proposed longwalls would experience maximum compressive strains of 5.5 mm/m, or less.

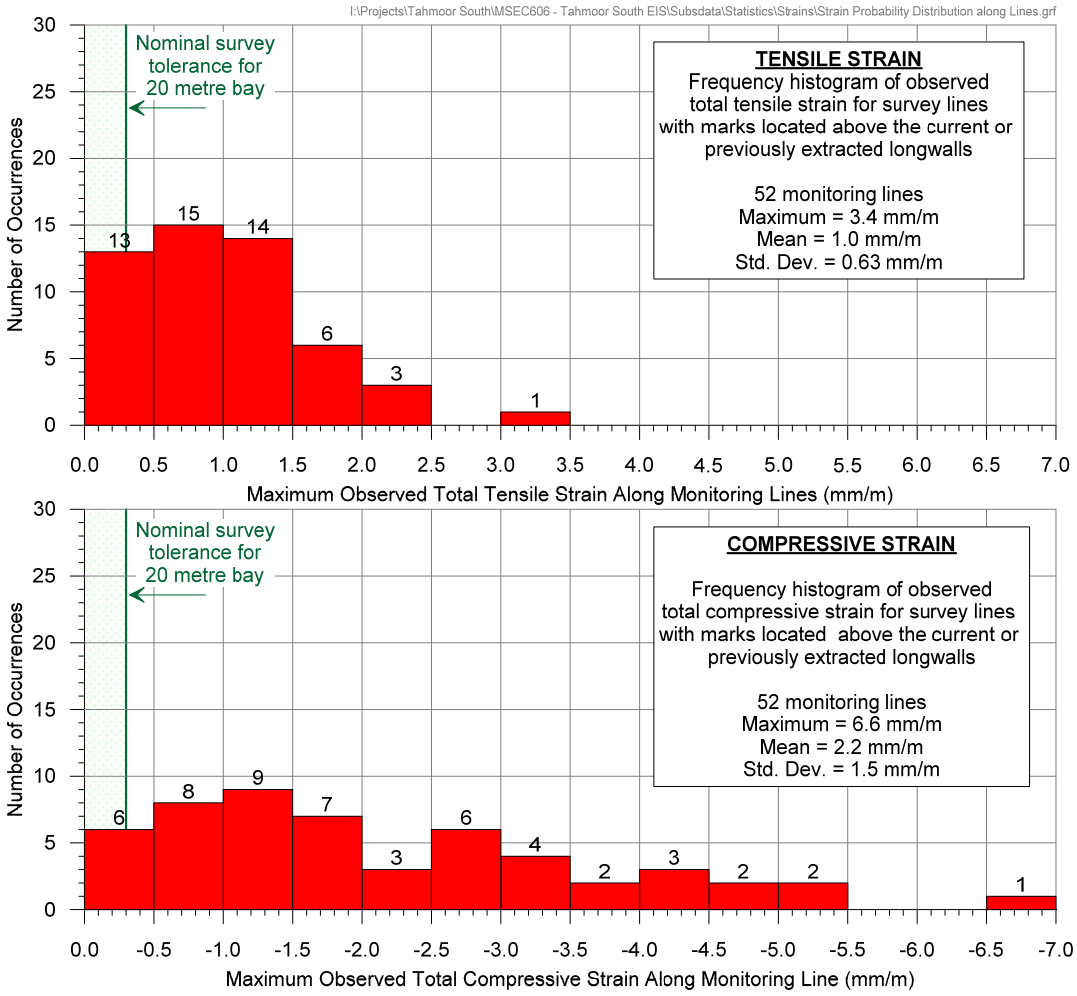


Fig. 4.4 Distributions of measured maximum tensile and compressive strains anywhere along the monitoring lines at Tahmoor, Appin and West Cliff Collieries

4.3.3. Analysis of shear strains

As described in Section 3.3, ground strain comprises two components, being normal strain and shear strain, which can be interrelated using a Mohr's Circle analysis. The magnitudes of the normal strain and shear strain components are, therefore, dependent on the orientation in which they are measured. The maximum normal strains (i.e. principal strains) are those in the direction where the corresponding shear strain is zero.

Normal strains along monitoring lines can be measured using 2D and 3D techniques, by taking the change in horizontal distance between two points on the ground and dividing by the original horizontal distance between them. This provides the magnitude of normal strain along the orientation of the monitoring line but, this strain may not necessarily be the maximum (i.e. principal) strain.

Shear deformations are more difficult to measure, as they are the relative horizontal movements perpendicular to the direction of measurement. However, 3D monitoring techniques provide data on the direction and the absolute displacement of survey marks and, therefore, the shear deformations perpendicular to the monitoring line can be determined. It is possible to gain an understanding of the shear strain along a monitoring line with repeat measurements, but, in accordance with rigorous definitions and the principles of continuum mechanics, (e.g. Jaeger, 1969), it is not possible to accurately determine horizontal shear strains in any direction relative to the monitoring line using 3D monitoring data from a straight line of survey marks.

As described in Section 3.3, shear deformations perpendicular to monitoring lines can be described using various parameters, including horizontal tilt, horizontal curvature, horizontal mid-ordinate deviation, angular distortion and shear index. In this report, horizontal mid-ordinate deviation has been used as the measure for shear deformation, which is defined as the differential horizontal movement of each survey mark, perpendicular to a line drawn between two adjacent survey marks.

The frequency distribution of the maximum total horizontal mid-ordinate deviations measured at survey marks above goaf, for previously extracted longwalls in the Southern Coalfield, is provided in Fig. 4.5. As the typical survey bay length was 20 metres, the calculated mid-ordinate deviations were over a chord length of 40 metres. The probability distribution function, based on the fitted GPD, has also been shown in this figure.

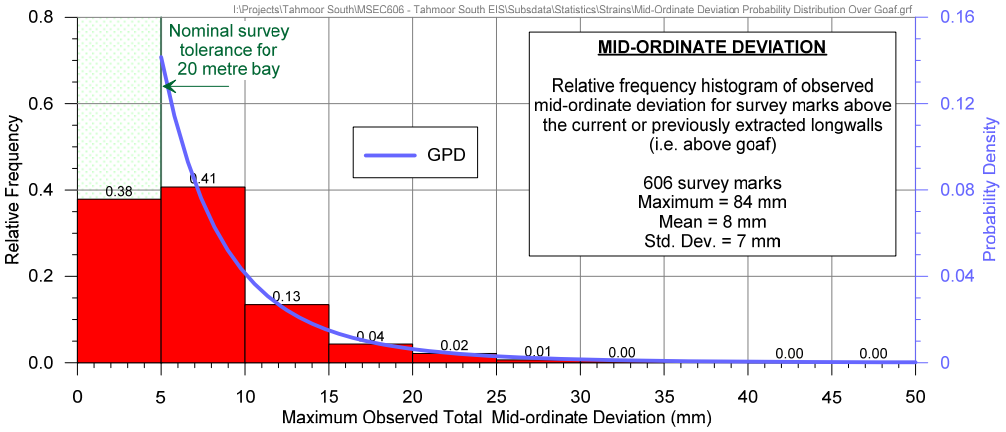


Fig. 4.5 Distribution of measured maximum mid-ordinate deviation during the extraction of previous longwalls in the Southern Coalfield for marks located above goaf

The 95 % and 99 % confidence levels for the maximum total horizontal mid-ordinate deviation that the individual survey marks located above goaf experienced at any time during mining were 20 mm and 35 mm, respectively. The shear deformations for the proposed longwalls are estimated to be 20 % to 40 % greater than those previously observed at Tahmoor, Appin and West Cliff Collieries and, therefore, it is expected that 95 % and 99 % of the horizontal mid-ordinate deviations measured above the proposed longwalls would be less than 30 mm and 50 mm, respectively.

4.4. Potential additional settlement above coal barriers between proposed and previous mine workings

Parts of the proposed longwalls are located close or adjacent to the previously extracted Longwall 2, Longwall 14B and Longwalls 15 to 19 with a proposed barrier of unmined coal being left between the previously extracted panels and the proposed workings, (except for development headings).

Slightly increased levels of subsidence over the predicted levels of subsidence were observed within the following areas at Tahmoor, Appin or Tower Collieries that were also located above similar unmined barriers of coal (with some development headings) between previously extracted areas, such as:

- Between Longwall 3 and Longwall 22 at Tahmoor Mine;
- Between Longwall 23A and 23B at Tahmoor Mine;
- Between Longwall 24A and the 200 Panels at Tahmoor Mine;
- Between Longwalls 22 to 24B and Longwall 24A and the 200 Panels and Longwall 25 (i.e. mining on three sides of a corridor of intact coal) at Tahmoor Mine;
- Between Longwalls 8-12, Longwall 18 and Longwall 408 at Appin Colliery; and
- Between Longwalls 14-18, 301-302 and 401 at Appin Colliery.

The amount of increased subsidence in these areas has generally been between 50 and 150 mm of subsidence above what was predicted using the IPM and generally low levels of tilt and strain were measured within these areas.

These areas of increased subsidence have not always been observed in these situations. For example, it was not observed between Longwalls 3-9 and Longwall 20, nor between Longwalls West 1-2 and Longwalls 30-32 at Tahmoor Mine.

While observed subsidence may exceed predictions above the coal barrier between proposed LW S1A and previously extracted Longwall 2, between proposed LWs S1A to S6A and previously extracted LWs 14B to 19, subsidence monitoring has shown that it is usually accompanied by relatively low systematic tilts, curvature and strains (less than 0.5 mm/m and usually within survey tolerance).

It is noted that the *Subsidence Study Area* encompasses the surface areas located directly above the coal barriers.

4.5. Predicted conventional horizontal movements

Tahmoor Coal commenced surveys of absolute horizontal movement during the mining of Longwall 25. The great majority of the surveys at Tahmoor Mine are now undertaken using 3D surveying techniques, including most of the pegs along the Main Southern Railway and within the monitoring network around the ends of Longwalls 25 to 32.

The maximum measured incremental horizontal movement to date has been 255 mm at Peg RE14 on Remembrance Drive during the mining of Longwall 26. The maximum measured incremental horizontal movement after the completion of Longwall 25 was 175 mm at Peg 25-21 along the Longwall 25 Centreline.

These horizontal movements are within the normal range in the Southern Coalfield at similar depths of cover.

Absolute horizontal movements by themselves do not directly impact on natural and built features, rather impacts occur as the result of differential horizontal movements. Strain is a measure of change of horizontal movement as was discussed in Sections 3.3 and 0. The impacts of strain movements on the natural and built features are addressed in the impact assessments for each feature, which have been provided in Chapters 5 through to 11.

4.6. Predicted far-field horizontal movements

As discussed in Section 3.5, in addition to the conventional subsidence movements that have been predicted above and adjacent to the proposed longwalls, far-field horizontal movements will also be experienced during the extraction of the proposed longwalls.

The observed incremental far-field horizontal movements resulting from the extraction of incremental longwall panels, in any location above goaf, i.e. above the currently mined or previously mined panels, or above solid coal, i.e. unmined areas of coal, are provided in Fig. 4.6. The observed incremental far-field horizontal movements above solid coal only, i.e. outside the extents of extracted longwalls, are provided Fig. 4.7. The confidence levels, based on fitted *Generalised Pareto Distributions* (GPDs), have also been shown in these figures to illustrate the spread of the data. It can be seen from Fig. 4.6 and Fig. 4.7 that the magnitude of the observed far-field horizontal movements over solid unmined areas of coal are lower and more consistent than the observed far-field horizontal movements over previously extracted panels.

A far field monitoring program was conducted by Tahmoor Coal during the extraction of Longwall 32 at key civil structures. The observed horizontal movements were within the normal range. Similar experiences have been observed during the extraction of the Tahmoor West longwalls.

As successive longwalls within a series of longwalls are mined, the magnitudes of the incremental far-field horizontal movements decrease. This is possibly due to the fact that once the in-situ stresses within the strata have been redistributed around the collapsed zones above the first few extracted longwalls, the potential for further movement is reduced. The total far-field horizontal movement may be less, therefore, than the sum of the incremental far-field horizontal movements for the individual longwalls.

The predicted far-field horizontal movements resulting from the extraction of the proposed longwalls are very small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the extracted goaf area, and are accompanied by very low levels of strain, which are generally less than the order of survey tolerance (i.e. less than 0.3 mm/m). The potential impacts of differential far-field horizontal movements on the natural and built features within the vicinity of the proposed longwalls are not expected to be measurable, with possibly the exception of the road and railway bridges, which are discussed in the impact assessments for these features in Chapter 5 through to 11.

No measurable differential movements were observed during the far field monitoring program conducted by Tahmoor Coal during the extraction of Longwall 32 at key civil structures. Some of these structures were located near or across mapped first order faults, including structures within the Picton Water Recycling Plant, the Picton Viaduct, the Victoria Bridge and the Argyle Street Railway Underbridge.

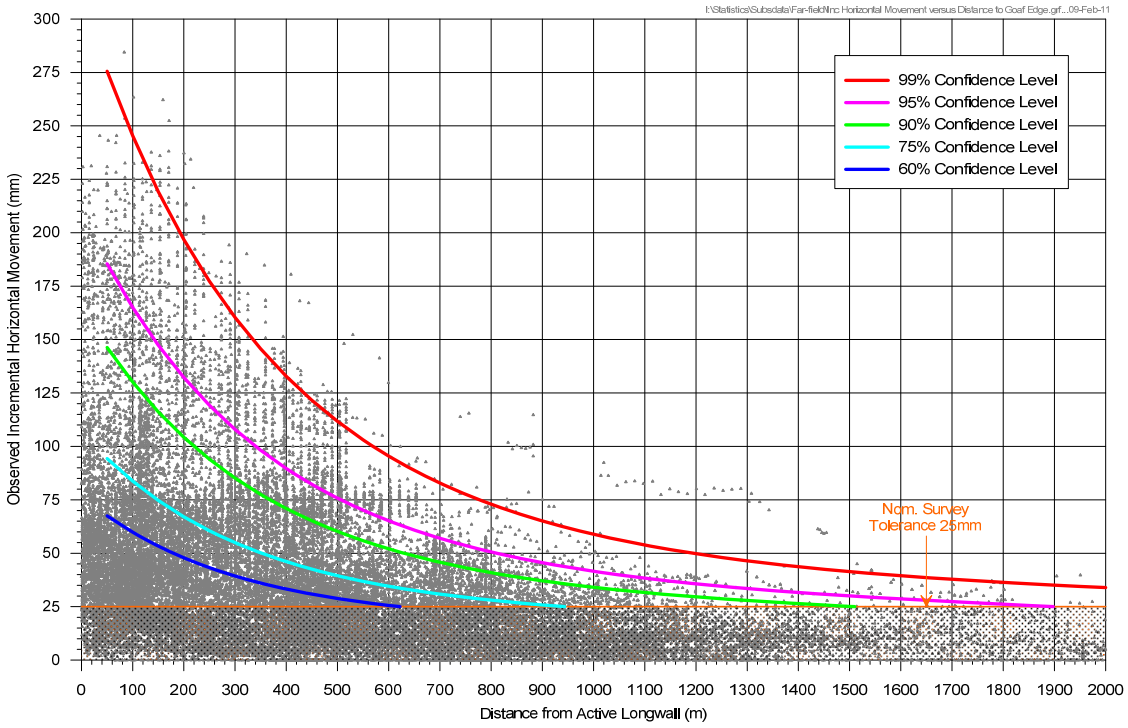


Fig. 4.6 Observed incremental far-field horizontal movements above goaf or solid coal

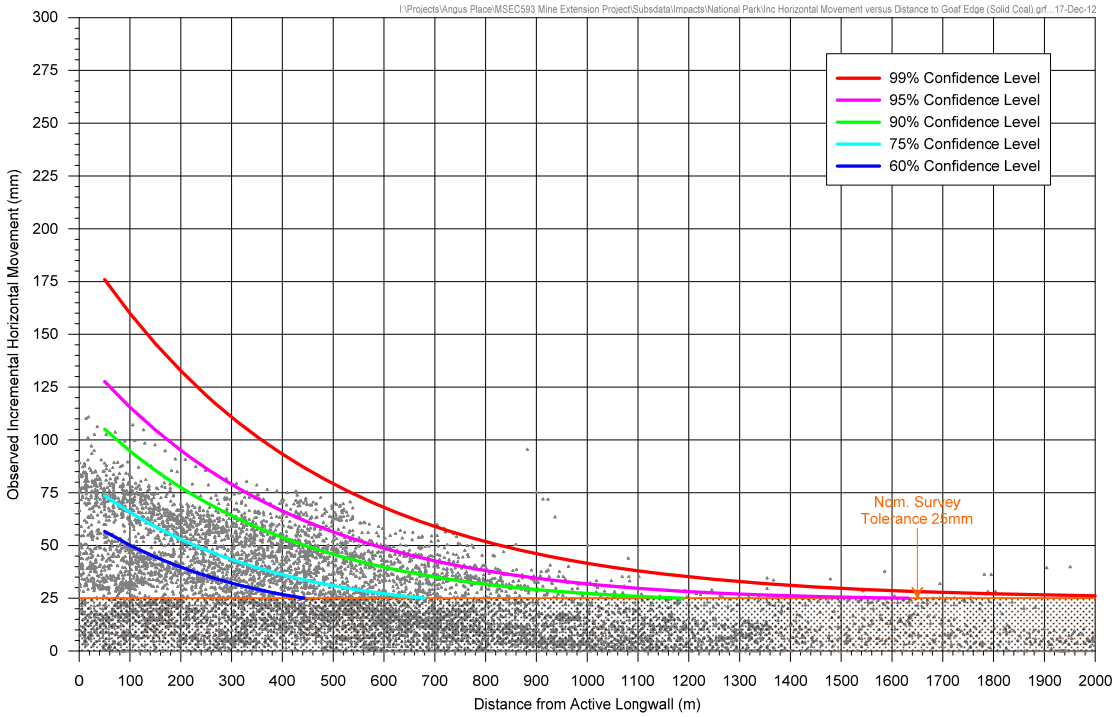


Fig. 4.7 Observed incremental far-field horizontal movements above solid coal only

4.7. Non-conventional ground movements

It is likely non-conventional ground movements will occur within and around the *Subsidence Study Area*, due to near surface geological conditions, steep topography and valley related movements, which were discussed in Section 3.4. These non-conventional movements are often accompanied by elevated tilts, curvatures and strains, which are likely to exceed the conventional predictions.

Specific predictions of upsidence, closure and compressive strain due to the valley related movements are provided for the streams in Section 5.3. The impact assessments for the streams are based on both the conventional and valley related movements. The potential for non-conventional movements associated with steep topography is discussed in the impact assessments for the steep slopes provided in Section 5.5.

In most cases, it is not possible to accurately predict the exact locations or magnitudes of the non-conventional anomalous movements due to near surface geological conditions. For this reason, the strain predictions provided in this report are based on a statistical analysis of measured strains in the Southern Coalfield, including both conventional and non-conventional anomalous strains, which is discussed in Section 4.3. In addition to this, the impact assessments for the natural features and surface infrastructure, which are provided in Chapters 5 through to 11, include historical impacts resulting from previous longwall mining which have occurred as the result of both conventional and non-conventional subsidence movements.

Mining beneath urban and semi-rural areas at Tahmoor and Thirlmere by Tahmoor Mine Longwalls 22 to 32 provides valuable "whole of panel" information. A plot of locations of potential non-conventional movement is shown in Fig. 4.9. The locations were selected based on ground monitoring results or observed impacts that appear to have been caused by non-conventional movement. A total of approximately 59 locations (not including valleys) have been identified over the extracted Longwalls 22 to 32. The surface area directly above the longwalls is approximately 9.1 km^2. This equates to a frequency of 6 sites per square kilometre or one site for every 16 hectares. The non-conventional movements were mainly characterised by elevated compressive ground strains that varied up to a maximum of approximately 5 mm/m.

The largest known case of non-conventional movement in the Southern Coalfield occurred above Appin Colliery Longwall 408 (Swarbrick, *et al.*, 2007). In this case, a low angle thrust fault was re-activated in response to mine subsidence movements, resulting in differential vertical and horizontal movements across the fault. Observations at the site showed that the non-conventional movements developed gradually over a period of time. Regular ground monitoring across the fault indicated that the rate of differential movement was less than 0.5 mm/day at the time non-conventional movements could first be detected. Subsequently as mining progressed, the rate of differential movement increased to a maximum of 28 mm/week.

A recent example occurred at a low angle fault that intersected the Main Southern Railway in the Deviation Cutting at Tahmoor, which was located directly above Longwall 29. The site was monitored extensively during the mining of Longwalls 28 to 31. This included three monitoring lines along the railway cutting, and survey prisms along the railway track.

The results of observed changes in vertical alignment of the pegs along the railway cutting are shown in Fig. 4.8. It can be seen that the most significant changes occurred during the mining of Longwall 29. The changes, however, developed gradually over time, allowing the railway track to be adjusted such that trains could continue to travel through the site.

The observations of the gradual development of differential movements have been consistently observed during the mining of previous longwalls at Tahmoor Mine. While some sites have experienced severe impacts, the subsidence movements developed gradually, allowing time for repair before they became unsafe.

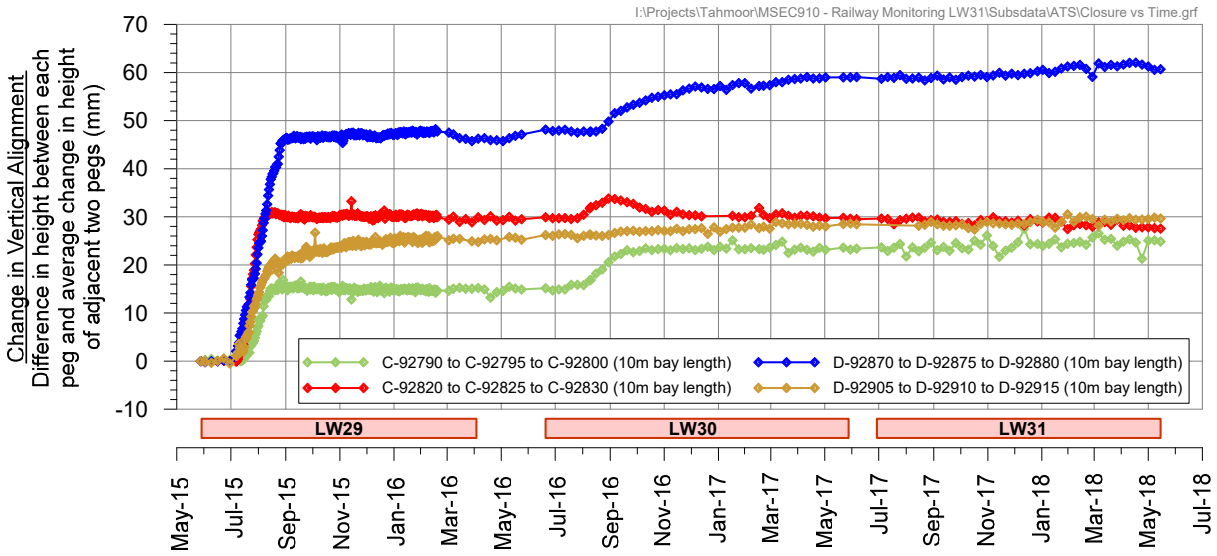


Fig. 4.8 Changes in vertical alignment across a geological fault within a railway cutting during the mining of Longwalls 29 to 31 at Tahmoor Coal

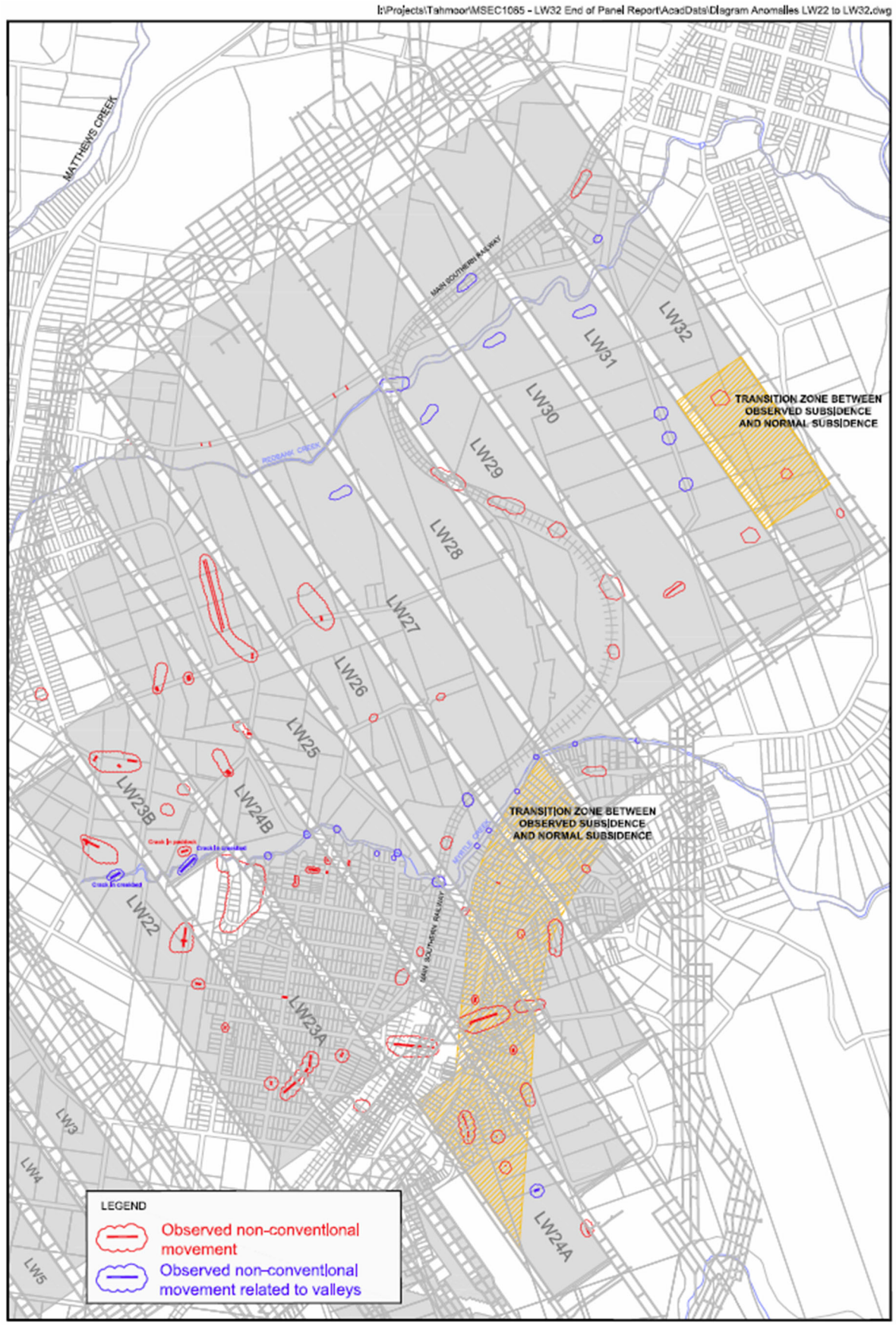


Fig. 4.9 Map showing locations of observed non-conventional movement above Tahmoor Mine Longwalls 22 to 32

4.8. General discussion on mining induced ground deformations

Longwall mining can result in surface cracking, heaving, buckling, humping and stepping at the surface. The extent and severity of these mining induced ground deformations are dependent on a number of factors, including the mine geometry, depth of cover, overburden geology, locations of natural jointing in the bedrock and the presence of near surface geological structures.

Faults and joints in bedrock develop during the formation of the strata and from subsequent distressing associated with movement of the strata. Longwall mining can result in additional fracturing in the bedrock, which tends to occur in the tensile zones, but fractures can also occur due to buckling of the surface beds in the compressive zones. The incidence of visible cracking at the surface is dependent on the pre-existing jointing patterns in the bedrock as well as the thickness and inherent plasticity of the soils that overlie the bedrock.

Surface cracking in soils as the result of conventional subsidence movements, i.e. away from valleys and steep slopes, is not commonly observed where the depths of cover are, for example, around 400 metres, such as the case within the *Subsidence Study Area*. Surface cracking that has been observed as the result of conventional subsidence movements has generally been relatively isolated and of a minor nature.

Cracking is found more often in the bases of valleys due to the compressive strains associated with upsidence and closure movements, which is discussed in Section 5.3. Cracking can also occur at the tops of steep slopes as the result of downslope movements, which is discussed in Section 5.5.

Surface cracks are more readily observed in built infrastructure such as compacted road pavements. In many cases, no visible ground deformations can be seen in the natural ground adjacent to the cracks in the road pavements. In rare instances, more noticeable ground deformations, such as humping or stepping of the ground can be observed at thrust faults. Examples of ground deformations previously observed in the Southern Coalfield, where the depths of cover are 400 metres, or greater, are provided in the photographs in Fig. 4.10 to Fig. 4.13 below.

Localised ground buckling and shearing can occur wherever faults, dykes and abrupt changes in geology occur near the ground surface. The identified geological structures within the *Subsidence Study Area* are discussed in Section 3.8 and it is possible that ground deformations could develop where the Nepean Fault daylights on the surface. Discussions on irregular ground movements were provided in Section 4.7.



Fig. 4.10 Surface compression buckling observed in a pavement



Fig. 4.11 Surface tension cracking along the top of a steep slope



Fig. 4.12 Surface tension cracking along the top of a steep slope

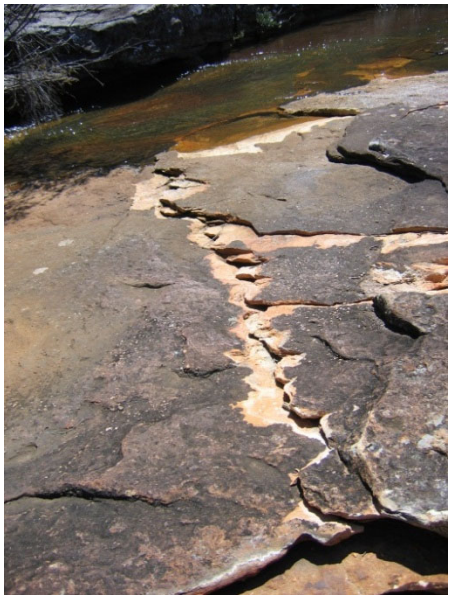


Fig. 4.13 Fracturing and bedding plane slippage in sandstone bedrock in the base of a stream

The following sections provide descriptions, predictions and impact assessments for natural features that have been identified within the *Subsidence Study Area*. The natural features located outside the *Subsidence Study Area*, which may be subjected to far-field movements or valley related movements and may be sensitive to these movements, have also been included as part of these assessments.

5.1. Catchment Areas or Declared Special Areas

There are no catchment areas or declared special areas within the Study Area. The nearest catchment area is the Metropolitan Special Area, which is located approximately 4.5 km southeast of the proposed longwalls.

5.2. The Bargo River

The location of the Bargo River is shown in Drawing No. MSEC1192-07. Descriptions, predictions and impact assessments for the river are provided in the following sections.

5.2.1. Description of the Bargo River

The Bargo River commences north of Colo Vale and near the townships of Hill Top and Yerrinbool and flows generally towards the north and to the west of the Bargo township. The Bargo River then flows to the west and north of the proposed Tahmoor South longwalls. The Bargo River then drains into the Nepean River approximately 4.9 kilometres north-east of the proposed Longwall S1A.

The Bargo River is not located within the 600m Subsidence Study Area for Natural Features. The closest distance between the Bargo River and the proposed longwalls is 690 metres, i.e. to the nearest corner of LW S2A. This section of the river was directly mined beneath by Longwalls 14B to 19.

A summary of the minimum distances between the river and the proposed longwalls is provided below in Table 5.1.

Table 5.1 Minimum distances of the proposed longwalls from the Bargo River

Longwall	Minimum distance from the centreline of Bargo River (m)
LW S1A	720
LW S2A	690
LW S3A	730
LW S4A	780
LW S5A	830
LW S6A	850

The length of the river that is nearest to the *Subsidence Study Area* is a 5th order perennial stream as defined by the Strahler Stream Order Method. This section of the river was directly mined beneath by Longwalls 14B to 19.

The surface water flows in this section of the river are controlled by the Picton Weir (also called the Bargo Weir) with discharge regulated by a fixed discharge valve. The reservoir is emptied following extended dry periods, but it is quickly filled with the spillway overtopping following large storm events. The following article from the Picton Post, dated 1945, provides some background;

> *"The existing dam was built to T.W.L.912 in 1899, the lowest foundation being at R.L.887, which was a few feet below river bed level. In 1910 the wall was raised to T.W.L.920, giving a storage of 37 m.g."*
>
> *"During the recent drought the water level dropped considerably, and it was ascertained that the dam had silted up. It is understood that the silt level is approximately at R.L.904, which would leave an available storage, if this level were uniform, of 33 m.g. It is quite probable that the silt level in the upper reaches of storage is higher."*

The water stored by the Picton Weir was initially used to supply the nearby communities. After pipes were laid from the much larger Nepean Dam, however, Bargo, Thirlmere, Picton and The Oaks were supplied water from the Nepean Dam (now through the Nepean Water Filtration Plant), and the water from the Picton Weir is no longer used for town water supply.

The reports by Fluvial Systems (2013) and the Water Management Plan (Tahmoor Coal, 2022a) provide a detailed description of the river.

As shown in Drawings No. MSEC1192-01 and MSEC1192-07, Tahmoor Mine extracted longwalls LW14B to LW19 under parts of this section of the Bargo River valley. The overall depth of the Bargo River valley varies from 90 metres down to 50 metres with the steeper sections of the valley comprising cliffs, rock outcrops and talus slopes in a number of locations.

There has been a long history of mining directly beneath or near the Bargo River at Tahmoor Mine. While impacts have occurred when various previously extracted longwalls were mined directly beneath the river (refer Section 5.3.4), impacts have been not observed when mining has been undertaken more than 500 metres away from the river.

Previously extracted Longwall 24A was approximately 340 metres from the river at its closest point and Longwall 25 was approximately 510 metres from the river. Ground surveys measured very little vertical subsidence (less than 20 mm) and closure (less than 10 mm) occurred even though at this section of the river the gorge was 80 metres deep. Impacts to the river were not observed during the extraction of these longwalls.

Based on the previous experience at Tahmoor Mine, it is unlikely that the extraction of the proposed longwalls would result in any adverse impacts on the river. Even if the predictions and impact assessments were exceeded, the likelihood of pool drainage is considered extremely low given the water flows in the river.

Further detailed discussions on the impacts and consequences of changes in the surface water flows are provided in the Water Management Plan (Tahmoor Coal, 2022a).

5.2.2. Management of potential impacts on the Bargo River

Tahmoor Coal has previously developed Environmental Management Plans to manage potential impacts on streams during the mining of longwalls, including the Bargo River. The management plans include monitoring and triggered response plans. They include monitoring of the required pre-mining conditions and data collection during mining. Monitoring typically continues for a period following mining.

While the proposed longwalls do not mine directly beneath the Bargo River, it is recommended that Tahmoor Coal monitor changes in the Bargo River during the extraction of proposed Tahmoor South longwalls. Tahmoor Coal is required to development and implement a Water Management Plan as part of the Extraction Plan.

5.3. Streams

5.3.1. Descriptions of the streams

The locations of the streams within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-07. A summary of the major streams within the *Subsidence Study Area* is provided below in Table 5.2.

The reports by Fluvial Systems (2013) and the Water Management Plan (Tahmoor Coal, 2022a) provide a description of the streams.

Table 5.2 Streams within the Subsidence Study Area

Location	Strahler Stream Order	Description
Teatree Hollow	3rd Order	Located directly above the proposed LW S1A to LW S6A, with a total length of 2.1 kilometres directly mined beneath. LW1 and LW2 have been previously mined beneath a 0.5 kilometre section downstream of LW S1A
Tributary to Teatree Hollow (Wirrimbirra Creek)	3rd Order	Located directly above the proposed LW S1A to LW S4A, with a total length of 1.3 kilometres directly mined beneath

The streams have flow controlling features along their alignments that include; rockbars, riffles, knick points and debris accumulations. The locations of pools along the streams were determined by the specialist geomorphology consultant, (Fluvial Systems, 2013), and the locations of the pools are shown in Drawing No. MSEC1192-09. Descriptions of the streams are provided in the Water Management Plan (Tahmoor Coal, 2022a).

Example photographs of the streams within the *Subsidence Study Area* are shown in Fig. 5.1 to Fig. 5.4.



Fig. 5.1 Pool TT9 in Teatree Hollow directly above proposed LW S2A



Fig. 5.2 Pool TT12 in Teatree Hollow directly above proposed LW S1A



Fig. 5.3 Pool TT11 and TT3 (Ockenden Pools) in Tributary to Teatree Hollow directly above proposed LW S2A

The Tributary of Teatree Hollow is named Wirrimbirra Creek and Pools TT3 and TT11 are named Ockenden Pools at the Australian Wildlife Sanctuary (formerly called Wirrimbirra Sanctuary). Water levels at Ockenden Pools are partly controlled by a small weir, which was damaged during the 2019 bush fire. The pools were dry at this time. A surface water level sensor is located at this site.



Fig. 5.4 Pool TT2 (Big Pool) in Tributary to Teatree Hollow directly above proposed LW S3A

Pool TT2 is named the Big Pool at Wirrimbirra Sanctuary. The pool was observed to contain water after the 2019 bush fire. A surface water level sensor is located at this site.

Hidden creeks are defined as natural watercourses that appear to have been covered during development of a property or road. Hidden creeks have been identified from surface contours and historical aerial photographs. Two hidden creeks have been identified within the *Subsidence Study Area*. The creeks were infilled as part of the development of Tahmoor Mine and their locations are shown in Drawing No. MSEC1192-09.

5.3.2. Predictions for the streams

The predicted profiles of subsidence, upsidence and closure, using the IPM subsidence model and the 2002 ACARP valley closure prediction model, along the streams within the *Subsidence Study Area* are shown in Figs. E.02 to E.03, in Appendix E. The predictions are based on the extraction of the proposed longwalls, as shown in Drawing No. MSEC1192-07. The predicted total profiles along the alignments of the streams, after the completion of each of the proposed amended longwalls, are shown as solid blue lines.

A summary of the maximum predicted values of total subsidence, upsidence and closure for the streams is provided in Table 5.3.

Table 5.3 Maximum predicted total subsidence, upsidence and closure for the streams

Location	Figure no. (Appendix E)	Maximum predicted subsidence (mm)	Maximum predicted upsidence (mm)	Maximum predicted closure (mm)
Teatree Hollow	E.02	1,350*	400*	275*
Tributary to Teatree Hollow	E.03	1,300	450	375

** Note: downstream sections of Teatree Hollow have been previously mined beneath by LW1 and LW2 at Tahmoor Mine. The maximum predicted parameters provided in the above table include those resulting from the extraction of these earlier longwalls.*

The streams, which are located directly above the proposed longwalls, could experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

5.3.3. Predicted changes in stream gradients

The natural and the predicted post mining surface levels and grades along Teatree Hollow are illustrated in Fig. 5.5 and indicated in Fig. E.02. The natural grades along the stream vary between 20 mm/m and 50 mm/m above the proposed longwalls. The predicted maximum tilts, therefore, are substantially less than the natural grades along the stream.

The predicted maximum decreasing tilts are 8 mm/m (i.e. 0.8 %, or 1 in 125) along Teatree Hollow, directly above LW S1A.

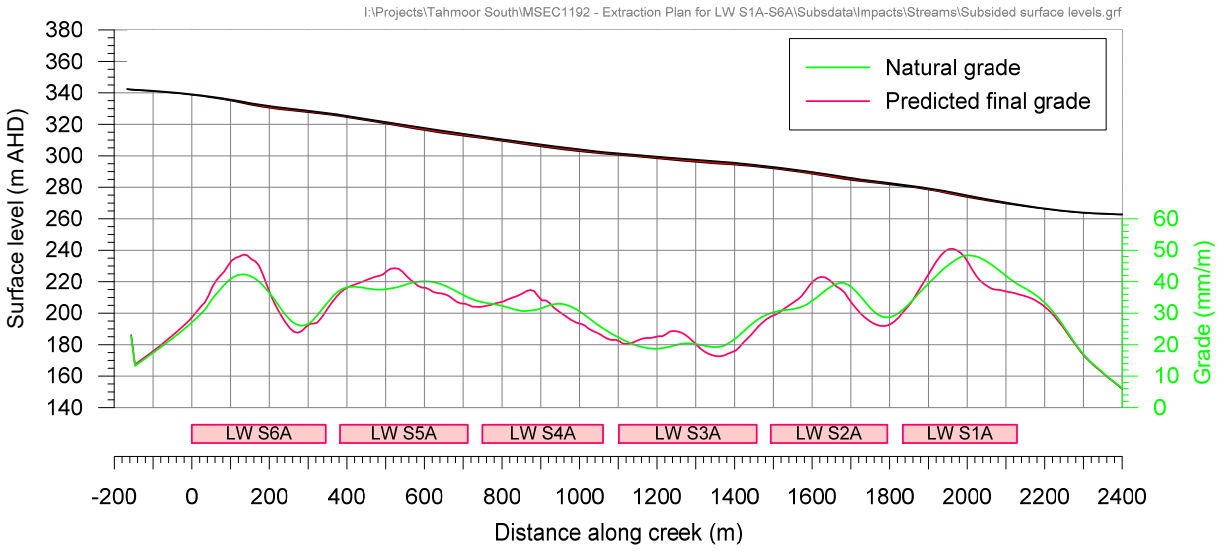


Fig. 5.5 Natural and predicted post mining surface levels along Teatree Hollow

The natural and the predicted post mining surface levels and grades along the Tributary of Teatree Hollow are illustrated in Fig. 5.6 and indicated in Fig. E.03. The natural grades along the stream vary between 9 mm/m and 40 mm/m above the proposed longwalls. The predicted maximum tilts, therefore, are substantially less than the natural grades along the stream.

The predicted maximum decreasing tilts are 6 mm/m (i.e. 0.6 %, or 1 in 167) along the Tributary of Teatree Hollow, directly above LW S1A.

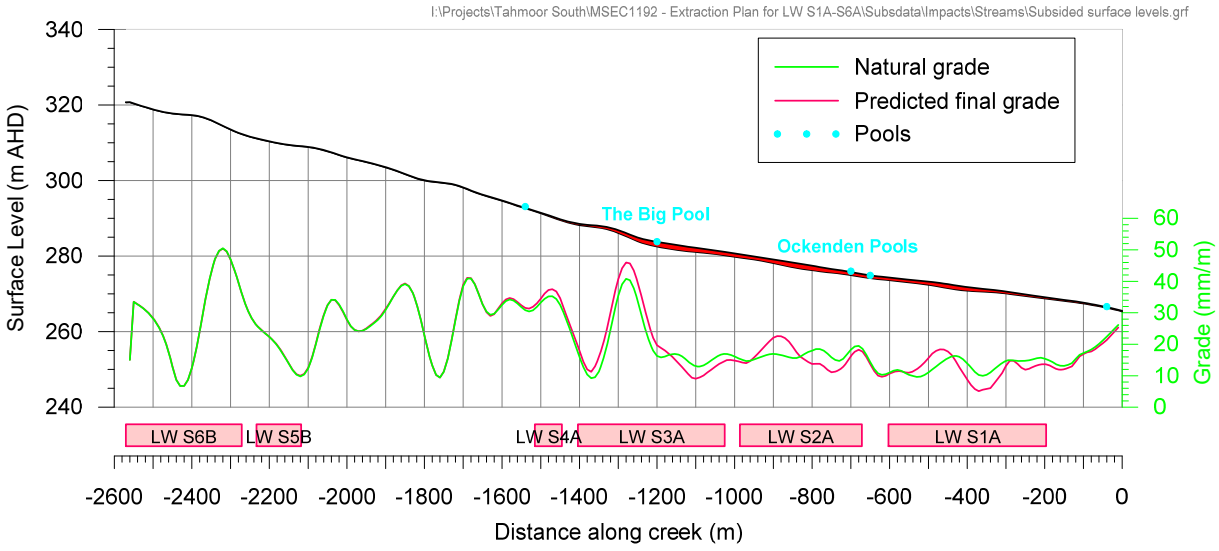


Fig. 5.6 Natural and predicted post mining surface levels along Tributary of Teatree Hollow

A summary of the maximum predicted changes in grade and the predicted curvatures, due to the conventional subsidence resulting from the extraction of the proposed longwalls, is provided in Table 5.4. The maximum predicted increases in grades occur downstream of the longwall goaf edges, whilst the maximum predicted decreases in grade occur upstream of the longwall goaf edges.

The predicted changes in grade provided in Table 5.4 are the maxima along the alignments of the streams after the extraction of any or all of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of the proposed longwalls.

The streams will also experience strains resulting from far field movements and valley related movements and discussions are provided in Section 5.3.4 on the impact assessments from these movements.

The locations of the pools along the streams are shown in Drawing No. MSEC1123-09. A summary of the maximum predicted subsidence, upsidence and closure at the pools along Teatree Hollow and the Tributary to Teatree Hollow is provided in Table D.01, in Appendix D.

Table 5.4 Maximum predicted changes in grade along the streams

Location	Maximum change in grade (mm/m)		Maximum conventional curvature (km^{-1})	
	Increase in grade	Decrease in grade	Hogging curvature	Sagging curvature
Teatree Hollow	7.0	8.0	0.11	0.22
Tributary to Teatree Hollow	6.0	6.0	0.10	0.21

5.3.4. Impact assessments for the streams

The impact assessments for the streams within the *Subsidence Study Area* are provided in the following sections. The assessments provided in this report should be read in conjunction with the Water Management Plan (Tahmoor Coal, 2022a) and the Biodiversity Management Plan (Tahmoor Coal, 2022c), which assess the consequences of the impacts on surface water flows and ecology.

Potential for increased levels of ponding, scouring or desiccation due to mining tilt

Mining can potentially result in increased levels of ponding in locations where the mining induced tilts oppose and are greater than the natural stream gradients that exist before mining. Mining can also potentially result in an increased likelihood of scouring of the stream beds in the locations where the mining induced tilts considerably increase the natural stream gradients that exist before mining.

There are no other predicted reversals of grade due to the proposed extraction of LWs S1A to S6A.

It is possible that there could be localised areas along the streams which could experience small increases in the levels of ponding, where the predicted maximum tilts occur in the locations where the natural gradients are low. As the predicted changes in grade are typically less than 1 %, however, any localised changes in ponding are expected to be minor and not result in adverse impacts on these streams.

It can also be seen from the above figures that the stream gradients increase where they flow into the predicted subsidence trough near the edges of the proposed longwalls. The streams flow predominantly over Hawkesbury Sandstone, which has a high resilience to scouring. As discussed in the report by Fluvial Systems (2013), mud was commonly found in the channel bed with soft knickpoints in small streams on the plateau. The predicted maximum increases in grade are up to 1.0 %, which are relatively small compared to the natural gradients and, therefore, the potential for increased scouring is not expected to be substantial.

Further discussions on the potential changes in ponding and flooding along the streams and the impacts, consequences and implications of the changes are provided by the specialist surface water consultant in the Water Management Plan (Tahmoor Coal, 2022a).

Potential for fracturing and surface water flow diversion in the streams

Where the longwalls mine directly beneath the streams it is considered likely that fracturing could result in surface water flow diversions. Upsidence and compressive strains due to valley closure are expected to be of sufficient magnitude to cause the underlying strata to buckle and induce cracking at the surface at some locations. This can lead to the diversion of water from the stream beds into the dilated strata beneath it.

It is unlikely, however, that there would be any net loss of water from the catchment since any redirected flow would not intercept any flow path that would allow the water to be diverted into deeper strata or the mine.

Geotechnical and groundwater reports by Strata Control Technology (2013) and SLR (2022a) present further discussions on the impacts, consequences and implications of the changes and potential for hydraulic connectivity from surface to seam.

The maximum predicted conventional curvatures for the streams located directly above the proposed longwalls are 0.11 km^{-1} hogging and 0.22 km^{-1} sagging, which equate to minimum radii of curvature of 9.1 kilometres and 4.5 kilometres, respectively.

The range of non-valley related movement strains above the proposed longwalls is expected to be similar to the range of strains measured during the previously extracted longwalls in the Southern Coalfield, which is described in Section 4.3 and the results illustrated in Fig. 4.4. It is also likely that the streams would experience elevated compressive strains as a result of valley closure movements.

The compressive strains resulting from valley related movements are more difficult to predict than conventional strains. It has been observed in the past, however, that compressive strains due to valley related movements between 10 mm/m and 20 mm/m (over a standard 20 metre bay length) have occurred above previously extracted longwalls at similar depths of cover, where the magnitudes of closure were similar to those predicted for the streams in the *Subsidence Study Area*.

It has been observed in the past that the depth of buckling and dilation of the uppermost bedrock, resulting from longwall mining, is generally less than 10 metres to 15 metres (Mills 2003, Mills 2007, and Mills and Huuskes 2004).

If substantial fracturing were to occur, partial or complete diversion of surface water and drainage of pools could occur at locations and times where the rate of flow diversion is greater than the rate of incoming surface water. The majority of the streams are ephemeral and so water typically flows during and for a period of time after each rain event. In times of heavy rainfall, most of the runoff would flow over the beds of the streams and would not be diverted into the dilated strata below the stream beds. In times of low flow, however, some or all of the water could be diverted into the strata below the stream beds for those sections of the streams that are located over the mined panels.

While much of the channel beds are exposed bedrock, Fluvial Systems (2013) report that sand, gravel, cobble and mud were also commonly found in the channel beds throughout the Project Area. Where such loose materials occur, it is possible that fracturing in the bedrock would not be seen at the surface. In the event that fracturing of the bedrock occurs in these locations within the alignments of the streams, the fractures may be filled with soil during subsequent flow events reducing the flow through the fractures.

Tahmoor Mine has previously extracted longwalls beneath streams and their ability to naturally fill mining-induced fractures has varied, mainly depending on the availability of sediment.

- Longwalls 1 and 2 were mined in 1987 directly beneath a 500 metre section of Teatree Hollow immediately downstream of the proposed longwalls. Bord and pillar workings with secondary extraction also took place prior to longwall mining directly beneath this stream.

  Substantial fracturing was observed by Fluvial Systems (2013) at one location in a small tributary to Teatree Hollow (Site TT1-18) directly above the bord and pillar workings with secondary extraction. It is likely that this fracturing was mining-induced.

  No flow diversions were reported at this location, nor in other sections of Teatree Hollow located directly above Longwalls 1 and 2. Water flows in the section of Teatree Hollow, which is located above the previously extracted longwalls and secondary extraction workings, were greatly controlled by Tahmoor Mine's licensed discharge LDP4 and this has likely aided in filling the mining-induced fractures.

- Longwalls 8, 10 to 13 were mined between 1991 and 1994 directly beneath a 2.0 kilometre section of the Bargo River and directly beneath a 1.0 kilometre section of Dog Trap Creek.

  These were the first series of longwalls to be mined directly beneath the Bargo River at Tahmoor Mine. Very little monitoring of the river occurred during this time, although extensive protective works were undertaken at the Rockford Road Bridge that was located over Longwall 12.

Surface fracturing of exposed bedrock was observed near to the supporting piers of the Bridge following the extraction of Longwalls 12 and 13. Fractures were also observed in flute holes downstream of the bridge over the goaf edge of Longwall 13, which were first observed during the extraction of Longwall 12 (Holla and Barclay, 2000). The fractures were localised and did not consistently run along the length of the river valley. They appeared to be the result of localised shearing and compressive buckling and some fractures were located where there was noticeable cross bedding within the river bed. There were no reports of impact to water flows along this section of river.

While surface fracturing is still visible in the flute holes that are located on a large, exposed rockbar, surface water diversion is not evident and large pools exist directly above the previously extracted longwalls, as Tahmoor Mine's licensed discharge has contributed a base flow to this section of the Bargo River.



Fig. 5.7 Large pool in the Bargo River, located upstream of Rockford Road Bridge, directly above previously extracted Longwall 12

Very little monitoring of the Dog Trap Creek occurred when Longwalls 12 and 13 mined directly beneath it, although extensive monitoring and works were undertaken at the small Road Bridge over Dog Trap Creek on Arina Road. No surface fractures are visible in the stream at the location, however, and pools are observed to exist. It is noted that this section of Dog Trap Creek contains plenty of sediment that could assist in the filling of fractures.



Fig. 5.8 Ponded water in Dog Trap Creek near bridge over Arina Road above previously extracted Longwall 13

- Longwalls 14 to 19 were mined between 1995 and 2002 directly beneath a 1.7 kilometre section of the Bargo River. As shown in Table 5.1, this section of river is located between 720 metres and 850 metres north-west of the proposed LWs S1A to S6A.

  Limited monitoring indicated little impact on the River during the extraction of Longwalls 14 to 17. Fracturing was not observed on the surface, although many sections were concealed by alluvial and talus deposits.

  The first adverse impacts on the river were reported in January 2002, after the extraction of Longwall 18, when residents alerted Tahmoor Mine to reduced pool levels downstream of the mining area. At that time there was very little water in the Picton Weir due to low rainfalls and surface flows from the weir had reduced to a mere trickle. Inspections along the river indicated minor fracturing of rock shelves in the river bed and drainage of some shallow pools.



Fig. 5.9 Immediately upstream of Picton Weir – January 2002

Detailed subsidence monitoring of survey pegs within the Bargo River over the centre of LW18 after LW18 was extracted, i.e. in October 2001 had indicated that total upsidence in the base of LW18 was 250 mm, the total valley closure was approximately 400 mm and the maximum measured valley closure strain was 15 mm/m.

The inspections in January 2002 found that the river had been drained directly above Longwall 18 and the length of drainage extended downstream for some distance beyond Longwall 14.

Shortly after this time a large rainfall event occurred, which filled the Weir and restored surface water flows along the River. A dry period followed and by July 2002 the Picton Weir was empty again and the extraction of Longwall 19 was completed. Inspections showed that surface flows ceased again, with the furthest drained pool from the longwalls being located 125 metres upstream of LW19. This coincided with the completion of this longwall.

Detailed subsidence monitoring of survey pegs within the Bargo River over the centre of LW18 after LW19 was extracted indicated that total upsidence in the base of LW18 was 450 mm, the total valley closure was approximately 700 mm and the maximum measured valley closure strain was 18 mm/m.

A further period of heavy rainfall occurred in February 2003 which then refilled the upstream sections of Picton Weir which then overtopped (see Fig. 5.10 and Fig. 5.11).



Fig. 5.10 Picton Weir 1st February 2003



Fig. 5.11 Picton Weir 24th February 2003

After this large storm, it was then observed that the water flows along the surface above the longwalls were progressively restored even during the following drier periods. It is believed that the high sediment load in the river, that was retained by the Picton Weir except when it is overtopped, had been washed down the river and filled in the mining induced fractures in the bedrock reducing the loss of surface water flows.

The extraction of Longwalls 14 to 19 also mined directly beneath small tributaries to the Bargo River. Fluvial Systems (2013) reports fracturing and surface flow diversions in two unnamed tributaries, which are located above previously extracted Longwalls 15 and 19. The stream channel bed in this was exposed bedrock.

- Longwalls 22 to 28 were mined between 2004 and 2014 beneath a 3 kilometre section of Myrtle Creek.

  The impacts observed along this creek were localised bed cracking in exposed sandstone areas, surface flow diversions in four locations over Longwalls 22, 23B and 25 as well as cracking in soil within the upper banks and flanks over Longwall 23B. Three areas of isolated cracking of exposed sandstone were also observed in the base or sides of generally dry pools above Longwall 25.

  The extraction of Longwalls 26 to 28 has resulted in further mining-induced fractures on exposed bedrock. At times of low flow, pools have been observed to drain.

- Longwalls 25 to 32 have mined, since 2008, beneath a 2.8 kilometre section of Redbank Creek.

  The impacts observed along the creek were cracks along most pools located directly above Longwalls 25 to 32. At times of low flow, pools have been observed to drain. Stream flow re-emerges in a section of the creek downstream from Longwall 32.

Based on the previous experience of mining beneath streams at Tahmoor Mine, it is likely that fracturing and surface flow diversions will occur in the sandstone bedrock along the streams over Tahmoor South, particularly for streams that are located directly above the proposed longwalls. In some of these locations, the fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls. It is unlikely, however, that there would be any net loss of water from the catchment.

Where there are substantial sediment accumulations upstream of these areas, it is expected that some of the fractures would be naturally filled over time with sediment during subsequent flow events, as was observed in the Bargo River. Where little sediment is present, the impacts are likely to remain for longer periods of time and remediation may be required after the completion of mining, which could include sealing these fractures and voids with grout.

With respect to streams or sections of streams located away from the proposed longwalls, the likelihood of fracturing and surface flow diversions reduces substantially compared to stream sections located directly above the proposed longwalls. The furthest known rockbar impact site where fracturing resulted in the diversion of surface water was at Pool F in the Waratah Rivulet that was being affected by a previously extracted longwall on one side and by the end of another longwall, i.e. the rockbar was located over solid unmined coal, but it was located in the corner between two longwalls. This site was located 160 metres to the side of one longwall and 230 metres from the approaching face of the active longwall. Surface water diversions have also been observed at three sites from the sides of longwalls at distances between 125 metres and 100 metres at the Bargo River, Waratah Rivulet and Native Dog Creek. Surface water diversion has only been observed at one site at Pool G1 in the Waratah Rivulet beyond the ends of the longwalls and in this case the closest distance was approximately 75 metres.

Minor and isolated fracturing could also occur outside the extents of the proposed longwalls. The furthest distance of an observed fracture from longwall mining was at the base of Broughtons Pass Weir, which was located approximately 415 metres from Appin Colliery Longwall 401. Another minor fracture was also recorded in the upper Cataract River, approximately 375 metres from Appin Colliery Longwall 301. This fracture occurred in a large rockbar, which was formed in thinly bedded sandstone, which had experienced movements from nearby previously extracted longwalls. These are the furthest most recorded fractures from longwall mining in the NSW Coalfields.

Further discussions on the potential impacts of surface cracking and on changes in surface water flows are provided in the Water Management Plan (Tahmoor Coal, 2022a) and the Biodiversity Management Plan (Tahmoor Coal, 2022c).

Potential for Gas Emissions and Changes to Water Quality

Gas emissions from the sandstone strata have been previously observed above and adjacent to mining areas in the Southern Coalfield, and some gas emissions have also been observed in water bores. Analyses of gas compositions indicate that the Bulli seam is not the direct and major source of the gas and that the most likely source is the Hawkesbury Sandstone (APCRC, 1997).

It is likely that gas emissions will occur as a result of the mining of the longwalls. Gas is often released into rivers and streams as these areas form topographical low points in the landscape. Where these gas releases occur into the water column there is insufficient time for any substantial amount of gas to dissolve into the water. The majority of the gas is released into the atmosphere and is unlikely to have an adverse impact on water quality.

It is possible for substantial gas emissions at the surface to cause localised vegetation die-back. This is a rare event and has only been observed to occur previously on one occasion at Tower Colliery, over small areas in the base of the Cataract Gorge that had been directly mined beneath by Longwalls 10 and 14. These impacts were limited to small areas of vegetation, local to the points of emission, and when the gas emissions declined, the affected areas were successfully restored.

A description of potential water quality impacts, including iron stains, and environmental consequences is presented in the Water Management Plan (Tahmoor Coal, 2022a) and the Biodiversity Management Plan (Tahmoor Coal, 2022c).

5.3.5. Impact assessments for the streams based on increased predictions

If the actual conventional subsidence movements exceeded those predicted by a factor of 2 times, the maximum tilts along the streams would be 16 mm/m (i.e. 1.6 %, or 1 in 63) along Teatree Hollow. The existing stream grades are greater than the predicted tilts multiplied by a factor of 2 times and no reversals of grade due to the proposed extraction of LWs S1A to S6A.

If the actual conventional subsidence movements exceeded those predicted by a factor of 2 times, the maximum tilts along the streams would be 12 mm/m (i.e. 1.2 %, or 1 in 83) along the Tributary of Teatree Hollow. This would result in a short section of stream of approximately 10 to 20 metres experiencing grades that are close to level or slightly reverse.

If the actual strains or valley related movements exceeded those predicted by a factor of 2 times, the extent of fracturing in the uppermost bedrock would increase along the streams which are located directly above the proposed longwalls.

While the predicted ground movements are important parameters when assessing the potential impacts on the streams, it is noted that the impact assessments for fracturing and loss of surface water were primarily based on historical observations from previous longwall mining at Tahmoor Mine and other mines operating at similar depths of cover in the Southern Coalfield. The overall levels of impact on the streams, resulting from the extraction of the proposed longwalls, are expected to be similar to those observed where longwalls have previously mined directly beneath streams at the mine.

Further discussions on the potential impacts, consequences and implications of changes along these streams are provided in the surface water and ecology reports by Water Management Plan (Tahmoor Coal, 2022a) and the Biodiversity Management Plan (Tahmoor Coal, 2022c).

5.3.6. Comparison of predictions and assessments provided based on the proposed LWs S1A to S6A and the EIS Layout

A summary comparison between maximum predicted subsidence, upsidence and closure along the streams between the approved EIS Layout and the proposed LWs S1A to S6A is shown in Table 5.5.

Table 5.5 Predicted Total Subsidence, Upsidence and Closure along Streams resulting from the extraction of the Extraction Plan Layout and the approved EIS Layout

Layout	Location	Maximum predicted total subsidence (mm)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
Proposed Extraction Plan LWs S1A to S6A	Teatree Hollow	1,350*	400*	275*
	Tributary to Teatree Hollow	1,300	450	375
EIS Layout (MSEC1123)	Teatree Hollow	1,350*	375*	275*
	Tributary to Teatree Hollow	1,250	400	350

It can be seen that the predicted maximum total conventional subsidence, upsidence and closure movements due to the extraction of proposed LWs S1A to S6A are slightly greater than the predicted maxima from the EIS Layout. The differences for Teatree Hollow are very slight and reflect the very minor changes in panel and chain pillar widths. The differences for the Tributary to Teatree Hollow are also very slight and in addition to the panel and chain pillar widths, the increase in predictions is also due to the extensions of the commencing ends of LWs S3A and S4A.

It should be noted though that, whilst the overall predicted total subsidence, upsidence and closure along the streams have been increased slightly, predictions at points on the surface directly above the longwalls will be greater or less than predictions previously provided for the EIS Layout due to the lateral shift in the mine layout.

Specific subsidence predictions have been provided for streams in this report. Detailed comparisons can be made for each stream by comparing this report with detailed predictions that were provided in our previous Report No. MSEC1123.

The potential for physical impacts (i.e. surface cracking and rock fracturing) is not, however, dependent on absolute vertical subsidence. Physical impacts develop due to differential movements, which are described by curvature and strain.

Whilst the predicted strains and valley closure and, hence, the potential for physical impacts increase with wider longwall panel widths and narrower pillar widths, the strains and valley closure due to the extraction of the proposed Extraction Plan and the EIS layout are both predicted to be of sufficient magnitude to result in the fracturing of bedrock.

Based on the above, the potential for impacts on the sections of streams that are proposed to be directly mined beneath due to the extraction of proposed Extraction Plan do not materially change as a result of the changes in mine layout, even though the overall mining-induced movements and associated frequency and severity of impacts are expected to slightly increase.

This assessment is supported by the observations of adverse impacts along streams that have been directly mined beneath at nearby collieries at similar depths of cover in the Southern Coalfield, including where longwall void widths are less than those that are proposed in the Extraction Plan.

In the case of streams that are not directly mined beneath, the offset distances between the proposed longwalls in the proposed LWs S1A to S6A and the streams remain sufficiently large such that the impact assessments do not change significantly compared to the assessments that were provided for the approved EIS Layout. This includes the fourth and fifth order sections of Hornes Creek and the Bargo River, which are located more than 670 metres and 690 metres, respectively, from the proposed longwalls.

5.3.7. Management of potential impacts on the streams

Tahmoor Coal has previously developed Environmental Management Plans to manage the potential impacts on streams during the mining of longwalls. The management plans include ground monitoring, water quality and pool level monitoring and visual inspections. The plans also commit to remediation of waterways if impacts occur.

Tahmoor Coal is required to develop and implement a Water Management Plan as part of the Extraction Plan for LWs S1A to S6A.

5.4. Cliffs

5.4.1. Descriptions of the cliffs

A total of 2 cliffs are located within the *600 metre Study Area for Natural Features* but outside the general *Subsidence Study Area*. The locations of the cliffs are shown in Drawing No. MSEC1192-08, and in greater detail in Drawing No. MSEC1192-09.

One cliff is located within a tributary to the Bargo River and is more than 500 metres from the proposed LW S4A. A small portion of another cliff is located along Hornes Creek and is located approximately 600 metres from the proposed LW S6A.

For the purposes of this report, a cliff has been defined as a continuous rockface having a maximum height greater than 10 metres, a minimum length of 20 metres and a minimum slope of 2 in 1, i.e. having a minimum angle to the horizontal of 63°. The definition is consistent with the definition provided in the Project Approval of the EIS layout. The locations and heights of cliffs within the *Subsidence Study Area* were determined by Fluvial Systems based on the results of an airborne laser scan, refer to Fluvial Systems (2013).

5.4.2. Predictions for the cliffs

The cliffs are located outside the predicted limit of subsidence due to the extraction of LWs S1A to S6A. They are not expected to experience any substantial conventional tilts, curvatures and strains.

5.4.3. Impact assessments for cliffs located above solid coal

The two cliffs are located more than 500 metres from the proposed longwalls and will not be directly mined beneath.

It is extremely difficult to assess the likelihood of cliff instabilities based upon predicted ground movements. The likelihood of a cliff becoming unstable is dependent on a number of factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rock mass, groundwater pressure and seepage flow behind the rockface. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors influence the stability of a cliff naturally or when it is exposed to mine subsidence movements. It is possible, therefore, that cliff instabilities may occur during mining that may be attributable to either natural causes, mine subsidence, or both.

The likelihood of cliff instabilities can be assessed using case studies where previous longwall mining has occurred close to but not directly beneath cliffs. Although very minor rock falls have been observed over solid coal outside the extracted goaf areas of longwall mining in the Southern Coalfield, there have been no recorded large cliff instabilities outside the extracted goaf areas of longwall mining in the Southern Coalfield. This statement is based on the following observations:-

- ***Tahmoor Longwalls 24A to 26***

  Tahmoor Longwalls 24A to 26 were mined near and adjacent to the cliff lines along the Bargo River valley between November 2007 and July 2011. The cliff lines are continuous on both sides of the valley along this section of the river. The cliffs are located at a minimum distance of 300 metres east of Longwall 24A, at their closest point to these longwalls. The whilst the overall valley depths, within one depth of cover of this gorge was over 100 metres, the heights of the cliffs are around 60 metres and are formed within the Hawkesbury Sandstone.

  Tahmoor Longwalls 24A to 26 have void widths of 285 metres, solid chain pillar widths of 35 metres to 40 metres and were extracted from the Bulli seam at a depth of cover of 350 metres at the base of the gorge and 450 metres around the plateau areas. There were no impacts observed on the cliffs along the Bargo River Valley as a result of the extraction of Tahmoor Longwalls 24A to 26.

- ***Appin Longwalls 301 and 302 near the Cataract River***

  Appin Longwalls 301 and 302 were mined adjacent to a number of cliff lines located along the Cataract River valley between October 2006 and September 2007. A total of 68 cliffs were identified within a 35 degree angle of draw from these longwalls. These cliffs had continuous lengths ranging between 5 metres and 230 metres, overall cliff heights ranging between 10 metres and 37 metres, overall valley depths, within one depth of cover of the river, ranging from 50 to 75 metres, and had been formed within the Hawkesbury Sandstone.

  Appin Longwalls 301 and 302 have void widths of 260 metres, solid chain pillar widths of 40 metres and were extracted from the Bulli seam at a depth of cover of 420 metres at the base of the gorge and 490 metres around the plateau areas. These longwalls mined to within 50 metres of the identified locations of the cliffs along the Cataract River valley.

  There were no large cliff instabilities observed as a result of the extraction of Appin Longwalls 301 and 302. There were, however, five minor rock falls or disturbances which occurred during the mining period, of which, three were considered likely to have occurred due to a substantial rainfall event and one was probably a natural instability of the cliff overhang. Nevertheless, the length of cliff line disturbed as a result of the extraction of Appin Longwalls 301 and 302 was, therefore, estimated to be less than 0.5 % of the total face area of the cliff lines within the mining domain.

- ***Tower Longwalls 18 to 20 and Appin Longwalls 701 to 704 near the Nepean River***

  Tower Longwalls 18 to 20 and Appin Longwalls 701 to 704 mined adjacent to a number of cliff lines located along the Nepean River valley. A total of approximately 50 cliffs were identified within a 35 degree angle of draw from these longwalls. The cliffs had continuous lengths ranging between 5 metres and 225 metres, overall heights ranging between 10 metres and 40 metres, overall valley depths, within one depth of cover of the river, ranging from 60 to 80 metres and had been formed within the Hawkesbury Sandstone.

  Tower Longwalls 18 to 20 have void widths of 235 metres, solid chain pillar widths of 40 metres and were extracted from the Bulli seam at a depth of cover of 460 metres at the base of the gorge and 510 metres around the plateau areas. Appin Longwalls 701 to 704 have void widths of 320 metres, solid

chain pillar widths of 40 metres and were extracted from the Bulli seam at a depth of cover of 460 metres at the base of the gorge and 510 metres around the plateau areas.

Tower Longwall 20 was mined directly beneath some cliffs located at the confluence of Elladale Creek and the Nepean River. Appin Longwalls 701 to 704 mined to within 75 metres of the identified locations of the cliffs along the Nepean River valley.

There were no cliff instabilities observed as a result of the extraction of Tower Longwalls 18 to 20 and Appin Longwalls 701 to 704.

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

5.4.4. Impact assessments for the cliffs based on increased predictions

If the actual mine subsidence exceeded those predicted values by a factor of 2 times, the likelihood of impacts for the cliffs that are located well outside the proposed longwalls would still be expected to be very low.

While the predicted ground movements are important parameters when assessing the potential impacts on the cliffs, it is noted that the impact assessments for cliff instabilities have primarily been based on historical observations from previous longwall mining in the Southern Coalfield.

5.5. Steep slopes

The purpose of identifying steep slopes for this assessment is to highlight areas in which existing ground slopes may be marginally stable. As a conservative first pass, a steep slope has been defined as an area of land having a gradient greater than 1 in 3 (33 % or 18.3°). The definition is consistent with the definition provided in the Project Approval of the EIS layout. The minimum slope of 1 to 3 represents a slope that would generally be considered stable for slopes consisting of rocky soils or loose rock fragments. Clearly the stability of natural slopes varies depending on their soil or rock types, and in many cases, natural slopes are stable at much higher gradients than 1 to 3 (for example, talus slopes in Hawkesbury Sandstone).

The locations of the steep slopes within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-08, with greater detail in Drawing No. MSEC1192-09. The steep slopes were identified by Fluvial Systems from an airborne laser scan supplied by Tahmoor Coal. The steep slopes shown on the drawings can be broadly categorised as:

a) Steep slopes on the sides of valleys;
b) Batters of road and railway embankments and cuttings;
c) Slopes on Farm dams; and
d) Slopes around Tahmoor Mine infrastructure, including spoil heaps, coal piles and dams.

Types (b) to (d) are addressed in Chapter 6 of this report.

The steep slopes on the sides of valleys are predominantly found in Hawkesbury Sandstone and consist of a mixture of cliffs and rock outcrops, which are stable at vertical to overhanging, and screed slopes with rocky soils and loose rock fragments. The majority of slopes are stabilised, to some extent, by natural vegetation.

The ranges of predicted subsidence parameters for the steep slopes are similar to those predicted along the streams, which are provided in Section 5.3.2.

There has been extensive experience of mining beneath steep slopes in the Southern Coalfield. These include steep slopes along the Cataract, Nepean, Bargo and Georges Rivers and streams such as Myrtle Creek and Redbank Creek above Tahmoor Mine Longwalls 22 to 32, slopes on Redback Range above Tahmoor Mine Longwalls 26 and 27 and slopes along ridges and valleys above Tahmoor LWs W1-W3. No large-scale slope failures have been observed along these slopes, even where longwalls have been mined directly beneath them. Surface cracking and minor rock falls along clifflines or rock outcrops have been observed, for example, during the mining of Appin Longwalls 301 and 302 adjacent to the Cataract River, however, no large-scale slope failures have been observed.

Potential impacts on steep slopes would generally result from the movement of soils, causing tension cracks to appear at the tops of the slopes and compression ridges to form at the bottoms of the slopes. These movements are consistent with observations of upsidence and closure of creek valleys where compression is developed at the bottoms of the valleys and tension is developed at the tops of the valleys. If tension cracks were left untreated it is possible that soil erosion could occur.

It is possible, therefore, that some remediation might be required to ensure that mining-induced surface cracking does not result in the formation of soil erosion channels. In some cases, erosion protection

measures may be needed, such as the planting of additional vegetation in order to stabilise the slopes in the longer term.

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

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

5.5.1. Management of potential impacts on steep slopes

Tahmoor Coal has developed subsidence management plans for managing potential impacts on steep slopes during the mining of Longwalls 22 to 32 and LWs W1-W4. These management plans include:

- Identification of all structures, dams and roads that are in close proximity to steep slopes;
- Site investigation and landslide risk assessment of structures near slopes by a qualified geotechnical engineer;
- Site investigation and structural assessment of structures where recommended by the geotechnical engineer. This may include recommendations to mitigate against potential impacts;
- Monitoring, including ground survey and visual inspections; and
- Remediation if cracking or slippage occurs.

It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts on slopes during the mining of the proposed longwalls. Tahmoor Coal is required to develop and implement a Land Management Plan as part of the Extraction Plan for LWs S1A to S6A.

5.6. Escarpments

There are no major escarpments within the *Subsidence Study Area*. Discussions on the cliffs are provided in Section 5.4.

5.7. Land prone to flooding and inundation

There are areas prone to flooding or inundation within the *Subsidence Study Area*. The subsidence ground movement predictions determined for the Tahmoor South project have been provided to hydrologist ATC Williams, who have undertaken a detailed flood study for the project and provided detailed discussions of the impacts and consequences of the subsidence ground movements on future floods within the *Subsidence Study Area* in the Water Management Plan (Tahmoor Coal, 2022a).

5.8. Swamps, wetlands and water related ecosystems

As discussed in detail in the Biodiversity Management Plan (Tahmoor Coal, 2022c), there are some water related ecosystems and wet areas in the headwaters of some streams but there are no upland swamps or wetlands within the *Subsidence Study Area*.

Please refer to the Biodiversity Management Plan (Tahmoor Coal, 2022c).

5.9. Threatened, protected species or critical habitats

Please refer to the Biodiversity Management Plan (Tahmoor Coal, 2022c).

5.10. National Parks or Wilderness Areas

There are no National Parks, nor any land identified as wilderness under the Wilderness Act 1987 within the *Subsidence Study Area*.

5.11. State Recreational or Conservation Areas

There are no State Recreational or Conservation Areas within the *Subsidence Study Area*.

5.12. Natural vegetation

Please refer to the terrestrial and aquatic ecology assessments in the Biodiversity Management Plan (Tahmoor Coal, 2022c).

5.13. Areas of significant geological interest

There are no areas of significant geological interest within the *Subsidence Study Area*.

5.14. Any other natural feature considered significant

The Australian Wildlife Sanctuary is located on Remembrance Driveway. 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 Australian Wildlife Sanctuary covers an area of approximately 95 ha.

Wirrimbirra preserves a part of the original 'Bargo Brush' which was of considerable historical importance in the problems which faced the settlement of the Argyle or Southern Tablelands during the early half of the 1800s. 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. Within the 43 established gardens, there are over 1800 native plants representing a resource base for the study of native flora.

The Australian Wildlife Sanctuary is located above LWs S1A to S4A near Teatree Hollow and the Main Southern Railway Line and will be directly mined beneath by the proposed longwalls.

The Australian Wildlife Sanctuary has named the creeks that flow through its property. Wirrimbirra Creek has been identified as Tributary of Teatree Hollow in this report. The Big Pool (Ref. TT2) and Ockenden Pools (TT3 and TT11) are located on Tributary of Teatree Hollow (Wirrimbirra Creek) and their locations are shown in Drawing No. MSEC1123-09. Predictions for these pools are provided in Table D.01. The descriptions and impact assessments for streams are provided in Section 5.3 of this report.

Predictions and impact assessments for the structures within the Australian Wildlife Sanctuary are provided separately in Section 10.2.3 of this report. A site of archaeological significance has been identified on the property and predictions and impact assessments for the site are provided separately in Section 10.1 of this report.

The following sections provide the descriptions, predictions and impact assessments for the Public Utilities within the *Subsidence Study Area*. The public utilities located outside the *Subsidence Study Area*, which may be subjected to far-field movements or valley-related movements and may be sensitive to these movements, have also been included as part of these assessments.

6.1. The Main Southern Railway

The location of the Main Southern Railway is shown in Drawing No. MSEC1192-11. Descriptions, predictions and impact assessments for the railway are provided in the following sections.

6.1.1. Description of the Main Southern Railway

The Main Southern Railway is a key national transport route that carries substantial freight and passenger services between Sydney and Melbourne. The Main Southern Railway is leased by Australian Rail Track Corporation (ARTC), who is responsible for maintaining the track.

Approximately 3 km of track is located within the *Subsidence Study Area* between kilometrages 98 km and 101 km. Approximately 2.1 km of track is located directly above proposed Longwalls S1A to S5A, between 98.6 km and 100.7 km.

The railway line is a dual track consisting of 60 kg rail on concrete sleepers with a mix of straight and curved track sections within the *Subsidence Study Area*. The maximum speed limits on both tracks are 95 km/h for normal services and 105 km/h for XPT services. A photograph of a section of the railway at 99.400 km directly above proposed LW S4A is provided in Fig. 6.1.



Photograph courtesy Newcastle Geotech

Fig. 6.1 Main Southern Railway at 99.400 km

The railway consists of a number of items of infrastructure within the *Subsidence Study Area* and these are listed below in Table 6.1. Further details on each feature are provided later in this report.

Table 6.1 Major railway structures within the Subsidence Study Area

Approximate Kilometrage	Major structure	Closest distance to extent of amended longwall layout
96.300	Railway Viaduct over Bargo River	1.75 kilometres north of LW S1A
96.400	Remembrance Drive Bridge over Bargo River and Main Southern Railway	1.69 kilometres north of LW S1A
98.160	Tahmoor Mine overhead coal conveyor	450 metres to the north western side of LW S1A
101.162	Wellers Road Overbridge	370 metres south of LW S6A

In addition to the major structures listed in Table 6.1, there are a number of smaller railway structures within the *Subsidence Study Area*. These include:-

- Culverts;
- Cuttings;
- Embankments; and
- Signalling, electrical and telecommunications equipment.

6.1.2. Predictions for the Main Southern Railway

The predicted profiles of conventional subsidence and tilt along the alignment of Main Southern Railway, resulting from the extraction of the proposed longwalls, are shown in Fig. E.04, in Appendix E. The initial and the predicted post mining grade of the track are also shown in this figure.

A summary of the maximum predicted total conventional subsidence parameters along the alignment of the railway, after the extraction of each of the proposed longwalls, is provided in Table 6.2. The predicted subsidence effects are predominately due to Longwalls S1A to S5A, which directly mine beneath the railway.

Table 6.2 Maximum predicted total conventional subsidence parameters along the alignment of the Main Southern Railway after the extraction of the proposed LWs S1A to S6A

Longwall	Maximum predicted total subsidence (mm)	Maximum predicted change in Grade (%)	Maximum predicted total hogging curvature along alignment (km^{-1})	Maximum predicted total sagging curvature along alignment (km^{-1})
After LW S1A	775	0.55	0.06	0.12
After LW S2A	1000	0.75	0.08	0.20
After LW S3A	1150	0.65	0.09	0.20
After LW S4A	1250	0.70	0.10	0.20
After LW S5A	1300	0.70	0.10	0.20
After LW S6A	1350	0.85	0.10	0.20

The maximum predicted conventional strains for the railway, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.5 mm/m tensile and 3.0 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The railway is a linear feature and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. An analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.2 and the results are provided in Fig. 4.4.

6.1.3. Impact assessments for the Main Southern Railway

Tahmoor Coal and the Australian Rail Track Corporation (ARTC) have developed detailed risk management plans for managing potential mine subsidence impacts on the Main Southern Railway due to the extraction of LWs 25 to 32 and LWs W1-W4 at Tahmoor Mine. South32 Illawarra Coal has also developed similar strategies to manage potential impacts on the railway due to the extraction of Longwalls 702 to 708, and Longwalls 901 to 904 at Appin Colliery.

The management measures described in this plan are similar to those that have been developed in consultation with ARTC and successfully implemented at Tahmoor Mine and Appin Colliery, as described in a paper by Pidgeon, et al. (2011).

A Rail Management Group have been coordinated to develop the risk management strategies. The Rail Management Group includes representatives from ARTC, Tahmoor Coal and specialist consultants in the fields of railway track engineering, geotechnical engineering, structural engineering, track signalling, mine subsidence, risk assessment and project management. The Technical Committee consults with the Resources Regulator and the Office of the National Rail Safety Regulator.

Works by the Rail Management Group include:-

- Identification of potential impacts on the railway;
- Undertaking a risk management approach, where identified risks are assessed and risk control measures are implemented; and
- Development of management measures that include mitigation and preventive works, monitoring plans, triggered response plans and communication plans; and
- Supervision and oversight of railway track and infrastructure mitigation, monitoring and maintenance of affected rail track and infrastructure.

Tahmoor Coal and ARTC continue to develop plans to manage potential impacts during the mining of the proposed LWs S1A to S6A. The following sub-sections provide details of the potential impacts to the Main Southern Railway and management measures that have been developed by the Rail Management Group to ensure that the railway remains safe and serviceable during mining.

The following sections provide the impact assessments and discuss the proposed strategies to manage the potential impacts on the Main Southern Railway for the proposed Tahmoor South longwalls.

6.1.4. Changes in track geometry

The extraction of the proposed LWs S1A to S6A will result in changes to track geometry along the Main Southern Railway. Changes to track geometry are described using a number of parameters:-

- Vertical misalignment (top) – vertical deviation of the track from design;
- Horizontal misalignment (line) – horizontal deviation of the track from design;
- Changes in Track Cant – changes in superelevation across the rails of each track from design; and
- Track Twist – changes in superelevation over a length of track from design.

The Australian Rail Track Corporation's National Code of Practice for Track Geometry provides allowable deviations in track geometry. Predictions of conventional subsidence, tilt and horizontal movement have been made at 5 metre intervals along the railway to calculate each track geometry parameters at any stage of mining. The predicted changes in cant and long twist for the railway are shown in Fig. E.05.

A summary of the maximum allowable and maximum predicted changes in geometry are provided in Table 6.3.

Table 6.3 Allowable and predicted maximum changes in track geometry due to conventional subsidence movements

Track Geometry parameter	Description	Value at which speed limit is first applied*	Value at which trains are stopped*	Predicted maximum due to conventional subsidence
Top	Mid-ordinate vertical deviation Design Offset	14 mm over 4m chord 56 mm over 20m chord	16 mm over 4m chord 66 mm over 20m chord	< 5
Line	Mid-ordinate horizontal deviation over a 10 m chord	34 mm	44 mm	< 5
Change in Cant	Deviation from design superelevation across rails spaced 1.435 m apart	20 to 50 mm (depends on whether track is on a straight or curve)	40 to 75 mm (depends on whether track is on a straight or curve)	8
Long Twist	Changes in Cant over a 14 m chord	46 mm	52 mm	< 3

Note: Values have been taken from the trigger levels in the Tahmoor Mine LW32 Railway Management Plan, which were based on the ARTC National Code of Practice.

Table 6.4 shows that the predicted changes in track geometry are an order of magnitude less than the maximum allowable deviations specified in the National Code of Practice, if conventional subsidence occurs. For example, the maximum allowable change in cant is 75 mm over a length of 1.435 metres before the trains are stopped. In mining terminology, this represents a tilt of approximately 50 mm/m, which is substantially greater than the maximum predicted tilt anywhere above the proposed longwalls of 8.3 mm/m.

It is recognised that subsidence predictions in the Southern Coalfield are generally based on the results of surveys marks that are spaced nominally 20 metres apart. The bay lengths used to measure the track geometry parameters, described in Table 6.3, are less than these mark spacings, particularly for changes in track cant and twist. However, confidence in the predictions is gained from the following observations:-

- Monitoring of track geometry at 125 mm intervals along both tracks during the mining of Longwalls 25 to 32 at Tahmoor Mine and Longwalls 703 to 708, and Longwalls 901 to 904 at Appin Colliery have shown that the observed changes compared reasonably well with predictions. The observed changes were very small and an order of magnitude less than the National Code of Practice;
- Monitoring of track geometry during the mining of other longwalls beneath railways has shown that the observed changes to track geometry have been well below ARTC standards; and
- Literature studies of mining beneath railways in NSW (Lea, 1991) and the UK (Grainger, 1993) indicate that mine subsidence results in minimal impacts to track geometry.

It is, however, possible that mine subsidence could result in changes in track geometry that exceed ARTC Standards in the following ways:-

- Track becomes unstable as the result of rail stress, which is discussed in the following section; or
- Track loses support as the result of failure or collapse of culverts or embankment slopes; or
- Development of substantial non-conventional ground movements.

Non-conventional movements can occur and have occurred in the Southern Coalfield as a result of, among other things, valley upsidence and closure movements and anomalous movements. The impact assessments for the valley related movements at the stream crossings are provided in Section 6.1.11. Discussion on the likelihood and nature of anomalous movements is provided in Sections 3.4 and 4.7.

One example occurred at a low angle fault that intersected the Main Southern Railway in a railway cutting, which was located directly above Tahmoor Longwall 29. The site was monitored extensively during the mining of Longwalls 28 to 31. This included three monitoring lines along the railway cutting, and survey prisms along the railway track. The results of observed changes in vertical alignment of the pegs along the railway cutting are shown in Fig. 4.8. It can be seen that the most significant changes occurred during the mining of Longwall 29. The changes, however, developed gradually over time, allowing sufficient time for the railway track to be adjusted such that trains could continue to travel through the site.

It is therefore considered that while non-conventional movements may potentially result in changes to track geometry that exceed National Code of Practice, the potential risk to track safety can be managed through early detection via monitoring and early response through the implementation of triggered response plans. It is likely that the following management measures will be used to manage changes in track geometry:-

- Assess pre-mining track condition and adjust track (if necessary) so that pre-mining track geometry is at or close to design prior to the development of subsidence;
- Identify potential sites of non-conventional movement, such as creeks and geological structures;
- Install a monitoring system, which includes, among other things, the monitoring of ground movements, rail stress, rail temperature, switch displacement and track geometry;
- Regularly review and assess the monitoring data;
- Conduct regular visual inspections of the track; and
- Adjust the track in response to monitoring results during mining if required to keep the track well within safety limits.

With an appropriate management plan in place, it is considered that potential impacts on track geometry can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.1.5. Changes in track grades

The Main Southern Railway climbs steadily in a southbound direction through the *Subsidence Study Area* from Tahmoor to Bargo and Yanderra.

Existing track gradients have been estimated from Curve and Gradient Diagrams provided by ARTC. The maximum gradient along the Main Southern Railway within the *Subsidence Study Area* is 1.4 % (1 in 73), which is located between 101 km and 102 km, above the proposed longwalls. Steeper grades exist regionally along the track, such as 1 in 63 (1.59 % or 15.9 mm/m) between Moss Vale and Exeter.

The predicted changes in track gradient along the Main Southern Railway and the predicted gradients along the track after the completion of mining are shown in Fig. E.04.

It can be seen that the predicted maximum grade after mining is 1.9 % or 1 in 52, which is higher than the regional maximum grades.

It should be noted, however, that the locations of high grades exist over short lengths (a couple of hundred metres), which is of less concern as freight trains are many hundreds of metres long. It is expected, however, that track resurfacing will be required to reduce the magnitude of the mining-induced undulations in the track. This work can be undertaken during planned ARTC maintenance weekends.

6.1.6. Changes in rail stress

Mine subsidence will result in changes to rail stress unless preventive measures are implemented. If no action is taken, it is likely that the rails will become unstable as a result of the mining of the proposed longwalls. The maximum predicted change in stress free temperature is approximately 140 degrees if 100 % of predicted ground strains are transferred into the rails. By comparison a change in stress free temperature of approximately 14 degrees is sufficient to warrant immediate preventative action on a track with concrete sleepers.

Management of rail stress during active mine subsidence has been a primary focus of the Rail Management Group. Traditionally, rail stress has been managed in Australia and overseas by rail strain or stress monitoring. Once measured changes in rail stress reach defined triggers, the stress is dissipated by unclipping the rails from the sleepers, cutting the rails and adding steel to, or removing steel from the rails as required, followed by re-stressing the rails to their desired stress. This process is effective, but it is labour intensive and very difficult to undertake on busy tracks such as the Main Southern Railway, particularly if the frequency of required rail re-stressing is likely to be more often than weekly, as would be expected during the mining of the proposed longwalls at Tahmoor Mine.

For this reason, the Rail Management Group has introduced a combination of rail expansion switches and zero toe load clips to dissipate mining and temperature related rail stress during mining. Rail expansion switches consist of a tapered joint in the track, which allow the rails on each side of the joints to slide independently. Maximum allowable displacements of expansion switches vary between different types of switches and those that have been employed above Tahmoor Mine Longwalls 25 to 32 have a capacity of approximately 310 mm. Expansion switches are standard rail equipment and operate in non-subsidence applications in Australia and overseas to accommodate, for example, differential thermal movements between bridges and natural ground. A rail expansion switch is shown in Fig. 6.2.



Fig. 6.2 Rail expansion switch

Zero toe load clips allow the rails to slide longitudinally along the track while maintaining lateral stability. In combination, the rails are able to expand or contract in response to mine subsidence and thermal loads into and out of the expansion switches. It is estimated that the switches will be spaced between 200 metres and 400 metres apart along the track within the subsidence area.

The combination of expansion switches and zero toe load clips has been successfully employed during the mining of Longwalls 25 to 32 at Tahmoor Mine and Longwalls 703 to 708, and Longwalls 901 and 902 at Appin Colliery.

A substantial advantage of using rail expansion switches and zero toe load clips is that the system is flexible and can be adjusted during mining should the tolerance of the switches reach their design limits. The rails can be cut and steel can be either added or removed as necessary to restore capacity in the switches. The process is substantially faster than conventional re-stressing work as the clips do not have to be removed and reinstated and no stressing work is required. The process can be safely achieved in between the passage of trains without delaying the operation of trains.

It is likely that the following management measures will be used to manage changes in rail stress:

- Assess pre-mining track condition and adjust track if required so that pre-mining track geometry and sleeper arrangements are at or close to design prior to the development of subsidence. This will include non-destructive measurement of rail stresses in the track;
- Identify potential sites of non-conventional movement, such as creeks and geological structures;
- Assess the required spacing of expansion switches based on the predicted ground movements;
- Install the expansion switches and zero toe load clips;
- Install a monitoring system, which includes, among other things, the monitoring of ground movements, rail stress, rail temperature, switch displacement and track geometry;
- Regularly review and assess the monitoring data;
- Conduct regular visual inspections of the track, switches and clips; and
- Adjust the track in response to monitoring results during mining if required.

With an appropriate management plan in place, it is considered that potential impacts on rail stress can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.1.7. Potential impacts on Railway Viaduct over Bargo River and Remembrance Drive Bridge over Bargo River and Main Southern Railway

The Railway Viaduct and Remembrance Drive Road Bridge are located approximately 1.7 km to the north of LW S1A. While the Viaduct and Bridges may experience small far field horizontal movements during the extraction of the proposed longwalls, they are not expected to experience impacts.

The Viaduct consists of a series of masonry arches and is an item of Heritage Significance. The Remembrance Drive Bridge is a reinforced concrete deck supported by a series of reinforced concrete piers.

Previous mining at Tahmoor Mine has virtually surrounded the Viaduct and Bridge. The closest distance between the Viaduct and Bridge and the previously extracted Longwalls 4 and 5 is 640 metres. No impacts have been reported at the Viaduct or Bridge during mining at Tahmoor Mine.

It is planned to monitor horizontal movements on both side of the Viaduct as part of Tahmoor Coal's monitoring program.

6.1.8. Potential impacts on Tahmoor Mine overhead coal conveyor 3R

Tahmoor Mine's overhead coal conveyor 3R crosses over the Main Southern Railway near 98.160 km. It is located approximately 450 metres to the side of LW S1A.

The conveyor is supported by a series of steel supports, and is shown in Fig. 6.3.



Fig. 6.3 Tahmoor Mine overhead coal conveyor 3R over the Main Southern Railway near 98.160 km

The conveyor is predicted to experience approximately 50 mm of vertical subsidence at the railway crossing, with negligible tilts, curvature and strain.

The supports to the conveyor can be adjusted in the unlikely event that increased differential horizontal movements are observed.

Tahmoor Coal, in consultation with ARTC, will study the potential for impacts to the coal conveyor and develop management measures to ensure that the conveyor and the Main Southern Railway remains safe and serviceable throughout the mining period. The study would require input from structural engineers and subsidence engineers. The management measures will include a combination of:-

- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and structure movements and visual inspections;
- Implementation of a response plan, where actions are triggered by monitoring results. This will include an adjustment of the conveyor supports if triggered by monitoring results; and
- Implementation of a reporting and communication plan.

With an appropriate management plan in place, it is considered that potential impacts on the conveyor crossing can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.1.9. Potential impacts on Wellers Road Overbridge

The Wellers Road Overbridge is located at Bargo at 101.162 km. A photograph of the Overbridge is shown in Fig. 6.4. Wellers Road Overbridge is located just outside the *Subsidence Study Area*, 370 metres from the commencing end of LW S6A.



Fig. 6.4 Wellers Road Overbridge at 101.162 km

The bridge structure consists of a single span supported by a concrete arch on masonry abutments with masonry vehicle barrier walls. The concrete arch appears to have been reinforced with old steel rails. The bridge was constructed between 1917 and 1920 and is listed as an item of heritage significance.

The bridge is predicted to experience less than 20 mm of conventional subsidence, with negligible tilt, curvature and strain due to the extraction of LWs S1A to S6A.

Mining-induced ground movements will develop gradually at the bridge. With the implementation of an effective subsidence management plan, the development of ground movements and impacts can be detected early with time to implement intervention measures before the bridge becomes unserviceable.

Tahmoor Coal, in consultation with ARTC, will study the potential for impacts to the bridge and develop management measures to ensure that the Wellers Road Overbridge remains safe and serviceable throughout the mining period. The study would require input from structural and geotechnical engineers and subsidence engineers. The management measures may include a combination of:

- Re-assessment of the pre-mining condition of the bridge prior to mining;
- Consideration of mitigation measures prior to mining and implementation if required;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and bridge movements. It is planned to monitor horizontal movements at the Bridge as part of Tahmoor Coal's monitoring program;
- Regular review and assess the monitoring data,
- Regular visual inspections of the bridge; and
- Implementation of planned responses if triggered by monitoring and inspections.

With an appropriate management plan in place, it is considered that potential impacts on the Wellers Road Overbridge can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.1.10. Railway Culverts

There are 7 railway culverts located within the *Subsidence Study Area* and their locations are shown in Drawing No. MSEC1192-10. A summary is provided in Table 6.4.

Table 6.4 Railway Culverts within Study Area

Kilometrage (km)	Diameter (mm)	Description	Location relative to Proposed Longwalls
98.445 km	900 dia	Brick arch culvert with concrete extension on both sides	Approx. 170 m to the side of LW S1A
98.739 km	900 dia	Brick arch culvert with concrete extension on both sides	Above LW S1A
99.035 km	1200 dia	Brick arch culvert with concrete extension on both sides	Above LW S2A
99.388 km	1200 dia	Brick arch culvert with concrete extension on UP side	Above LW S3A
100.121 km	1500 dia	Brick arch culvert	Above LW S4A
100.425 km	2000 dia	Brick arch culvert	Above LW S5A
101.000 km	1200 dia	Brick arch culvert	Approx. 230 m beyond the end of LW S6A

Photographs of culverts are shown in Fig. 6.5 to Fig. 6.9.



Photograph courtesy Robinson Rail

Fig. 6.5 Culvert with concrete extension on Up side at 98.739 km



Photographs courtesy Robinson Rail / MSEC

Fig. 6.6 Culvert at 99.388 km on Up and Down sides



Photograph courtesy Newcastle Geotech

Fig. 6.7 Internal view of Culvert at 99.035 km



Photograph courtesy Robinson Rail

Fig. 6.8 Culvert with concrete extension on Up side at 100.121 km



Photograph courtesy Robinson Rail

Fig. 6.9 Culvert with concrete extension on Up side at 100.425 km

The railway crosses a number of streams within the *Subsidence Study Area* and valley-related movements could be experienced in these locations. A summary of the maximum predicted conventional subsidence and valley related movements for the railway culverts is provided in Table 6.5.

Table 6.5 Predicted Conventional Subsidence and Valley Related Movements for the Main Southern Railway Culverts within the Study Area

Location	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (1/km)	Maximum predicted total sagging curvature (1/km)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
98.445 km	125	< 0.5	< 0.01	< 0.01	20	20
98.739 km	1050	8.0	0.05	0.17	100	50
99.035 km	1000	5.0	0.05	0.04	100	75
99.388 km	1225	5.0	0.06	0.04	200	150
100.121 km	1225	7.0	0.08	0.09	200	100
100.425 km	1275	3.5	0.05	0.12	150	75
101.000 km	20	< 0.5	< 0.01	< 0.01	50	20

The values provided in Table 6.5 are the maximum predicted parameters within a 20 metre radius of each culvert.

6.1.11. Potential impacts on railway culverts at creek crossings

There are a number of railway culverts within the *Subsidence Study Area*. The majority of the culverts are relatively small in size, being 2 metres in diameter or less.

The culverts above proposed LWs S1A to S6A are situated in defined drainage lines that form part of the Teatree Hollow catchment. The culverts are buried beneath small railway embankments. These culverts are expected to experience non-conventional valley related subsidence movements in addition to conventional subsidence movements.

Given that the maximum predicted tilt is 8.0 mm/m, which equates to a 0.8% change in grade, it is expected that mining-induced conventional tilts will not substantially impact the drainage flows in the culverts. It is, however, recommended that the culverts be cleared of ballast which has accumulated in the culvert prior to mining.

The main impact identified with the brick arch culverts is the potential for physical impacts to occur. It is possible that these culverts will experience some cracking and spalling of the masonry as a result of mining the longwalls. Cracking may occur in the masonry arch or in the wingwalls and headwalls. The predicted movements are not considered likely to result in collapse of the culvert.

However, given the potentially severe consequences of culvert collapse, the Rail Management Group will consider mitigation measures prior to each culvert experiencing subsidence movements. Mitigation works could include, for example, sleeving the masonry arch with new pipes. Alternatively, in the case of small shallow buried culverts, steel baulk structures could be placed above the culvert to prevent impacts on the track in the event of culvert collapse.

More substantial mitigation measures may be required for the larger culverts, which may include substantial strengthening of the culvert, wingwalls and headwalls. Substantial strengthening work has successfully been undertaken at culverts above Longwalls 25 and 29 at Tahmoor Mine (Leventhal, *et al.*, 2011; Leventhal, *et al.*, 2017).

A structural steel liner was successfully installed by Tahmoor Mine in a small culvert above Longwall 26. In this case a small air gap was left between the structural steel liner and the original masonry culvert. It was found that while the masonry culvert has experienced cracking during mining, it has remained safe and serviceable during mining. While providing effective insurance against failure, the structural steel liner was not required to support the track and maintain the waterway.

It is likely that the following management measures will be used to manage potential impacts on culverts:-

- Assess pre-mining condition of culverts;
- Consider and implement mitigation measures to reduce or avoid the potential for culvert collapse;
- Install a monitoring system, which includes, among other things, the monitoring of ground movements around the culverts and changes in track geometry and rail stress;

- Regularly review and assess the monitoring data;
- Conduct regular visual inspections of the culverts, and
- Provide additional track and/or culvert support in response to actual measurements and observations during mining.

With an appropriate management plan in place, it is considered that potential impacts on the culverts can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

The predicted valley upsidence and closure movements are also expected to result in changes in track geometry and rail stress. Methods for managing of changes in track geometry and rail stress are provided in Section 6.1.4 and Section 6.1.6.

6.1.12. Potential impacts on railway cuttings

The Main Southern Railway follows a ridgeline within the *Subsidence Study Area* and only small cuttings less than 4 metres in depth are present.

The cutting batters consist of competent sandstone rock, as shown in Fig. 6.10.



Photograph courtesy Newcastle Geotech

Fig. 6.10 Railway cutting at 98.900 km

In the unlikely event that the faces of these cuttings are impacted by mine subsidence, the failure is likely to be very minor, in the form of small fragments of rock, and likely to fall into the clear area at the base of the cutting (the *cess*).

Tahmoor Mine has successfully mined directly beneath railway cuttings during the extraction of Longwalls 25 to 32, with only minor impacts observed on cuttings.

The Rail Management Plan will consider mitigation measures before the cuttings experience subsidence movements. Mitigation works could include, for example, scaling the cutting faces and removing debris from *the cess*. *The cess* will then be maintained during the mining period.

With an appropriate management plan in place, it is considered that potential impacts on the cuttings can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.1.13. Potential impacts on embankments

The Main Southern Railway crosses relatively small valleys in the *Subsidence Study Area* and the railway embankments are less than 5 metres in height. The embankments are typically constructed with local fill material and contain relatively steep batters.

Photographs of embankments are shown previously in Fig. 6.1 and below in Fig. 6.11.



Photograph courtesy Newcastle Geotech

Fig. 6.11 Railway embankment at 100.200 km

The likelihood of impacts on the embankments is considered to be relatively low provided that the culverts remain serviceable and do not become blocked.

The embankments may experience tensile surface cracking during mining, however, these can be readily treated before they develop into a safety hazard. Compressive impacts are less likely as the voids within the embankment can accommodate some compressive movement.

The Rail Management Group will consider mitigation measures before each embankment experiences subsidence movements. Mitigation works could include, for example, cleaning out of the culverts and drainage lines beneath the embankments, or the stabilisation of the batters.

With an appropriate management plan in place, it is considered that potential impacts on the embankments can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occurred.

6.1.14. Potential impacts on signalling and communications systems

There are a number of signalling, communications and electrical services along the Main Southern Railway. These include signal boxes and an optical fibre cable.

The potential for impacts on cabling and wiring along the track is considered to be very low. Mine subsidence impacts on electrical and telecommunications cabling is historically very low in the Southern Coalfield, as discussed in Section 6.10. It is noted that there are failsafe signalling procedures designed within the track management system that substantially reduce the potential for train collisions.

With an appropriate management plan in place, it is considered that the potential impacts on signalling, communications and electrical services can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occurred.

6.2. Tahmoor Mine Rail Loop

The location of Tahmoor Mine's Rail Loop is shown in Drawing No. MSEC1192-10. Descriptions, predictions and impact assessments for the railway are provided in the following sections.

6.2.1. Description of the Rail Loop

Trains enter Tahmoor Mine's Rail Loop at 95.000 km on the Main Southern Railway and travel through the mine site in a clockwise direction. The Rail Loop passes beneath four overhead coal conveyors, the rail loader bin and a road crossing.

The Rail Loop consists of 53 kg rail on concrete sleepers. The track speed limit in the Rail Loop 15 km/hour and 5 km/hour when coal loading. Rail operations vary depending on volumes of coal available at the stockpile and the arrival of ships at port. The maximum rail activity at the mine is 4 train movements per day.



Fig. 6.12 Rail Loop under road bridge



Fig. 6.13 Aerial view of Rail Loop

The Rail Loop is located within the *Subsidence Study Area.* The closest distance between the Rail Loop and LW S1A is approximately 160 metres.

6.2.2. Predictions for the Rail Loop

The predicted profiles of conventional subsidence, tilt and curvature along the alignment of Rail Loop, resulting from the extraction of the proposed longwalls, are shown in Fig. E.09, in Appendix E.

A summary of the maximum predicted total conventional subsidence parameters along the alignment of the Rail Loop, after the extraction of each of the proposed longwalls, is provided in Table 6.6.

Table 6.6 Maximum predicted total conventional subsidence parameters along the alignment of the Rail Loop after the extraction of the proposed LWs S1A to S6A

Longwall	Maximum predicted total subsidence (mm)	Maximum predicted change in Grade (%)	Maximum predicted total hogging curvature along alignment (km^{-1})	Maximum predicted total sagging curvature along alignment (km^{-1})
After LW S6A	90	< 0.05	< 0.01	< 0.01

The majority of the subsidence movements are predicted to occur during the extraction of proposed LW S1A.

The maximum predicted conventional strains for the railway, based on applying a factor of 15 to the maximum predicted conventional curvatures, are less than 0.5 mm/m. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

6.2.3. Impact assessments for the Rail Loop

The Rail Loop is predicted to experience minor subsidence movements due to the extraction of proposed LWs S1A to S6A.

The changes in track geometry and rail stress are expected to be very minor and unlikely to adversely impact on rail operations. Non-conventional movements can, however, occur and impact the track. In the unlikely event that impacts occur, they can be readily repaired in between rail operations.

A Rail Management Group has been coordinated to develop the risk management strategies. The Rail Management Group includes representatives from ARTC, Tahmoor Coal and specialist consultants in the fields of railway track engineering, geotechnical engineering, structural engineering, track signalling, mine subsidence, risk assessment and project management. The Technical Committee consults with the Resources Regulator and the Office of the National Rail Safety Regulator.

Works by the Rail Management Group include:-

- Identification of potential impacts on the railway;
- Undertaking a risk management approach, where identified risks are assessed and risk control measures are implemented;
- Development of management measures that include mitigation and preventive works, monitoring plans, triggered response plans and communication plans; and
- Supervision and oversight of railway track and infrastructure mitigation, monitoring and maintenance of affected rail track and infrastructure.

With an appropriate management plan in place, it is considered that potential impacts on the Rail Loop can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.2.4. Potential impacts on Tahmoor Mine overhead coal conveyors 3R, 4S, 4C and 7C

Tahmoor Mine's overhead coal conveyors 3R, 4S, 4C and 7C cross over the Rail Loop. The conveyors are supported by a series of steel supports. Conveyors 4S and 4C and the Rail Loader Bin are shown in Fig. 6.14



Fig. 6.14 Conveyors 4S and 4C over Rail Loop and Rail Loader Bin

The conveyor is predicted to experience approximately 90 mm of vertical subsidence at the railway crossing, with negligible tilts, curvature and strain.

The supports to the conveyor can be adjusted in the unlikely event that increased differential horizontal movements are observed.

Tahmoor Coal will study the potential for impacts to the coal conveyor and develop management measures to ensure that the conveyor and the Rail Loop remains safe and serviceable throughout the mining period. The study would require input from structural engineers and subsidence engineers. The management measures will include a combination of:-

- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and structure movements and visual inspections;
- Implementation of a response plan, where actions are triggered by monitoring results. This will include an adjustment of the conveyor supports if triggered by monitoring results; and
- Implementation of a reporting and communication plan.

With an appropriate management plan in place, it is considered that potential impacts on the conveyor crossings over the Rail Loop can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.2.5. Potential impacts on Tahmoor Mine road bridge over Rail Loop

The road bridge over the Rail Loop is supported by an Armco Culvert with a compacted earth embankment fill. A close up view is shown in Fig. 6.15.



Photograph courtesy JMA Solutions

Fig. 6.15 Tahmoor Mine road bridge over Rail Loop

The road bridge is predicted to experience approximately 40 mm of vertical subsidence with negligible tilts, curvatures and strains. Non-conventional movements can, however, occur and impact the road bridge.

The Armco structure is generally ductile in nature and can tolerate differential movement.

Tahmoor Coal will study the potential for impacts to the road bridge over the Rail Loop and develop management measures to ensure that the track and road remains safe and serviceable throughout the mining period. The study would require input from structural engineers and subsidence engineers. The management measures will include a combination of:-

- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and structure movements and visual inspections;
- Implementation of a response plan, where actions are triggered by monitoring results. This will include an adjustment of the Armco culvert if triggered by monitoring results; and
- Implementation of a reporting and communication plan.

With an appropriate management plan in place, it is considered that potential impacts on the road bridge and the Rail Loop can be managed during the mining of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.3. Local roads

6.3.1. Descriptions of local roads

The locations of local roads within the Study Area are shown in Drawing No. MSEC1192-11.

The main local road within the *Subsidence Study Area* is Remembrance Drive which runs along the western side of the Main Southern Railway and crosses directly above the proposed Longwalls S1A to S5A. The road provides a connection between the M31 Hume Motorway and the township of Bargo with the township of Tahmoor to the north of the Study Area.

Caloola Road and Yarran Road are one-way sealed roads that connect to Remembrance Drive from the west. The two road are located within the *Subsidence Study Area.*

Great Southern Road runs alongside the eastern side of the Main Southern Railway and becomes Avon Dam Road, which connects to the M31 Hume Motorway. Only the northern end of Great Southern Road is located within the *Subsidence Study Area.* Charlies Point Road is a sealed local road that connects Great Southern Road and Arina Road.

The local roads are maintained by Wollondilly Shire Council. A photograph of Remembrance Drive near the intersection with Caloola Road is provided in Fig. 6.16.



Photograph courtesy Building Inspection Services

Fig. 6.16 Remembrance Drive near Caloola Road

There are no bridges along local roads within the *Subsidence Study Area.* A number of culverts are located within the *Subsidence Study Area*, as shown in Drawing No. MSEC1192-11. Almost every culvert is a reinforced concrete pipe (RCP), with the exception of one earthenware pipe on Charlies Point Road. The pipe diameters vary between 500 mm and 1.8 metres.

A photograph of twin, 1.35 metre diameter reinforced concrete culverts beneath bus stop at the end of Caloola Road is shown in Fig. 6.17. The culvert carries the pavement over Teatree Hollow and continues beneath Remembrance Drive. A photograph of the road embankment to Remembrance Drive at Teatree Hollow is shown in Fig. 6.18.

Two culverts are located in close proximity at the intersection between Remembrance Drive, Yarran Road and the Main Southern Railway. The 1800 mm RCP culvert beneath Remembrance Drive drains into a small parcel of privately owned land and a 2000 mm diameter brick arch culvert beneath the Main Southern Railway.



Photograph courtesy Building Inspection Services

Fig. 6.17 Culvert beneath approach to Caloola Road and continuing under Remembrance Drive along Teatree Hollow



Photograph courtesy Building Inspection Services

Fig. 6.18 Remembrance Drive embankment at intersection with Caloola Road



Photographs courtesy Building Inspection Services

Fig. 6.19 RCP culvert beneath Remembrance Drive and brick arch culvert beneath Main Southern Railway at 100.425 km with private land in between them

6.3.2. Predictions for local roads

The predicted profiles of conventional subsidence and tilt along the alignment of Remembrance Drive, resulting from the extraction of the proposed longwalls, are shown in Fig. E.07, in Appendix E.

A summary of the maximum predicted total conventional subsidence parameters for Remembrance Drive, after the extraction of each of the proposed longwalls, is provided in Table 6.7.

The predicted tilts are the maxima along the alignment of the road after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Table 6.7 Maximum predicted total conventional subsidence parameters for Remembrance Drive due to the extraction of LWs S1A to S6A

Longwall	Maximum predicted subsidence (mm)	Maximum predicted tilt along alignment (mm/m)	Maximum predicted tilt across alignment (mm/m)	Maximum predicted hogging curvature in any direction (km^{-1})	Maximum predicted sagging curvature in any direction (km^{-1})
LW S1A	325	2.5	5.0	0.06	0.06
LW S2A	1000	5.0	5.5	0.08	0.20
LW S3A	1200	6.5	5.5	0.10	0.21
LW S4A	1250	6.0	6.0	0.12	0.21
LW S5A	1300	6.5	5.5	0.12	0.21
LW S6A	1350	7.5	5.5	0.12	0.21

The maximum predicted conventional strains for Remembrance Drive, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.8 mm/m tensile and 3.2 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The road is a linear feature and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. The analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.2 and the results are provided in Fig. 4.4.

Caloola Road and Yarran Road are located directly above the proposed longwalls and, therefore, could experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the Study Area is provided in Chapter 4.

Remembrance Drive crosses Teatree Hollow and a number of its tributaries within the *Subsidence Study Area* and valley-related movements could be experienced in these locations. A summary of the maximum predicted conventional subsidence and valley related movements for the crossing at Teatree Hollow is provided in Table 6.8.

Table 6.8 Predicted Conventional Subsidence and Valley Related Movements for the Culverts along Remembrance Drive within the Study Area

Location	Maximum Predicted Total Subsidence (mm)	Maximum Predicted Total Tilt along Culvert (mm/m)	Maximum Predicted Total Hogging Curvature (1/km)	Maximum Predicted Total Sagging Curvature (1/km)	Maximum Predicted Total Upsidence (mm)	Maximum Predicted Total Closure (mm)
Teatree Hollow (Caloola Road)	1300	6.9	0.06	-0.18	250	150
Tributary to Teatree Hollow	1100	3.6	0.05	-0.04	125	100
Tributary to Teatree Hollow (Yarran Road)	1300	6.7	0.05	-0.22	150	75
Tributary to Teatree Hollow (Wellers Road)	25	< 0.5	< 0.01	< 0.01	40	25

6.3.3. Impact assessments for local roads

There is extensive experience of mining directly beneath local roads in the Southern Coalfield which demonstrates that impacts can be managed with the implementation of suitable management strategies. In all cases the local roads have remained in safe and serviceable condition and have been remediated using normal road maintenance techniques.

Longwalls 22 to 32 and LW W1-W3 at Tahmoor Mine have mined directly beneath 28 kilometres of local roads and a total of 54 impact sites have been observed. The observed rate of impact on the local roads equates to an average of one impact for every 520 metres of pavement. In most cases, the impacts were relatively minor and were remediated by locally resurfacing the pavements.

The most severe impacts were located where substantial non-conventional movements had developed. These impact sites were identified using visual and ground monitoring and remediation was undertaken during active subsidence to maintain these roads in safe and serviceable conditions.

Photographs of typical impacts observed on local roads at Tahmoor are provided in Fig. 6.20.



Fig. 6.20 Previously observed impacts on local roads above Tahmoor Mine

As the predicted subsidence parameters for the proposed longwalls are greater than those at Tahmoor North, it is expected that the rates of impact on the local roads within the *Subsidence Study Area* will be greater than experienced at Tahmoor. The impacts, however, can be managed with the implementation of

suitable management strategies. Impacts on local roads have been successfully managed elsewhere in the NSW Coalfields, where the predicted subsidence parameters were similar to or greater than those predicted for the proposed longwalls.

6.3.4. Impact assessments for local road culverts

The maximum predicted tilt across Remembrance Drive within the *Subsidence Study Area* is 6.9 mm/m (i.e. 0.69 %), which represents a change in grade of 1 in 145.

The predicted changes in grade are small, in the order of 1 % and, therefore, are unlikely to result in any adverse impacts on the serviceability of the drainage culverts. If the flow of water through any drainage culverts were to be adversely affected, as a result of the proposed mining, this could be remediated by re-levelling the affected culverts.

The predicted curvatures and strains could be of sufficient magnitudes to result in cracking in the culverts or the headwalls. It is unlikely, however, that these movements would adversely impact on the stabilities or structural integrities of the culverts. The potential impacts on the drainage culverts could be managed by visual inspection and, where required, any affected culverts can be repaired or replaced.

The drainage culverts are located along drainage lines and could, therefore, experience valley related upsidence and closure movements. The drainage culverts are orientated along the alignments of the drainage lines and, therefore, the upsidence and closure movements are orientated perpendicular the main axes of the culverts and unlikely to result in adverse impacts to the culvert pipes.

Previous experience of mining beneath culverts in the NSW Coalfields, at similar depths of cover, indicates that the incidence of impacts is low. Impacts have generally been limited to cracking in the concrete headwalls which can be readily remediated. In some cases, however, cracking in the culvert pipes occurred which required the culverts to be replaced.

6.3.5. Management of potential impacts on local roads

Tahmoor Coal has developed a Subsidence Management Plan in consultation with Wollondilly Shire Council for the extraction of existing longwalls at Tahmoor Mine to manage the impacts on the public roads, bridges and culverts.

It is recommended that a similar Subsidence Management Plan be developed in consultation with Wollondilly Shire Council to manage potential impacts on the local roads, bridges and culverts within the *Subsidence Study Area*. With the implementation of these management strategies, it would be expected that the local roads could be maintained in safe and serviceable conditions during and after the extraction of the proposed longwalls.

With an appropriate management plan in place, it is considered that potential impacts on the roads, bridges and culverts can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.4. Road bridges

Descriptions, predictions and impact assessments for Wellers Road Bridge over the Main Southern Railway is provided in Section 6.1.9. There are no other bridges within the *Subsidence Study Area.*

6.5. Tunnels

There are no tunnels within the *Subsidence Study Area*.

6.6. Potable water infrastructure

6.6.1. Descriptions of potable water infrastructure

The locations of the potable water infrastructure within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-12. The water pipelines are owned and operated by Sydney Water.

The potable water infrastructure includes a Cast Iron Cement Lined (CICL) 450 mm diameter watermain which follows the alignment of Remembrance Drive, before crossing beneath the Main Southern Railway and following Great Southern Road. 200 mm and 250 mm diameter Ductile Iron Cement Lined (DICL) water pipelines are located along Caloola Road, Yarran Road and along a short section Remembrance Drive to the south the railway crossing.

A summary of the potable water pipelines within the Study Area is provided in Table 6.9.

Table 6.9 Potable water pipelines within the Study Area

Type	Size (diameter) (mm)	Total length of pipeline within Study Area (km)	Total length of pipeline located directly above proposed LWs S1A to S6A (km)
450 mm dia. watermain along Remembrance Drive	450	3.0	2.4
Distribution Network	100 to 200	3.4	2.1

The distribution of water mains by pipe diameter within the Study Area is shown in Table 6.10.

Table 6.10 Distribution of water mains by pipe diameter

Pipe diameter (mm)	Total length within Study Area (km)	%
100	2.9	44.5
150	< 0.1	0.1
200	0.6	8.7
375	< 0.1	< 0.1
450	3.0	46.7
Total	**6.4**	**100.0**

The types of pipeline within the *Subsidence Study Area* are mainly DICL and CICL, with short sections of Steel Cement Lined (SCL) beneath road crossings. The distribution of water mains by type of pipe is shown in Table 6.11.

Table 6.11 Distribution of water mains by pipe type

Pipe diameter (mm)	Total length within Study Area (km)	%
CICL	4.6	71.9
DICL	1.8	27.6
SCL IBL	< 0.1	0.4
Unknown	< 0.1	< 0.1
Total	**6.4**	**100.0**

6.6.2. Predictions for potable water infrastructure

The 450 mm diameter CICL watermain generally follows the alignment of Remembrance Drive. Predictions of subsidence effects along the pipeline, including predictions of valley closure at creek crossing are provided in Section 6.3.2.

6.6.3. Impact assessments for potable water pipelines

Longwalls 22 to 32 at Tahmoor Mine have directly mined beneath approximately 5.5 kilometres of DICL pipe and 19.5 kilometres of CICL pipe, with only minor impacts recorded to the older CICL pipes. Water leaks were repaired by Sydney Water using normal response procedures.

The predicted systematic curvatures and strains for the water pipelines within the *Subsidence Study Area* are of a similar order of magnitude to those observed and predicted along the pipelines that have been mined directly beneath by previously extracted longwalls in the Southern Coalfield. The overall levels of impacts on the water pipelines in the *Subsidence Study Area*, therefore, are expected to be similar to those observed during the previously extracted longwalls in the Southern Coalfield. Longwalls in the Southern Coalfield have been mined directly beneath water pipelines in the past, and some of these cases are provided in Table 6.12.

Table 6.12 Examples of previous experience of mining beneath water pipelines in the Southern Coalfield

Colliery and Longwalls	Pipelines	Observed movements	Observed impacts
Appin LW301 and LW302	0.6 km of 150 dia. DICL 0.6 km of 300 dia. CICL 0.6 km of 1200 dia. SCL	650 mm Subsidence 4.5 mm/m Tilt 1 mm/m Tensile Strain 3 mm/m Comp. Strain (Measured M & N-Lines)	Leakage of the 150 mm and 300 mm CICL pipelines at a creek crossing, elsewhere no other reported impacts
Tahmoor Mine LW22 to LW32	5.5 km DICL pipes 19.5 km CICL pipes	1200 mm Subsidence 6 to 10 mm/m Tilt 1.5 mm Tensile Strain 2 mm (typ.) and up to 5 mm/m Comp. Strain (Extensive street monitoring)	Impacts occurred to the distribution network at 8 locations and a very small number of minor leaks in the consumer connection pipes
West Cliff LW5A3, LW5A4 & LW29 to LW34	2.8 km of 100 dia. CICL pipe directly mined beneath	1100 mm Subsidence 10 mm/m Tilt 1 mm/m Tensile Strain 5.5 mm/m Comp. Strain (Measured B-Line)	No reported impacts

Based on this experience, it is expected that some minor leakages of the water pipelines could occur at isolated locations, as the result of the extraction of the longwalls, however, the incidence of impacts is expected to be low. Impacts are more likely to occur in the locations of non-systematic movements, and at creek crossings, due to valley related movements.

Any impacts are expected to be of a minor nature which could be easily remediated. It is recommended that Tahmoor Coal develop management strategies, in consultation with Sydney Water, to manage these potential impacts.

6.6.4. Management of potential impacts on water infrastructure

Tahmoor Coal has developed a Subsidence Management Plan in consultation with Sydney Water for the extraction of existing longwalls at Tahmoor Mine to manage potential impacts on potable water infrastructure.

With an appropriate management plan in place, it is considered that the potential impacts on the Sydney Water potable water pipelines can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions.

6.7. Sewerage pipelines

6.7.1. Descriptions of sewerage pipelines

A *Priority Sewer Program* has been constructed in the township of Bargo by Sydney Water. The sewer infrastructure includes a pressure main along Remembrance Drive and a consumer reticulation network along the local roads. The locations of the sewerage infrastructure are shown in Drawing No. MSEC1192-13.

The sewerage system was designed to accommodate mine subsidence movements and consists of polyethylene (PE) pipelines with diameters up to 630 mm.

A summary of the sewerage pipelines within the *Subsidence Study Area* is provided in Table 6.13.

Table 6.13 Sewerage pipelines within the Subsidence Study Area

Type	Size (diameter) (mm)	Total length of pipeline within Subsidence Study Area (km)	Total length of pipeline located directly above proposed LWs S1A to S6A (km)
PE Pressure Main along Remembrance Drive	180	3.0	2.3

6.7.2. Predictions for sewer infrastructure

The 180 mm diameter PE pressure main generally follows the alignment of Remembrance Drive. Predictions of subsidence effects along the pipeline, including predictions of valley closure at creek crossing are provided in Section 6.3.2.

6.7.3. Impact assessments for sewer infrastructure

The sewer reticulation network within the *Subsidence Study Area* consists of a 180 mm diameter welded PE pipe.

Tahmoor Coal, in consultation with Sydney Water, has successfully mined beneath a sewerage system at Tahmoor and Thirlmere during the mining of Longwalls 22 to 32. The sewerage infrastructure at Tahmoor and Thirlmere are gravity sewers and consist mainly of PVC pipes. While impacts on the sewerage system at Tahmoor have been successfully managed, the pressurised sewerage system at Bargo will be able to accommodate substantially greater differential subsidence movements.

The sewer main transports sewage by hydraulic pressure and does not rely on gravity. While the sewer main will experience changes in grade due to subsidence, the changes will not adversely affect it.

The PE pipes can accommodate substantial deformations without losing their integrity. Only extreme deformations, such as the development of a step in the ground may adversely impact on the pipes.

If the PE pipe experiences severe deformation, the pipe may become blocked. The sewerage system has been designed to store sewage for approximately 8 hours after which time sewage may leak or overflow from the sewerage system. This can be readily repaired by local excavation and repair.

There do not appear to be any house connections to the pressure main within the *Subsidence Study Area.* Houses can connect to the system via a Sydney Water designed pot that is approximately 2 metres deep and 1 metre in diameter. The pot stores sewage, which is pumped into the reticulation network. The connection between each house and the pot consists of a gravity flow PVC pipe. It is possible that the pot and the house will act as anchors to the ground during subsidence, and that differential horizontal movements between the two structures may result in leakage at the connections. This is similar to the current connections between houses and septic tanks. Experience from mining beneath septic tanks has been that while impacts have previously occurred during, the rate of impact is low. Impacts to the connections can be readily repaired.

A number of valves and chambers are located above the proposed longwalls. These chambers, valves and pipe fittings are small in size and are connected via flange adapters. It is expected that the chambers, valves and fittings will act as anchors to the ground during subsidence, allowing the PE pipe to stretch or compress in response to mining-induced differential horizontal movements. While there is potential for impacts to occur at these locations, many similar structures are located within the Tahmoor sewerage system and no impacts have occurred to chambers, valves and other pipe fittings during mining. There is, however, a remote chance that anomalous ground deformation could occur during extraction of the proposed longwalls.

Any impacts are expected to be of a minor nature which could be easily remediated. It is recommended that Tahmoor Coal develop management strategies, in consultation with Sydney Water, to manage these potential impacts.

6.7.4. Management of potential impacts on proposed sewerage infrastructure

Tahmoor Coal has developed a Subsidence Management Plan in consultation with Sydney Water for the extraction of existing longwalls at Tahmoor Mine to manage potential impacts on sewerage infrastructure.

With an appropriate management plan in place, it is considered that the potential impacts on the Sydney Water sewerage pipelines can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions.

6.8. Gas infrastructure

6.8.1. Moomba-Sydney Gas Pipeline and Gorodok Ethane Pipeline

The *Moomba-Sydney Gas Pipeline and Gorodok Ethane Pipeline* is located south of Bargo township and is outside the *Subsidence Study Area* for LWs S1A to S6A.

6.8.2. Local Jemena infrastructure

The locations of local gas infrastructure within and adjacent to the *Subsidence Study Area* are shown in Drawing No. MSEC1192-14. There is a 150 mm diameter steel main, which runs along Remembrance Drive and distributes gas to the townships north of Bargo, including Tahmoor, Thirlmere and Picton.

The take-off point for the 150 mm steel main from the Moomba-Sydney Gas Pipeline is located on Hawthorne Road outside the *Subsidence Study Area*. The local Jemena gas infrastructure servicing the Bargo township has a take-off point at the same location. The take-off point consists of a number of buried pits, a pillar box and guard rail.

A summary of the local gas infrastructure within the *Subsidence Study Area* is provided in Table 6.14.

Table 6.14 Summary of the local gas infrastructure within the Subsidence Study Area

Type	Total length of local gas infrastructure within Subsidence Study Area (km)	Total length of local gas infrastructure directly above proposed LWs S1A to S6A (km)
32 mm nylon	0.2	0
50 mm nylon	< 0.05	0
150 mm steel	3.0	2.4

6.8.3. Predictions for gas infrastructure

The 150 mm diameter PE pressure main generally follows the alignment of Remembrance Drive. Predictions of subsidence effects along the pipeline, including predictions of valley closure at creek crossing are provided in Section 6.3.2.

6.8.4. Impact assessments for gas infrastructure

Longwalls 22 to 32 have directly mined beneath approximately 19 kilometres of gas pipes and no impacts have been recorded so far. The local nylon and 160 mm polyethylene main along Remembrance Drive are very flexible and have demonstrated that they are able to withstand the full range of subsidence experienced during longwall extraction at Tahmoor Mine to date. While no impacts have been experienced to date, it is acknowledged that the most vulnerable element of the system is the rigid copper pipe connections between the gas mains and houses, which can be readily repaired.

A difference between the gas infrastructure at Bargo compared to the gas infrastructure at Tahmoor is the existence of the 150 mm steel gas main at Bargo. This pipe passes through the Bargo township, mainly along Remembrance Drive. As the steel pipe was constructed in 1994, it was designed and constructed in accordance with the requirements of SA NSW. Steel gas pipelines of similar and larger diameter have been successfully mined directly beneath in the past in the Southern Coalfield (McGill, 2007) and Newcastle Coalfield (Robinson, 2007). Being of relatively small diameter, the pipe is expected to withstand considerable deformation.

Tahmoor Coal has consulted with Jemena and has engaged specialist pipeline engineers who are experienced in mine subsidence to conduct analyses to assess the potential for impacts on the pipeline. The analyses includes an assessment of changes in pipe stresses due to the predicted subsidence, tilt, curvature and strain movements and a sensitivity analysis to assess the magnitudes at which differential movements may exceed acceptable limits. The results indicate that the pipeline can tolerate the predicted conventional subsidence movements due to the extraction of LWs S1A and S2A.

Investigations are currently underway to assess the risks and select feasible risk controls that can be implemented either prior to mining and/or during mining, taking into account the specific site conditions along Remembrance Drive. This may include, for example, exposing sections of pipeline at creek crossings prior to the influence of subsidence.

If observed ground strains or severe ground deformations are observed to develop during mining, the pipe can be exposed and adjusted to decouple the pipe from the differential ground movements. Pre-planned traffic control and security measures would be required to be implemented if these works are required. In the event of a minor gas leak, the pipeline can also be repaired without interruption to services.

6.8.5. Management of potential impacts on gas infrastructure

Tahmoor Coal has developed Subsidence Management Plans in consultation with Jemena for the existing longwalls at Tahmoor Mine to manage potential impacts on local gas infrastructure at Tahmoor.

It is recommended that a similar Subsidence Management Plan be developed in consultation with Jemena to manage potential impacts on the local gas infrastructure within the *Subsidence Study Area*. With the implementation of these management strategies, it would be expected that the local gas infrastructure could be maintained in safe and serviceable conditions during and after the extraction of the proposed longwalls.

With an appropriate management plan in place, it is considered that potential impacts on the local gas infrastructure can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.9. Electrical Infrastructure

6.9.1. Descriptions of electrical infrastructure

The locations of the electrical infrastructure within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-15.

The electrical infrastructure comprises 66 kV, 11 kV and low voltage powerlines which are located across the *Subsidence Study Area*. There are no transmission lines located within the *Subsidence Study Area*.

A summary of the power lines within the *Subsidence Study Area* is provided in Table 6.15.

Table 6.15 Summary of the electrical infrastructure within the Subsidence Study Area

Type	Total length of powerline within Subsidence Study Area (km)	Total length of powerline directly above proposed LWs S1A to S6A (km)
66 kV Powerlines	1.5	Nil
11 kV Powerlines	11.4	5.4
Low Voltage Powerlines	11.1	6.9

The power lines generally comprise aerial copper cables supported on timber poles, but there are also some sections of direct buried cables. The power lines are owned and operated by Endeavour Energy.

6.9.2. Predictions for electrical infrastructure

The power lines are located across the *Subsidence Study Area* and, therefore, could experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

6.9.3. Impact assessments for electrical infrastructure

The aerial power lines will not be directly affected by the ground strains, as the cables are supported by poles above ground level. The cables may, however, be affected by changes in the bay lengths, i.e. the distances between the poles at the levels of the cables, resulting from differential subsidence, horizontal movements, and tilt at the pole locations. The stabilities of the poles may also be affected by conventional tilt, and by changes in the catenary profiles of the cables.

There is extensive experience of mining directly beneath power lines in the Southern Coalfield which indicates that the incidence of impacts is very low and that any impacts are readily repairable. A summary of previous experiences is provided in Table 6.16.

Table 6.16 Previous experience of mining beneath powerlines in the Southern Coalfield

Colliery and LWs	Length of powerlines directly mined beneath (km)	Observed maximum movements at powerlines	Observed impacts
Appin LW1 to LW12	5.2 km of 11 kV 104 power poles	850 mm Subsidence 6 mm/m Tilt (Measured WX-Line)	No significant impacts
Appin LW14 to LW29	1.0 km of 66 kV 4.6 km of 11 kV 76 power poles	1200 mm Subsidence 7 mm/m Tilt (Measured A-Line)	No significant impacts
Appin LW301 and LW302	0.6 km of 66 kV 0.2 km of 11 kV 14 power poles	650 mm Subsidence 4.5 mm/m Tilt (Measured M & N-Lines)	No significant impacts
Appin LW401 to LW408	3.4 km of 66 kV 0.6 km of 33 kV 2.9 km of 11 kV 96 power poles	700 mm Subsidence 5 mm/m Tilt (Measured A-Line)	No significant impacts
Appin LW702	1.5 km of 11 kV 19 power poles	550 mm Subsidence 3.5 mm/m Tilt (Measured MPR-Line)	No significant impacts
Dendrobium LW3 and LW4	0.8 km of 33 kV	1100 mm Subsidence 40 mm/m Tilt (Measured 2000-Line)	No significant impacts
Tahmoor LW22 to LW32	Approx. 44 km of electrical cables and 1100 power poles	1200 mm Subsidence 12 mm/m Tilt (Extensive street monitoring, surveys of critical power poles)	Some minor adjustments to cable catenaries, pole tilts and consumer cables required.
Tower LW1 to LW10	6.0 km of 66 kV 4.3 km of 11 kV 112 power poles	400 mm Subsidence 3 mm/m Tilt (Measured T & TE-Lines)	No significant impacts
West Cliff LW5A3 to LW5A4 & LW29 to LW33	0.8 km of a 66 kV 3.7 km of 11 kV 113 power poles	950 mm Subsidence 5 mm/m Tilt (Measured B-Line)	No significant impacts

Some remedial measures have been required, in the past, which included adjustments to cable catenaries, pole tilts and to consumer cables which connect between the power lines and building structures. It is expected that the mining during the proposed development will result in similar experiences.

6.9.4. Impact assessments for electrical infrastructure based on increased predictions

If the actual subsidence movements exceeded those predicted by a factor of 2 times, the maximum tilt at the power lines would be 16.6 mm/m (i.e. 1.6 %), or a change in grade of 1 in 60. In this case, the tilts would still be less than the tolerable tilt, which is in the order of 33 mm/m. The incidence of impacts would increase in the locations of greatest tilt, such as adjacent to the active longwall maingate and adjacent to the ends of the proposed longwalls. It would still be expected that any impacts could remediated, including some adjustments of the cable catenaries, pole tilts and the consumer cables, as has been undertaken in the past.

While the predicted ground movements are important parameters when assessing the potential impacts on the power lines, it is noted that the impact assessments were primarily based on historical observations from previous longwall mining in the Southern Coalfield. The overall levels of impact on the power lines, resulting from the extraction of the proposed longwalls, are expected to be similar to those observed where longwalls have previously mined directly beneath power lines in the Southern Coalfield.

6.9.5. Management of potential impacts on electrical infrastructure

Tahmoor Coal has developed Subsidence Management Plans in consultation with Endeavour Energy for the existing longwalls at Tahmoor Mine to manage potential impacts on electrical infrastructure.

It is recommended that a similar Subsidence Management Plan be developed in consultation with Endeavour Energy to manage potential impacts on the electrical infrastructure within the *Subsidence Study Area*.

With an appropriate management plan in place, it is considered that potential impacts on the electrical infrastructure can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.10. Telecommunications Infrastructure

6.10.1. Description of telecommunications infrastructure

The locations of the telecommunications infrastructure are shown in Drawing No. MSEC1192-16.

The telecommunications infrastructure within the *Subsidence Study Area* comprises optical fibre cables and copper cables. A summary of the telecommunications cables within the *Subsidence Study Area* is provided in Table 6.17.

Table 6.17 Summary of telecommunications infrastructure within the Subsidence Study Area

Type	Total length of cable within Subsidence Study Area (km)	Total length of cable located directly above proposed LWs S1A to S6A (km)
Copper Cables		
Telstra	15.9	10.5
National Broadband Network (NBN)	16.7	11.1
Optical Fibre Cables		
Telstra	3.6	2.6
TPG	2.8	2.3

Telstra telecommunications infrastructure

A Telstra optical fibre cable follows the alignment of Remembrance Drive and the Main Southern Railway and crosses directly above the proposed LWs S1A to S5A.

The copper telecommunications cables are generally direct buried and follow the alignments of local roads across the *Subsidence Study Area*.

National Broadband Network (NBN) infrastructure

The National Broadband Network (NBN) cables comprise both Optical fibre and copper service cables. NBN optical fibre cable follows the alignment of Remembrance Drive. Copper service cables follow the alignments of local roads across the *Subsidence Study Area*.

An NBN telecommunications tower is located at No. 3166 Remembrance Drive, with access from Yarran Road. The tower is located directly above LW S6A, as shown in Drawing No. MSEC1192-16. An aerial photograph is shown in Fig. 6.21.

TPG infrastructure

TPG have installed an optical fibre cable along Remembrance Drive from the Wollondilly Anglican College to the Bargo Exchange, following the same route as the NBN optical fibre cable, as shown in Drawing No. MSEC1192-16.



Fig. 6.21 NBN telecommunications tower with access from Yarran Road

6.10.2. Predictions for telecommunications infrastructure

Predictions of subsidence effects along Remembrance Drive, including predictions of valley closure at creek crossings are provided in Section 6.3.2.

The predicted profiles of conventional subsidence, tilt and curvature along the Telstra optical fibre cable along Remembrance Drive and the Main Southern Railway are shown in Fig. E.08, in Appendix E. The predicted profiles of conventional subsidence, tilt and curvature along the NBN and TPG optical fibre cables along Remembrance Drive are shown in Fig. E.07, in Appendix E. The predicted incremental profiles along the alignments of the cables, due to the extraction of each of the proposed longwalls, are shown as dashed black lines. The predicted total profiles along the alignments of the cables, after the completion of each of the proposed longwalls, are shown as solid blue lines. The range of predicted curvatures in any direction to the cables, at any time during or after the extraction of the proposed longwalls, is shown by the grey shading.

A summary of the maximum predicted total conventional subsidence parameters for the optical fibre cable, after the completion of each of the proposed longwalls, is provided in Table 6.18. The predicted tilts are the maxima along the alignments of the cables after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Table 6.18 Maximum predicted total conventional subsidence parameters for the Telstra optical fibre cable along Remembrance Drive and Main Southern Railway

Longwall	Maximum predicted subsidence (mm)	Maximum predicted tilt along alignment (mm/m)	Maximum predicted hogging curvature in any direction (km^{-1})	Maximum predicted sagging curvature in any direction (km^{-1})
LW S1A	325	2.5	0.06	0.06
LW S2A	1000	7.5	0.08	0.20
LW S3A	1200	6.5	0.10	0.20
LW S4A	1250	7.0	0.14	0.20
LW S5A	1300	7.0	0.14	0.20
LW S6A	1350	8.5	0.14	0.20

The optical fibre cables along the Main Southern Railway and Remembrance Drive cross a number of streams within the *Subsidence Study Area* and could experience valley related movements in these locations. A summary of the maximum predicted upsidence and closure movements at the stream crossings is provided in Table 6.19.

Table 6.19 Maximum predicted upsidence and closure movements for optical fibre cables along Remembrance Drive and Main Southern Railway at the stream crossings

Location	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (1/km)	Maximum predicted total sagging curvature (1/km)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
Main Southern Railway						
99.388 km	1225	5.0	0.06	0.04	200	150
100.121 km	1225	7.0	0.08	0.09	200	100
100.425 km	1275	3.5	0.05	0.12	150	75
101.000 km	20	< 0.5	< 0.01	< 0.01	50	20
Remembrance Drive						
Teatree Hollow (Caloola Road)	1300	6.9	0.06	-0.18	250	150
Tributary to Teatree Hollow	1100	3.6	0.05	-0.04	125	100
Tributary to Teatree Hollow (Yarran Road)	1300	6.7	0.05	-0.22	150	75
Tributary to Teatree Hollow (Wellers Road)	25	< 0.5	< 0.01	< 0.01	40	25

The predicted total closure at each stream crossing is the sum of the valley related movement calculated using the 2002 ACARP prediction method (Waddington and Kay, 2002) plus the conventional movement within the valley. It is noted that this provides some additional conservatism, as the 2002 ACARP prediction method also includes some component of the conventional movement.

The maximum predicted conventional strains for the optical fibre cables, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 2.1 mm/m tensile and 3.0 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The optical fibre cables are linear features and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. An analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.2 and the results are provided in Fig. 4.4.

The Telstra, NBN and TPG copper telecommunications cables are located across the *Subsidence Study Area* and, therefore, could experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

The NBN telecommunications tower is located off at No. 3166 Remembrance Drive, with access from Yarran Road. Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at points located around the perimeter of the tower and the shed, as well as at points located at a distance of 20 metres from the perimeter of each structure. A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each structure is provided in Table 6.20.

Table 6.20 Maximum predicted total conventional subsidence parameters for the NBN telecommunications tower at No. 3166 Remembrance Drive

Structure	Maximum predicted subsidence (mm)	Maximum predicted tilt along alignment (mm/m)	Maximum predicted hogging curvature in any direction (km^{-1})	Maximum predicted sagging curvature in any direction (km^{-1})
Shed	900	3.0	0.05	0.04
Tower	850	2.5	0.04	0.04

6.10.3. Impact assessments for optical fibre cables

The optical fibre cables are direct buried or buried in conduit and could, therefore, potentially be impacted by ground strains. The greatest potential for impacts will occur as the result of localised ground strains due to non-conventional movements or valley related movements.

Tensile strains in the optical fibre cables could be higher than predicted, where the cables connect to the support structures, which may act as anchor points, preventing any differential movements that may have been allowed to occur with the ground. Tree roots have also been known to anchor cables to the ground. The extent to which the anchor points affect the ability of the cables to tolerate the mine subsidence movements depends on the cable size, type, age, installation method and ground conditions.

In addition to this, optical fibre cables contain additional fibre lengths over the sheath lengths, where the individual fibres are loosely contained within tubes. Compression of the sheaths can transfer to the loose tubes and fibres and result in “micro-bending” of the fibres constrained within the tubes, leading to higher attenuation of the transmitted signal. If the maximum predicted compressive strains were to be fully transferred into the optical fibre cables, the strains could be of sufficient magnitude to result in the reduction in capacities of the cables or transmission loss.

Strains transferred into the optical fibre cables can be monitored using Optical Time Domain Reflectometry (OTDR), which can be used to notify the infrastructure owners of strain concentrations due to non-conventional ground movements or valley related movements.

Longwalls in the Southern Coalfield have been successfully mined directly beneath optical fibre cables in the past, with little to no adverse impacts on these cables. A summary of some of these cases is provided in Table 6.21.

Table 6.21 Examples of mining beneath optical fibre cables

Colliery and Longwalls	Length of optical fibre cables directly mined beneath (km)	Observed maximum movements at optical fibre cables	Pre-mining mitigation, monitoring and observed impacts
Appin LW301 and LW302	0.8	650 mm Subsidence 1 mm/m Tensile Strain 3 mm/m Comp. Strain (Measured M & N-Lines)	600 metre aerial cable on standby. Ground survey, visual, OTDR. No reported impacts.
Appin LW703 to LW705	10.0 total for five cables	1200 mm Subsidence 2.1 mm/m Tensile Strain 4.5 mm/m Comp. Strain (Measured HW2, ARTC and MPR Lines)	New cable redirection to avoid potential impacts to old optical fibre cable. Ground survey, visual, OTDR. Strain concentrations detected in three cables, attenuation losses were relieved by locally exposing the cables or by building a bypass cable.
Tahmoor LW22 to LW32	4.5	775 mm Subsidence 0.8 mm/m Tensile Strain 1.9 mm/m Comp. Strain	Ground survey, visual, OTDR, SBS. No reported impacts.
Tower LW1 to LW10	1.7	400 mm Subsidence 3 mm/m Tilt 0.5 mm/m Tensile Strain 1 mm/m Comp. Strain	No reported impacts
West Cliff LW5A3, LW5A4 and LW29 to LW36	3.4	1300 mm Subsidence 1.3 mm/m Tensile Strain 5.5 mm/m Comp. Strain (Measured B-Line)	Survey, visual, OTDR, SBS. No reported impacts.

Note: SBS is a method of monitoring optical fibres and means Stimulated Brillouin Scattering

6.10.4. Impact assessments for copper telecommunications cables

The copper telecommunications cables are direct buried and could, therefore, potentially be impacted by ground strains. The greatest potential for impacts will occur as the result of localised ground strains due to non-conventional movements or valley related movements.

The copper cables are more likely to be impacted by tensile strains rather than compressive strains. It is possible, that the direct buried cables could experience higher tensile strains where they are anchored to the ground by associated infrastructure, or by tree roots. The cables could also experience higher compressive strains at the creek crossings as the result of valley related movements.

Aerial copper telecommunications cables are generally not affected by ground strains, as they are supported by the poles above ground level. The aerial cables, however, could be affected by the changes in bay lengths, i.e. the distances between the poles at the levels of the cables, which result from mining induced differential subsidence, horizontal ground movements and lateral movements at the tops of the poles due to tilting of the poles. The stabilities of the poles can also be affected by mining induced tilts and by changes in the catenary profiles of the cables.

Longwalls in the Southern Coalfield have been successfully mined directly beneath copper telecommunications cables, where the magnitudes of the predicted mine subsidence movements were similar to those predicted within the *Subsidence Study Area*. Some of these cases have been summarised in Table 6.22.

Table 6.22 Examples of mining beneath copper telecommunications cables

Colliery and Longwalls	Length of copper cables directly mined beneath (km)	Observed maximum movements at the copper cables	Observed impacts
Appin LW301 and LW302	0.8	650 mm Subsidence 1 mm/m Tensile Strain 3 mm/m Comp. Strain (Measured M & N-Lines)	No adverse impacts
Appin LW401 to LW409	4 km of underground cables and 0.8 km of aerial cables	700 mm Subsidence 5 mm/m Tilt 1 mm/m Tensile Strain 2 mm/m Comp. Strain (Measured A6000-Line)	No adverse impacts
Appin LW702 to LW705	8.3	1200 mm Subsidence 2.1 mm/m Tensile Strain 4.5 mm/m Comp. Strain (Measured HW2, ARTC and MPR Lines)	No adverse impacts
Tahmoor Mine LW22 to LW30	43.1 km of underground cables and 4.9 km of aerial cables	1300 mm Subsidence 12 mm/m Tilt 3.2 mm Tensile Strain 2 mm (typ.) and up to 7 mm/m Comp. Strain (Extensive street monitoring)	No adverse impacts to underground cables. Some pole tilts and cable catenaries adjusted. Some consumer cables were re-tensioned as a precautionary measure
West Cliff LW29 to LW36	13.9 km of underground cables	1300 mm Subsidence 1.3 mm/m Tensile Strain 5.5 mm/m Comp. Strain (Measured B-Line)	No adverse impacts

It can be seen from the above table, that there were no reported impacts on the direct buried copper telecommunications cables in the above examples. It is expected that the mining during the proposed development will result in similar experiences.

6.10.5. Impact assessments for NBN telecommunications tower

The NBN telecommunications tower is expected to experience subsidence during the extraction of proposed LWs S4A and S6A. The tower is a single pole structure and its structural integrity is unlikely to be adversely affected by the extraction of the proposed longwalls. The predicted tilts of 2.5 mm/m, while small, may affect the operation of the antennae on the structure.

The tilts can be readily adjusted by either relevelling the pole or the individual antennae, if required.

It is recommended that Tahmoor Coal consult with NBN regarding the tower to manage potential impacts on the tower and its operations.

6.10.6. Management of potential impacts on telecommunications infrastructure

Tahmoor Coal has developed Subsidence Management Plans in consultation with Telstra for the existing longwalls at Tahmoor Mine to manage potential impacts on telecommunications infrastructure.

It is recommended that similar Subsidence Management Plans be developed in consultation with Telstra, NBN and TPG to manage potential impacts on the telecommunications infrastructure within the *Subsidence Study Area*.

With appropriate management plans in place, it is considered that potential impacts on the telecommunications infrastructure can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

6.11. Dams, reservoirs or associated works

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 provided water to the surrounding townships. It is now heavily silted and is no longer used for water supply. Water retained by the weir is released at its base through a seized open valve and outlet pipe. No impacts were reported on the Picton Weir during the mining of previously extracted Longwalls 14 to 19, the closest of which was approximately 1.5 kilometres from the Weir (Longwall 19).

The Picton Weir is located approximately 940 metres from LW S6A. At this distance the Weir could experience very small far-field horizontal movements. While the Weir may experience very small differential horizontal movements as a result of the extraction of the proposed longwalls, it is extremely unlikely that the Picton Weir would be adversely impacted by the proposed mining.

It is recommended that Tahmoor Coal, in consultation with relevant government agencies, study the potential for impacts to the Picton Weir and develop management measures to ensure that it remains safe throughout the mining period and that impacts on the Picton Weir do not result in environmental consequences on the Bargo River. The study would require input from structural, geotechnical and subsidence engineers. The management measures may include a combination of:

- Mitigation or strengthening measures prior to mining;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements;
- Conduct regular visual inspections of the Picton Weir; and
- Implement planned responses if triggered by monitoring and inspections.

As Tahmoor Mine will progressively approach the Picton Weir, it will be possible to review observations during the mining of each longwall and adjust the mine plan, if necessary to reduce the potential for impacts on Picton Weir. Picton Weir is also located beyond the finishing ends of the longwalls and it will be possible to stop the longwall during mining, if necessary based on actual observations during mining.

With an appropriate management plan in place, it is considered that the Picton Weir will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

6.12. Survey control marks

The locations of the survey control marks in the vicinity of the proposed longwalls are shown in Drawing No. MSEC1192-21. The locations and details of the survey control marks were obtained from Spatial Services using the *SCIMS Online* website (SCIMS, 2013).

The survey control marks are located across the *Subsidence Study Area* and, therefore, are expected to experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

The survey control marks located outside and in the vicinity of the *Subsidence Study Area* are also expected to experience small amounts of subsidence and small far-field horizontal movements. It is possible that other survey control marks outside the immediate area could also be affected by far-field horizontal movements, up to 3 kilometres outside the *Subsidence Study Area*. Far-field horizontal movements and the methods used to predict such movements are described further in Sections 3.5 and 4.6.

6.12.1. Recommendations for the survey control marks

In accordance with the Surveying and Spatial Information Act (2002) and the Surveyor-General's Direction No. 11 (2017), Tahmoor Coal is required to make a POSI application to disturb the survey control marks.

It will be necessary on the completion of the longwalls, when the ground has stabilised, to re-establish any state survey control marks that are required for future use. Consultation between Tahmoor Coal and Spatial Services NSW will be required throughout the mining period to ensure that these survey marks are reinstated at an appropriate time, as required.

A number of public amenities have been identified within the Study Area and their locations are shown in Drawing No. MSEC1192-19.

7.1. Predictions and impact assessments for each public amenity

The public amenities within the *Subsidence Study Area* are spread over the proposed longwall mining area. The structures will collectively experience a range of subsidence movements varying from very small movements, where longwalls do not extract directly beneath them, to the maximum movements directly above the proposed longwalls. In a small proportion of cases, non-conventional subsidence movements will develop on the surface and these may coincide with the structures.

The maximum predicted values of conventional subsidence, tilt and curvature, based on the proposed LWs S1A to S6A, are provided in Table D.08, in Appendix D.

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at points located around the perimeter of each structure, as well as at points located at a distance of 20 metres from the perimeter of each public amenity.

The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures provided in this table are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

7.2. Methods of impact assessment

Some public amenities are of similar size and construction to houses and the method of assessment adopted for houses has been applied to these public amenities, the results of which are summarised in Appendix C.

Other public amenities are substantial in size and the method of assessment for houses is not applicable. The potential for impacts to these structures has been assessed on a case by case basis.

7.3. Hospitals

There are no hospitals within the *Subsidence Study Area*.

7.4. Places of worship

There are no places of worship within the *Subsidence Study Area*.

7.5. Schools

The Wollondilly Anglican College is located within the *Subsidence Study Area* and its location is shown in Drawing No. MSEC1192-19.

The Wollondilly Anglican College is located on Remembrance Drive opposite Tahmoor Mine, directly above and beyond the finishing end of proposed LW S1A. The structures have been constructed in stages from 2003 to 2020. Photographs of some of the buildings are provided in Fig. 7.1 to Fig. 7.11.



Fig. 7.1 Wollondilly Anglican College – Clifford Warne Auditorium



Fig. 7.2 Wollondilly Anglican College – Clifford Warne Auditorium with articulation joints in brick wall



Fig. 7.3 Wollondilly Anglican College – Banks Cottage and Sturt Cottage (single storey)



Fig. 7.4 Wollondilly Anglican College – Elizabeth Cottage (two-storey)



Fig. 7.5 Wollondilly Anglican College – Example of brickwork details



Fig. 7.6 Wollondilly Anglican College – Example of equipment inside Bradfield Cottage



Fig. 7.7 Wollondilly Anglican College – Hospitality training facilities inside TTC



Fig. 7.8 Wollondilly Anglican College – Lift in Cuthbert Cottage



Fig. 7.9 Wollondilly Anglican College – Shoulder to Shoulder Shelter



Fig. 7.10 Wollondilly Anglican College – Footbridge



Fig. 7.11 Wollondilly Anglican College – Sewage treatment tanks

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.

As demonstrated by the photographs, the building structures are in good condition and have been designed to accommodate future subsidence movements. The brickwork is consistent across the buildings, with recessed yellow coloured brickwork beneath the window sills. Most of the windows have light-weight panelling above the window and door openings, which will reduce the potential for impacts (Fig. 7.5).

While the majority of the building consist of standard classrooms, there are some specialised rooms that contain manufacturing and hospitality training equipment. A passenger lift is located within Cuthbert Cottage, as shown in Fig. 7.8. The open air Shoulder to Shoulder Shelter has been constructed with structural steel portal frames, as shown in Fig. 7.9.

Small creeks drainage surface water at the rear of the campus. A steel footbridge crosses a creek to provide access to the Rev. John Flynn Collegiate. A photograph of the footbridge is shown in Fig. 7.10. The steel deck connects to the concrete pavements at each end of the bridge, where a small air gap is present to accommodate expansion and contraction of the deck in response to changes in temperature.

Wollondilly Anglican College has provided details of services infrastructure within the property. Reinforced concrete sewage treatment tanks are located at the rear of the campus, as shown in Fig. 7.11.

7.5.1. Predictions for school infrastructure

The maximum predicted values of conventional subsidence, tilt and curvature, based on the proposed LWs S1A to S6A, are provided in Table D.08, in Appendix D. A summary image overlaying the predicted subsidence contours over Wollondilly Anglican College is shown in Fig. 7.12.



Fig. 7.12 Predicted subsidence contours overlaid on aerial photograph of Wollondilly Anglican College

It can be seen from Fig. 7.12 that the majority of the school structures are predicted to experience less than 100 mm of vertical subsidence, with very small tilts and curvatures. One structure, the Auditorium, is partly located directly above the finishing end of proposed LW S1A. The Auditorium is predicted to experience 300 mm of vertical subsidence, with maximum tilt of 4 mm/m and hogging curvature of 0.05 km^{-1}.

As the Wollondilly Anglican College is adjacent to previously extracted Longwalls 14B to 19, the property may also experience additional subsidence as has been previously observed above similar unmined coal barriers, as discussed in Section 4.4.

Where longwalls have previously been extracted on either side of main headings, the amount of increased subsidence in these areas has been generally been between 50 and 150 mm of subsidence above what was predicted using the prediction model. Subsidence monitoring from previous situations has shown that the additional subsidence is usually accompanied by relatively low conventional tilts, curvatures and strains (less than 0.5 mm/m and usually within survey tolerance).

7.5.2. Impact assessments for school infrastructure

Whilst many of the school buildings are larger in size, the form of construction of the structures within the Wollondilly Anglican School are similar to other rural and residential structures in the area. There is extensive experience of mining directly beneath similar structures in the Southern Coalfield which indicates that the incidence of impacts on these structures is very low and the structures have remained in safe and serviceable conditions. This is not surprising as these structures are generally small in size and of light-weight construction, such that they are relatively flexible and ductile compared to masonry buildings.

Tahmoor Mine has mined directly beneath more than 2000 structures of similar construction during the mining of LWs 22 to 32 and LW W1-W3. It has managed the mining induced impacts with the implementation of suitable management strategies. The structures have remained safe and serviceable during mining.

The primary risk associated with mining beneath the school structures is public safety. Occupants of building structures have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mining at the depths of cover similar to those found within the *Subsidence Study Area*. This includes the recent experience at Tahmoor Mine, where longwall mining has occurred beneath more than 2000 houses and civil structures. Tahmoor Mine has successfully mined directly beneath public amenity structures during the extraction of Longwalls 22 to 32.

Emphasis is placed on the words “immediate and sudden” as in rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time (over a period of months or weeks rather than hours) to relocate occupants.

Given that the proposed longwalls do not mine directly beneath the majority of the school campus, the potential for impacts is considered to be relatively low. The building structures have been designed to accommodate mine subsidence parameters. The structures consist of steel or reinforced concrete frames and the external walls are generally well articulated, with flexible panelling above window and door openings.

While the potential for impacts on the health and safety of students and staff at the school is considered to be very low, there is a chance that some cracking may develop at the school in isolated locations. The most likely areas to experience cracking are long brick walls, including the rendered feature walls that are located on the campus. Trip hazards may also develop along footpaths.

Tahmoor Coal has commenced consultation with Wollondilly Anglican School and has engaged an experienced structural engineer to conduct a pre-mining hazard identification inspection to assess the potential for impacts on school infrastructure, taking into account the predicted subsidence movements. The inspection has been completed and the findings from the structural assessments will inform a risk assessment.

In the event that impacts occur, repairs can be undertaken outside school hours, on weekends or during school holidays, to minimise inconvenience to students and staff. Any impacts would be expected to be minor and develop gradually, allowing them to be repaired at a suitable time. In the extremely unlikely event that severe impacts develop, it would be possible to pause longwall extraction as it approaches the school to ensure that the school remains safe, serviceable and operational during and after the proposed mining.

Based on the above information, it is assessed that with the implementation of a robust subsidence management plan, the proposed longwalls can be extracted without impacting on the safety of students and staff, or affect the use of the buildings at any time for educational or other purposes.

7.5.3. Management of potential impacts on Wollondilly Anglican School

Tahmoor Coal has extensive experience in successfully managing potential impacts on critical public amenities, including Picton High School during the extraction of LW 32.

Tahmoor Coal will develop a Property Subsidence Management Plan in consultation with Wollondilly Anglican School to manage potential impacts on during the extraction of the proposed longwalls. The management measures will include a combination of:

- Pre-mining hazard identification inspection of each structure by structural engineer (complete);
- Consider the implementation of possible mitigation measures prior to mining to reduce the likelihood of severe impacts;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements around the school buildings, footbridge and sewage treatment tanks, and baseline measurements of sensitive classroom equipment;
- Conduct regular visual inspections of the building structures, and
- Implement planned responses if triggered by monitoring and inspections. Repairs would be completed outside school hours.

With an appropriate management plan in place, it is considered that potential impacts on the Wollondilly Anglican School can be managed during the extraction of the proposed longwalls, even if actual subsidence movements are greater than the predictions or substantial non-conventional movements occur.

7.6. Shopping centres

There are no shopping centres within the *Subsidence Study Area*. There are, however, a number of shops are located along Remembrance Drive within the *Subsidence Study Area* and the predictions and impact assessments for these establishments are provided in Section 9.1.

7.7. Community centres

With there are no community centres within the *Subsidence Study Area*.

7.8. Office buildings

There are no large commercial office buildings within the *Subsidence Study Area*. Small office buildings are located within the *Subsidence Study Area* and the predictions and impact assessments for these establishments are provided in Section 9.1.

7.9. Swimming Pools

There are no public swimming pools within the *Subsidence Study Area*.

7.10. Bowling greens

There are no bowling greens within the *Subsidence Study Area*.

7.11. Ovals or cricket grounds

A sportsground is located at the Wollondilly Anglican College. The oval, which is called the WACA, is located 260 metres from the end of proposed LW S2A. Given the offset distance from the proposed longwalls, it is not expected to experience impacts as a result of the proposed extraction.

Part of the oval is located above previously extracted LW 16 but was constructed well after mining had occurred. As the oval is located between previously extracted Longwalls 14B to 19 and the proposed LW S1A to S6A, the oval may also experience additional subsidence as has been previously observed above similar unmined coal barriers, as discussed in Section 4.4.

Where longwalls have previously been extracted on either side of main headings, the amount of increased subsidence in these areas has generally been between 50 and 150 mm of subsidence above what was predicted using the prediction model. Subsidence monitoring from previous situations has shown that the additional subsidence is usually accompanied by relatively low systematic tilts, curvature and strains (less than 0.5 mm/m and usually within survey tolerance).

With an appropriate management plan in place, it is considered that the oval will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

7.12. Racecourses

There are no racecourses within the *Subsidence Study Area*.

7.13. Golf courses

There are no golf courses within the *Subsidence Study Area*.

7.14. Tennis courts

There are two tennis courts within the *Subsidence Study Area* at the Wollondilly Anglican College. The courts are located 150 and 180 metres from the end of proposed LW S1A. Given the offset distance from the proposed longwalls, it is not expected to experience impacts as a result of the proposed extraction.

With an appropriate management plan in place, it is considered that the tennis courts will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

7.15. Any other public amenities

Australian Wildlife Sanctuary

The Australian Wildlife Sanctuary (formerly the Wirrimbirra Sanctuary) is located on Remembrance Drive and covers an area of approximately 95 ha. 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.

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.

The Australian Wildlife Sanctuary structures are located above LWs S3A and S4A near Teatree Hollow and the Main Southern Railway Line and will be directly mined beneath by the proposed longwalls. Predictions of subsidence, tilt and curvature have been provided for the identified structures within the Australian Wildlife Sanctuary in Table D.08, in Appendix D.

The visitor centre and surrounding structures are located directly above a chain pillar between LWs S3A and S4A. These structures will, therefore, experience slightly reduced subsidence, tilt and curvature compared to locations that are closer to the centre of LW S4A where greater subsidence movements typically occur.

The structures were inspected by John Matheson of JMA Solutions in January 2020. The structures generally comprise timber-framed structures with metal-clad timber-framed rooves on reinforced concrete ground slabs. The structures were found to be in serviceable condition. A photograph of the visitor centre is shown in Fig. 7.13.



Fig. 7.13 Australian Wildlife Sanctuary visitor centre

The nature and footprint size of structures within the Australian Wildlife Sanctuary are similar to other rural and residential structures in the area. There is extensive experience of mining directly beneath similar structures in the Southern Coalfield which indicates that the incidence of impacts on these structures is very low and the structures have remained in safe and serviceable conditions. This is not surprising as these structures are generally small in size and of light-weight construction, such that they are relatively flexible and ductile compared to masonry buildings.

Tahmoor Mine has mined directly beneath more than 2000 structures of similar construction during the mining of Longwalls 22 to 32. It has managed the mining induced impacts with the implementation of suitable management strategies. The structures have remained safe and serviceable during mining.

If impacts occur, they will most likely consist of non-structural cracking of walls, concrete floors or ceilings. There remains a small probability (less than 2 %), however, that a structure may experience severe impacts as result of substantial non-conventional movements. If impacts occur to heritage listed properties, the damage can be repaired in consultation with a heritage consultant to ensure that the heritage value of the structure is restored.

The primary risk associated with mining beneath the public amenity structures is public safety. Occupants of building structures have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mining at the depths of cover similar to those found within the *Subsidence Study Area*. This includes the recent experience at Tahmoor Mine, where longwall mining has occurred beneath more than 2000 houses and civil structures. Tahmoor Mine has successfully mined directly beneath public amenity structures during the extraction of Longwalls 22 to 32.

Emphasis is placed on the words “immediate and sudden” as in rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time (over a period of months or weeks rather than hours) to relocate occupants.

The Dingo Sanctuary Bargo is located on the same property as the Australian Wildlife Sanctuary but is managed separately. The dingos reside in a fenced enclosure with small structures. It is unlikely that dingo enclosure and associated structures will experience adverse impacts due to the extraction of the proposed longwalls. It is important, however, that integrity of the fences be monitored during periods of active subsidence, so that potential impacts can be readily repaired.

Tahmoor Coal has developed a draft Property Subsidence Management Plan to manage potential impacts on the Australian Wildlife Sanctuary. The management plan is currently being considered by Australian Wildlife Sanctuary as part of the consultation process. The management measures include a combination of:-

- Pre-mining hazard identification inspection of each structure by structural engineer (complete);
- Consider the implementation of possible mitigation measures prior to mining to reduce the likelihood of severe impacts (complete);
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements around the visitor centre;
- Conduct regular visual inspections of the building structures and the adjacent Dingo Sanctuary; and
- Implement planned responses if triggered by monitoring and inspections. Repairs to heritage structures would be planned in consultation with a heritage consultant.

With an appropriate management plan in place, it is considered that the Australian Wildlife Sanctuary will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

Bargo Cemetery

The Bargo Cemetery is managed by Wollondilly Shire Council. It is located at the northern end of Great Southern Road directly above the south-eastern end of the proposed LW 5SA, as shown in Drawing No. MSEC1192-19. The Cemetery is expected to experience less than the maximum predicted movements as provided in Table 4.1. Non-conventional subsidence movements may also develop at the cemetery.

The small cemetery is surrounded by a plantation of mature trees (Tahmoor Coal, 2022d). The grave sites and tombstones are in various condition and some graves do not have tombstones. The tombstones are generally of low height. The grounds are grassed and well kept. The cemetery is listed as an item of Heritage Significance.

The grave sites consist of isolated concrete and stone structures that are typically placed on the natural ground surface with minimal foundations. Due to their small sizes, the sites are expected to accommodate normal conventional subsidence movements. Impacts may occur, however, if substantial non-conventional movements developed at the cemetery. This may result in cracking of the surrounds or displacement of tombstones relative to the graves. Non-conventional movements are localised in nature and should substantial non- conventional movements develop at the cemetery, it is extremely unlikely that they will affect every grave site.

It is recommended that Tahmoor Coal consult with Wollondilly Shire Council to develop a subsidence management plan.

With an appropriate management plan in place, it is considered that the grave sites can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

The following sections provide the descriptions, predictions and impact assessments for the farm land and farm facilities within the *Subsidence Study Area*.

8.1. Agricultural utilisation

The agricultural land classification types within the *Subsidence Study Area* are illustrated in Fig. 8.1.

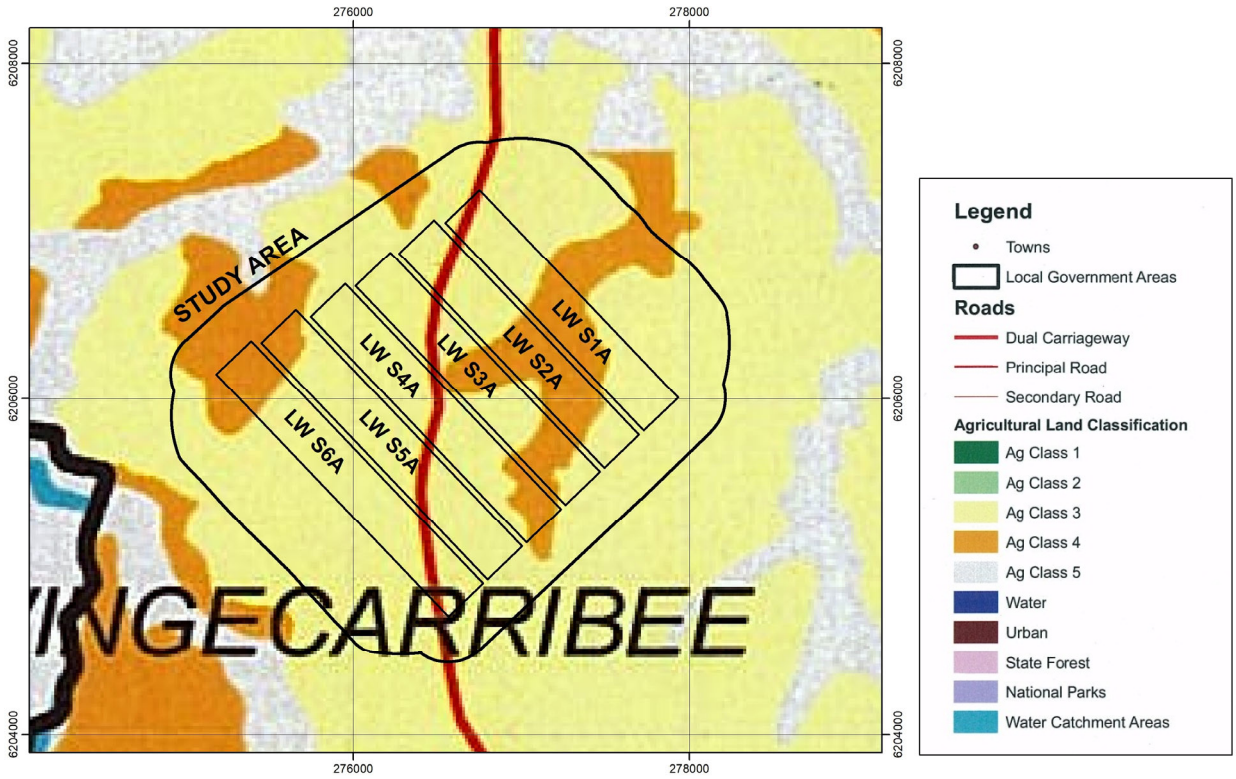


Fig. 8.1 Agricultural Land Classification within the Subsidence Study Area (Source DTIRIS, November 2008)

The above figure shows that there are two main agricultural land classification types within the *Subsidence Study Area*, which are:-

- Class 3 – Grazing land or land well suited to pasture improvement; and
- Class 4 – Land suitable for grazing but not for cultivation.

The flatter areas of land within the *Subsidence Study Area* have been predominately cleared and are used for light agricultural and residential purposes. The deeper valleys within the *Subsidence Study Area* have generally not been cleared of the natural vegetation.

Further information is included in the Land Management Plan (Tahmoor Coal, 2022b).

8.2. Rural structures

8.2.1. Descriptions of the rural structures

The locations of the rural structures (Structure Type R) within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-18.

There are 441 rural structures which have been identified within the *Subsidence Study Area*, of which 62 % will be mined directly beneath by the proposed longwalls. The rural structures include sheds, garages, carports, gazebos, pergolas, greenhouses, shade structures and other non-residential structures. The locations and sizes of the rural structures were determined from aerial photographs of the area.

8.2.2. Predictions for rural structures

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at the vertices of each rural structure, as well as at eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped structure, predictions have been made at a minimum of 45 points within and around the structure.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each rural structure within the *Subsidence Study Area* is provided in Table D.04, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Distributions of the maximum predicted conventional subsidence, tilt and curvature for the rural structures within the *Subsidence Study Area* are illustrated in Fig. 8.2 and Fig. 8.3.

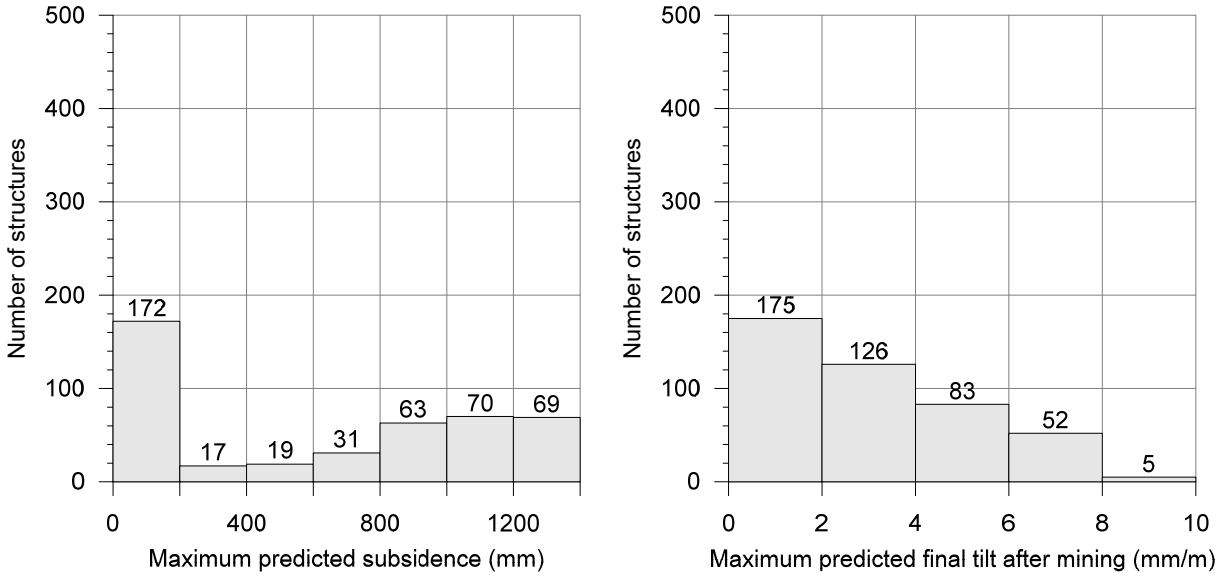


Fig. 8.2 Maximum predicted conventional subsidence and tilt for rural structures within the Subsidence Study Area

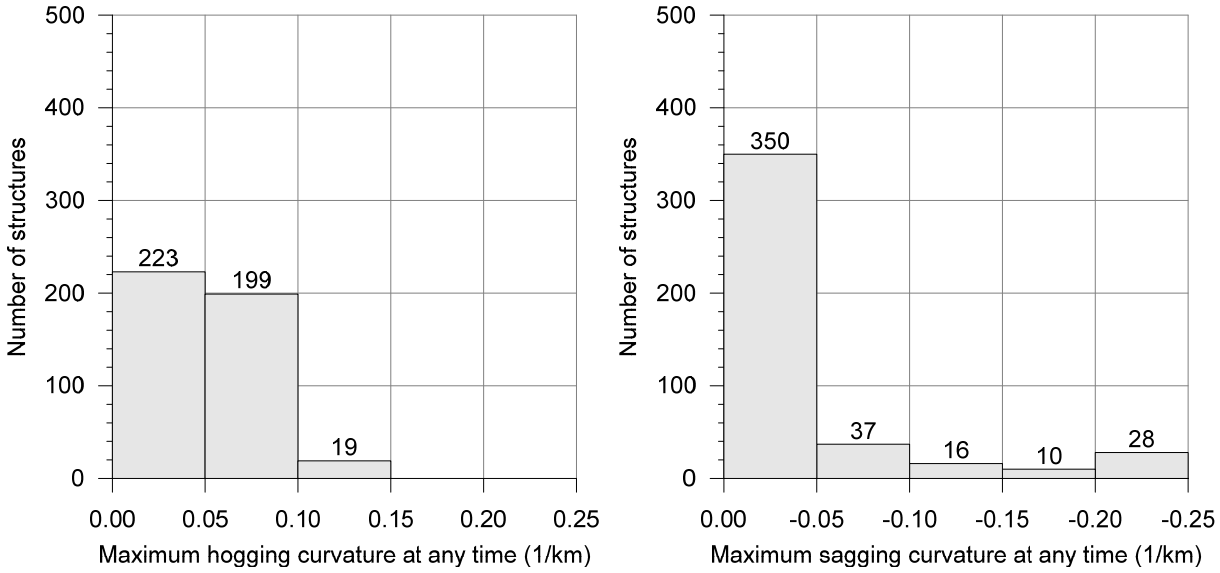


Fig. 8.3 Maximum predicted conventional hogging curvature (left) and sagging curvature (right) for rural structures within the Subsidence Study Area

The maximum predicted conventional curvatures for the rural structures are 0.11 km^{-1} hogging and 0.23 km^{-1} sagging, which equate to minimum radii of curvature of 9.1 kilometres and 4.3 kilometres, respectively. The maximum predicted conventional strains for the rural structures, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.7 mm/m tensile and 3.5 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The rural structures are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

8.2.3. Impact assessments for rural structures

The maximum predicted tilt for the rural structures is 9 mm/m (i.e. 0.9 %), which represents a change in grade of 1 in 111. The majority of the rural structures within the *Subsidence Study Area* are of lightweight construction and able to tolerate mining-induced tilt. It has been found from past longwall mining experience that tilts of the magnitudes predicted within the *Subsidence Study Area* generally do not result in adverse impacts on rural structures. Some minor serviceability impacts could occur at the higher levels of predicted tilt, including door swings and issues with roof and pavement drainage, all of which can be remediated using normal building maintenance techniques.

There is extensive experience of mining directly beneath rural structures in the Southern Coalfield which indicates that the incidence of impacts on these structures is very low and the structures have remained in safe and serviceable conditions. This is not surprising as rural structures are generally small in size and of light-weight construction, which makes them less susceptible to impact than houses which are typically more rigid.

Tahmoor Mine has mined directly beneath more than 2000 rural structures of similar construction during the mining of LWs 22 to 32 and LW W1-W3. It has managed the mining induced impacts with the implementation of suitable management strategies. The structures have remained safe and serviceable during mining.

Whilst the predicted subsidence parameters for the proposed longwalls are greater than those at Tahmoor North, it would still be expected that the rates of impact would be low and could be managed with the implementation of suitable management strategies. Impacts on rural structures have been successfully managed elsewhere in the NSW Coalfields, where the predicted subsidence parameters were similar to or greater than those predicted for the proposed longwalls.

Based on previous experiences, it is expected that the rural structures within the *Subsidence Study Area* would remain safe and serviceable during the mining period, provided that they are in sound existing condition. The risk of impact is clearly greater if the structures are in poor existing condition, though the chances of there being a public safety risk remains very low. A number of rural structures which were in

poor existing condition have been directly mined beneath and these structures have not experienced impacts during mining.

Impacts on the rural structures that occur as the result of the extraction of the proposed longwalls are expected to be remediated using well established building techniques. With these remediation measures available, it is unlikely that there would be long term impacts on rural structures resulting from the extraction of the proposed longwalls.

8.2.4. Impact assessments for rural structures based on increased predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the maximum tilt at the rural structures would be 18 mm/m (i.e. 1.8 %), or a change in grade of 1 in 56. In this case, the incidence of serviceability impacts, such as door swings and issues with gutter and pavement drainage, would increase in the locations of greatest tilt, such as adjacent to the active longwall maingate and adjacent to the ends of the proposed longwalls. It would still be unlikely that stabilities of these rural structures would be affected by tilts of these magnitudes.

If the actual curvatures exceeded those predicted by a factor of 2 times, the incidence of impacts would increase for the rural structures located directly above the proposed longwalls. Since rural structures are generally small in size and of light-weight construction, they would still be expected to remain safe, serviceable and repairable using normal building maintenance techniques. With the implementation of any necessary remediation measures, it is unlikely that there would be any substantial long-term impacts on the rural structures.

While the predicted ground movements are important parameters when assessing the potential impacts on the rural structures, it is noted that the impact assessments were primarily based on historical observations from previous longwall mining in the Southern Coalfield. The overall levels of impact on the rural structures, resulting from the extraction of the proposed longwalls, are expected to be similar to those observed where longwalls have previously mined directly beneath rural structures in the Southern Coalfield.

8.2.5. Management of potential impacts on rural structures

Tahmoor Coal has developed and acted in accordance with a risk management plan to manage potential impacts to farm buildings during the mining of LWs 22 to 32 and LWs W1-W3. The management plan provides for identification of buildings in poor pre-mining condition that are hazardous or may become hazardous due to mining, and monitoring of structures during active subsidence. If impacts occur, the structure will be repaired in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts on rural structures during the mining of the proposed longwalls.

With an appropriate management plan in place, it is considered that rural structures can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

8.3. Tanks

8.3.1. Descriptions of the tanks

The locations of the tanks (Structure Type T) within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-18.

There are 74 tanks which have been identified within the *Subsidence Study Area*, just less than half of which will not be mined directly beneath by the proposed longwalls. The locations and sizes of the tanks were determined from aerial photographs of the area and kerb side inspections. There are also a number of smaller rainwater tanks associated with the houses which are not shown in these drawings.

8.3.2. Predictions for the tanks

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at points located around the perimeter of each tank, as well as at points located at a distance of 20 metres from the perimeter of each tank.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each tank within the *Subsidence Study Area* is provided in Table D.05, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures provided in this table are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Distributions of the maximum predicted conventional subsidence, tilt and curvature for the tanks within the *Subsidence Study Area* are illustrated in Fig. 8.4 and Fig. 8.5.

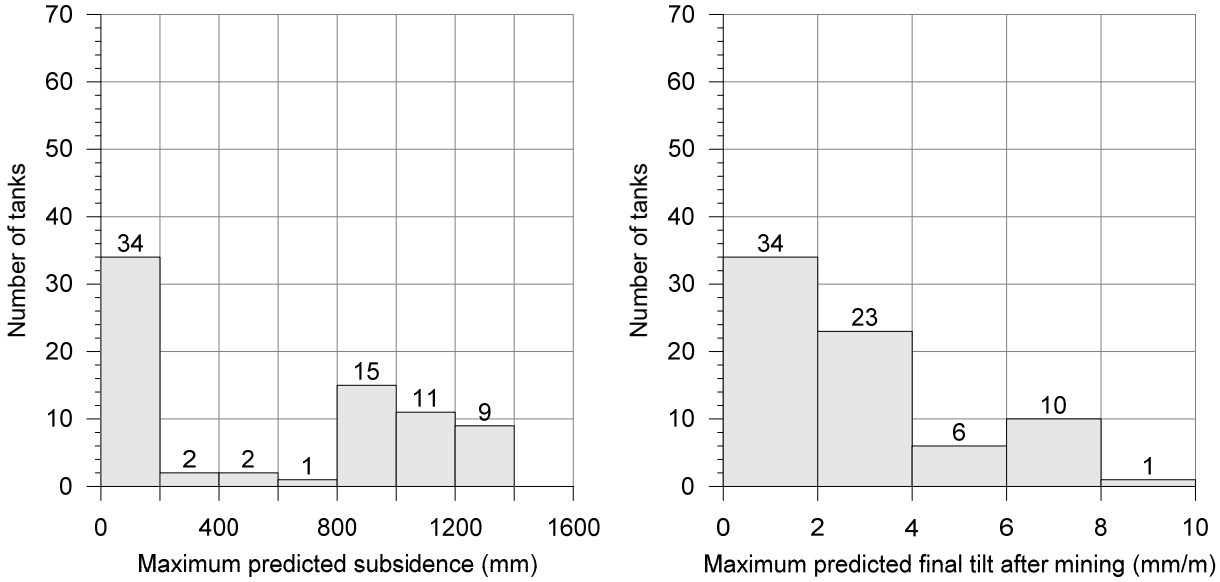


Fig. 8.4 Maximum predicted conventional subsidence and tilt for tanks within the Subsidence Study Area

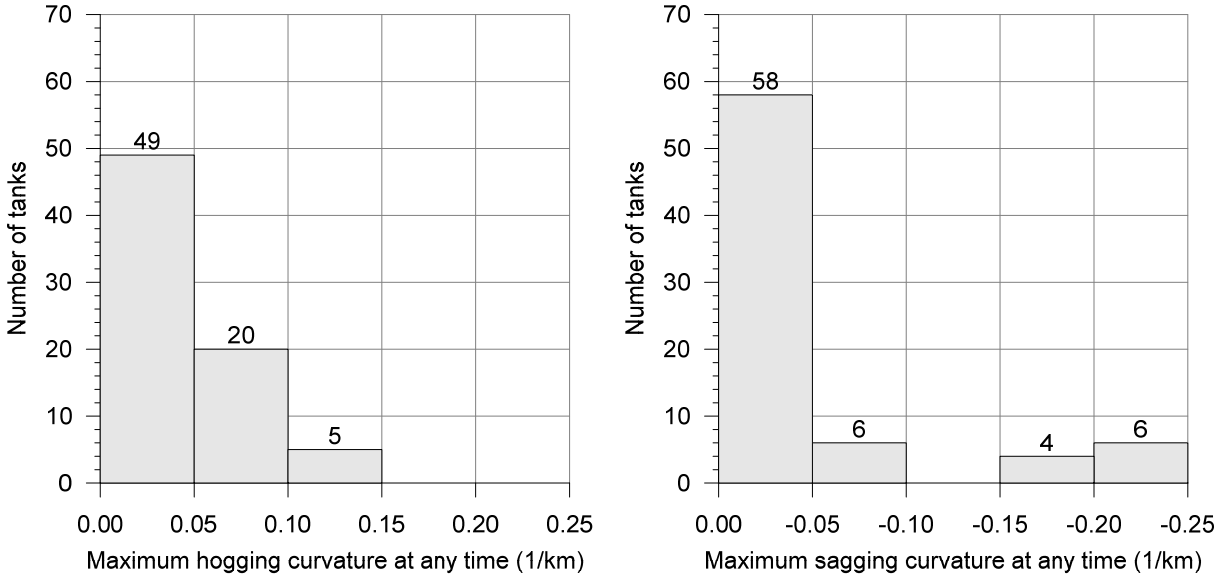


Fig. 8.5 Maximum predicted conventional hogging curvature (left) and sagging curvature (right) for tanks within the Subsidence Study Area

The maximum predicted conventional strains for the tanks, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.7 mm/m tensile and 3.3 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The tanks are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

8.3.3. Impact assessments for the tanks

Tilt can potentially affect the serviceability of tanks by altering the water levels in the tanks, which can in turn affect the minimum level of water which can be released from the outlets. The maximum predicted conventional tilt for the tanks within the *Subsidence Study Area* is 9 mm/m (i.e. 0.9 %), which represents a change in grade of 1 in 111. The predicted changes in grade are small and unlikely, therefore, to result in any adverse impacts on the serviceability of the tanks.

The tanks are typically constructed above ground level and, therefore, are unlikely to experience the curvatures and ground strains resulting from the extraction of the proposed longwalls. It is possible that any buried water pipelines associated with the tanks within the *Subsidence Study Area* could be impacted by the ground strains, if they are anchored by the tanks, or by other structures in the ground.

Any impacts are expected to be of a minor nature, including leaking pipe joints, and could be easily repaired. With these remedial measures in place, it would be unlikely that there would be any adverse impacts on the pipelines associated with the tanks.

8.3.4. Impact assessments for the tanks based on increased predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the maximum tilt at the tanks would be 18 mm/m (i.e. 1.8 %), or a change in grade of 1 in 56. In this case, the incidence of serviceability impacts, such as changes in the minimum water levels which can be released from the outlets, could increase in the locations of greatest tilt, such as adjacent to the active longwall maingate and adjacent to the ends of the proposed longwalls. Impacts would be expected to be remediated by relevelling the tanks.

If the actual curvatures exceeded those predicted by a factor of 2 times, the incidence of impacts on the tank structures would not be expected to change substantially, as they are not expected to experience these ground movements. The incidence of impacts on the buried pipelines would, however, be expected to increase in the locations directly above the proposed longwalls. Impacts would still be expected to be of a minor nature which could be easily repaired. With these remediation measures in place, it would be unlikely that there would be long term impacts on the pipelines associated with the tanks.

8.3.5. Management of potential impacts on the tanks

Tahmoor Coal has developed and acted in accordance with a risk management plan to manage potential impacts to tanks during the mining of LWs 22 to 32 and LWs W1-W3. The management plan provides for identification of tanks in poor pre-mining condition that are hazardous or may become hazardous due to mining, and monitoring of structures during active subsidence. If impacts occur, the structure will be repaired in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts on tanks during the mining of the proposed longwalls.

With an appropriate management plan in place, it is considered that tanks can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

8.4. Gas and fuel storages

A number of the residences within the *Subsidence Study Area* have gas or fuel storages.

The domestic gas and fuel storages are located across the *Subsidence Study Area* and, therefore, are expected to experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

The storage tanks are generally elevated above ground level and, therefore, are not susceptible to mine subsidence movements. It is possible, however, that any buried gas pipelines associated with the storage tanks within the *Subsidence Study Area* could be impacted by the curvatures and ground strains, if they are anchored by the storage tanks, or by other structures in the ground.

Impacts are expected to be of a minor nature, including minor gas leaks, which could be easily repaired. It is unlikely that there would be any adverse impacts on the pipelines associated with the gas and fuel storage tanks, even if the actual movements exceeded the predictions by a factor of 2 times.

8.5. Poultry sheds

There are 21 poultry sheds within the *Subsidence Study Area*. The poultry sheds are lightweight structures up to 113 metres in length.

The Inghams Bargo Chicken Breeder Complex Production Complex is located on Remembrance Drive, beyond the finishing ends of LWs S2A and S3A (MSEC Ref. BRE_030). The Inghams Turkey Farm (MSEC Ref. BYR_065) and Bargo Valley Produce poultry sheds, which are leased to Inghams (MSEC Ref. BYR_055) are located on Yarran Road, to the side of LW S6A. Part of one shed at Bargo Valley Produce is located directly above LW S6A.

8.5.1. Predictions for the poultry sheds

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at points located around the perimeter of each poultry shed, as well as at points located at a distance of 20 metres from the perimeter of each poultry shed.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each poultry shed within the *Subsidence Study Area* is provided in Table D.10, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures provided in this table are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

The poultry sheds are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

8.5.2. Impact assessments for the poultry sheds

The poultry sheds are predicted to experience relatively mild conventional subsidence, tilt, curvatures and strains as the proposed LWs S1A to S6A do not mine directly beneath all but one of them. The maximum predicted conventional subsidence for the poultry sheds within the *Subsidence Study Area* is 325 mm.

Tilt can potentially affect the serviceability of poultry sheds by altering the watering and drainage systems in the sheds. The maximum predicted conventional tilt for the poultry sheds within the *Subsidence Study Area* is 3.5 mm/m (i.e. 0.35 %), which represents a change in grade of 1 in 285. The predicted changes in grade are small and unlikely, therefore, to result in any adverse impacts on the serviceability of the poultry sheds.

Mining-induced curvature and ground strain can result in the opening of gaps or cracks in the wall linings of the poultry sheds. This may adversely affect their hygiene integrity, depending on the birds that are housed in them. The potential for impacts are, however, considered low as the proposed LWs S1A to S6A do not mine directly beneath all but one of the sheds.

A number of large poultry sheds have been previously mined beneath in the Southern Coalfield. West Cliff Longwalls 30 to 33, for example, mined directly beneath 40 poultry sheds and in all cases the structures remained in safe and serviceable condition. This included four sheds which experienced large non-conventional ground movements, due to near surface geological structures, which resulted in impacts to the walls and roofs of the sheds but did not result in the structures becoming unsafe.

It is expected that the predicted mine subsidence movements on the sheds and ancillary building structures can be managed by the implementation of suitable management strategies, which may include visual monitoring during active subsidence. The level of monitoring and management may vary depending on the type and age of bird in the sheds and the level of isolation that is required from the external environment.

8.5.3. Management of potential impacts on the poultry sheds

Tahmoor Coal has developed and acted in accordance with a risk management plan to manage potential impacts to commercial operations during the mining of LWs 22 to 32 and LWs W1-W3.

It is recommended that Tahmoor Coal continues its current practice of ensuring that the structures remain safe and serviceable at all times during mining and that impacts on business operations are minimised. It is recommended that Tahmoor Coal, in consultation with the owners of the poultry farms, study the potential for impacts on the poultry sheds and other infrastructure and develop management measures. The management measures may include a combination of:-

- Pre-mining hazard identification inspection of each structure by structural engineer;
- Consider the implementation of possible mitigation measures prior to mining to reduce the likelihood of severe impacts;

- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements;
- Conduct regular visual inspections of the poultry farms; and
- Implement planned responses if triggered by monitoring and inspections.

With an appropriate management plan in place, it is considered that poultry farms will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occur.

8.6. Glass houses

No glass houses have been identified within the *Subsidence Study Area*, though there are a number of greenhouses and hothouses. These structures are expected to experience the full range of predicted subsidence movements. As these structures are relatively lightweight in construction, they are usually able to tolerate differential subsidence movements. Impacts can occur, for example, if the roof materials are designed to be slid open or closed to ventilation the greenhouse or hothouse, as substantial differential horizontal movements can cause the frames to rack and prevent sliding of the materials.

It is expected that the predicted mine subsidence movements on the greenhouses and hothouses can be managed in consultation with the landowner by the implementation of suitable management strategies, which may include visual monitoring during active subsidence.

8.7. Hydroponic systems

There are no known hydroponic systems within the *Subsidence Study Area*. However, there are a number of greenhouses and hothouses. These buildings may have hydroponic systems. While the water pipes are usually flexible and able to tolerate differential subsidence movements, the drainage of the systems may require monitoring and adjustment, if necessary.

It is expected that the predicted mine subsidence movements on the hydroponic systems can be managed in consultation with the landowner by the implementation of suitable management strategies, which may include visual monitoring during active subsidence.

8.8. Irrigation systems

Irrigation systems are used on commercial and private properties with agricultural utilisation. Elevated troughs are located on Bargo Valley Produce on Yarran Road, to the side of LW S6A. Irrigation systems are usually constructed from polyethylene pipes which can tolerate ground movements much larger than the predicted mine subsidence movements within the *Subsidence Study Area*.

Elevated strains can occur in the pipelines where they are anchored to the ground, or where they are subjected to non-systematic ground movements. Impacts are expected to be minor, including leaking joints, which could be readily remediated.

8.9. Farm fences

Fences are located across the *Subsidence Study Area* and, therefore, are expected to experience the full range of predicted subsidence movements. A summary of the maximum predicted conventional subsidence movements within the *Subsidence Study Area* is provided in Chapter 4.

The fences are linear features and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. The analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.2 and the results are provided in Fig. 4.4.

Non-conventional movements can also occur and have occurred in the NSW Coalfields as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The fences within the *Subsidence Study Area* are constructed in a variety of ways, generally using either timber, brick or metal materials.

Wire fences can be affected by tilting of the fence posts and by changes of tension in the fence wires due to strain as mining occurs. These types of fences are generally flexible in construction and can usually tolerate tilts of up to 10 mm/m and strains of up to 5 mm/m without adverse impacts. It is possible, that some of the wire fences within the *Subsidence Study Area* could be impacted as the result of the extraction of the proposed longwalls. Any impacts on the wire fences are likely to be of a minor nature and relatively easy to remediate by re-tensioning the fencing wire, straightening the fence posts, and if necessary, replacing some sections of fencing.

Colorbond, brick and timber paling fences are more rigid than wire fences and, therefore, are more susceptible to impacts resulting from mine subsidence movements. It is possible that these types of fences could be impacted as the result of the extraction of the proposed longwalls. Any impacts on Colorbond, brick or timber paling fences can be remediated or, where necessary, affected sections of the fences replaced.

It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts on fences during the mining of the proposed longwalls.

8.10. Farm dams

8.10.1. Descriptions of the farm dams

The locations of the farm dams within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-18. The maximum plan dimensions and plan areas for these dams are provided in Table D.07, in Appendix D.

There are 45 farm dams (Structure Type D) which have been identified within the *Subsidence Study Area*. The locations and sizes of the farm dams were determined from aerial photographs of the area. The distributions of the longest lengths and surface areas of the farm dams within the *Subsidence Study Area* are shown in Fig. 8.6.

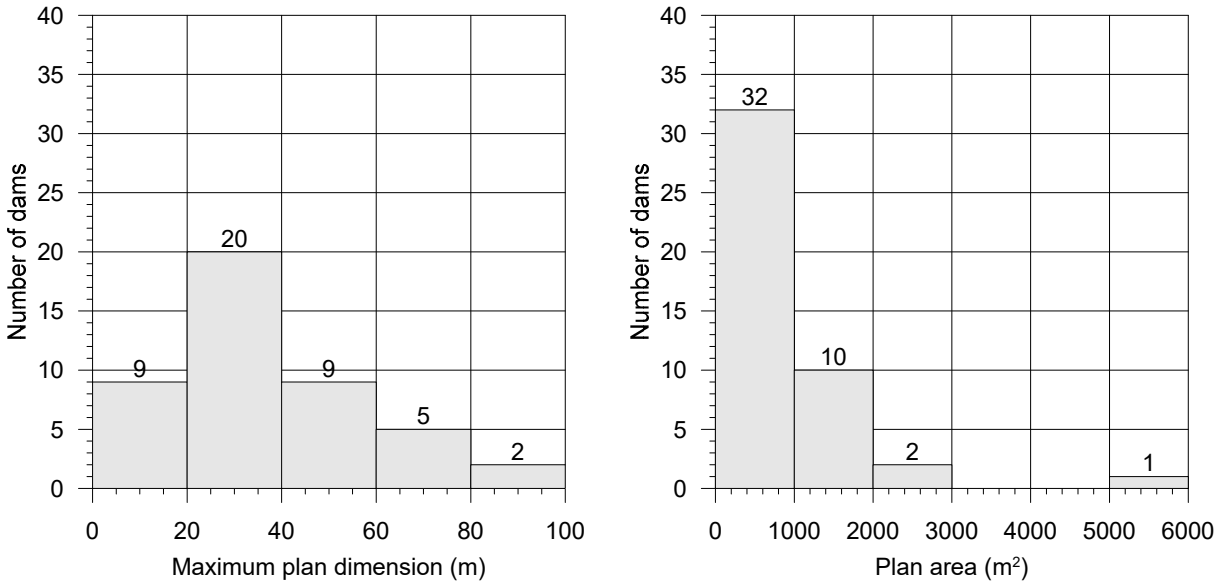


Fig. 8.6 Distributions of longest lengths and surface areas of the farm dams

The longest lengths of the farm dams within the *Subsidence Study Area* vary between 8 metres and 99 metres and the plan areas vary between 26 m^2 and 5,047 m^2.

The dams are typically of earthen construction and have been established by localised cut and fill operations within the natural streams. The farm dams are generally shallow, with the dam wall heights generally being less than 3 metres.

8.10.2. Predictions for the farm dams

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and around the perimeters of each farm dam, as well as at points located at a distance of 20 metres from the perimeter of each dam.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each farm dam within the *Subsidence Study Area* is provided in Table D.07, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Distributions of the maximum predicted conventional subsidence, tilt and curvature for the farm dams within the *Subsidence Study Area* are illustrated in Fig. 8.7 and Fig. 8.8.

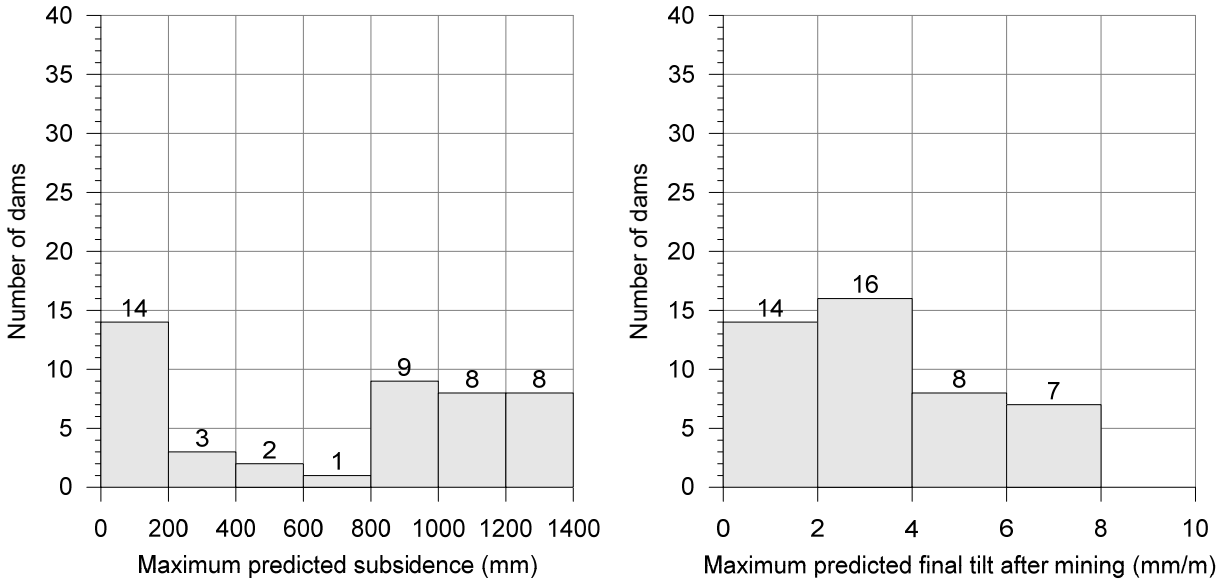


Fig. 8.7 Maximum predicted conventional subsidence and tilt for the farm dams within the Subsidence Study Area

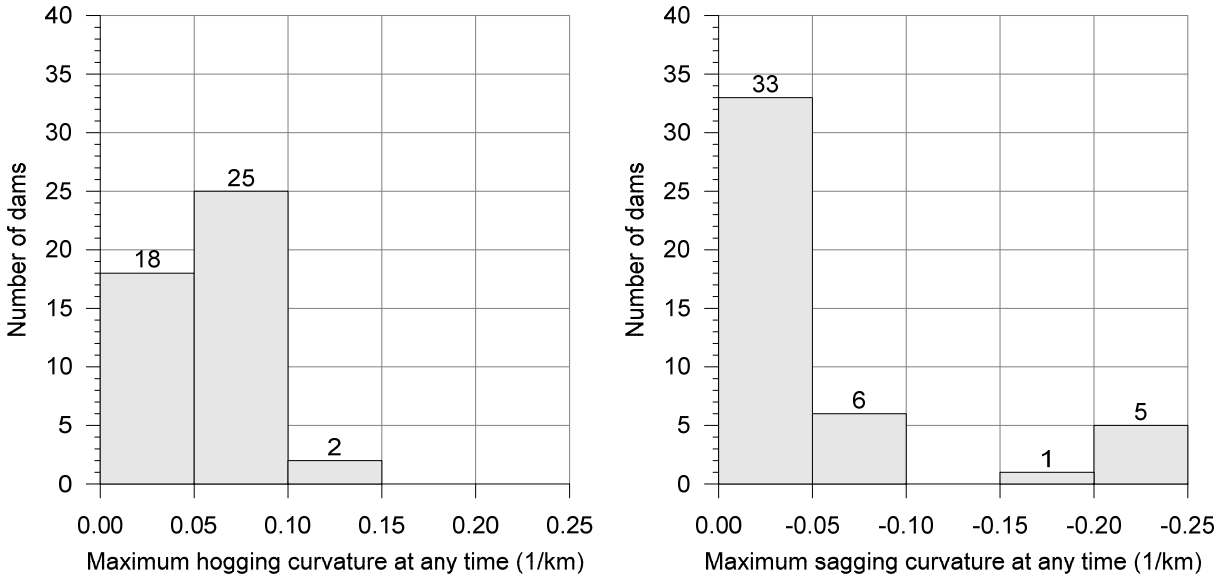


Fig. 8.8 Maximum predicted conventional hogging curvature (left) and sagging curvature (right) for the farm dams within the Subsidence Study Area

The maximum predicted conventional strains for the farm dams, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 2.0 mm/m tensile and 3.3 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The farm dams are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

The farm dams have typically been constructed within the streams and, therefore, may be subjected to valley related movements resulting from the extraction of the proposed longwalls. The equivalent valley heights at the dams are very small and it is expected, therefore, that the predicted valley related upsidence and closure movements at the dam walls would be much less than the predicted conventional subsidence movements and would not be substantial.

8.10.3. Impact Assessments for the farm dams

The maximum predicted final tilt for the farm dams is 7.5 mm/m (i.e. 0.75 %), which represents a change in grade of 1 in 133. Mining induced tilts can affect the water levels around the perimeters of farm dams, with the freeboard increasing on one side, and decreasing on the other. Tilt can potentially reduce the storage capacity of farm dams, by causing them to overflow, or can affect the stability of the dam walls.

The predicted changes in freeboard at the farm dams within the *Subsidence Study Area* were determined by taking the difference between the maximum predicted subsidence and the minimum predicted subsidence anywhere around the perimeter of each farm dam. The predicted maximum changes in freeboard at the farm dams within the *Subsidence Study Area*, after the completion of the proposed longwalls, are provided in Table D.07, in Appendix D, and are illustrated in Fig. 8.9.

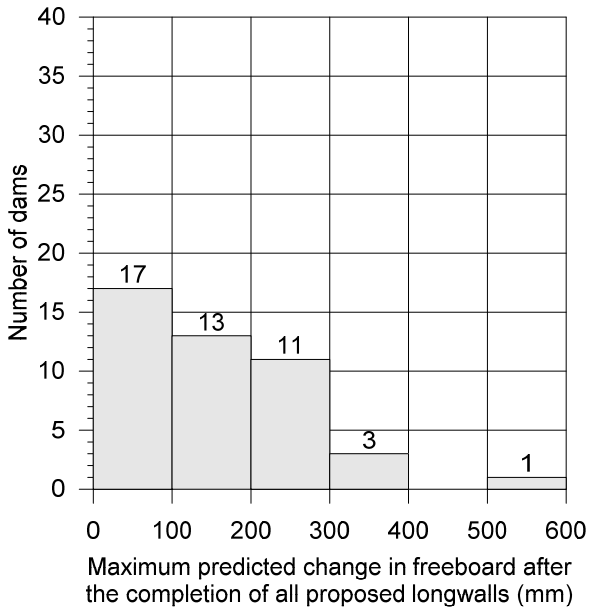


Fig. 8.9 Predicted changes in freeboards for the farm dams within the Subsidence Study Area

It can be seen from the above figure, that the predicted changes in freeboard are less than 300 mm at 41 dams within the *Subsidence Study Area* (i.e. 91 % of the total) and less than 400 mm at 44 dams (i.e. 98 % of the total). It is unlikely that the majority of the farm dams within the *Subsidence Study Area* would experience adverse impacts on the storage capacities due to these small changes in freeboard.

The predicted changes in freeboard are greater than 500 mm at 1 dam within the *Subsidence Study Area* (i.e. < 2 % of the total), with the maximum predicted change in freeboard being 500 mm. It is possible that this dam could experience a reduced storage level, however, this could be remediated by increasing the height of the affected dam wall.

The maximum predicted conventional curvatures for farm dams are 0.14 km^{-1} hogging and 0.22 km^{-1} sagging, which represent minimum radii of curvature of 7.1 kilometres and 4.5 kilometres, respectively. The predicted curvatures and strains could be sufficient to result in cracking in the bases and walls of some farm dams within the *Subsidence Study Area*.

There is extensive experience of mining directly beneath farm dams in the Southern Coalfield, which indicates that the incidence of impacts on these features is very low. Farm dams are commonly constructed with cohesive materials in the bases and walls which can absorb the conventional subsidence movements typically experienced in the Southern Coalfield without the development of substantial cracking. Non-conventional movements can result in localised cracking and deformations at the surface and, where coincident with farm dams, could result in adverse impacts.

Tahmoor Coal has mined LW22 to LW32 and LW W1-W3 beneath approximately 110 dams. While a small number of landowners have advised of impacts, there has been one claim to SA NSW for impacts on farm dams at the time of the report.

Similarly, South32 Illawarra Coal has mined directly beneath more than 200 farm dams in Appin Area 3, Appin Area 4, Appin Area 7, Appin Area 9 and West Cliff Area 5. Loss of water was reported for one dam in Appin Area 7, however, it was noted that this dam was of poor, shallow construction and seepage was observed at the base of the dam wall prior to mining.

Whilst the predicted subsidence parameters for the proposed longwalls are greater than those at Tahmoor North and at Appin and West Cliff Collieries, it would still be expected that the rates of impact on the farm dams would be very low and could be managed with the implementation of suitable management strategies.

Any substantial cracking in the dam bases or walls could be repaired by reinstating with cohesive materials. If any farm dams were to lose water as a result of mining, the mine would provide an alternative water source until the completion of repairs in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

8.10.4. Impact assessments for the farm dams based on increased predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the maximum tilt at the farm dams, at the completion of mining, would be 15 mm/m (i.e. 1.5 %), or a change in grade of 1 in 67. In this case, there would be 7 dams within the *Subsidence Study Area* (i.e. 16 % of the total) where the predicted change in freeboard was greater than 500 mm. In some cases, the tilts could be sufficient to reduce the capacities of the farm dams below acceptable levels, however, these could be remediated by increasing the heights of the affected dam walls.

If the actual curvatures or strains exceeded those predicted by a factor of 2 times, the likelihood and extent of cracking would increase for the farm dams located directly above the proposed longwalls. Any surface cracking would still be expected to be of a minor nature and could be readily repaired by reinstating with cohesive materials. If any farm dams were to lose water as a result of mining, the mine would provide an alternative water source until the completion of repairs in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

8.10.5. Management of potential impacts on the farm dams

Tahmoor Coal has developed and acted in accordance with a risk management plan to manage potential impacts to dams during the mining of LWs 22 to 32 and LWs W1-W3. This includes an assessment of potential environmental or safety consequences as a result of dam breach. The management plan provides for visual monitoring of dams immediately prior to and after active subsidence at each dam.

If impacts occur to the dams, Tahmoor Coal will supply water to the landowner on a temporary basis until the dam is repaired in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts on dams during the mining of the proposed longwalls, as part of the Land Management Plan.

With an appropriate management plan in place, it is considered that dams can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

8.11. Groundwater bores

The Groundwater Impact Assessment (SLR, 2022a) provides an assessment on groundwater bores.

9.1. Industrial, commercial and business establishments in general

A total of 143 structures are located within the *Subsidence Study Area* that are used for industrial, commercial or business purposes. The establishments include the Bargo Petroleum and Hill Top Pit Stop (petrol station, automotive repair workshop), Wreck1 (an auto wreckers yard), MKD Machinery (a concrete plant), Inghams poultry farms, Bargo Valley Produce facilities, the Canine Country Club and Cattery, Pamak Hobbies and garden railway and the Tahmoor Garden Centre. They also include mine infrastructure owned and operated by Tahmoor Mine.

The Bargo Waste Management Centre is located more than 1 kilometre from the proposed LWs S1A to S6A and will not experience mine subsidence as a result of the extraction of the proposed longwalls.

As shown in Drawing No. MSEC1192-19, most of the structures are located along either Remembrance Drive or Yarran Road.



Photograph courtesy JMA Solutions

Fig. 9.1 Tahmoor Garden Centre

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and around the perimeters of each structure, as well as at points located at a distance of 20 metres from the perimeter of each structure.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature and impact assessments for each structure within the *Subsidence Study Area* is provided in Table D.10, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Tahmoor Coal has previously developed and acted in accordance with risk management plans to successfully manage potential impacts to industrial, commercial and business establishments during the mining of LWs 22 to 32, including a turkey processing plant, a large shopping centre and a variety of shops.

Each business is unique in terms of the structures on the property and the activities that are conducted on each property.

Due to the unique nature of each business, it is recommended that individual subsidence management plans be developed in consultation with the owners of each business that are predicted to experience more than 20 mm of subsidence due to the extraction of the proposed longwalls. The management strategy for each business would include:

- Consultation with the owner of each business
- Pre-mining hazard identification inspection of each structure by structural engineer
- Identification and assessment of potential impacts to the operation of each business and safety of workers and the general public
- Consideration of mitigation measures to reduce risk prior to the commencement of subsidence movements
- Consideration of appropriate monitoring measures
- Consideration of appropriate triggered responses during mining
- Development of an agreed detailed subsidence management plan between Tahmoor Coal and the owners of each business

Each management plan would be reviewed periodically by Tahmoor Coal and the owners of each business.

9.2. Gas or fuel storages and associated plant

The Bargo Petroleum service station (MSEC Structure Ref. BRE_040) is located on Remembrance Drive near the Wollondilly Anglican College. It is located directly above LW S2A. A vehicle mechanic workshop and a wreckers yard is located adjacent to the service station.

Photographs of the site were taken during the pre-mining hazard identification inspection by structural engineer JMA Solutions and a selection is provided in Fig. 9.2.



Photographs courtesy JMA Solutions

Fig. 9.2 Bargo Petroleum and Mechanic's Workshop

There is limited history of longwall mining beneath petrol stations in the Southern Coalfield. Appin Longwall 1 mined directly beneath a petrol station in the 1970's and no information on impacts on this operation is known.

West Cliff Longwall 5A3 mined directly beneath a petrol station at Appin. A flexible coupling was installed prior to mining to ensure that ground movement between pumps, tanks and the connecting pipes could be accommodated. A monitoring line (B-Line) was installed directly outside the petrol station. Substantial non-conventional movements were observed in the vicinity of the petrol station, including a bulge in the road directly outside it. The monitoring line indicated that total subsidence of 140 mm to 290 mm developed during the mining of Longwalls 5A1 to 5A4, with observed compressive ground strain of 3.7 mm/m, which is substantial.

The MSB (now SA NSW) reported that no impacts were observed to the petrol tank, though some impacts were observed to the anti-flood valve and some lines connecting the petrol tank to the bowsers and fill points. There were also some impacts to the shop and concrete pavement. The impacts did not present an immediate public safety hazard.

Tahmoor Mine Longwall 25 mined adjacent to but not directly beneath a petrol station located at Thirlmere Way at Tahmoor. The petrol station experienced approximately 250 mm of subsidence during the mining of Longwalls 22 to 25. While no impacts were observed to the petrol tanks, some impacts were observed to the concrete slabs and kerbs. The structural steel columns to the awning were also observed to bend as a result of differential subsidence movements.

Predictions for the petrol station structures are provided in Table D.10, in Appendix D, where it can be seen that the Bargo Petroleum service station is predicted to experience subsidence of approximately 1000 mm at the workshop.

It is possible the Bargo Petroleum station could experience impacts to the petrol tanks and fuel lines, the hardstand areas or the building and awning structures as a result of the extraction of the proposed longwalls.

Tahmoor Coal has commenced consultation with the owner of the petrol station, for the purposes of developing management measures to ensure that the petrol station remains safe and serviceable throughout the mining period. The management measures may include a combination of:

- Engineering inspections of existing condition of the petrol stations, including the buried tanks;
- Pre-mining hazard identification inspection of each structure by structural engineer;
- Mitigation or strengthening measures prior to mining, particularly to the petrol tanks and fuel lines;
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements and integrity of the petrol tanks and fuel lines;
- Conduct regular visual inspections of the petrol station; and
- Implement planned responses if triggered by monitoring and inspections.

With appropriate management plans in place, it is considered that the petrol station will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

9.3. Mine infrastructure including tailings dams or emplacement areas

Surface facilities at Tahmoor Mine, including a total of 142 building structures, tanks and dams are located within the *Subsidence Study Area*, as shown in Drawing No. MSEC1192-20. The majority of the facilities will not be directly mined beneath but a number of structures and other infrastructure will experience mine subsidence movements due to the extraction of the proposed LWs S1A to S6A. These include:

- 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 *Subsidence 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 stockpile area will be directly mined beneath by LW S1A and this consists of an Overhead Conveyor 5C with the reclaim tunnel and Conveyor 6C underneath. Photographs are provided in Fig. 9.3 to Fig. 9.5.



Fig. 9.3 Aerial view of Tahmoor Mine site



Fig. 9.4 Aerial view of Stockpile area and Overhead Conveyor 5C



Fig. 9.5 Reclaim tunnel with Underground Conveyor 6C

9.3.1. Predictions for the mine infrastructure

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and around the perimeters of each structure, tank and dam, as well as at points located at a distance of 20 metres from the perimeter of each feature.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature and impact assessments for each mine structure, tank and dam within the *Subsidence Study Area* is provided in Table D.10, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

The predictions in Table D.10 do not include linear infrastructure features, including the rail loop and the conveyors. A map of the surface facilities at Tahmoor Mine has been overlaid with the predicted subsidence contours, which is shown in Fig. 9.6

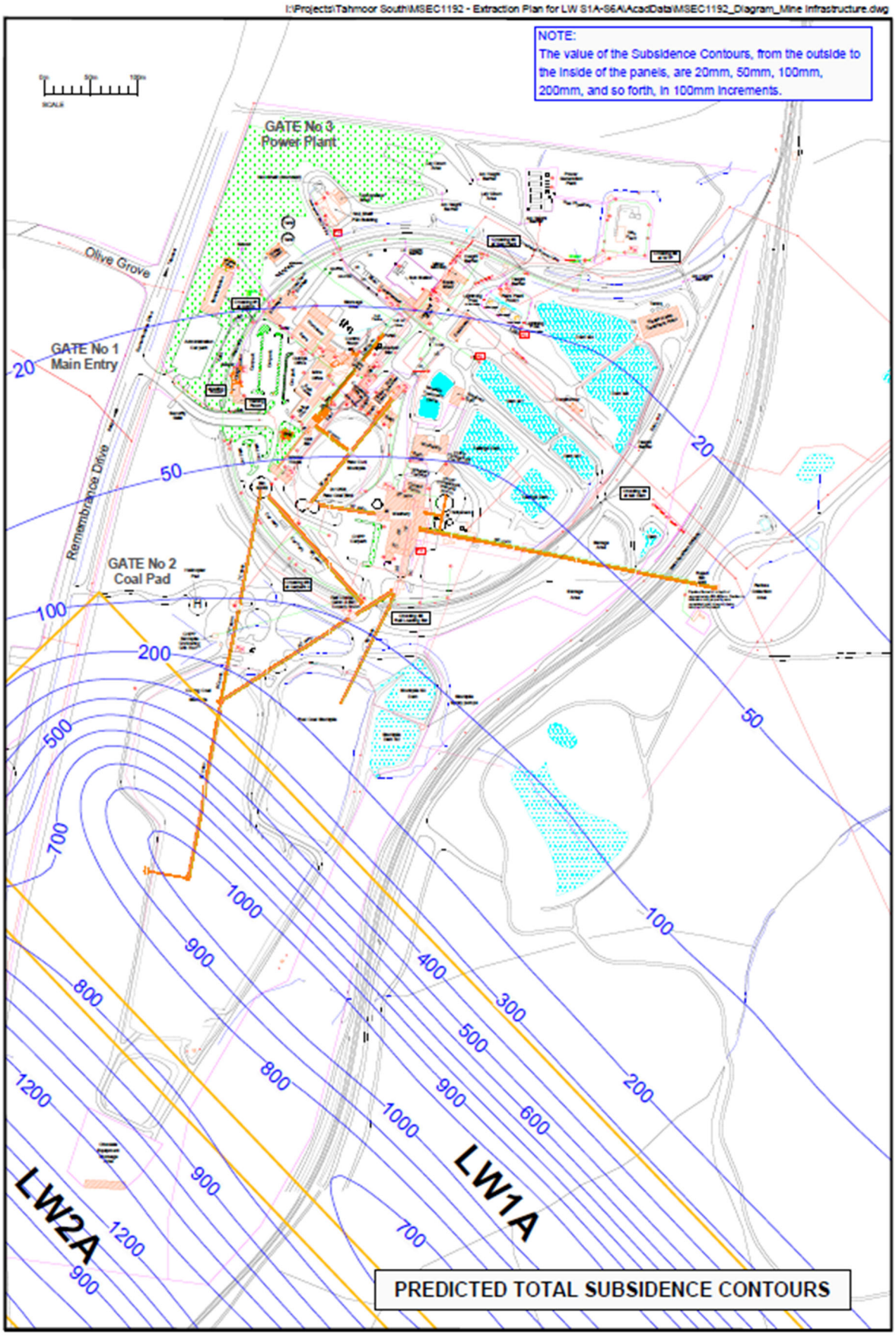


Fig. 9.6 Tahmoor Mine Site overlaid with predicted total subsidence contours due to LWs S1A to S6A

The predicted profiles of conventional subsidence, tilt and curvature along the alignment of Rail Loop, resulting from the extraction of the proposed longwalls, are shown in Fig. E.09, in Appendix E.

The predicted profiles of conventional subsidence, tilt and curvature along the alignment of Conveyors 5C, 6C and 7C, resulting from the extraction of the proposed longwalls, are shown in Fig. E.10, in Appendix E.

A summary of the maximum predicted total conventional subsidence parameters along the alignment of the Conveyors 5C, 6C and 7C, after the extraction of each of the proposed longwalls, is provided in Table 9.1. The predicted subsidence effects are predominately due to Longwalls S1A to S3A.

Table 9.1 Maximum predicted total conventional subsidence parameters along the alignment of Conveyors 5C, 6C and 7C after the extraction of the proposed LWs S1A to S6A

Longwall	Maximum predicted total subsidence (mm)	Maximum predicted tilt along conveyors (mm/m)	Maximum predicted tilt across conveyors (mm/m)	Maximum predicted total hogging curvature along alignment (km^{-1})	Maximum predicted total sagging curvature along alignment (km^{-1})
After LW S1A	750	5.0	4.0	0.06	0.17
After LW S2A	975	6.0	3.5	0.07	0.17
After LW S3A	1000	6.0	3.5	0.07	0.17
After LW S4A	1050	6.0	3.5	0.07	0.17
After LW S5A	1050	6.0	3.5	0.07	0.17
After LW S6A	1050	6.0	3.5	0.07	0.17

The majority of the subsidence movements are predicted to occur during the extraction of proposed LW S1A.

The maximum predicted conventional strains for the conveyors and associated structures, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.1 mm/m tensile and 2.6 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The reclaim tunnel is a linear feature and, therefore, the most relevant distribution of strain is the maximum strains measured along whole monitoring lines above previous longwall mining. An analysis of strains along whole monitoring lines during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.2 and the results are provided in Fig. 4.4.

A minor creek was infilled during the construction of the surface facilities. Using historical aerial photographs, the “hidden creek” passed through conveyor 7C. Minor valley closure and upsidence movements of less than 20 mm may develop across the conveyors, potentially resulting in closure between the bases of the conveyor trestles.

9.3.2. Impact assessments for Mine Infrastructure

Rail Loop

Predictions and impact assessments for the Rail Loop are provided in Section 6.2.

Conveyors

Conveyor 5C and 6C and the associated supporting structures in the Stockpile area are located directly above proposed LW S1A. The infrastructure is predicted to experience up to 1,050 mm of vertical subsidence.

The conveyors are predicted to experience a reversal in grade of up to 6 mm/m. The conveyors were constructed with a grade of 20 mm/m (2%) and the predicted changes in grade will not affect the operation of the conveyors and the tripper that runs along the conveyor.

Tahmoor Coal conduct regular structural engineering inspections of the conditions of its building structures and the support structure for Conveyor 5C is currently in reasonable condition. Inspections and structural assessments are currently being conducted by JMA Solutions to assess the ability of the structure to accommodate the predicted conventional subsidence movements and potential non-conventional subsidence movements.

The support structure consists of reinforced concrete piers with 6 structural steel trestles in between them. The legs of the steel trestles are mounted on and cast into the reinforced concrete reclaim tunnel structure underneath. Whilst each pair of trestle legs are effectively held together by reinforced concrete, it is possible that mining-induced ground strains could result in differential movements between each trestle.

The primary concern is the potential for impacts resulting in workplace safety hazards. Tahmoor Coal is currently considering options to control the risks. This may include managing the gap in the structural frame superstructure to accommodate potential differential movements. Monitoring measures are currently being developed, which include the monitoring the gap in the superstructure and surveying the tops of the trestles and along the reclaim tunnel underneath. It is also possible, for example, to restrict stockpiling operations in areas of concern.

The other conveyors on site will not be directly mined beneath. The support trestles for the overhead conveyors are founded on concrete footings at the surface. While the potential for adverse impacts on these conveyors is low, the primary concern remains the potential for impacts resulting in workplace safety hazards. Tahmoor Coal is currently considering options to control the risks associated with mining adjacent to these overhead conveyors, including where they cross railways, access roads, carparking spaces and pedestrian walkways.

Tahmoor Coal is currently considering options to control the risks associated with mining adjacent to the conveyors themselves. The conveyors can be readily managed for potential changes due to subsidence. The conveyor linestands can be adjusted, if required, to maintain vertical and lateral alignment to with operating tolerances. The alignment can be monitored by a combination of surveys and visual inspections.

Building structures

The building structures generally consist of structural steel frames with metal sheet cladding on concrete slabs. These structures can accommodate substantial differential movements. They will be inspected and assessed prior to mining by a structural engineer to identify potential hazards and consider risk controls.

The Washery building includes an overhead gantry crane and a monorail, which are regularly serviced. Tahmoor Coal has extensive experience in managing potential impacts on overhead gantry cranes. An inspection and assessment will be conducted by a mechanical engineer that is experienced with overhead gantry cranes and mine subsidence. The advice will be used to develop monitoring and management measures.

Three circular reinforced concrete bin structures are located on site. The bins temporarily hold either raw or washed coal material. The structures are found on reinforced concrete slabs. The structures will not be mined directly beneath and will likely withstand the predicted mining-induced tilts, even if they are greater than predicted. They will be inspected and assessed prior to mining by a structural engineer to identify potential hazards and consider controls.

While the potential for adverse impacts to occur on the building structures is considered to be low, Tahmoor Coal will implement measures to ensure that the buildings remain safe and serviceable during the mining of the proposed longwalls. The measures will include monitoring for changes in addition to visual inspections.



Fig. 9.7 Aerial photograph showing Bins, Raw Stockpile, Drift Portal and Winder

Drift Portal

The Drift is the primary entry and exit to the underground mine. The drift conveyor is mounted on the roof of the drift and trolley cars transport workers, materials and equipment on rails via a rope and pulley system that is powered by a winder at the surface. The drift portal is located approximately 380 metres from proposed LW S1A. The drift then proceeds underground away from the proposed longwalls. A photograph of the drift portal is shown in Fig. 9.8.



Fig. 9.8 Drift Portal

The portal structure is predicted to experience approximately 20 mm of vertical subsidence with negligible tilt, curvature and strain. While the potential for adverse impacts to occur on the drift portal is considered to be very low, Tahmoor Coal will implement measures to ensure that the drift remains safe and serviceable during the mining of the proposed longwalls. The measures will include monitoring for changes across the drift, in addition to visual inspections that are routinely conducted as part of the mine's safety management system.

Reject Emplacement Area (REA)

The section of the REA within the *Subsidence Study Area* is predominantly bush with unsealed access roads. The western portion of emplacement activities is located within the *Subsidence Study Area*. The REA will experience low level subsidence movements (less than 50 mm) as a result of the proposed longwall extraction. Tahmoor Coal will implement measures to ensure that the emplacement area remains safe and serviceable during the mining of the proposed longwalls. The measures will include visual inspections that are routinely conducted as part of the mine's safety management system.

Dams

A number of dams are located within the *Subsidence Study Area* a, as shown in Drawing No. MSEC1192-20. As discussed in Section 8.10, the likelihood of impacts on dams is very low. Despite the low likelihood, it is recognised that the dams are located in close proximity to a tributary to Teatree Hollow. The consequences of leakage from the pond can be minimised by dewatering the pond prior to active subsidence and the likelihood of impacts could be reduced by installing a flexible waterproof liner in the pond.

The dams will be inspected by geotechnical engineer Douglas Partners prior to the influence of mining to identify potential hazards and consider risk controls. While the potential for adverse impacts to occur on the dams is considered to be very low, Tahmoor Coal will implement measures to ensure that the dams remain safe and serviceable during the mining of the proposed longwalls. The measures will include monitoring for changes across dam walls, in addition to visual inspections that are routinely conducted as part of the mine's safety management system.

Services infrastructure

Tahmoor Coal has an extensive network of services infrastructure, including water pipework, sewer pipework, gas pipework, electrical and telecommunications cabling. Tahmoor Coal has extensive experience in managing services infrastructure. While the potential for impacts is considered to be low, Tahmoor Coal will implement measures to ensure that the infrastructure remains safe and serviceable during the mining of the proposed longwalls. The measures will include monitoring of subsidence and visual inspections.

Summary

Tahmoor Coal is currently developing management measures to ensure that the mine remains safe and serviceable throughout the mining period and that impacts on the facilities do not result in environmental consequences on the adjacent Teatree Hollow catchment. The study would require input from structural, geotechnical and subsidence engineers. The management measures may include a combination of:

- Mitigation or strengthening measures prior to mining, particularly in relation to the coal conveyor support structures and dams,
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements,
- Conduct regular visual inspections of the surface facilities, and
- Implement planned responses if triggered by monitoring and inspections.

With appropriate management plans in place, it is considered that the surface facilities at Tahmoor Mine will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred.

Descriptions, predictions and impact assessments for the archaeological and heritage sites within the *Subsidence Study Area* are provided in the following sections. The sites located outside the *Subsidence Study Area*, which may be subjected to far-field movements or valley related movements and may be sensitive to these movements, have also been included as part of these assessments.

10.1. Archaeological sites

There are no lands within the *Subsidence Study Area* declared as an Aboriginal Place under the *National Parks and Wildlife Act 1974*.

There are 3 archaeological sites which have been identified within the *Subsidence Study Area* and their locations are shown in Drawing No. MSEC1192-17. There is one rock shelter site on the Tributary to Teatree Hollow, one open camp site and one isolated find. Detailed descriptions of the archaeological sites within the *Subsidence Study Area* are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

10.1.1. Predictions for the archaeological sites

The predicted conventional subsidence, tilts and curvatures for the archaeological sites within the *Subsidence Study Area* are provided in Table D.11, in Appendix D. A summary of the maximum predicted conventional subsidence parameters for the archaeological sites is provided in Table 10.1. The predicted tilts are the maxima after the completion of any or all of the proposed longwalls. The predicted curvatures are the maxima at any time during or after the extraction of the proposed longwalls.

Table 10.1 Maximum Predicted Total Conventional Subsidence Parameters for the Archaeological Sites

Site Type	Maximum predicted total conventional subsidence (mm)	Maximum predicted total conventional tilt (mm/m)	Maximum predicted total conventional hogging curvature (km^{-1})	Maximum predicted total conventional sagging curvature (km^{-1})
Open Camp Site (52-2-3968)	550	5.0	0.05	0.02
Rock Shelter Site (52-2-4471)	900	4.5	0.06	0.03
Isolated Find (48-2-0275)	70	< 0.5	< 0.01	< 0.01

The maximum predicted conventional strains for the archaeological sites, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 0.9 mm/m tensile and 0.5 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The archaeological sites are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays above goaf are provided in Fig. 4.2. The results for survey bays above solid coal are provided in Fig. 4.3.

The rock shelter is located along the side of a valley and, therefore, could experience valley-related movements. A summary of the maximum predicted upsidence and closure movements for the stream in the location of this sites is provided in Table 10.2.

Table 10.2 Maximum predicted total upsidence and closure for the archaeological sites

Site Type	Stream	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
Rock Shelter Site (52-2-4471)	Tributary of Teatree Hollow (Wirrimbirra Creek)	300	350

10.1.2. Impact assessments for the Open Camp Site

There is one open camp site located within the *Subsidence Study Area*. The site is located directly above the chain pillars between proposed LWs S3A and S4A.

The maximum predicted final tilt for the open camp site is 5.0 mm/m (i.e. 0.5 %), which represents a change in grade of 1 in 200. It is unlikely that the sites would experience any adverse impacts resulting from the mining induced tilts.

The maximum predicted curvatures for the open camp site are 0.05 km^{-1} hogging and 0.02 km^{-1} sagging, which represent minimum radii of curvature of 20 kilometres and 50 kilometres, respectively. The maximum predicted conventional strains for this site, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 0.8 mm/m tensile and 0.3 mm/m compressive.

The open camp site can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely, however, that artefacts within the camp site would be impacted by surface cracking.

Further assessments of the potential impacts on the open camp site are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

10.1.3. Impact assessments for the rock shelter

There is one rock shelter identified within the *Subsidence Study Area*, directly above LW S2A on the Tributary to Teatree Hollow.

The maximum predicted tilt for the rock shelters is 4.5 mm/m (i.e. 0.45 %), which represents a change in grade of 1 in 222. It is unlikely that the site would experience any adverse impacts resulting from the mining induced tilt.

The maximum predicted curvatures for the rock shelters are 0.06 km^{-1} hogging and 0.03 km^{-1} sagging, which represent minimum radii of curvature of 17 kilometres and 33 kilometres, respectively. The maximum predicted conventional strains for these sites, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 0.9 mm/m tensile and 0.5 mm/m compressive. The predicted closure across the valley at the rock shelter site is 350 mm.

It is extremely difficult to assess the likelihood of instabilities for the rock shelters based upon predicted ground movements. The likelihood of the shelters becoming unstable is dependent on a number of factors which are difficult to fully quantify. These factors include jointing, inclusions, weaknesses within the rockmass, groundwater pressure and seepage flow behind the rockface. Even if these factors could be determined, it would still be difficult to quantify the extent to which these factors may influence the stability of the shelter naturally or when it is exposed to mine subsidence movements.

The predicted conventional and valley related movements at the rock shelters are similar to the typical movements in the Southern Coalfield, where there is extensive experience of mining beneath rock shelters. It has been reported that, where longwall mining has previously been carried out in the Southern Coalfield, beneath 52 shelters, that approximately 10 % of the shelters have been affected by fracturing of the strata or shear movements along bedding planes and that none of the shelters have collapsed (Sefton, 2000). Regal Heritage (2022) advises that 221 rock shelter sites have been monitored since 1990, of which 22 sites have observed changes due to mine subsidence, which is consistent with Sefton's advice in 2000. Two of the affected sites have experienced adverse consequences to the physical fabric that supports the heritage value of the site.

The experience from the Southern Coalfield indicates that the likelihood of substantial physical impacts on rock shelters within the *Subsidence Study Area* is relatively low.

10.1.4. Impact assessments for the Isolated Find site

There is one isolated find site located within the *Subsidence Study Area*. The site is located to the north of LW S1A directly above the previously extracted Tahmoor LW 2.

The maximum predicted final tilt for the isolated find site is less than 0.5 mm/m (i.e. 0.05 %), which represents a change in grade of 1 in 2000. It is unlikely that the site would experience any adverse impacts resulting from the mining induced tilts.

The maximum predicted curvatures for the isolated find site are less than 0.01 km^{-1} hogging and sagging, which represent minimum radii of curvature of 100 kilometres. The maximum predicted conventional strains for these sites, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 0.2 mm/m tensile and compressive.

The isolated find site can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely, however, that the isolated finds themselves would be impacted by surface cracking.

Further assessments of the potential impacts on the isolated find site are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

10.1.5. Impact assessments for the archaeological sites based on increased predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the maximum tilts would be 10 mm/m (i.e. 1.0 %, or 1 in 100) for the open camp site, 9 mm/m (i.e. 0.9 %, or 1 in 111) for the rock shelter and less than 1 mm/m (i.e. 0.1 %, or 1 in 1000) for the isolated find. These types of archaeological sites are not adversely affected by tilt and, therefore, the likelihoods of impact would not be expected to increase.

If the actual curvatures or strains at the open camp site exceeded those predicted by a factor of 2 times, the likelihoods and extents of cracking in the surface soils would also increase. It would still be unlikely that the artefacts themselves would be impacted by the surface cracking and the methods of subsidence management would not be expected to change.

If the actual curvatures or strains at the rock shelter site exceeded those predicted by a factor of 2 times, the likelihoods and extents of fracturing in the bedrock would also increase. Whilst the observed curvatures could exceed those predicted, the experience from the Southern Coalfield indicates that the likelihood of substantial impacts on shelters is relatively low, particularly when they are not directly mined beneath.

10.1.6. Management of potential impacts on the archaeological sites

Tahmoor Coal has developed a Heritage Management Plan to manage potential impacts to Aboriginal heritage sites for previously extracted longwalls at the mine. The management plan included consultation with the community, monitoring and reporting. Tahmoor Coal is required to develop a Heritage Management Plan as part of the Extraction Plan for LWs S1A to S6A, in consultation with the community, to manage the Aboriginal heritage sites during the extraction of the proposed longwalls.

10.2. Heritage sites

10.2.1. Descriptions of the heritage sites

There are 5 heritage sites which have been identified within the *Subsidence Study Area* and their locations are shown in Drawing Nos. MSEC1192-17. Brief descriptions of the heritage sites are provided below in Table 10.3, and more detailed descriptions are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

Table 10.3 Heritage sites within the Subsidence Study Area

Name	Description	Closest distance to extent of longwall mining area
Bargo Cemetery	Grave sites	Directly above longwall mining area
Wirrimbirra Sanctuary (now called Australian Wildlife Sanctuary)	Native gardens	Directly above longwall mining area
Great Southern Road	Local road	Directly above LW S5A
Tahmoor Mine	Coal mine and coal handling preparation plant	Centre of surface facilities ~500 m from extent of LW mining area
Picton Weir	Concrete arch dam	850 m west of LW S6A

Wellers Road Railway Overbridge over the Main Southern Railway is located just outside the *Subsidence Study Area*. Descriptions and impact assessments for this site are provided in Section 6.1.9.

10.2.2. Predictions and impact assessments for heritage sites previously discussed

Predictions and impact assessments have been provided previously in this report for some of the heritage sites:

- Bargo cemetery (Section 7.15);
- Tahmoor Mine (Section 9.3); and
- Picton Weir (Section 6.11).

The predictions and impact assessments for heritage aspects of Wirrimbirra Sanctuary and Great Southern Road are provided below.

10.2.3. Wirrimbirra Sanctuary

The Wirrimbirra Sanctuary is located on Remembrance Driveway and is listed as an item of heritage on the State Heritage Register (01508). Wirrimbirra Sanctuary is now called the Australian Wildlife Sanctuary and covers an area of approximately 95 ha.

Wirrimbirra preserves a part of the original 'Bargo Brush' which was of considerable historical importance in the problems which faced the settlement of the Argyle or Southern Tablelands during the early half of the 1800s. 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. Within the 43 established gardens, there are over 1800 native plants representing a resource base for the study of native flora.

The Australian Wildlife Sanctuary includes a visitor centre, a glass house and other shade structures, along with established gardens and walks. Two cottages are located next to the visitor centre. Dingo Sanctuary Bargo is also located on the property. 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.

The Australian Wildlife Sanctuary structures are located directly above proposed LWs S3A and S4A. The Australian Wildlife Sanctuary was inspected by heritage consultant EMM in January 2020. The Heritage Management Plan (Tahmoor Coal, 2022d) has identified the following items of heritage significance.

- Complex of building structures at and around the visitor centre;
- Animal pens (dingo sanctuary)
- Allen Strom pond
- Landscaping
- Shale and sandstone relics at multiple locations
- Artefact deposits
- Wells

Structures including within the Dingo Sanctuary

Predictions of subsidence, tilt and curvature have been provided for the identified heritage structures within the Australian Wildlife Sanctuary in Table D.10, in Appendix D.

The Australian Wildlife Sanctuary property will experience the full range of subsidence movements due to the extraction of the proposed longwalls. The visitor centre and surrounding structures are located near the chain pillar between LWs S3A and S4A. These structures will, therefore, experience slightly reduced subsidence, tilt and curvature compared to locations that are closer to the centre of the longwall panels where greater subsidence movements typically occur.

The structures were inspected by John Matheson of JMA Solutions in January 2020. The structures generally comprise timber-framed structures with metal-clad timber-framed rooves on reinforced concrete ground slabs. The structures were found to be in serviceable condition. Impact assessments for the building structures and the dingo sanctuary are provided in Section 7.15.

A farm dam is located to the north of the complex. The dam has been constructed with compacted earth. The inlet to the dam appears to have been cut through surface rock.

There is extensive experience of mining directly beneath farm dams in the Southern Coalfield, which indicates that the incidence of impacts on these features is very low. Farm dams are commonly constructed with cohesive materials in the bases and walls which can absorb the conventional subsidence movements typically experienced in the Southern Coalfield without the development of substantial cracking. Non-conventional movements can result in localised cracking and deformations at the surface and, where coincident with farm dams, could result in adverse impacts.

Tahmoor Coal has mined LW22 to LW32 and LW W1-W3 beneath approximately 110 dams. While a small number of landowners have advised of impacts, there has been one claim to SA NSW for impacts on farm dams at the time of the report.

Any substantial cracking in the dam bases or walls could be repaired by reinstating with cohesive materials. If any farm dams were to lose water as a result of mining, the mine would provide an alternative water source until the completion of repairs in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

Further assessments of the potential impacts on the structures are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

Allen Strom Pond

The Allen Strom Pond is a shallow pond, which is located within the formalised garden area of the Australian Wildlife Sanctuary. The pond was damaged during the bushfires of late 2019. EMM inspected the pond after the bushfires. A random-split sandstone edging surrounds the pond and does not appear to have been mortared together. The floor of the pond has been lined with cement or concrete.

The pond may experience adverse impacts from ground strains and curvature due to the extraction of the proposed longwalls. The cement or concrete floor may experience cracking, resulting in leakage. The damage can be readily repaired.

Further assessments of the potential impacts on the Pond are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

Landscape

The Australian Wildlife Sanctuary preserves a part of the original 'Bargo Brush' landscape, which was of considerable historical importance in the problems which faced the settlement of the Argyle or Southern Tablelands during the early half of the 1800s.

While the landform will experience mine subsidence movements, the mining-induced changes in slope will be orders of magnitude less than natural gradients and not visually perceptible. It is very unlikely, therefore, that the vertical subsidence would reduce the visual aesthetics or the heritage value of the landscape.

Historical relics and artefact deposits

A number of historical relic sites were identified by EMM during the site inspection in January 2020. Some of the sites were discovered following the loss of vegetation by the bushfires.

The relics include remnant sandstone structures including an old fireplace, old fireplaces consisting of mixtures of clay and small stones, and collections of rocks and pebbles.

The relic sites can potentially be affected by cracking of the surface soils as a result of mine subsidence movements. It is unlikely, however, that the sandstone features or isolated artefact deposits would be impacted by surface cracking. The cracks would fill in over time and not be visible.

Further assessments of the potential impacts on the relic sites are provided in the Heritage Management Plan (Tahmoor Coal, 2022d).

Wells

Two small, shallow excavations were identified on the property. The excavations have previously been identified as wells but have been reinterpreted as non-specific waterholes/soaks. The wells are relatively shallow, being less than 2 metres deep. The sides and base of these features are unlined.

The wells are very unlikely to experience adverse impacts due to the extraction of the proposed longwalls.

Heritage Management Plan

Tahmoor Coal has previously developed historical heritage management plans to manage potential impacts on items of heritage significance above previously extracted LWs 22 to 32 and LWs W1-W3.

Tahmoor Coal has developed a draft Property Subsidence Management Plan to manage potential impacts on the Australian Wildlife Sanctuary. The management plan is currently being considered by Australian Wildlife Sanctuary as part of the consultation process. The management measures include a combination of:-

- Pre-mining hazard identification inspection of each structure by structural engineer (complete);
- Consider the implementation of possible mitigation measures prior to mining to reduce the likelihood of severe impacts (complete);
- Installation of a monitoring system, which includes, among other things, the monitoring of ground movements around the visitor centre;
- Conduct regular visual inspections of the building structures and dingo sanctuary; and
- Implement planned responses if triggered by monitoring and inspections. Repairs to heritage structures would be planned in consultation with a heritage consultant.

With an appropriate management plan in place, it is considered that the Australian Wildlife Sanctuary will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

10.2.4. Great Southern Road

The northern section of Great Southern Road is located directly above the southern end of proposed LW S5A. There are sealed and unsealed sections of pavement within the *Subsidence Study Area*.

The sealed and unsealed sections of pavement are predicted to experience minor subsidence movements and impacts as a results of the extraction of the proposed longwalls. Further information is provided in Section 6.3.3.

As the road has been upgraded many times, there is little evidence of the original heritage fabric. While impacts may occur to the road, repairs will not impact on the heritage value of the road, which is generally related to its alignment and this will not be affected by the proposed mining.

10.2.5. Management of potential impacts on heritage sites

Tahmoor Coal has previously developed a Heritage Management Plan to manage the potential impacts on heritage sites. The management plans include pre-mining assessments by structural engineers and heritage consultants, monitoring and triggered response plans. Monitoring typically continues for a period following mining.

Tahmoor Coal has developed a Heritage Management Plan as part of the Extraction Plan for LWs S1A to S6A to manage potential impacts on heritage sites in consultation with each landowner during the mining of the proposed longwalls.

10.3. Items of architectural significance

There are no items of architectural significance within the *Subsidence Study Area*.

11.1. Houses

11.1.1. Descriptions of the houses

There are 105 houses that have been identified within the *Subsidence Study Area.* A total of 65 houses are located directly above the proposed longwalls. The locations of the houses are shown in Drawing No. MSEC1192-18 and details are provided in Table D.02, in Appendix D.

The locations, sizes, and construction details of the houses were determined from orthophotographs of the area in 2017 and 2021, kerbside inspections in 2013 and *Google Street View*® in February 2021. In some cases, the houses were inspected at the request or consent of the landowners.

Given the medium-term nature of the proposed mining activity, it is likely that there will be a growth and renewal of houses over time. It is likely the total number of houses affected by the extraction of the proposed longwalls will be greater than currently identified.

The following provides further discussions on the details of the houses within the *Subsidence Study Area*.

Locations

There are 65 houses located directly above the proposed longwalls (i.e. 62 % of the total number of houses within the *Subsidence Study Area*). A summary of the number of houses located directly above each of the proposed longwalls is provided in Table 11.1.

Table 11.1 Number of houses located directly above each of the proposed longwalls

Layout	Longwall	Number of houses directly above each proposed longwall
Extraction Plan LWs S1A to S6A	LW S1A	0
	LW S2A	1
	LW S3A	13
	LW S4A	20
	LW S5A	20
	LW S6A	11
	Total	**65**
EIS Layout (MSEC1123) LWs S1A to S6A	LW101A	0
	LW102A	1
	LW103A	8
	LW104A	22
	LW105A	16
	LW106A	8
	Total	**55**

When compared to the count provided in Report No. MSEC1123 for the EIS, the numbers of houses directly above the proposed LWs S1A to S6A have increased for the following reasons:

- The commencing ends of LWs S1A to S6A have been aligned compared to the previous staggered layout. The outcome of the change is that LWs S2A to S6A have been extended in length. The gap between the A and B series longwalls will be maintained, such that the future B series will be shortened when compared to the mine layout that was submitted for development consent. This means that fewer houses will experience mine subsidence movements due to future extraction in the B Series than were previously counted under the previous EIS layout.
- Six new houses have been constructed and identified from recent aerial images that were not present since the area was previously mapped for the EIS report from a 2017 aerial photograph.
- Two structures that were previously mapped as sheds have been identified to be houses or granny flats.

Maximum plan dimension, plan area and height

Distributions of the maximum plan dimensions and plan areas of the houses within the *Subsidence Study Area* are provided in Fig. 11.1. The majority of the houses are between 10 metres and 30 metres in length, with an average of 20 metres. The majority of the houses have plan areas between 100 m^2 and 300 m^2, with an average of 220 m^2.

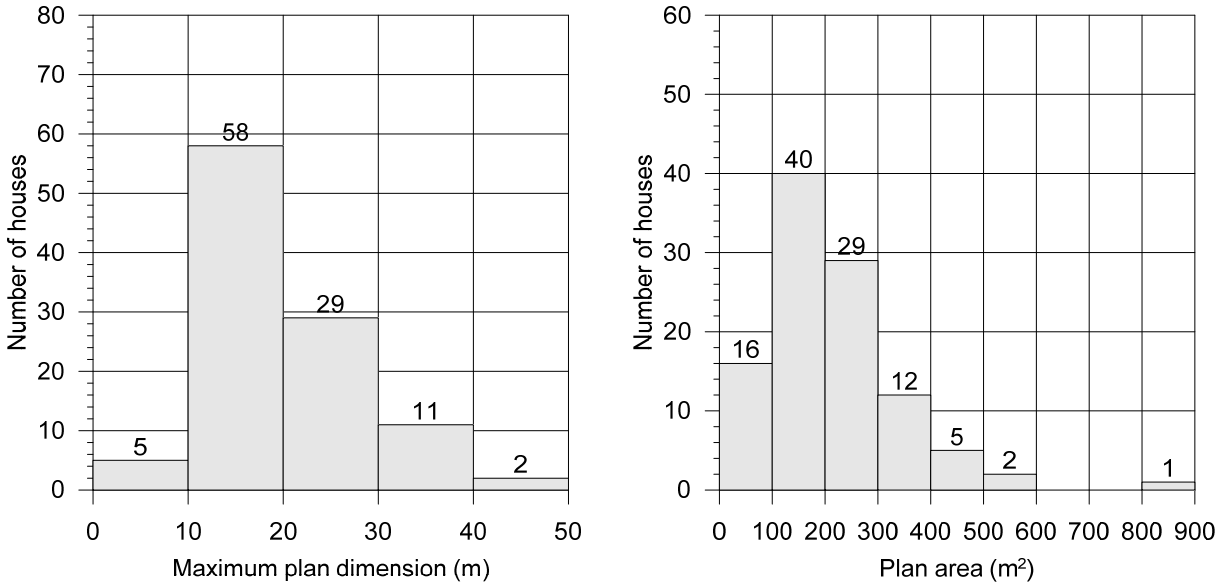


Fig. 11.1 Distribution of houses by maximum plan dimension and plan area

The houses have been categorised into four groups, on the basis of their maximum plan dimension and the number of stories. A summary of these house type categories is provided in Table 11.2 below. It is noted that two-storey houses include split-level houses.

Table 11.2 House type categories

House type	Description	Number	Percentage
H1	Single-storey with maximum plan dimension less than 30 metres	86	81 %
H2	Single-storey with maximum plan dimension of 30 metres or greater	13	12 %
H3	Two-storey with maximum plan dimension less than 30 metres	6	6 %
H4	Two-storey with maximum plan dimension of 30 metres or greater	0	0 %

It can be seen from the above table that the majority of houses within the *Subsidence Study Area* are single-storey with a maximum plan dimension less than 30 metres (i.e. Type H1), and there are no two-storey houses with a maximum plan dimension greater than 30 metres (i.e. Type H4) identified within the *Subsidence Study Area*.

The distribution of house heights within the *Subsidence Study Area* at this point in time has been compared to the distribution of house types in the township of Tahmoor, which have previously experienced mine subsidence movements. Of the 105 houses within the *Subsidence Study Area*, 86 houses (81 %) are single-storey houses with maximum plan dimension less than 30 metres.

Type of construction

Distributions of the wall and footing construction of the houses within the *Subsidence Study Area* are provided in Fig. 11.2. The majority of the houses within the *Subsidence Study Area* are of brick or brick-veneer construction. There are similar numbers of houses with slab on ground and piered footings, with a small number of houses on strip footings.

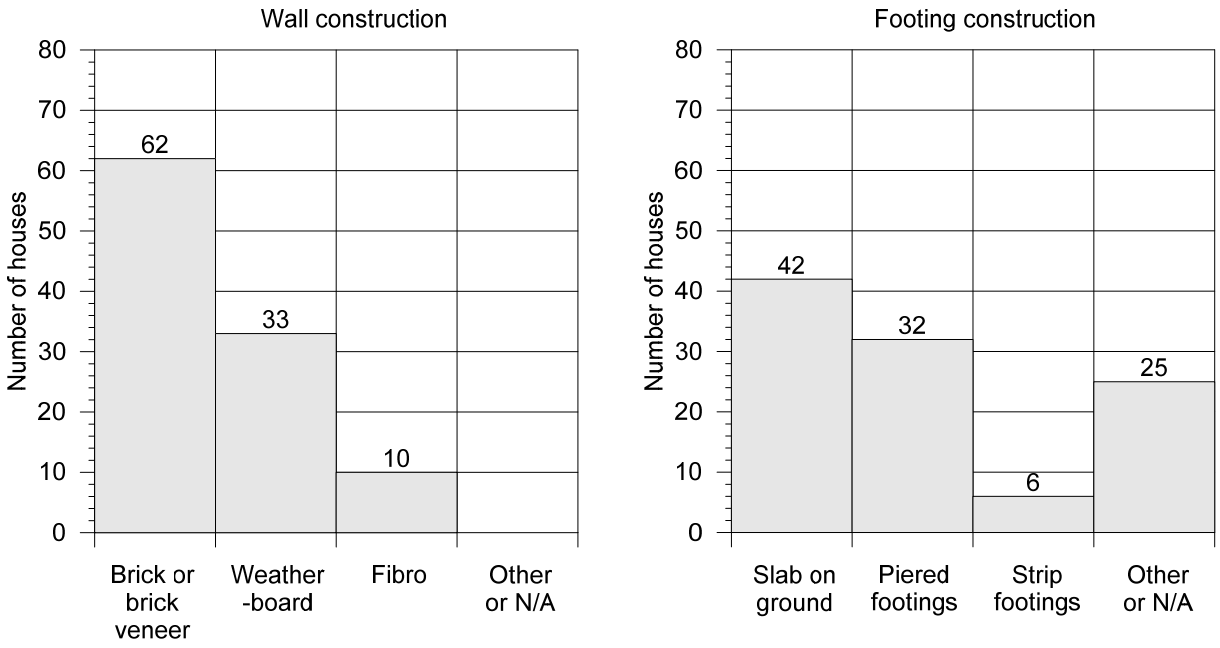


Fig. 11.2 Distributions of wall and footing construction for houses within the Subsidence Study Area

Following a review of impacts to houses during the mining of Tahmoor Mine Longwalls 22 to 25, it was found that there was a noticeable difference in structural performance in response to mine subsidence movements between the following construction types:-

- Brick or brick-veneer houses constructed on a ground slab;
- Brick or brick-veneer houses constructed on strip footings; and
- Weatherboard or fibro houses constructed on either ground slabs or strip footings.

The distribution of houses by construction type is provided in Table 11.3.

Table 11.3 Distribution of houses by construction type

Description	Number of houses	Percentage of houses
Brick or brick-veneer houses constructed on a ground slab	37	35 %
Brick or brick-veneer houses constructed on strip footings	25	24 %
Weatherboard or fibro houses constructed on either ground slabs or strip footings or other	43	41 %

Of the 105 houses within the *Subsidence Study Area*, 62 houses (58 %) are brick or brick-veneer houses.

A map showing the spatial distribution of structures by construction type is provided in Fig. 11.3.

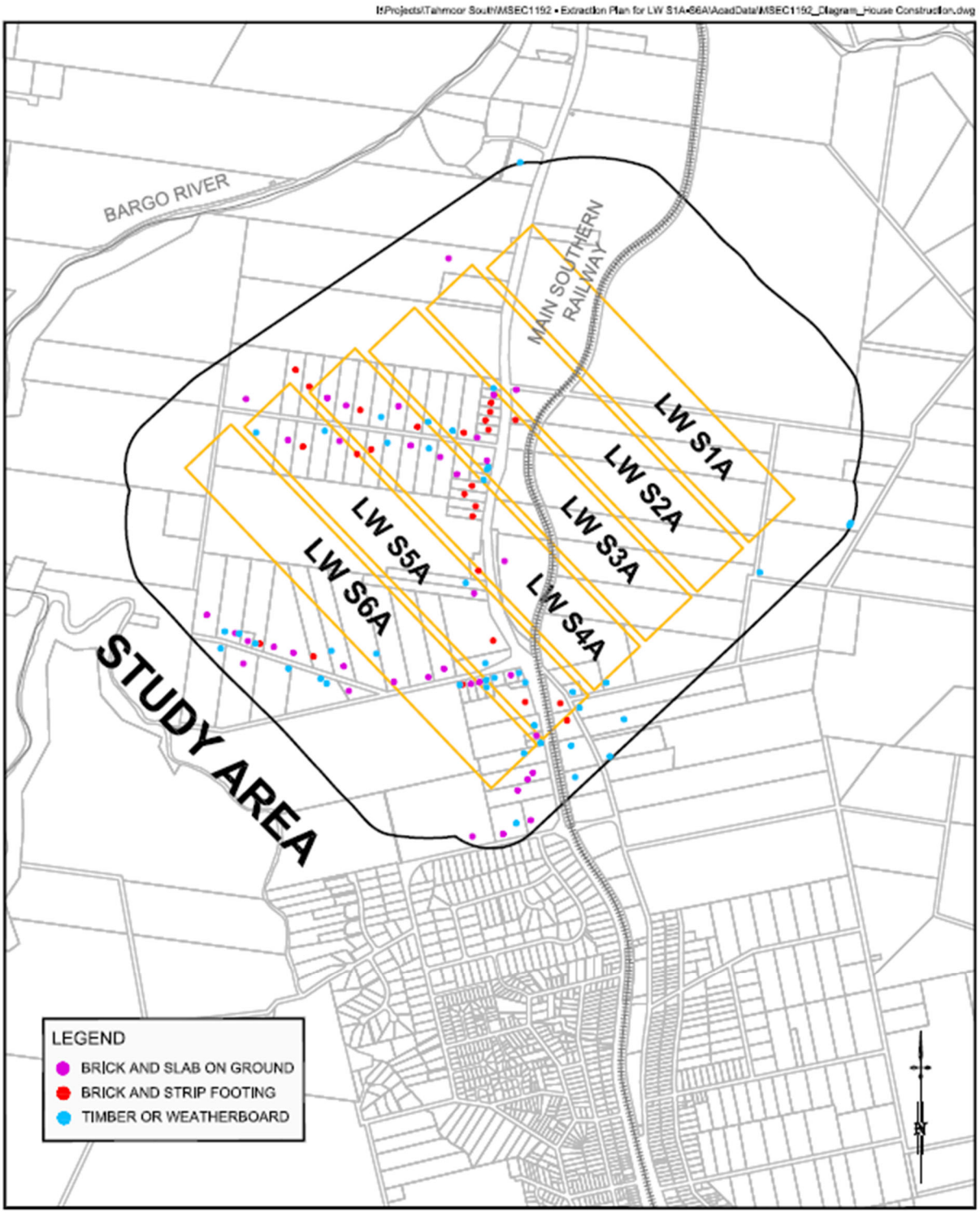


Fig. 11.3 Location of houses by construction type

The information on construction types has been undertaken using *Google Street View*® images and front of house inspections. It is possible that some houses will be renovated or rebuilt before the proposed longwalls are extracted.

As discussed in Section 11.1.3 and in Appendix C, construction type is an input parameter to the probabilistic method of assessment of impacts.

Age of houses

The Bargo area has expanded from a rural township to an urban village, as demonstrated by the following two images. An aerial photograph taken in 1975 is shown in Fig. 11.4. The most recent available aerial photograph in 2021 is shown in Fig. 11.5 for comparison. 51% of houses in the *Subsidence Study Area* have been built since the Bargo Mine Subsidence District was declared in 1975.

House age has been determined by examination of a series of historical aerial photographs provided by Land and Property Information. The photographs that were available over the Subsidence Study Area were taken in 1963, 1975, 1984, 1994, 2002 and Tahmoor Mine commissioned orthophotographs over the *Subsidence Study Area* in 2013. A Nearmap image taken in 2017 was used to identify houses with the *Subsidence Study Area* at the time MSEC's report in support of the original EIS was submitted. A Nearmap image taken in 2021 was used to identify new houses with the *Subsidence Study Area* at the time of preparing the Extraction Plan.



Photograph courtesy Department of Lands (now Spatial Services NSW)

Fig. 11.4 Aerial photograph of Study Area in 1975 when Mine Subsidence District was declared



Photograph courtesy Nearmap

Fig. 11.5 Aerial photograph of Study Area in 2021

A map showing the spatial distribution of structures by house age is provided in Fig. 11.7. The older houses are located throughout the *Subsidence Study Area*. A histogram showing the distribution of houses by age is shown in Fig. 11.6.

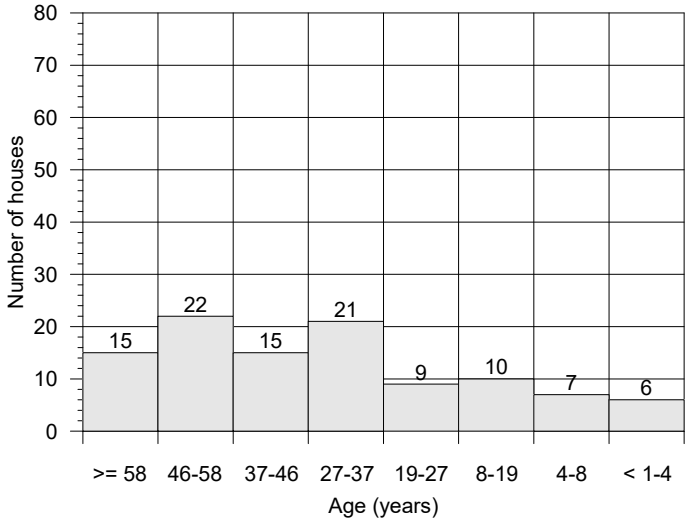


Fig. 11.6 Distribution of Houses by Age as at 2021

It can be seen from Fig. 11.6 that, as at 2021, the greatest proportion of houses were constructed 27 to 58 years prior between 1975 and 1994.

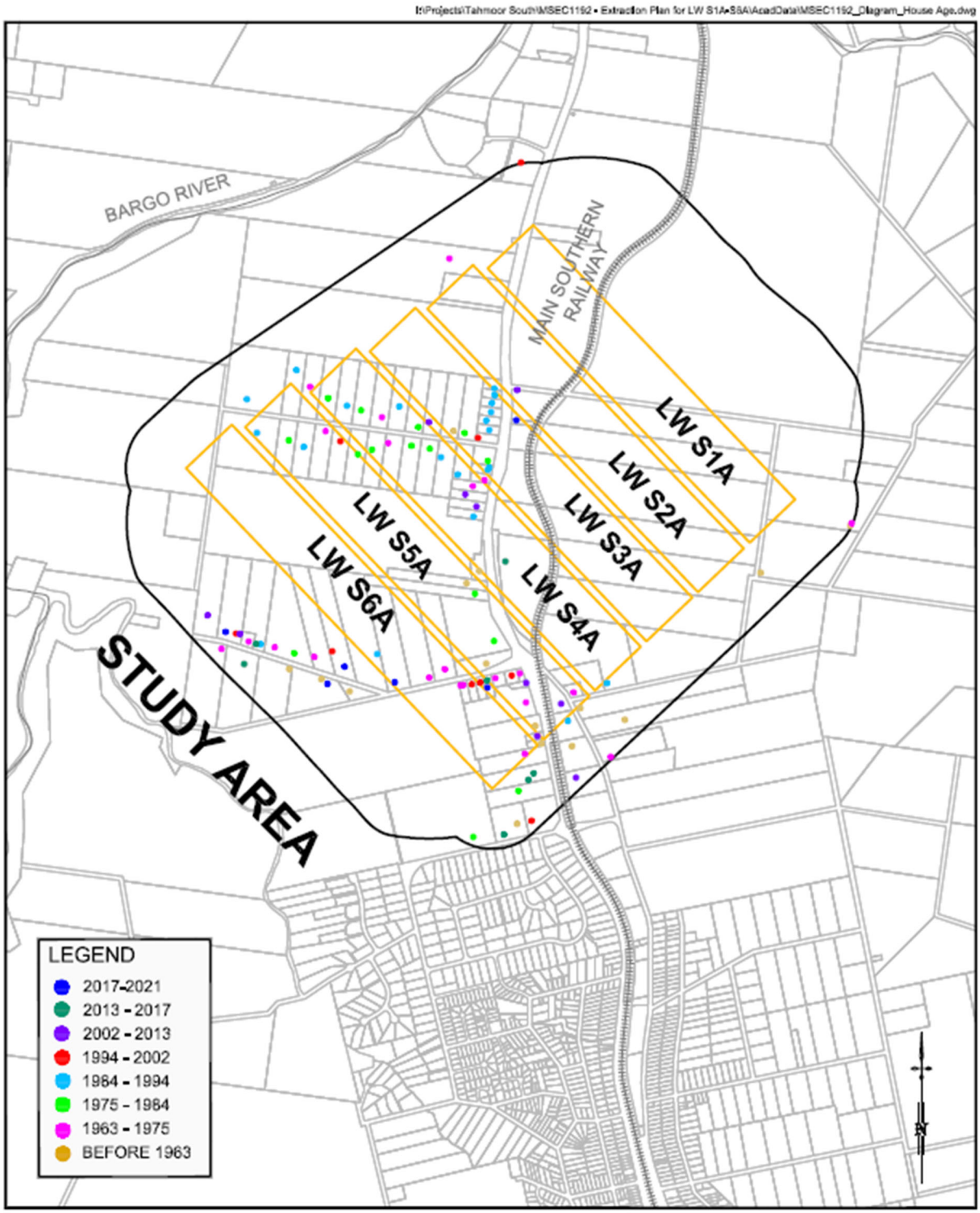


Fig. 11.7 Location of houses by age

11.1.2. Predictions for the houses

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at the vertices of each house, as well as eight equally spaced points placed radially around the centroid and vertices at a distance of 20 metres. In the case of a rectangular shaped structure, predictions have been made at a minimum of 45 points within and around the structure.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each house within the *Subsidence Study Area*, resulting from the extraction of the proposed longwalls, is provided in Table D.03, in Appendix D. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Distributions of the predicted conventional subsidence parameters for the houses within the *Subsidence Study Area* are illustrated in Fig. 11.8, Fig. 11.9 and Fig. 11.10 below.

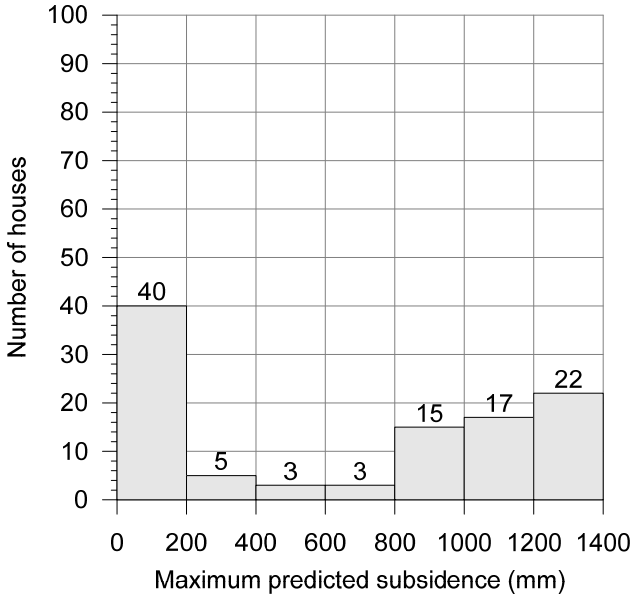


Fig. 11.8 Maximum predicted conventional subsidence for the houses within the Subsidence Study Area

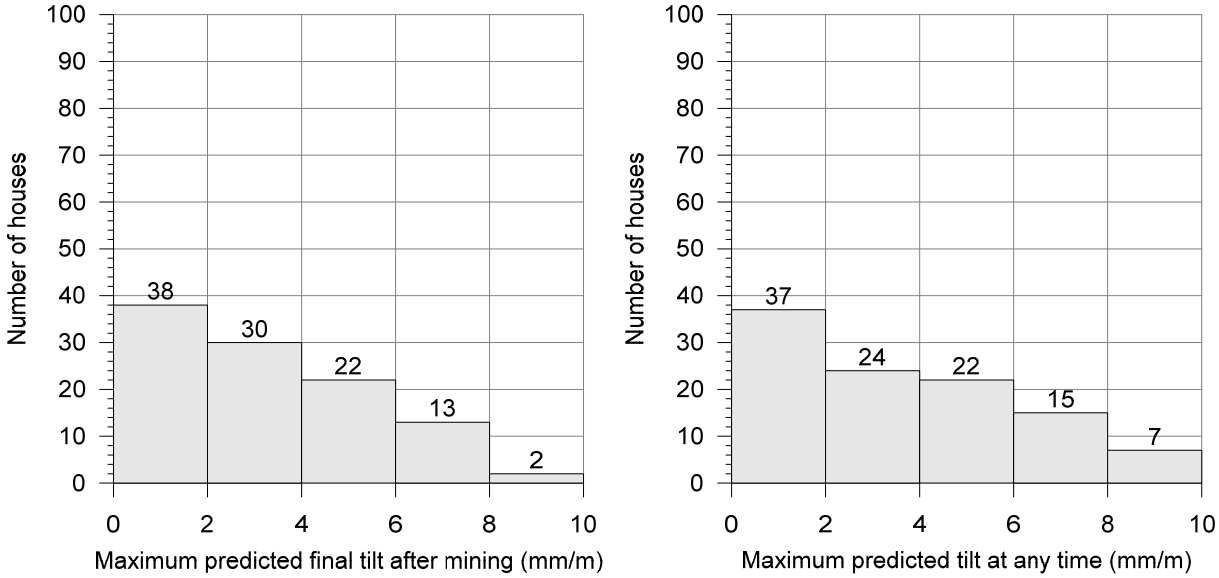


Fig. 11.9 Maximum predicted conventional tilts after the extraction of all longwalls (left) and maximum predicted conventional tilts after the extraction of any longwall (right)

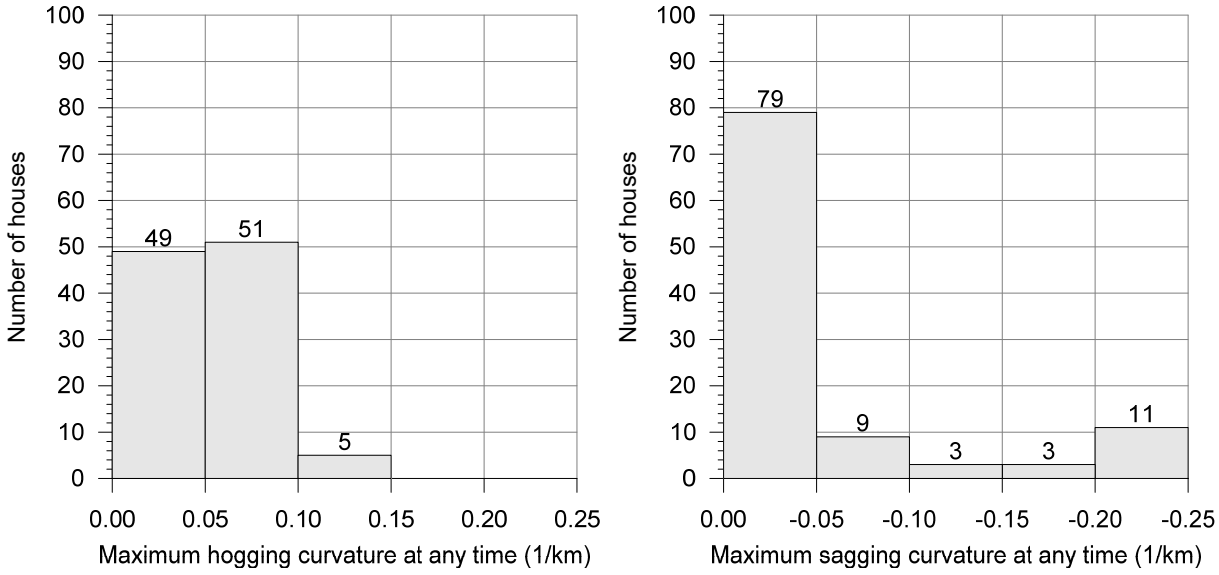


Fig. 11.10 Maximum predicted conventional hogging curvature (left) and sagging curvature (right) for the houses within the Subsidence Study Area

The maximum predicted conventional strains for the houses, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.7 mm/m tensile and 3.5 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The houses are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. An analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

11.1.3. Impact assessments for the houses

The following sections provide the impact assessments for the houses within the *Subsidence Study Area*.

Potential impacts resulting from vertical subsidence

Vertical subsidence does not directly affect the stability or serviceability of houses. The potential for impacts on houses is affected by differential subsidence, which includes tilt, curvature and strain, and the impact assessments based on these parameters are described in the following sections.

Vertical subsidence may affect the heights of some the houses above the flood level. The potential impacts on the houses resulting from the changes in flood level from the proposed mining has been assessed as part of the flood model, which is described in the Water Management Plan (Tahmoor Coal, 2022a).

Potential impacts resulting from tilt

It has been found from past longwall mining experience that tilts of less than 7 mm/m generally do not result in any substantial impacts on houses. Some minor serviceability impacts can occur at these levels of tilt, including door swings and issues with roof gutter and wet area drainage, all of which can be remediated using normal building maintenance techniques. Tilts greater than 7 mm/m can result in greater serviceability impacts which may require more substantial remediation measures, including the relevelling of wet areas or, in some cases, the relevelling of the building structure.

The predicted maximum tilts are less than 7 mm/m at 97 of the houses within the *Subsidence Study Area* (i.e. 92 % of the total) at the completion of mining. It is expected that only minor serviceability impacts would occur at these houses, as the result of tilt, which could be remediated using normal building techniques.

The maximum predicted tilt for the houses is 9 mm/m (i.e. 0.9 %, or 1 in 111). A total of 8 houses (i.e. 8 % of the total) are predicted to experience tilts greater than 7 mm/m. The potential for serviceability impacts is greater for these houses. In some cases, more substantial remediation measures may be required, such as relevelling of the building structure.

The distribution of predicted final tilts for the houses within the *Subsidence Study Area* is provided in Fig. 11.11.

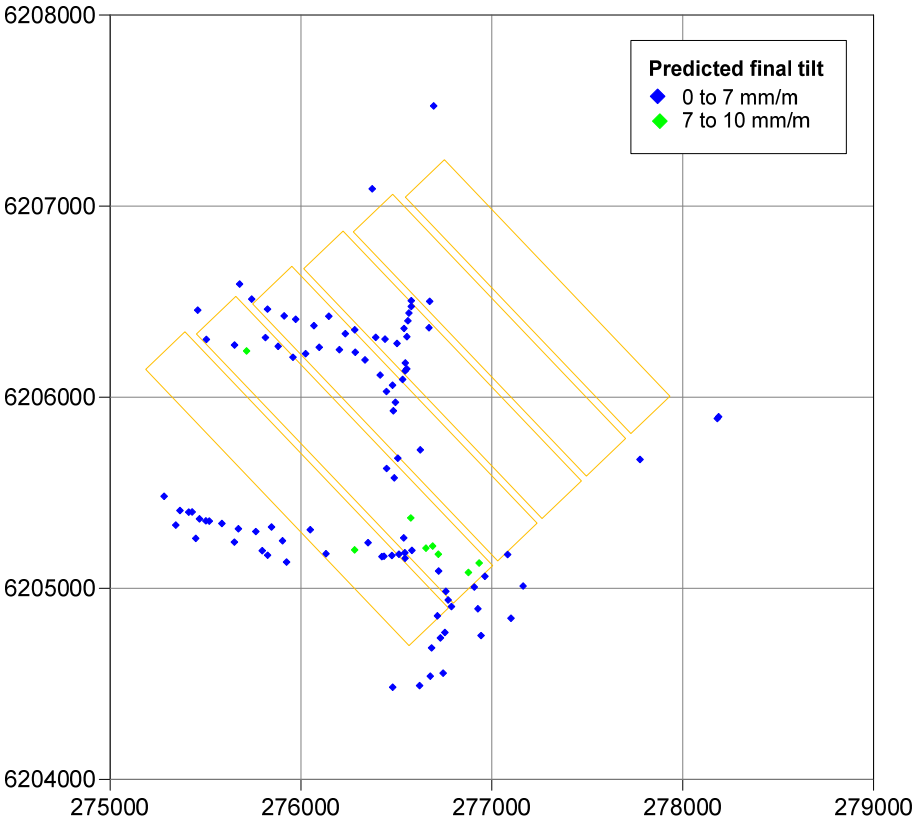


Fig. 11.11 Distribution of predicted final tilts for the houses at the completion of mining

It can be seen from the above figure, that the houses with predicted final tilts greater than 7 mm/m are located above proposed LWs S5A and S6A.

Houses located above previously extracted longwalls at Tahmoor have experienced mining-induced tilts within the predicted range for the Amended Layout. This includes tilts at magnitudes of 10 mm/m and greater, which were observed above Tahmoor Mine LW 24A and above the south-eastern ends of LWs 25 and 26, in the areas of increased subsidence. To date, there have been very few claims to SA NSW for impacts on houses as a result of mining induced tilt. Claims in these areas have mainly been based on impacts resulting from mining induced curvatures or strains.

The distribution of measured tilts for the survey bays located in the area of increased subsidence above LWs 24B, 25 and 26, is provided in Fig. 11.12. A gamma function has also been fitted to the observed data which is shown by the blue curve.

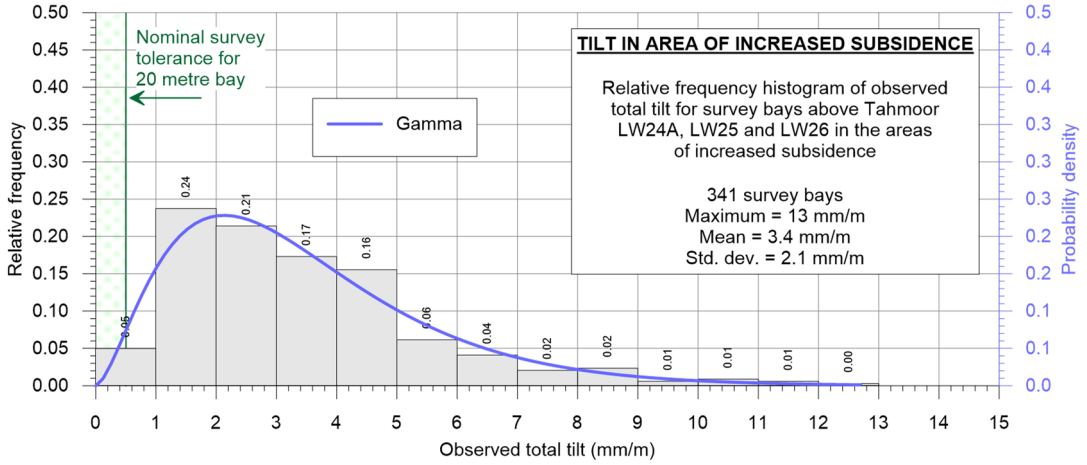


Fig. 11.12 Distribution of measured tilts for survey bays located in the areas of increased subsidence above Tahmoor Mine longwalls 24A, 25 and 26

It can be seen from the above figure, that the maximum observed total tilt for the survey bays in the areas of increased subsidence was 13 mm/m, which is greater than the maximum predicted tilt at the houses directly above the proposed longwalls, which is 9 mm/m.

The range of predicted tilts for the houses within the *Subsidence Study Area*, therefore, is less than that observed above previously extracted longwalls at Tahmoor Mine, including LW 24A and above the south-eastern ends of LWs 25 and 26, in the areas of increased subsidence. It is expected that the incidence of claims for impacts resulting from the mining induced tilt would be low, due to the extraction of the proposed longwalls, as was previously experienced in the areas of increased subsidence.

It is expected that, in all cases, the houses within the *Subsidence Study Area* will remain in safe and serviceable conditions as the result of the mining induced tilts as tilts by themselves rarely impact on the stability of building structures at the levels that are predicted to occur.

Potential impacts resulting from curvature and strain

It has been found from past longwall mining experience that the majority of mining-induced impacts on houses are a result of curvature and strain.

There are 100 houses within the *Subsidence Study Area* (i.e. 95 % of the total) that are predicted to experience hogging curvatures less than 0.10 km^{-1} and 88 houses (i.e. 84 % of the total) that are predicted to experience sagging curvatures less than 0.10 km^{-1}, which represent minimum radii of curvature of 10 kilometres.

The maximum predicted curvatures for the houses within the *Subsidence Study Area* are 0.11 km^{-1} hogging and 0.23 km^{-1} sagging, which represent minimum radii of curvature of 9.1 kilometres and 4.3 kilometres, respectively.

The distribution of predicted curvatures for the houses within the *Subsidence Study Area* is provided in Fig. 11.13.

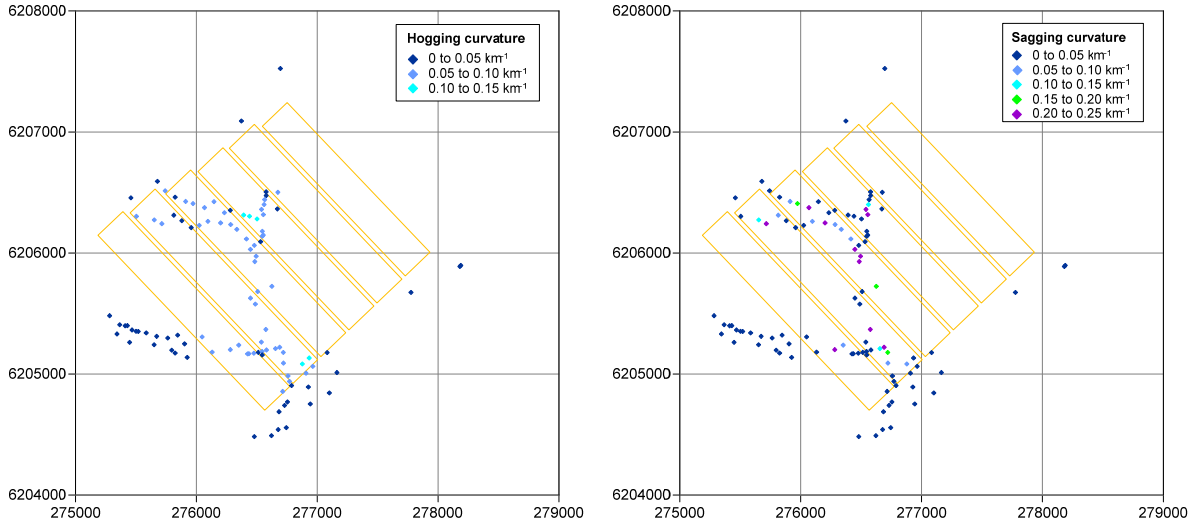


Fig. 11.13 Distribution of predicted hogging curvatures (left) and sagging curvatures (right) for houses at the completion of mining

The above figure shows that the greatest predicted curvatures occur directly above the proposed longwalls.

Houses located above previously extracted longwalls at Tahmoor have experienced mining-induced curvatures within the predicted range for the Amended Layout. This includes curvatures greater than 0.10 km^{-1}, which were observed above Tahmoor Mine LW 24A and above the south-eastern ends of LWs 25 and 26, in the areas of increased subsidence. The distributions of measured hogging and sagging curvatures for the survey bays located in the area of increased subsidence above LW 24A, LWs 25 and 26, is provided in Fig. 11.14. Generalised Pareto Distributions (GDPs) have also been fitted to the observed data which are shown by the blue curves.

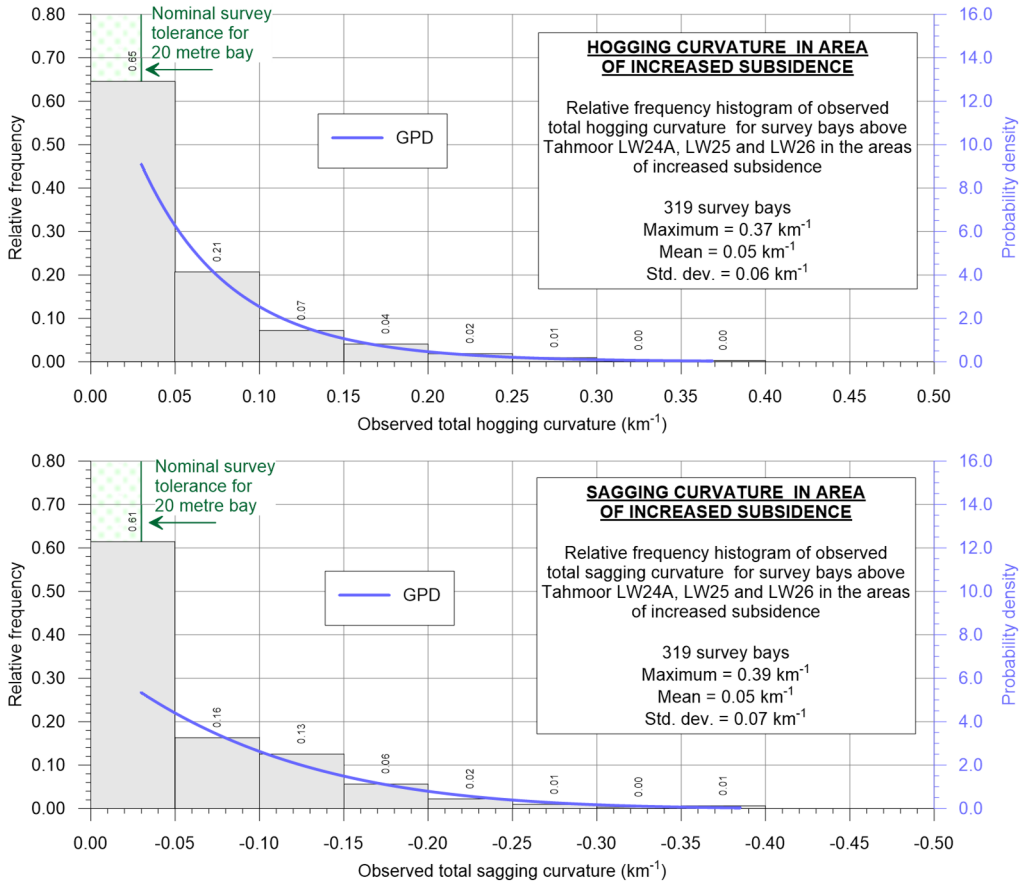


Fig. 11.14 Distributions of measured curvatures for survey bays located in the areas of increased subsidence above Tahmoor Mine LWs 24A, 25 and 26

It can be seen from the above figure, that the maximum observed total curvatures for the survey marks in the areas of increased subsidence were 0.37 km^{-1} hogging and 0.39 km^{-1} sagging, which are greater than the maximum predicted curvatures at the houses within the *Subsidence Study Area* of 0.11 km^{-1} hogging and 0.23 km^{-1} sagging.

The range of predicted curvatures for the houses within the *Subsidence Study Area*, therefore, less than those observed above previously extracted longwalls at Tahmoor Mine, including LW 24A and above the eastern ends of LWs 25 and 26 in the areas of increased subsidence. It is expected, therefore, that the incidence of claims for impacts resulting from the mining induced curvature and strain for the proposed longwalls would be similar to those previously experienced in the areas of increased subsidence. The methods for predicting and assessing impacts on building structures have developed over time as knowledge and experience has grown. MSEC has provided predictions and impact assessments for the houses within the *Subsidence Study Area* using the latest methods available at the time of writing.

Building structures have been directly mined beneath at a number of collieries throughout the NSW Coalfields. The experience gained has provided substantial information that has been used to continually develop the methods of impact assessment for houses. The assessments provided in this report are based on the latest research, which is summarised in Appendix C.

Trend analyses were conducted following the mining of Tahmoor Mine LWs 22 to 29. The analyses indicated that the chance of impact is higher for the following houses:-

- Houses predicted to experience higher strains and curvatures,
- Houses with masonry walls,
- Masonry walled houses that are constructed on strip footings,
- Larger houses, and
- Houses with variable foundations, such as those with extensions added.

The probabilities of impacts for each house within the *Subsidence Study Area* have been assessed using the method developed as part of ACARP Research Project C12015 (Waddington, 2009) and it has been updated based on observations of impacts at Tahmoor up to 2016 when the extraction of Longwall 29 was completed. This method uses the primary parameters of ground curvature and type of construction and is described in Appendix C. The parameter of strain is indirectly used in this method due to its relationship with curvature. A summary of the predicted movements and the assessed impacts for each house within the *Subsidence Study Area* is provided in Table D.03, in Appendix D.

The overall distribution of the assessed impacts for the houses within the *Subsidence Study Area* is provided in Table 11.4. The assessed impacts have been determined based on the existing construction type of each house, as described in Section 11.1.1.

Table 11.4 Assessed impacts for houses within the *Subsidence Study Area*

Group	Repair category			
	No Claim or R0	R1 or R2	R3 or R4	R5
All houses (total of 105)	74 (71 %)	21 (20 %)	8 (8 %)	2 (1 %)
Directly above proposed longwalls (total of 65)	38 (59 %)	18 (28 %)	7 (11 %)	1 (2 %)
Directly above solid coal (total of 40)	36 (90 %)	3 (8 %)	1 (2 %)	< 1 (< 0.5 %)

In comparison, extensive data has come from the extraction of Tahmoor Mine Longwalls 22 to 29, where approximately 1,900 houses have experienced mine subsidence movements. A summary of the observed distribution of impacts for all houses within a 35° angle of draw of previously extracted Longwalls 22 to 29 as at 2016 is provided in Table 11.5.

Table 11.5 Observed frequency of impacts for building structures resulting from the extraction of Tahmoor Mine longwalls 22 to 29

Group	Repair category			
	No Claim or R0	R1 or R2	R3 or R4	R5
All houses within 35 degree angle of draw of LWs 22 to 29 (total of 1890)	1430 (76 %)	329 (17 %)	111 (6 %)	20 (1 %)
All houses, located directly above LWs 24A to 27 in Zone of Increased Subsidence (total of 432)	235 (54 %)	128 (30 %)	55 (13 %)	14 (3 %)

As discussed previously, the range of predicted curvatures for the houses within the *Subsidence Study Area* are less than but similar to those observed above Tahmoor Mine Longwalls 24A to 27 within the observed zone of increased subsidence.

When the assessed distribution of impacts for the houses located directly above the proposed longwalls (second row of Table 11.4) are compared with the observed distribution of impacts of houses and major civil structures located directly above Longwalls 24A to 27 within the zone of increased subsidence (bottom row of Table 11.5), it can be seen that these are reasonably similar.

As mentioned earlier, the assessed impacts have been undertaken based on the existing construction type of each house. It is recognised that houses may be rebuilt in the future before the proposed mining occurs. The proportion of houses impacted by mining would, for example, increase if a greater proportion of houses are constructed directly above the proposed longwalls, or if a greater proportion of houses are constructed with brick walls rather than timber-framed weatherboard style structures. The most vulnerable style of house affected by mine subsidence movements above Tahmoor Mine Longwalls 22 to 29 were constructed as brick or brick-veneer houses on strip footings.

Severe impacts have previously occurred as a result of substantial non-conventional movements and in plateau areas away from incised valleys, such as where the houses are located within the *Subsidence Study Area.* The precise location of non-conventional movements cannot be predicted prior to mining. The impacts, however, develop gradually such that they can be detected early and repairs can be undertaken incrementally to ensure that the houses remain safe and serviceable during mining.

As noted in Appendix C, at the time of writing ACARP Research Project C12015 (Waddington, 2009), the observed proportion of houses where the Mine Subsidence Board (MSB, now SA NSW) and affected landowners had agreed to rebuild rather than repair, i.e. Category R5 impacts was less than 0.5 %. Since the publication of the research report, the proportion of houses where a decision has been made to rebuild has increased to approximately 1.1 % overall and 3.2 % above Longwalls 24A to 27 within the observed zone of increased subsidence.

The observed proportion of houses with Category R1 to R4 impacts have also increased since the original ACARP study. This is partly due to the time lag effect between the mining impact, when damage is claimed by residents and when the nature and level of the damage requiring repairs is assessed in detail by SA NSW. The latest review includes observations up to the end of Longwall 29 in 2016, which was approximately two years after the completion of Longwall 27 and one year after the completion of Longwall 28, which was the last panel to directly mine beneath the urban areas of Tahmoor.

The primary risk associated with mining beneath houses is public safety. Residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements in the NSW Coalfields, where the depths of cover were greater than 350 metres, such as the case above the proposed longwalls. This includes the recent experience at Tahmoor Mine, which has affected more than 1,950 houses, and the experiences at Appin, Teralba, West Cliff and West Wallsend Collieries, which have affected around 500 houses.

Emphasis is placed on the words “immediate and sudden” as in rare cases, some structures have experienced severe impacts, but the impacts did not present an immediate risk to public safety as they developed gradually with ample time to temporarily relocate residents.

All houses within the *Subsidence Study Area* are expected to remain safe and repairable throughout the mining period, provided that effective management measures are adopted during mining and these are described in Section 11.1.5.

11.1.4. Future development of houses within the *Subsidence Study Area*

There are no known future developments within the *Subsidence Study Area*.

11.1.5. Management of potential impacts on the houses

Tahmoor Mine has extensive experience of mining beneath urban areas. It has developed and acted in accordance with a risk management process to manage potential impacts to residential structures during the mining of LWs 22 to 32 and LWs W1-W3.

The Subsidence Management Process has been developed in consideration of the following facts and observations:

1. Australian standards have been available for use in the design of structures since 1948. The great majority of structures at Tahmoor and Thirlmere (approximately 80 %) have been constructed after the declaration of the Bargo Mine Subsidence District in November 1975.
2. There is sufficient redundancy in structural design such that ductile deformation will develop and be noticeable to residents before structural failure occurs.
3. Subsidence movements develop gradually over time at Tahmoor Mine as they have above other previously extracted longwalls at similar depths of cover.
4. Experiences during the mining of LWs 22 to 32 and LWs W1-W3 have found that the most effective method of managing potential impacts on the safety and serviceability of structures are by way of community consultation. Residents living within the active subsidence zone have often provided early feedback to Tahmoor Mine and/or SA NSW about impacts developing at their houses or along their local roads. Contact is made well before impacts develop to a level of severity sufficient to become a safety hazard.
5. On the basis of the above, there is sufficient time for residents to notify Tahmoor Mine or SA NSW of significant displacement or deflection well before structural failure will occur.
6. The conclusions are supported by the observation that residents have not been exposed to immediate and sudden safety hazards as a result of impacts that occur due to mine subsidence movements at Tahmoor Mine and above other previously extracted longwalls at similar depths of cover. This includes the recent experience at Tahmoor Mine during the mining of LWs 22 to 32 and LWs W1-W3, which have affected more than 2000 houses and civil structures.

While severe impacts have developed during the mining of LWs 22 to 32, there is sufficient redundancy in structural design such that when structures have experienced severe impacts, they have developed gradually with ample time for residents to notify Tahmoor Mine or SA NSW to repair the structure and/or relocate residents before structural failure occurs.

While the three most important factors in managing risks to public safety are redundancy in structural design, gradual development of subsidence movements and an effective community consultation program, a number of additional management measures have been undertaken, including site specific investigations, regular surveys and inspections during mining and triggered response measures. The method of management would not change if additional houses are constructed in the future as described in Section 11.1.4.

It is recommended that Tahmoor Coal continues its current practice of ensuring that built structures remain safe and serviceable at all times during mining. It is recommended that Tahmoor Coal, in consultation with landowners, study the potential for impacts on the structures and other infrastructure and develop management measures. The study would require input from structural and subsidence engineers. The risk management process includes the following processes:-

1. Regular consultation, cooperation and coordination with the community before, during and after mining. This includes letters and door knocking to all residents of structures that will soon be affected by subsidence. The letters offer a free pre-mining inspection and hazard identification inspection by a structural engineer;
2. Site-specific investigations, where they are necessary and appropriate, into the conditions of buildings and associated structures and their surrounding environment (where access is allowed). The site-specific investigations have been and will continue to be undertaken early so that there is adequate time, if required, to arrange additional inspections and/or surveys and implement any mitigation measures before mining-induced impacts are experienced;

   For properties located directly above the first 300 metres of the commencing end of a longwall, the investigations are targeted to be undertaken prior to extraction or at the latest, they will be undertaken prior to the first 200 metres of extraction of the longwall.

   The site-specific investigations include the following:

   a) Identification of structures from aerial photographs and kerbside inspections;
   b) Front of house risk and visual screening inspections by Tahmoor Coal in company with a structural engineer for all properties that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of each upcoming longwall. The purpose of the inspections is to identify hazards where access has not been granted by the landowner.

In some cases, particularly in semi-rural and rural areas, it is difficult to inspect a structure that is remote from the street front. Where these cases involve properties that are located directly above a longwall, Tahmoor Coal will request access to conduct a pre-mining inspection and hazard identification inspection by a structural engineer;

c) Tahmoor Coal will request access to conduct pre-mining geotechnical inspections of structures located on or immediately adjacent to steep slopes that are predicted to experience more than 20 mm of incremental vertical subsidence due to the extraction of each longwall;

d) Tahmoor Coal will request access to conduct pre-mining hazard identification inspections by a structural engineer (where access is allowed by the landowner) to properties with structures that have been specifically targeted on the basis that may be more sensitive to mine subsidence movements. These include:

   i) Commercial and business establishments, public amenities and public utilities;

   ii) Structures of heritage significance;

   iii) Structures that are located above hidden creeks (none identified within the *Subsidence Study Area*);

   iv) Structures that are located above mapped geological structures (none identified within the *Subsidence Study Area*);

   v) Structures that are located on or adjacent to steep slopes or that have been recommended for structural inspection by the geotechnical engineer;

   vi) Structures that have been identified as being potentially unstable or unsafe by landowners (Item 1), or from the front of house inspections (Item 2b);

   vii) Houses and units located outside the declared Mine Subsidence Districts; and

   viii) Houses and units estimated to have been constructed prior to the declaration of the Bargo Mine Subsidence District (in November 1975).

3. Implementation of pre-mining mitigation measures following inspections by the geotechnical engineer and the structural engineer, in consultation and agreement with the landowner.

4. Surveys and inspections during mining within the active subsidence area:

   a) detailed visual inspections and vehicle-based inspections along the streets;

   b) ground surveys along the streets;

   c) specific ground surveys for selected properties, where recommended by the geotechnical engineer or structural engineer due to their proximity to steep slopes or pre-existing condition;

   d) visual inspections of residential structures that are either: located on or adjacent to steep slopes, are in poor existing condition (based on the hazard identification inspections), have previously reported impacts, or where recommended by the Structures Response Group;

   e) visual inspections of pool fences and gates; and

   f) visual inspections of commercial, industrial and business establishments, public amenities and public utilities.

With appropriate management plans in place, it is considered that the houses will remain safe and serviceable at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

11.2. Flats or units

There are no flats or units within the *Subsidence Study Area*.

11.3. Caravan parks

There are no caravan parks within the *Subsidence Study Area*.

11.4. Retirement or aged care villages

There is no retirement village within the *Subsidence Study Area*.

11.5. Swimming pools

11.5.1. Descriptions of the swimming pools

The locations of the private swimming pools within the *Subsidence Study Area* are shown in Drawing No. MSEC1192-18.

There are 22 privately owned swimming pools which have been identified within the *Subsidence Study Area*. The majority of these pools (68 %) will be directly mined beneath by the proposed longwalls. The locations and sizes of the pools were determined from orthophotographs of the area.

11.5.2. Predictions for the swimming pools

Predictions of conventional subsidence, tilt and curvature have been made at the centroid and at points located around the perimeter of each pool, as well as at points located at a distance of 20 metres from the perimeter of each pool.

A summary of the maximum predicted values of conventional subsidence, tilt and curvature for each pool within the *Subsidence Study Area* is provided in Table D.06, in Appendix D. The predictions are based on the proposed longwall layout, as shown in Drawing No. MSEC1192-18. The predicted tilts provided in this table are the maxima in any direction after the completion of each of the proposed longwalls. The predicted curvatures are the maxima in any direction at any time during or after the extraction of each of the proposed longwalls.

Distributions of the maximum predicted conventional subsidence, tilt and curvature for the pools within the *Subsidence Study Area* are illustrated in Fig. 11.15 and Fig. 11.16.

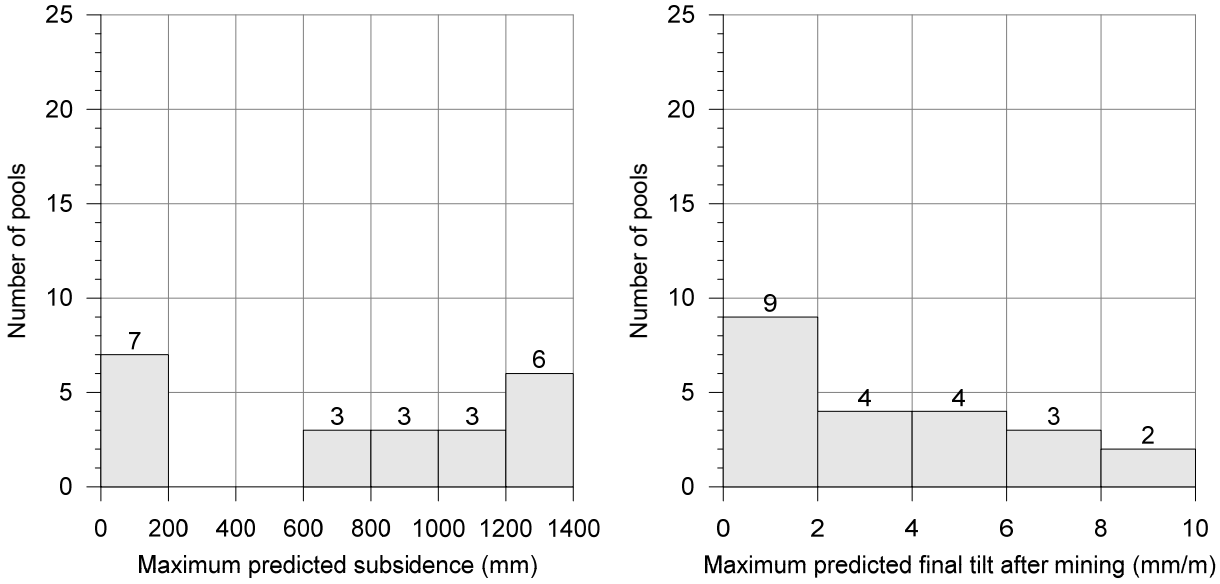


Fig. 11.15 Maximum predicted conventional subsidence and tilt for pools within the Subsidence Study Area

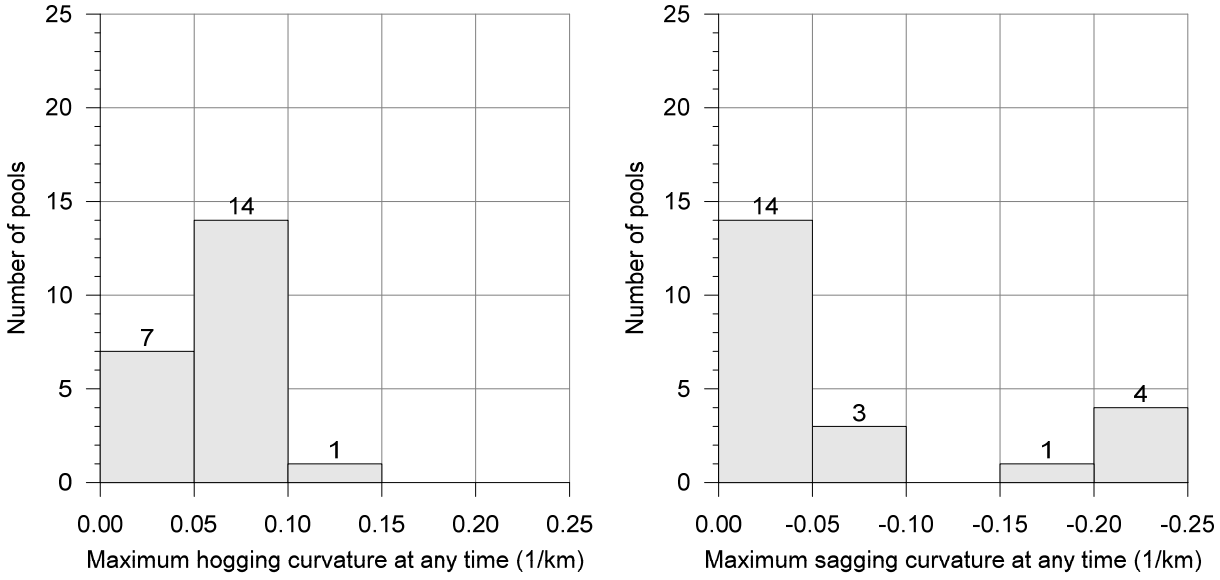


Fig. 11.16 Maximum predicted conventional hogging curvature (left) and sagging curvature (right) for the pools within the Subsidence Study Area

The maximum predicted conventional strains for the pools, based on applying a factor of 15 to the maximum predicted conventional curvatures, are 1.7 mm/m tensile and 3.4 mm/m compressive. Non-conventional movements can also occur as a result of, among other things, anomalous movements. The analysis of strains provided in Chapter 4 includes those resulting from both conventional and non-conventional anomalous movements.

The pools are at discrete locations and, therefore, the most relevant distributions of strain are the maximum strains measured in individual survey bays from previous longwall mining. The analysis of strains in survey bays during the mining of previous longwalls in the Southern Coalfield is discussed in Section 4.3.1. The results for survey bays located above goaf are provided in Fig. 4.2 and the results for survey bays located above solid coal are provided in Fig. 4.3.

11.5.3. Impact assessments for the swimming pools

Mining-induced tilts are more noticeable in pools than other structures due to the presence of the water line and the small gap to the edge coping, particularly when the pool lining has been tiled. Skimmer boxes are also susceptible of being lifted above the water line due to mining tilt.

The Australian Standard AS2783-1992 (Use of reinforced concrete for small swimming pools) requires that pools be constructed level ± 15 mm from one end to the other. This represents a tilt of approximately 3 mm/m for pools that are 10 metres in length. Australian Standard AS/NZS 1839:1994 (Swimming pools – Pre-moulded fibre-reinforced plastics – Installation) also requires that pools be constructed with a tilt of 3 mm/m or less.

There are 11 pools within the *Subsidence Study Area* (i.e. 50 % of the total) which are predicted to experience final tilts of 3 mm/m or less, at the completion of the proposed longwalls, which is similar to or less than the Australian Standard.

There are 9 pools (i.e. 41 % of the total) predicted to experience final tilts between 3 mm/m and 7 mm/m and 2 pools (i.e. 9 % of the total) predicted to experience final tilts greater than 7 mm/m. The maximum predicted final tilt for the pools is 9 mm/m (i.e. 0.9 %), which represents a change in grade of 1 in 111. It is likely that a number of these pools would require some remediation of the pool copings.

The maximum predicted conventional curvatures for the pools are 0.11 km^{-1} hogging and 0.23 km^{-1} sagging, which equate to minimum radii of curvature of 9.1 kilometres and 4.3 kilometres, respectively. Whilst the predicted subsidence parameters for the proposed longwalls are greater than those at Tahmoor North, it would still be expected that the rates of impact on pools at Tahmoor North would provide a reasonable guide to the likely levels of impact.

Observations during the mining of Tahmoor Mine LWs 22 to 32 have shown that pools, particularly in-ground pools, are more susceptible to severe impacts than houses and other structures. Pools cannot be easily repaired and most of the impacted pools need to be replaced.

As of June 2017, a total of 157 pools have experienced mine subsidence movements during the mining of Tahmoor Mine Longwalls 22 to 30, of which 141 were located directly above the extracted longwalls. A total of 36 pools have reported impacts, all of which were located directly above the extracted longwalls. This represents an impact rate of approximately 23 %. A higher proportion of impacts have been observed for in-ground pools, particularly fibreglass pools. The majority of the impacts related to tilt or cracking, though in a small number of cases the impacts were limited to damage to skimmer boxes or the edge coping.

It is expected that the rate of impact on the pools within the *Subsidence Study Area* would be similar, but, slightly greater than those previously experienced at Tahmoor North. Impacts to the pools would be repaired or, if required the pool would be replaced in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

11.5.4. Impact assessments for the swimming pools based on increased predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the final tilts would still be 3 mm/m or less at 7 pools within the *Subsidence Study Area* (i.e. 32 % of the total) at the completion of mining. In this case, there would be 5 pools (i.e. 23 % of the total) predicted to experience final tilts between 3 mm/m and 7 mm/m and 10 pools (i.e. 45 % of the total) predicted to experience final tilts greater than 7 mm/m. It is possible that approximately half the pools within the *Subsidence Study Area* would require some remediation of the coping due to the mining induced tilt, if the actual tilts exceeded those predicted by a factor of 2 times.

If the actual curvatures exceeded those predicted by a factor of 2 times, the incidence of impacts would increase for the pools located directly above the proposed longwalls. While the predicted ground movements are important parameters when assessing the potential impacts on the pools, it is noted that the impact assessments were primarily based on observed rate of impact from Tahmoor North. The overall

levels of impact on the pools, resulting from the extraction of the proposed longwalls, are expected to be similar to, but, slightly greater than those observed at Tahmoor North.

11.5.5. Management of potential impacts on the swimming pools

Tahmoor Coal has developed and acted in accordance with a risk management plan to manage potential impacts to pools during the mining of LWs 22 to 32 and LWs W1-W3. The management plan is reviewed periodically by Tahmoor Coal. It is recommended that Tahmoor Coal continue to develop management plans to manage potential impacts during the mining of the proposed longwalls.

While not strictly related to the pool structure, a number of pool gates have been impacted as the result of the previous extraction of longwalls beneath pools. While the gates can be easily repaired, the worst-case consequence of breaching pool fence integrity could be severe. As a result, Tahmoor Coal inspects the integrity of pool fences once a week for pools that are experiencing active subsidence during mining.

With an appropriate management plan in place, it is considered that pools and pool fences can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non- conventional movements occurred.

11.5.6. Tennis courts

There are no privately owned tennis courts within the *Subsidence Study Area*.

11.5.7. On-site waste water systems

The majority of the residences within the *Subsidence Study Area* operate on-site waste water systems.

The on-site waste water system tanks are generally small, typically less than 3 metres in diameter, are constructed from reinforced concrete, and are usually bedded in sand and backfilled. It is unlikely, therefore, that the maximum predicted curvatures and strains would be fully transferred into the tank structures.

It is possible, however, that the buried pipelines associated with the on-site waste water tanks could be impacted by the strains if they are anchored by the tanks or other structures in the ground. Any impacts are expected to be of a minor nature, including leaking pipe joints, and could be readily repaired. With the implementation of these remedial measures, it would be unlikely that there would be any adverse impacts on the pipelines associated with the on-site wastewater systems.

11.5.8. Rigid external pavements

Adverse impacts on rigid external pavements are often reported to SA NSW in the NSW Coalfields. This is because pavements are typically thin relative to their length and width. The design of external pavements is also not regulated by Council or SA NSW.

A study by MSEC of 120 properties at Tahmoor and Thirlmere indicated that 98 % of the properties with external concrete pavements demonstrated some form of cracking prior to mining. These cracks are sometimes difficult to distinguish from cracks caused by mine subsidence. It is therefore uncertain how many claims for damage can be genuinely attributed to mine subsidence impacts.

Residential concrete pavements are typically constructed with tooled joints which do not have the capacity to absorb compressive movements. It is possible that some of the smaller concrete footpaths or pavements within the *Subsidence Study Area*, in the locations of the larger compressive strains, could buckle upwards if there are insufficient movement joints in the pavements. It is expected, however, that the buckling of footpaths and pavements would not be common, given the magnitudes of the predicted ground strains, and could be easily repaired.

11.6. Fences

Predictions and impact assessments for fences are provided in Section 8.9.

11.7. Any other residential feature

There are no other substantial residential features within the *Subsidence Study Area*.

12.0 ANY KNOWN FUTURE DEVELOPMENTS

There are currently no known future developments *Subsidence Study Area*.

13.0 CONCLUSIONS

Mine Subsidence Engineering Consultants (MSEC) has studied the Extraction Plan Layout and identified the natural features and items of surface infrastructure that are in the *Subsidence Study Area*.

Predictions of subsidence movements have been provided for each of these natural features and items of surface infrastructure. The predictions have been produced using a model that has been calibrated from observations of previous movements during the extraction of previous longwalls at Tahmoor Mine and more broadly from observations of previous movements during the extraction of previous longwalls at similar depths of cover at nearby mines in the Southern Coalfield.

The maximum predicted total subsidence, after the completion of the proposed longwalls, is 1,350 mm which represents around 61 % of the extraction height.

The potential for impacts has been assessed based on the predicted subsidence movements, consultation with infrastructure owners and experiences gained during the extraction of previous longwalls at Tahmoor Mine and more broadly from experiences during the extraction of previous longwalls at similar depths of cover at nearby mines in the Southern Coalfield.

The overall findings of the assessments undertaken by MSEC are that the levels of impact and damage to all identified natural features and built infrastructure are manageable and can be controlled by the preparation and implementation of Subsidence Management Plans (or Extraction Plans), many of which have been successfully implemented during previous mining at Tahmoor Mine. These management plans are developed in consultation with the owners of infrastructure and are approved by relevant government agencies. The findings in this report should be read in conjunction with all other associated consultant reports.

Recommended management measures generally include monitoring of ground movements and the condition of surface features. Some mitigation measures are recommended to mitigate or avoid the risk of serious consequences should impacts occur to some critical surface features.

It is recommended that Tahmoor Coal continues to develop management plans to manage the potential impacts for the surface features due to the extraction of the proposed longwalls.

APPENDIX A. GLOSSARY OF TERMS AND DEFINITIONS

Glossary of Terms and Definitions

Some of the more common mining terms used in the report are defined below:-

Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence).
Chain pillar	A block of coal left unmined between the longwall extraction panels.
Cover depth (H)	The depth from the surface to the top of the seam. Cover depth is normally provided as an average over the area of the panel.
Closure	**T**he reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of *millimetres (mm)*, is the greatest reduction in distance between any two points on the opposing valley sides. It should be noted that the observed closure movement across a valley is the total movement resulting from various mechanisms, including conventional mining induced movements, valley closure movements, far-field effects, downhill movements and other possible strata mechanisms.
Critical area	The area of extraction at which the maximum possible subsidence of one point on the surface occurs.
Curvature	The change in tilt between two adjacent sections of the tilt profile divided by the average horizontal length of those sections, i.e. curvature is the second derivative of subsidence. Curvature is usually expressed as the inverse of the **Radius of Curvature** with the units of *1/kilometres (km-1)*, but the value of curvature can be inverted, if required, to obtain the radius of curvature, which is usually expressed in *kilometres (km)*. Curvature can be either **hogging** (i.e. convex) or **sagging** (i.e. concave).
Extracted seam	The thickness of coal that is extracted. The extracted seam thickness is thickness normally given as an average over the area of the panel.
Effective extracted seam thickness (T)	The extracted seam thickness modified to account for the percentage of coal left as pillars within the panel.
Face length	The width of the coalface measured across the longwall panel.
Far-field movements	The measured horizontal movements at pegs that are located beyond the longwall panel edges and over solid unmined coal areas. Far-field horizontal movements tend to be bodily movements towards the extracted goaf area and are accompanied by very low levels of strain.
Goaf	The void created by the extraction of the coal into which the immediate roof layers collapse.
Goaf end factor	A factor applied to reduce the predicted incremental subsidence at points lying close to the commencing or finishing ribs of a panel.
Horizontal displacement	The horizontal movement of a point on the surface of the ground as it settles above an extracted panel.
Inflection point	The point on the subsidence profile where the profile changes from a convex curvature to a concave curvature. At this point the strain changes sign and subsidence is approximately one half of S max.
Incremental subsidence	The difference between the subsidence at a point before and after a panel is mined. It is therefore the additional subsidence at a point resulting from the excavation of a panel.
Panel	The plan area of coal extraction.
Panel length (L)	The longitudinal distance along a panel measured in the direction of mining from the commencing rib to the finishing rib.
Panel width (Wv)	The transverse distance across a panel, usually equal to the face length plus the widths of the roadways on each side.
Panel centre line	An imaginary line drawn down the middle of the panel.
Pillar	A block of coal left unmined.
Pillar width (Wpi)	The shortest dimension of a pillar measured from the vertical edges of the coal pillar, i.e. from rib to rib.

Shear deformations	The horizontal displacements that are measured across monitoring lines and these can be described by various parameters including; horizontal tilt, horizontal curvature, mid-ordinate deviation, angular distortion and shear index.
Strain	The change in the horizontal distance between two points divided by the original horizontal distance between the points, i.e. strain is the relative differential displacement of the ground along or across a subsidence monitoring line. Strain is dimensionless and can be expressed as a decimal, a percentage or in parts per notation. **Tensile Strains** are measured where the distance between two points or survey pegs increases and **Compressive Strains** where the distance between two points decreases. Whilst mining induced **strains** are measured **along** monitoring lines, ground **shearing** can occur both vertically, and horizontally **across** the directions of the monitoring lines.
Sub-critical area	An area of panel smaller than the critical area.
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel, but, 'subsidence of the ground' in some references can include both a vertical and horizontal movement component. The vertical component of subsidence is measured by determining the change in surface level of a peg that is fixed in the ground before mining commenced and this vertical subsidence is usually expressed in units of *millimetres (mm)*. Sometimes the horizontal component of a peg's movement is not measured, but in these cases, the horizontal distances between a particular peg and the adjacent pegs are measured.
Super-critical area	An area of panel greater than the critical area.
Tilt	The change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the horizontal distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of *millimetres per metre (mm/m)*. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %, or 1 in 1000.
Uplift	An increase in the level of a point relative to its original position.
Upsidence	Upsidence results from the dilation or buckling of near surface strata at or near the base of the valley. The magnitude of upsidence, which is typically expressed in the units of *millimetres (mm)*, is the difference between the observed subsidence profile within the valley and the conventional subsidence profile which would have otherwise been expected in flat terrain.

APPENDIX B. REFERENCES

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APPENDIX C. METHOD OF IMPACT ASSESSMENTS FOR HOUSES

APPENDIX C METHOD OF IMPACT ASSESSMENT FOR HOUSES

C.1. Introduction

The methods for predicting and assessing impacts on building structures have developed over time as knowledge and experience has grown. MSEC has provided predictions and impact assessments for the building structures within the *Subsidence Study Area* using the latest methods available at this time.

Longwall mining has occurred directly beneath building structures at a number of collieries in the Southern Coalfield, including Appin, West Cliff, Tower and Tahmoor Mines. The most extensive data has come from extraction of Tahmoor Mine Longwalls 22 to 29, where approximately 2000 houses have experienced subsidence movements. The experiences gained during the mining of these longwalls, as well as longwalls at other collieries in the Southern and Newcastle Coalfields, have provided substantial additional information that has been used to further develop the methods.

The information was initially collected during the mining of Tahmoor Mine Longwalls 22 to 24A and reviewed in two parallel studies, one as part of a funded ACARP Research Project C12015 (Waddington, 2009), and the other at the request of Industry and Investment NSW (now the Department of Planning, Industry and Environment – Resources Regulator).

The outcomes of these studies include:-

- Review of the performance of the previous method,
- Recommendations for improving the method of Impact Classification, and
- Recommendations for improving the method of Impact Assessment.

Additional information was collected in 2016 after the completion of Longwall 29 and impact assessments for the houses in this report have been based on the updated information provided. A summary is provided in the following sections.

C.2. Review of the Performance of the Previous Method

The previous method of impact assessment applied predictions of curvature on the overall length of each house to predict a crack width in the external walls that was classified based primarily in accordance with Table C1 of Australian Standard 2870-1996. This method did not include impacts to other elements, finishes or services.

Extensive data on house impacts has come from extraction of Tahmoor Mine Longwalls 22 to 25 and a comparison between predicted and observed impacts is provided in Table C.1. The comparison is based on pre-mining predictions that were provided in SMP Applications for these longwalls and the observations of impacts using the previous method of impact classification. The comparison is based on information up to 30 November 2008. At that point in time, the length of extraction of Longwall 25 was 611 metres.

A total of 1037 houses and civil structures were affected by subsidence due to the mining of Tahmoor Mine Longwalls 22 to 25 at that time. A total of 175 claims had been received by the MSB, now SA NSW (not including claims that were refused) of which 14 claims did not relate to the main residence or civil structure.

Table C.1 Summary of Comparison between Observed and Predicted Impacts for each Structure

Strain Impact Category	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 0	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 1	Total No. of Observed Impacts for Structures predicted to be Strain Impact Category 2	Total
No impact	483	373	20	876
Cat 0	31	70	6	107
Cat 1	8	9	1	18
Cat 2	7	11	2	20
Cat 3	2	2	0	4
Cat 4	3	5	0	8
Cat 5	3	1	0	4
Total	537	471	29	1037
% claim	**10 %**	**21 %**	**31 %**	16 %
% Obs > Pred	**4 %**	**4 %**	**0 %**	-
% Obs <= Pred	**96 %**	**96 %**	**100 %**	-

Note: Predicted impacts due to conventional subsidence only, as described in the SMP Application.

Given that observed impacts are less than or equal to predicted impacts in 96 % of cases, it is considered that the previous methods are generally conservative even though non-conventional movements were not taken into account in the predictions and assessments. However, when compared on a house by house basis, the predictions have been substantially exceeded in a small proportion of cases.

The majority, if not all, of the houses that have experienced Category 3, 4 or 5 impacts are considered to have experienced substantial non-conventional subsidence movements. The consideration is based on nearby ground survey results, where localised bumps are observed in subsidence profiles and high localised strain is observed. The potential for impact from non-conventional movements were discussed generally and not included in the specific impact assessments for each structure.

The inability to specify the number or probability of impacts due to the potential for non-conventional movements is a shortcoming of the previous method. It was considered that there was substantial room for improvement in this area and recommendations are provided to improve the previous method.

The comparison shows a favourable observation that the overall proportion of claims increased for increasing observed ground movements. This suggests that the main parameters currently used to make impact assessments (namely predicted conventional curvature and maximum plan dimension of each structure) are credible. Please note that we have stated predicted conventional curvature rather than strain, as predictions of strain were directly based on predictions of conventional curvature.

A substantial over-prediction is observed at the low end of the spectrum of impacts (Category 0 and 1). A number of causes and/or possible causes for the deviations have been identified:

- Construction methods and standards may mitigate against small differential ground movements.
- The impacts may have occurred but the residents have not made a claim for the following reasons:-
  - All structures contain some existing, pre-mining defects. A pre-mining field investigation of 119 structures showed that it is very rare for all elements of a building to be free of cracks. Cracks up to 3 mm in width are commonly found in buildings. Cracks up to 1 mm in width are very common. There is a higher incidence of cracking in brittle forms of construction such as masonry walls and tiled surfaces.
  - In light of the above, additional very slight Category 0 and 1 impacts may not have been noticed by residents. A forensic investigation of all structures before or after mining may reveal that the number of actual impacts is greater than currently known.
  - Similarly, impacts have been noticed but some residents may consider them to be too trivial to make a claim. While difficult to prove statistically, it is considered that the frequency of claims from tenanted properties is less than the frequency of claims from owner-occupied properties.
- The impacts have been noticed but some residents are yet to make a claim at this stage. It has been observed that there is a noticeable time lag between the moment of impact and the moment of making a claim. At the time of the original study in 2008, more claims were therefore expected to be received in the future within areas that have already been directly mined beneath. This has been confirmed by the findings of the most recent study based on information received in 2016. It has also been found that as assessments and repairs were progressively determined at each house, the level of impacts at each house has generally been greater than was originally reported.
- The predictive method is deliberately conservative in a number of ways.
  - Predicted subsidence movements for each structure are based on the maximum predicted subsidence movements within 20 metres of the structure.
  - An additional 0.2 mm/m of strain was added
  - Maximum strains were applied to the maximum plan dimension, regardless of the maximum predicted strain orientation.
  - The method of impact assessment does not provide for “nil impacts”. The minimum assessed level of impact is Category 0.
  - The impact data was based on double-storey full masonry structures in the UK.

Finally, it is considered that the previous method impact classification has masked the true nature and extent of impacts. It is recommended that an improved method of classification be adopted before embarking on any further analysis. This is discussed in the next chapter of this report.

C.3. Method of Impact Classification

C.3.1. Previous Method

The impacts to structures were previously classified in accordance with Table C1 of Australian Standard 2870-1996, but the table has been extended by the addition of Category 5 and is reproduced below.

Table C.2 Classification of Damage with Reference to Strain

Impact Category	Description of typical damage to walls and required repair	Approximate crack width limit
0	Hairline cracks.	< 0.1 mm
1	Fine cracks which do not need repair.	0.1 mm to 1.0 mm
2	Cracks noticeable but easily filled. Doors and windows stick slightly	1 mm to 5 mm
3	Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weather-tightness often impaired	5 mm to 15 mm, or a number of cracks 3 mm to 5 mm in one group
4	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window or door frames distort. Walls lean or bulge noticeably. Some loss of bearing in beams. Service pipes disrupted.	15 mm to 25 mm but also depends on number of cracks
5	As above but worse, and requiring partial or complete rebuilding. Roof and floor beams lose bearing and need shoring up. Windows broken with distortion. If compressive damage, severe buckling and bulging of the roof and walls.	> 25 mm

Note 1 of Table C1 states that *"Crack width is the main factor by which damage to walls is categorized. The width may be supplemented by other factors, including serviceability, in assessing category of damage.*

Impacts relating to tilt were classified according to matching impacts with the description in Table C.3, not the observed actual tilt. This is because many houses that had experience tilts greater than 5 mm had not made a claim to the MSB (now SA NSW).

Table C.3 Classification of Damage with Reference to Tilt

Impact Category	Tilt (mm/m)	Description
A	< 5	Unlikely that remedial work will be required.
B	5 to 7	Adjustment to roof drainage and wet area floors might be required.
C	7 to 10	Minor structural work might be required to rectify tilt. Adjustments to roof drainage and wet area floors will probably be required and remedial work to surface water drainage and sewerage systems might be necessary.
D	> 10	Considerable structural work might be required to rectify tilt. Jacking to level or rebuilding could be necessary in the worst cases. Remedial work to surface water drainage and sewerage systems might be necessary.

C.3.2. Need for Improvement to the Previous Method of Impact Classification

It is very difficult to design a method of impact classification that covers all possible scenarios and permutations. The application of any method is likely to find some instances that do not quite fit within the classification criteria.

Exposure to a large number of affected structures has allowed the mining industry to appreciate where improvements can be made to all aspects including the identification of areas for improvement in the previous method of impact classification.

A number of difficulties have been experienced with the previous method during the mining period. The difficulty centres on the use of crack width as the main classifying factor, as specified in Table C1 of Australian Standard 2870-1996.

A benefit of using crack width as the main factor is that it provides a clear objective measure by which to classify impact. However, experience has shown that crack width is a poor measure of the overall impact and extent of repair to a structure. The previous method of impact classification may be useful for assessing impact to newly built structures in a non-subsidence environment but further improvement and clarification is recommended before it can be effectively applied to houses impacted by mine subsidence.

The following aspects highlight areas where the previous classification system could be improved.-

- *Slippage on Damp Proof Course*

  Many houses have experienced slippage along the damp proof course in Tahmoor. Slippage on some houses is relatively small (less than 10 mm) though substantial slippage has been observed in a number of cases, such as shown in Fig. C.1 below.



Fig. C.1 Example of slippage on damp proof course

Under the previous classification method, the “crack” width of the slippage may be very small (Category 1) but the distortion in the brickwork is substantial. Moreover, the extent of work required to repair the impact is substantial as it usually involves re-lining the whole external skin of the structure. Such impacts would be considered Category 4 based on extent of repair but only Category 1 or 2 based on maximum crack width.

There is no reference to slippage of damp proof course in the previous method of impact classification. However, if the extent of repair was used instead of using crack width as the main factor, the impact category would be properly classified as either Category 4 or Category 5.

It was recommended that slippage of damp proof courses be added to the previous impact classification table.

- *Cracks to brickwork*

  In some cases, cracks are observed in mortar only. For example, movement joints in some structures have been improperly filled with mortar instead of a flexible sealant, as shown in Fig. C.2. In these situations, the measured crack width may be substantial but the impact is relatively simple to repair regardless of the crack width.



Fig. C.2 Example of crack in mortar only

In other cases, a small number of isolated bricks have been observed to crack or become loose. This is usually straightforward to repair. Under the previous impact classification method, a completely loose brick could be strictly classified as Category 5 as the crack width is infinitely large. This is clearly not the intention of the previous method but clarification is recommended to avoid confusion.

If a panel of brickwork is cracked, the method of repair is the same regardless of the width. While it is considered reasonable to classify large and severe cracks by its width, it is recommended that cracks less than 5 mm in width be treated the same rather than spread across Categories 0, 1 and 2.

If a brick lined structure contains many cracks of width less than 3 mm, the impact would be classified as no more than Category 2 under the previous method of impact classification. The extent of repair may be substantially more than a house that has experienced only one single 5 mm crack. However, it is recognised that it is very difficult to develop a simple method of classifying impacts based on multiple cracks in wall panels. How many cracks are needed to justify an increase in impact category?

- *Structures without masonry walls*

  Timber framed structures with lightweight external linings such weatherboard panels and fibro sheeting are not referenced in the previous classification table. If crack widths were strictly adopted to classify impacts, it may be possible to classify movement in external wall linings beyond Category 3 when in reality the repairs are usually minor.

  It was recommended that the impact classification table be extended to include structures with other types of external linings.

- *Minor impacts such as door swings*

  Experience has shown that one of the earliest signs of impact is the report of a sticking door. In some instances, the only observed impact is one or two sticking doors. It takes less than half an hour to repair a sticking door and impact is considered negligible.

  Such an impact would be rightly classified as Category 0 based on the previous method of impact classification as there is no observed crack. However, the previous classification table suggests that sticking doors and windows occur when Category 2 crack widths develop. It was recommended that the impact classification table be amended in this respect.

C.3.3. Broad Recommendations for Improvement of Previous Method of Impact Classification

It was recommended that crack width no longer be used as the main factor for classifying impacts. This does not mean that the use of crack width should be abandoned altogether. Crack width remains a good indicator of the severity of impacts and should be used to assist classification, particularly for impacts that are moderate or greater.

By focussing on crack width, the previous impact classification table appears to be classifying impacts from a structural stability perspective. It was recommended that a revised impact classification table be more closely aligned with all aspects of a building, including its finishes and services. Residents who are affected by impacts are concerned as much about impacts to internal linings, finishes and services as they are about cracks to their external walls and a revised impact classification method should reflect this.

With crack width no longer used as the main factor, it was recommended that the wording of the descriptions of impact in the classification table be extended to cover impacts to more elements of buildings. In keeping with the previous method of assessment, the level of impact should distinguish between cosmetic, serviceability and stability related impacts:-

- Low impact levels should relate to cosmetic impacts that do affect the structural integrity of the building and are relatively straight-forward to repair,
- Mid-level impact categories should relate to impacts to serviceability and minor structural issues, and
- High level impacts should be reserved for structural stability issues and impacts requiring extensive repairs.

C.3.4. Revised Method of Impact Classification

The following revised method of impact classification has been developed.

Table C.4 Revised Classification based on the Extent of Repairs

Repair Category	Extent of Repairs
Nil	No repairs required
R0 **Adjustment**	One or more of the following, where the damage does not require the removal or replacement of any external or internal claddings or linings:- - **Door** or **window** jams or swings, or - Movement of **cornices**, or - Movement at external or internal **expansion joints**.
R1 **Very Minor Repair**	One or more of the following, where the damage can be repaired by filling, patching or painting without the removal or replacement of any external or internal brickwork, claddings or linings:- - Cracks in **brick mortar** only, or isolated cracked, broken, or loose **bricks** in the external façade, or - Cracks or movement < 5 mm in width in any external or internal wall **claddings**, **linings**, or **finish**, or - Isolated cracked, loose, or drummy floor or wall **tiles**, or - Minor repairs to any **services** or **gutters**.
R2 **Minor Repair**	One or more of the following, where the damage affects a small proportion of external or internal claddings or linings, but does not affect the integrity of external brickwork or structural elements:- - Continuous cracking in **bricks** < 5 mm in width in one or more locations in the total external façade, or - Slippage along the **damp proof course** of 2 to 5 mm anywhere in the total external façade, or - Cracks or movement ≥ 5 mm in width in any external or internal wall **claddings**, **linings**, **finish**, or - Several cracked, loose or drummy floor or wall **tiles**, or - Replacement of any **services**.
R3 **Substantial Repair**	One or more of the following, where the damage requires the removal or replacement of a large proportion of external brickwork, or affects the stability of isolated structural elements:- - Continuous cracking in **bricks** of 5 to 15 mm in width in one or more locations in the total external façade, or - Slippage along the **damp proof course** of 5 to 15 mm anywhere in the total external façade, or - Loss of bearing to isolated walls, piers, columns, or other load-bearing elements, or - Loss of stability of isolated structural elements.
R4 **Extensive Repair**	One or more of the following, where the damage requires the removal or replacement of a large proportion of external brickwork, or the replacement or repair of several structural elements:- - Continuous cracking in **bricks** > 15 mm in width in one or more locations in the total external façade, or - Slippage along the damp proof course of 15 mm or greater anywhere in the total external façade, or - Relevelling of building, or - Loss of stability of several structural elements.
R5 **Re-build**	Extensive damage to house where the MSB (now SA NSW) and the owner have agreed to rebuild as the cost of repair is greater than the cost of replacement.

As discussed at the start of this chapter, it is very difficult to design a method of impact classification that covers all possible scenarios and permutations. While the method has been floated among some members of the mining industry, it is recommended that this table be reviewed broadly.

The recommended method has attempted to follow the current Australian Standard in terms of the number of impact categories and crack widths for Categories 3 and 4. The method is based on the extent of repairs required to repair the physical damage that has occurred, and does not include additional work that is occasionally required because replacement finishes cannot match existing damaged ones. It is therefore likely that the actual cost of repairs will vary greatly between houses depending on the nature of the existing level and type of finishes used.

The impacts experienced at Tahmoor have been classified in accordance with the revised method of classification with good results. The method allowed clearer trends to be found when undertaking statistical analyses.

A comparison between the previous and revised methods is shown in Fig. C.3.

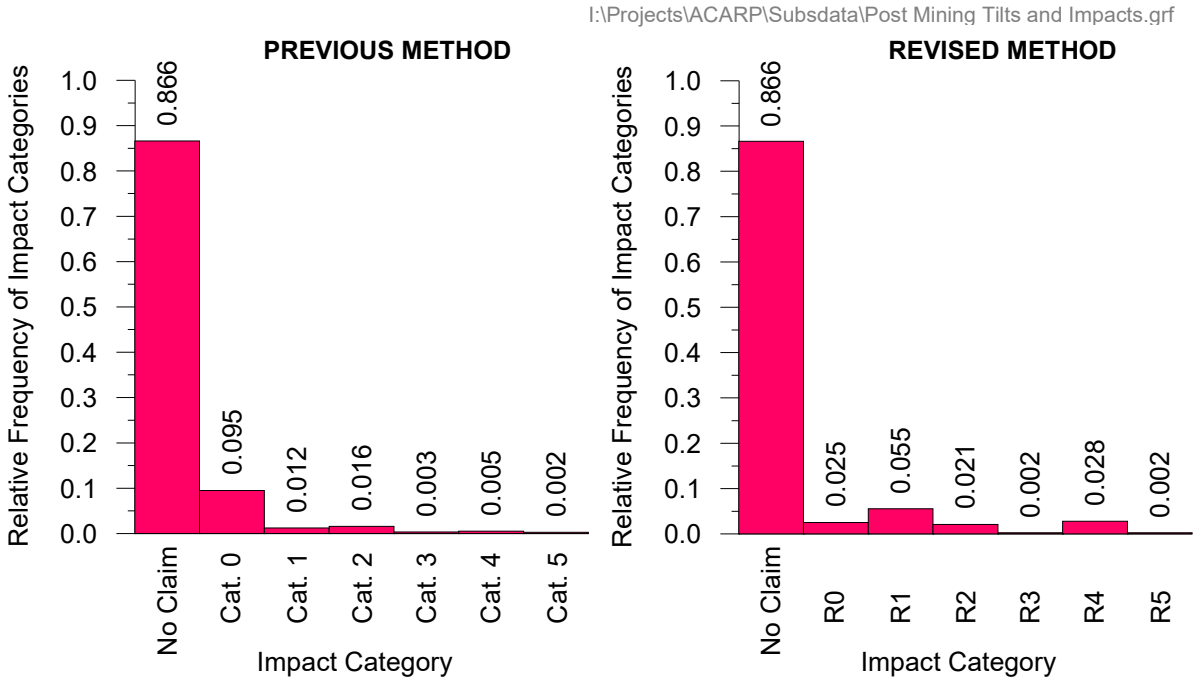


Fig. C.3 Comparison between Previous and Revised Methods of Impact Classification

It can be seen that there was an increased proportion in the higher impact categories using the revised method. This is brought about mainly by the recorded slippage on damp proof courses, which are classified as either Category 3 or Category 4 when they were previously classified as Category 1 or 2.

There was also a noticeable reduction in proportion of Category 0 impacts and noticeable increase in proportion of Category 1 impacts using the revised method. This is because the revised method reserves Category 0 impacts for impacts that did not result in cracking any linings, while the previous method allows hairline cracking to occur.

The consistent low proportion of Category 3 impacts under both the previous and current methods raises questions as to whether this category should be merged with Category 4.

C.4. Method of Impact Assessment

C.4.1. Need for Improvement of the Previous Method

The previous method of impact assessment provided specific quantitative predictions based on predicted conventional subsidence movements and general qualitative statements concerning the potential for impacts due to non-conventional movements. These non-conventional movements are additional to the predicted conventional movements.

This message was quite complex and created the potential for confusion and misunderstanding among members of the community who may easily focus on numbers and letters in a table that deal specifically with their house and misunderstand the message contained in the accompanying words of caution about the low level of reliability concerning predictions of conventional strain and potential for non-conventional movements.

This was unfortunately a necessary shortcoming of the previous method at the time as there was very little statistical information available to quantify the potential for impacts due to non-conventional movement. However, a great deal of statistical information was available following the mining of Tahmoor Mine Longwalls 22 to 24A at the time of the 2009 ACARP study and the method and message to the community could be improved. Additional statistical information was collected in 2016, which was approximately two years after the completion of Longwall 27 and one year after the completion of Longwall 28, which was the last panel to directly mine beneath the urban areas of Tahmoor. The timing of the data is such that it accounts for much of the time lag effect that occurs between the time of impact, when damage is claimed by residents and when the nature and level of the damage requiring repairs is assessed in detail by SA NSW.

While additional statistical information is now available, there remains limited knowledge at this point in time to accurately predict the locations of non-conventional movement. Substantial gains are still to be made in this area.

In the meantime, therefore, a probabilistic method of impact assessment has been developed. The method combines the potential for impacts from both conventional and non-conventional subsidence movement.

C.4.2. Factors that Could be Used to Develop a Probabilistic Method of Prediction

Trend analyses have highlighted a number of factors that could be used to develop a probabilistic method. The trends examined were:-

- *Ground tilt*

  This was found to be an ineffective parameter at Tahmoor Mine as ground tilts have been relatively benign and a low number of claims have been made solely in relation to tilt.

- *Ground strain*

  There appears to be a clear link between ground strain and impacts, particularly compressive strain. The difficulty with adopting ground strain as a predictive factor lies in the ability to accurately predict ground strain at a point.

  Another challenge with using strain to develop a probabilistic method is that there is limited information that links maximum observed strains with observed impacts at a structure. Horizontal strain is a two-dimensional parameter and it has been measured along survey lines that are oriented in one direction only.

  The above issues are less problematic for curvature and the statistical analysis on the relationship between strain and curvature shows that the observed frequency of high strains increased with increasing observed curvature.

- *Ground curvature*

  Curvature appears to be the most effective subsidence parameter to develop a probabilistic method. The trend analysis showed that the frequency of impacts increased with increasing observed curvature.

  It should be noted that we are referring to conventional curvature and not curvatures that have developed as a result of non-conventional subsidence behaviour. This is because conventional curvature can be readily predicted with reasonable correlation with observations. It is also a relatively straight-forward exercise to estimate the observed smoothed or “conventional” mining-induced curvature that has previously been experienced at houses provided some ground monitoring is undertaken across and along extracted longwalls.

  Non-conventional curvature cannot be predicted prior to mining and is accounted for by using a probabilistic method of impact assessment.

  It has also been shown that the observed frequency of high strains increased with increasing observed curvature.

- *Position of structure relative to longwall*

  A clear trend was understandably found that structures located directly above goaf were substantially more likely to experience impact. The calculated probabilities may be applicable for mining conditions that are similar to those experienced at Tahmoor Mine but will be less applicable for other mining conditions. An effective probabilistic method should create a link between the magnitude of differential subsidence movements and impact.

- *Construction type*

  Two trends have been observed. Not surprisingly, structures constructed with lightweight flexible external linings are able to accommodate a far greater range of subsidence movements than brittle inflexible linings such as masonry. The analyses merely quantified what was already well known. The second observation was that houses constructed with strip footings were noticeably more likely to experience impacts than houses constructed with a ground slab, particularly in relation to higher levels of impact. This is because houses with strip footings are more susceptible to slippage along the damp proof course.

- *Structure size*

  Trend analysis showed that larger structures attract a higher likelihood of impact. This is understandable as the chance of impacts increases with increasing footprint area. However, it is noted that the probability of severe impacts was not substantially greater for larger structures even though this would be expected if considering probabilities theoretically rather than empirically. It may be worthwhile including structure size as a factor in the development of a probabilistic method, though it is considered that it is a third order effect behind subsidence movements and construction type.

- *Structure age*

  The trend analysis for structure age did not reveal any noticeable trends.

- *Extensions, variable foundations and building joints*

  There is a clear trend of a higher frequency of impacts for structures that include extensions, variable foundations and building joints. The increased frequency appears to be related mainly to lower impact categories.

- *Urban or rural setting*

  While trends were observed, it is considered that they can be explained by other factors. However, consideration can be made to provide a more conservative estimate of probabilities in rural areas if structure size has not been taken into account.

C.4.3. Revised Method of Impact Assessment

A revised method of impact assessment has been developed, based on information received in 2016 at a time when the extraction of Longwall 29 had been completed. The method is probabilistic and currently includes conventional ground curvature and construction type as input factors.

At the time of the original 2009 ACARP study, the trends in the data were difficult to determine within small ranges of curvature because of the relatively low number of buildings that reported damage at this time. A decision was therefore taken to analyse the data in a limited number of curvature ranges, so that where possible a reasonable sample size would be available in each range. The ranges of curvature originally chosen were 5 to 15 kilometres, 15 to 50 kilometres and greater than 50 kilometres.

Additional information provided in 2016 has demonstrated that the proportion of houses reporting impacts has increased. This has allowed statistical analyses to be conducted using narrower bands of observed curvatures though some inconsistencies remain in some bands due to the sample sizes. The ranges of curvature provided in this report are 2.5 to 15 kilometres, 15 to 50 kilometres and greater than 50 kilometres.

Because the incidence of damage for different construction types showed strong trends and because the sample size was reasonable for each type of structure, the data were analysed to determine the effect of radius of curvature on the incidence of damage for each of the three structure types and for each of the three curvature ranges.

The following probabilities are proposed in Table C.5.

Table C.5 Probabilities of Impact based on Curvature and Construction Type based on the Revised Method of Impact Classification

R (km)	Repair Category			
	No Repair or R0	R1 or R2	R3 or R4	R5
Brick or brick-veneer houses with Slab on Ground				
> 50	90 ~ 95 %	3 ~ 10 %	1 %	< 0.5 %
15 to 50	70 ~ 75 %	20 ~ 25 %	5 ~ 10 %	< 0.5 %
2.5 to 15	45 ~ 65 %	25 ~ 35 %	10 ~ 15 %	1 ~ 3 %
Brick or brick-veneer houses with Strip Footing				
> 50	85 ~ 90 %	5 ~ 15 %	1 ~ 3 %	< 2 %
15 to 50	60 ~ 75 %	20 ~ 30 %	5 ~ 15 %	1 ~ 3 %
2.5 to 15	45 ~ 65 %	25 ~ 30 %	5 ~ 15 %	5 ~ 10 %
Timber-framed houses with flexible external linings of any foundation type				
> 50	90 ~ 95 %	3 ~ 10 %	1 %	< 0.5 %
15 to 50	75 ~ 85 %	10 ~ 20 %	5 ~ 10 %	< 0.5 %
2.5 to 15	70 ~ 80 %	20 ~ 25 %	7 ~ 12 %	< 0.5 %

The results have been expressed as a range of values rather than a single number, recognising that the data had considerable scatter within each curvature range. While structure size and building extensions have not been included in the predictive tables, it is recommended to adopt percentages at the higher end of the range for larger structures or those with building extensions.

The percentages stated in each table are the percentages of building structures of that type that would be likely to be damaged to the level indicated within each curvature range. The levels of damage in the tables are indicated with reference to the repair categories described in the damage classification given in Table C.4.

To place these values in context, Table C.6 shows the actual percentages recorded at Tahmoor Mine for all buildings within the sample.

Table C.6 Observed Frequency of Impacts observed for all buildings at Tahmoor Mine

R (km)	Repair Category			
	No Claim or R0	R1 or R2	R3 or R4	R5
> 50	91 %	7 %	2 %	0 %
15 to 50	72 %	20 %	7 %	1 %
5 to 15	59 %	27 %	14 %	3 %

It can be seen that the proposed probabilities for the higher impact categories have been increased compared to those observed to date. These have been deliberately increased, because it has been noticed that some of the claims for damage have been submitted well after the event and it is possible that the numbers damaged in this category could be increased as further claims are received and investigated. These numbers are sensitive to change. In light of the above, it is recommended that the probabilities be revisited in the future as mining progresses.

The ranges provided in Table C.5 have been converted into a set of probability curves to remove artificial discontinuities that are formed by dividing curvatures into three categories. These are shown in Fig. C.4. The probability curves are applicable for all houses and civil structures.

At the time of writing ACARP Research Project C12015 (Waddington, 2009), the observed proportion of houses where the MSB (now SA NSW) and affected landowners had agreed to rebuild rather than repair (Category R5) impacts was less than 0.5 %. Since the publication of the research report, the proportion of houses where a decision has been made to rebuild has increased to approximately 1.1 % overall and 3.2 % above Longwalls 24A to 27 within the observed zone of increased subsidence. The decision to rebuild rather than repair a house is based on a variety of factors.

Whilst acknowledging the significance of a decision to rebuild compared to repair a house, all houses previously impacted at Tahmoor could have been repaired rather than replaced, including those where a decision has been made to rebuild them. This does not diminish the significance of this category from a social and economic impact point of view and it is important to continue recording the number of instances where a decision has been made to rebuild a house.

C.4.4. Review of Observed Probabilities as mining continues

Reviews of observed probabilities are continually undertaken as Tahmoor Mine and other mines continue to extract beneath houses. The provision of additional information on impact on houses in 2016 has improved the level of understanding on the nature and frequency of impacts during the mining of Longwalls 22 to 29 compared to the information that was collected for the previous 2009 ACARP study, which was conducted after the mining of Longwalls 22 to 24A.

Additional statistical information was collected in 2016, which was approximately two years after the completion of Longwall 27 and one year after the completion of Longwall 28, which was the last panel to directly mine beneath the urban areas of Tahmoor.

A finding from the additional information is that the proportion of houses that have experienced impacts has increased over time. The reasons for the increase are due to the time lag effect that occurs between the mining impact, when damage is claimed by residents and when the nature and level of the damage requiring repairs is assessed in detail by SA NSW.

In light of the above, it is recommended that the probabilities be revisited in the future.

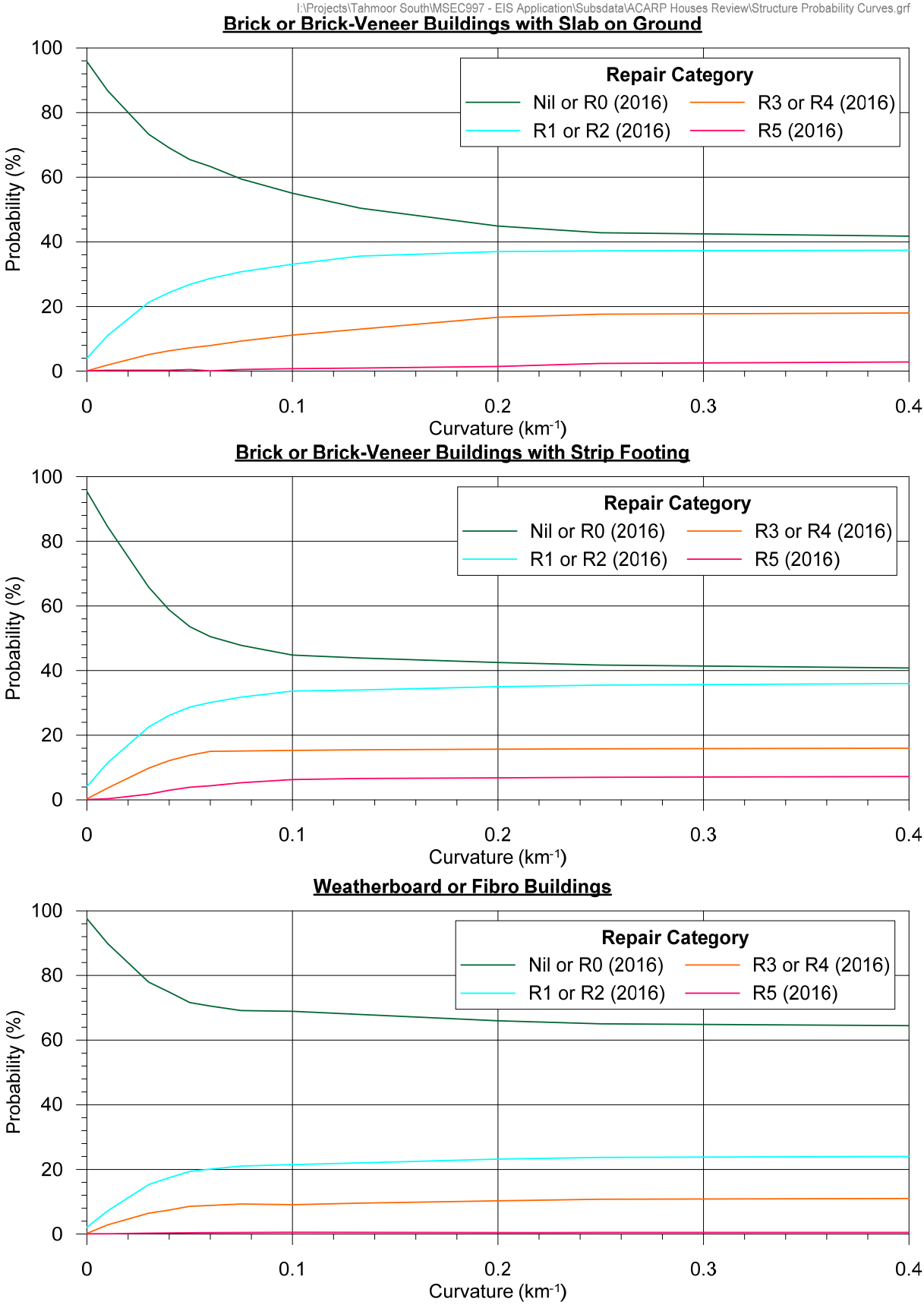


Fig. C.4 Probability Curves for Impacts to Buildings (based on observations up to Longwall 29)

APPENDIX D. TABLES

Table D.01 - Tahmoor South - Predictions for Stream Pools

Stream	Pool	Predicted Total Subsidence after all Longwalls (mm)	Predicted Total Upsidence after all Longwalls (mm)	Predicted Total Closure after all Longwalls (mm)
Teatree Hollow	TT9	1250	275	225
	TT12	1050	375	250
	TT7	100	90	175
	TT14	100	80	150
	TT5	70	50	100
	TT6	< 20	< 20	< 20
	TT4	< 20	< 20	< 20
	TT8	< 20	< 20	< 20
Tributary of Teatree Hollow	TT1	125	125	70
	TT2	1300	375	225
	TT11	850	275	325
	TT3	750	300	350
	TT13	200	125	250

Table D.02 - Tahmoor South - Details of the Houses

House Ref.	Maximum Plan Dimension (m)	Plan Area (m2)	Number of Stories	Wall Construction	Footing Construction	Wall and Footing Construction	Roof Construcftion	House Located Above Goaf	House Located Above Solid Coal
BCA_001_h01	21	234	1	Fibro	Slab on Ground	Timber Framed	Metal	1	
BCA_010_h01	24	252	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BCA_015_h01	18	227	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Metal	1	
BCA_020_h01	17	217	1	Weatherboard	N/A	Timber Framed	Metal	1	
BCA_025_h01	30	298	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BCA_030_h01	32	291	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BCA_035_h01	17	181	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BCA_040_h01	14	159	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BCA_045_h01	18	138	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BCA_050_h01	10	71	2	Fibro	Suspended on Piers	Timber Framed	Metal	1	
BCA_055_h01	21	239	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BCA_060_h01	28	350	2	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BCA_065_h01	23	337	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BCA_070_h01	19	194	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BCA_075_h01	15	106	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BCA_080_h01	17	176	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BCA_085_h01	22	241	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BCA_090_h01	13	138	1	Fibro	Suspended on Piers	Timber Framed	Tiled	1	
BCA_095_h01	22	279	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BCA_100_h01	31	370	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BCA_105_h01	22	196	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BCA_110_h01	23	189	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Metal		1
BCA_115_h01	34	377	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Metal		1
BCA_120_h01	19	230	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BCP_010_h01	13	124	1	Weatherboard	Suspended on Piers	Timber Framed	Tiled		1
BCP_040_h01	14	98	1	Fibro	Suspended on Piers	Timber Framed	Metal		1
BCP_050_h01	6	32	1	Fibro	Suspended on Piers	Timber Framed	Metal		1
BCP_050_h02	11	98	1	Fibro	Suspended on Piers	Timber Framed	Metal		1
BGR_180_h01	19	207	1	Weatherboard	Suspended on Piers	Timber Framed	Tiled		1
BGR_193_h01	16	244	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BGR_203_h01	16	185	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BGR_213_h01	18	145	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BGR_218_h01	27	245	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Metal	1	
BGR_221_h01	26	304	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Tiled		1
BGR_225_h01	19	180	1	Fibro	Suspended on Piers	Timber Framed	Metal		1
BGR_230_h01	32	432	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BRE_016_h01	15	106	1	Weatherboard	Slab on Ground	Timber Framed	Metal		1
BRE_030_h01	17	140	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BRE_055_h01	13	91	1	Weatherboard	Slab on Ground	Timber Framed	Metal	1	
BRE_057_h01	13	127	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BRE_059_h01	19	189	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_061_h01	18	197	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_063_h01	28	349	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_065_h01	22	256	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_067_h01	15	172	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BRE_070_h01	18	175	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	

Table D.02 - Tahmoor South - Details of the Houses

House Ref.	Maximum Plan Dimension (m)	Plan Area (m2)	Number of Stories	Wall Construction	Footing Construction	Wall and Footing Construction	Roof Construcftion	House Located Above Goaf	House Located Above Solid Coal
BRE_075_h01	18	172	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BRE_075_h02	11	95	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BRE_077_h01	16	126	1	Fibro	Suspended on Piers	Timber Framed	Metal	1	
BRE_080_h01	29	260	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_083_h01	19	236	2	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Metal	1	
BRE_086_h01	29	409	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Metal	1	
BRE_089_h01	18	285	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_140_h01	28	361	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Metal	1	
BRE_143_h01	17	176	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BRE_148_h01	20	303	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BRE_154_h01	19	174	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Tiled	1	
BRE_165_h01	9	63	1	Weatherboard	N/A	Timber Framed	Metal	1	
BRE_167_h01	19	160	2	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BRE_177_h01	14	158	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BRE_187_h01	29	396	2	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BRE_189_h01	11	94	1	Fibro	Suspended on Piers	Timber Framed	Metal	1	
BRE_191_h01	15	134	1	Weatherboard	N/A	Timber Framed	Metal	1	
BRE_195_h01	30	372	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BRE_195_h02	14	146	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BRE_201_h01	22	272	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BRE_515_h02	26	401	2	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BRE_644_h01	31	317	1	Brick or Brick-Veneer	Strip Footing	Brick with Strip Footings	Metal	1	
BRE_665_h01	23	261	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BWE_031_h01	16	143	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BWE_041_h01	11	96	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BWE_041_h02	31	412	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BWE_051_h01	22	201	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BYR_001_h01	10	95	1	Weatherboard	Suspended on Piers	Timber Framed	Tiled	1	
BYR_005_h01	22	165	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BYR_015_h01	17	232	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BYR_025_h01	35	538	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal	1	
BYR_035_h01	17	119	1	Weatherboard	N/A	Timber Framed	Metal	1	
BYR_045_h01	18	152	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BYR_045_h02	50	819	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BYR_055_h01	19	275	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled		1
BYR_065_h01	18	245	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BYR_065_h02	15	131	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BYR_075_h01	21	264	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled		1
BYR_075_h02	10	80	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BYR_084_h01	17	171	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BYR_085_h01	19	200	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BYR_085_h02	8	45	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BYR_085_h03	18	147	1	Weatherboard	Slab on Ground	Timber Framed	Metal		1
BYR_095_h01	37	591	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1
BYR_105_h01	11	87	1	Fibro	Suspended on Piers	Timber Framed	Metal		1
BYR_115_h02	24	281	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Metal		1

Table D.02 - Tahmoor South - Details of the Houses

House Ref.	Maximum Plan Dimension (m)	Plan Area (m2)	Number of Stories	Wall Construction	Footing Construction	Wall and Footing Construction	Roof Construcftion	House Located Above Goaf	House Located Above Solid Coal
BYR_125_h01	18	156	1	Weatherboard	Suspended on Piers	Timber Framed	Metal		1
BYR_135_h01	16	141	1	Weatherboard	Suspended on Piers	Timber Framed	Tiled		1
BYR_135_h02	41	484	1	Weatherboard	Slab on Ground	Timber Framed	Metal		1
BYR_145_h01	21	215	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled		1
BYR_150_h01	12	102	1	Brick or Brick-Veneer	N/A	Brick with Unknown Footings	Tiled	1	
BYR_150_h02	7	39	1	Weatherboard	N/A	Timber Framed	Tiled	1	
BYR_152_h01	20	257	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BYR_154_h01	27	327	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BYR_156_h01	22	268	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BYR_156_h02	12	95	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BYR_158_h01	13	89	1	Weatherboard	Suspended on Piers	Timber Framed	Metal	1	
BYR_160_h01	30	285	1	Brick or Brick-Veneer	Slab on Ground	Brick with Slab on Ground	Tiled	1	
BYR_162_h01	18	156	1	Weatherboard	N/A	Timber Framed	Metal	1	

Table D.03 - Tahmoor South - Predictions for Houses

House Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)	Predicted Probability of Nil or Category R0 Impact (%)	Predicted Probability of Category R1 or R2 Impact (%)	Predicted Probability of Category R3, R4 or R5 Impact (%)	Predicted Probability of Category R3 or R4 Impact (%)	Predicted Probability of Category R5 Impact (%)
BCA_001_h01	450	4.5	4.5	0.05	0.02	71.5	19.4	9.0	8.6	0.4
BCA_010_h01	1100	7.0	7.5	0.09	0.14	49.9	35.7	14.4	13.4	1.0
BCA_015_h01	1250	7.0	8.0	0.09	0.22	42.3	35.2	22.6	15.7	6.9
BCA_020_h01	1150	4.0	4.0	0.04	0.05	71.5	19.5	9.0	8.6	0.4
BCA_025_h01	1100	3.5	3.5	0.05	0.04	66.7	26.0	7.3	6.9	0.4
BCA_030_h01	1050	3.5	3.5	0.05	0.04	55.2	27.9	16.9	13.3	3.6
BCA_035_h01	900	2.0	4.5	0.08	0.03	46.7	32.5	20.8	15.2	5.6
BCA_040_h01	1200	6.5	8.0	0.09	0.09	69.0	21.4	9.6	9.1	0.5
BCA_045_h01	1350	5.0	6.0	0.06	0.21	44.3	37.1	18.6	16.9	1.7
BCA_050_h01	1300	4.5	4.5	0.06	0.07	70.0	20.5	9.5	9.0	0.5
BCA_055_h01	1300	4.5	4.5	0.06	0.06	62.7	29.0	8.3	8.1	0.2
BCA_060_h01	1300	4.5	4.5	0.06	0.06	63.4	28.6	8.0	7.9	0.1
BCA_065_h01	1000	5.5	7.0	0.10	0.03	44.7	33.7	21.6	15.3	6.3
BCA_070_h01	850	2.5	4.5	0.10	0.02	68.9	21.5	9.6	9.1	0.5
BCA_075_h01	1000	3.5	3.5	0.04	0.03	74.3	17.8	7.9	7.6	0.3
BCA_080_h01	1200	4.0	4.0	0.05	0.04	52.3	29.3	18.4	14.3	4.1
BCA_085_h01	1200	4.0	4.0	0.05	0.04	65.4	26.9	7.7	7.2	0.5
BCA_090_h01	1350	6.0	7.0	0.06	0.21	65.9	23.3	10.9	10.4	0.5
BCA_095_h01	1250	6.0	7.5	0.08	0.17	43.1	34.6	22.3	15.6	6.7
BCA_100_h01	1000	5.5	7.0	0.08	0.06	58.7	31.1	10.2	9.6	0.6
BCA_105_h01	650	4.0	4.0	0.05	0.03	65.9	26.5	7.6	7.1	0.5
BCA_110_h01	375	5.0	5.0	0.05	< 0.01	52.2	29.3	18.4	14.3	4.1
BCA_115_h01	100	1.5	1.5	0.03	< 0.01	64.7	23.1	12.2	10.2	2.0
BCA_120_h01	80	1.0	1.0	0.01	< 0.01	84.2	13.0	2.8	2.5	0.3
BCP_010_h01	150	2.0	2.0	0.05	< 0.01	73.2	18.4	8.4	8.0	0.4
BCP_040_h01	50	< 0.5	< 0.5	< 0.01	< 0.01	95.2	3.7	1.1	1.0	0.1
BCP_050_h01	< 20	< 0.5	< 0.5	< 0.01	< 0.01	97.4	2.2	0.4	0.3	0.1
BCP_050_h02	< 20	< 0.5	< 0.5	< 0.01	< 0.01	97.4	2.3	0.4	0.3	0.1
BGR_180_h01	20	< 0.5	< 0.5	< 0.01	< 0.01	96.0	3.2	0.9	0.8	0.1
BGR_193_h01	30	< 0.5	< 0.5	< 0.01	< 0.01	96.1	3.1	0.8	0.7	0.1
BGR_203_h01	175	2.5	2.5	0.05	< 0.01	71.2	19.6	9.1	8.7	0.4
BGR_213_h01	475	7.5	7.5	0.11	< 0.01	68.7	21.6	9.7	9.2	0.5
BGR_218_h01	650	9.0	9.0	0.11	0.09	44.4	33.8	21.8	15.4	6.4
BGR_221_h01	175	2.5	2.5	0.06	0.02	51.2	29.8	19.0	14.7	4.3
BGR_225_h01	50	< 0.5	< 0.5	< 0.01	< 0.01	94.3	4.2	1.4	1.3	0.1
BGR_230_h01	20	< 0.5	< 0.5	< 0.01	< 0.01	96.6	2.7	0.6	0.5	0.1
BRE_016_h01	< 20	< 0.5	< 0.5	< 0.01	< 0.01	97.1	2.4	0.5	0.4	0.1
BRE_030_h01	90	1.0	1.0	< 0.01	< 0.01	87.2	10.7	2.1	1.8	0.3
BRE_055_h01	950	3.5	3.5	0.05	0.03	72.3	19.0	8.7	8.4	0.4

Table D.03 - Tahmoor South - Predictions for Houses

House Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)	Predicted Probability of Nil or Category R0 Impact (%)	Predicted Probability of Category R1 or R2 Impact (%)	Predicted Probability of Category R3, R4 or R5 Impact (%)	Predicted Probability of Category R3 or R4 Impact (%)	Predicted Probability of Category R5 Impact (%)
BRE_057_h01	1050	4.0	4.0	0.05	0.03	66.2	26.3	7.5	7.0	0.5
BRE_059_h01	1200	4.5	4.5	0.05	0.04	52.6	29.2	18.2	14.2	4.0
BRE_061_h01	1300	4.5	4.5	0.06	0.11	44.6	33.7	21.7	15.3	6.3
BRE_063_h01	1300	5.5	7.0	0.06	0.21	42.3	35.1	22.6	15.7	6.8
BRE_065_h01	1350	6.5	8.0	0.06	0.21	42.3	35.1	22.6	15.7	6.8
BRE_067_h01	1150	6.5	8.0	0.11	0.04	54.1	33.6	12.3	11.5	0.8
BRE_070_h01	950	3.5	6.0	0.10	0.02	55.8	32.7	11.5	10.8	0.7
BRE_075_h01	900	2.5	4.5	0.09	0.02	69.0	21.4	9.6	9.1	0.5
BRE_075_h02	900	2.0	3.5	0.09	0.03	69.0	21.3	9.6	9.1	0.5
BRE_077_h01	1000	3.5	3.5	0.04	0.03	74.5	17.7	7.9	7.6	0.3
BRE_080_h01	1250	4.0	4.0	0.06	0.04	51.9	29.5	18.6	14.4	4.1
BRE_083_h01	1350	4.0	4.0	0.06	0.20	42.4	35.0	22.5	15.7	6.8
BRE_086_h01	1350	4.0	4.0	0.06	0.20	42.4	35.0	22.5	15.7	6.8
BRE_089_h01	1350	6.0	8.0	0.06	0.20	42.4	35.0	22.5	15.7	6.8
BRE_140_h01	950	3.0	3.0	0.07	0.03	49.6	30.7	19.7	15.0	4.7
BRE_143_h01	1200	3.5	3.5	0.05	0.04	71.1	19.7	9.2	8.7	0.4
BRE_148_h01	1250	3.5	3.5	0.06	0.05	63.8	28.2	7.9	7.7	0.2
BRE_154_h01	1300	7.0	8.0	0.06	0.22	42.2	35.2	22.6	15.7	6.9
BRE_165_h01	1250	7.0	8.0	0.08	0.19	66.4	22.9	10.6	10.1	0.5
BRE_167_h01	800	5.0	6.0	0.08	0.05	46.8	32.4	20.8	15.2	5.6
BRE_177_h01	400	5.5	5.5	0.07	< 0.01	69.3	20.9	9.8	9.3	0.5
BRE_187_h01	250	4.5	4.5	0.08	< 0.01	59.3	30.8	9.9	9.4	0.5
BRE_189_h01	125	2.0	2.0	0.04	< 0.01	73.7	18.1	8.2	7.8	0.3
BRE_191_h01	200	3.5	3.5	0.08	< 0.01	69.1	21.1	9.8	9.3	0.5
BRE_195_h01	80	0.5	0.5	< 0.01	< 0.01	87.2	10.7	2.1	1.8	0.3
BRE_195_h02	70	0.5	0.5	< 0.01	< 0.01	88.2	9.9	1.9	1.6	0.3
BRE_201_h01	40	0.5	0.5	< 0.01	< 0.01	92.3	6.7	1.0	0.8	0.2
BRE_515_h02	1300	6.0	8.0	0.09	0.17	47.5	36.3	16.2	14.9	1.2
BRE_644_h01	1100	4.5	4.5	0.05	0.04	54.4	28.3	17.3	13.6	3.8
BRE_665_h01	850	3.0	5.0	0.10	0.02	55.1	33.0	11.9	11.1	0.8
BWE_031_h01	< 20	< 0.5	< 0.5	< 0.01	< 0.01	94.8	4.8	0.4	0.3	0.1
BWE_041_h01	< 20	< 0.5	< 0.5	< 0.01	< 0.01	97.1	2.5	0.5	0.4	0.1
BWE_041_h02	< 20	< 0.5	< 0.5	< 0.01	< 0.01	95.5	4.2	0.3	0.2	0.1
BWE_051_h01	< 20	< 0.5	< 0.5	< 0.01	< 0.01	95.3	4.4	0.3	0.2	0.1
BYR_001_h01	850	4.0	5.5	0.09	0.02	69.0	21.3	9.7	9.2	0.5
BYR_005_h01	1100	3.0	3.0	0.06	0.08	59.4	30.8	9.8	9.3	0.5
BYR_015_h01	1100	8.5	8.5	0.06	0.23	43.7	37.1	19.2	17.2	2.0
BYR_025_h01	350	4.0	4.0	0.07	0.01	60.6	30.1	9.3	8.9	0.4
BYR_035_h01	450	5.5	5.5	0.09	0.02	69.0	21.3	9.7	9.2	0.5

Table D.03 - Tahmoor South - Predictions for Houses

House Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)	Predicted Probability of Nil or Category R0 Impact (%)	Predicted Probability of Category R1 or R2 Impact (%)	Predicted Probability of Category R3, R4 or R5 Impact (%)	Predicted Probability of Category R3 or R4 Impact (%)	Predicted Probability of Category R5 Impact (%)
BYR_045_h01	150	1.0	1.0	< 0.01	< 0.01	91.7	6.0	2.3	2.2	0.1
BYR_045_h02	150	1.0	1.0	< 0.01	< 0.01	88.1	10.0	1.9	1.7	0.3
BYR_055_h01	100	< 0.5	< 0.5	< 0.01	< 0.01	90.4	7.5	2.1	1.9	0.2
BYR_065_h01	80	< 0.5	< 0.5	< 0.01	< 0.01	92.5	6.6	0.9	0.8	0.2
BYR_065_h02	60	< 0.5	< 0.5	< 0.01	< 0.01	93.1	6.1	0.8	0.6	0.2
BYR_075_h01	60	< 0.5	< 0.5	< 0.01	< 0.01	92.5	6.1	1.4	1.2	0.2
BYR_075_h02	50	< 0.5	< 0.5	< 0.01	< 0.01	95.7	3.4	1.0	0.9	0.1
BYR_084_h01	50	< 0.5	< 0.5	< 0.01	< 0.01	93.7	5.6	0.7	0.5	0.1
BYR_085_h01	40	< 0.5	< 0.5	< 0.01	< 0.01	93.8	5.5	0.6	0.5	0.1
BYR_085_h02	50	< 0.5	< 0.5	< 0.01	< 0.01	95.9	3.2	0.9	0.8	0.1
BYR_085_h03	40	< 0.5	< 0.5	< 0.01	< 0.01	96.1	3.1	0.8	0.7	0.1
BYR_095_h01	40	< 0.5	< 0.5	< 0.01	< 0.01	94.0	5.4	0.6	0.5	0.1
BYR_105_h01	30	< 0.5	< 0.5	< 0.01	< 0.01	96.4	2.9	0.7	0.6	0.1
BYR_115_h02	30	< 0.5	< 0.5	< 0.01	< 0.01	94.2	5.2	0.5	0.4	0.1
BYR_125_h01	60	< 0.5	< 0.5	< 0.01	< 0.01	95.4	3.5	1.0	0.9	0.1
BYR_135_h01	80	< 0.5	< 0.5	< 0.01	< 0.01	94.7	4.0	1.3	1.2	0.1
BYR_135_h02	80	< 0.5	< 0.5	< 0.01	< 0.01	94.6	4.1	1.3	1.2	0.1
BYR_145_h01	100	< 0.5	< 0.5	< 0.01	< 0.01	91.4	7.4	1.2	1.0	0.2
BYR_150_h01	1050	3.0	3.0	0.06	0.05	50.5	30.1	19.3	15.0	4.4
BYR_150_h02	1100	3.0	3.0	0.06	0.05	70.5	20.2	9.4	8.9	0.5
BYR_152_h01	1000	3.0	3.0	0.06	0.04	64.4	27.8	7.9	7.6	0.3
BYR_154_h01	900	3.0	3.0	0.05	0.04	66.2	26.3	7.5	7.0	0.5
BYR_156_h01	850	2.5	2.5	0.06	0.03	70.6	20.1	9.3	8.8	0.5
BYR_156_h02	850	3.0	3.0	0.04	0.04	73.4	18.3	8.3	7.9	0.3
BYR_158_h01	800	2.5	4.5	0.09	0.03	69.1	21.2	9.7	9.2	0.5
BYR_160_h01	1150	7.0	8.0	0.09	0.10	54.8	33.2	12.0	11.2	0.8
BYR_162_h01	1300	7.0	8.0	0.08	0.22	65.6	23.4	11.0	10.5	0.5
Maxima:	**1350**	**9.0**	**9.0**	**0.11**	**0.23**					

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BCA_001_r01	375	4.5	4.5	0.05	< 0.01
BCA_001_r02	800	5.5	5.5	0.02	0.06
BCA_001_r03	850	4.0	4.0	0.03	0.05
BCA_001_r04	950	4.5	4.5	0.04	0.06
BCA_001_r05	800	7.0	7.0	0.03	0.12
BCA_001_r07	475	5.5	5.5	0.04	0.03
BCA_001_r09	950	4.0	4.0	0.04	0.06
BCA_001_r10	950	4.0	4.0	0.04	0.06
BCA_010_r01	1000	7.0	7.5	0.09	0.05
BCA_010_r02	800	4.5	6.0	0.08	0.04
BCA_010_r03	850	5.0	7.0	0.08	0.03
BCA_010_r04	1000	6.5	8.0	0.09	0.04
BCA_010_r05	1050	7.0	8.0	0.09	0.06
BCA_010_r06	1050	7.0	8.0	0.09	0.04
BCA_010_r07	1000	7.0	8.0	0.09	0.04
BCA_010_r08	800	2.5	2.5	0.05	0.04
BCA_010_r09	800	5.0	6.5	0.08	0.04
BCA_015_r01	1150	7.0	8.0	0.09	0.12
BCA_015_r02	1200	7.0	8.0	0.09	0.12
BCA_015_r03	1050	7.0	8.0	0.09	0.04
BCA_020_r02	1150	4.0	4.0	0.04	0.05
BCA_020_r03	1150	4.0	4.0	0.05	0.05
BCA_020_r07	1100	3.5	3.5	0.04	0.05
BCA_020_r08	1150	3.5	3.5	0.05	0.05
BCA_020_r09	1200	3.5	3.5	0.05	0.05
BCA_020_r10	1200	3.5	3.5	0.05	0.05
BCA_020_r11	1200	4.0	4.0	0.05	0.06
BCA_020_r12	1250	4.0	4.0	0.05	0.06
BCA_020_r13	1250	4.0	4.0	0.05	0.08
BCA_020_r14	1250	3.5	3.5	0.05	0.10
BCA_020_r15	1250	3.5	3.5	0.05	0.14
BCA_020_r16	1250	3.5	3.5	0.05	0.17
BCA_020_r17	1250	3.0	3.0	0.05	0.20
BCA_020_r18	1300	3.0	3.0	0.05	0.21
BCA_025_r01	1100	3.5	3.5	0.05	0.04
BCA_025_r03	1150	3.5	3.5	0.05	0.04
BCA_025_r04	1200	3.5	3.5	0.05	0.05
BCA_025_r05	1250	3.5	3.5	0.06	0.05
BCA_025_r06	1200	3.5	3.5	0.06	0.05
BCA_025_r07	1250	3.5	3.5	0.06	0.05
BCA_025_r08	1250	3.5	3.5	0.06	0.05
BCA_025_r09	1150	3.5	3.5	0.05	0.04
BCA_030_r01	1000	3.0	3.0	0.04	0.03
BCA_030_r02	1200	3.5	3.5	0.06	0.04
BCA_030_r03	1050	3.5	3.5	0.05	0.04
BCA_030_r04	1100	3.5	3.5	0.05	0.04
BCA_035_r01	900	1.5	4.0	0.08	0.03
BCA_035_r02	1050	3.5	3.5	0.05	0.04
BCA_035_r03	1100	3.5	3.5	0.05	0.04
BCA_040_r02	1100	6.0	8.0	0.09	0.03
BCA_040_r03	1050	5.5	7.5	0.09	0.03
BCA_040_r04	1000	5.0	7.5	0.09	0.03
BCA_040_r05	1000	5.0	7.0	0.09	0.03
BCA_040_r06	950	4.0	6.0	0.09	0.02
BCA_045_r01	1350	5.0	6.0	0.06	0.21
BCA_045_r07	1300	6.5	8.0	0.07	0.18
BCA_045_r08	1350	6.0	6.5	0.06	0.21

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BCA_050_r01	1350	4.0	4.0	0.06	0.22
BCA_050_r03	1350	3.5	4.5	0.06	0.22
BCA_055_r01	1300	4.5	4.5	0.06	0.05
BCA_055_r07	1200	4.5	4.5	0.06	0.04
BCA_055_r08	1200	4.5	4.5	0.06	0.04
BCA_060_r01	1150	4.0	4.0	0.05	0.04
BCA_060_r02	1150	4.0	4.0	0.05	0.04
BCA_060_r03	1200	4.0	4.0	0.05	0.04
BCA_060_r04	1200	4.0	4.0	0.05	0.04
BCA_060_r05	1200	4.0	4.0	0.05	0.04
BCA_060_r06	1250	4.0	4.0	0.06	0.04
BCA_060_r07	1300	4.5	4.5	0.06	0.06
BCA_065_r01	950	5.0	7.0	0.10	0.02
BCA_065_r02	1000	5.5	7.5	0.10	0.03
BCA_065_r03	950	4.5	7.0	0.10	0.02
BCA_065_r04	950	5.0	7.0	0.10	0.03
BCA_065_r05	1200	6.5	8.0	0.10	0.11
BCA_065_r06	1250	6.5	8.0	0.10	0.12
BCA_070_r01	900	3.0	5.5	0.10	0.02
BCA_070_r02	850	3.0	5.0	0.10	0.02
BCA_075_r01	900	3.5	5.5	0.09	0.02
BCA_075_r02	850	2.5	4.5	0.09	0.02
BCA_075_r03	850	1.5	4.0	0.09	0.02
BCA_075_r04	1300	6.5	8.0	0.10	0.20
BCA_075_r05	1000	3.0	3.0	0.04	0.03
BCA_075_r06	850	2.0	4.5	0.10	0.02
BCA_080_r01	1150	4.0	4.0	0.05	0.04
BCA_080_r02	1050	3.5	3.5	0.04	0.04
BCA_080_r03	950	3.0	3.0	0.04	0.03
BCA_080_r06	900	2.5	3.0	0.08	0.03
BCA_080_r07	900	2.0	3.5	0.09	0.03
BCA_080_r08	1150	4.0	4.0	0.05	0.04
BCA_080_r09	950	3.0	3.0	0.04	0.03
BCA_085_r03	1200	4.0	4.0	0.05	0.05
BCA_085_r04	1050	4.0	4.0	0.04	0.04
BCA_085_r05	950	3.0	3.0	0.04	0.04
BCA_090_r07	1050	4.5	4.5	0.03	0.05
BCA_095_r01	1100	7.0	7.0	0.01	0.16
BCA_095_r02	1150	6.0	7.5	0.07	0.14
BCA_095_r03	1200	6.0	7.5	0.07	0.15
BCA_100_r01	800	5.5	6.0	0.07	0.05
BCA_100_r02	800	5.5	6.5	0.06	0.05
BCA_100_r03	750	5.5	6.0	0.06	0.05
BCA_100_r04	750	4.5	5.5	0.07	0.05
BCA_100_r05	750	4.5	5.5	0.07	0.05
BCA_105_r01	800	4.5	4.5	0.03	0.04
BCA_105_r02	475	4.0	4.0	0.04	0.02
BCA_105_r03	700	4.5	4.5	0.03	0.04
BCA_110_r01	375	5.0	5.0	0.05	< 0.01
BCA_110_r02	375	4.0	4.0	0.04	0.01
BCA_110_r04	350	4.0	4.0	0.04	< 0.01
BCA_110_r05	125	2.0	2.0	0.03	< 0.01
BCA_110_r07	800	5.0	5.0	0.03	0.04
BCA_110_r08	200	3.0	3.0	0.04	< 0.01
BCA_115_r01	60	0.5	0.5	0.01	< 0.01
BCA_115_r02	60	0.5	0.5	< 0.01	< 0.01
BCA_115_r03	90	1.0	1.0	0.02	< 0.01

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BCA_115_r04	80	1.0	1.0	0.02	< 0.01
BCA_115_r05	60	0.5	0.5	< 0.01	< 0.01
BCA_120_r01	90	1.0	1.0	0.02	< 0.01
BCA_120_r02	90	1.0	1.0	0.02	< 0.01
BCA_120_r03	90	1.0	1.0	0.02	< 0.01
BCA_120_r04	50	< 0.5	< 0.5	< 0.01	< 0.01
BCA_120_r05	80	1.0	1.0	0.01	< 0.01
BCA_120_r06	70	0.5	0.5	< 0.01	< 0.01
BCA_120_r07	50	< 0.5	< 0.5	< 0.01	< 0.01
BCP_010_r01	200	3.0	3.0	0.07	0.02
BCP_010_r02	150	2.0	2.0	0.04	< 0.01
BCP_040_r01	40	< 0.5	< 0.5	< 0.01	< 0.01
BCP_040_r02	50	< 0.5	< 0.5	< 0.01	< 0.01
BCP_040_r04	40	< 0.5	< 0.5	< 0.01	< 0.01
BCP_040_r05	40	< 0.5	< 0.5	< 0.01	< 0.01
BCP_040_r06	30	< 0.5	< 0.5	< 0.01	< 0.01
BCP_040_r07	50	< 0.5	< 0.5	< 0.01	< 0.01
BCP_050_r05	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BCP_050_r06	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BCP_050_r09	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_180_r01	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_180_r02	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_180_r03	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r01	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r02	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r03	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r04	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r05	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r06	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r07	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_193_r08	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_203_r01	200	3.0	3.0	0.07	< 0.01
BGR_203_r02	175	2.5	2.5	0.06	< 0.01
BGR_203_r03	125	1.5	1.5	0.03	< 0.01
BGR_203_r04	100	1.0	1.0	0.02	< 0.01
BGR_203_r05	90	1.0	1.0	0.01	< 0.01
BGR_203_r06	80	0.5	0.5	< 0.01	< 0.01
BGR_203_r09	150	2.0	2.0	0.04	< 0.01
BGR_213_r01	500	8.0	8.0	0.10	< 0.01
BGR_213_r02	475	7.5	7.5	0.10	< 0.01
BGR_213_r03	450	7.0	7.0	0.10	< 0.01
BGR_213_r04	375	6.5	6.5	0.10	< 0.01
BGR_213_r05	500	7.5	7.5	0.10	< 0.01
BGR_218_r01	450	7.5	7.5	0.11	0.06
BGR_218_r02	600	9.0	9.0	0.11	0.09
BGR_218_r03	450	7.5	7.5	0.11	0.05
BGR_218_r04	800	9.0	9.0	0.08	0.13
BGR_221_r01	300	5.5	5.5	0.10	0.03
BGR_221_r02	175	2.5	2.5	0.06	0.01
BGR_221_r03	100	1.5	1.5	0.02	< 0.01
BGR_221_r04	175	3.0	3.0	0.06	0.02
BGR_221_r05	175	2.5	2.5	0.06	0.02
BGR_221_r06	300	5.5	5.5	0.10	0.02
BGR_221_r07	300	5.5	5.5	0.10	0.02
BGR_225_r01	60	0.5	0.5	< 0.01	< 0.01
BGR_225_r02	50	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r03	50	< 0.5	< 0.5	< 0.01	< 0.01

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BGR_225_r04	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r05	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r06	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r07	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r08	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r09	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r10	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r11	50	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r12	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r13	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r14	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r15	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r16	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_r17	30	< 0.5	< 0.5	< 0.01	< 0.01
BGR_230_r01	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_016_r02	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_016_r03	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_016_r04	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_016_r05	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_016_r06	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_r30	80	1.0	1.0	< 0.01	< 0.01
BRE_030_r31	90	1.0	1.0	< 0.01	< 0.01
BRE_055_r01	900	3.0	3.0	0.05	0.03
BRE_057_r01	950	3.5	3.5	0.05	0.03
BRE_057_r02	900	3.0	3.0	0.05	0.03
BRE_057_r03	950	3.5	3.5	0.05	0.03
BRE_057_r04	950	3.5	3.5	0.05	0.03
BRE_057_r06	1000	4.0	4.0	0.05	0.03
BRE_057_r07	1000	4.0	4.0	0.05	0.03
BRE_057_r08	1200	4.5	4.5	0.05	0.04
BRE_059_r01	1300	4.5	4.5	0.06	0.09
BRE_059_r02	1300	4.5	4.5	0.06	0.10
BRE_059_r03	1300	4.5	4.5	0.06	0.10
BRE_061_r02	1300	4.5	4.5	0.06	0.08
BRE_061_r03	1300	4.5	4.5	0.06	0.12
BRE_061_r04	1300	4.0	4.0	0.06	0.21
BRE_061_r05	1200	4.5	4.5	0.05	0.04
BRE_063_r01	1300	6.5	8.0	0.06	0.21
BRE_063_r02	1300	4.0	5.5	0.06	0.21
BRE_063_r03	1300	4.5	6.0	0.06	0.21
BRE_063_r04	1300	5.0	6.5	0.06	0.21
BRE_065_r01	1350	6.5	8.0	0.06	0.21
BRE_065_r02	1250	6.5	8.0	0.10	0.13
BRE_065_r03	1350	6.5	8.0	0.06	0.21
BRE_065_r04	1300	6.5	8.0	0.07	0.19
BRE_070_r01	950	4.0	6.5	0.10	0.02
BRE_070_r02	900	3.5	5.5	0.10	0.02
BRE_070_r03	900	2.0	3.5	0.09	0.03
BRE_070_r04	900	2.0	3.5	0.10	0.03
BRE_070_r05	850	1.5	4.0	0.10	0.02
BRE_070_r06	900	1.5	3.5	0.09	0.03
BRE_070_r07	850	2.0	4.0	0.10	0.02
BRE_070_r08	950	3.5	6.0	0.10	0.02
BRE_070_r09	900	3.5	6.0	0.10	0.02
BRE_070_r10	900	3.5	6.0	0.10	0.02
BRE_075_r01	1000	3.0	3.0	0.04	0.03
BRE_075_r02	900	2.0	3.5	0.09	0.03

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BRE_075_r03	900	2.5	2.5	0.07	0.03
BRE_075_r04	900	2.0	3.5	0.09	0.03
BRE_077_r02	1050	3.5	3.5	0.04	0.03
BRE_077_r05	1050	4.0	4.0	0.04	0.04
BRE_077_r06	1000	3.0	3.0	0.04	0.03
BRE_080_r01	1300	4.0	4.0	0.06	0.09
BRE_080_r02	1150	4.0	4.0	0.05	0.04
BRE_080_r03	1300	4.0	4.0	0.06	0.05
BRE_080_r04	1150	4.0	4.0	0.05	0.04
BRE_080_r05	1200	4.0	4.0	0.05	0.04
BRE_080_r06	1350	4.0	4.0	0.06	0.10
BRE_080_r07	1200	4.0	4.0	0.05	0.04
BRE_080_r08	1200	4.0	4.0	0.05	0.04
BRE_080_r09	1200	4.0	4.0	0.05	0.04
BRE_083_r01	1350	4.5	5.5	0.06	0.21
BRE_083_r02	1350	5.0	6.0	0.06	0.21
BRE_083_r03	1350	6.0	7.0	0.06	0.21
BRE_083_r04	1350	4.0	4.0	0.06	0.21
BRE_086_r01	1350	6.5	8.0	0.06	0.21
BRE_086_r02	1350	6.5	8.0	0.06	0.21
BRE_089_r01	1350	6.0	8.0	0.06	0.20
BRE_089_r02	1300	6.0	8.0	0.06	0.19
BRE_089_r03	1250	6.5	8.0	0.08	0.14
BRE_089_r04	1300	6.5	8.0	0.08	0.16
BRE_090_r01	1200	3.5	3.5	0.05	0.04
BRE_140_r01	950	2.5	2.5	0.05	0.03
BRE_140_r02	1000	3.0	3.0	0.04	0.03
BRE_143_r01	1200	3.5	3.5	0.06	0.04
BRE_143_r02	1250	3.5	3.5	0.06	0.05
BRE_143_r03	1250	3.5	3.5	0.06	0.04
BRE_148_r01	1250	3.5	3.5	0.06	0.05
BRE_148_r02	1250	3.5	3.5	0.06	0.08
BRE_148_r03	1300	3.0	3.0	0.06	0.21
BRE_148_r04	1250	3.5	3.5	0.06	0.06
BRE_154_r01	1300	7.0	8.0	0.07	0.22
BRE_154_r02	1250	7.0	8.0	0.08	0.20
BRE_154_r03	1300	7.0	8.0	0.08	0.22
BRE_154_r04	1200	7.0	8.0	0.08	0.15
BRE_154_r05	1100	7.0	8.0	0.09	0.05
BRE_154_r06	1100	7.0	8.0	0.09	0.04
BRE_154_r07	1100	7.0	8.0	0.09	0.06
BRE_167_r01	850	5.0	6.5	0.09	0.05
BRE_167_r02	800	3.5	5.0	0.09	0.04
BRE_167_r03	750	3.0	4.5	0.08	0.04
BRE_167_r04	750	2.5	4.0	0.08	0.04
BRE_167_r05	750	3.0	3.0	0.05	0.05
BRE_167_r06	750	2.0	3.5	0.07	0.04
BRE_167_r07	700	2.5	3.0	0.07	0.04
BRE_167_r08	750	3.0	4.0	0.08	0.05
BRE_167_r09	700	3.0	3.5	0.07	0.05
BRE_167_r10	750	3.5	4.5	0.08	0.05
BRE_167_r12	700	3.0	3.0	0.06	0.05
BRE_167_r13	700	3.0	3.0	0.06	0.05
BRE_167_r14	700	3.0	3.0	0.06	0.05
BRE_167_r15	750	4.5	4.5	0.05	0.06
BRE_167_r16	750	3.5	3.5	0.05	0.05
BRE_167_r17	850	3.5	3.5	0.04	0.05

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BRE_167_r18	750	3.0	4.0	0.08	0.04
BRE_177_r01	400	5.5	5.5	0.07	0.01
BRE_187_r01	300	5.5	5.5	0.08	< 0.01
BRE_187_r02	200	3.5	3.5	0.07	< 0.01
BRE_187_r03	225	4.0	4.0	0.08	< 0.01
BRE_189_r01	200	3.0	3.0	0.07	< 0.01
BRE_189_r02	125	2.0	2.0	0.04	< 0.01
BRE_189_r03	175	3.0	3.0	0.06	< 0.01
BRE_191_r01	200	3.5	3.5	0.08	0.01
BRE_191_r02	250	4.5	4.5	0.09	0.02
BRE_191_r03	400	7.0	7.0	0.09	0.07
BRE_195_r01	100	1.0	1.0	0.02	0.01
BRE_195_r02	100	1.0	1.0	0.02	0.01
BRE_195_r03	125	1.5	1.5	0.03	0.02
BRE_195_r04	60	0.5	0.5	< 0.01	< 0.01
BRE_195_r05	100	1.0	1.0	0.02	0.01
BRE_195_r06	125	1.5	1.5	0.03	0.02
BRE_195_r07	60	0.5	0.5	< 0.01	< 0.01
BRE_195_r08	60	0.5	0.5	< 0.01	< 0.01
BRE_195_r09	90	1.0	1.0	0.01	< 0.01
BRE_195_r10	80	0.5	0.5	< 0.01	< 0.01
BRE_195_r11	125	2.5	2.5	0.05	< 0.01
BRE_195_r12	100	1.5	1.5	0.03	0.01
BRE_195_r13	80	1.0	1.0	0.01	0.01
BRE_201_r01	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_201_r02	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_201_r03	40	0.5	0.5	< 0.01	< 0.01
BRE_201_r04	40	0.5	0.5	< 0.01	< 0.01
BRE_515_r01	1300	4.0	5.0	0.06	0.20
BRE_515_r02	1300	4.0	5.0	0.06	0.20
BRE_644_r03	900	3.5	3.5	0.05	0.03
BRE_644_r04	1000	4.0	4.0	0.05	0.03
BRE_665_r01	850	2.5	5.0	0.10	0.02
BRE_665_r02	800	1.5	4.0	0.09	0.02
BWE_031_r01	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_031_r02	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_031_r03	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_031_r04	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_031_r05	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_041_r01	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_041_r02	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_041_r03	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_041_r04	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r01	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r02	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r03	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r04	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r05	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_051_r07	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BYR_001_r02	850	4.0	6.0	0.09	0.03
BYR_001_r03	900	5.0	7.0	0.09	0.02
BYR_001_r05	950	5.5	7.5	0.09	0.03
BYR_005_r01	1100	3.0	3.0	0.06	0.09
BYR_005_r02	1100	3.0	3.0	0.06	0.07
BYR_005_r03	1050	3.0	3.0	0.06	0.06
BYR_005_r04	1100	3.0	3.0	0.06	0.10
BYR_005_r05	1000	3.0	3.0	0.06	0.04

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BYR_015_r01	1100	6.5	6.5	0.06	0.23
BYR_015_r02	1100	8.5	8.5	0.06	0.23
BYR_015_r06	1100	3.0	3.0	0.06	0.15
BYR_015_r07	1050	8.5	8.5	0.07	0.23
BYR_025_r05	325	3.5	3.5	0.07	0.01
BYR_025_r08	275	2.5	2.5	0.04	0.01
BYR_035_r02	400	5.0	5.0	0.08	0.02
BYR_035_r03	425	5.0	5.0	0.09	0.02
BYR_035_r04	450	6.0	6.0	0.09	0.02
BYR_035_r05	550	7.0	7.0	0.09	0.02
BYR_035_r06	600	7.5	7.5	0.09	0.03
BYR_035_r07	750	8.5	8.5	0.09	0.03
BYR_035_r08	550	7.0	7.0	0.09	0.02
BYR_035_r09	550	7.0	7.0	0.09	0.02
BYR_035_r10	550	7.0	7.0	0.09	0.02
BYR_035_r12	450	5.5	5.5	0.09	0.02
BYR_045_r10	125	0.5	0.5	< 0.01	< 0.01
BYR_045_r11	125	0.5	0.5	< 0.01	< 0.01
BYR_065_r01	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r02	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r03	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r04	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r05	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r06	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r07	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r08	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r09	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r10	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_r11	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r01	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r02	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r03	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r04	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r05	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r06	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r07	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r08	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r09	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r10	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_r11	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_084_r01	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_084_r02	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_084_r03	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r01	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r03	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r04	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r05	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r06	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r08	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r09	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r10	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r11	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r12	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r13	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r14	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_r15	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_r02	50	< 0.5	< 0.5	< 0.01	< 0.01

Table D.04 - Tahmoor South - Predictions for Rural Structures

Structure Ref.	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BYR_095_r03	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_r04	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_r05	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_r06	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r01	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r02	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r03	20	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r07	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r08	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r09	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_105_r10	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_r01	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_r02	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_r04	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_r08	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_125_r04	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_r01	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_r02	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_r03	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_r04	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_r01	100	0.5	0.5	< 0.01	< 0.01
BYR_145_r02	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_r03	125	0.5	0.5	< 0.01	< 0.01
BYR_145_r04	90	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_r05	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_r06	90	< 0.5	< 0.5	< 0.01	< 0.01
BYR_150_r01	1100	3.0	3.0	0.06	0.05
BYR_150_r02	1100	3.0	3.0	0.06	0.05
BYR_150_r03	1100	3.0	3.0	0.06	0.05
BYR_150_r04	1100	3.0	3.0	0.06	0.09
BYR_152_r01	950	3.0	3.0	0.05	0.04
BYR_152_r02	950	3.0	3.0	0.05	0.04
BYR_152_r03	1000	3.0	3.0	0.06	0.04
BYR_152_r04	1050	3.0	3.0	0.06	0.05
BYR_152_r05	1050	3.0	3.0	0.06	0.05
BYR_152_r06	1100	3.0	3.0	0.06	0.05
BYR_152_r07	1050	3.0	3.0	0.06	0.04
BYR_154_r01	950	3.0	3.0	0.05	0.04
BYR_156_r01	850	2.5	2.5	0.05	0.03
BYR_158_r01	750	1.5	3.5	0.08	0.03
BYR_160_r01	1150	7.0	8.0	0.09	0.07
BYR_160_r02	1100	7.0	8.0	0.09	0.04
Maxima:	**1350**	**9.0**	**9.0**	**0.11**	**0.23**

Table D.05 - Tahmoor South - Predictions for Tanks

Structure Ref.	Maximum Plan Dimension (m)	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BCA_001_t01	7	200	3.5	3.5	0.06	< 0.01
BCA_001_t02	2	450	4.5	4.5	0.03	0.02
BCA_015_t01	4	1250	7.0	7.5	0.05	0.22
BCA_015_t02	3	1050	7.0	8.0	0.09	0.04
BCA_015_t03	3	1050	7.0	8.0	0.09	0.05
BCA_025_t01	1	1000	3.5	3.5	0.04	0.04
BCA_045_t01	3	1350	3.5	3.5	0.06	0.21
BCA_060_t01	2	1100	4.0	4.0	0.05	0.04
BCA_075_t01	4	900	3.0	5.5	0.09	0.02
BCA_080_t01	4	950	3.0	3.0	0.04	0.03
BCA_080_t02	3	950	3.0	3.0	0.04	0.03
BCA_085_t01	3	1100	4.0	4.0	0.04	0.04
BCA_115_t01	2	60	0.5	0.5	< 0.01	< 0.01
BCA_120_t01	3	950	3.0	3.0	0.04	0.03
BCP_040_t01	2	40	< 0.5	< 0.5	< 0.01	< 0.01
BCP_050_t01	3	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_180_t01	2	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_180_t02	2	20	< 0.5	< 0.5	< 0.01	< 0.01
BGR_213_t01	1	350	6.0	6.0	0.10	< 0.01
BGR_218_t01	2	450	8.0	8.0	0.11	0.04
BGR_218_t02	2	650	9.0	9.0	0.11	0.09
BGR_225_t01	2	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_t02	2	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_t03	3	40	< 0.5	< 0.5	< 0.01	< 0.01
BGR_225_t04	2	40	< 0.5	< 0.5	< 0.01	< 0.01
BRE_057_t01	2	1050	4.0	4.0	0.04	0.04
BRE_083_t02	2	1350	6.5	7.5	0.06	0.21
BRE_086_t01	2	1350	6.5	8.0	0.06	0.20
BRE_089_t01	2	1300	6.0	8.0	0.06	0.17
BRE_148_t01	2	1300	2.5	2.5	0.06	0.21
BRE_154_t01	4	1300	6.5	7.5	0.06	0.22
BRE_195_t01	4	60	< 0.5	< 0.5	< 0.01	< 0.01
BRE_515_t01	8	1300	6.0	7.5	0.06	0.20
BRE_515_t02	6	1350	6.0	7.0	0.06	0.20
BRE_644_t01	3	900	3.0	3.0	0.05	0.03
BRE_644_t02	3	900	3.0	3.0	0.05	0.03
BRE_644_t03	3	900	3.0	3.0	0.05	0.03
BRE_665_t01	2	900	4.5	6.5	0.10	0.02
BRE_665_t02	2	900	4.0	6.0	0.10	0.02
BWE_031_t01	2	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_031_t02	3	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BWE_041_t01	3	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BYR_001_t01	1	850	3.5	5.0	0.09	0.02
BYR_001_t02	3	850	3.5	5.5	0.09	0.02
BYR_005_t01	3	1100	3.0	3.0	0.06	0.08
BYR_015_t02	3	1100	3.0	3.0	0.06	0.17
BYR_065_t01	9	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_t02	3	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_t01	3	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_t02	2	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_t03	2	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_075_t04	2	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_t01	3	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_t02	3	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_t03	3	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_085_t04	3	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_t01	3	50	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_t02	3	50	< 0.5	< 0.5	< 0.01	< 0.01

Table D.05 - Tahmoor South - Predictions for Tanks

Structure Ref.	Maximum Plan Dimension (m)	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BYR_105_t01	2	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_t01	4	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_t02	4	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_t03	2	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_t04	2	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_115_t05	2	30	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_t01	2	90	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_t02	2	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_145_t03	2	100	0.5	0.5	< 0.01	< 0.01
BYR_150_t01	2	1100	3.0	3.0	0.06	0.09
BYR_152_t01	2	1100	3.0	3.0	0.06	0.05
BYR_152_t02	2	1100	3.0	3.0	0.06	0.05
BYR_154_t01	2	950	3.0	3.0	0.05	0.04
BYR_156_t01	2	850	2.5	2.5	0.04	0.03
BYR_156_t02	2	850	2.5	2.5	0.04	0.03
BYR_156_t03	2	850	2.5	2.5	0.04	0.03
	Maxima:	**1350**	**9.0**	**9.0**	**0.11**	**0.22**

Table D.06 - Tahmoor South - Predictions for Pools

Structure Ref.	Maximum Plan Dimension (m)	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BCA_035_p01	7	900	2.0	3.0	0.07	0.03
BCA_095_p01	10	1250	6.0	7.5	0.07	0.18
BCA_100_p01	10	950	5.5	7.0	0.07	0.06
BCA_105_p01	9	650	4.0	4.0	0.05	0.03
BCA_115_p01	7	80	1.0	1.0	0.02	< 0.01
BCA_120_p01	9	80	1.0	1.0	0.01	< 0.01
BGR_218_p01	3	650	9.0	9.0	0.11	0.10
BRE_063_p01	7	1300	5.5	7.0	0.06	0.21
BRE_075_p01	9	900	2.0	3.5	0.09	0.03
BRE_080_p01	10	1300	4.0	4.0	0.06	0.07
BRE_089_p01	8	1350	6.0	8.0	0.06	0.20
BRE_148_p01	9	1250	3.5	3.5	0.06	0.05
BRE_167_p01	8	800	4.0	5.5	0.09	0.04
BRE_515_p01	10	1350	6.0	7.5	0.06	0.20
BYR_005_p01	10	1050	3.0	3.0	0.06	0.05
BYR_015_p01	9	1050	8.5	8.5	0.06	0.23
BYR_045_p01	11	125	0.5	0.5	< 0.01	< 0.01
BYR_055_p01	8	90	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_p01	6	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_095_p01	9	40	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_p01	10	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_152_p01	12	1050	3.0	3.0	0.06	0.05
	Maxima:	**1350**	**9.0**	**9.0**	**0.11**	**0.23**

Table D.07 - Tahmoor South - Predictions for Farm Dams

Dam Ref.	Maximum Length (m)	Plan Area (m2)	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)	Predicted Change in Freeboard (mm)
BCA_001_d01	25	345	950	5.0	5.0	0.03	0.06	250
BCA_010_d01	21	251	775	4.0	5.5	0.08	0.04	100
BCA_015_d01	26	342	1200	5.0	5.0	0.04	0.07	250
BCA_055_d01	15	135	1250	4.5	4.5	0.06	0.05	250
BCA_060_d01	46	703	1350	6.5	8.0	0.08	0.22	400
BCA_065_d01	55	1424	1200	4.5	4.5	0.05	0.04	350
BCA_070_d01	20	231	1250	4.5	4.5	0.06	0.06	250
BCA_075_d01	14	124	1300	4.0	4.5	0.06	0.20	100
BCA_080_d01	32	627	1100	6.5	8.0	0.12	0.04	250
BCA_085_d01	13	96	850	3.0	5.5	0.08	0.04	100
BCA_105_d01	12	86	525	5.5	5.5	0.08	0.05	250
BCA_105_d02	30	392	325	4.0	4.0	0.04	0.03	200
BCA_110_d01	24	414	575	6.5	6.5	0.06	0.05	300
BCP_010_d01	37	866	125	1.0	1.0	0.02	0.01	50
BCP_020_d01	31	460	90	1.0	1.0	0.01	< 0.01	< 50
BCP_040_d01	35	628	90	1.0	1.0	0.01	< 0.01	< 50
BGR_193_d01	53	1738	30	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BGR_203_d01	95	5047	50	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BGR_203_d02	35	363	70	0.5	0.5	< 0.01	< 0.01	< 50
BGR_230_d01	27	369	20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BGR_230_d02	16	127	20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BGR_230_d03	8	26	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BRE_016_d01	33	601	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BRE_020_d01	43	1115	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BRE_040_d01	50	369	225	3.5	3.5	0.06	0.01	150
BRE_045_d01	61	1253	50	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BRE_061_d01	9	55	1150	4.5	4.5	0.05	0.04	200
BRE_090_d01	52	1889	875	4.5	6.5	0.09	0.03	150
BRE_090_d02	24	310	925	2.5	3.0	0.07	0.03	100
BRE_090_d03	69	1849	975	3.0	3.0	0.05	0.04	250
BRE_090_d04	36	508	1000	7.5	7.5	0.04	0.21	250
BRE_143_d01	29	534	825	3.5	5.5	0.09	0.03	100
BRE_148_d01	35	693	1000	3.0	3.0	0.05	0.04	200
BRE_148_d02	22	170	1000	3.0	3.0	0.06	0.04	150
BRE_154_d01	76	2658	1300	6.5	7.0	0.06	0.22	200
BRE_154_d02	64	1554	1250	7.5	8.0	0.09	0.20	500
BRE_167_d01	99	2924	925	3.0	5.0	0.09	0.05	200
BRE_167_d02	16	180	1100	3.0	3.0	0.06	0.08	150
BRE_600_d01	18	205	1200	6.5	8.0	0.14	0.09	300
BWE_031_d01	39	955	< 20	< 0.5	< 0.5	< 0.01	< 0.01	< 50
BYR_005_d01	28	404	1050	3.0	3.0	0.06	0.05	200
BYR_005_d02	73	1662	875	3.0	3.5	0.07	0.04	150
BYR_015_d01	50	1415	1100	3.0	3.0	0.06	0.16	200
BYR_065_d01	44	790	325	3.5	3.5	0.07	0.01	150
BYR_095_d01	43	1003	100	< 0.5	< 0.5	< 0.01	< 0.01	< 50
		Maxima:	**1350**	**7.5**	**8.0**	**0.14**	**0.22**	**500**

Table D.08 - Tahmoor South - Predictions for Public Amenities

Structure Ref.	Maximum Plan Dimension (m)	Description	Structure Type	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BRE_020_pa01	43	Wollondilly Anglican College - Clifford Warne Auditorium	Building	300	4.0	4.0	0.05	0.02
BRE_020_pa02	24	Wollondilly Anglican College - White Cottage	Building	100	1.5	1.5	0.02	< 0.01
BRE_020_pa03	19	Wollondilly Anglican College - Canteen	Building	90	1.0	1.0	0.01	< 0.01
BRE_020_pa04	29	Wollondilly Anglican College - Sturt Cottage	Building	100	1.0	1.0	0.02	< 0.01
BRE_020_pa05	41	Wollondilly Anglican College - Bradfield Cottage	Building	100	1.0	1.0	0.02	< 0.01
BRE_020_pa06	32	Wollondilly Anglican College - Melba Cottage	Building	80	0.5	0.5	0.01	< 0.01
BRE_020_pa07	59	Wollondilly Anglican College - Rev John Flynn Collegiate	Building	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa08	29	Wollondilly Anglican College - Cook Cottage	Building	60	0.5	0.5	< 0.01	< 0.01
BRE_020_pa09	61	Wollondilly Anglican College - Alfred Deakin Admin Centre	Building	70	1.0	1.0	0.01	< 0.01
BRE_020_pa10	22	Wollondilly Anglican College - Amenities	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa11	15	Wollondilly Anglican College - Fred's Shed	Shed	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa12	33	Wollondilly Anglican College - Hardcourt 1	Tennis Court	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa13	33	Wollondilly Anglican College - Hardcourt 2	Tennis Court	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa14	29	Wollondilly Anglican College - Elizabeth Cottage	Building	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa15	164	Wollondilly Anglican College - WACA	Sports Oval	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa16	43	Wollondilly Anglican College - Shoulder to Shoulder Shelter	Building	80	0.5	0.5	0.01	< 0.01
BRE_020_pa17	30	Wollondilly Anglican College - Johnston Cottage	Building	60	0.5	0.5	< 0.01	< 0.01
BRE_020_pa18	40	Wollondilly Anglican College - Cuthbert Cottage	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa19	48	Wollondilly Anglican College - Banks Cottage	Building	125	1.5	1.5	0.02	< 0.01
BRE_020_pa20	40	Wollondilly Anglican College - Quarmby Cottage	Building	40	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_pa21	2	Wollondilly Anglican College	Shed	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_t01	2	Wollondilly Anglican College	Tank	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_t02	2	Wollondilly Anglican College	Tank	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_t04	8	Wollondilly Anglican College	Tank	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_t05	8	Wollondilly Anglican College	Tank	< 20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_020_t06	3	Wollondilly Anglican College	Tank	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_580_pa05	7	Australian Wildlife Sanctuary - Nursery	Building	900	1.5	3.5	0.08	0.02
BRE_580_pa16	6	Australian Wildlife Sanctuary - Shed	Building	900	1.5	3.5	0.08	0.02
BRE_600_pa01	25	Australian Wildlife Sanctuary - Visitor Centre	Building	900	2.0	4.5	0.08	0.03
BRE_600_pa02	14	Australian Wildlife Sanctuary - Cottage 1	Building	950	3.0	5.5	0.08	0.02
BRE_600_pa03	7	Australian Wildlife Sanctuary - Shade house	Building	900	2.5	4.5	0.08	0.02
BRE_600_pa04	12	Australian Wildlife Sanctuary - Workshop	Building	950	3.0	5.5	0.08	0.02
BRE_600_pa06	6	Australian Wildlife Sanctuary - Glass house	Glass house	900	1.5	4.0	0.08	0.02
BRE_600_pa07	14	Australian Wildlife Sanctuary - Enclosure 1	Enclosure	1000	3.0	3.0	0.05	0.03
BRE_600_pa08	7	Australian Wildlife Sanctuary - Enclosure 2	Enclosure	1000	3.0	3.0	0.04	0.03
BRE_600_pa09	10	Australian Wildlife Sanctuary - Cottage 2	Building	950	3.5	6.5	0.08	0.02
BRE_600_pa10	6	Australian Wildlife Sanctuary - Awning	Awning	950	3.0	5.5	0.08	0.02
			Maxima:	**1000**	**4.0**	**6.5**	**0.08**	**0.03**

Table D.09 - Tahmoor South - Predictions for Public Utilities

Structure Ref.	Location	Description	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BYR_200_pu01	NBN Infrastructure Yarran Rd	Shed	900	3.0	3.0	0.05	0.04
BYR_200_pu02	NBN Infrastructure Yarran Rd	Tower	850	2.5	2.5	0.04	0.04
		Maxima:	**900**	**3.0**	**3.0**	**0.05**	**0.04**

Table D.10 - Tahmoor South - Predictions for Commercial and Business Establishments

Structure Ref.	Maximum Plan Dimension (m)	Description	Structure Type	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BRE_030_c01	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	50	0.5	0.5	< 0.01	< 0.01
BRE_030_c02	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c03	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	40	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c04	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	40	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c05	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c06	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c07	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c08	113	Inghams Bargo Chicken Breeder Production Complex	Poultry Shed	20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c25	13	Inghams Bargo Chicken Breeder Production Complex	Shed	20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c26	6	Inghams Bargo Chicken Breeder Production Complex	Shed	20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c27	8	Inghams Bargo Chicken Breeder Production Complex	Shed	30	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_c28	11	Inghams Bargo Chicken Breeder Production Complex	Shed	20	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_t08	6	Inghams Bargo Chicken Breeder Production Complex	Tank - gas	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_030_t09	6	Inghams Bargo Chicken Breeder Production Complex	Tank - gas	50	< 0.5	< 0.5	< 0.01	< 0.01
BRE_040_c01	14	Auto Wreckers	Shed	700	4.0	4.0	0.05	0.04
BRE_040_c02	28	Auto Wreckers	Shed	800	6.0	6.0	0.05	0.06
BRE_040_c03	17	Bargo Petroleum and Hill Top Pit Stop	Awning	900	4.5	4.5	0.06	0.04
BRE_040_c04	26	Bargo Petroleum and Hill Top Pit Stop	Petrol Station	900	4.5	4.5	0.06	0.04
BRE_040_c05	13	Bargo Petroleum and Hill Top Pit Stop	Workshop	1000	4.5	4.5	0.05	0.05
BRE_040_c06	9		Shed	1050	5.0	5.0	0.03	0.05
BRE_040_c07	17		Shed	1050	5.5	5.5	0.02	0.08
BRE_040_c08	14		Shed	1050	6.5	6.5	0.02	0.12
BRE_040_c09	128		Greenhouse	700	7.0	7.0	0.08	0.10
BRE_040_c10	51		Greenhouse	950	7.5	7.5	0.08	0.15
BRE_040_c11	12		Shed	700	7.0	7.0	0.08	0.10
BRE_040_c12	12		Shed	600	7.0	7.0	0.08	0.06
BRE_040_c13	11		Shed	375	5.0	5.0	0.07	0.01
BRE_055_c01	27	Tahmoor Garden Centre	Cafe	950	3.5	3.5	0.05	0.03
BRE_055_c02	9	Tahmoor Garden Centre	Shop	950	3.5	3.5	0.05	0.03
BRE_055_c03	7	Tahmoor Garden Centre	Shed	1000	4.0	4.0	0.05	0.03
BRE_055_c04	17	Tahmoor Garden Centre	Shade structure	1000	4.0	4.0	0.05	0.03
BRE_515_c01	7	MKD Machinery	Shed	1300	6.0	8.0	0.07	0.20
BRE_515_c02	3	MKD Machinery	Hopper	1300	6.0	7.5	0.06	0.20
BRE_515_c03	6	MKD Machinery	Shed	1300	6.0	7.5	0.07	0.18
BRE_515_c04	3	MKD Machinery	Shed	1350	6.0	7.5	0.06	0.20
BRE_515_c05	3	MKD Machinery	Shed	1350	6.0	7.5	0.06	0.20
BRE_515_c06	14	MKD Machinery	Shed	1300	6.0	7.5	0.07	0.20
BYR_055_c01	29	Bargo Valley Produce	Shed	125	0.5	0.5	< 0.01	< 0.01
BYR_055_c02	41	Bargo Valley Produce	Shed	100	0.5	0.5	< 0.01	< 0.01
BYR_055_c03	89	Bargo Valley Produce	Poultry Shed	175	1.0	1.0	0.01	< 0.01
BYR_055_c04	89	Bargo Valley Produce	Poultry Shed	200	1.5	1.5	0.02	< 0.01
BYR_055_c05	89	Bargo Valley Produce	Poultry Shed	250	2.0	2.0	0.03	< 0.01
BYR_055_c06	89	Bargo Valley Produce	Poultry Shed	325	3.5	3.5	0.06	0.01
BYR_055_c07	86	Bargo Valley Produce	Greenhouse	700	8.5	8.5	0.09	0.03
BYR_055_t01	8	Bargo Valley Produce	Tank	100	0.5	0.5	< 0.01	< 0.01

Table D.10 - Tahmoor South - Predictions for Commercial and Business Establishments

Structure Ref.	Maximum Plan Dimension (m)	Description	Structure Type	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
BYR_055_t02	3	Bargo Valley Produce	Tank	175	1.0	1.0	0.01	< 0.01
BYR_065_c06	91	Ingham Turkey Farm	Poultry Shed	90	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_c07	96	Ingham Turkey Farm	Poultry Shed	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_c08	83	Ingham Turkey Farm	Poultry Shed	100	0.5	0.5	< 0.01	< 0.01
BYR_065_c09	11	Ingham Turkey Farm	Poultry Shed	100	0.5	0.5	< 0.01	< 0.01
BYR_065_c10	15	Ingham Turkey Farm	Poultry Shed	125	0.5	0.5	< 0.01	< 0.01
BYR_065_c11	26	Ingham Turkey Farm	Poultry Shed	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_c12	91	Ingham Turkey Farm	Poultry Shed	150	1.0	1.0	< 0.01	< 0.01
BYR_065_c13	90	Ingham Turkey Farm	Poultry Shed	150	1.0	1.0	< 0.01	< 0.01
BYR_065_c14	91	Ingham Turkey Farm	Poultry Shed	175	1.0	1.0	0.01	< 0.01
BYR_065_t02	5	Ingham Turkey Farm	Tank	100	< 0.5	< 0.5	< 0.01	< 0.01
BYR_065_t03	4	Ingham Turkey Farm	Tank	80	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c01	14	Canine Country Club and Cattery	Shed	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c02	20	Canine Country Club and Cattery	Shed	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c03	9	Canine Country Club and Cattery	Shed	70	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c04	17	Canine Country Club and Cattery	Shed	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c05	26	Canine Country Club and Cattery	Shed	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c06	3	Canine Country Club and Cattery	Shed	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c07	14	Canine Country Club and Cattery	Shed	60	< 0.5	< 0.5	< 0.01	< 0.01
BYR_135_c08	25	Canine Country Club and Cattery	Awning	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_c01	49	Tahmoor Mine - Administration	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c04	25	Tahmoor Mine - Storage	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c05	37	Tahmoor Mine - Workshop	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c06	24	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c07	32	Tahmoor Mine - Store	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c08	20	Tahmoor Mine - Meeting Room	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c09	14	Tahmoor Mine - OH&S	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c10	12	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c11	12	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c12	21	Tahmoor Mine - Training Room	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c13	25	Tahmoor Mine - Winder House	Building	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_c14	5	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c15	12	Tahmoor Mine - Bath	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c16	66	Tahmoor Mine - Bath House and Mine Office	Building	20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c17	12	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c18	9	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c19	10	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c20	8	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c21	24	Tahmoor Mine - Conveyor Drive	Building	20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c22	8	Tahmoor Mine - Gas	Building	20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c23	18	Tahmoor Mine	Building	20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c24	12	Tahmoor Mine - Contractors Offices	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c25	12	Tahmoor Mine - Contractors Offices	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c26	12	Tahmoor Mine - DOM Room	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c27	12	Tahmoor Mine - Bath	Building	30	< 0.5	< 0.5	< 0.01	< 0.01

Table D.10 - Tahmoor South - Predictions for Commercial and Business Establishments

Structure Ref.	Maximum Plan Dimension (m)	Description	Structure Type	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
TM_c28	12	Tahmoor Mine - Bath	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c29	15	Tahmoor Mine - Critical Equipment	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c30	15	Tahmoor Mine - Fire Services	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c31	9	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c32	6	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c33	15	Tahmoor Mine - Bath	Building	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_c34	7	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c35	3	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c36	3	Tahmoor Mine	Building	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_c37	19	Tahmoor Mine - Washery Equipment	Building	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_c38	35	Tahmoor Mine - Bath House and Workshop	Building	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_c39	3	Tahmoor Mine	Building	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_c40	12	Tahmoor Mine - CHPP Contractors Crib Room	Building	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_c41	12	Tahmoor Mine - CHPP Contractors Training Room	Building	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_c42	78	Tahmoor Mine - Washery and Control Room	Building	80	< 0.5	< 0.5	< 0.01	< 0.01
TM_c43	8	Tahmoor Mine	Building	80	< 0.5	< 0.5	< 0.01	< 0.01
TM_c44	6	Tahmoor Mine	Building	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c45	8	Tahmoor Mine	Building	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c46	7	Tahmoor Mine	Building	125	1.5	1.5	0.01	< 0.01
TM_c47	8	Tahmoor Mine	Building	125	1.5	1.5	0.01	< 0.01
TM_c48	6	Tahmoor Mine - CHPP Stockpile Contractor Crib Room	Building	175	2.0	2.0	0.02	0.01
TM_c49	2	Tahmoor Mine	Building	200	2.0	2.0	0.02	0.01
TM_c50	4	Tahmoor Mine	Building	200	2.0	2.0	0.02	0.01
TM_c54	10	Tahmoor Mine	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c57	24	Tahmoor Mine - Longwall Shed	Building	< 20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c60	30	Tahmoor Mine - Equipment	Building	20	< 0.5	< 0.5	< 0.01	< 0.01
TM_c70	8	Tahmoor Mine	Shed	50	< 0.5	< 0.5	< 0.01	< 0.01
TM_c71	5	Tahmoor Mine	Shed	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_c72	6	Tahmoor Mine	Shed	50	< 0.5	< 0.5	< 0.01	< 0.01
TM_c73	5	Tahmoor Mine	Shed	50	< 0.5	< 0.5	< 0.01	< 0.01
TM_c74	22	Tahmoor Mine - 6000t Bin	Bin	50	0.5	0.5	< 0.01	< 0.01
TM_c75	12	Tahmoor Mine - 1250t Raw Coal Bin	Bin	60	0.5	0.5	< 0.01	< 0.01
TM_c76	12	Tahmoor Mine - 1250t Raw Coal Bin	Bin	60	0.5	0.5	< 0.01	< 0.01
TM_c77	18	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c78	4	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c79	6	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c80	12	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c81	2	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_c82	1	Tahmoor Mine	Thickeners	70	< 0.5	< 0.5	< 0.01	< 0.01
TM_d01	109	Tahmoor Mine - Dam M1	Dam	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_d02	51	Tahmoor Mine - Dam M2	Dam	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_d03	114	Tahmoor Mine - Dam M3	Dam	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_d04	106	Tahmoor Mine - Dam M4	Dam	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_d05	74	Tahmoor Mine - Tailings Dam	Dam	60	< 0.5	< 0.5	< 0.01	< 0.01
TM_d06	51	Tahmoor Mine - Tailings Dam	Dam	60	< 0.5	< 0.5	< 0.01	< 0.01

Table D.10 - Tahmoor South - Predictions for Commercial and Business Establishments

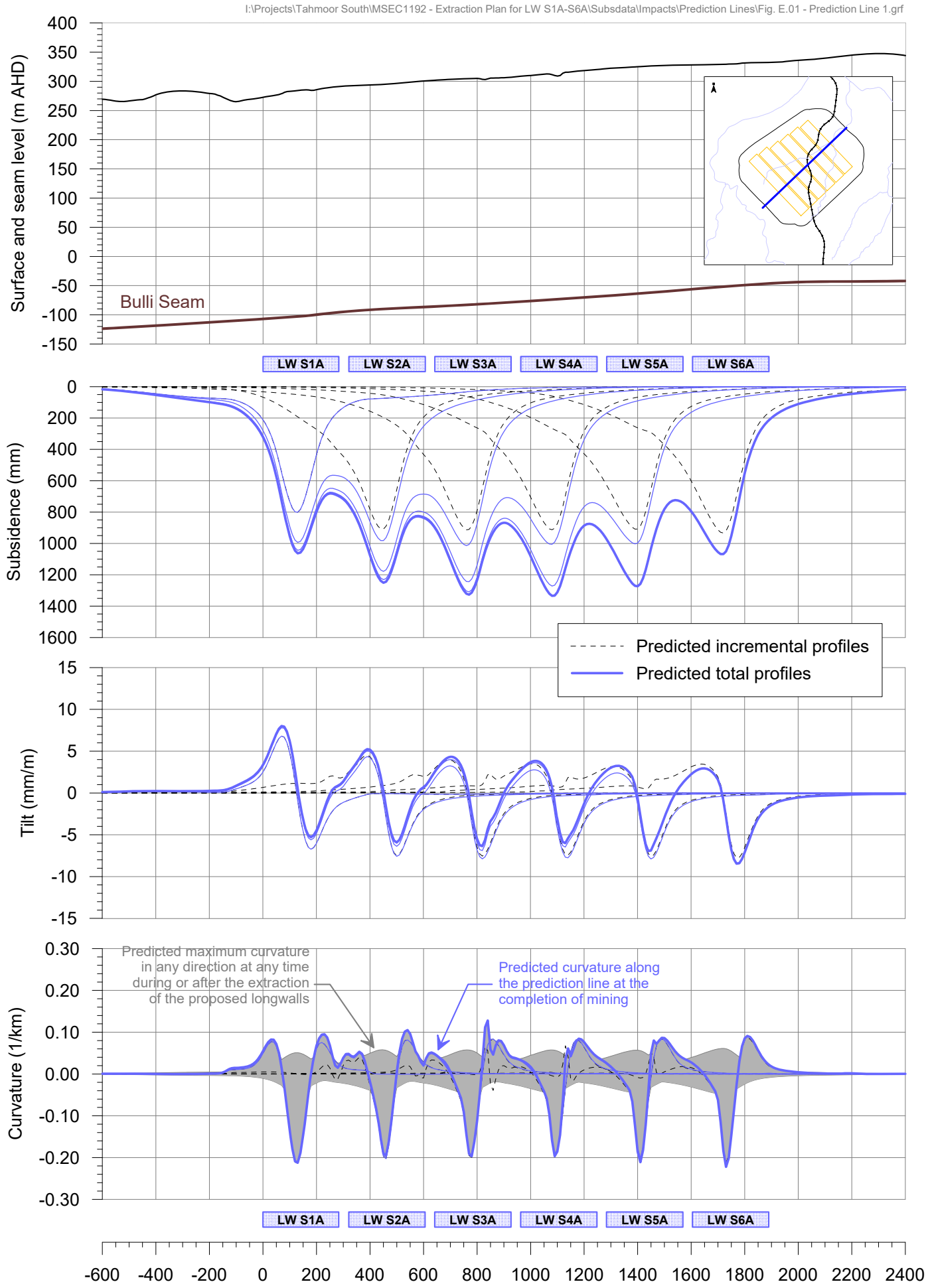
Structure Ref.	Maximum Plan Dimension (m)	Description	Structure Type	Predicted Total Subsidence (mm)	Predicted Final Tilt after all Longwalls (mm/m)	Predicted Maximum Tilt after any Longwall (mm/m)	Predicted Total Hogging Curvature (1/km)	Predicted Total Sagging Curvature (1/km)
TM_d07	24	Tahmoor Mine - Dam	Dam	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_d08	24	Tahmoor Mine - Dam	Dam	40	< 0.5	< 0.5	< 0.01	< 0.01
TM_d09	35	Tahmoor Mine - Dam	Dam	50	< 0.5	< 0.5	< 0.01	< 0.01
TM_d10	35	Tahmoor Mine - Dam	Dam	90	< 0.5	< 0.5	< 0.01	< 0.01
TM_d11	144	Tahmoor Mine - Dam	Dam	125	1.0	1.0	0.01	< 0.01
TM_d12	109	Tahmoor Mine	Building	200	1.5	1.5	0.02	< 0.01
TM_d13	11	Tahmoor Mine - Dam	Dam	30	< 0.5	< 0.5	< 0.01	< 0.01
TM_t03	10	Tahmoor Mine - Tank	Tank	70	< 0.5	< 0.5	< 0.01	< 0.01
			Maxima:	**1350**	**8.5**	**8.5**	**0.09**	**0.20**

Table D.11 - Tahmoor South - Predictions for Archaeological Sites

Site ID	Type	Significance	Predicted Total Subsidence after all Longwalls (mm)	Predicted Total Tilt after all Longwalls (mm/m)	Predicted Total Hogging Curvature after all Longwalls (1/km)	Predicted Total Sagging Curvature after all Longwalls (1/km)
52-2-3968	Open camp site	Low	550	5.0	0.05	0.02
52-2-4471	Rockshelter with art and deposit	Low	900	4.5	0.06	0.03
48-2-0275	Isolated find	Low	70	< 0.5	< 0.01	< 0.01
		Maxima:	**900**	**5.0**	**0.06**	**0.03**

APPENDIX E. FIGURES SHOWING PREDICTED SUBSIDENCE PARAMETERS OVER THE TAHMOOR SOUTH PROJECT

Predicted profiles of conventional subsidence, tilt and curvature along Prediction Line 1 resulting from the extraction of Longwalls S1A to S6A

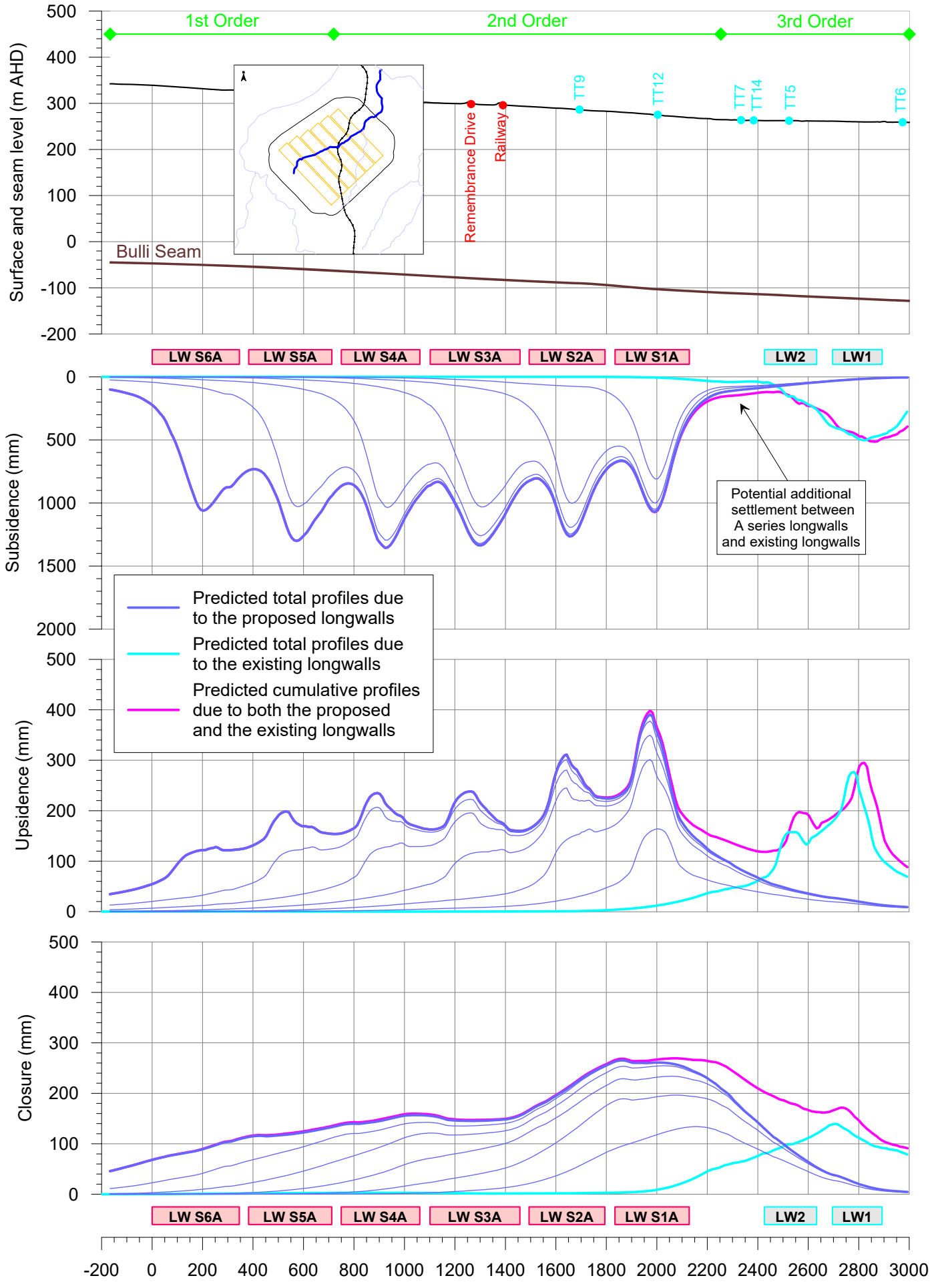


msec

Fig. E.01

Predicted profiles of subsidence, upsidence and closure along Teatree Hollow resulting from the extraction of Longwalls S1A to S6A

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\Subsdata\Impacts\Streams\Fig. E.02 - Teatree Hollow.grf

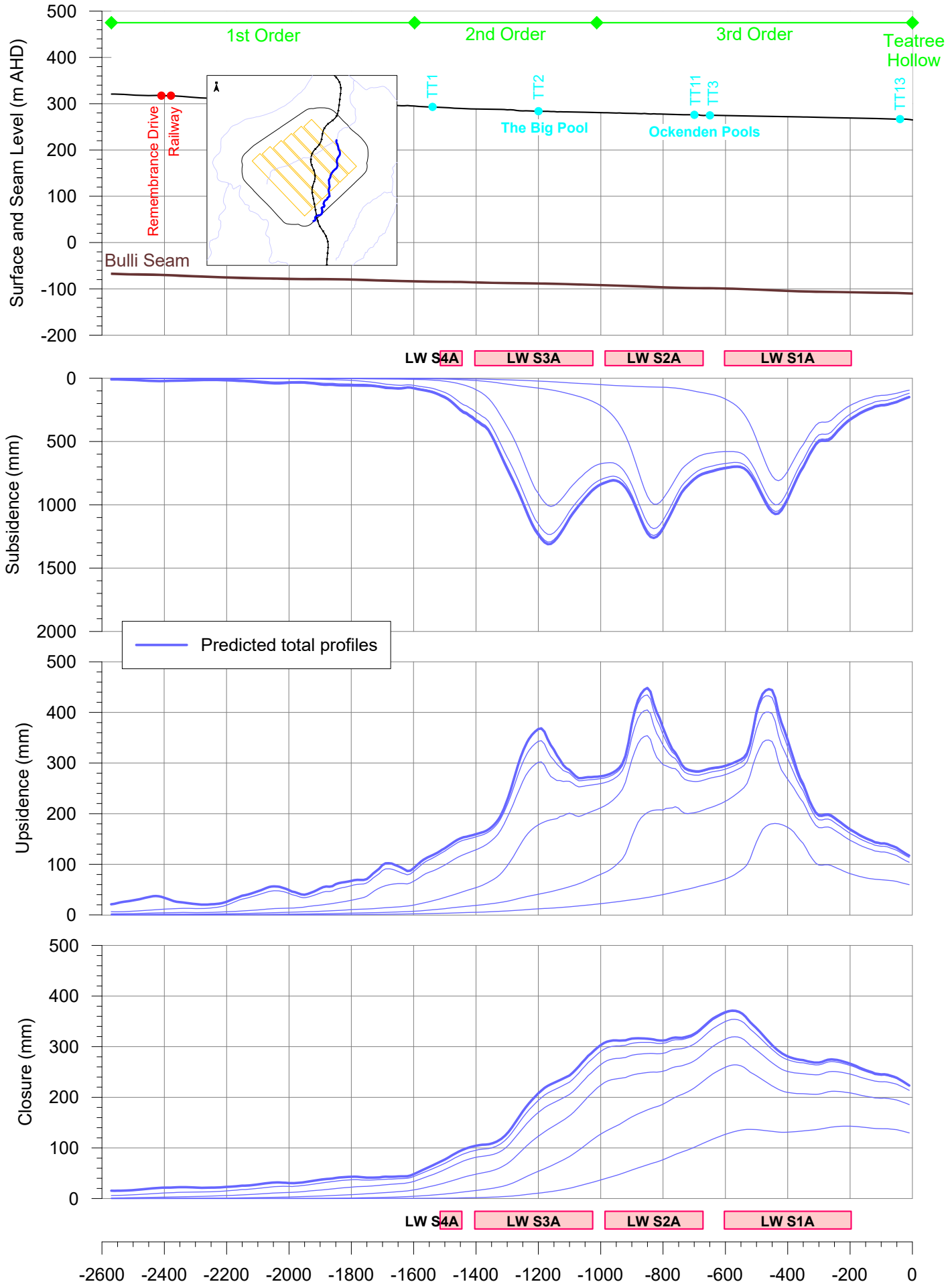


msec

Fig. E.02

Predicted profiles of subsidence, upsidence and closure along Tributary of Teatree Hollow resulting from the extraction of Longwalls S1A to S6A

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\Subsdata\Impacts\Streams\Fig. E.03 - Tributary of Teatree Hollow.grf



msec

Fig. E.03

Predicted profiles of conventional subsidence, tilt and change in grade along the Main Southern Railway due to the extraction of Longwalls S1A to S6A

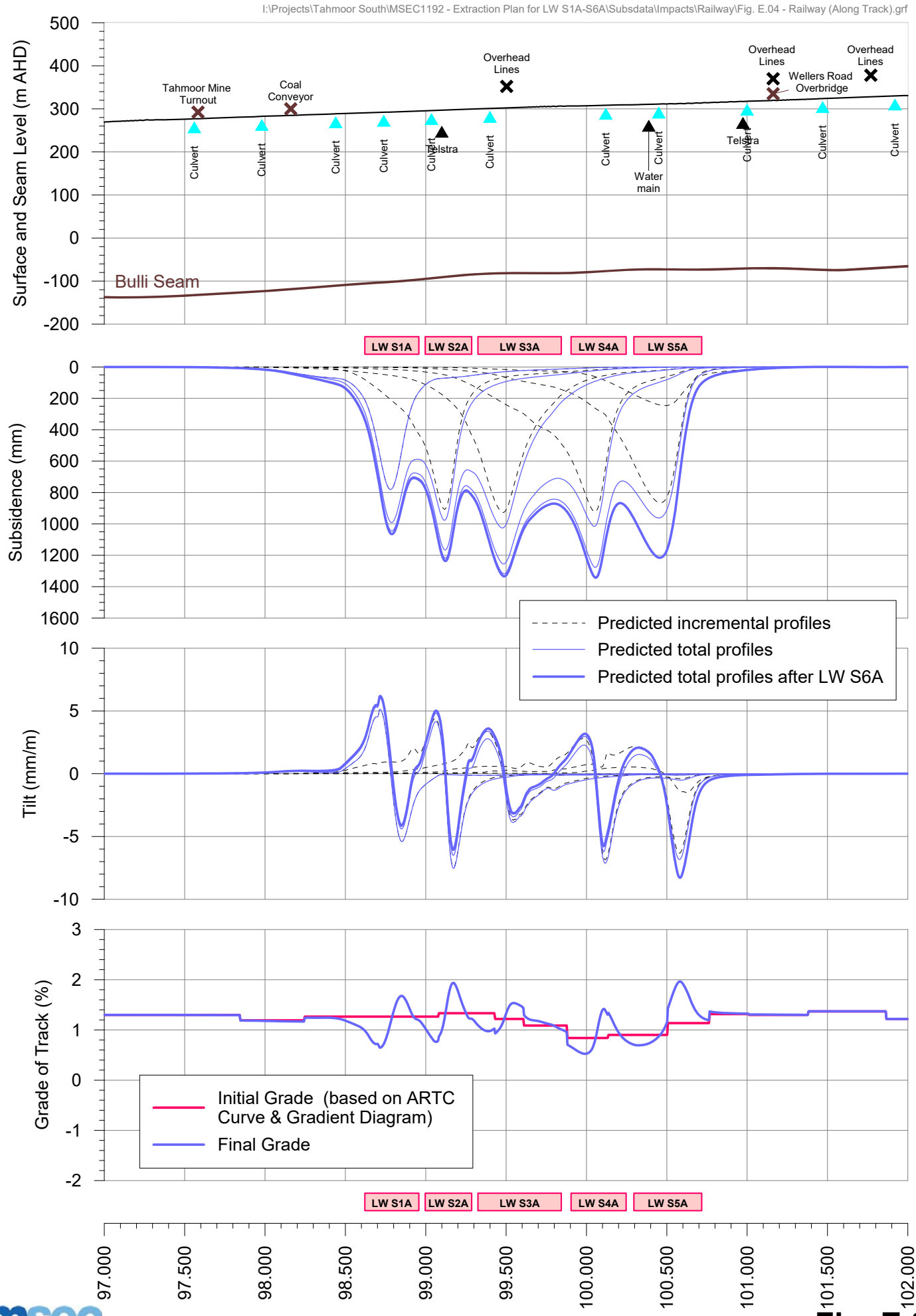
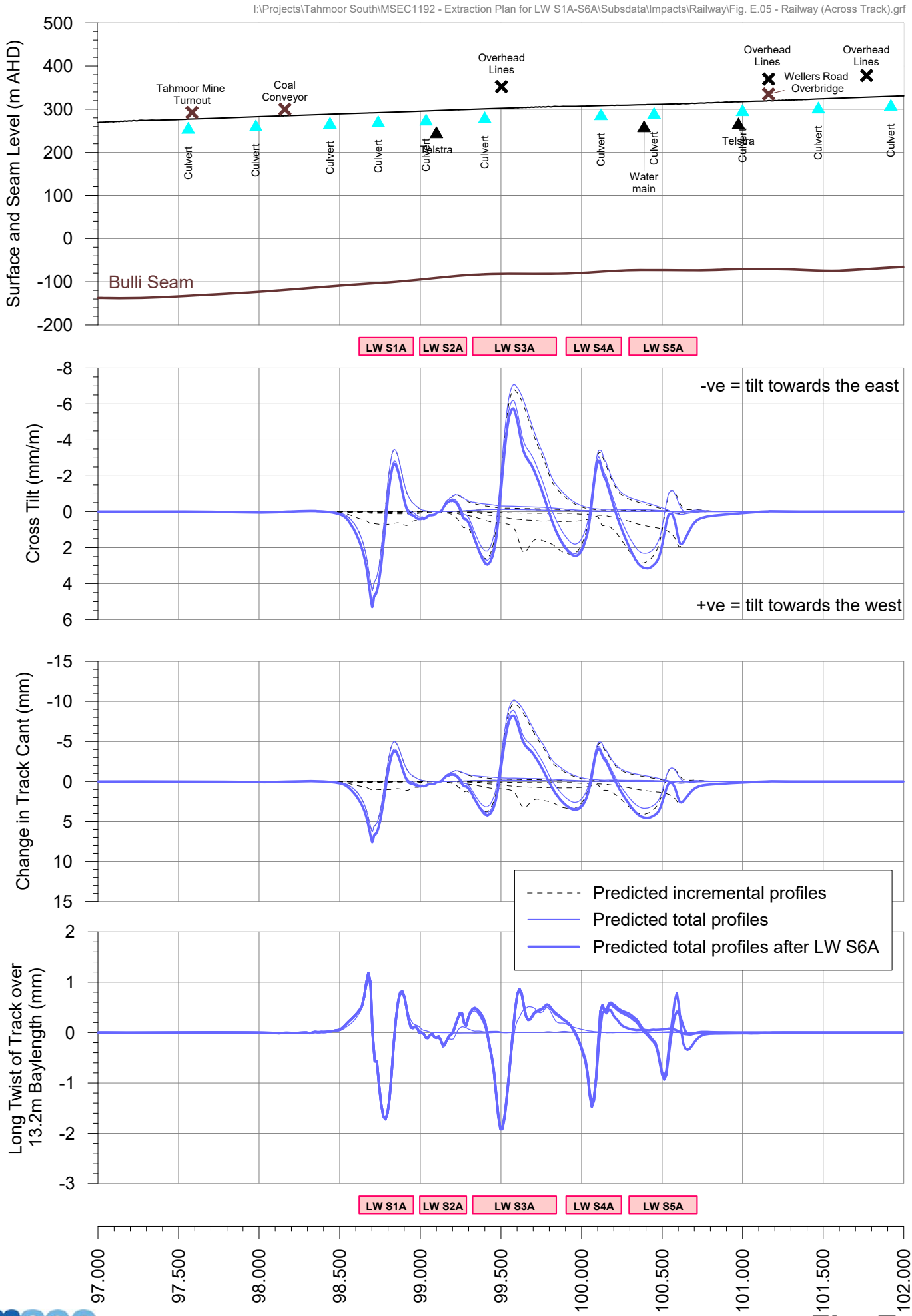


Fig. E.04

Predicted profiles of conventional cross tilt, change in track cant and long twist along the Main Southern Railway due to the extraction of Longwalls S1A to S6A



msec

Fig. E.05

Predicted profiles of conventional horizontal movement along track, change in 100 metre long bay length and change in SFT for the Main Southern Railway due to the extraction of Longwalls S1A to S6A

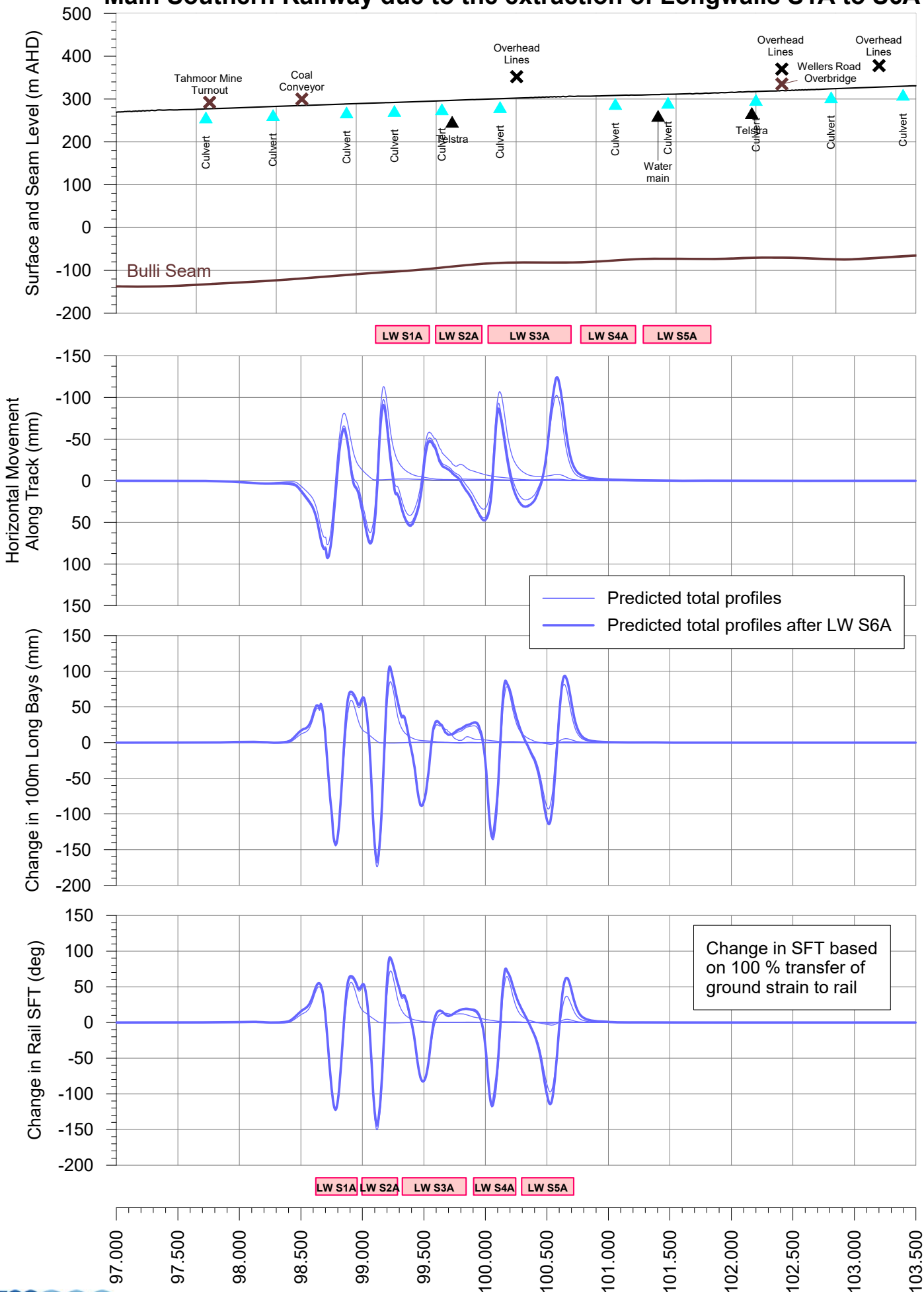
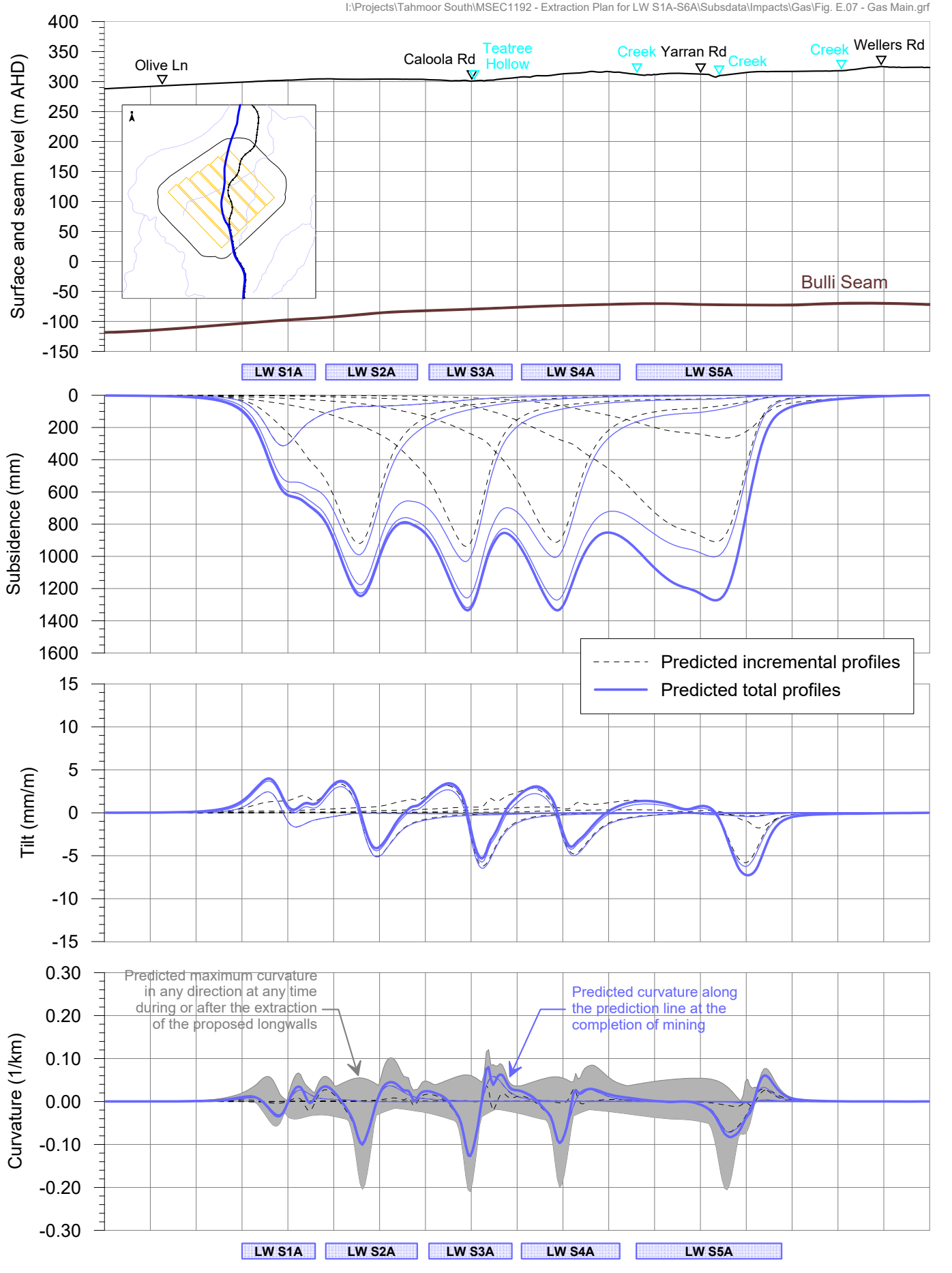


Fig. E.06

Predicted profiles of conventional subsidence, tilt and curvature along Remembrance Drive and the 150mm steel gas main resulting from the extraction of Longwalls S1A to S6A

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\Subsdata\Impacts\Gas\Fig. E.07 - Gas Main.grf

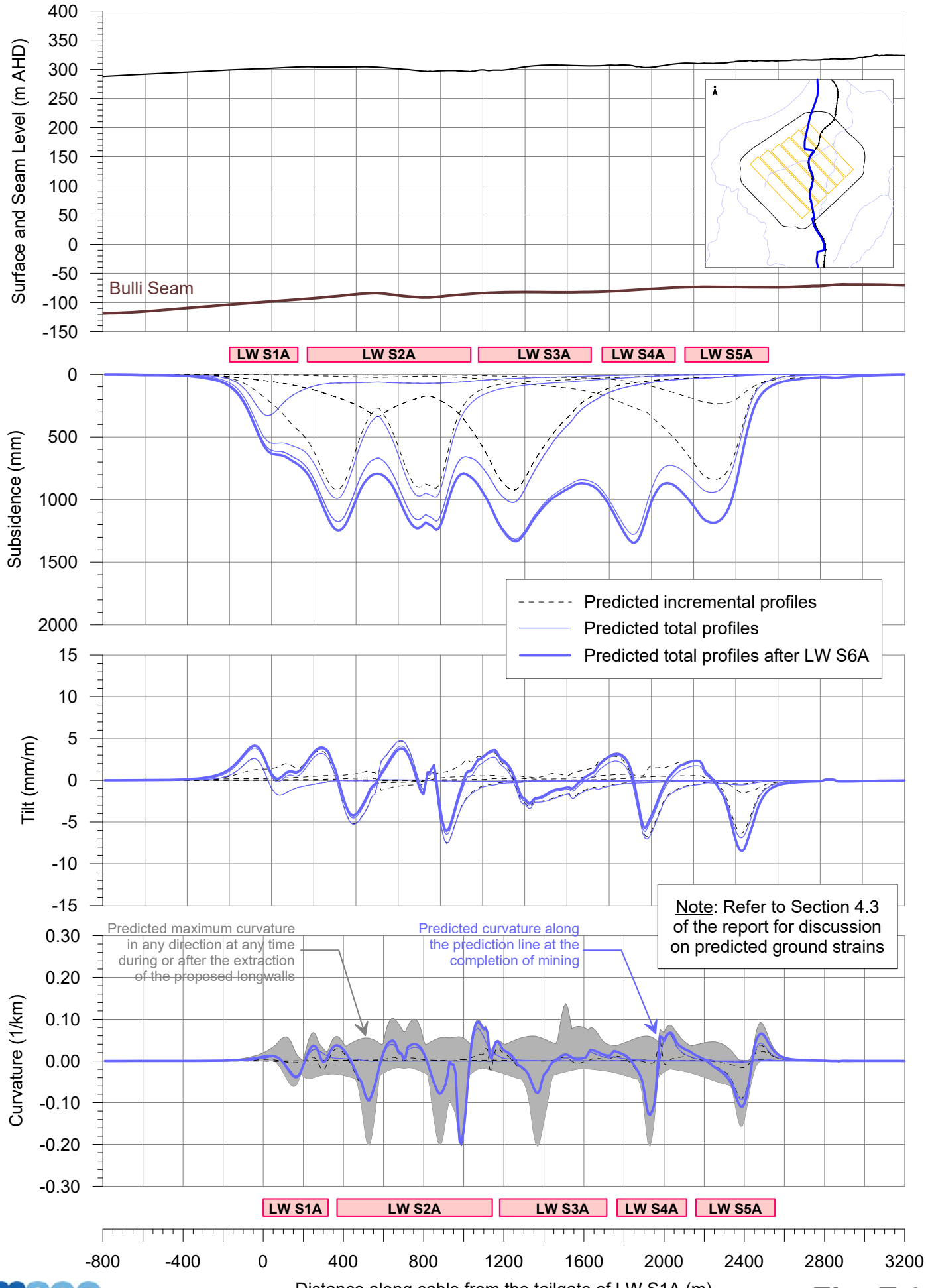


msec

Fig. E.07

Predicted profiles of conventional subsidence, tilt and curvature along Optical Fibre Cable resulting from the extraction of Longwalls S1A to S6A

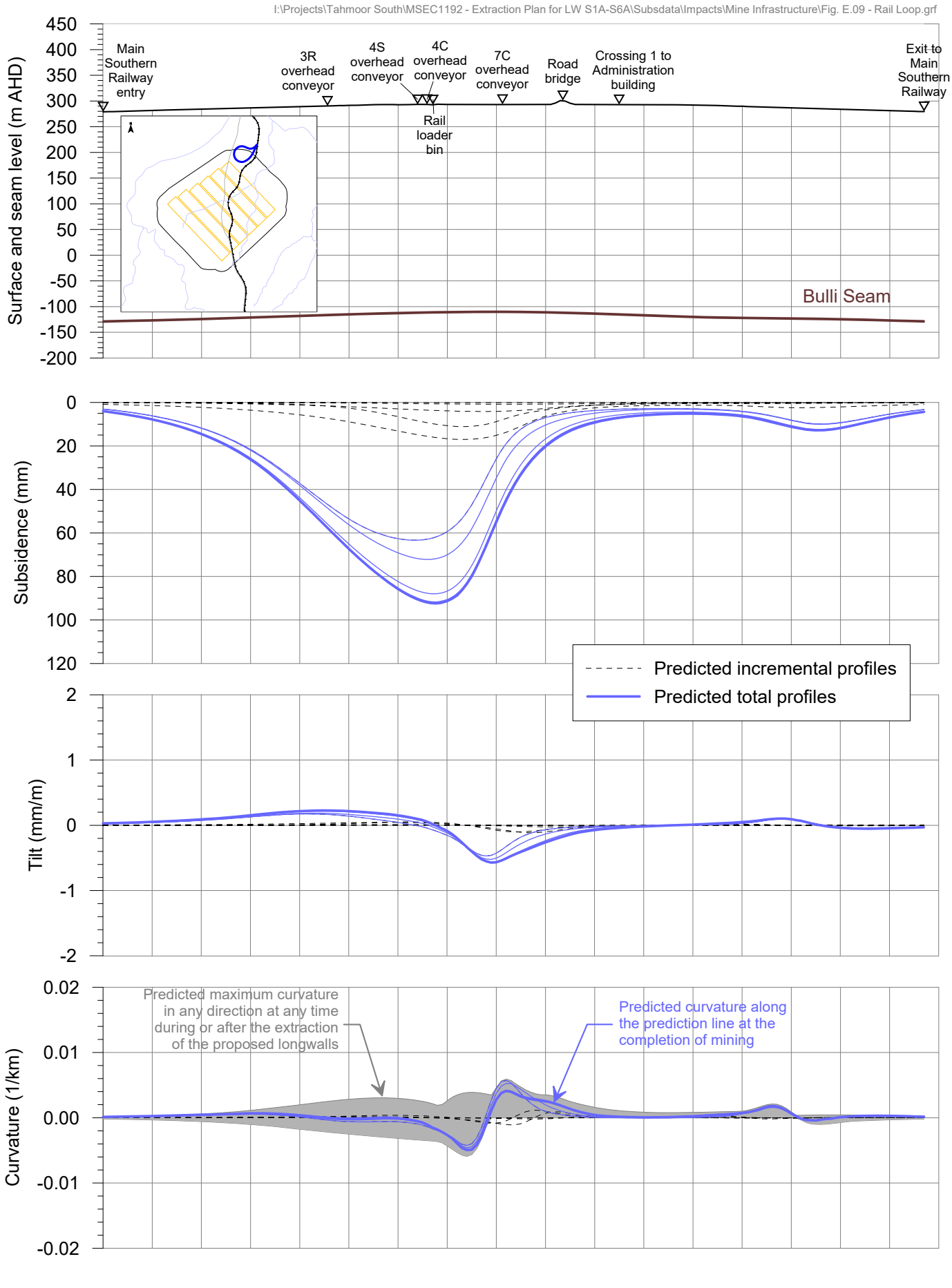
I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\Subsdata\Impacts\Telecommunications\Fig. E.08 - Optical Fibre Cable.grf



msec

Fig. E.08

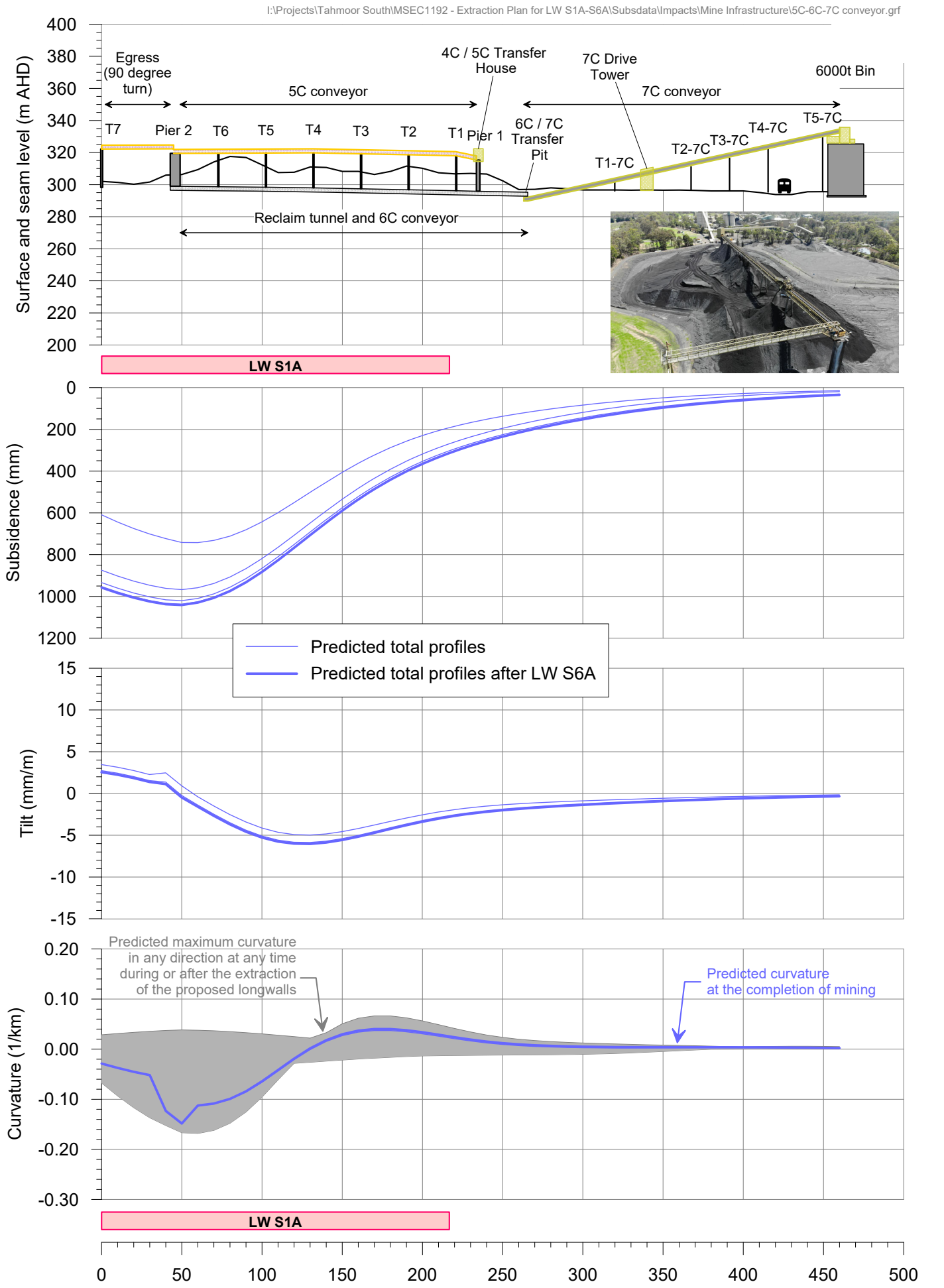
Predicted profiles of conventional subsidence, tilt and curvature along Tahmoor Mine rail loop resulting from the extraction of Longwalls S1A to S6A



msec

Fig. E.09

Predicted profiles of conventional subsidence, tilt and curvature along 5C-6C-7C conveyors resulting from the extraction of Longwalls S1A to S6A



msec

Fig. E.10

APPENDIX F. DRAWINGS

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-01 General Layout (LWS1A to LWS6A).dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	as shown	MSEC1192-01	B

TAHMOOR
COURIDJAH
BARGO
YANDERRA

Railway Viaduct
Remembrance Drive Bridge over Bargo River & Main Southern Railway
1755 m
1690 m
940 m
PICTON WEIR

LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A

Predicted 20mm Contour after LW S1A to LW S6A
Study Area
600m Study Area for Natural Features
EXTENT OF LONGWALLS

BARGO RIVER
MAIN SOUTHERN RAILWAY
M31 HUME MOTORWAY
MOOMBA-SYDNEY GAS PIPELINE

BARGO RIVER ROAD
REMEMBRANCE DR
REMEMBRANCE DRIVE
FIRE ROAD NO P1
OLIVE GROVE
CALOOLA ROAD
YARRAN ROAD
CHARLIES POINT ROAD
WELLERS ROAD
CLAREMONT DRIVE
ASHBY CLOSE
HOGANS DRIVE
ELVY STREET
HAMBRIDGE ROAD
MIMOSA STREET
KADER STREET
GWYNN HUGHES STREET
GREAT SOUTHERN ROAD
WATTLE STREET
IRONBARK ROAD
GOVERNMENT ROAD
EDMOND ROAD
BARGO ROAD
TYLERS ROAD
HAWTHORNE ROAD
AVON DAM RD
JOHNSTON RD
MARSHALL AVENUE
RESERVOIR ROAD
CARLISLE STREET
SILICA ROAD
LUPTON ROAD
AVON DAM ROAD
FIRE ROAD NO 5B
ANTHONY ROAD
GLENGARRY ROAD
WARROBYN RD
DWYERS RD
ARINA ROAD
PHEASANTS NEST RD
STRATFORD RD

LW 1 LW 2 LW 3 LW 4 LW 5 LW 6 LW 7 LW 8 LW 9 LW 10A LW 10B LW 11 LW 12 LW 13 LW 14A LW 14B LW 15 LW 16 LW 17 LW 18 LW 19

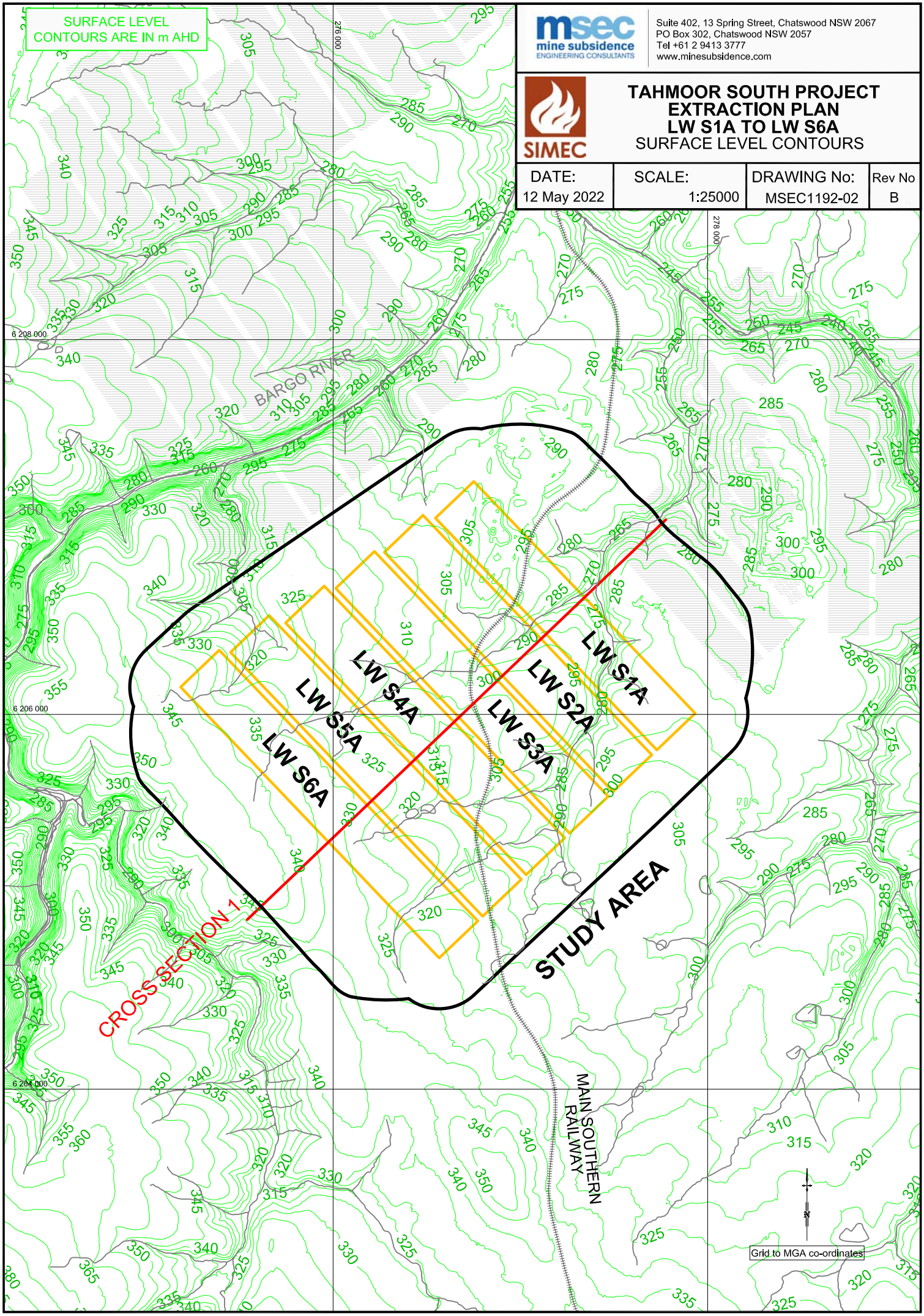
276 000
278 000
280 000
6 208 000
6 206 000
6 204 000
6 202 000

Grid to MGA co-ordinates

LEGEND
- Structures potentially sensitive to differential far field movements
- Historical Mine Workings

Note: The 'Extent of Longwalls' boundary encompasses the proposed extent of underground workings, being the proposed longwall panels & mains headings (first workings).

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-02 Surface Level Contours.dwg



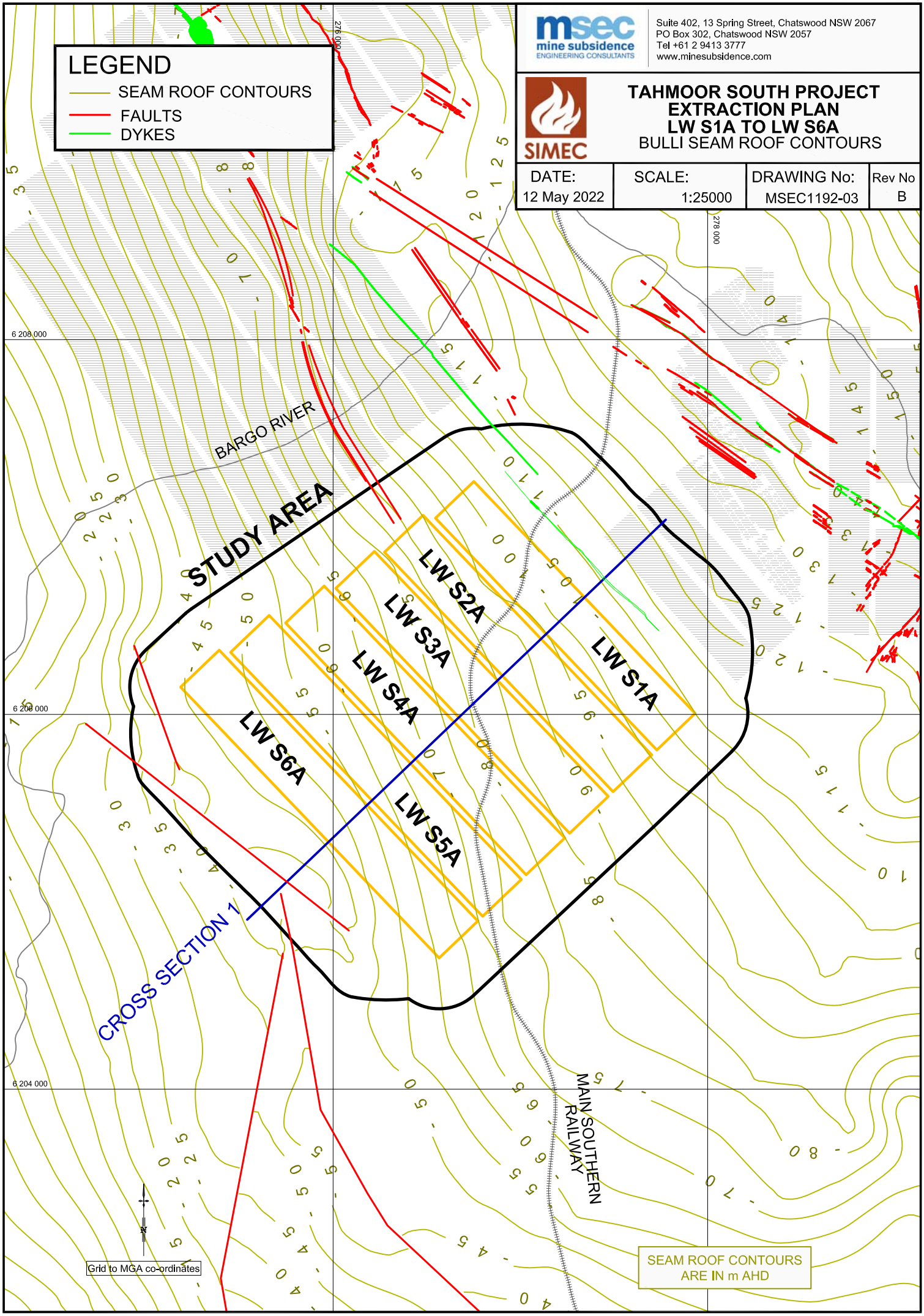
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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
SURFACE LEVEL CONTOURS

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12 May 2022	1:25000	MSEC1192-02	B

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
BULLI SEAM ROOF CONTOURS

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
EXTRACTION HEIGHT

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Grid to MGA co-ordinates

276 000

278 000

6 208 000

6 206 000

6 204 000

BARGO RIVER

LW S1A

LW S2A

LW S3A

LW S4A

LW S5A

LW S6A

STUDY AREA

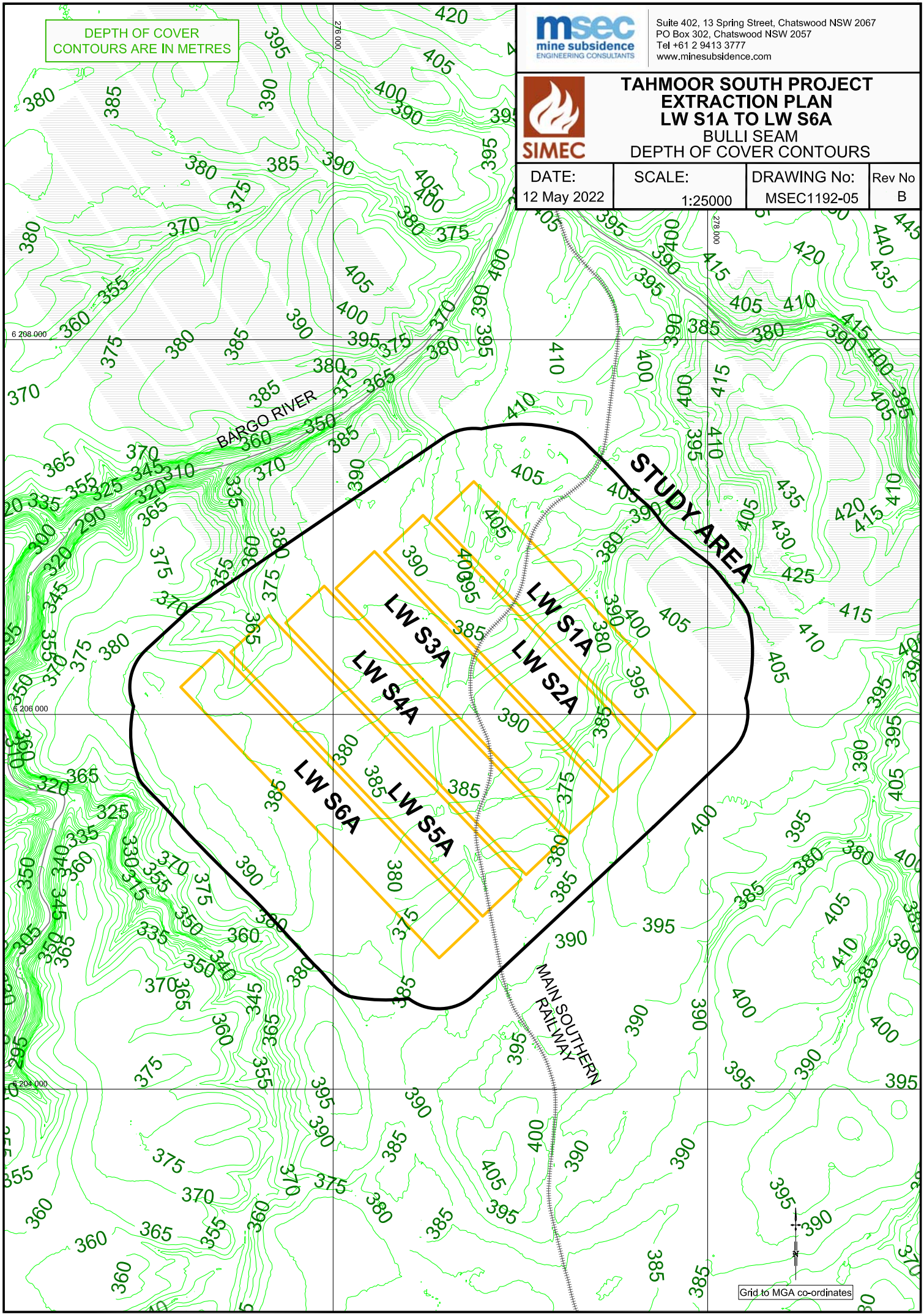
MAIN SOUTHERN RAILWAY

LEGEND

2.1m

2.2m

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-05 Depth of Cover Contours.dwg



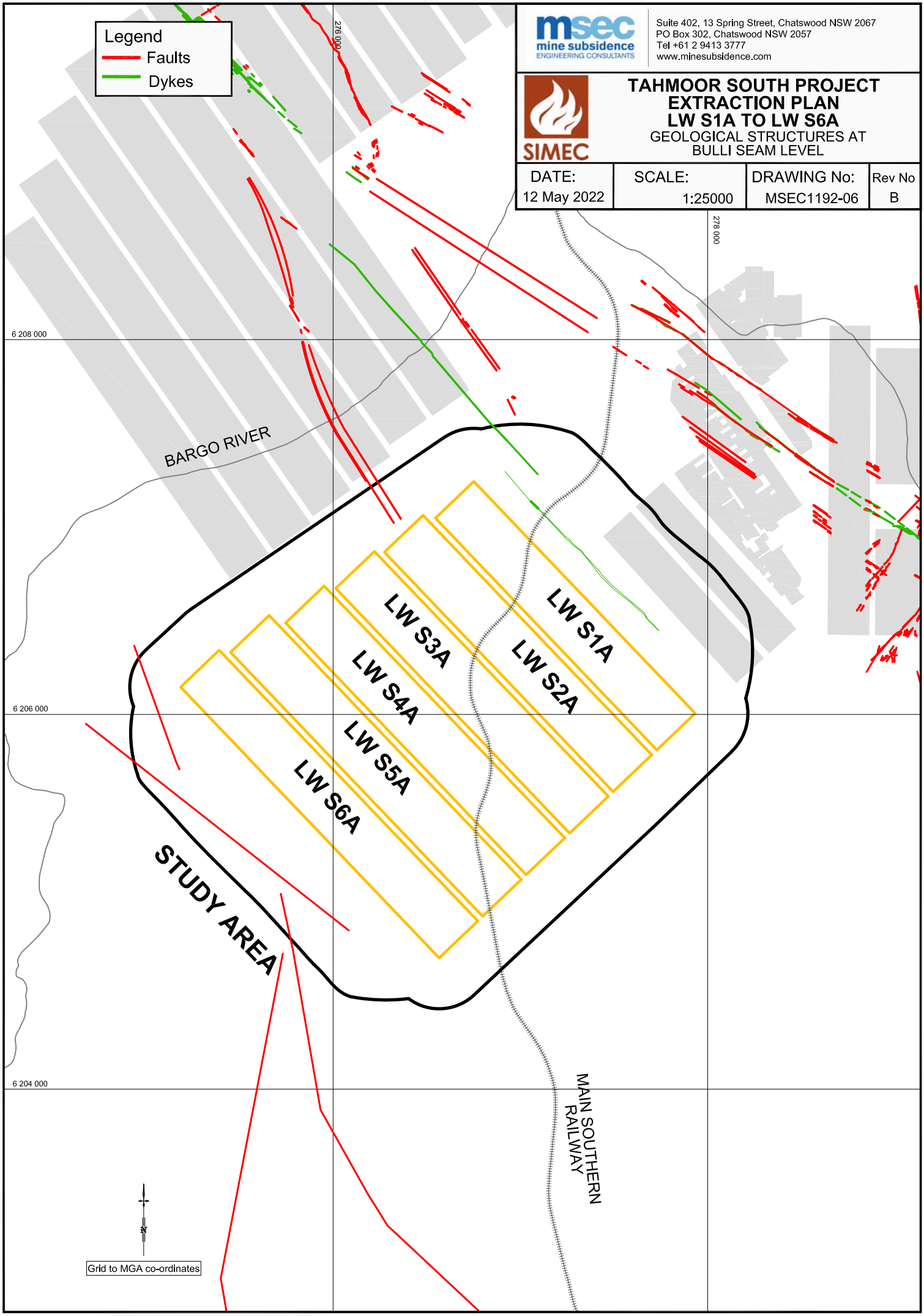
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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
BULLI SEAM
DEPTH OF COVER CONTOURS

DATE:	SCALE:	DRAWING No:	Rev No
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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

GEOLOGICAL STRUCTURES AT BULLI SEAM LEVEL

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN LWS1A TO LWS6A

STREAMS - GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
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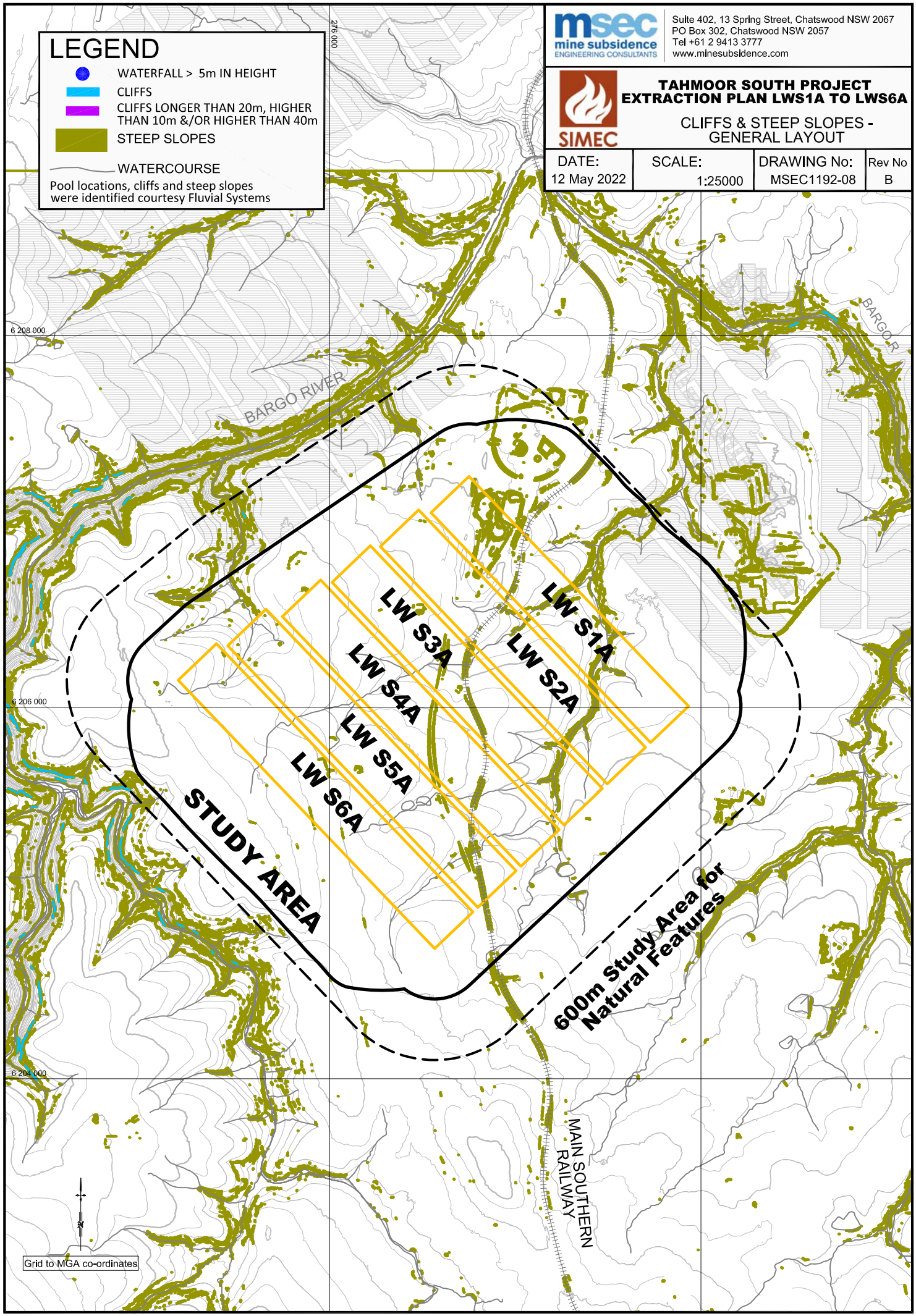
278 000
276 000
6 208 000
6 206 000
6 204 000

BARGO RIVER
BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden Creek
Hidden Creek
LW S2A
LW S3A
TEATREE HOLLOW
LW S1A
TRIBUTARY OF TEATREE HOLLOW
LW S4A
LW S5A
LW S6A
PICTON WEIR
STUDY AREA
600m Study Area for Natural Features
DOGTRAP CK
TRIBUTARY 2 OF DOG TRAP CREEK
TRIBUTARY 1 OF DOG TRAP CREEK
HORNES CK
MAIN SOUTHERN RAILWAY
DOGTRAP CK

LEGEND
Stream order information courtesy Fluvial Systems
- 1st ORDER STREAMS
- 2nd ORDER STREAMS
- 3rd ORDER STREAMS
- 4th ORDER STREAMS
- 5th ORDER STREAMS
- 7th ORDER STREAMS
- SURFACE CONTOURS

Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-08 Cliffs & Steep Slopes - General Layout.dwg



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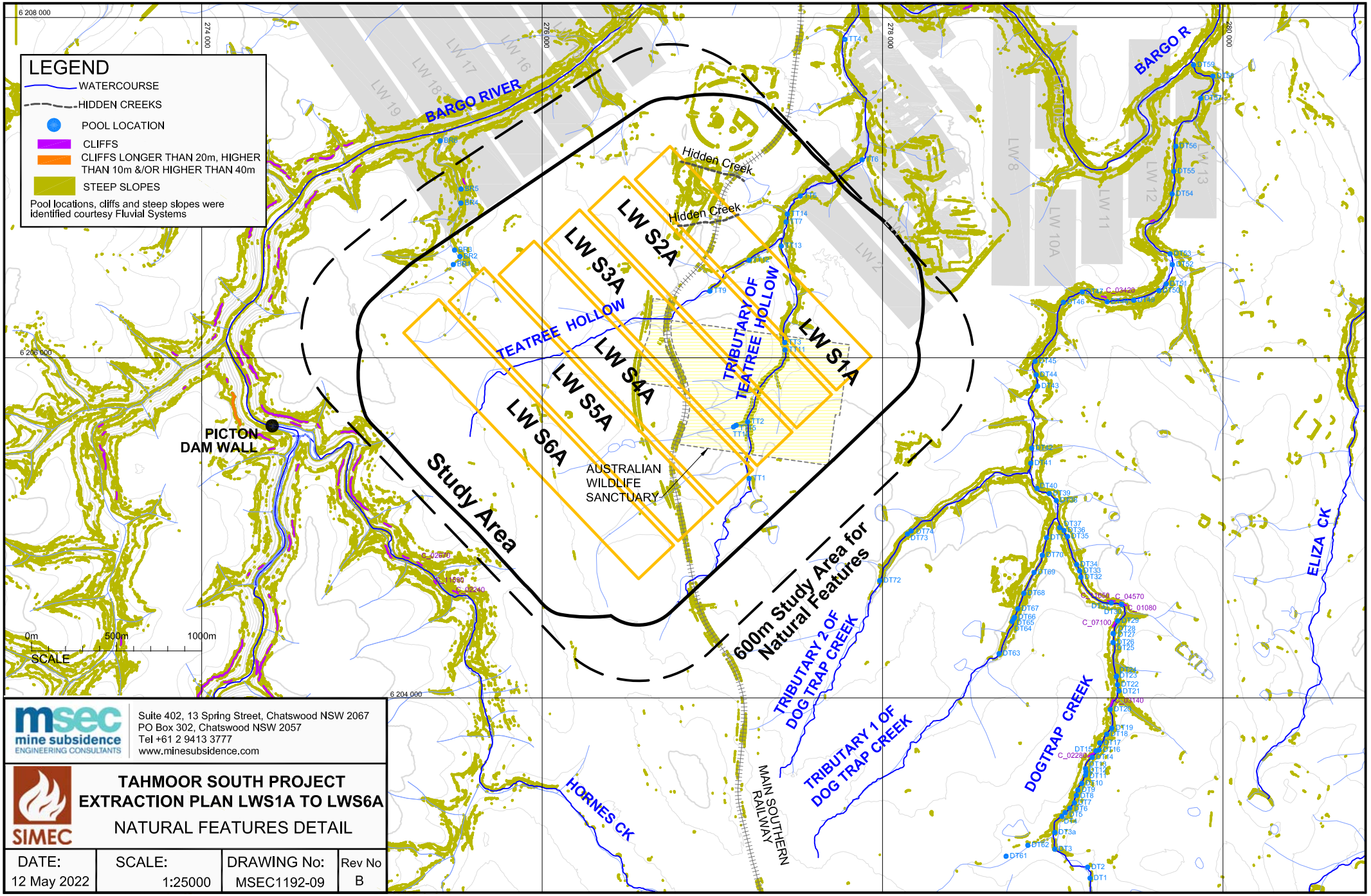
SIMEC

TAHMOOR SOUTH PROJECT
EXTRACTION PLAN LWS1A TO LWS6A

CLIFFS & STEEP SLOPES - GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-08	B

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-09 Natural Features Detail Map.dwg



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EXTRACTION PLAN LWS1A TO LWS6A
NATURAL FEATURES DETAIL

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN LWS1A TO LWS6A
RAILWAYS & ASSOCIATED INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	25000	MSEC1192-10	B

Bargo River Road Bridge
Railway Viaduct (over Bargo R)
Remembrance Drive bridge (over Rail)
Railway culvert
See inset diagram below for Railway loop features
Railway culvert (over tributary of Bargo River)
Tahmoor Mine coal conveyor
Rail culverts (over tributary of Teatree Hollow)
Rail culverts (over tributary of Teatree Hollow)
Rail culvert (over tributary of Teatree Hollow)
Wellers Road bridge
Bargo Railway Station & Pedestrian footbridge

STUDY AREA
LWS1A
LWS2A
LWS3A
LWS4A
LWS5A
LWS6A

BARGO RIVER
Hidden creek
Hidden creek
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK
MAIN SOUTHERN RAILWSAY

96.300
96.400
96.860
97.560
97.980
98.160
98.445
98.739
99.035
99.388
100.121
100.425
101.000
101.192
101.470
101.920
102.244
102.279
102.440
102.873

278 000
276 000
6 208 000
6 206 000
6 204 000

LEGEND
RAILWAYS
BRIDGE
CULVERT

Railways Loop
Level Crossing
cutting
Pedestrian Crossing
Tunnel opening
Road Bridge
Tunnel opening
embankment
Level Crossing
Level Crossing
Level Crossing
Road culvert
cutting
STUDY AREA

Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-11 Roads.dwg

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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

ROADS & ASSOCIATED INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-11	B

Bargo River RD bridge (over Main Southern Railway)

Bargo River RD bridge (over tributary of Bargo R)

Railway Viaduct (over Bargo R)

Remembrance DR Bridge over Bargo River & Main Southern Railway

Wellers RD bridge WR-BR1

KS-BR1 Kader ST bridge

BR-BR1

STUDY AREA

LW S1A

LW S2A

LW S3A

LW S4A

LW S5A

LW S6A

REMEMBRANCE DR

BARGO RIVER RD

BARGO RIVER

MAIN SOUTHERN RAILWAY

STRATFORD RD

ROCKFORD RD

OLIVE GROVE

FIRE RD NO P1

Hidden Creek

CALOOLA RD

TEATREE HOLLOW

TRIBUTARY OF TEATREE HOLLOW

YARRAN RD

CHARLIES POINT RD

DOGTRAP CK

ANTHONY RD

WELLERS RD

CLAREMONT DR

ASHBY CLOSE

ELVY ST

LLOYDS WAY

HOGANS DR

HAMBRIDGE RD

MIMOSA ST

CAMBALAN ST

RADNOR RD

KADER ST

GWYNN HUGHES CR

NOONGAH ST

GREAT SOUTHERN RD

HAWTHORNE RD

WATTLE ST

IRONBARK RD

DYMOND RD

GOVERNMENT RD

BARGO RD

6 208 000

6 206 000

6 204 000

278 000

Grid to MGA co-ordinates

LEGEND

- RAILWAY
- PRINCIPAL RDS
- LOCAL RDS
- FIRE RDS
- BRIDGE
- CULVERT

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-12 Water Infrastructure.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
POTABLE WATER INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-12	B

PIPE SIZE
- 100 mm Ø
- 150 mm Ø
- 200 mm Ø
- 250 mm Ø
- 300 mm Ø
- 375 mm Ø
- 450 mm Ø
- 500 mm Ø
- 600 mm Ø

276 000
278 000
6 208 000
6 206 000
6 204 000
BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden creek
Hidden creek
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
STUDY AREA
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK
TANK
N
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-13 Sewer Infrastructure.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
SEWER INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-13	B

PIPE SIZE
- 40 mm Ø
- 50 mm Ø
- 63 mm Ø
- 75 mm Ø
- 90 mm Ø
- 100 mm Ø
- 110 mm Ø
- 125 mm Ø
- 140 mm Ø
- 150 mm Ø
- 160 mm Ø
- 180 mm Ø
- 225 mm Ø
- 630 mm Ø

276 000
278 000
6 208 000
6 206 000
6 204 000
BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden Creek
Hidden Creek
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK
STUDY AREA
N
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-14 Gas.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
GAS INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-14	B

LEGEND:
Jemena Pipeline
- Ø 32mm NY
- Ø 50mm NY
- Ø 63mm PE
- Ø 150mm Steel Main
- Ø 160mm PE

276 000
278 000
6 208 000
6 206 000
6 204 000

BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden Creek
Hidden Creek
STUDY AREA
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK

N
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-15 Electrical.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
ELECTRICAL INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-15	B

276 000

278 000

6 208 000

6 206 000

BARGO RIVER

MAIN SOUTHERN RAILWAY

Hidden Creek

Hidden Creek

STUDY AREA

LW S1A

LW S2A

LW S3A

LW S4A

LW S5A

LW S6A

TEATREE HOLLOW

TRIBUTARY OF TEATREE HOLLOW

DOGTRAP CK

LEGEND:

- Transmission Lines
- Low Voltage
- 11 kV
- 66 kV
- Substation
- Power Poles

N

Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-16 Telecommunications.dwg

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EXTRACTION PLAN
LW S1A TO LW S6A

TELECOMMUNICATIONS INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-16	B

TELSTRA
- OPTICAL FIBRE
- COPPER CABLES

NBN
- OPTICAL FIBRE
- COPPER CABLES

TPG
- OPTICAL FIBRE

276 000
278 000
6 208 000
6 206 000
6 204 000

BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden creek
Hidden creek
STUDY AREA
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK
NBN Tower
Bargo Exchange
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-17 Archaeological & Heritage Sites.dwg

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Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

ARCHAEOLOGICAL & HERITAGE SITES

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-17	B

LEGEND
ARCHAEOLOGICAL SITES -
- GRINDING GROOVE
- OPEN CAMP SITE
- ISOLATED FIND
- ABORIGINAL DREAMING STORY
- SCARRED TREE
- SHELTER WITH ART
- HERITAGE
- WATERCOURSE

Locations courtesy of Niche

276 000
278 000
6 208 000
6 206 000
6 204 000

BARGO RIVER
MAIN SOUTHERN RAILWAY
STUDY AREA
Tahmoor Mine
Hidden creek
Hidden creek
48-2-0275
52-2-3968
LW S3A
LW S4A
LW S5A
LW S6A
LW S1A
LW S2A
52-2-4471
TEATREE HOLLOW
Picton Weir
Wirrimbirra Sanctuary (Australian Wildlife Sanctuary)
TRIBUTARY OF TEATREE HOLLOW
Bargo Cemetery
52-2-1532
DOGTRAP CK
52-2-3921
52-2-1540
Kalinya Gardens
52-2-4194
52-2-4195
52-2-1538
52-2-1539
Wellers Road bridge (Bargo Railway Bridge North)
Old Coomeroo Homestead
52-2-4395
Great Southern Road
Homestead
Cottage
Bargo Surgery
Post Office
Hotel Bargo
Bargo Rural Trading Centre
Bargo Railway Station and WC
House
House
Commercial
Railway cottages
Cottage
Bargo Public School
Hawthorne
Bargo Public School Residence
Avon Dam Road bridge (over Railway)
52-2-4034
52-2-3872

N
Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-18 Buildings & Dams.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
BUILDINGS & DAMS

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-18	B

276 000

278 000

6 208 000

6 206 000

6 204 000

STUDY AREA

LW S1A

LW S2A

LW S3A

LW S4A

LW S5A

LW S6A

Hidden creek

Hidden creek

TRIBUTARY OF TEATREE HOLLOW

TEATREE HOLLOW

DOGTRAP CK

MAIN SOUTHERN RAILWAY

BARGO RIVER

BARGO RIVER

BARGO RIVER RD

OLIVE GROVE

REMEMBRANCE DR

STRATFORD RD

CALOOLA RD

YARRAN RD

CHARLIES POINT RD

ANTHONY RD

WELLERS RD

CLAREMONT DR

HOGANS DR

ASHLEY CLOSE

ELVY LO

FLORENCE WAY

KADER ST

GLENN HUGHES CO

AMBERLEY RD

MIMOSA ST

CAMPBELL ST

ADDISON RD

FULLERTON CL

GREAT SOUTHERN RD

HAWTHORNE RD

WATTLE ST

IRONBANK RD

DYMOND RD

GOVERNMENT RD

BARGO RD

MOONGA PL

LEGEND

- HOUSES
- RURAL STRUCTURES
- HERITAGE STRUCTURES
- COMMERCIAL STRUCTURES
- PUBLIC AMENITIES & UTILITIES
- POOLS
- TANKS
- DAMS

N

Grid is MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-19 Public Amenities & Commercial.dwg

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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

PUBLIC AMENITIES & COMMERCIAL PREMISES

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-19	B

LEGEND
- COMMUNITY BUILDINGS & SPACES
- PUBLIC UTILITIES
- COMMERCIAL OR INDUSTRIAL BUILDINGS

Grid to MGA co-ordinates

278 000

6 208 000

6 206 000

6 204 000

Tahmoor Mine

MAIN SOUTHERN RAILWAY

BARGO RIVER

Wollondilly Anglican College

Hidden creek

Auto Wreckers

Inghams Bargo Chicken Breeder Production Complex

Bargo Petroleum and Hill Top Pit Stop

Tahmoor Mine Reject Emplacement Area (REA)

Tahmoor Garden Centre

LW S3A

LW S4A

LW S2A

LW S1A

NBN Tower

TEATREE HOLLOW

Australian Wildlife Sanctuary

MKD Machinery

Bargo Valley Produce

Ingham Turkey Farm

LW S5A

LW S6A

Bargo Cemetery

TRIBUTARY OF TEATREE HOLLOW

DOGTRAP CK

STUDY AREA

Canine Country Club and Cattery

Bargo Waste Management Centre

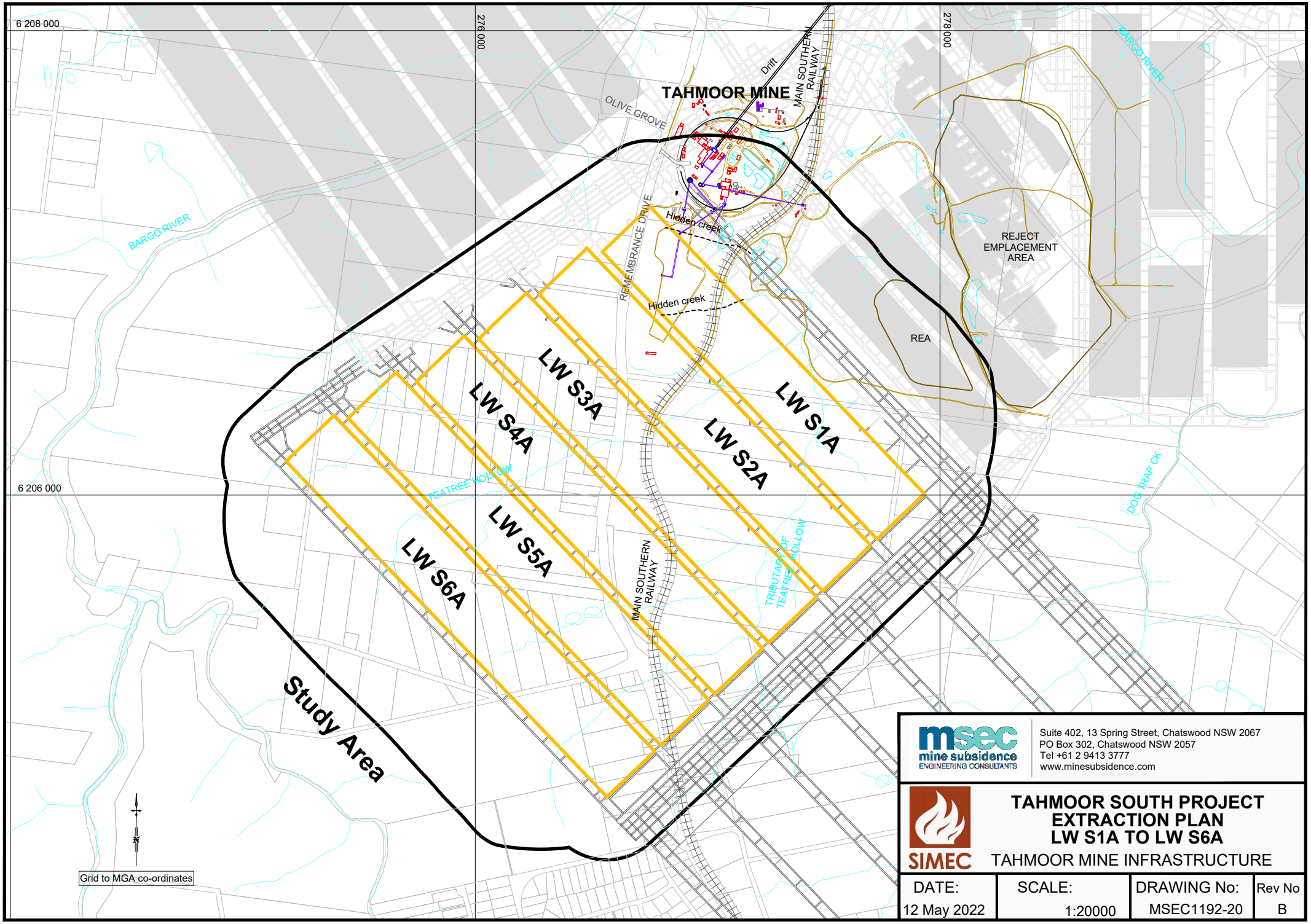
Sydney Water Reservoir

BARGO EXCHANGE

Existing Mine shaft of Historical workings

Bargo Railway Station

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-20 Tahmoor Mine Infrastructure.dwg



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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

TAHMOOR MINE INFRASTRUCTURE

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:20000	MSEC1192-20	B

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-21 Groundwater Bores & Survey Control Marks.dwg

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TAHMOOR SOUTH PROJECT EXTRACTION PLAN LW S1A TO LW S6A

GROUNDWATER BORES & SURVEY CONTROL MARKS

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-21	B

LEGEND

- SURVEY CONTROL MARKS

GROUNDWATER BORES

- PRIVATELY OWNED BORES
- SHALLOW MONITORING BORES
- DEEP MONITORING BORES
- PIT-TOP & REA MONITORING BORES

STUDY AREA

LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A

BARGO RIVER
Hidden creek
TEATREE HOLLOW
TRIBUTARY OF TEATREE HOLLOW
DOGTRAP CK
MAIN SOUTHERN RAILWAY

276 000
278 000
6 208 000
6 206 000
6 204 000

GW062068
PM 46930
PM 46929
PM 46931
PM 46932
SS 23783
PM 60503
PM 46939
PM 46940
PM 68136
PM 46934
PM 60502
PM 46941
PM 46933
GW110669
SS 1909
REA1
SS 92424
SS 154156
SS 139423
PM 33057
PM 33058
PitTop2
SS 121598
PitTop1
SS 154287
TS 10705
SS 154157
SS 108773
GW104659
PitTop4
PM 60501
REA7
REA6
P51
PM 60500
MM 2006
P53
REA4
P52
REA5
TBC001
PM 60499
MM 2012
REA3
GW104323
GW032443
PM 60498
REA2
PM 3116
PM 34218
P56
PM 60497
P54
MM 2009
PM 60496
TSC-1
SS 12146
TBC033
PM 59421
PM 60495
P55
SS 12165
SS 12164
GW109257
MM 2005
SS 12147
SS 12153
SS 12163
SS 12165
SS 12161
SS 12160
SS 12148
SS 1910
TBC032
P57
GW014262
SS 12159
GW105883
SS 175052
PM 60494
SS 12166
MM 2004
GW111810
SS 12158
PM 71324
SS 12149
SS 12169
GW105847
SS 12257
SS 12251
PM 59417
PM 66365
GW007445
SS 12157
TBC024
SS 52436
PM 66368
SS 12156
SS 52437
SS 101949
PM 60493
MM 2003
SS 101950
SS 12154
SS 12253
SS 20172
SS 55112
SS 118556
SS 12254
SS 118555
SS 175195
PM 60492
PM 33056
SS 19036
PM 32597
SS 118554
MM 2002
PM 71331
SS 12250
SS 133466
SS 12151
SS 12155
PM 71332
MM 2001
SS 12152
SS 12252
SS 64024
SS 12248
SS 118920
SS 118921
SS 88067
SS 64035
PM 50489
SS 1911
SS 47468
SS 12150
SS 58694
PM 59409
GW105395
PM 50490
PM 60491
SS 81810

Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-22 Predicted Subs Colour Contours.dwg

NOTE:
The value of the Subsidence Contours, from the outside to the inside of the panels, are 20mm, 50mm, 100mm, 200mm and so forth, in 100mm increments.

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Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
PREDICTED TOTAL SUBSIDENCE CONTOURS AFTER LW S6A

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-22	B

276 000
278 000
6 208 000
6 206 000
6 204 000

BARGO RIVER
MAIN SOUTHERN RAILWAY
Hidden creek
Hidden creek
1350
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A
PREDICTION LINE

LEGEND
SUBSIDENCE CONTOUR COLOUR SCALE (mm)
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
50
20

Grid to MGA co-ordinates

I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192-23 Proposed Monitoring.dwg

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TAHMOOR SOUTH PROJECT
EXTRACTION PLAN
LW S1A TO LW S6A
PROPOSED MONITORING

DATE:	SCALE:	DRAWING No:	Rev No
12 May 2022	1:25000	MSEC1192-23	B

STUDY AREA
LW S1A
LW S2A
LW S3A
LW S4A
LW S5A
LW S6A

BARGO RIVER ROAD
REMEMBRANCE DR
Railway Viaduct
GNSS
MAIN SOUTHERN RAILWAY
STRATFORD RD
ROCKFORD ROAD
BARGO RIVER
FIRE ROAD NO P1
OLIVE GROVE
Wollondilly Anglican College
Tahmoor Colliery
Hidden creek
Poultry Sheds
Wrecker
Igloos
Service Station
Tahmoor Garden Centre
CALOOLA ROAD
TEATREE HOLLOW
TT12
TT9
Along Tahmoor Mine property boundary
Teatree 3
Teatree 2
Australian Wildlife Sanctuary
Concrete materials plant
NBN Tower
Picton Weir
DOG TRAP CK
YARRAN ROAD
CHARLIES POINT RD
Wellers Rd Bridge
GREAT SOUTHERN RD
ANTHONY ROAD
WELLERS RD
CLAREMONT DRIVE
ASHBY CL
LLOYDS WAY
ELVY STREET
HOGANS DRIVE
HAMBRIDGE ROAD
IRONBARK ROAD
WATTLE STREET
DYMOND ROAD
GOVERNMENT ROAD
MIMOSA STREET
KADER STREET
CAMBALAN STREET
RADNOR ROAD
GWYNN HUGHES
NOONGAH ST
BARGO ROAD
276 000
278 000
6 208 000
6 206 000

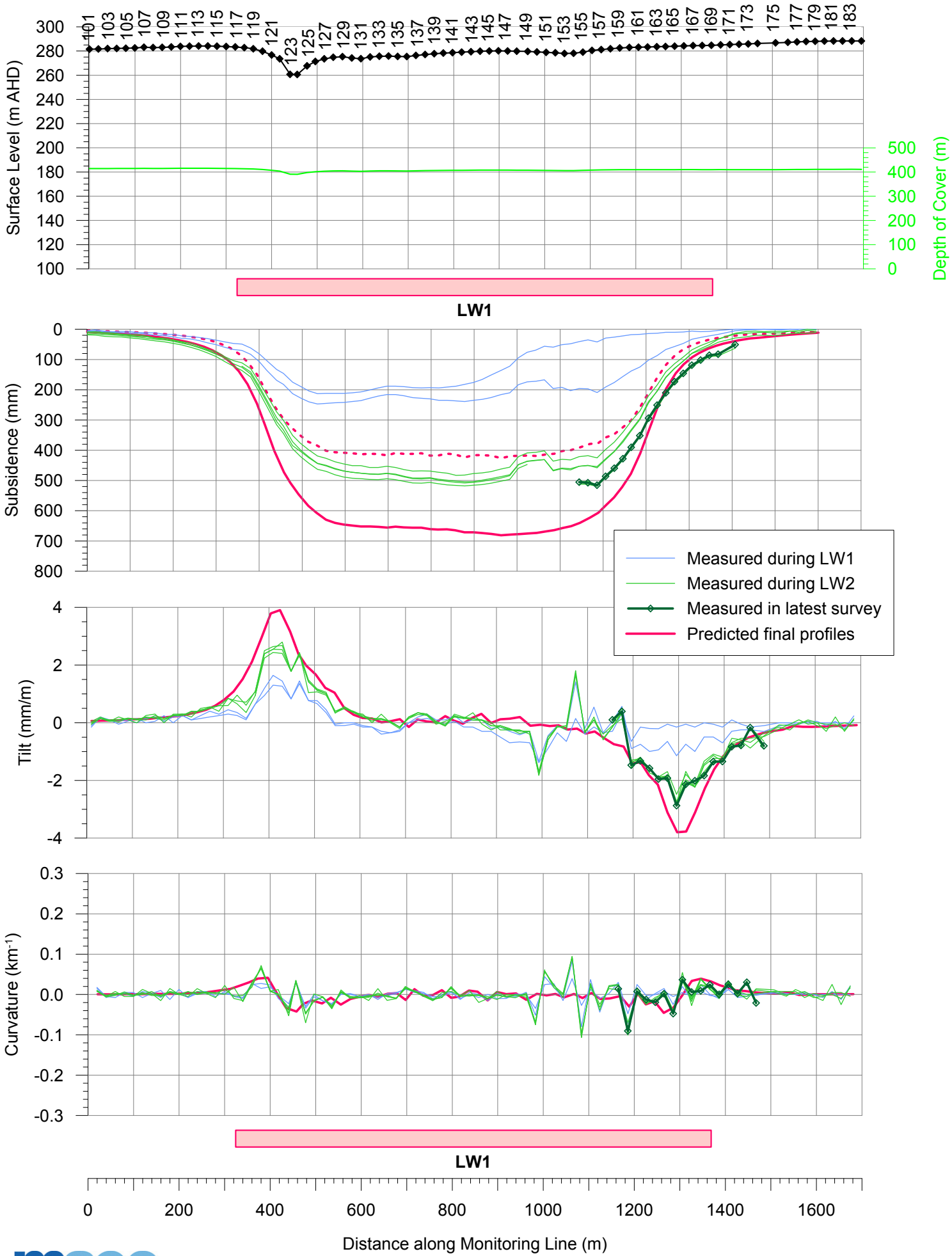
LEGEND

- WATER MONITORING SITE
- PROPOSED MONITORING LINES
- PROPOSED MONITORING PEGS
- PROPOSED CREEK CROSSLINES
- PROPOSED GNSS
- WATERCOURSE

Grid to MGA co-ordinates

APPENDIX G. FIGURES COMPARING OBSERVED AND PREDICTED SUBSIDENCE PARAMETERS OVER PREVIOUSLY EXTRACTED LONGWALLS AT TAHMOOR MINE

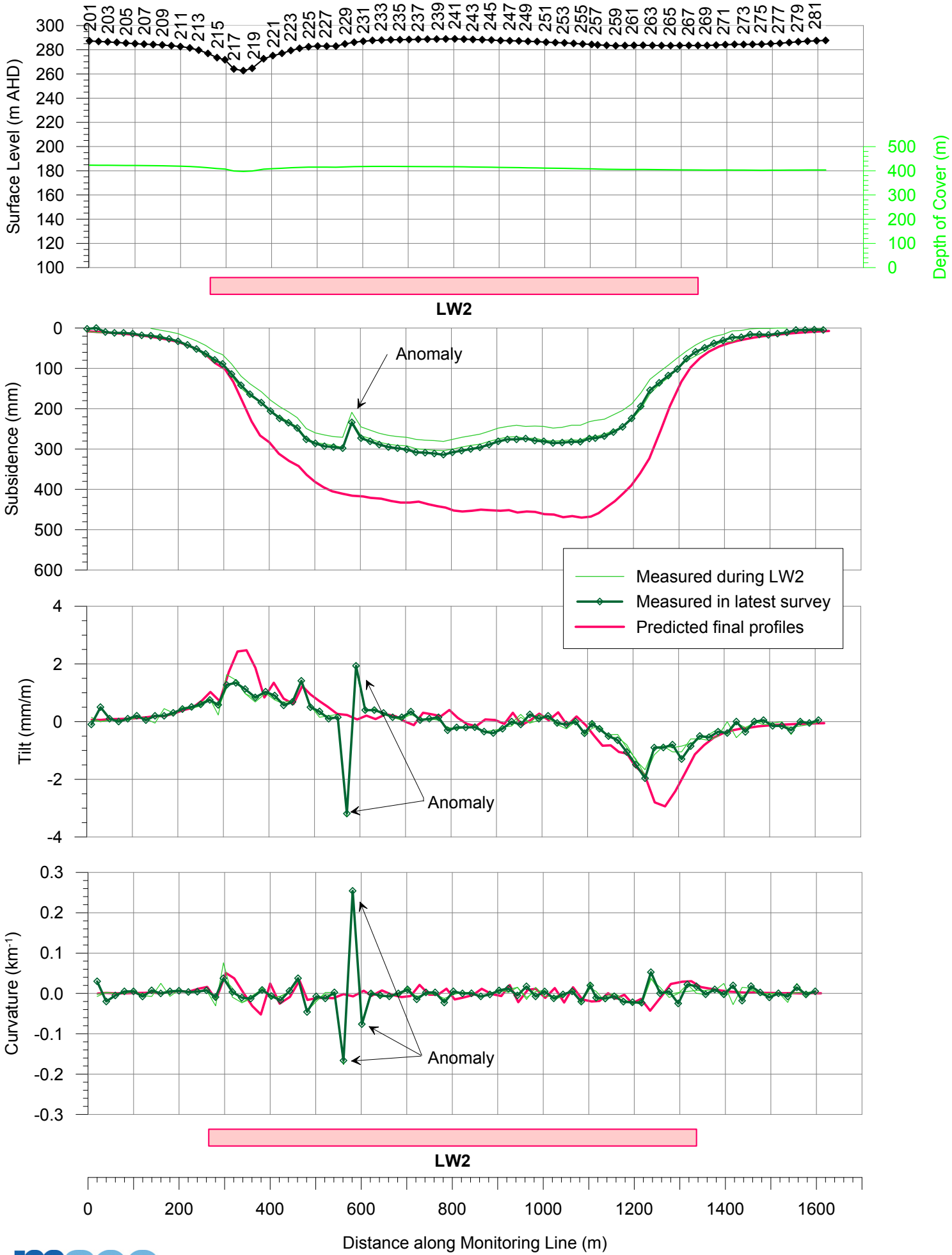
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 100-Line due to Tahmoor LW1 and LW2



msec

Fig. G.01

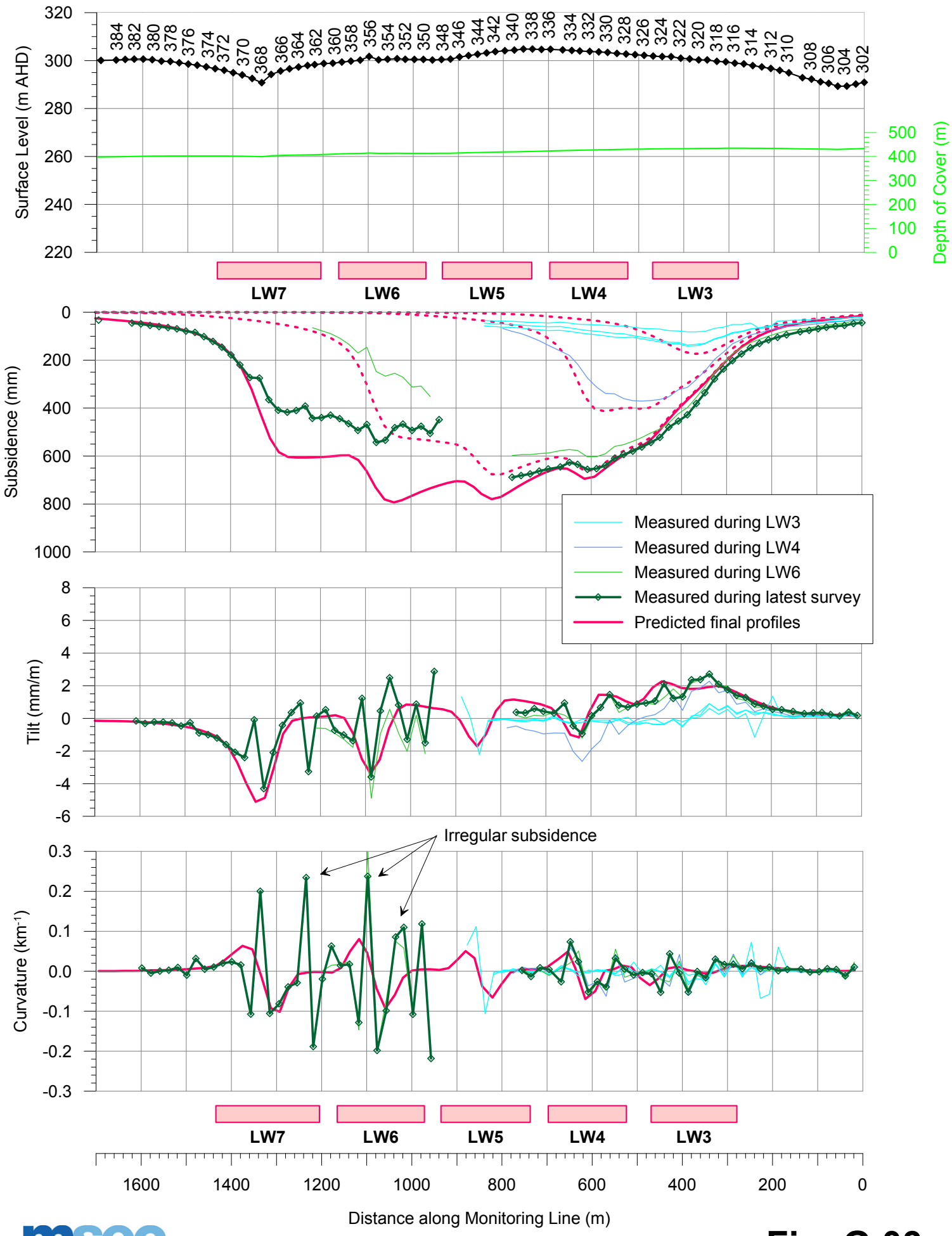
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 200-Line due to Tahmoor LW2



msec

Fig. G.02

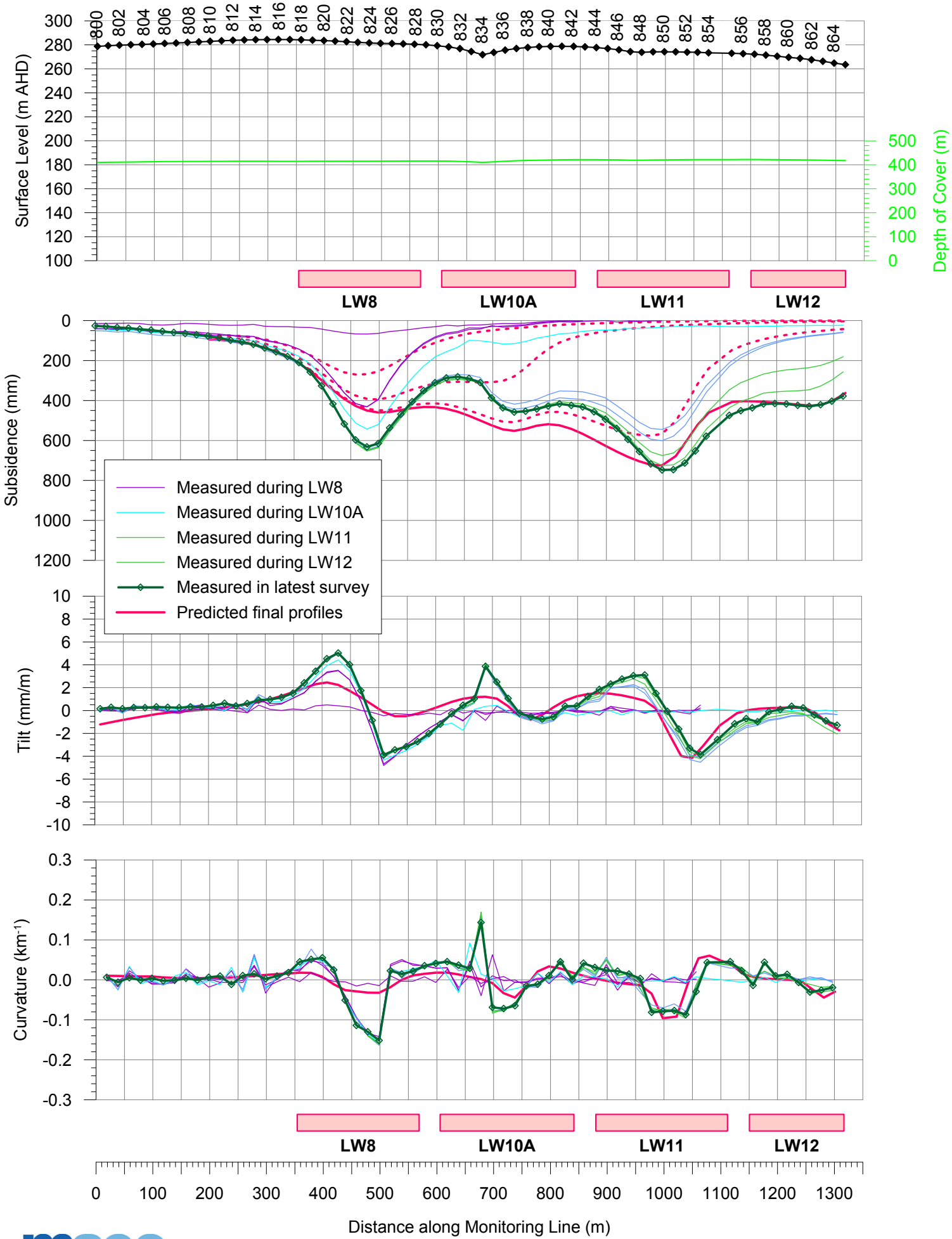
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 300-Line due to Tahmoor LW3 to LW7



msec

Fig. G.03

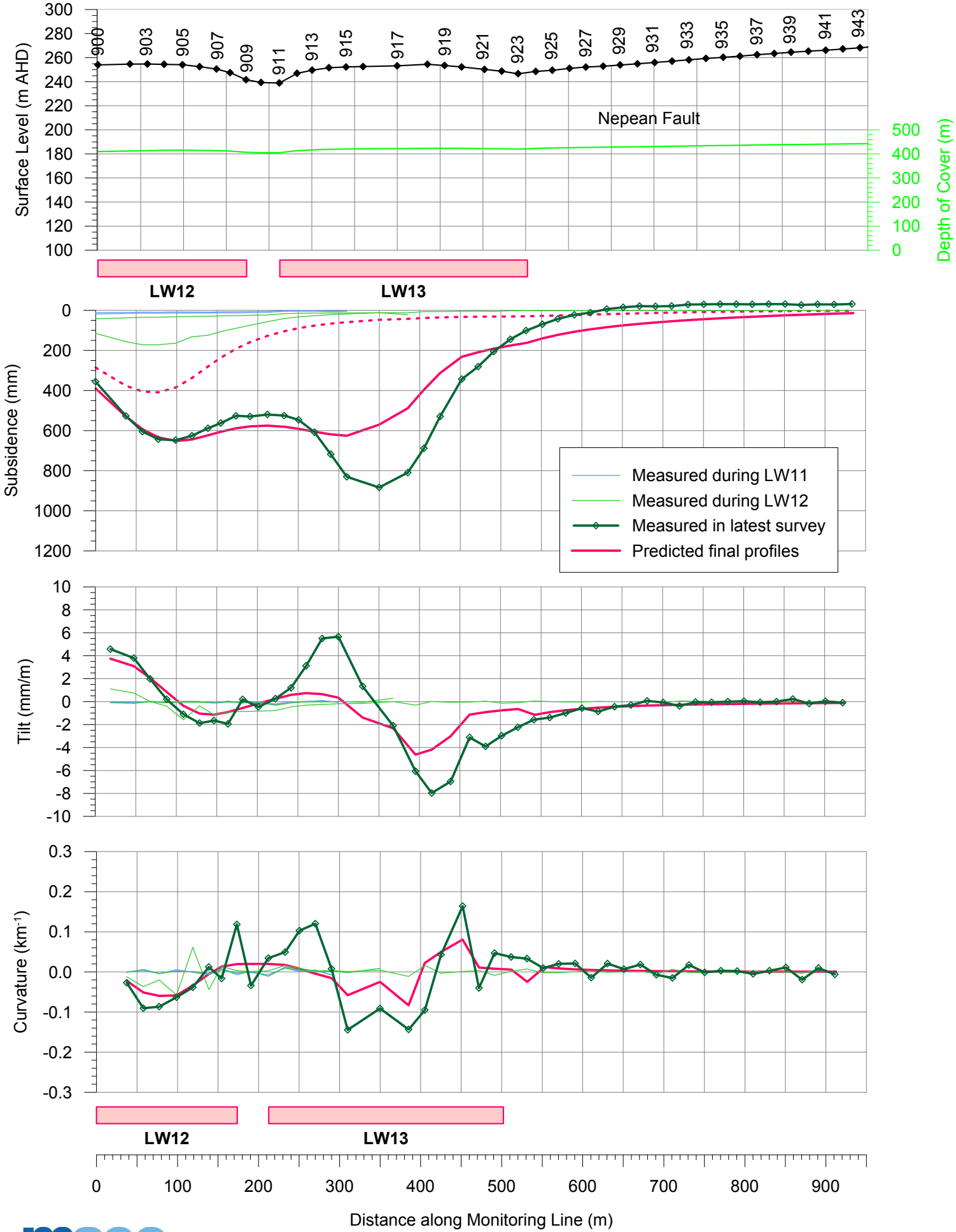
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 800-Line due to Tahmoor LW8 to LW12



msec

Fig. G.04

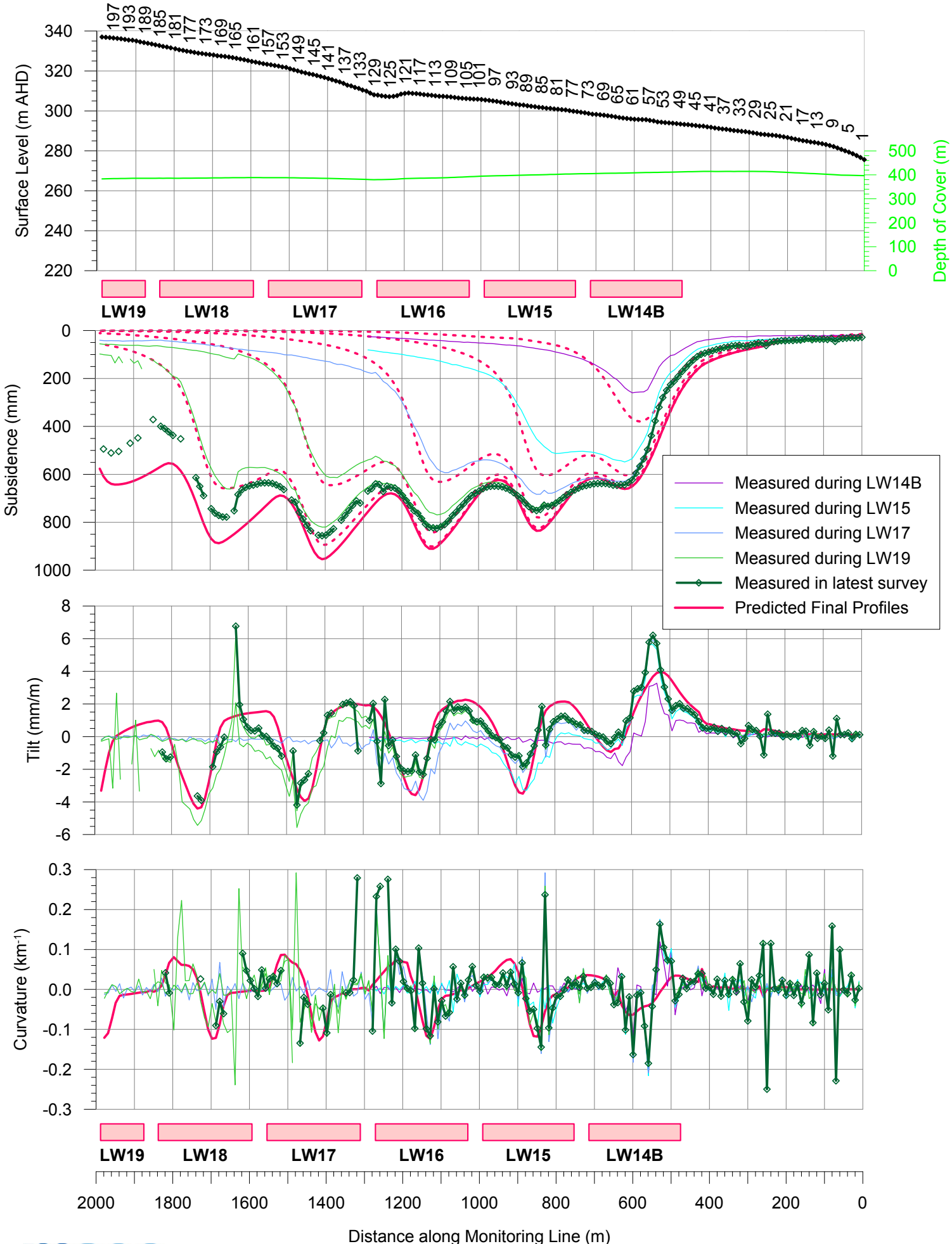
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 900-Line due to Tahmoor LW10A to LW13



msec

Fig. G.05

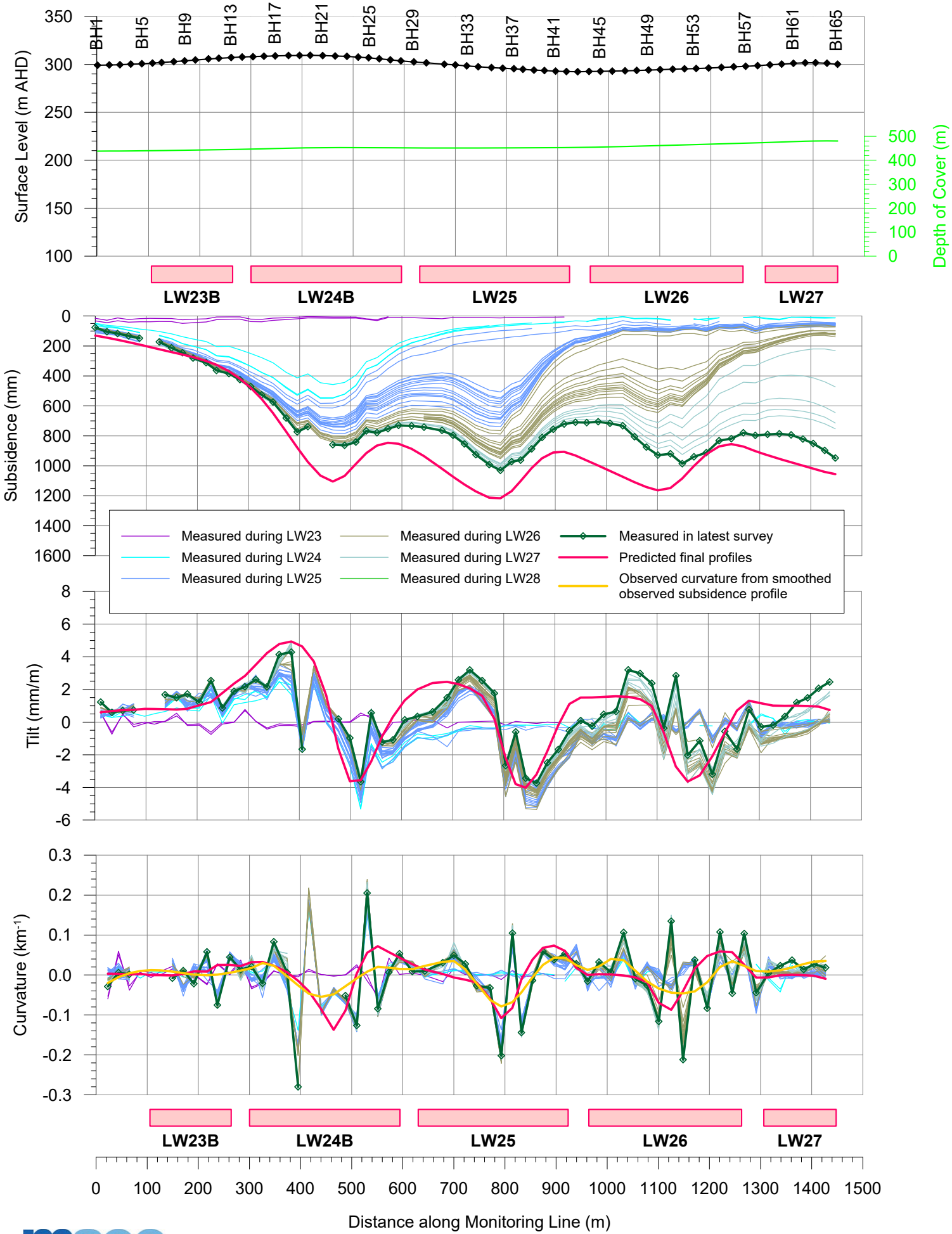
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the 1000-Line due to Tahmoor LW14B to LW19



msec

Fig. G.06

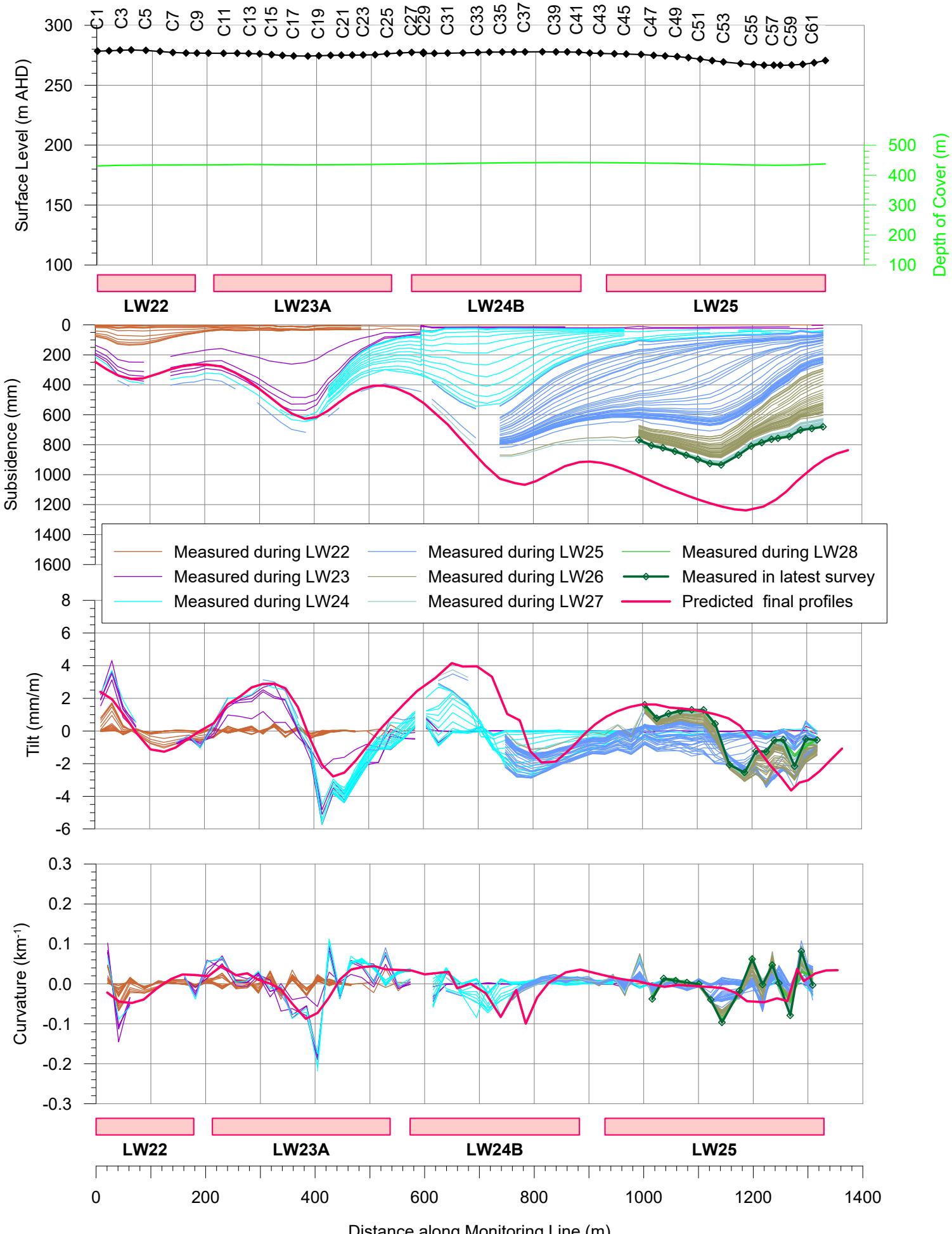
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the Brundah Road Line due to Tahmoor North LW23B to LW28



msec

Fig. G.07

Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the Castlereagh Street Line due to Tahmoor North LW22 to LW28



msec

Fig. G.08

Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the Remembrance Drive Line due to Tahmoor North LW23A to LW30

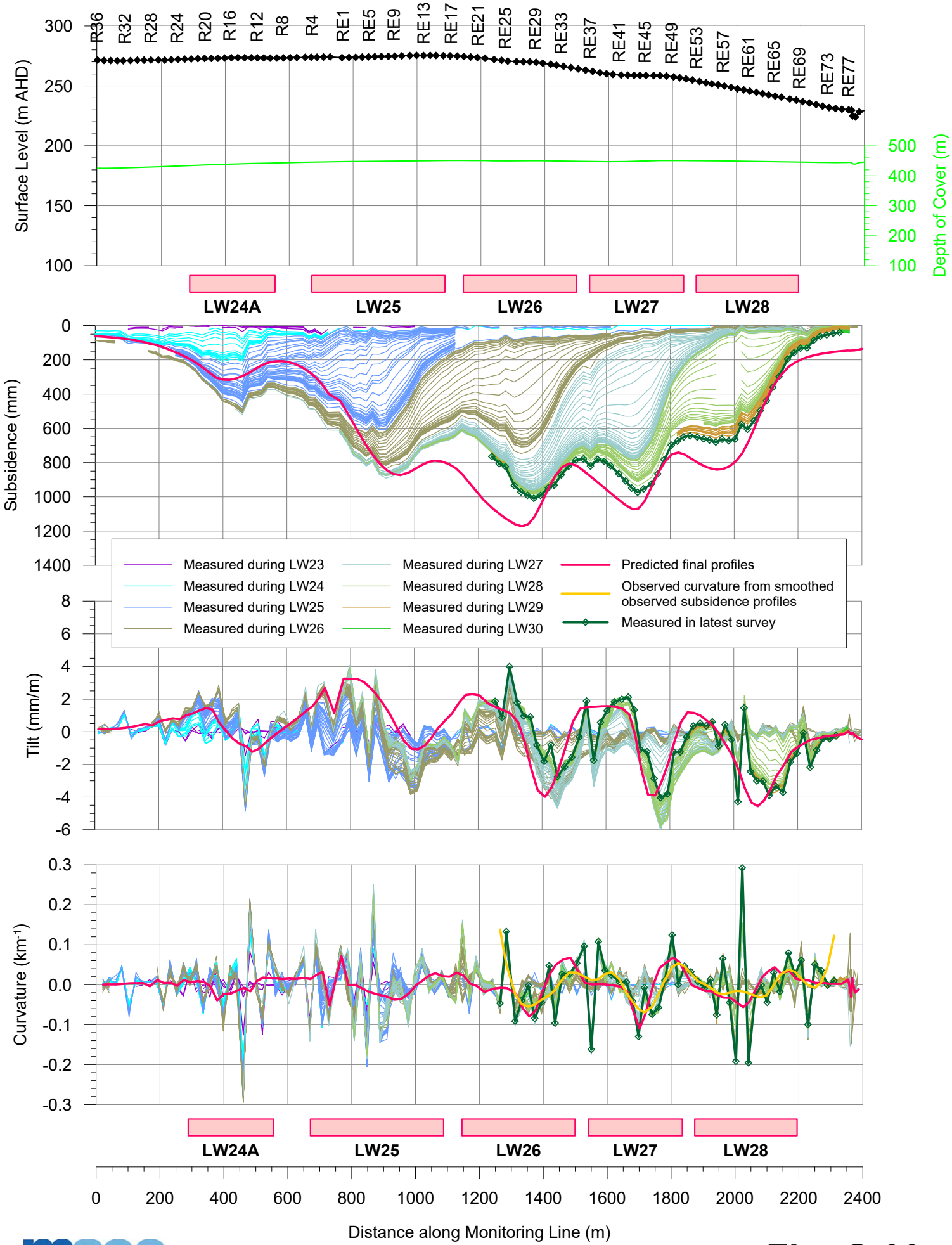


Fig. G.09

Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the Thirlmere Way Line due to Tahmoor North LW22 to LW27

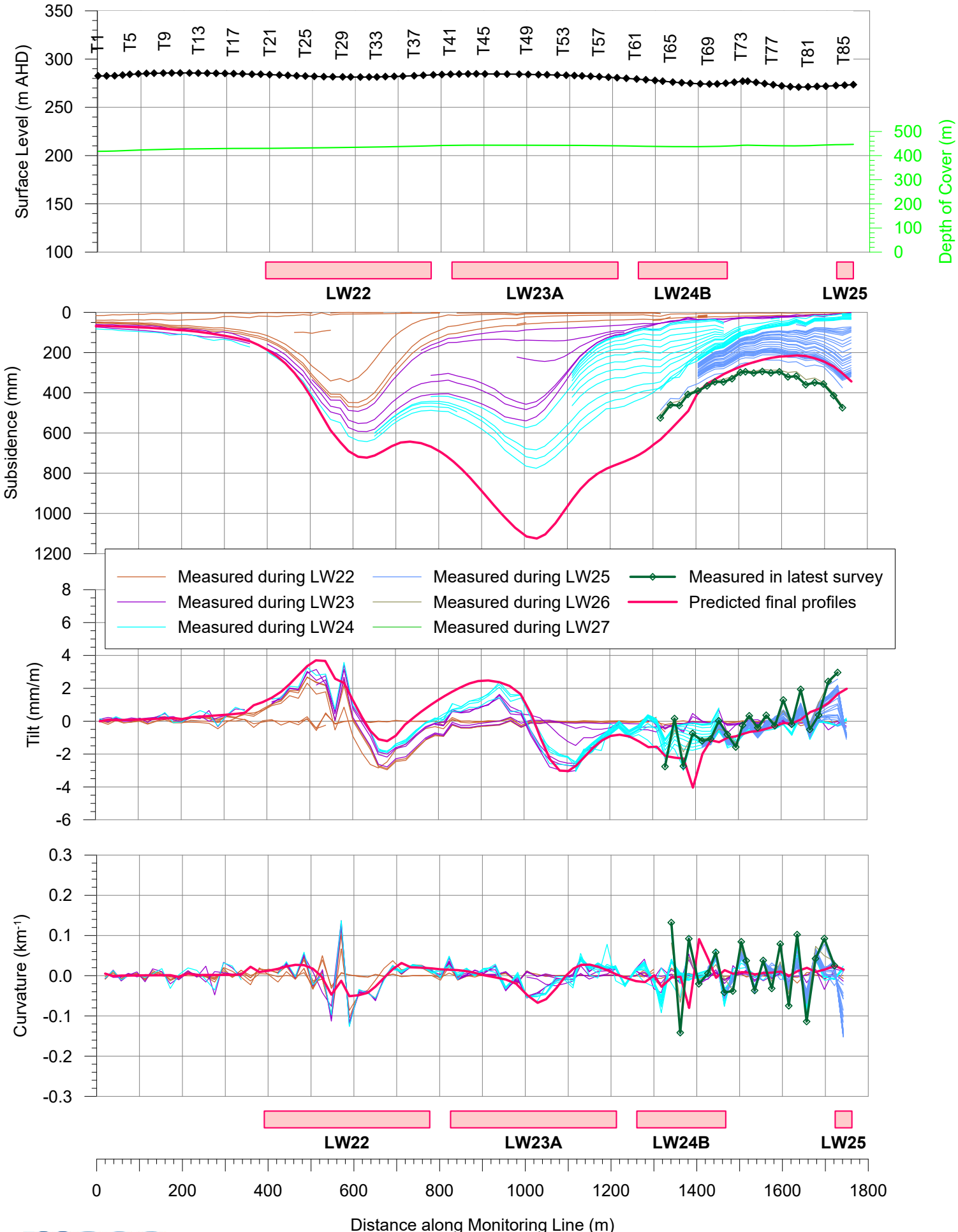


Fig. G.10

Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the York Street Line due to Tahmoor North LW24A to LW28

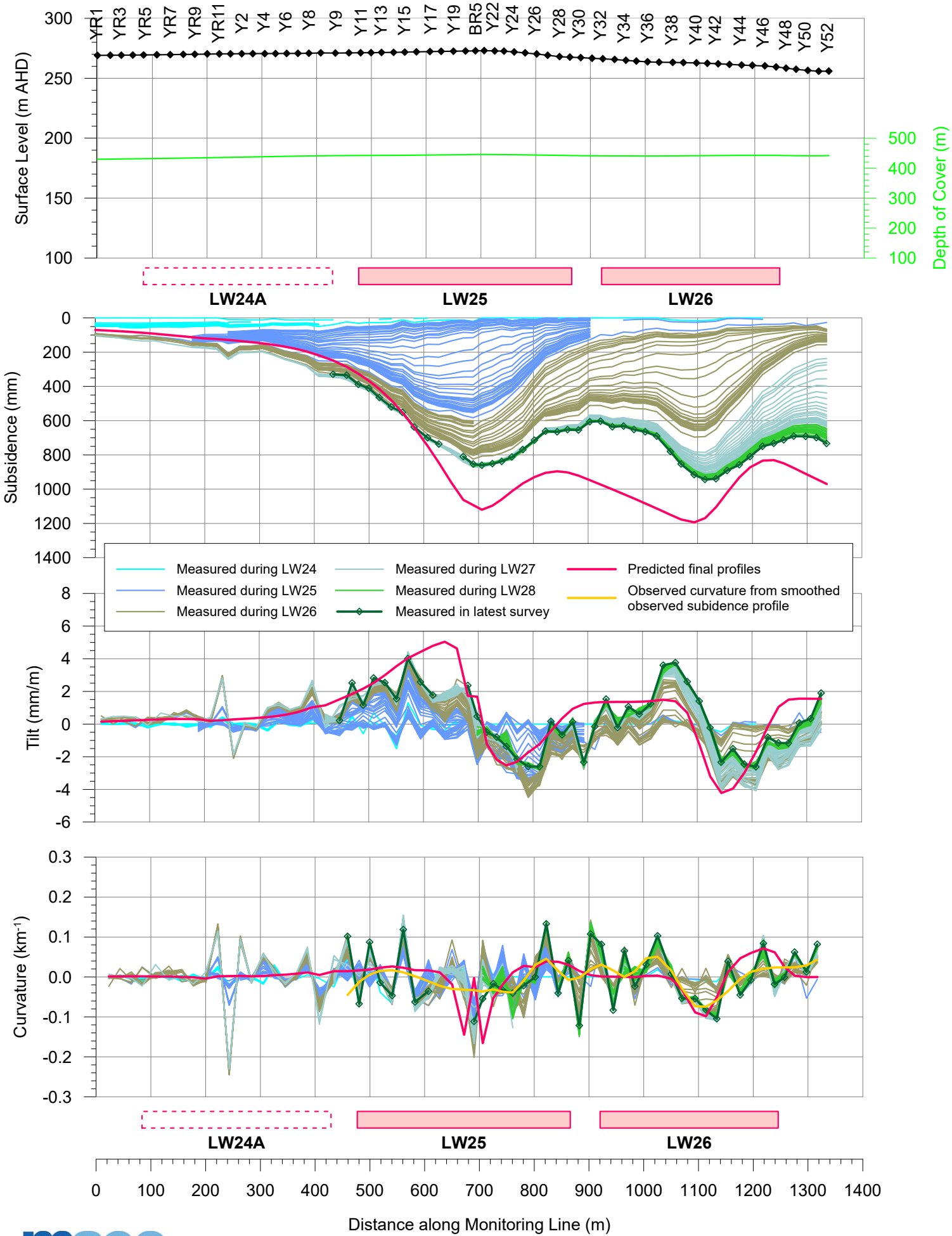
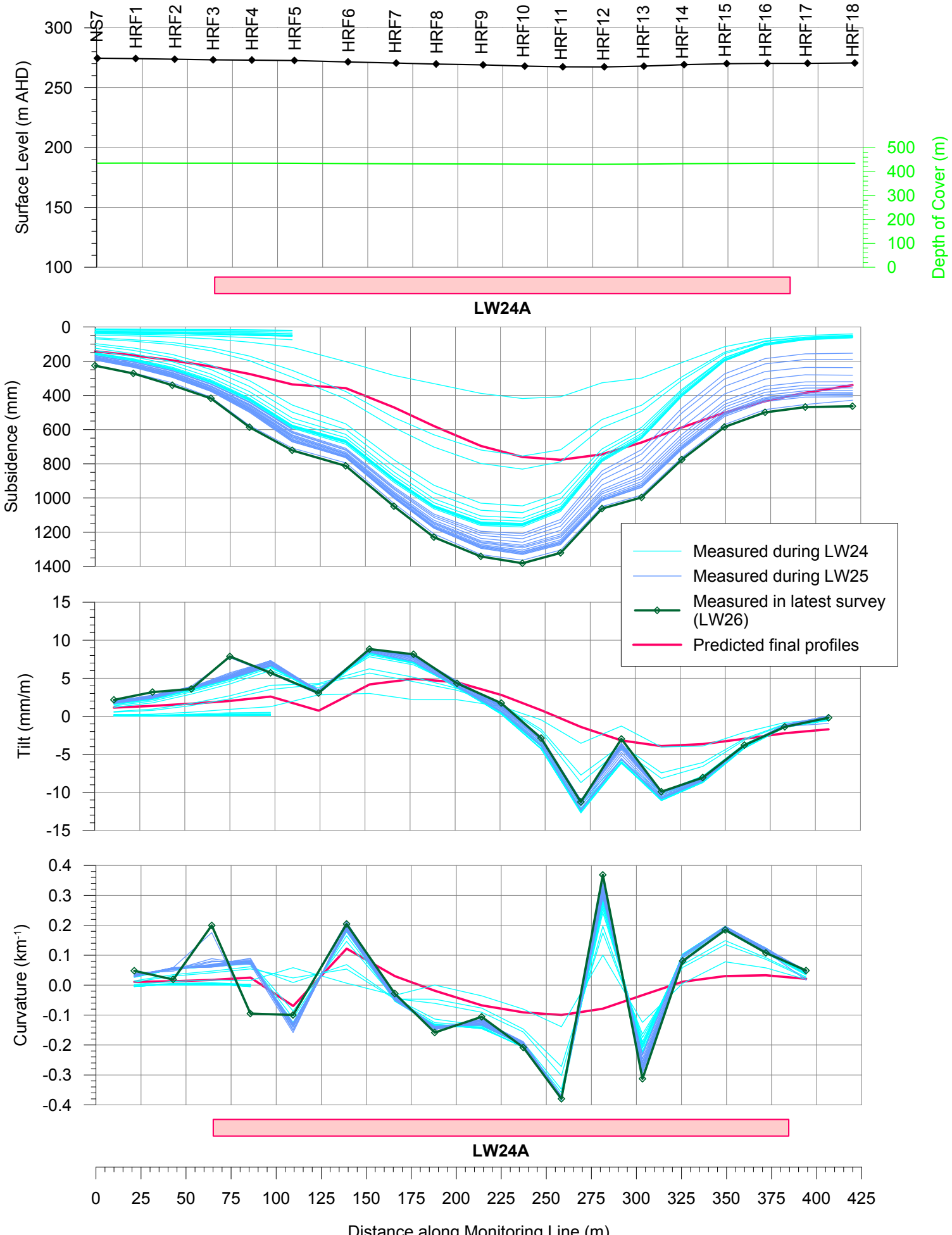


Fig. G.11

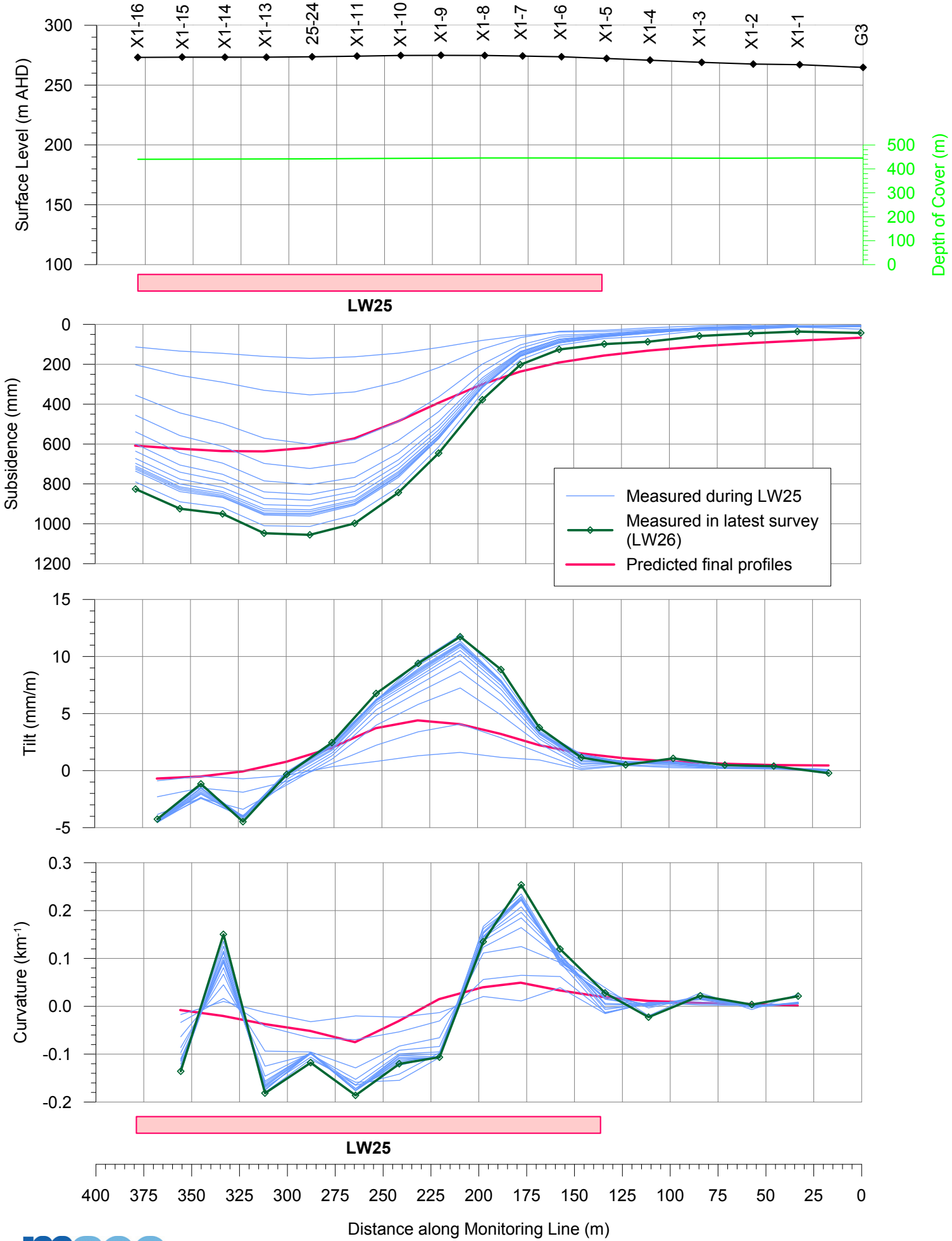
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the HRF Line due to Tahmoor North LW24A and LW25



msec

Fig. G.12

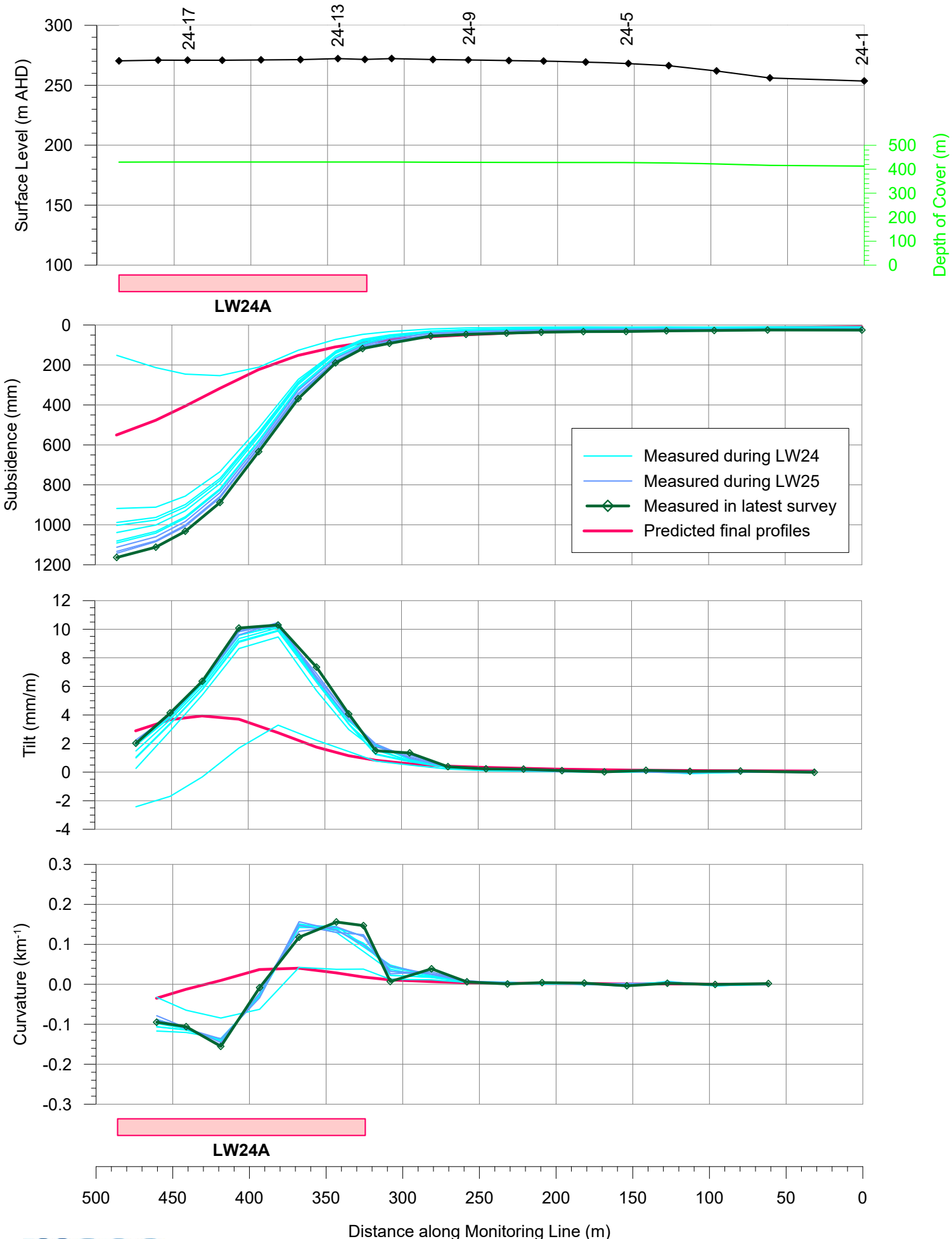
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the LW25 XS1 Line due to Tahmoor North LW25



msec

Fig. G.13

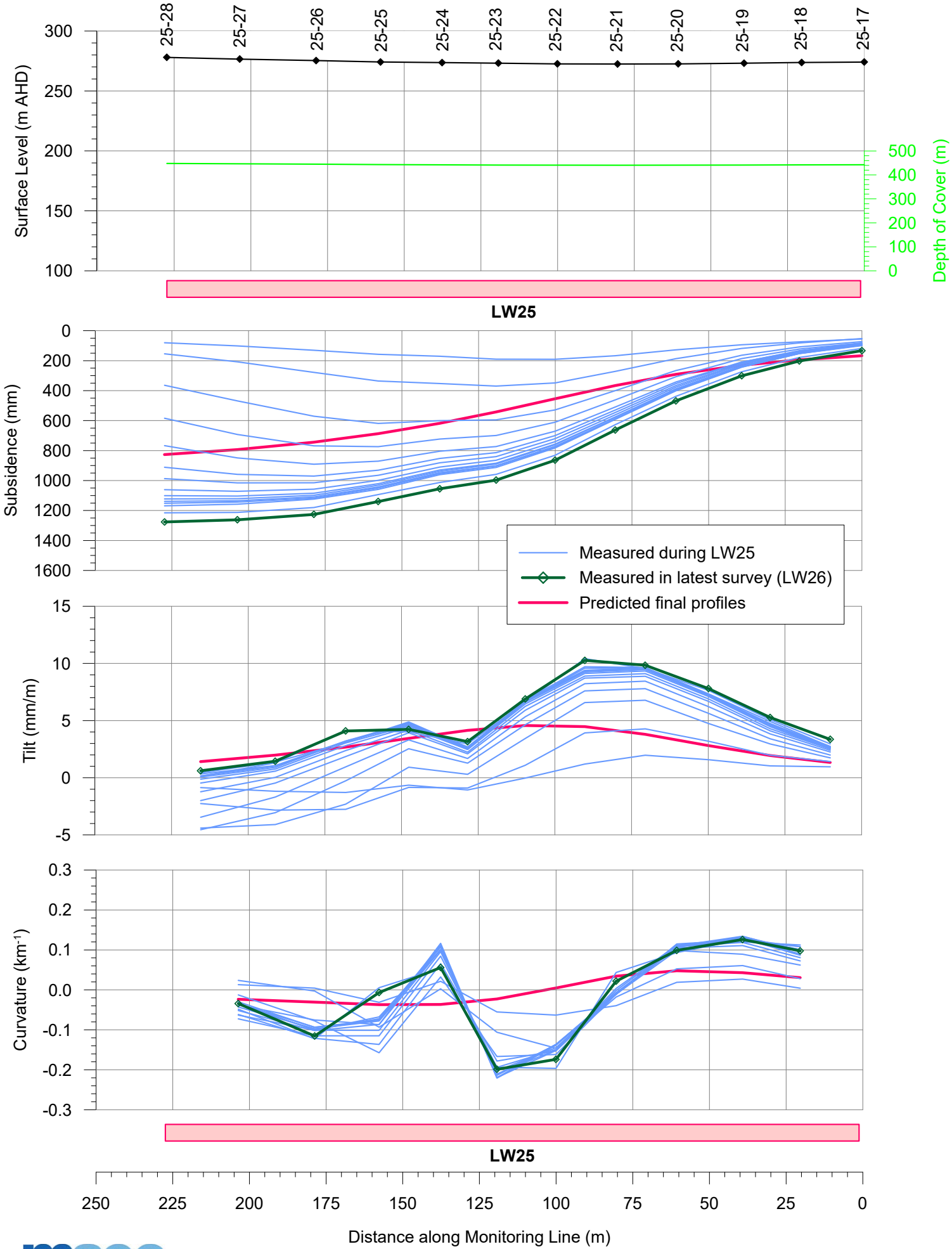
Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the LW24A Draw Line due to Tahmoor North LW24A and LW25



msec

Fig. G.14

Observed and Predicted Profiles of Total Subsidence, Tilt and Curvature along the LW25 Centreline due to Tahmoor North LW25



msec

Fig. G.15

APPENDIX B – Master Trigger Action Response Plan

WATER MANAGEMENT PLAN TARP – WMP1 STREAM WATER QUALITY FOR ALL WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

<table>
<tr><th>Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th>Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th></th><th></th><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="6"><u>Performance Measure Feature</u>
All watercourses within the Subsidence Area[1].

<u>Performance Measure</u>
No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.

The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures.

<u>Performance Indicator</u>
Exceedance of the site specific guideline values (SSGVs), as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.

<u>TARP Objective</u>
This TARP defines levels of variation in surface water quality from normal conditions[3] and the actions required to be implemented in response to each level of variation.

<u>Assessment Criteria</u>
SSGV as listed in table below.</td><td rowspan="6"><u>Locations</u>
<table><tr><th>Longwall</th><th>Potential Impact Sites</th><th>Reference Sites</th></tr><tr><td>LW S1A</td><td>TT7-QRLa
TT12-QLa
TT13-QLa
TT14-QLa</td><td rowspan="3">TT1-QRLa</td></tr><tr><td>LW S2A</td><td>TT9-QLa[4]
TT3-QLa[5]
All sites above</td></tr><tr><td>LW S3A</td><td>TT2-QLa
All sites above</td></tr><tr><td>LW S4A</td><td rowspan="2">BR2-QLa
TT1-QRLa</td><td rowspan="3">DT73-QRLa
DT64-QRLa</td></tr><tr><td>LW S5A</td></tr><tr><td>LW S6A</td><td>All sites above</td></tr></table>
All monitoring locations are shown in Figure 20 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly sampling prior to secondary extraction of relevant longwall.

During Mining
Monthly sampling and analysis or as required by a specified action relevant to a trigger level.

Post-mining
Monthly sampling and analysis for a minimum of 12 months following the completion of LW S6A or as required in accordance with a Watercourse Corrective Action Management Plan.</td><td colspan="3">Normal Condition</td></tr>
<tr><td>• Exceedance of an SSGV does not occur or occurs for less than three consecutive months.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 1</td></tr>
<tr><td>• Exceedance of an SSGV occurs at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as required for Normal Condition.
• Assess if the trigger was exceeded during the baseline period prior to commencement of mining activities.
• Review water quality trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
• Discuss findings with and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater quality monitoring results) necessary to inform assessment.
• Consider and decide on reasonable and feasible options for remediation as relevant (e.g. limestone cobbles for increasing pH level).</td><td>• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. limestone cobbles for increasing pH level).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Exceedance of an SSGV occurs at a given potential impact site in four or five consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as stated in Level 1.
• Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 2 has been reached or at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change that resulted in a water quality change).
• If increased monitoring is adopted, undertake further analysis of water quality trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
• Review CMAs in light of findings from further investigations and consider additional remediation options.
• Review Water Management Plan and modify if necessary.</td><td>• Responses as stated in Level 1.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Exceedance of an SSGV occurs at a given potential impact site in six consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as stated in Level 2.
• Increase monitoring and review of data frequency to fortnightly for sites where Level 3 has been reached and at corresponding reference sites, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effects unrelated to mining or the prevailing climate.</td><td>• Responses as stated in Level 2.
If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts:
• Offer site visit with DPE and other key stakeholders.
• Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection.
• Implement approved WCAMP, subject to land access.</td></tr>
</table>

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management				
		Trigger	Action		Response	
Site Specific Guideline Value (SSGV)						
Parameter	**TT1-QRLa**	**TT2-QLa**	**TT6-QRLa**	**TT12-QLa**	**TT13-QLa**	**TT14-QLa**
No. of Values[6]	30	10[7]	33	11[8]	11[8]	11[8]
pH (pH units)	6.5 – 8	5.9 – 8	6.5 – 8	6.5 – 8	6.5 – 8	6.5 – 8
EC (µS/cm)	531	350	361	350	350	350
Dissolved Aluminium (mg/L) pH > 6.5	0.06	0.13	0.06	0.08	0.055	0.1
Dissolved Copper (mg/L)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Dissolved Iron (mg/L)	0.71	0.49	0.86	0.56	0.42	0.54
Dissolved Manganese (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)	0.011	0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)	0.03	0.03	0.03	0.008	0.008	0.008

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] As defined by the site specific guideline value (SSGV).
[4] Sites to be installed, subject to land access. The monitoring program relevant to this TARP has been designed to record at least 24 months of baseline data prior to commencement of mining of the relevant longwall (with the exception of TT12-Qla, TT13-Qla, TT14-Qla which will have 12 months of baseline data). Additional sites will be included prior to commencement of mining the relevant longwall. The derived SSGV for each relevant monitoring site would be included in the Water Management Plan and provided to the relevant government agencies for review and approval.
[5] SSGVs have not been derived for TT3-QLa as the pool was dry on five of eight sampling occasions.
[6] Minimum number of values used in SSGV derivation – for some constituents, a greater number of values were adopted.
[7] Number of values used to derive SSGV for TT2-QLa, prior to commencement of mining LWS3A, is expected to be greater than 24.
[8] TT12-QLa, TT13-QLa, TT14-QLa – a minimum of 12 samples (12 months) would be collected prior to secondary extraction.

WATER MANAGEMENT PLAN TARP – WMP2 STREAM WATER QUALITY FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

<table>
<tr><th>Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th>Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="2"><u>Performance Measure Feature</u>
Other watercourses.

<u>Performance Measure</u>
Negligible environmental consequences including beyond those predicted in the EIS.

<u>Performance Indicator</u>
The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water quality changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River.

<u>TARP Objective</u>
This TARP defines levels of variation in surface water quality from normal conditions[1], indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of variation or exceedance of the performance measure.

<u>Assessment Criteria</u>
SSGV as listed in table below.</td><td rowspan="2"><u>Locations</u>

<table><tr><th>Longwall</th><th>Potential Impact Sites</th><th>Reference Sites</th></tr><tr><td>LW S1A</td><td>BR12-QRLa
BR13-QRLa</td><td rowspan="3">BR16-QLa[2,3]</td></tr><tr><td>LW S2A</td><td>BR18-QLa[2]
All sites above</td></tr><tr><td>LW S3A</td><td>BR17-QLa[2]
All sites above</td></tr><tr><td>LW S4A
LW S5A</td><td>BR6-QLa[2]
All sites above</td><td>DT73-QRLa
DT64-QRLa
All sites above</td></tr><tr><td>LW S6A</td><td>HC13-QLa[2]
HC16-QLa[2]
HC10-QRLa
HC3-QRLa
HC19-QRLa
All sites above</td><td>HC18-QRLa
HC17-QRLa
HC1-QRLa
All sites above</td></tr></table>
All monitoring locations are shown in Figure 20 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly sampling prior to secondary extraction or other relevant mining activity.

During Mining
Monthly sampling and analysis or as required by a specified action relevant to a trigger level.

Post-mining
Monthly sampling and analysis for a minimum of 12 months following the completion of LW S6A or as required in accordance with a Watercourse Corrective Action Management Plan.</td><td>Normal Condition
• Exceedance of an SSGV does not occur or occurs for less than three consecutive months.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1
• Exceedance of an SSGV occurs at a given potential impact site in three consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as required for Normal Condition.
• Assess if the trigger was exceeded during the baseline period prior to commencement of mining activities.
• Review water quality trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater quality monitoring results) necessary to inform assessment.
• Consider and decide on reasonable and feasible options for remediation as relevant (e.g. limestone cobbles for increasing pH level).</td><td>• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
• Provide DPE and key stakeholders with proposed CMAs for consultation (e.g. limestone cobbles for increasing pH level).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td>Level 2
• Exceedance of an SSGV occurs at a given potential impact sites in four or five consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as stated in Level 1.
• Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 2 has been reached or at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change that resulted in a water quality change).
• If increased monitoring is adopted, undertake further analysis of water quality trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions.
• Review CMAs in light of findings from further investigations and consider additional remediation options.
• Review Water Management Plan and modify if necessary.</td><td>• Responses as stated in Level 1.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td>Level 3
• Exceedance of an SSGV occurs at a given potential impact site in six consecutive months and the same has not occurred at the reference site(s).</td><td>• Actions as stated in Level 2.
• Increase monitoring and review of data frequency to fortnightly for sites where Level 3 has been reached and at corresponding reference sites, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.
• Undertake an investigation to determine if an exceedance of the performance measure is likely.</td><td>• Responses as stated in Level 2.
• If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.</td></tr>
<tr><td>Exceeds Performance Measure
• It is concluded from the Level 3 investigation that mining results in exceedance of an SSGV at a given potential impact site for six or more consecutive months.</td><td>• Investigate reasons for the performance measure exceedance.
• Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with future longwall extraction.</td><td>• Submit a report to DPE (in accordance with E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE).
• Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days.
• Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).
• Offer site visit with DPE and other key stakeholders.
• Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection.
• Implement approved WCAMP, subject to land access.</td></tr>
</table>

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management				
		Trigger	Action		Response	
Site Specific Guideline Value (SSGV)						
Parameter		BR12-QRLa	BR13-QRLa	HC3-QRLa	HC10-QRLa	HC19-QRLa
No. of Values[4]		35	35	34	28	30
pH (pH units)		6.5 - 8	6.5 - 8	5.7 - 8	6.5 - 8	6.5 - 8
EC (µS/cm)		350	350	365	350	350
Dissolved Aluminium (mg/L) pH > 6.5		0.062	0.055	0.09	0.07	0.1
Dissolved Copper (mg/L)		0.0014	0.0014	0.002	0.002	0.0014
Dissolved Iron (mg/L)		0.54	0.65	4.5	0.62	0.5
Dissolved Manganese (mg/L)		1.9	1.9	1.9	1.9	1.9
Dissolved Nickel (mg/L)		0.011	0.011	0.011	0.011	0.011
Dissolved Zinc (mg/L)		0.008	0.009	0.03	0.008	0.008

Notes:
[1] As defined by the SSGV.
[2] Sites to be installed, subject to land access. The monitoring program relevant to this TARP has been designed to record at least 24 months of baseline data prior to commencement of mining of the relevant longwall. Additional sites will be included prior to the commencement of mining the relevant longwall. The derived SSGV for each relevant monitoring site would be updated in the Water Management Plan and provided to the relevant government agencies for review and approval.
[3] Data collected from BR11-QRLa (water quality data collected between 2012-2021 and water level data collected between 2013-2021) will be used in combination with data from BR16-QLa (once established) to provide a long-term baseline dataset for the Bargo River upstream of mining activities. [4] Minimum number of values used in SSGV derivation - for some constituents, a greater number of values were adopted.

WATER MANAGEMENT PLAN TARP – WMP3 POOL WATER LEVEL FOR ALL WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
All watercourses within the Subsidence Area[1].

Performance Measure
No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS.

The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures.

Performance Indicator
Water level decline as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure.

TARP Objective
This TARP defines levels of variation in pool water level from normal conditions[3] and the actions required to be implemented in response to each level of variation.

Assessment Criteria
- Comparison of baseline and operational recorded water level data (all levels).
- Water level recession analysis for Level 2 and above.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	TT7-QRLa TT12-QLa TT13-QLa TT14-QLa	TT1-QRLa
LW S2A	TT9-QLa[4] TT3-QLa All sites above	
LW S3A	TT2-QLa All sites above	
LW S4A	BR2-QLa[4] TT1-QRLa All sites above	DT73-QRLa DT64-QRLa

All monitoring locations are shown in Figure 20 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Continuous record and monthly manual measurements. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements. Data downloaded and reviewed monthly.

Post-mining
Continuous record and monthly manual measurements for a minimum of 12 months following the completion of LW S6A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• The recorded water level has not declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• The recorded water level has declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Review water level trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Review streamflow data recorded at TT-F1 and conduct streamflow reduction assessment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater level monitoring results) necessary to inform assessment.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
Level 2		
• The recorded water level has declined atypically[5] below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 2 has been reached and at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change that resulted in a water level change). • If increased monitoring is undertaken, conduct further analysis of water level trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
Level 3		
• The recorded water level has declined atypically[6] below the recorded baseline minimum level for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency to fortnightly for sites where Level 3 has been reached and at corresponding reference sites, subject to land access. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate.	• *Responses as stated in Level 2.* If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts: • Offer site visit with DPE and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] As indicated by the baseline water level and recession rate.
[4] Sites to be installed, subject to land access. The monitoring program relevant to this TARP has been designed to record at least 24 months of baseline data prior to commencement of mining of the relevant longwall. Additional sites will be included prior to the commencement of mining the relevant longwall. The pool water levels for each relevant monitoring site would be updated in the Water Management Plan and provided to the relevant government agencies for review and approval.
[5] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions

WATER MANAGEMENT PLAN TARP – WMP4 POOL WATER LEVEL FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
Other watercourses.

Performance Measure
Negligible environmental consequences including beyond those predicted in the EIS, including:
- Negligible diversion of flows or changes in the natural drainage behaviour of pools.

Performance Indicator
The performance measure will be considered to be exceeded if a Level 3 TARP is triggered in relation to water level changes and the investigation outcomes indicate a mining related impact based on monitoring data for sites in Hornes Creek and the Bargo River.

TARP Objective
This TARP defines levels of variation in pool water level from normal conditions[1] and the actions required to be implemented in response to each level of variation.

Assessment Criteria
- Comparison of baseline and operational recorded water level data (all levels).
- Water level recession analysis for Level 2 and above.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	BR12-QRLa BR13-QRLa	BR16-QLa[2,3]
LW S2A	BR18-QLa[2] All sites above	
LW S3A	BR17-QLa[2] All sites above	
LW S4A LW S5A	BR6-QLa[2] All sites above	DT73-QRLa DT64-QRLa All sites above
LW S6A	HC13-QLa[2] HC16-QLa[2] HC10-QRLa HC3-QRLa HC19-QRLa All sites above	HC18-QRLa HC17-QRLa HC1-QRLa All sites above

All monitoring locations are shown in Figure 20 of the Water Management Plan.

Monitoring Frequency

Pre-mining
Continuous record and monthly manual measurements. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements. Data downloaded and reviewed monthly.

Post-mining
Continuous record and monthly manual measurements for a minimum of 12 months following the completion of LW S6A or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• The recorded water level has not declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level).	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• The recorded water level has declined by greater than 10 centimetres (cm) below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) and the same has not occurred at the reference site(s).	• *Actions as required for Normal Condition.* • Review water level trends along watercourse (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, groundwater level monitoring results) necessary to inform assessment.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
Level 2		
• The recorded water level has declined atypically[4] below the recorded baseline minimum level for less than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 2 has been reached or at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change that resulted in a water level change). • If increased monitoring is adopted, undertake further analysis of water level trends along creek (upstream to downstream) to identify spatial changes with consideration to climatic conditions. • Complete water level recession analysis for sites where Level 2 has been reached. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
Level 3		
• The recorded water level has declined atypically[4] below the recorded baseline minimum level for greater than one month (as a consecutive period) and the same has not occurred at the reference site(s).	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency to fortnightly for sites where Level 3 has been reached and at corresponding reference sites, subject to land access. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing), other catchment changes, effect unrelated to mining or the prevailing climate. • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 2.* • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.
Exceeds Performance Measure		
• It is concluded from the detailed investigation that mining has resulted in an atypical[3] decline in water level for greater than one month (as a consecutive period).	• Investigate reasons for the performance measure exceedance. • Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with further longwall extraction.	• Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project). • Offer site visit with DPE and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response

Notes:

[1] As indicated by the baseline water level and recession rate.

[2] Sites to be installed, subject to land access. The monitoring program relevant to this TARP has been designed to record at least 24 months of baseline data prior to commencement of mining of the relevant longwall. Additional sites will be included prior to the commencement of mining the relevant longwall. The derived SSGV for each relevant monitoring site would be updated in the Water Management Plan and provided to the relevant government agencies for review and approval.

[3] Data collected from BR11-QRLa (water quality data collected between 2012-2021 and water level data collected between 2013-2021) will be used in combination with data from BR16-QLa (once established) to provide a long-term baseline dataset for the Bargo River upstream of mining activities.

[4] 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the cease to flow level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

WATER MANAGEMENT PLAN TARP – WMP5 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF WATERCOURSES WITHIN THE SUBSIDENCE AREA[1]

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature All watercourses within the Subsidence Area[1]. **Performance Measure** No greater subsidence impact or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the EIS. The EIS concludes that where the longwalls directly mine beneath the streams, it is considered likely that fracturing would result in surface water flow diversion and that localised and transient increases in water quality constituents would occur[2]. The performance measure will be considered to be exceeded if subsidence impacts cannot be repaired in a manner that restores pool water holding capacity and stream health. Remediation measures will be developed as required and detailed in the Watercourse Corrective Action Management Plan (C12 of the SSD 8445). These plans will contain relevant performance indicators specific to remediation performance measures. **Performance Indicator** Variation in pool physical features and natural behaviour, as defined in the Level 1 to Level 3 trigger, where a Level 3 trigger denotes progression towards a potential exceedance of the performance measure. **TARP Objective** This TARP defines levels of variation in pool physical features and natural behaviour and the actions required to be implemented in response to each level of variation. **Assessment Criteria** Comparison of baseline and operational pool physical features and natural behaviour.	**Locations** Accessible pools and reaches in Teatree Hollow, Teatree Hollow Tributary and Bargo River Tributary (subject to land access). All monitoring locations are shown in Figure 21 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** One observation prior to mining using fixed location photo points. **During Mining** Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone[3] using fixed location photo points. **Post-mining** Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.	**Normal Condition**		
		• No observed impact to pool water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s)[3]. AND/OR • Visual observation of fracturing.	• *Actions as required for Normal Condition.* • Assess visual change along watercourse (upstream to downstream) to observe any spatial changes with consideration to climatic conditions. • Discuss findings with and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results) necessary to inform assessment. • Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 1 has been reached and at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. surface fracturing of weathered bedrock that does not affect water holding capacity of rockbar control or pool base).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing other catchment changes, effect unrelated to mining or the prevailing climate). • Review Water Management Plan and modify if necessary. If the changes have been confirmed to be related to mining effects: • Increase monitoring and review of data frequency to fortnightly for sites where Level 2 has been reached and at corresponding reference sites, subject to land access.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s). AND • The change in behaviour has been investigated and confirmed to be related to mining effects.	• *Actions as stated in Level 2.*	• *Responses as stated in Level 2.* • Offer site visit with DPE and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] Due to the predicted surface fracturing of watercourses which directly overlie the longwall panels.
[3] Survey area to include upstream, downstream and adjacent pools (to the extent of the potential impact) where a trigger exceedance has occurred at a potential impact site(s) in accordance with the TARPs.

WATER MANAGEMENT PLAN TARP – WMP6 PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS FOR OTHER WATERCOURSES (BARGO RIVER AND HORNES CREEK)

Performance Measure and Indicator, TARP Objective and Assessment Criteria

Performance Measure Feature
Other watercourses.

Performance Measure
Negligible environmental consequences including beyond those predicted in the EIS, including:

- Negligible diversion of flows or changes in the natural drainage behaviour of pools;
- Negligible gas releases and iron staining; and
- Negligible increase in water turbidity.

Performance Indicator
The performance measure will be considered to be exceeded if changes in physical features and natural behaviour of pools occur for three consecutive months and the investigation outcomes indicate a mining related impact based on visual observation records for sites in Hornes Creek and the Bargo River.

TARP Objective
This TARP defines levels of variation in pool physical features and natural behaviour and the actions required to be implemented in response to each level of variation.

Assessment Criteria
Comparison of baseline and operational pool physical features and natural behaviour.

Monitoring Program

Locations

Longwall	Potential Impact Sites	Reference Sites
LW S1A	BR12-QRLa BR13-QRLa	BR16-QLa[1,2]
LW S2A	BR18-QLa[1] All sites above	
LW S3A	BR17-QLa[1] All sites above	
LW S4A LW S5A	BR6-QLa[1] All sites above	DT73-QRLa DT64-QRLa All sites above
LW S6A	HC13-QLa[1] HC16-QLa[1] HC10-QRLa HC3-QRLa HC19-QRLa All sites above	HC18-QRLa HC17-QRLa HC1-QRLa All sites above

All monitoring locations are shown in Figure 20 of the Water Management Plan.

Pre-mining
One observation prior to mining using fixed location photo points.

During Mining
Observations every month during the active subsidence period (after 200 m of secondary extraction of relevant longwall) for sites within the active subsidence zone using fixed location photo points.

Post-mining
Quarterly observations over 12 months for pools that are no longer within the active subsidence zone or as required in accordance with a Watercourse Corrective Action Management Plan.

Management

Trigger	Action	Response
Normal Condition		
• No observed impact to pool water level, overland connected flow, iron staining, gas release, turbidity or channel stability - as compared with baseline conditions.	• Continue monitoring and review of data as per monitoring program.	• No response required.
Level 1		
• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs in one month and the same has not occurred at the reference site(s). AND/OR • Visual observation of fracturing.	• *Actions as required for Normal Condition.* • Assess visual change along watercourse (upstream to downstream) to observe any spatial changes with consideration to climatic conditions. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results) necessary to inform assessment. • Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 1 has been reached and at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. surface fracturing of weathered bedrock that does not affect water holding capacity of rockbar control or pool base).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
Level 2		
• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for two consecutive months and the same has not occurred at the reference site(s).	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing other catchment changes, effect unrelated to mining or the prevailing climate). • Review Water Management Plan and modify if necessary. If the changes have been confirmed to be related to mining effects: • Increase monitoring and review of data frequency to fortnightly for sites where Level 2 has been reached and at corresponding reference sites, subject to land access. • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.
Exceeds Performance Measure		
• Visually observed anomalous change in water level, overland connected flow, iron staining, gas release or turbidity - as compared with baseline conditions - occurs for three consecutive months and the same has not occurred at the reference site(s). AND • The change in behaviour has been investigated and confirmed to be related to mining effects.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Based on the outcomes of the investigation, review predictions of subsidence impacts and environmental consequences associated with further longwall extraction.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project). • Offer site visit with DPE and other key stakeholders. • Develop Watercourse Corrective Action Management Plan (WCAMP) in consultation with the Resources Regulator, DPE and other key stakeholders (in accordance with C12 of SSD 8445). The stream remediation measures in the WCAMP could include grout curtain and grout pattern injection. • Implement approved WCAMP, subject to land access.

[1] Sites to be installed, subject to land access. The monitoring program relevant to this TARP has been designed to record at least 24 months of baseline data prior to commencement of mining of the relevant longwall. Additional sites will be included prior to the commencement of mining the relevant longwall. The derived SSGV for each relevant monitoring site would be updated in the Water Management Plan and provided to the relevant government agencies for review and approval.
[2] Data collected from BR11-QRLa (water quality data collected between 2012-2021 and water level data collected between 2013-2021) will be used in combination with data from BR16-QLa (once established) to provide a long-term baseline dataset for the Bargo River upstream of mining activities.

WATER MANAGEMENT PLAN TARP – WMP7 CHANNEL STABILITY, SEDIMENTATION AND EROSION

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant[1,2,3].

<u>TARP Objective</u>
This TARP defines levels of variation in channel stability, erosion and sedimentation and the actions required to be implemented in response to each level of variation.

<u>Assessment Criteria</u>
Comparison of baseline and operational condition of headwater streams and soft knickpoints.</td><td rowspan="8"><u>Locations</u>
10 headwater sites and soft knickpoints, as shown in Figure 22 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
• One observation prior to mining using fixed location photo points.
• One inspection of 10 headwater sites.

During Mining
• Observations of knickpoint formation every month during the active subsidence period for sites within the active subsidence zone using fixed location photo points.
• Annual inspection of 10 headwater sites.

Post-mining
• One observation of knickpoint formation at sites that are no longer within the active subsidence zone using fixed location photo points.
• One inspection of 10 headwater sites.
• Post-mining geomorphology survey following completion of mining.</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• No further development of soft knickpoints or increased erosion of headwater streams.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Visually observed minor increase in knickpoint development and/or minor erosion and sedimentation of headwater streams.</td><td>• Actions as required for Normal Condition.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, biodiversity monitoring results) necessary to inform assessment.
• Consider increasing monitoring and review of data frequency to fortnightly at sites where Level 2 has been reached or at other relevant sites, subject to land access. Reasons for not increasing monitoring frequency could include confident identification of causation (e.g. singular, anthropogenic, non-mining related change that resulted in increased erosion).
• Consider and decide on reasonable and feasible options for remediation as relevant (e.g. enhanced vegetation establishment, rock armouring).</td><td>• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for approval (e.g. enhanced vegetation establishment, rock armouring).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Visually observed moderate increase in knickpoint development and/or moderate or greater increase in erosion and sedimentation of headwater streams.</td><td>• Actions as stated in Level 1.
• Increase monitoring and review of data frequency to fortnightly for sites where Level 3 has been reached and at corresponding reference sites, subject to land access.
• Undertake an investigation to assess if the change in behaviour is related to mining effects (e.g. subsidence induced, other catchment changes, effect unrelated to mining or the prevailing climate).
• Obtain specialist advice on further CMAs.
• Review CMAs in light of findings from further investigations and consider additional remediation options.
• Review Water Management Plan and modify if necessary.</td><td>• Responses as stated in Level 1.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
If it is concluded from the detailed investigation that watercourses have been damaged by subsidence impacts:
• Offer site visit with DPE and other key stakeholders.
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
[1] Subsidence Area is defined as the ‘Subsidence Study Area’ as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] It is noted that SSD 8445 does not specify a performance measure in relation to channel stability, sedimentation and erosion for all watercourses within the Subsidence Area[1].
[3] It is noted that no soft knickpoints have been mapped in Hornes Creek or Bargo River. Therefore, assessment of ‘decline in baseline channel stability’ for these watercourses is not applicable.</td></tr>
</table>

WATER MANAGEMENT PLAN TARP – WMP8 SHALLOW GROUNDWATER LEVEL (OPEN STANDPIPES AND PRIVATE BORES)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. This TARP supports TARP WMP13, where groundwater levels as they pertain to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) are covered. **Assessment Criteria** Bore specific trigger values based on baseline data for each reporting level.	**Locations** **Open standpipes** Existing sites: P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c Proposed sites: P50a, P50b, P50c, P57a, P57b **Private bores** GW109257, GW104008, GW112473, GW104659, GW062068, GW105395, GW104323 All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** Continuous record and monthly manual measurements of water level. Data downloaded prior to the commencement of secondary extraction of the relevant longwall. **During Mining** Continuous record and monthly manual measurements of water level. Data downloaded and reviewed monthly. **Post-mining** Continuous record and quarterly manual measurements of water level for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan.	**Normal Condition**		
		• Groundwater level remains consistent with baseline variability and pre-mining trends with reductions in groundwater level less than two meters.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Greater than 2 m water level reduction[1] for a period of 6 months following the commencement of extraction.	For Private Bores and Open Standpipe Monitoring Bores: • *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Undertake investigation to demonstrate if the decline will impact the long-term viability of the affected water supply works. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results). **If the changes have been confirmed to be related to mining effects:** For Private Bores only: • Initiate negotiations with impacts landowners as soon as practicable. Consider and decide on reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores, etc - as per Section 6.2.1.4 of the Water Management Plan). For Open Standpipe Monitoring Bores only: • For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.	For Private Bores and Open Standpipe Monitoring Bores: • Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. **If the changes have been confirmed to be related to mining effects:** For Private Bores only: • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan). • Implement CMAs, subject to land access (finalise negotiations and implement the agreed "make-good" arrangements) • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Water level declines below the average between the 'maximum modelled drawdown' (Level 3 trigger) and the '2 m drawdown' (Level 1 trigger)[1] for a period of greater than 6 months following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	For Private Bores and Open Standpipe Monitoring Bores: • *Actions as stated in Level 1.* • Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary. For Private Bores only: • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.	For Private Bores and Open Standpipe Monitoring Bores: • *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan. For Private Bores only: • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access.
		Level 3		
		• Water level reduction greater than the maximum modelled drawdown[1] for a period of 6 months following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	For Private Bores and Open Standpipe Monitoring Bores: • *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).	For Private Bores and Open Standpipe Monitoring Bores: • *Responses as stated in Level 2.* For Private Bores only: • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-3 in Appendix E of the Water Management Plan.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP9 SHALLOW GROUNDWATER PRESSURE (VWP SENSORS < 200 m DEPTH)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on baseline data for each reporting level.	**Locations** Baseline / Impact sites: TBC032, TBC033, TBC009, TBC018 Reference Sites: TBC024, TBC027, TBC034, TBC038 Monitoring of all VWP < 200 m depth. All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **During Mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **Post-mining** Monitoring of data (transmitted continuously) for 12 months following the completion of LW S6A.	**Normal Condition**		
		• No recorded mining induced change at VWP depth.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Greater than 5 m water level reduction at VWP depth[1] following the commencement of extraction.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Water level declines below the calculated Level 2 trigger[2] following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 1.* • Review deeper VWP data at monitored sites. Determine whether additional review of data is required. Determine if review of additional existing VWP sites is required. Reasons for not increasing frequency of data review could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Compare against base case and deterministic model scenarios[3]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Water level reduction greater than the maximum modelled drawdown[1] following the commencement of extraction. AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Undertake investigative to review model results in conjunction with field data.	• *Responses as stated in Level 2.*

Notes:
[1] Level 1, 2 and 3 triggers for water level reduction is provided in Table 6-3 in Appendix E of the Water Management Plan.
[2] Level 2 trigger is calculated as being the average of Level 1 (5 m drawdown) and Level 3 (the 'maximum modelled drawdown').
[3] "Deterministic" model scenario refers to the predictive scenario modelling utilised to determine the trigger level.

WATER MANAGEMENT PLAN TARP – WMP10 GROUNDWATER LEVEL / PRESSURE DEEP VWPS (> 200 m DEPTH EXCLUDING MONITORING THE BULLI COAL SEAM)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measure relevant. **TARP Objective** This TARP defines levels of deviation in groundwater level from 'normal' or baseline conditions and the actions to be implemented in response to each level deviation. **Assessment Criteria** Bore specific trigger values based on modelled data for each reporting level. Model layers utilised to define predicted drawdown for each VWP logger provided in Table below.	**Locations** Baseline / Impact sites: TBC009, TBC0018, TBC020, TBC026, TBC032, TBC033, TBC039 Reference sites: TBC024, TBC027, TBC034, TBC038 Monitoring of all VWP > 200 m depth excluding those monitoring the Bulli Coal Seam. All monitoring locations are shown in Figure 23 of the Water Management Plan. **Monitoring Frequency** **Pre-mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **During Mining** VWPs recording pressure readings hourly. The system is telemetered so that data is transmitted continuously and can be accessed at any point in time. **Post-mining** Monitoring of data (transmitted continuously) for 12 months following the completion of LW S6A.	**Normal Condition**		
		• Recorded data within (do not exceed) modelled impacts (predicted drawdown)[1].	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Recorded drawdown is within 30 m of modelled predicted drawdown[1], for a period less than 6 months.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results).	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Recorded drawdown exceeds modelled predicted drawdown[1] by less than 30 metres for a period of greater than 6 months. OR • Recorded drawdown exceeds modelled predicted drawdown[1] by greater than 30 m, for a period of 6 to 12 months.	• *Actions as stated in Level 1.* • Assess suitability of increasing frequency of data review at sites where Level 2 has been reached. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change). • Review data in conjunction with VWP data from additional existing VWP sites. • Compare against base case and deterministic model scenarios[2]. • Review Water Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Inclusion of more regional VWPs into data review to assess likely extent and depth of depressurisation. • Advise DPE and key stakeholders of any required amendments to Water Management Plan.
		Level 3		
		• Recorded drawdown exceeds modelled predicted drawdown[1] by 30 m, for a period of 12 months or more.	• *Actions as stated in Level 2.* • Increase review of data frequency for sites where Level 3 has been reached. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Review base case and deterministic model scenarios[2] in conjunction with water pressure data and report findings.	• *Responses as stated in Level 2.*

Notes:
[1] Predicted drawdown refers to the drawdown as generated by the groundwater model and varies over time as extraction progresses. Recorded drawdown will be plotted on a monthly basis against the predicted drawdown to assess if a trigger has occurred. Therefore, as the predicted drawdown will be constantly changing according to extraction progression, it is not possible to set a specific trigger limit.
[2] "Deterministic" model scenario refers to the predictive scenario modelling utilised to assess the trigger level.

Sensor	Model Layer	Model Geology		Sensor	Model Layer	Model Geology		Sensor	Model Layer	Model Geology
TBC09_322	8	BUSS Mid		TBC20_375	8	BUSS Mid		TBC32_257	8	BUSS Mid
TBC09_343	8	BUSS Mid		TBC20_397	13	WBCS		TBC32_294	8	BUSS Mid
TBC09_357	12	SBSS Lower		TBC20_411	7	BUSS Upper		TBC32_314	8	BUSS Mid
TBC09_381	10	SPCS		TBC20_434	17	Wongawilli		TBC33_247	8	BUSS Mid
TBC09_391	15	Bulli Seam		TBC20_439	4	HBSS Mid		TBC33_306	8	BUSS Mid
TBC09_397	17	Wongawilli		TBC26_211	8	BUSS Mid		TBC33_363	11	SBSS Upper
TBC18_282	8	BUSS Mid		TBC26_278	8	BUSS Mid		TBC33_384	16	Eckersley
TBC18_366	8	BUSS Mid		TBC26_344	8	BUSS Mid		TBC33_408	16	Eckersley
TBC18_377	13	WBCS		TBC26_409	13	WBCS		TBC39_243	8	BUSS Mid
TBC18_404	15	Bulli Seam		TBC26_432	15	Bulli Seam		TBC39_299	8	BUSS Mid
TBC18_426	17	Wongawilli		TBC26_440	16	Eckersley		TBC39_354	11	SBSS Upper
TBC18_432	17	Wongawilli		TBC26_460	16	Eckersley		TBC39_375	16	Eckersley
TBC20_211	8	BUSS Mid		TBC32_200	8	BUSS Mid		TBC39_402	16	Eckersley
TBC20_293	8	BUSS Mid		TBC32_237	8	BUSS Mid				

WATER MANAGEMENT PLAN TARP – WMP11 GROUNDWATER QUALITY (OPEN STANDPIPES AND PRIVATE BORES)

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant.

<u>TARP Objective</u>
This TARP defines levels of deviation in groundwater level from ‘normal’ or baseline conditions and the actions to be implemented in response to each level deviation.
This TARP supports TARP WMP13, where groundwater quality as it pertains to groundwater dependent ecosystems (GDEs) (Thirlmere Lakes) is covered.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level.</td><td rowspan="8"><u>Locations</u>
Open standpipes
Existing sites:
P51a, P51b, P52, REA4, P53a, P53b, P53c, P54a, P54b, P55a, P55b, P55c, P56a, P56b, P56c

Proposed sites:
P50a, P50b, P50c, P57a, P57b

Private bores
GW109257, GW104008, GW112473, GW104659, GW062068, GW105395, GW104323

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Monthly water quality sampling.

During Mining
Monthly water quality sampling.

Post-mining
Quarterly manual measurements of water quality for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan.

Water quality sample parameters:
<table><tr><th>Field Parameters</th></tr><tr><td>PH, EC, TDS, DO, ORP</td></tr><tr><th>Laboratory Analysis</th></tr><tr><td>Total alkalinity as CaCO3, HCO3, CO3, DOC
Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4)
Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Nitrogen
Total Phosphorus
Ionic Balance (Total Anions and Total Cations)</td></tr></table></td><td colspan="3">Normal Condition</td></tr>
<tr><td>• No recorded changes in salinity, pH or metals outside of the baseline variability.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 1</td></tr>
<tr><td>• Recorded salinity and/or metals or pH outside of defined trigger levels[1] for 3 consecutive months or less. The effect does not persist after a significant rainfall recharge event.
AND
• A similar trend or response is noted at other monitored bores or private groundwater bores.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and assess if mining related.
• Undertake investigation to demonstrate if the change in quality will impact the long-term viability of the affected water supply works.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results).

If the changes have been confirmed to be related to mining effects:
For Private Bores only:
• Initiate negotiations with impacted landholders as soon as practicable. Consider and decide on reasonable and feasible options for remediation as relevant. This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners (e.g. provision of access to an alternative source of water).
For Open Standpipe Monitoring Bores only:
• For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.

If the changes have been confirmed to be related to mining effects:
For Private Bores only:
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. provision of access to an alternative source of water as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Recorded salinity and/or metals or pH outside of defined trigger levels[1], for 3 consecutive months or less. The effect persists after a significant rainfall recharge event.
AND
• The change in water quality is assessed not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Actions as stated in Level 1.
• Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water quality change).
• Review Water Management Plan and modify if necessary.
For Private Bores only:
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Responses as stated in Level 1.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
For Private Bores only:
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Recorded salinity and/or metals or pH outside of defined trigger levels[1], for greater than 3 consecutive months.
AND
• The change in water quality is assessed not to be controlled by climatic or external anthropogenic factors.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Actions as stated in Level 2.
• Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).
• Undertake investigative report to demonstrate if the water quality change will impact the long-term viability of any affected water supply works.</td><td>For Private Bores and Open Standpipe Monitoring Bores:
• Responses as stated in Level 2.

If ascertained impact is due to mining activities and has potential to impact long-term viability of supply for private groundwater bores:
For Private Bores only:
• Develop a Rehabilitation Management Plan in consultation with DPE and landowner.
• Implement Rehabilitation Management Plan, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
[1] Defined trigger levels for groundwater quality are listed in Table 6-5 of Appendix E of the Water Management Plan.</td></tr>
</table>

WATER MANAGEMENT PLAN TARP – WMP12 GROUNDWATER - SURFACE WATER INTERACTION

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
No performance measure relevant[1].

<u>TARP Objective</u>
This TARP defines levels of deviation in surface water - groundwater interactions from ‘normal’ conditions and the actions to be implemented in response to each level deviation.
The instigation of this TARP will be dictated by triggers exceedances in pertinent groundwater or surface water sites requiring further investigation of groundwater – surface water interactions.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level. For this TARP, the aligned groundwater and surface water sites would be considered collectively to interpret potential changes/impacts to groundwater – surface water interaction.</td><td rowspan="8"><u>Locations</u>
Open standpipes
P51a, P51b, P52, REA4, P53a, P53b, P53c
P54a, P54b, P54c, P55a, P55b, P55c

The aligned surface water and groundwater sites are as follows:
• P51a, P51b with surface water site BR2-QLa
• P52, REA4 with surface water site-TT14-QLa
• P53a, P53b, P53c with surface water site-TT14-QLa
• P54a, P54b, P54c with surface water site TT3-QLa
• P55a, P55b, P55c with surface water site TT1-QRLa

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Continuous record and monthly manual measurements of water level. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements of water level. Data downloaded and reviewed monthly.

Post-mining
Continuous record and quarterly manual measurements of water level for 12 months following the completion of LW S6A, or as required in accordance with a Rehabilitation Management Plan.</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• Recorded (or inferred where not immediately neighbouring a surface water site) groundwater and surface water interaction remains consistent with baseline variability and/pre-mining trends, and decrease in groundwater inflow not persisting after significant rainfall recharge events.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Recorded (or inferred where not immediately neighbouring a surface water site) groundwater levels at surface water monitoring site decline below Level 1 (in TARP WMP8) following the commencement of extraction.</td><td>• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and assess if mining related.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results, biodiversity monitoring results).</td><td>• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
If the changes have been confirmed to be related to mining effects:
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Recorded (or inferred where not immediately neighbouring a surface water site) groundwater levels at aligned surface water monitoring site decline below Level 2 (in TARP WMP8) following the commencement of extraction.
AND
• The reduction in water level is assessed not to be controlled by climatic or external anthropogenic factor.</td><td>• Actions as stated in Level 1.
• Increase frequency of data review to fortnightly at sites where Level 2 has been reached, subject to land access. Reasons for not increasing frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change).
• Compare against base case and deterministic model scenarios[2].
• Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline.
• Review surface water data to assess for surface water level decline at relevant site.
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.
• Review Water Management Plan and modify if necessary.</td><td>• Responses as stated in Level 1.
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan, including reporting on relationship of observations to baseline and deterministic model scenarios, as necessary.</td></tr>
<tr><td>Level 3</td><td></td><td></td></tr>
<tr><td>• Recorded (or inferred where not immediately neighbouring a surface water site) groundwater levels at aligned surface water monitoring site decline below Level 3 (in TARP WMP8) following the commencement of extraction.
AND
• The reduction in water level is assessed not to be controlled by climatic or external anthropogenic factor.</td><td>• Actions as stated in Level 2.
• Increase frequency of data review for sites where Level 3 has been reached, subject to land access.
• Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate).</td><td>• Responses as stated in Level 2.
• Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders.
• Implement Rehabilitation Management Plan, subject to land access.</td></tr>
<tr><td colspan="5">Notes:
[1] Where groundwater – surface water connectivity indicates a gaining stream, there is potential for riparian vegetation to be supported by groundwater. Consequently, riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE). Riparian GDEs are addressed through the Riparian Vegetation TARP (BMP3). Discussion of findings through the Tahmoor Coal Environmental Response Group will enable linkage of this TARP to BMP3 to consider groundwater – surface water relationships when pertinent.
[2] “Deterministic” model scenario refers to the predictive scenario modelling utilised to assessed the trigger level.</td></tr>
</table>

WATER MANAGEMENT PLAN TARP – WMP13 GROUNDWATER BORES MONITORING FOR THIRLMERE LAKES

<table>
<tr><th rowspan="2">Performance Measure and Indicator, TARP Objective and Assessment Criteria</th><th rowspan="2">Monitoring Program</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8"><u>Performance Measure Feature</u>
GDEs including Thirlmere Lakes[1].

<u>Performance Measure</u>
Negligible impacts including:
• Negligible change in groundwater levels; and
• Negligible change in groundwater quality.

<u>Performance Indicator</u>
The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for the Thirlmere Lakes.

<u>TARP Objective</u>
This TARP defines levels of deviation at Thirlmere Lakes from ‘normal’ conditions and the actions to be implemented in response to each level deviation.

<u>Assessment Criteria</u>
Bore specific trigger values based on baselines data for each reporting level.</td><td rowspan="8"><u>Locations</u>
“Early warning” bores
Existing sites:
P51a, P51b, GW062068, GW104659, TBC039 (sensor at 65 metres in Hawkesbury Sandstone (HBSS))

Thirlmere Lakes bores
Existing sites:
GW075409–1, GW075409–2, GW075410, GW075411 (paired with gauging station 212066)
Proposed sites:
P50a, P50b, P50c

All monitoring locations are shown in Figure 23 of the Water Management Plan.

<u>Monitoring Frequency</u>
Pre-mining
Continuous record and monthly manual measurements of water level and water quality. Data downloaded prior to the commencement of secondary extraction of the relevant longwall.

During Mining
Continuous record and monthly manual measurements of water level and water quality. Data downloaded and reviewed monthly.

Post-mining
Continuous record and quarterly manual measurements of water level and water quality for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan.

Water quality sample parameters:
Field Parameters
PH, EC, TDS, DO and ORP
Laboratory Analysis
Total alkalinity as CaCO3, HCO3, CO3, DOC
Dissolved Major Cations (Ca, K, Na, Mg, F, Cl, SO4)
Dissolved Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Metals (Al, As, Ba, Co, Cu, Pb, Li, Mn, Ni, Se, Sr, Zn, Fe)
Total Nitrogen
Total Phosphorus
Ionic Balance (Total Anions and Total Cations)</td><td>Normal Condition</td><td></td><td></td></tr>
<tr><td>• Groundwater levels and water quality remain consistent with baseline variability and/pre-mining trends, and changes in groundwater levels/quality not persisting after significant rainfall recharge events.</td><td>• Continue monitoring and review of data as per monitoring program.</td><td>• No response required.</td></tr>
<tr><td>Level 1</td><td></td><td></td></tr>
<tr><td>• Level 1 trigger of TARP WMP8 for a minimum of two “early warning” bores.
OR
• Level 1 trigger of TARP WMP11 for a minimum of two “early warning” bores.</td><td>• Actions as required for Normal Condition.
• Undertake an investigation to assess cause and assess if mining related.
• Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water level monitoring results).
If the changes have been confirmed to be related to mining effects:
• Consider and decide on reasonable and feasible options for remediation as relevant (e.g. extending the depth of the bore, establishment of additional bores). This could include potential for implementation of make-good provisions as per Section 6.2.1.4 of the Water Management Plan for affected private bore owners.
• For monitoring sites relevant to Thirlmere Lakes or associated with surface water monitoring sites, initiate groundwater – surface water interaction TARP.</td><td>• Report trigger exceedance to DPE and key stakeholders.
• Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
If the changes have been confirmed to be related to mining effects:
• Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. extending the depth of the bore, establishment of additional bores, compensation to affected landowners as detailed in Section 6.2.1.4 of the Water Management Plan).
• Implement CMAs, subject to land access.
• Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.</td></tr>
<tr><td>Level 2</td><td></td><td></td></tr>
<tr><td>• Level 2 trigger of TARPs WMP8 for a minimum of three bores (“early warning” bores and Thirlmere Lakes bores)
OR
• Level 2 trigger of TARPs WMP11 for a minimum of three bores (“early warning” bores and Thirlmere Lakes bores).</td><td>• Actions as stated in Level 1.
If the changes have been confirmed to be related to mining effects:
• Consider increasing monitoring and review of data at sites where Level 2 has been reached, subject to land access. Reasons for not increasing monitoring frequency could include solid identification causation that do not require further monitoring (e.g. singular anthropogenic impact resulting in water level change).
• Compare against base case and deterministic model scenarios[2].
• Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline.
• Review surface water data to assess for surface water level decline at relevant site.
• Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options.
• Review Water Management Plan and modify if necessary.
• Undertake an investigation to assess if an exceedance of the performance measure is likely.</td><td>• Responses as stated in Level 1.
• Provide findings of CMA review to DPE and key stakeholders for consultation.
• Implement additional CMAs, subject to land access.
• Advise DPE and key stakeholders of any required amendments to Water Management Plan.
• If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.</td></tr>
<tr><td>Exceeds Performance Measure</td><td></td><td></td></tr>
<tr><td>• Level 3 trigger of TARPs WMP8 for a minimum of four bores (“early warning” bores and Thirlmere Lakes bores)
OR
• Level 3 trigger of TARPs WMP11 for a minimum of four bores (“early warning” bores and Thirlmere Lakes bores).</td><td>• Actions as stated in Level 2.
If the changes have been confirmed to be related to mining effects:
• Increase monitoring and review of data frequency for sites where Level 3 has been reached, subject to land access.
• Investigate reasons for the performance measure exceedance.
• Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.
• Consider modifying mine plan.</td><td>• Responses as stated in Level 2.
• Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE) describing remediation options and any preferred remediation measures or other course of action.
• Implement any reasonable remediation measures as directed by DPE, subject to land access.
• Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days.
• Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).
• Update numerical groundwater model and re-run predictive scenarios to assess the likely extent and depth of depressurisation
• in the vicinity of Thirlmere Lakes, and to assess whether any additional
• management actions are required such as modifying the mine plan.</td></tr>
</table>

Notes:
[1] It is noted that the only Groundwater Dependent Ecosystem (GDE) pertinent to the Tahmoor South Project is that of Thirlmere Lakes[2] “Deterministic” model scenario refers to the predictive scenario modelling utilised to assess the trigger level.

LAND MANAGEMENT PLAN TARP – LMP1 CLIFFS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Any cliff within Subsidence Area[1] beyond the extent of longwalls[2]. **Performance Measure** Negligible environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs within Subsidence Area). **Performance Indicator** This performance measure will be considered to be triggered if more than 0.5% of the total face area of the cliffs within the 600 m Environmental Features Study Area is impacted by mining (e.g. by occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing). **TARP Objective** This TARP defines measures to manage potential impacts on cliff lines and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** Extent of surface cracking, rockfalls, displacement or dislodgement of boulders or slabs observed.	**Locations** Cliffs (BC1 and BC2) within the 600 m Environmental Features Study Area as illustrated in Figure 3 of the Land Management Plan. **Monitoring Frequency** **Pre-mining** Visual inspection baseline before mining by a geotechnical engineer, subject to land access (Cliff BC1 prior to LW S6A, Cliff BC2 prior to LW S3A). **During Mining** None required (as the identified cliffs are located near the finishing ends of the longwalls). **Post-mining** Visual inspection at the completion of mining by a geotechnical engineer, subject to land access (Cliff BC1 after LW S6A, Cliff BC2 after LW S3A, S4A, S5A and S6A).	**Normal Range of Condition**		
		• Surface cracking < 10 mm wide above the cliff line, on the cliff face, or in the underside of overhangs. AND/OR • No rockfalls, displacement or dislodgement of boulders or slabs observed.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Surface cracking > 10 mm wide above the cliff line, on the cliff face, or in the underside of overhangs. AND/OR • No rockfalls, displacement or dislodgement of boulders or slabs observed.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialises (e.g. subsidence monitoring results). If it is concluded that the cliff has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options to support the cliff line, where relevant (e.g. repairing cracks, installation of support (e.g. rockbolts)). • Erect hazard/warning signs and restrict access to areas where necessary. • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential cliff instability and monitoring results relevant to the cliff locations.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. repairing cracks, installation of support). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Rockfalls, collapse of overhang, displacement or dislodgement of boulders or slabs observed.	• *Actions as stated in Level 1.* • Determine the percentage area of impacted area relative to the total face area. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, or the effect is unrelated to mining such as environmental effects, tree root jacking). If it is concluded that cliff line has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential cliff instability and monitoring results relevant to the cliff locations. • Notify and consult with affected landowner(s). • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Land Management Plan and modify if necessary. • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 1.* If it is concluded that cliffs have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders if relevant. • Notify DAWE of any predictions of an exceedance of a performance measure (if relevant) within two business days. • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan.
		Exceeds Performance Measure		
		• More than 0.5% of the total face area of the cliffs within the 600 m Environmental Features Study Area is impacted due to mining (e.g. by occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing).	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan for future longwalls located near cliffs.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE) describing remediation options and any preferred remediation measures or other course of action. • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Notes:
[1] Subsidence Area is defined as the 'Subsidence Study Area' as illustrated in Figure 1 of Appendix 2 of SSD 8445.
[2] It is noted that there are no cliff lines located directly above Longwalls S1A-S6A. Therefore, the performance measure for 'Any cliff located directly above longwalls' is not relevant.

LAND MANAGEMENT PLAN TARP – LMP2 NATURAL STEEP SLOPE (EXCLUDING CONSTRUCTED STEEP SLOPES ASSOCIATED WITH ROADS, RAILWAY AND THE TAHMOOR MINE SITE)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature All land within the Subsidence Area[1,2]. **Performance Measure** No greater subsidence impact or environmental consequences than predicted in the EIS[3]. **Performance Indicator** This performance measure will be considered to be triggered if mining results in mine subsidence-induced slope instability, which would be a greater subsidence impact or consequence than predicted in the EIS. **TARP Objective** This TARP defines measures to manage potential impacts on natural steep slopes[4,5] and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** Extent of surface cracking and stepping, ground bulging, buckling and shearing for steep slopes[4].	**Locations** Natural steep slopes (WC1, WC2 and WC3) Locations of natural steep slopes shown in Figure 3 of the Land Management Plan. **Monitoring Frequency** **Pre-mining** Visual inspection baseline one month before active subsidence period by a geotechnical engineer, subject to land access. **During Mining** Monthly visual inspection during active subsidence period by a geotechnical engineer, subject to land access. **Post-mining** Quarterly visual inspection for 12 months following active subsidence period by a geotechnical engineer, or as required in accordance with a Rehabilitation Management Plan, subject to land access.	**Normal Range of Condition**		
		• Discontinuous surface cracking < 10 mm wide on steep slope (e.g. other than natural desiccation cracking). AND/OR • No localised ground bulging, buckling or shearing.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Persistent[6] surface cracking 10 - 20 mm, or stepping (including shearing) across a crack 10 – 20 mm high on steep slope. AND/OR • Localised ground bulging or buckling (between 100 – 200 mm) is observed on steep slope.	• *Actions as required for Normal Condition.* • Geotechnical consultant inspection to assess cause and determine need for further action/investigation. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results). If it is concluded that the slope has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. backfilling or grout filling of surface cracking, re-profiling of compression humps). • Erect warning signs and restrict access to areas where necessary. • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential slope instability and monitoring results relevant to the steep slope locations. • Consider additional specific monitoring at the impact site and implement if feasible and effective.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. backfilling or grout filling of surface cracking, re-profiling of compression humps, re-direct drainage) • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Persistent[5] surface cracking > 20 mm wide or stepping > 20 mm high on slope. AND/OR • Localised ground bulging or buckling > 200 mm is observed on steep slope. AND/OR • Slope instability < 300 m^3 is observed or assessed as likely by a geotechnical engineer based on the extent of surface cracking or deformation.	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced cracking, or the effect is unrelated to mining such as wet weather or other environmental effects). If it is concluded that the slope has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of potential slope instability and monitoring results relevant to the steep slope locations. • Assess potential for slope instability (and if an exceedance of the performance measure is possible). • Consider actions to avoid or reduce the likelihood and/or consequence of slope instability and implement if feasible and effective. • Notify and consult with affected landowner(s). • Review CMAs with regards to the findings from further investigations and consider additional remediation options. • Review Land Management Plan and modify if necessary.	• *Responses as stated in Level 1.* If it is concluded that the slope has been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders if relevant. • Notify DAWE of any predictions of an exceedance of a performance measure (if relevant) within two business days. • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan.
		Exceeds Performance Measure		
		• Subsidence-induced impacts or environmental consequences that result in slope instability > 300 m^3.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed with DPE) describing temporary protection measures and long-term remediation options and any preferred remediation measures or other course of action. • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

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

LAND MANAGEMENT PLAN TARP – LMP3 FARM DAMS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Other privately-owned built features and improvements, including… farm dams. **Performance Measure** • Always safe. • Serviceability should be maintained wherever practicable. • Loss of serviceability must be fully compensated. • Damage must be fully repairable, and must be fully investigated and repaired or else replaced or fully compensated at the cost of the Applicant. **Performance Indicator** This performance measure will be considered to be triggered if mining results in damage to a farm dam such that the dam is not safe and serviceable and/or any damages cannot be fully repairable and/or compensated. **TARP Objective** This TARP defines measures to manage potential impacts on farm dams and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** Dam embankment integrity, water level and seepage observations.	**Locations** Identified farm dams within the Study Area. Locations shown in Figure 8 of the Land Management Plan. **Monitoring Frequency** **Pre-mining** Dam embankment integrity and water level observation by a geotechnical consultant one month before active subsidence period using fixed location photo points. **During Mining** Dam embankment integrity and water level observation every week during the active subsidence period by Tahmoor Coal, and every month during the active subsidence period by a geotechnical consultant, using fixed location photo points. **Post-mining** Dam embankment integrity and water level observation using fixed location photo points on a quarterly basis for 12 months following completion of active subsidence by a geotechnical consultant, or as required in accordance with a Rehabilitation Management Plan.	**Normal Range of Condition**		
		• No cracks develop within dam embankment (e.g. other than natural desiccation cracking).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Development of isolated cracks (> 10 mm wide) within the dam wall (e.g. other than natural desiccation cracking). AND/OR • Development of isolated seepage without suspended solids (e.g. clear water) from the face or toe of the farm dam embankment.	• *Actions as required for Normal Condition.* • Geotechnical consultant inspection to assess cause and determine need for further action/investigation. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results). If it is concluded that dam has been damaged by subsidence impacts: • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. backfilling surface cracking, reinstatement). • Notify and consult with affected landowner. • Erect warning signs and restrict access to areas where necessary and permitted by the landowner.	• Report trigger exceedance to DPE, SA NSW and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE, SA NSW and landowner with proposed corrective management actions (CMAs) for consultation (e.g. backfilling surface cracking, reinstatement). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Development of persistent longitudinal or arcuate cracking within dam wall > 20 mm. AND • Development of seepage with suspended solids (e.g. turbid water) from the face or toe of the farm dam embankment.	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequence of potential dam break, and monitoring results relevant to the dam locations. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Land Management Plan and modify if necessary. • Geotechnical Consultant to advise on the need for a reduction in the dam water level (e.g. half dam volume) to reduce the risk of a dam break failure.	• *Responses as stated in Level 1.* • Advise DPE, SA NSW and key stakeholders of any required amendments to Land Management Plan. • Provide findings of CMA review to DPE, SA NSW and landowner for consultation. • Implement additional CMAs, subject to land access.
		Level 3		
		• Development of persistent longitudinal or arcuate cracking within dam wall > 20 mm. AND • Subsidence monitoring identifies subsidence-induced impacts or environmental consequences that result in any slope instability to the farm dam embankment.	• *Actions as stated in Level 2.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, or the effect is unrelated to mining such as environmental effects). If it is concluded that the dam has been damaged by subsidence impacts: • Increase frequency of monitoring by geotechnical consultant during active subsidence period at sites where Level 3 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequence of potential dam break, and monitoring results relevant to the dam locations. • Reduction of dam water level in accordance with advice from Geotechnical Consultant. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Assess potential for the safety and serviceability of the dam to be lost (and if an exceedance of the performance measure is possible).	• *Responses as stated in Level 2.* If it is concluded that the dam has been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Repair or replace farm dam in consultation with DPE and SA NSW and landowner. • Provide alternate water supply for landowner, if required. • Notify DAWE of any predictions of an exceedance of a performance measure (if relevant) within two business days.
		Exceeds Performance Measure		
		• Mining results in damage to a farm dam such that the dam is not safe and serviceable and/or any damages cannot be fully repairable and/or compensated.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of mine subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed with DPE) describing temporary protection measures and long-term remediation options and any preferred remediation measures or other course of action.

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
				• Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

LAND MANAGEMENT PLAN TARP – LMP4 AGRICULTURAL LAND

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measures relevant. **TARP Objective** This TARP defines measures to manage potential impacts on agricultural land and the actions required to be implemented in response to exceedance of defined trigger levels. **Assessment Criteria** Changes to agricultural land such as to impact the use of the land for agricultural productivity[1].	**Locations** Identify agricultural land uses within the Study Area (refer to Figure 8 in the Land Management Plan). **Monitoring Frequency** **Pre-mining** Visual inspection prior to the commencement of mining from fixed photo points. **During Mining** Weekly inspections along local roads and farm dams. **Post-mining** Visual inspection at the completion of each longwall for land within the predicted limit of subsidence for each longwall.	**Normal Condition**		
		• Negligible impact to agricultural productivity or use of land, negligible effects from mining-induced changes in slope (tilt) on ponding / flooding (reversal of natural slope), or increase in soil / tunnel erosion (increase in slope).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Minor impact to agricultural land from subsidence resulting in increased flooding or ponding within predicted impacts. AND/OR • Minor impact to drainage systems due to increased ponding / flooding or increased soil / tunnel erosion that can be remediated. AND/OR • Surface cracking affecting safety of livestock.	• *Actions as required for Normal Condition.* • Undertake an investigation to assess cause and determine if mining related. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results). • Consider and decide on reasonable and feasible options for remediation as relevant (e.g. adjustment of farm gate levels, fence tensioning, backfilling of surface cracking). • Consider increasing monitoring and review of data frequency at sites where Level 1 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of further impacts on agricultural land use and monitoring results relevant to the agricultural land.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. adjustment of farm gate, fence tensioning, backfilling of surface cracking). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Significant impact and change to agricultural land functionality or agricultural productivity greater than predicted (e.g. excessive subsidence and mining-induced changes in slope (tilt), resulting in substantial ponding / flooding (reversal in natural slope), excessive soil / tunnel erosion (increase in slope), or excessive surface cracking affecting safety of livestock that require livestock to be relocated from a property in order to rehabilitate the land.	• *Actions as stated in Level 1.* • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, or the effect is unrelated to mining such as environmental effects). If it is concluded that agricultural land has been damaged by subsidence impacts: • Increase frequency of monitoring during active subsidence period at sites where Level 2 has been reached, subject to land access. Considerations will take into account position of LW face relative to impact site, rate of longwall retreat, current weather conditions, development of conventional subsidence above longwall, consequences of further impacts on agricultural land use and monitoring results relevant to the agricultural land. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Land Management Plan and modify if necessary.	• *Responses as stated in Level 1.* If it is concluded that the agricultural land has been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders if relevant. • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan.

Notes:
[1] It is noted that the management of rural structures used for agricultural and farming purposes located in the Study Area are discussed in the Built Features Management Plan (e.g. poultry sheds, greenhouses, greenhouses, hothouses, irrigation systems, and tanks), the Water Management Plan (e.g. watercourses and groundwater bores), and the separate TARP for farm dams as part of this Land Management Plan.

BIODIVERSITY MANAGEMENT PLAN TARP – BMP1 AQUATIC HABITAT AND MACROINVERTEBRATE INDICATORS (STREAM HEALTH)

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Aquatic habitat **Performance Measure** Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS[1]. **Performance Indicator** This performance measure will be considered to be triggered if subsidence impacts cannot be remediated in a manner that restores aquatic habitat. **TARP Objective** This TARP defines levels of deviation in aquatic habitat and associated stream health from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Reduction in aquatic habitat through loss of pools or associated reduction in stream health (AUSRIVAS assessment).	**Locations** • AUSRIVAS stream health sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 16, 17. • Quantitative macroinvertebrate sampling at aquatic ecology monitoring sites 7, 8, 12, 13, 14, 15, 16, 17. Refer to Figure 9 of the Biodiversity Management Plan for the location of aquatic ecology monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal conditions**		
		• Visual monitoring indicates aquatic pool habitat parameters are similar to baseline observations at aquatic ecology monitoring sites. AND • AUSRIVAS score equal to or greater than Band C.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for two consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for two consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as required for Normal Condition.* • Undertake an investigation of BACI quantitative macroinvertebrate data to assess Level 1 observations and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant (e.g. limestone cobble for pH management). • Following investigation, any declines detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation (e.g. limestone cobbles for pH management). • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for three consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for three consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the inclusion of additional sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Biodiversity Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Visual monitoring indicates reduction in aquatic pool habitat compared to baseline observations at aquatic ecology monitoring sites for four consecutive sampling occasions. OR • AUSRIVAS score of Band D recorded for four consecutive sampling occasions at one or more aquatic ecology monitoring site(s).	• *Actions as stated in Level 2.* • Increase monitoring frequency for sites where Level 3 has been reached and at corresponding reference sites, subject to land access. • Add additional monitoring sites as required. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effects unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 2.* If it is concluded that pools/aquatic habitat have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		
		• Structural integrity of the bedrock base of permanent pools or controlling rockbars in third order and above reaches of Teatree Hollow and Teatree Hollow tributary and/or pool TT2 cannot be restored e.g. pool holding capacity is not reinstated to pre-mining conditions after WCAMP completion.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Notes:
[1] EIS predictions for aquatic habitat are summarised in Table 19 of the Biodiversity Management Plan.

BIODIVERSITY MANAGEMENT PLAN TARP – BMP2 AMPHIBIAN POPULATIONS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature No performance measures relevant. **TARP Objective** This TARP defines levels of deviation in amphibian populations and habitat from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** • Decline in amphibian populations (species abundance and richness) attributed to mining effects. • The presence of a significant interaction (P-value <0.05) between Before/After and Control/Impact indicates an effect on amphibian assemblages[1,2].	**Locations** Amphibian monitoring and photo-point monitoring at all amphibian monitoring sites (sites i01-i03 and c04-c06). Refer to Figure 10 of the Biodiversity Management Plan for the location of amphibian monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates amphibian populations (richness and abundance) are stable[3] and habitat parameters are predominantly within a reasonable range of baseline data (supported by statistical analyses).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates amphibian populations (species abundance) have reduced significantly below baseline values[4].	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative monitoring data to assess the cause and determine if differences are mining related or are in the response to environmental conditions (e.g. drought) within the catchment. Cross check biodiversity monitoring data against other related environmental data (e.g. aquatic monitoring results or subsidence monitoring results) upon identification of the potential trigger. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Investigate whether any surface water TARP indicators have been triggered. • Consider and decide on reasonable and feasible options for remediation, where relevant. • Following investigation, any significant differences detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates amphibian populations (species abundance and richness) have reduced significantly below baseline values[4] over two consecutive sampling seasons that, following investigation, is attributed to mining impacts[5].	• *Actions as stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates amphibian populations (species abundance and richness) have reduced significantly below baseline values[4] over four consecutive sampling seasons that, following investigation, is attributed to mining impacts[5].	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects.	• *Response as stated in Level 2.* If it is concluded that amphibian habitat have been damaged by subsidence impacts: • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access.

Notes:

[1] Multivariate statistical analyses have been performed to test whether there is a difference between frog assemblages at future control and impact (using the baseline data). The non-significant interaction (P-value of >/= 0.05) between Control/Impact sites indicates that established future Control and Impact sites are suitable for mining and post-mining monitoring purposes, as they support similar amphibian assemblages (taxa and numbers of individuals), and similar microhabitats.

[2] Baseline amphibian surveys did not identify the presence of Red-crowned Toadlet (*Pseudophryne australis*) (listed as Vulnerable under the BC Act) or Giant Burrowing Frog (*Heleioporus australiacus*) (listed as Vulnerable under the BC Act and EPBC Act) within the LW S1A-S6A Study Area. Red-crowned Toadlet and Giant Burrowing Frog were recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A–S6A. Giant Burrowing Frog was recorded at Cow Creek, and Red-crowned Toadlet was recorded at Hornes Creek (Niche, 2018a). If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and associated TARPs are required.

[3] Stable is defined as no significant interaction between Before/After and Control/Impact indicating the mining activity has not affected amphibian assemblages (which comprises of all detected amphibian species recorded during monitoring surveys).

[4] Determined by BACI interaction analyses. Significantly below baseline values is determined to be a P-value result of less than or equal to 0.05 for Before, After, either/or Control and Impact groups. The detection of a significant interaction between Before/After and Control/Impact indicates the mining activity has an effect on amphibian assemblages. All detected amphibian species are to be recorded during monitoring surveys. The amphibian data will be subject to statistical hypothesis testing. Species richness and abundance are population metrics used to assess amphibian populations in the locality.

[5] Mining impacts results in a decline in water quantity or quality influencing habitats.

BIODIVERSITY MANAGEMENT PLAN TARP – BMP3 RIPARIAN VEGETATION

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature 1. Aquatic habitat. 2. GDEs including Thirlmere Lakes[1]. **Performance Measure** 1. Negligible environmental consequences to aquatic and riparian ecosystems beyond those predicted in the EIS[2]. 2. Negligible impacts including: • Negligible change in groundwater levels; and • Negligible change in groundwater quality. **Performance Indicator** 1. This performance measure will be considered to be triggered if subsidence impacts cannot be remediated in a manner that restores aquatic habitat. 2. The performance measure will be considered to be exceeded if the groundwater levels or groundwater quality decline below Level 3 (in the relevant groundwater TARP triggers for water level and water quality – TARP WMP8 or WMP11) following the commencement of extraction, and the investigation outcomes indicate a mining related impact based on monitoring data for riparian vegetation. **TARP Objective** This TARP defines levels of deviation in riparian vegetation condition from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Dieback and reduced condition of riparian vegetation community within the Study Area.	**Locations** Permanent floristic plots, vegetation condition assessment, photo-point monitoring and plant taxonomy at all riparian vegetation monitoring sites (sites i01-i03 and c04-c06). Refer to Figure 10 of the Biodiversity Management Plan for the location of monitoring sites. **Monitoring Frequency** **Pre-mining** Bi-annually (Spring and Autumn). **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates riparian vegetation parameters are predominantly within a reasonable range of baseline data[3], specifically that Vegetation Integrity (VI) scores are within 10% of baseline. AND • Monitoring indicates native vegetation cover (percent cover) is within a reasonable range of baseline data[4].	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates the VI score has reduced further than 10 % of average baseline score, over two consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4] over two consecutive sampling event.	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative data to assess the cause and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant. • Following investigation, any significant differences detected that are not attributable to mining impacts (e.g. are a result of environmental conditions or stochastic events) are to be considered 'normal condition' and are continued to be included in the ongoing development of the ecological monitoring dataset.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over four consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4].	• Actions as stated in Level 1. • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over six consecutive sampling event (and cannot be attributed to climatic conditions or natural attrition). AND • Monitoring indicates native vegetation cover (percent cover) has reduced significantly below baseline values[4] over six consecutive sampling events.	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency for sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Response as stated in Level 2.* If it is concluded that riparian habitat have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		
		• This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat. AND/OR • A mining related impact has occurred to riparian vegetation (Level 3 triggered of this TARP) and a Level 3 TARP trigger has occurred for groundwater levels or groundwater quality (Level 3 of TARP WMP8 or WMP11) in a corresponding location.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Notes: [1] Where groundwater – surface water connectivity indicates a gaining stream, there is potential for riparian vegetation to be supported by groundwater. Consequently, riparian vegetation in these situations could be a Groundwater Dependent Ecosystem (GDE). Discussion of findings through the Tahmoor Coal Environmental Response Group will enable linkage of this TARP to WMP12 to consider groundwater – surface water relationships when pertinent. [2] EIS predictions for riparian vegetation are summarised in Table 18 of the Biodiversity Management Plan. [3] No significant interaction between Before/After and Control/Impact indicating the mining activity has not affected riparian assemblages. [4] Determined by BACI interaction analyses. Significantly below baseline values is determined to be a P-value result of less than or equal to 0.05 for Before, After, either/or Control and Impact groups. The detection of a significant interaction between Before/After and Control/Impact indicates the mining activity has an effect on riparian assemblages.				

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Threatened species, threatened populations, or endangered ecological communities. **Performance Measures** No greater subsidence impacts or environmental consequences than predicted in the EIS[1]. Negligible impacts on threatened species, populations, or communities due to remediation of subsidence cracking. **Performance Indicator** This performance measure will be triggered if subsidence impacts cannot be remediated in a manner that restores habitat. **TARP Objective** This TARP defines levels of deviation in Shale Sandstone Transition Forest (STFF) TEC and threatened flora species from normal conditions and the actions required to be implemented in response to each level of deviation. **Assessment Criteria** Decline or significant negative change in condition class of the TEC and threatened flora species (e.g. *Pomaderris brunnea*, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *parviflora*). This TARP excludes the monitoring of threatened fauna species and habitat[2,3].	**Locations** Permanent floristic plots within the 600 m buffer study area, subject to land access. Refer to Figure 10 of the Biodiversity Management Plan for the location of monitoring sites. **Monitoring Frequency** **Pre-mining** Annually **During Mining** Bi-annually (Spring and Autumn). **Post-mining** Bi-annually (Spring and Autumn) for 12 months following the completion of LW S6A or as required in accordance with a Rehabilitation Management Plan and/or if required to monitor a corrective management action(s).	**Normal Condition**		
		• Monitoring indicates STFF TEC parameters are within a reasonable range of average baseline data (Vegetation Integrity (VI) scores are within reasonable range of baseline [within 10 %]). AND • Monitoring indicates target threatened flora species[4] numbers are stable (within reasonable range of baseline numbers).	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Monitoring indicates the VI score has reduced further than 10 % of average baseline score. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or signs dieback are evident.	• *Actions as required for Normal Condition.* • Undertake an investigation of quantitative/qualitative data to assess the cause and determine if mining related or the response to environmental conditions (e.g. drought) within the catchment. • Discuss findings and obtain other relevant information from key specialists (e.g. subsidence monitoring results, surface water monitoring results, groundwater monitoring results). • Consider and decide on reasonable and feasible options for remediation, where relevant.	• Report trigger exceedance to DPE and key stakeholders. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE and key stakeholders with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Continue monitoring to determine if a Level 2 TARP trigger will occur.
		Level 2		
		• Monitoring indicates the VI score has reduced further than 10 % of the average baseline VI score, over two consecutive sampling events. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or visual signs of dieback are continued, over two consecutive sampling seasons.	• *Actions stated in Level 1.* • Consider increasing monitoring and review of data frequency where Level 2 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area. • Review CMAs in light of findings from further investigations and consider additional reasonable and feasible options. • Review Biodiversity Management Plan and modify if necessary.	• *Responses as stated in Level 1.* • Provide findings of CMA review to DPE and key stakeholders for consultation. • Implement additional CMAs, subject to land access. • Advise DPE and key stakeholders of any required amendments to Land Management Plan. • Continue monitoring to determine if a Level 3 TARP trigger will occur.
		Level 3		
		• Monitoring indicates the VI score has reduced further than 10 % of baseline score, over four consecutive sampling event. AND/ OR • Monitoring indicates target threatened flora species[4] are in decline or visual signs of dieback are continued, over four consecutive sampling seasons.	• *Actions as stated in Level 2.* • Increase monitoring and review of data frequency to fortnightly at sites where Level 3 has been reached and at other relevant sites, subject to land access. • Consider the addition of monitoring sites within impact area, where relevant. • Undertake a detailed investigation to assess if the change in behaviour is related to mining effects (e.g. whether there has been subsidence induced fracturing, other catchment changes, effect unrelated to mining or the prevailing climate). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Response as stated in Level 2.* If it is concluded that threatened species, habitats or endangered ecological communities have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. • Implement Rehabilitation Management Plan, subject to land access. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days. • Continue monitoring to determine if an exceedance of the performance measure will occur.
		Exceeds Performance Measure		
		• Subsidence impacts cannot be remediated in a manner that restores habitat for TECs, or threatened flora.	• *Actions as stated in Level 3.* • Investigate reasons for the performance measure exceedance. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation.	• *Responses as stated in Level 3.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
Notes: [1] EIS predictions for threatened species, threatened populations and endangered ecological communities are summarised in Section 4.1 of the Biodiversity Management Plan. [2] Baseline amphibian surveys did not identify the presence of Red-crowned Toadlet (*Pseudophryne australis*) (listed as Vulnerable under the BC Act) or Giant Burrowing Frog (*Heleioporus australiacus*) (listed as Vulnerable under the BC Act and EPBC Act) within the LW S1A-S6A Study Area. Red-crowned Toadlet and Giant Burrowing Frog were recorded during the Tahmoor Amphibian Monitoring Program in 2013, outside the Study Area for LW S1A–S6A. Giant Burrowing Frog was recorded at Cow Creek, and Red-crowned Toadlet was recorded at Hornes Creek (Niche, 2018a). If recorded in the future during amphibian monitoring, the presence of threatened frog species would be reported, and further investigations will be initiated to determine ongoing presence of threatened species in the locality and assess whether updates to the BMP and associated TARPs are required. [3] During the 2020 biodiversity surveys, there were 11 threatened fauna species encountered within the LW S1A-S6A Study Area (Niche 2020). Potential habitat for these species within the Tahmoor South EIS Project Area, includes riparian hollow-bearing trees, potential overhangs (only two cliff lines are being monitored within the project area), and disused buildings. No caves were encountered during surveys completed by Niche, nor have any caves been reported by MSEC (2018). Furthermore, cliff line environments which may indicate cave-like habitat, are generally limited to the Nepean River to the north of the Study Area with some scattered cliff lines along the Dogtrap Creek, and Hornes Creek. Given the cliffs are located outside the predicted limit of subsidence as a result of the extraction of LW S1A-S6A, the probability that cave roosting habitat would be impacted is very low. Furthermore, no hollow-bearing trees, bridges or culverts within the Study Area that provide roosting habitat for threatened bats are likely to be substantially impacted by subsidence. As such, roosting habitat for threatened microbats is unlikely to be impacted by the extraction of LW S1A-S6A. Subsidence is unlikely to affect any resources or habitat features on which these species depend such that it would result in any measurable changes to their breeding or foraging behaviour or habitat. Further, individuals have not been incidentally encountered during other baseline monitoring surveys (irregular occurrence in the study area). Therefore, as these threatened fauna species are considered highly mobile (consisting of bats and birds) and the species (and habitat) is considered unlikely to be impacted by mining practices, they have not been addressed further in the biodiversity TARPs.[4] Threatened flora species monitored are *Pomaderris brunnea*, *Persoonia bargoensis* and *Grevillea parviflora* subsp. *Parviflora*.				

HERITAGE MANAGEMENT PLAN TARP – HMP1 ABORIGINAL CULTURAL HERITAGE SITES

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Aboriginal cultural heritage sites (listed in Appendix 4 of SSD 8445). **Performance Measure** No greater subsidence impacts or loss of heritage values than predicted in the EIS[1]. **Performance Indicator** **Open camp site (Remembrance Drive 2013.1) and Isolated find (TC14-2-19)** No performance indicators are currently established as impacts are predicted to be negligible[2]. **Rockshelter with art and deposit (Teatree Hollow 2013.1)** This performance measure will be considered to be triggered if more than 10% of rockshelters (i.e. more than two) in the Tahmoor South Domain (including A and B series longwalls) are impacted by: • subsidence monitoring identifies obvious perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and • these subsidence impacts result in impacts to the heritage values of the site, e.g. cracking, spalling or collapse of the art work panels that result in damage or loss of the art. This performance measure cannot be exceeded during the extraction of the A series longwalls, even if the above-mentioned performance indicators are fully triggered for Teatree Hollow 2013.1. Such impacts would not exceed the 10% threshold of impacts to the 19 total rockshelters in the longwalls A and B Study Area. **TARP Objective** This TARP defines levels of impacts to Aboriginal cultural heritage values from existing conditions identified at the time of their discovery, to indicators that subsidence impacts have or may occur, to indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of impact or exceedance of the performance measure. **Assessment Criteria** Discussion of performance measure indicators and their definitions is provided in Section 4.1.2 and Section 5.1 of the Heritage Management Plan.	**Locations** Teatree Hollow 2013.1. Location shown in Figure 3 of the Heritage Management Plan. Monitoring of stone artefact sites Remembrance Drive 2013.1 and TC14-2-19 is not required as impacts are not anticipated. **Monitoring Frequency** **Pre-mining** • Visual inspection by archaeologist with RAPs (completed). • Baseline recording, sampling and photogrammetry (completed). • Structural geotechnical review prior to secondary workings. **During Mining** • Fortnightly visual inspection of the rockshelter (monitoring overall rockshelter stability) during periods of active subsidence for LW S1A, S2A, S3A and S4A, to be completed from a safe distance. • Monitoring of GNSS units / survey lines in proximity to the rockshelter (refer to Subsidence Monitoring Plan for more detail), reviewed on a monthly basis during periods of active subsidence for LW S1A, S2A, S3A and S4A. **Post-mining** • Visual inspection by archaeologist with RAPs at the completion of LW S1A, S2A, S3A and S4A.	**Normal Condition**		
		• Aboriginal heritage site monitoring indicates no detectable environmental consequences.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Aboriginal heritage site monitoring indicates potential detectable environmental consequences, but with negligible impacts to the heritage value of Teatree Hollow 2013.1[3].	• *Actions as required for Normal Condition.* • An archaeologist to inspect the rock shelter within the area of potential impact and confirm Level 1 trigger is correct and that art panels have not been affected. • Detailed photographic recording of any damage to be documented and marked on the shelter base plan. • Undertake an investigation to assess cause and determine if mining related. • Consider and decide on reasonable and feasible options for remediation as relevant which could form corrective management actions (CMAs) in consultation with an archaeologist and RAPs. Engage specialists where relevant to address impact types (e.g consult an engineer to discuss management of rockfall or toppling of shelter). • Consider increasing monitoring and review of data frequency if it is determined that the shelter structural stability or art panels are at an increased risk of impact from the Level 1 trigger event, subject to land access. • Review Heritage Management Plan and modify if necessary.	• Report trigger exceedance to DPE and key stakeholders. • Notify RAPs within seven days of the event and co-ordinate a site inspection with at least one RAP representative. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review. • Provide DPE, RAPs, and Heritage NSW with proposed corrective management actions (CMAs) for consultation (e.g. structural support for shelter or additional measures for art panels in response to level of increased risk of impacts). • Consider the development of a Rehabilitation Management Plan, and/or an update to the Heritage Management Plan in consultation with DPE, Heritage NSW and RAPs and key stakeholders (e.g. if additional mitigation or alternative methods not covered in the Heritage Management Plan are proposed). • Implement CMAs. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • Advise DPE and key stakeholders of any required amendments to Heritage Management Plan.
		Level 2		
		• Aboriginal heritage site monitoring indicates environmental consequences to Teatree Hollow 2013.1[4].	• *Actions as stated in Level 1.* • Increase monitoring and review of data frequency for sites where Level 2 has been reached at Teatree Hollow 2013.1, subject to land access • Investigate exceedance of subsidence prediction. • Review mine design/predictions against mine criteria.	• *Responses as stated in Level 1.* If it is concluded that heritage items have been damaged by subsidence impacts: • Offer site visit with DPE and key stakeholders. • Develop a Rehabilitation Management Plan in consultation with DPE and key stakeholders. Developed CMAs are to be incorporated into this plan. • Implement Rehabilitation Management Plan, subject to land access.

Notes:
[1] EIS predictions for aboriginal cultural heritage sites summarised in Section 4.1 of the Heritage Management Plan.
[2] Subsidence movements are not expected to have observable effects on these two sites as they are located in open terrain with a very gently sloping gradient. The predicted likelihood of impact on artefact sites is considered extremely unlikely and subsidence movements are unlikely to constitute 'harm' as defined by the NPW Act. As such, these sites will not be monitored and therefore performance measures cannot be established.
[3] Visible perceptible change, such as rockfall, cracking, or toppling within the rockshelter similar to naturally caused examples and which does not impact the art panels.
[4] Visible perceptible change that results in impacts to the heritage values of the site, such as cracking, spalling or collapse of the art work panels that result in damage or loss of the art.

HERITAGE MANAGEMENT PLAN TARP – HMP2 HISTORICAL HERITAGE ITEMS

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	**Action**	**Response**
Performance Measure Feature Historic heritage sites (listed in Appendix 4 of SSD 8445). **Performance Measure** No greater subsidence impacts or loss of heritage values than predicted in the EIS[1]. **Performance Indicator** This performance measure will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historical heritage items (Wirrimbirra Sanctuary, Bargo Cemetery, Bargo Railway Bridge North, Picton Weir, Tahmoor Mine Site, Bargo Railway Viaduct, Great Southern Road (partial)). **TARP Objective** This TARP defines levels of impacts to historic heritage sites from existing conditions identified at the time of their recording as part of the project EIS, to indicators that subsidence impacts have or may occur, to indicators of exceedance of the performance measure and the actions required to be implemented in response to each level of impact or exceedance of the performance measure. **Assessment Criteria** The historic heritage values related to each site are based on significance assessment criteria adopted as part of the EIS for the project (Niche 2012). TARP assesses impacts in relation to the historically significant values of each heritage item. The significance of each item is summarised in Table 12 of the Heritage Management Plan.	**Locations** • Wirrimbirra Sanctuary (Australian Wildlife Sanctuary). • Bargo Cemetery. • Bargo Railway Bridge North (Wellers Road Overbridge). • Picton Weir. • Tahmoor Colliery (Tahmoor Mine Site). • Bargo Railway Viaduct. • Great Southern Road (partial). Locations of historical heritage items are shown in Figure 4 of the Heritage Management Plan. **Monitoring Frequency** **Wirrimbirra Sanctuary** Pre-mining: • Visual assessment by a heritage consultant as part of SoHI (completed). • Pre-mining condition and structural assessment as per the Australian Wildlife Sanctuary Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Australian Wildlife Sanctuary Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of LW S5A. • Inspections and assessments as per the Australian Wildlife Sanctuary Management Plan. **Bargo Cemetery** Pre-mining: • Baseline recording and visual assessment by heritage consultant (completed, see Appendix D). • Pre-mining assessments as per the Bargo Cemetery Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Bargo Cemetery Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S6A. • Inspections and assessments as per the Bargo Cemetery Management Plan. **Bargo Railway Bridge North** Pre-mining: • Visual assessment by a heritage consultant. • Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Main Southern Railway Management Plan. Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S6A. • Inspections and assessments as per the Main Southern Railway Management Plan. **Picton Weir** Pre-mining: • Pre-mining condition and structural assessment as per the Picton Weir Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Picton Weir Management Plan. Post-mining: Inspections and assessments as per the Picton Weir Management Plan. **Tahmoor Colliery** Pre-mining: • Pre-mining condition and structural assessment as per the Tahmoor Mine Site Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Tahmoor Mine Site Management Plan. Post-mining: Inspections and assessments as per the Tahmoor Mine Site Management Plan. **Great Southern Road (partial)** Pre-mining: Pre-mining condition as per the Wollondilly Shire Council Management Plan. During mining: Regular monitoring as per the Wollondilly Shire Council Management Plan. Post-mining: Inspections and assessments as per the Wollondilly Shire Council Management Plan. **Bargo Railway Viaduct** Pre-mining: • Visual assessment by a heritage consultant. • Pre-mining condition and structural assessment as per the Main Southern Railway Management Plan. • Install monitoring system as per the Subsidence Monitoring Plan. During mining: Regular monitoring as per the Main Southern Railway Management Plan.	**Normal Condition**		
		• Historical heritage site monitoring indicates no detectable environmental consequences.	• Continue monitoring and review of data as per monitoring program.	• No response required.
		Level 1		
		• Historical heritage site monitoring indicates potential detectable environmental consequences, but with negligible impacts to the heritage value of the heritage site(s).	• *Actions as required for Normal Condition.* • Co-ordinate a site inspection with a structural engineer. • Consult with a qualified archaeologist or heritage architect to determine whether impacts to heritage sites have occurred. • Consider increasing monitoring and review of data frequency for sites subject to a Level 1 trigger event, subject to land access. • Detailed photographic recording of any damage to be documented. • Erect warning signs and restrict access to areas where necessary.	• Report trigger exceedance to DPE and Heritage NSW. • Report trigger exceedance and investigation outcomes in Six Monthly Subsidence Impact Report and Annual Review.
		Level 2		
		• Historical heritage site monitoring indicates environmental consequences to heritage site(s) but to a level that could be repaired in a manner that preserves the heritage value of the site(s).	• *Actions as stated in Level 1.* • Consider and decide on reasonable and feasible options for remediation as relevant which could form corrective management actions (CMAs) that would result in the repair of the item to a level that preserves the heritage value of the site(s). • Increase monitoring and review of data frequency for sites subject to a Level 2 trigger event, subject to land access. • Review Heritage Management Plan and modify if necessary. • Investigate exceedance of subsidence prediction. • Review mine design/predictions against mine criteria (e.g. for Picton Weir – review environmental consequences after extraction of LW S5A and determine if LW S6A should be shortened). • Undertake an investigation to determine if an exceedance of the performance measure is likely.	• *Responses as stated in Level 1.* • Advise DPE and key stakeholders of any required amendments to Heritage Management Plan. If it is concluded that heritage items have been damaged by subsidence impacts: • Offer site visit with DPE and Heritage NSW. • Provide DPE and Heritage NSW with proposed corrective management actions (CMAs) for consultation. • Implement CMAs, subject to land access. • Monitor and report on success of CMAs in Six Monthly Subsidence Impact Report and Annual Review. • If relevant, notify DAWE of any predictions of an exceedance of a performance measure within two business days.
		Exceeds Performance Measure		
		• This performance measure will be considered to be triggered if subsidence impacts cannot be repaired in a manner that preserves the heritage value of the historic heritage item.	• *Actions as stated in Level 2.* • Investigate reasons for the performance measure exceedance. • Engage heritage specialist to determine if impacts to the heritage values of the site are irreparable even after reasonable remediation attempts have been made under the TARP. • Review predictions of subsidence impacts and environmental consequences associated with further longwall extraction based on the outcomes of the investigation. • Consider modifying mine plan.	• *Responses as stated in Level 2.* • Submit a report to DPE (in accordance with Condition E4 of SSD 8445) within 14 days of the exceedance occurring (or other timeframe agreed by DPE). • Implement reasonable remediation measures as directed by DPE, subject to land access. • Notify DAWE of any detection or predictions of an exceedance of a performance measure within two business days. • Submit an Impact Response Plan to DAWE (in accordance with Condition 11 of the DAWE Consent for the Tahmoor South Project).

Performance Measure and Indicator, TARP Objective and Assessment Criteria	Monitoring Program	Management		
		Trigger	Action	Response
	Post-mining: • Visual inspection by a heritage consultant at the completion of Longwalls LW S6A. • Inspections and assessments as per the Main Southern Railway Management Plan.			
Notes: [1] EIS predictions for historical heritage sites summarised in Section 4.2 of the Heritage Management Plan.				

APPENDIX C – Letters of Consultation

CONSULTATION MEETING MINUTES

Meeting	:	NSW Department of Planning, Industry and Environment (DPIE) & Tahmoor Coal Discussion of the Tahmoor South LW South 1A to South 6A Extraction Plan
Location	:	Teleconference
Date	:	20 December 2021
Time	:	3:30 pm – 4:30 pm
Attendees:	:	Jessie Evans (JE) – DPIE Gabrielle Allan (GA) - DPIE Zina Ainsworth (ZA) - Tahmoor Coal Charlie Wheatley (CW) – Tahmoor Coal April Hudson (AH) - Tahmoor Coal

Item	Summary of Discussions and Comments	Actions
1	**Point of Contact** » GA noted that Jessie Evans is taking over as point of contact for Tahmoor Coal from Stephen O'Donoghue.	None.
2	**Aboriginal heritage item** » GA asked how the proposed impact to the Aboriginal heritage item (AHIMS Site #52-2-4471, rockshelter) compares to the performance measures. » ZA advised that this would be addressed in the Heritage Management Plan as part of the Extraction Plan. » AH noted that the EIS assessment found that the rockshelter was associated with low research potential, representative-ness, rarity and significance from a heritage perspective. The assessment also noted that there may be indirect harm and a partial loss of value.	None.
3	**Infrastructure Management** » GA interested in management of the petrol station during subsidence. » CW noted that petrol stations have been successfully undermined by previous longwalls at Tahmoor Mine. A management plan for this property will be prepared to manage impacts from subsidence.	None.
4	**Structures Management** » GA enquired how many landowners are above the A longwall series. » CW noted that the number is less than that for the B longwall series and most are situated along Caloola Road and nearby streets. » ZA noted that consultation with all residents within the Study Area has started, including the provision of the resident information packs, and offering of Pre-Mining Inspections for those residents within the 20 mm subsidence contour for the first few longwalls. » ZA noted that the next round of landholder consultation will be provided early 2022.	None.
5	**Agency Meeting and Site Visit** » DPIE advised that a meeting with DPIE and other government agencies should coincide with lodgement of the Extraction Plan. » The meeting should be an overview only to prepare agencies for their review of the Extraction Plan. A site visit should also be included.	Tahmoor Coal and GA to coordinate agency meeting (early March 2022).

	» Tahmoor Coal to liaise with GA to set up this meeting and site visit at the time of lodgement of the Extraction Plan.	
6	Independent Advisory Panel for Underground Mining » CW asked at what stage will a decision be made regarding the involvement of IAPUM for the assessment of the LW S1A-S6A Extraction Plan. » JE advised that there are no set criteria to determine their involvement, and the decision is made once government agency comments are received and reviewed.	None.
7	Longwall West 4 Amendment » Tahmoor Coal noted that the start position of Longwall West 4 (LW W4) would be moved south, resulting in a reduced longwall length. An amendment report for this change will be provided to DPIE for approval. » GA acknowledged and noted that evidence to support less impacts should be provided. » GA also requested that all infrastructure owners / operators be informed prior to submission of the amendment report.	Tahmoor Coal to notify all infrastructure owners / operators prior to submission of amendment report.
8	Assessment of Management Plans » CW advised that the over-arching / site-wide management plans provided to DPIE will require approval prior to the commencement of construction (March 2022). » JE noted that most management plans have gone to the post-approval team and will be prioritised according to this deadline.	None.

22 November 2021

Jessie Evans
Director – Resource Assessments
NSW Department of Planning, Industry and Environment
Locked Bag 5022
Parramatta 2124

Emailed to:
Jessie.Evans@planning.nsw.gov.au
Gabrielle.allan@dpie.nsw.gov.au

Dear Jessie,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

Tahmoor Mine has been operating continuously since 1979, and longwall mining methods have been used since 1987. Tahmoor Coal has previously mined 34 longwalls to the north and west of the Tahmoor Mine's current pit top location.

Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

Tahmoor Coal is currently preparing an Extraction Plan for Longwalls South 1A to South 6A (LW S1A-S6A) in accordance with the condition C8 of the Development Consent (SSD 8445). The attached figure illustrates the location of the proposed longwalls, as well as the Study Area of this Extraction Plan and the predicted 20 mm subsidence contour.

The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

The Extraction Plan will be supported by the following key documents:

- Subsidence Prediction and Impact Assessment Report;
- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan;
- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

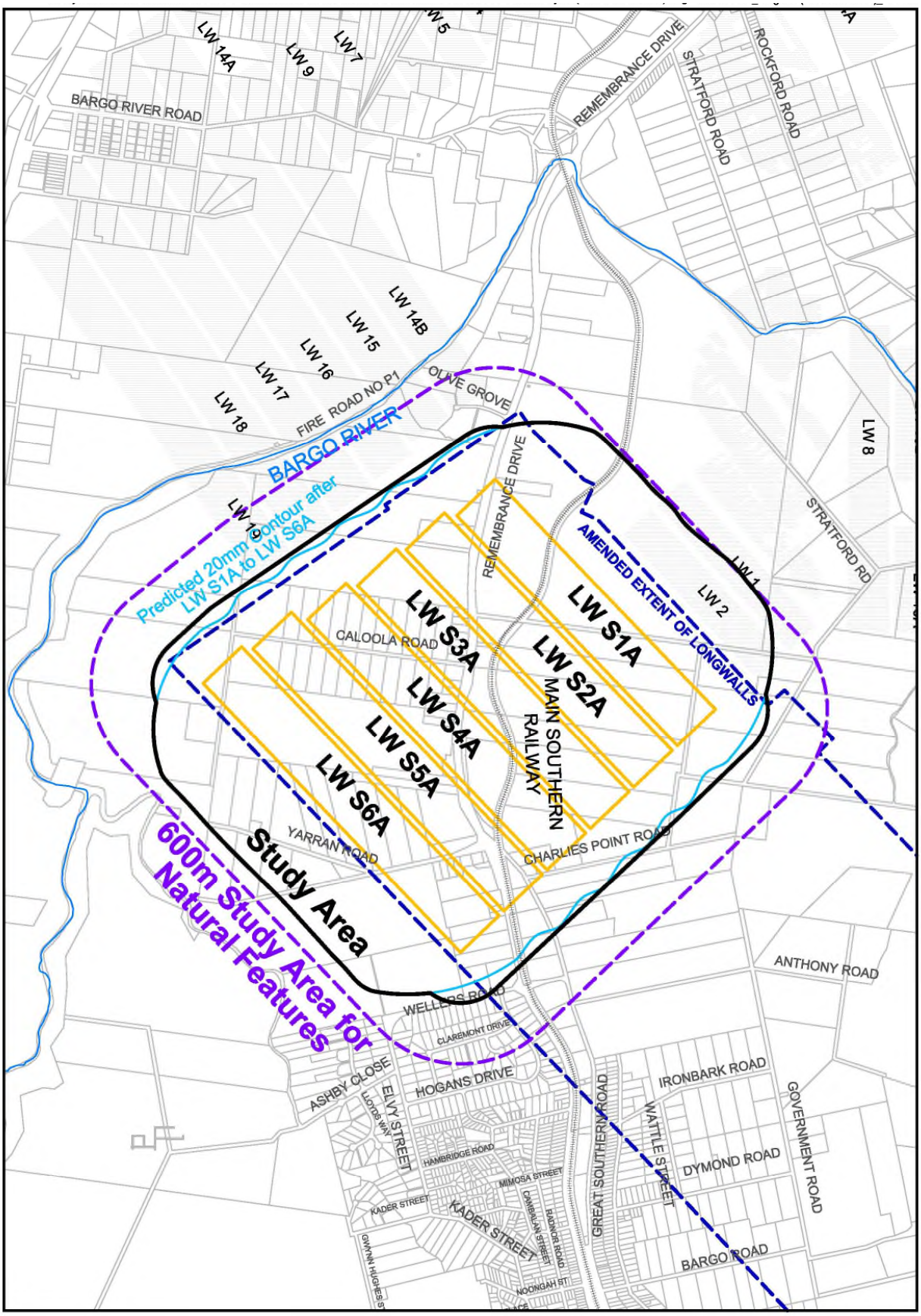
Tahmoor Coal notes that a presentation was provided to DPIE Planning regarding the LW S1A-S6A Extraction Plan on 20 December 2021. If you have any further comments on the proposed Extraction Plan, we would appreciate receiving your addition comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

Planning, Industry & Environment

Ms Zina Ainsworth
Manager Environment and Community
Tahmoor Coal – SIMEC Mining
PO Box 100
TAHMOOR New South Wales 2573

26/11/2021

Dear Ms Ainsworth

Tahmoor South Coal Project (SSD 8445)
Extraction Plan - Endorsement of experts

I refer to your request (SSD-8445-PA-12) for the Secretary's approval of suitably qualified persons to prepare the Longwalls 101A – 106A Extraction Plan for the Tahmoor South Coal Project (SSD-8445) as required under condition C8(a) of Schedule 4.

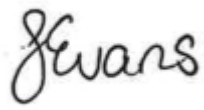
The Department has reviewed the nominations and information you have provided and is satisfied that these persons are suitably qualified and experienced. Consequently, I can advise that the Secretary approves the appointment of the following to prepare the Extraction Plan:

Extraction Plan Component	Person	Company
Main Document and Public Safety Management Plan	• Zina Ainsworth, Environment & Community Manager • April Hudson, Approvals Specialist	• Tahmoor Coal
Subsidence Predictions and Impact Assessment Report, Built Features Management Plan and associated infrastructure management plans, and Subsidence Monitoring Program	• Daryl Kay, Subsidence Specialist	• MSEC
Water Management Plan	• Anthony Marszalek, Water Resources Engineer • Camilla West, Water Resources Scientist	• HEC/ATC Williams
Supporting groundwater documents for the Water Management Plan	• Sharon Hulbert, Hydrogeologist • Maxime Philbert, Hydrogeologist • Will Minchin, Hydrogeologist	• SLR • SLR • Watershed Hydrogeo
Land management plan and supporting documents	• Roderick Haselden, Engineering Geologist • Sean Little, Geologist	• Douglas Partners
Biodiversity Management Plan	• Matthew Russell, Aquatic Ecologist • Jessie Bear, Ecologist • Sian Griffiths, Ecologist	• Niche Environment and Heritage
Heritage Management Plan	• Susan Lampart,	• EMM Consulting

	Archaeologist • Ryan Desic, Archaeologist • Anthony Dakhoul, Heritage Consultant • Pamela Chauvel, Archaeologist	
Graphical Plans	Zachary Burley, Lead Surveyor	Tahmoor Coal

If you wish to discuss the matter further, please contact me on jessie.evans@dpie.nsw.gov.au.

Yours sincerely



Jessie Evans
Director
Resource Assessments

As nominee of the Secretary

CONSULTATION MEETING MINUTES

Meeting	:	NSW Department of Planning, Industry and Environment (DPIE) & Tahmoor Coal Discussion of the Tahmoor South LW South 1A to South 6A Extraction Plan
Location	:	Teleconference
Date	:	10 February 2022
Time	:	4:00 – 4:30 pm
Attendees	:	Jessie Evans (JE) – DPIE Gabrielle Allan (GA) – DPIE Peter Vale (PV) – Tahmoor Coal Zina Ainsworth (ZA) – Tahmoor Coal Charlie Wheatley (CW) – Tahmoor Coal April Hudson (AH) – Tahmoor Coal
Apologies	:	Clay Preshaw – DPIE Stephen O'Donoghue - DPIE

Item	Summary of Discussions and Comments	Actions
1	**Point of Contact** » JE: Jessie Evans taking lead on assessment going forward.	None.
2	**Proposed assessment** » JE: Six longwalls of approximately four years for the Extraction Plan assessment has been done previously, and ok to proceed. » JE: Statutory requirement is three months for the assessment of an Extraction Plan. More time is preferable.	None.
3	**Independent Advisory Panel for Underground Mining** » JE: Extraction Plans over the last 5 years are getting more complex, as well as underground mining in general, hence the introduction of IAPUM. TARPs are key. » JE: IAPUM is likely to be involved, however will depend on agency advice and DPIE ability / expertise to deal with the matter. IAPUM focus can be broad or narrow, depending on the issues at hand. » CW: If it more likely that IAPUM will be involved, can they be involved earlier on? JE: No value in having them involved prior to the submission of the Extraction Plan. The Department can brief them earlier. It is an evolving space as to when to involve them. IAPUM receive all the agency advice and DPIE briefing.	None.
4	**Extraction Plan key considerations** » Key considerations: o Do the predictions meet the Performance Measures o Details of the TARPs o Sufficient and robust baseline monitoring o Adaptive management planning. Approval will depend on surface features and adaptive management proposed.	None.
5	**Wirrimbirra / Australian Wildlife Sanctuary** » JE: How will Wirrimbirra be covered? AH: A separate management plan will be prepared, and submitted prior to start of Longwall South 1A. ZA: We have a good relationship with Wirrimbirra / National Trust and have a Land Access Agreement in place.	None.

6	**Lodgement of the Extraction Plan** » Suggestion of a one hour briefing around the time of lodgement of the Extraction Plan.	None.

22 November 2021

Fabienne Boudoux d'Hautefeuille
Manager – Water Assessments
NSW Department of Planning, Industry and Environment
Locked Bag 5022
Parramatta NSW 2124

Emailed to:
fabienne.d'hautefeuille@dpie.nsw.gov.au
water.enquiries@industry.nsw.gov.au

Dear Fabienne,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

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The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

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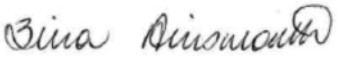
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- Land Management Plan;
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- Heritage Management Plan;
- Built Features Management Plan;
- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

Tahmoor Coal would like to consult with DPIE Water regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of surface water and groundwater resources in the Study Area, which would be considered in the LW S1A-S6A Water Management Plan.

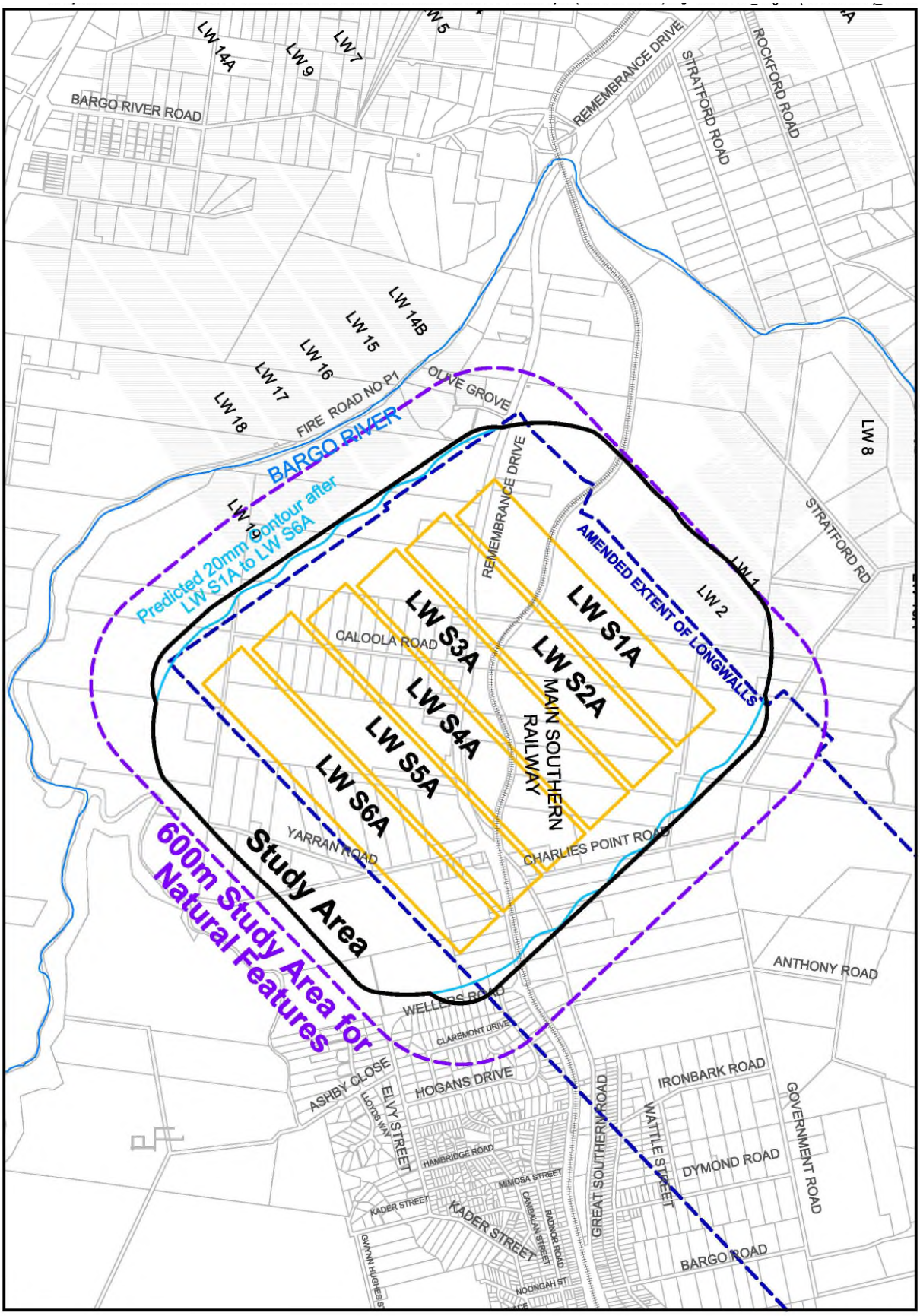
We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.** If required, we can also arrange a teleconference to discuss this matter with you further.

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Liz Rogers <liz.rogers@dpie.nsw.gov.au>
Sent: Tuesday, 1 March 2022 2:30 PM
To: April Hudson; Fabienne Boudoux d'Hautefeuille
Cc: Zina Ainsworth; DPIE Water Assessments Mailbox
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi April, we will not be providing any preliminary comments but will wait until we receive the submission via the portal.

We currently have a request for advice for Tahmoor South's Groundwater Management Plan as well as a request for comments on the Tahmoor South Water Management Plan and will be expecting a submission of the extraction plan. It would really help us if we understood how all these plans relate to each other and where you expect the detail to sit or which ones might be more of an overview. Are you able to advise or provide a contact?

Thanks Liz

Liz Rogers
Manager Assessments

Water Group | Department of Planning and Environment
| **M** 0428 600 421 | **E** liz.rogers@dpie.nsw.gov.au
Prince Street, Locked Bag 21, Orange NSW 2800
www.dpie.nsw.gov.au

Our Vision: Together, we create thriving environments, communities and economies.

I live and work on Wiradjuri Country

NSW GOVERNMENT

The Department of Planning and Environment acknowledges that it stands on Aboriginal land.
We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Monday, 28 February 2022 5:14 PM
To: Fabienne Boudoux d'Hautefeuille <fabienne.d'hautefeuille@dpie.nsw.gov.au>; Liz Rogers <liz.rogers@dpie.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; DPIE Water Assessments Mailbox <water.assessments@dpie.nsw.gov.au>
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi again Fabienne and Liz,

Just to clarify a previous mistake – we are preliminary comments for the preparation of the Longwall South 1A to South 6A Extraction Plan.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com







From: April Hudson
Sent: Monday, 28 February 2022 5:09 PM
To: Fabienne Boudoux d'Hautefeuille <fabienne.d'hautefeuille@dpie.nsw.gov.au>; Liz Rogers <liz.rogers@dpie.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; water.assessments@dpie.nsw.gov.au
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi Fabienne and Liz,

Tahmoor Coal is following up if your organisation has any preliminary comments for the preparation of the Longwall West 3 and West 4 Extraction Plan.
Otherwise, we will be happy to receive your detailed comments following the submission of the Extraction Plan documents and presentation by Tahmoor Coal.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140

E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

From: April Hudson
Sent: Tuesday, 18 January 2022 2:08 PM
To: Fabienne Boudoux d'Hautefeuille <fabienne.d'hautefeuille@dpie.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; Liz Rogers <liz.rogers@dpie.nsw.gov.au>; water.assessments@dpie.nsw.gov.au
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi Fabienne and Liz,

Thank you for your response. This stage of consultation (preliminary only) is to obtain any overview comments from your department for consideration during the Extraction Plan writing stage (e.g. items to pay particular attention to, conditions / requirements to ensure that we cover off on).

Following the submission of the Extraction Plan documents to DPIE, all documents will be provided to relevant Government Agencies (e.g. DPIE-Water and NRAR) by DPIE for detailed comments and consideration as per the DPIE process for the assessment of Extraction Plans. Tahmoor Coal will also provide a presentation on the Extraction Plan to DPIE and interested Government Agencies, as well as facilitating an optional field visit. This presentation will most likely be held just prior to submission of the Extraction Plan documents.

The documents that you have listed in your response are over-arching management plans for the Tahmoor South Domain and mine site operations. The Extraction Plan documents will draw information from these over-arching management plans where relevant to the six proposed longwalls, as well as providing more in-depth information regarding monitoring and management for the longwalls in question.

Please let me know if you have any further questions or comments.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com







From: Fabienne Boudoux d'Hautefeuille <fabienne.d'hautefeuille@dpie.nsw.gov.au>
Sent: Monday, 10 January 2022 2:34 PM
To: April Hudson <April.Hudson@simecgfg.com>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; Liz Rogers <liz.rogers@dpie.nsw.gov.au>
Subject: Re: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Some people who received this message don't often get email from fabienne.d'hautefeuille@dpie.nsw.gov.au. Learn why this is important

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello April,

Thank you for your letter. I tried to call, I have not left a message. Your letter refers to the preparation of extraction plan for LW south1A and South 6A. Neither DPIE Water, nor NRAR have received any documentation on such a draft document, I am wondering how you are suggesting we would provide preliminary comments. Ideally, we would require a document to base our comments on. An alternative could be a discussion with a presentation from you and possibly an exploration on how what you propose will meet the conditions of approvals and comments the Department would have made during the approval process.

Note that we have the following documents with us for comments:

- Tahmoor South Coal- GW Management Plan
- Tahmoor South Coal Project - Tahmoor South Water Management Plan (SSD-8445-PA-15)
- Tahmoor South Coal Project - Tahmoor South Surface water Management Plan (SSD-8445-PA-16)

How would the above documents fit with the extraction plans documents?

While my team, is the team where the hydrogeological advice comes from, Liz Rogers' team is the team who now coordinates the SSDs within DPIE Water and NRAR. I know it is not necessarily straight forward to know who to contact, but you got there! Please include Liz to our communications.

Please let me know how you would like to proceed.

Regards,

Fabienne

Fabienne d'Hautefeuille
Manager Groundwater Management and Science - Water Knowledge

Water Division | Department of Planning, Industry and Environment
M 0447 432 816 | **E** fabienne.d'hautefeuille@dpie.nsw.gov.au
Level 30, 4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150
www.dpie.nsw.gov.au

Our Vision: Together, we create thriving environments, communities and economies.



The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Wednesday, 22 December 2021 6:18 PM
To: Fabienne Boudoux d'Hautefeuille <fabienne.d'hautefeuille@dpie.nsw.gov.au>; water.enquiries@industry.nsw.gov.au <water.enquiries@industry.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Dear Fabienne,

Please see attached a letter regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992

F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

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Any opinions contained in this message are those of the author and are not provided or endorsed by ourselves unless clearly indicated and the authority or the author to so bind is duly verified.

Department of Planning and Environment

Zina Ainsworth

Email: zina.ainsworth@simecgfg.com

Contact: DPE Water Assessments

Email: water.assessments@dpie.nsw.gov.au

Our ref: OUT22/401

19 January 2022

Dear Ms Ainsworth

Re: Tahmoor South Surface Water Management Plan (SSD-8445-PA-16)

I refer to your request of 14 December 2021 to the Department of Planning and Environment (DPE) Water about the above matter.

The Department of Planning and Environment – Surface Water Science recommends the following:

1. A copy of the Fluvial Systems geomorphological survey and report on stream condition should be made available to DPE Water and a copy held on site for reference.
2. A record of pre- and post- subsidence state of key rock bars and pools should be maintained for review of impact predictions reporting.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments at water.assessments@dpie.nsw.gov.au.

Yours sincerely,



Liz Rogers

Manager, Assessments, Knowledge Division

Department of Planning and Environment: Water

22 November 2021

Liza Schaeper
Senior Team Leader, Ecosystems and Threatened Species, Greater Sydney
NSW Department of Planning, Industry & Environment – Environment, Energy & Science
Locked Bag 5022
Parramatta NSW 2124

Emailed to:
liza.schaeper@environment.nsw.gov.au
martin.krogh@environment.nsw.gov.au
meagan.hinds@environment.nsw.gov.au

Dear Liza,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

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Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

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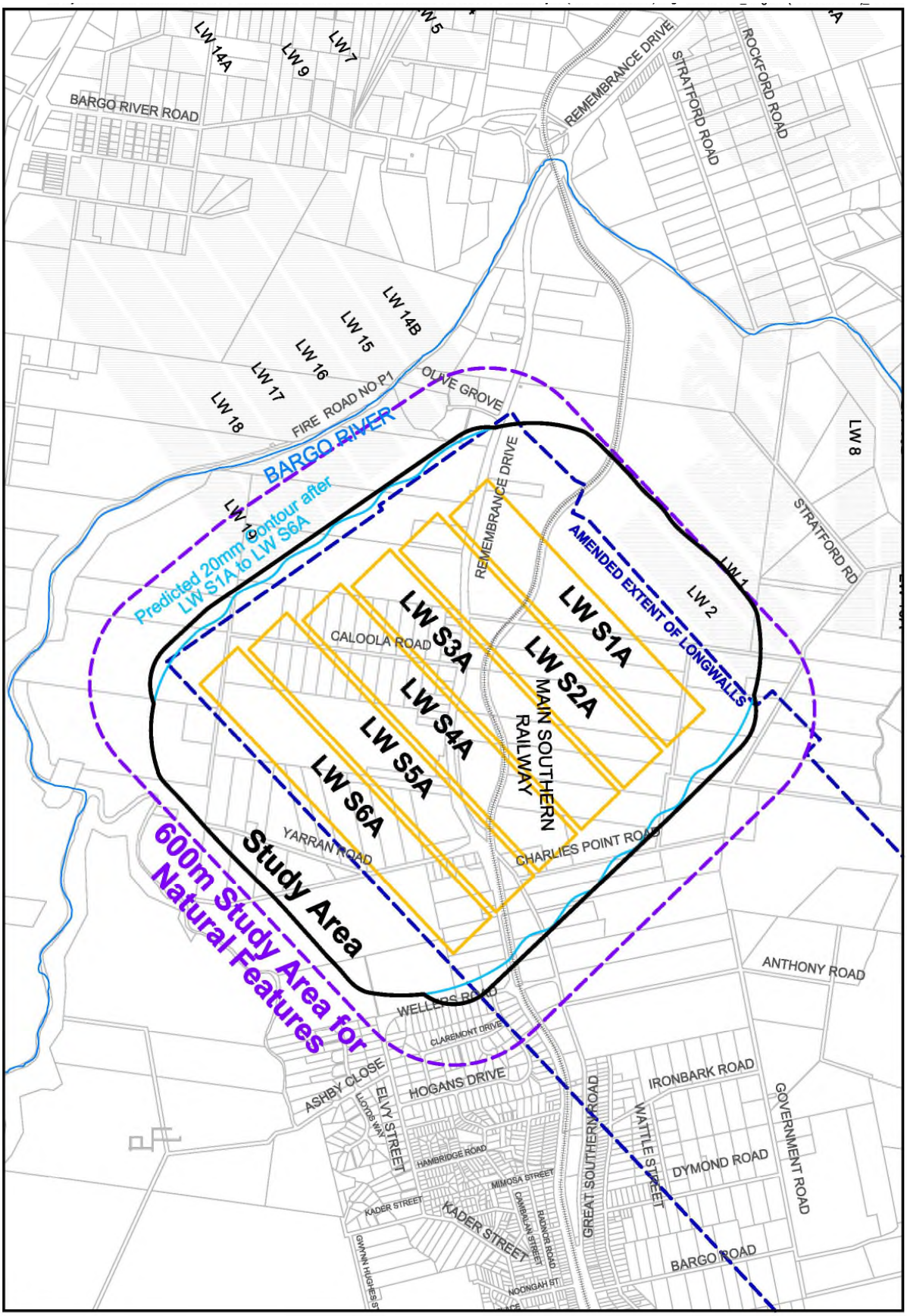
Tahmoor Coal would like to consult with DPIE Environment, Energy and Science Group regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of water resources and biodiversity items in the Study Area, which would be considered in the LW S1A-S6A Water Management Plan and the LW S1A-S6A Biodiversity Management Plan.

We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 20221.** If required, we can also arrange a teleconference to discuss this matter with you further.

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

Department of Planning and Environment

Our reference: DOC22/67868
Contact: Meagan Hinds
9585 6825
03-02-2022

April Hudson
Approvals Specialist
SIMEC Mining
April.Hudson@simecgfg.com

Dear April,

Re: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation.

I am writing in response to your email dated 22 December seeking comment on Tahmoor Coal's extraction plan currently in preparation for Longwalls South 1A to South 6A. I understand that this referral is to meet the consultation requirement with the Environment, Energy and Science Group during the development of this plan.

It is recommended that consideration be given to: subsidence impacts to Horne Creek which currently has good water quality and feeds into the Bargo River near Picton Weir and the re-opening of fractures in the Bargo River caused by extraction of longwalls 14 – 19 (grey shaded area in the supplied figure and mapped by MSEC). In both instances, this will require an appropriate water monitoring program and a clear commitment to undertake the necessary remediation actions, should impacts occur.

In addition, it suggested that an update is provided on the progress of the remediation of Myrtle and Redbank Creek which outlines the outcomes of an inspection of Redbank Creek remediation works and data that demonstrates 'success' of this work.

I will continue to co-ordinate the Divisions' review of the completed plans and when ready please forward them to me via email at liza.Schaeper@environment.nsw.gov.au.

Yours sincerely

Liza Schaeper

Liza Schaeper
Senior Team Leader
Ecosystems and Threatened Species, Greater Sydney

Locked Bag 5022 Parramatta NSW 2124
Parramatta Square 12 Darcy St Parramatta NSW 2150
Tel: (02) 9895 6211
ABN 30 841 387 271
www.environment.nsw.gov.au

22 November 2021

Crown Lands Division
NSW Department of Planning, Industry and Environment
PO Box 2155
Dangar NSW 2309

Emailed to:
cl.enquiries@crownland.nsw.gov.au

To whom it may concern,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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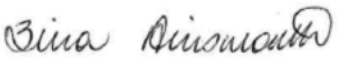
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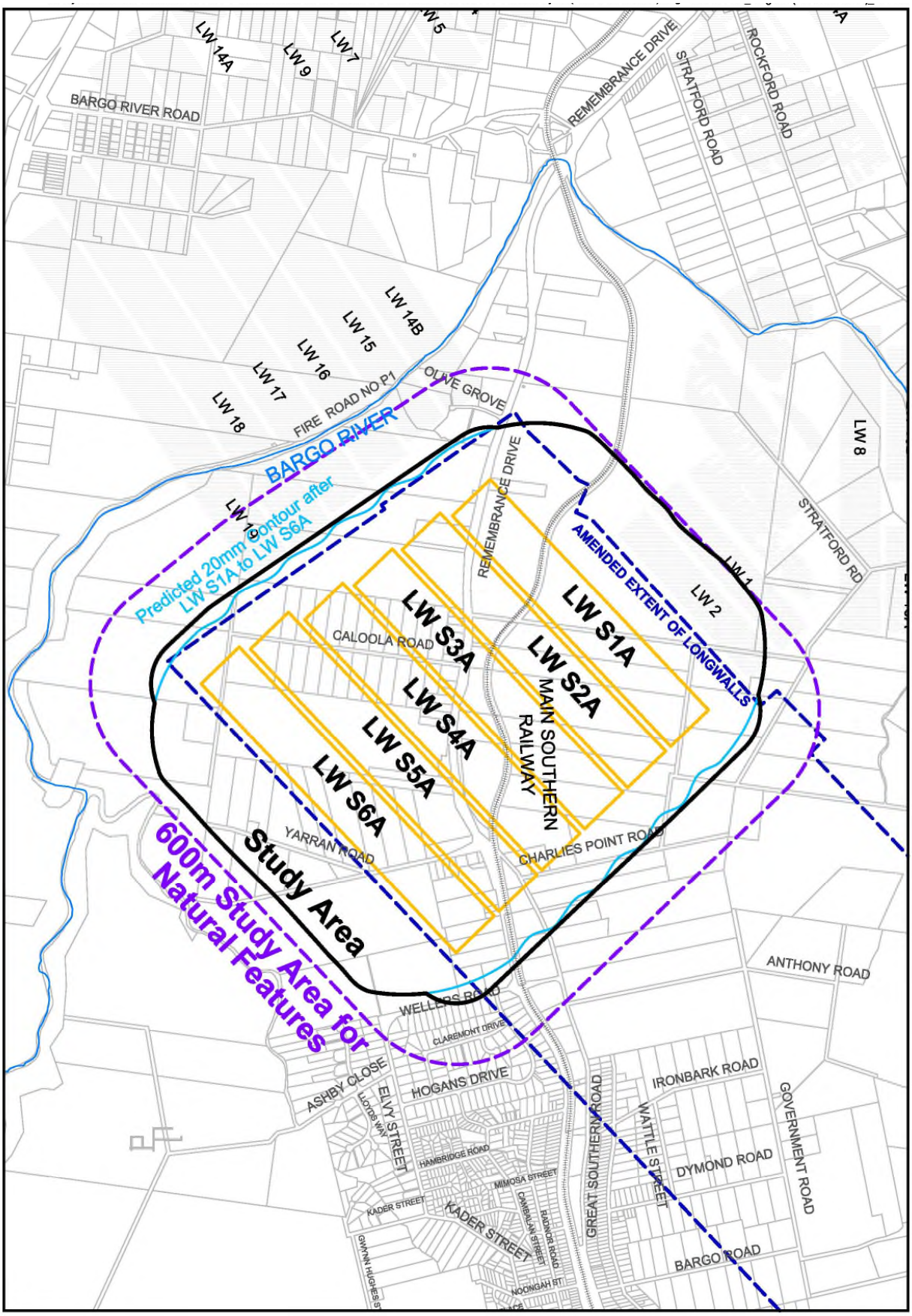
Tahmoor Coal would like to consult with DPIE Crown Lands Division regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

Department of Planning and Environment

Zina Ainsworth

Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining
PO Box 100, Tahmoor, NSW 2573

Our ref: DOC22/014083

Your ref:

File:22/00516

02 February 2022

Dear Ms Ainsworth

Subject: Tahmoor South Longwalls South 1A to South 6A Extraction Plan Letter of Consultation

Thank you for your request for Crown Lands' preliminary comments on the Extraction Plan.

I apologise for the delay in replying. It is envisaged that the purpose of the "Study Area" and "600m Study Area for Natural Features" outlined in the Extraction Plan, attached to your letter, will best be further explained in the plan.

Mitigation of impacts on the Bargo River and other watercourses, as a consequence of the longwall extraction works will need to be addressed in the plan.

Within the Longwall area , there is a substantial amount of Crown land. This Crown land includes Dedication 500432 managed by The National Trust of Australia for Conservation of Native Flora, Fauna (45.03 ha) including Lot 33 DP 751250, Lot 18 DP 751250, Lot 19 DP 751250, all on the eastern side of Remembrance Drive.

This reserve is adjoined by other Crown reserves e.g. R751250 (1784 ha), a Parish reserve for Bargo, Camden with purpose of future public requirements, environmental studies and training purposes.

Within the 600m Study Area for Natural Features, identified in the Extraction Plan, the Wingecarribee Shire Council holds Licence No 625498 (a Section 2.20 licence – Short Term Licence Type 1a – Combined) with Crown lands for Environmental Protection, which includes Lot 7311 DP1141025). The account area for this licence is 9397 ha of Crown land, so extends well beyond the Study Areas identified.

The Crown land area between Bargo and Tahmoor is understood to support numerous Endangered Ecological Communities and Threatened Species of Flora & Fauna . The Extraction Plan will need to address mitigation of adverse impacts of the extraction operation on flora and fauna within the Study Areas. Further, access arrangements to be made by Tahmoor Coal Pty Ltd are not to adversely impact any Crown land within the Study Areas.

Surface disposal areas for material from the underground longwall sites will likely be documented in the plan. It is desirable that arrangements for disposal of spoil do not adversely impact on public land (including Crown land) in the environs.

Should you have any queries about the comments made, please advise.

Yours sincerely,

Stan Rees.

Stan Rees

Natural Resources Management Project Officer Crown Lands, Parramatta

22 November 2021

Gang Li
Principal Inspector - Subsidence
Department of Regional NSW – Resources Regulator
PO Box 344
Hunter Region Mail Centre NSW 2310

Emailed to:
gang.li@planning.nsw.gov.au
subsidence.monitoring@planning.nsw.gov.au
nswresourcesregulator@service-now.com

Dear Gang,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

Tahmoor Mine has been operating continuously since 1979, and longwall mining methods have been used since 1987. Tahmoor Coal has previously mined 34 longwalls to the north and west of the Tahmoor Mine's current pit top location.

Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

Tahmoor Coal is currently preparing an Extraction Plan for Longwalls South 1A to South 6A (LW S1A-S6A) in accordance with the condition C8 of the Development Consent (SSD 8445). The attached figure illustrates the location of the proposed longwalls, as well as the Study Area of this Extraction Plan and the predicted 20 mm subsidence contour.

The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

The Extraction Plan will be supported by the following key documents:

- Subsidence Prediction and Impact Assessment Report;
- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan;
- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

Tahmoor Coal would like to consult with the Resources Regulator regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of built features in the Study Area and public safety, which would be considered in the LW S1A-S6A Built Features Management Plan and individual management plans, Subsidence Monitoring Program and the Public Safety Management Plan.

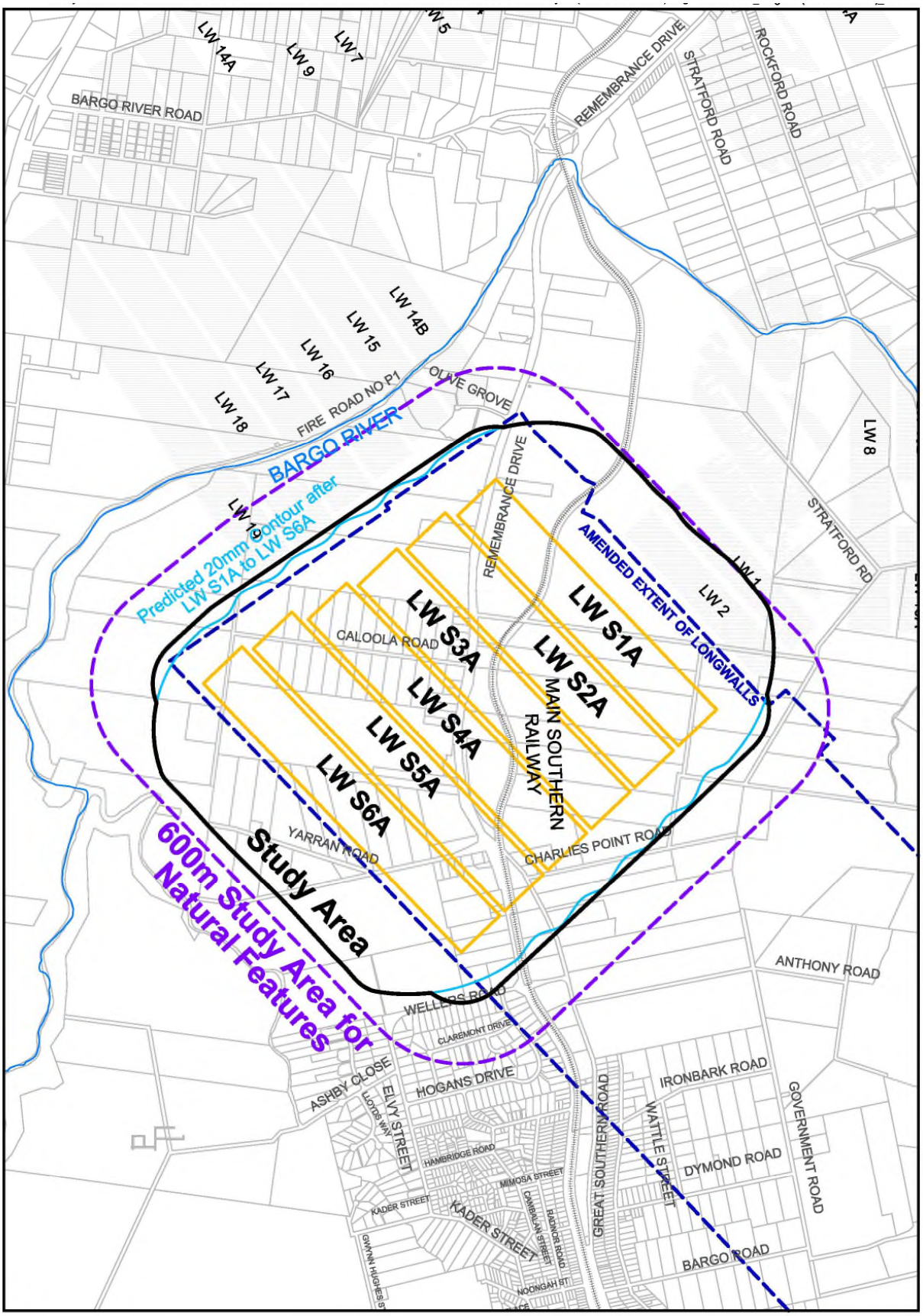
We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Ross Barber
Sent: Saturday, 14 May 2022 9:14 AM
To: Phil Steuart
Cc: Daryl Kay; Gang Li; Ray Ramage; RRD OCI Subsidence Monitoring Mailbox; April Hudson
Subject: RE: Tahmoor South (draft) Monitoring Plan
Attachments: LW S1A-S6A Subsidence Monitoring Plan_V1_20220513 (final).pdf

Hi Phil

As requested please see attached LWS1A – S6A Monitoring Plan V1 as requested

Sorry for the delay

Kind regards

Ross Barber
Project Manager Subsidence

T: +61-2-4640-0028
M: +61-0419 466 143
E: Ross.Barber@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Bargo NSW 2574
simec.com







From: Phil Steuart <phil.steuart@planning.nsw.gov.au>
Sent: Monday, 4 April 2022 12:00 PM
To: Ross Barber <Ross.Barber@simecgfg.com>
Cc: Daryl Kay <daryl@minesubsidence.com>; Gang Li <gang.li@planning.nsw.gov.au>; Ray Ramage <ray.ramage@planning.nsw.gov.au>; RRD OCI Subsidence Monitoring Mailbox <subsidence.monitoring@planning.nsw.gov.au>
Subject: RE: Tahmoor South (draft) Monitoring Plan

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Ross,

Whilst the draft monitoring layout plan sent for Tahmoor South is helpful, it is not possible for our team to form a view of the adequacy of subsidence survey monitoring proposed, based on proposed monitoring locations alone.

The Tahmoor South draft subsidence survey monitoring proposal (including a document outlining proposed frequencies, parameters to be measured, inspection locations/regimes, proposed target survey accuracies and methodologies etc) is required before our team can form an accurate view of the adequacy of the monitoring proposed for Tahmoor South. The draft proposal will also help provide focus to the planned site inspection by the subsidence inspectors.

Details provided soon should cover at least the initial longwall commencement, including surface features potentially influenced early on.

As you are aware, the time available is now quite short - especially in the event that changes to the proposed monitoring are considered warranted, based on the results of our reviews. This can potentially become difficult for Tahmoor Colliery to manage effectively.

To avoid any last minute "surprises" and/or potential delays, the additional details outlined above need to be provided for our review as soon as possible.

Regards,

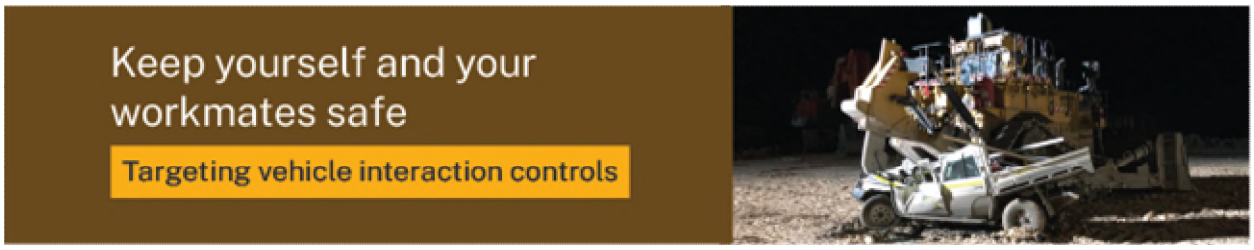
Phil Steuart
Senior Mine Safety Officer (Subsidence Engineering)

NSW Resources Regulator | Department of Regional NSW
T 02 4063 6484 | **E** phil.steuart@planning.nsw.gov.au
8 Hartley Drive, Thornton NSW 2322





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From: Ross Barber <Ross.Barber@simecgfg.com>
Sent: Thursday, 24 March 2022 2:32 PM
To: Phil Steuart <phil.steuart@planning.nsw.gov.au>
Cc: Daryl Kay <daryl@minesubsidence.com>; Amanda Fitzgerald <Amanda.Fitzgerald@simecgfg.com>; April Hudson <April.Hudson@simecgfg.com>
Subject: Tahmoor South (draft) Monitoring Plan

Hi Phil

As requested please see attached draft monitoring plan for Tahmoor South A-series
Worth noting

- The rail corridor survey is shown as a single line only and does not show any of the proposed detailed embankment survey
- The land at the start of LW SA1 to SA3 running to the railway corridor is Wirrimbirra Natural Reserve – they have significant vegetation restrictions and installing survey lines is not allowed under our access agreement

This is a draft document with all the assets and details known to date

I will send you updates as they arise until finalised

I hope this meets your requirements

Kind regards

Ross Barber
Project Manager Subsidence

T: +61-2-4640-0028
M: +61-0419 466 143
E: Ross.Barber@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Bargo NSW 2574
simec.com







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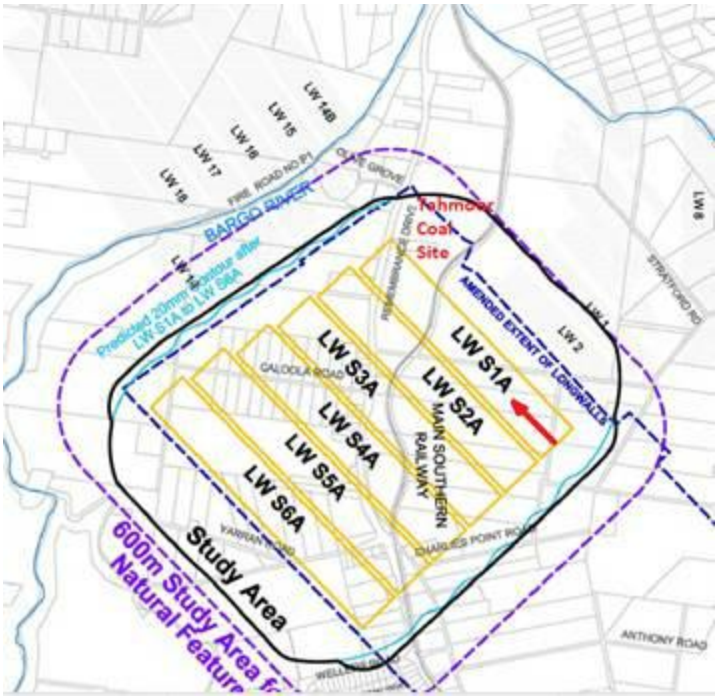
Archived: Tuesday, 1 March 2022 7:52:43 AM
From: Ross Barber
Sent: Tuesday, 25 January 2022 11:36:00 AM
To: Phil Steuart; Gang Li; April Hudson; Daryl Kay; Zina Ainsworth
Cc: RRD OCI Subsidence Monitoring Mailbox
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan
Sensitivity: Normal

Hi Phil

As discussed the letter dated the 23rd Dec from Tahmoor Coal was the initial consultation advice to all stakeholders involved in the Tahmoor South proposed development area.

The initial longwall blocks S1a – S6a will be extracted from north to south as shown with the red arrow on the below plan extract and in a sequence S1a to S6a.
The (draft) monitoring plan as requested is only in raw form and not at a stage for distribution.
Tahmoor Coal is planning to have a draft monitoring plan by March / April for distribution.
Tahmoor Coal recognises that Far Field assets will form part of the monitoring plan.

With the reduction in Longwall West W4 by approx. 300m, the Tahmoor South is currently schedule to start extraction around Sept 21, subject to all approvals in place.



I will endeavour to keep you informed on the progress if the advised dates slip.

Kind regards
Ross Barber
Project Manager Subsidence

T: +61-2-4640-0028
M: +61-0419 466 143

E: Ross.Barber@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Bargo NSW 2574
simec.com







From: Phil Steuart <phil.steuart@planning.nsw.gov.au>
Sent: Wednesday, 19 January 2022 12:56 PM
To: Ross Barber <Ross.Barber@simecgfg.com>
Cc: RRD OCI Subsidence Monitoring Mailbox <subsidence.monitoring@planning.nsw.gov.au>; Gang Li <gang.li@planning.nsw.gov.au>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan

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Ross,

Further to my email dated 23/12/21 (below), please advise if there has been any progress with the subsidence monitoring proposal for the proposed Tahmoor South LWS1A-S6A.

Please note that with proposed new longwall areas, it is common industry practice for Mine Operators to first provide a monitoring proposal - draft at least (with proposed monitoring line layout plan and documented monitoring details), to "get the ball rolling". This is then usually followed by (or concurrent with) site inspections etc - currently problematic, due to Covid.

Regards,

Phil Steuart
Senior Mine Safety Officer (Subsidence Engineering)

NSW Resources Regulator | Department of Regional NSW
T 02 4063 6484 | **E** phil.steuart@planning.nsw.gov.au
8 Hartley Drive, Thornton NSW 2322









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From: Phil Steuart **On Behalf Of** RRD OCI Subsidence Monitoring Mailbox
Sent: Thursday, 23 December 2021 9:57 AM
To: Ross Barber <Ross.Barber@simecgfg.com>
Cc: RRD OCI Subsidence Monitoring Mailbox <subsidence.monitoring@planning.nsw.gov.au>; Gang Li <gang.li@planning.nsw.gov.au>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan

Hi Ross,

Please provide a subsidence monitoring plan proposal (at least a draft) for the proposed Tahmoor South LWS1A-S6A, as soon as practicable.

Regards,

Phil Steuart
Senior Mine Safety Officer (Subsidence Engineering)

NSW Resources Regulator | Department of Regional NSW
T 02 4063 6484 | **E** phil.steuart@planning.nsw.gov.au
8 Hartley Drive, Thornton NSW 2322







NSW GOVERNMENT | Regional NSW

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22 November 2021

Greg Kininmonth
Manager Environmental Operations
Department of Regional NSW – Resources Regulator
PO Box 674
Wollongong NSW 2520

Emailed to:
greg.kininmonth@planning.nsw.gov.au
nswresourcesregulator@service-now.com

Dear Greg,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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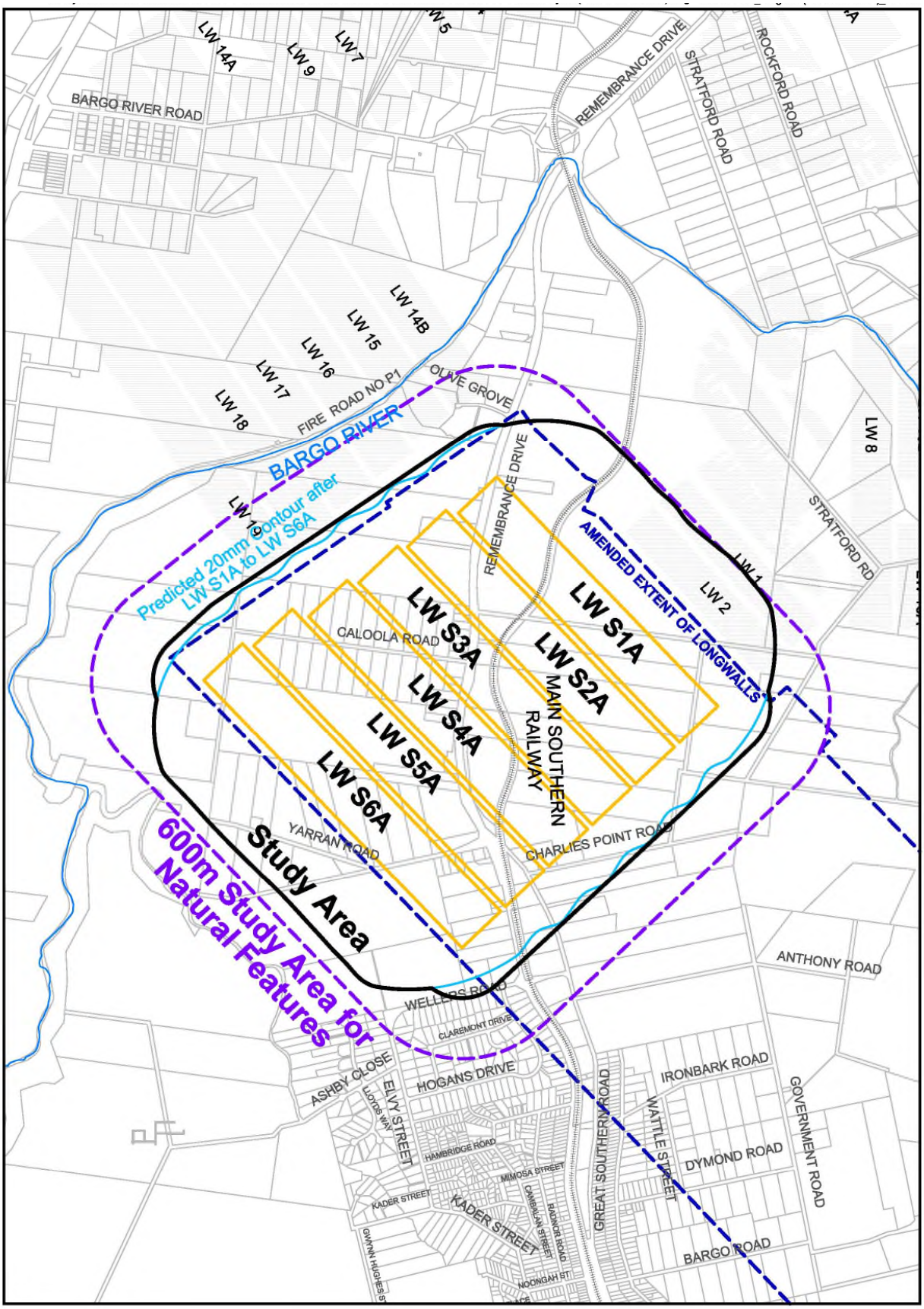
Tahmoor Coal would like to consult with Resources Regulator – Mining Act Inspectorate regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Resources Regulator <nswresourcesregulator@service-now.com>
Sent: Tuesday, 25 January 2022 3:57 PM
To: April Hudson
Cc: Zina Ainsworth; Peter McMillan; Greg Kininmonth
Subject: AREQ0024405 | Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation F

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Hi April,

At this stage the Resources Regulator has no specific comment regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Regards,

Peter McMillan
Inspector Environment
MAI - Team 1 | Resources Regulator
M 0499 944 843

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Ref:MSG0601401_Db9UVn83spSJnRdy5fuM

22 November 2021

Adam Bannister
Senior Advisory Officer – Assessment Coordination
Resources Assessments
Department of Regional NSW – Mining Exploration and Geoscience
PO Box 674
Wollongong NSW 2500

Emailed to:
assessment.coordination@planning.nsw.gov.au
resource.operations@planning.nsw.gov.au

Dear Adam,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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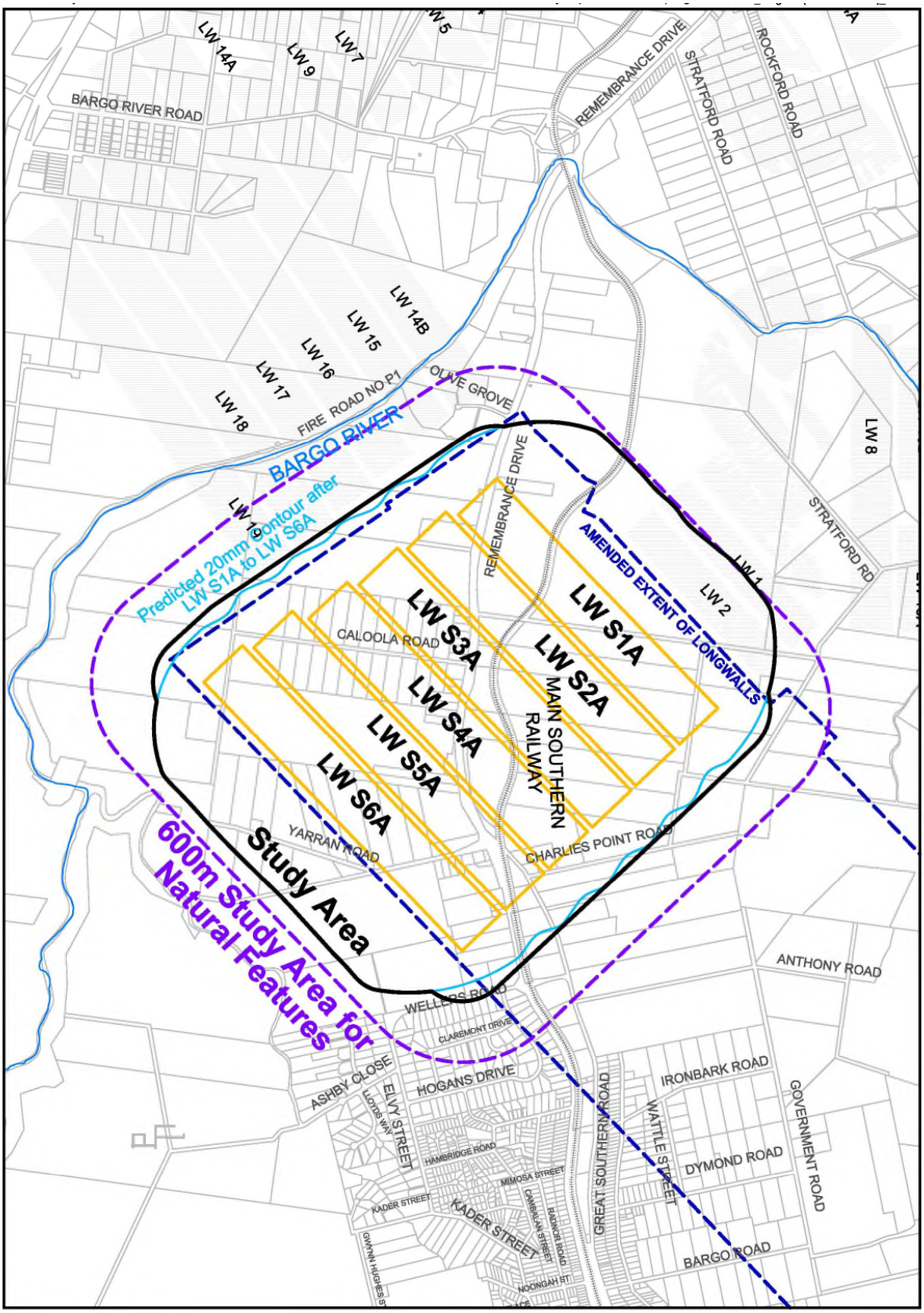
Tahmoor Coal would like to consult with the Department of Regional NSW - Mining Exploration and Geoscience regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

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Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Adam Banister <adam.banister@regional.nsw.gov.au>
Sent: Friday, 28 January 2022 2:03 PM
To: April Hudson
Cc: MEG Mining Concierge Mailbox
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

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Thanks April. MEG has no comments regarding the preliminary proposal for consultation that you have submitted to us.
We will feed any advice into the EP process with DPIE Resource Assessments.

Thank you for making contact. It is appreciated.

Kind Regards,

Adam W. Banister
Senior Advisor Industry Advisory & Mining Concierge | Industry Development
E: adam.banister@regional.nsw.gov.au
M: +61 499 299 570 | **T:** +61 2 4931 6439
Mon Tue Wed Thu Fri
✔ ✔ ✔ ✔ ✔
Chartered Geologist & Fellow – Geological Society of London
Certified Professional Geologist – American Institute of Professional Geologists

Regional NSW
Mining, Exploration & Geoscience | Department of Regional NSW
Location: 516 High Street Maitland NSW 2320 | Australia

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From: April Hudson <April.Hudson@simecgfg.com>
Sent: Friday, 28 January 2022 10:15 AM
To: Adam Banister <adam.banister@regional.nsw.gov.au>
Cc: MEG Mining Concierge Mailbox <Mining.Concierge@regional.nsw.gov.au>
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi Adam,

Thanks for your response. We are aiming for March / April submission of the Extraction Plan to DPIE.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com







From: Adam Banister <adam.banister@regional.nsw.gov.au>
Sent: Thursday, 27 January 2022 5:12 PM
To: April Hudson <April.Hudson@simecgfg.com>
Cc: MEG Mining Concierge Mailbox <Mining.Concierge@regional.nsw.gov.au>
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

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Hi April,

My apologies for the delay. I have only returned from leave this week.
I will review the EP and forward any advice back to you.

When do you expect to lodge the EP with Planning?

Adam.

Kind Regards,
Adam W. Banister
Senior Advisor Industry Advisory & Mining Concierge | Industry Development
E: adam.banister@regional.nsw.gov.au
M: +61 499 299 570 | **T:** +61 2 4931 6439
Mon Tue Wed Thu Fri
✔ ✔ ✔ ✔ ✔

Chartered Geologist & Fellow – Geological Society of London
Certified Professional Geologist – American Institute of Professional Geologists

Regional NSW
Mining, Exploration & Geoscience | Department of Regional NSW
Location: 516 High Street Maitland NSW 2320 | Australia

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Aboriginal people are included socially, culturally and economically through thoughtful and collaborative approaches to our work.

From: Mike Hagerthy <Michael.Hagerthy@planning.nsw.gov.au> **On Behalf Of** DRG RO Resource Operations Mailbox
Sent: Thursday, 23 December 2021 8:06 AM
To: Adam Banister <adam.banister@regional.nsw.gov.au>
Subject: FW: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi Adam,

This letter is addressed to you.

Please note that the Mining, Exploration and Geoscience Christmas shutdown period is from Monday 27 December 2021 to Friday January 7 2022. We will also be operating at a reduced capacity from 20 December 2021. Correspondence received during this time will be attended to on our return on Monday 10 January 2022.

Kind regards,

Mike Hagerthy
Project Officer

Mining, Exploration and Geoscience | Department of Regional NSW
T 02 4063 6600 | **E** resource.operations@planning.nsw.gov.au
516 High Street, Maitland NSW 2320
nsw.gov.au/regionalnsw

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Please note that my team and I are currently working remotely or from home until further notice. While we hope to maintain business as usual, we appreciate your patience with any potential delays associated with some services and requests.

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Wednesday, 22 December 2021 6:18 PM
To: DRG RO Assessment Coordination Mailbox <assessment.coordination@planning.nsw.gov.au>; DRG RO Resource Operations Mailbox <resource.operations@planning.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Dear Adam,

Please see attached a letter regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

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22 November 2021

NRAR Service Desk
NSW Infrastructure – Land & Water – Natural Resources Access Regulator
Locked Bag 5022
Parramatta NSW 2124

Emailed to:
nrar.servicedesk@dpie.nsw.gov.au

To whom it may concern,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

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Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

Tahmoor Coal is currently preparing an Extraction Plan for Longwalls South 1A to South 6A (LW S1A-S6A) in accordance with the condition C8 of the Development Consent (SSD 8445). The attached figure illustrates the location of the proposed longwalls, as well as the Study Area of this Extraction Plan and the predicted 20 mm subsidence contour.

The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

The Extraction Plan will be supported by the following key documents:

- Subsidence Prediction and Impact Assessment Report;
- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan;
- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

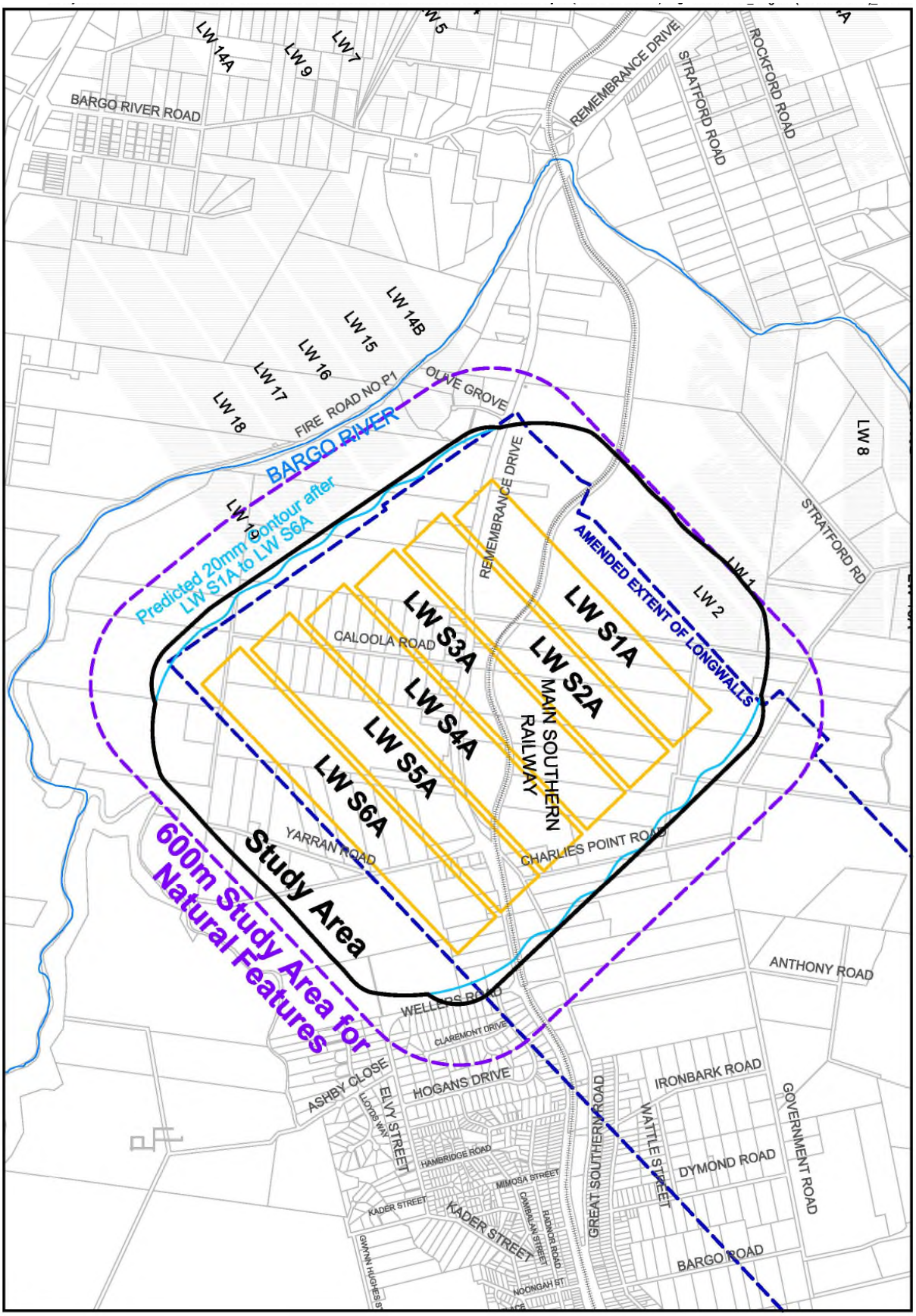
Tahmoor Coal would like to consult with the Natural Resources Access Regulator (NRAR) regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of surface water and groundwater resources in the Study Area, which would be considered in the LW S1A-S6A Water Management Plan.

We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

22 November 2021

Customer Helpdesk / Environmental Assessments
WaterNSW
PO box 398
Parramatta NSW 2124

Emailed to:
environmental.assessments@waternsw.com.au

To whom it may concern,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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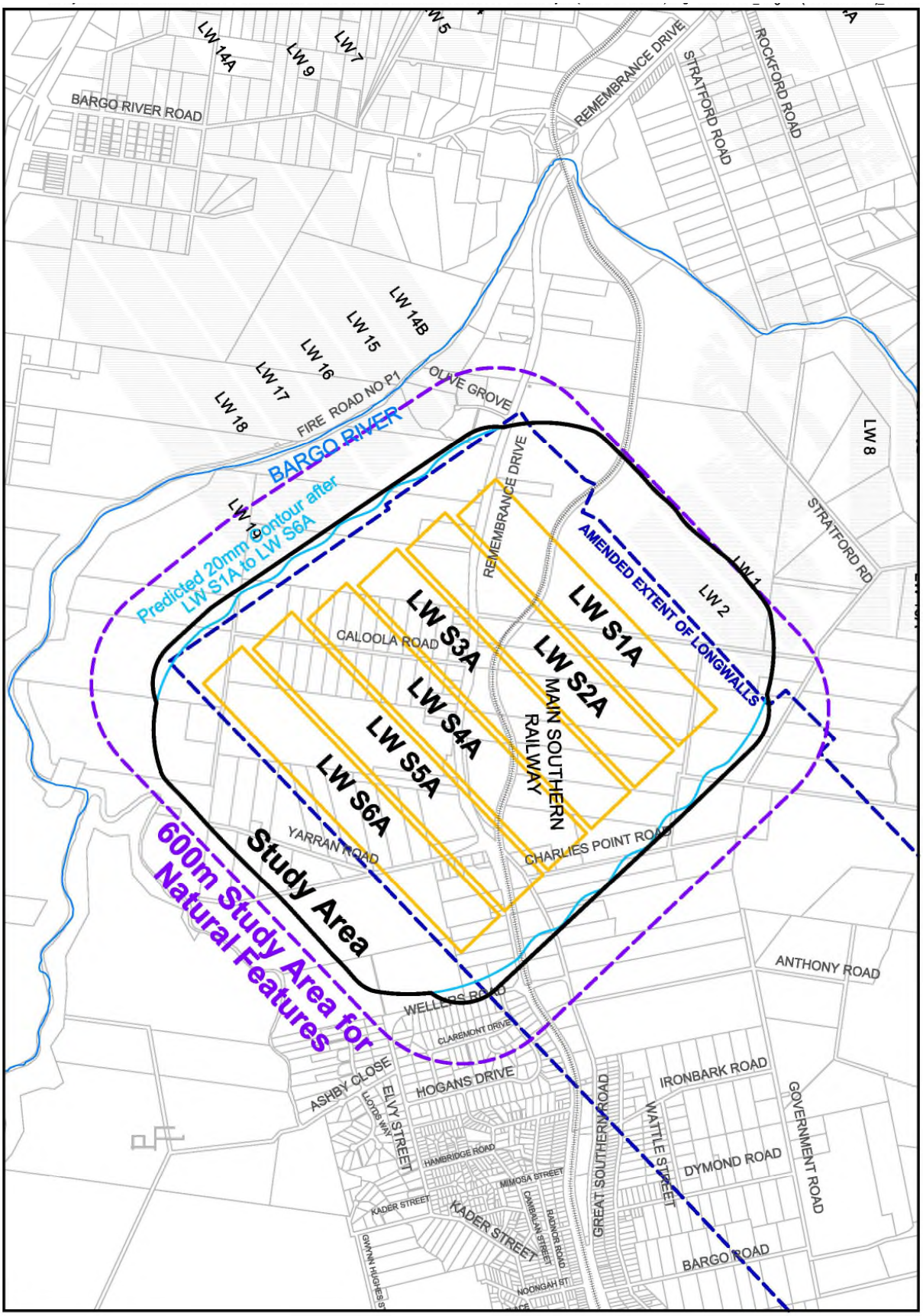
Tahmoor Coal understand that the Study Area is not located within the Sydney Drinking Water Catchment area. However, Tahmoor Coal would like to consult with the WaterNSW regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Ravi Sundaram <ravi.sundaram@waternsw.com.au>
Sent: Monday, 10 January 2022 4:59 PM
To: April Hudson
Cc: Zina Ainsworth; Girja Sharma; Daryl Gilchrist
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Some people who received this message don't often get email from ravi.sundaram@waternsw.com.au. Learn why this is important

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello April
Thank you for consulting with WaterNSW on the above application. The application is located outside the Sydney Drinking Water Catchment (SDWC) and Special Areas.

WaterNSW has previously reviewed the Project EIS, Response to Submissions (RTS) and the Project Amendment Report (PAR), and stated in its response dated 18th August 2020 (our reference - D2020/86406) that WaterNSW did not add any comments as the impact on SDWC was insignificant as:

1. The proposed mining areas are located outside Water NSW's Metropolitan Special Area and SDWC.
2. Overall, cumulative impacts of mining and associated subsidence on surface water and groundwater will be reduced due to reduced work plans. Impact on subsidence and mine inflow are predicted to be less due to shorter operation, but the peak impact is unchanged.
3. Surface water flow and quality within SDWC is predicted not to be impacted as a result of the proposed mining because:
   - the closest mining area is approximately 1 km away from Cow Creek within SDWC, and
   - the surface water from the proposed mining area will drain to Nepean catchment outside SDWC.
4. The groundwater assessment predicted
   - reduction of total mine inflow 1800 ML/y and cumulative reduction of 4100-6400 ML by 3 years shorter operation period
   - peak mine inflow is unlikely to change associated LW 104B & 105 B in 2028
   - baseflow losses predicted to be less in Cow Creek but no figures provided. Note the impact within SDWC was already low or insignificant as previously estimated in PAR as below:
     - Metropolitan Special Area 0.05/0.25 (ML/d)
     - Warragamba Special Area 0.01/0.005 (ML/d)
     - Cow Creek 0.018/0.019 (ML/d), equivalent to 0.69% for daily flow
     - Pheasant's nest weir 0.014/0.016 (ML/d)

WaterNSW recommends that:

1. The proposed Longwalls South 1A to South 6A extraction plan including the Surface Water Management Plan confirm the above assessment on the SDWC and detail relevant monitoring and management measures.
2. The extraction plan consider WaterNSW Mining Principles and Water Monitoring Guidelines for Underground Mining Activities even though the application area is located outside the SDWC and Special Areas. These documents are part of current accepted Best Recommended Practice for managing mining impacts In NSW. The documents can be downloaded from the WaterNSW website https://www.waternsw.com.au/water-quality/catchment/mining.

Please feel free to contact me if you wish to discuss any matter raised above. WaterNSW appreciates being consulted in developing the extraction plan and requests it be provided a copy of the Water Management Plan for review.

Regards

Ravi

Ravi Sundaram
Mining Catchment Specialist

PO Box 398, Parramatta NSW 2124
Level 14, 169 Macquarie Street
Parramatta NSW 2150
T: 02 9865 2507
M.: 0428 226 152/ 0451 510 194
ravi.sundaram@waternsw.com.au
www.waternsw.com.au

Note: Please contact me by email or on my mobile until further notice as I may be working remotely.

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Wednesday, 22 December 2021 6:18 PM
To: Environmental Assessments <Environmental.Assessments@waternsw.com.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

This Message Is From an External Sender

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Be careful opening emails, attachments and links from unknown senders.

To whom it may concern,

Please see attached a letter regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

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Any opinions contained in this message are those of the author and are not provided or endorsed by ourselves unless clearly indicated and the authority or the author to so bind is duly verified.

22 November 2021

Heritage NSW
Department of Premier and Cabinet
Locked Bag 5020
Parramatta 2124

Emailed to:
heritagemailbox@environment.nsw.gov.au

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Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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- Subsidence Monitoring Program; and
- Graphical Plans.

Tahmoor Coal would like to consult with the Heritage NSW regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of heritage items in the Study Area, which would be considered in the LW S1A-S6A Heritage Management Plan.

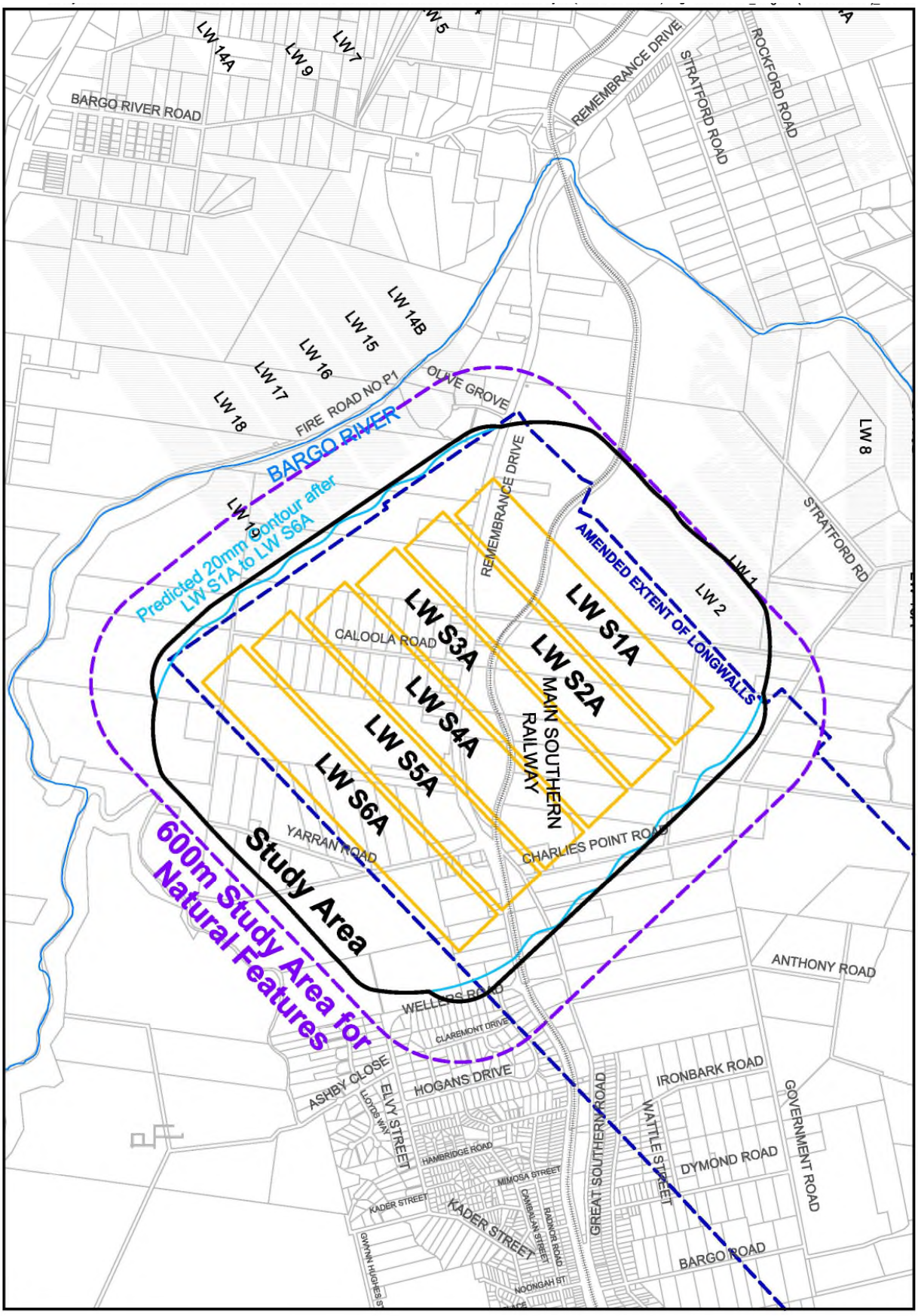
We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Nicole Davis <Nicole.Davis@environment.nsw.gov.au>
Sent: Sunday, 13 March 2022 3:00 PM
To: April Hudson
Subject: Heritage NSW Reply - Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation, 13.3.2022

You don't often get email from nicole.davis@environment.nsw.gov.au. Learn why this is important

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi April,

Thank you for your email. Heritage NSW does not have any preliminary comments for the preparation of the Longwall South 1A to South 6A Extraction Plan, with respect to Aboriginal cultural heritage.

Kind regards
Nicole Davis

Nicole Davis | Manager Assessments
Heritage NSW, Community Engagement, Department of Premier and Cabinet
Level 6, 10 Valentine Ave, Parramatta | Locked Bag 5020 Parramatta 2124
T: 02 4927 3156 M: 0409 394 343 | nicole.davis@environment.nsw.gov.au



I acknowledge and respect the traditional custodians and ancestors of the lands I work across.
Website Facebook Instagram LinkedIn

From: April Hudson <April.Hudson@simecgfg.com>
Sent: Monday, 28 February 2022 5:15 PM
To: OEH HD Heritage Mailbox <HERITAGEMailbox@environment.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>
Subject: FW: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

To whom it may concern,

Tahmoor Coal is following up if your organisation has any preliminary comments for the preparation of the Longwall South 1A to South 6A Extraction Plan.

We are seeking final comments by **Friday 18 March 2022**. If no response is received by this date, it will be assumed your organisation has no comments.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

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Sent: Wednesday, 22 December 2021 6:18 PM
To: OEH HD Heritage Mailbox <HERITAGEMailbox@environment.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

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Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
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Any opinions contained in this message are those of the author and are not provided or endorsed by ourselves unless clearly indicated and the authority or the author to so bind is duly verified.

This email is intended for the addressee(s) named and may contain confidential and/or privileged information.
If you are not the intended recipient, please notify the sender and then delete it immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment, Energy and Science.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

22 November 2021

Bill Ziegler
Manager Mining Impacts
Dam Safety Committee
10 Valentine Ave
Parramatta NSW 2150

Emailed to:
bill.ziegler@damsafety.nsw.gov.au

Dear Bill,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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- Graphical Plans.

Tahmoor Coal would like to consult with the Dam Safety Committee regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of the Picton Wier, which would be considered in the LW S1A-S6A Water Management Plan as well as in a specific management plan for this infrastructure. In addition, a number of small to medium sized dams located in the Study Area will be considered in the LW S1A-S6A Land Management Plan and LW S1A-S6A Water Management Plan.

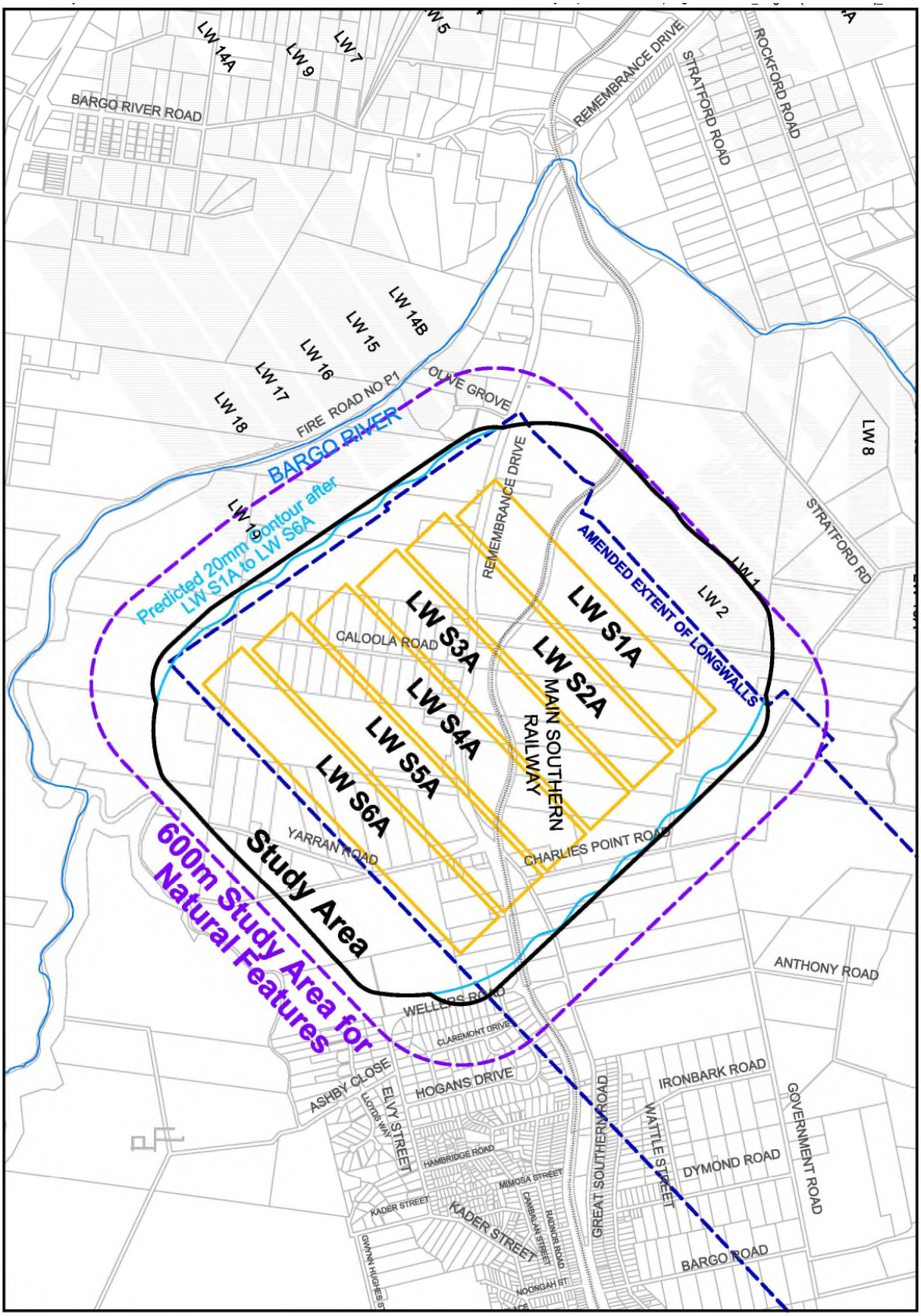
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Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

Dams Safety

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining

11/03/2022

Our ref: Tahmoor South1A-6A

Dear Zina,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Thank you for providing Dams Safety NSW (DSNSW) with the letter of consultation regarding Tahmoor South Longwalls South 1A to 4A. There are no declared dams or notification areas in the area and so DSNSW has no further comments on the proposal.

If you have any queries in this regard, please contact Heather Middleton on 0428288391 or heather.middleton@damsafety.nsw.gov.au.

Yours faithfully,

Heather Middleton
Manager Mining Impacts – Dams Safety NSW

22 November 2021

Andrew Couldridge
Senior Operations Officer – Metropolitan Illawarra
NSW Environment Protection Authority
PO Box 513
Wollongong NSW 2520

Emailed to:
andrew.couldridge@epa.nsw.gov.au
epa.illawarra@epa.nsw.gov.au

Dear Andrew,

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Letter of Consultation

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Tahmoor Coal would like to consult with the NSW Environment Protection Authority regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

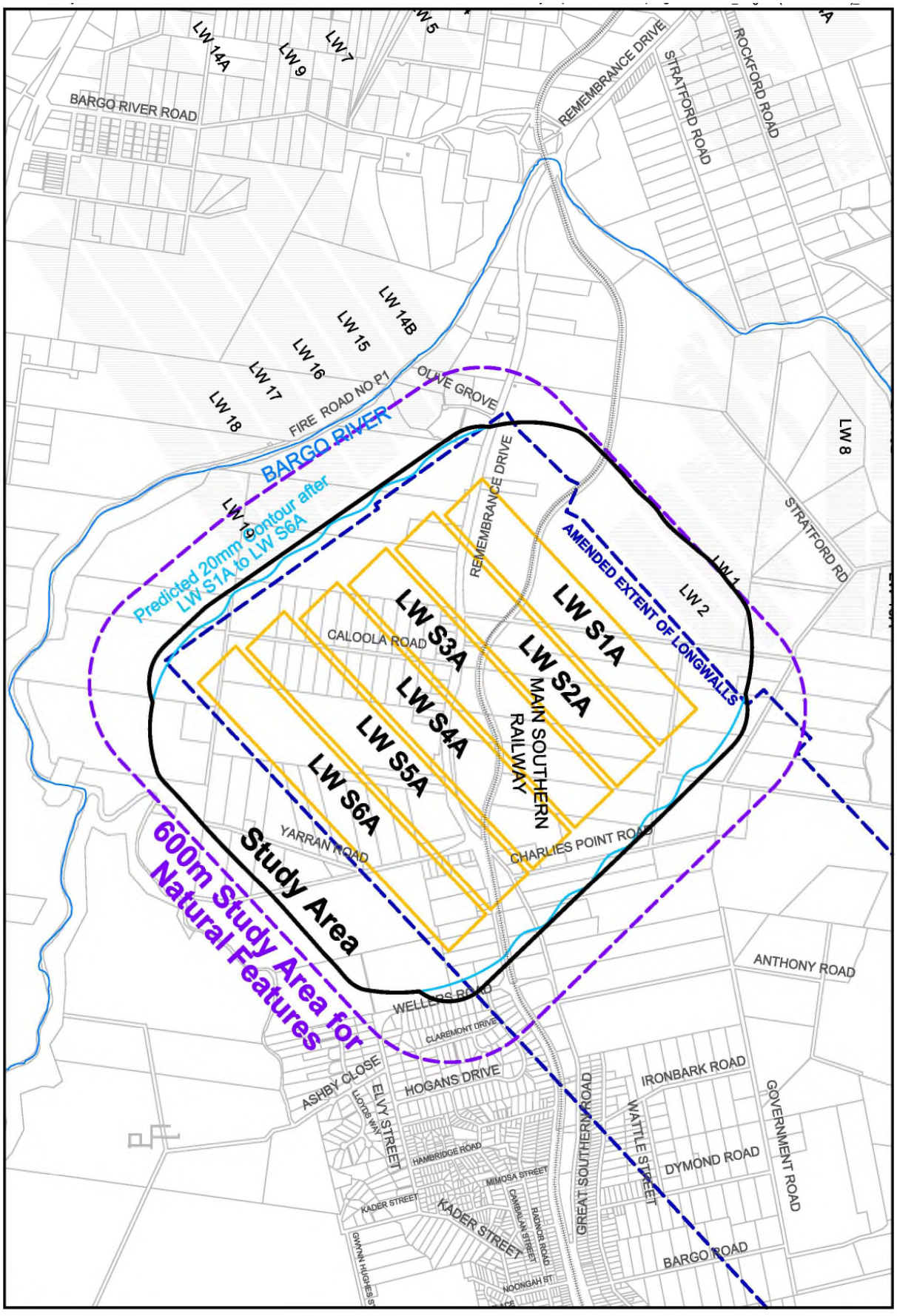
It is noted that the Bargo Waste Facility is not located within the Study Area of this Extraction Plan and will be included in the next Extraction Plan for the Tahmoor South Domain 'B' Series Longwalls.

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

DOC21/1623-01

Ms Zina Ainsworth
Tahmoor Coal Pty Ltd
PO Box 100
TAHMOOR NSW 2573

Email: zina.ainsworth@simecgfg.com

Dear Ms Ainsworth

Tahmoor South - Longwalls South 1A to South 6A - Extraction Plan

The EPA refers to Tahmoor Coal's letter dated 22 November 2021 requesting input to preparation of the above Extraction Plan for the Tahmoor South Coal Project.

The EPA does not generally assess subsidence impacts from underground coal mines because they are outside the EPA's licensing framework and regulated under development approvals issued by the Department of Planning, Industry and Investment (Planning and Assessment).

Consequently the EPA has no input to provide on the Extraction Plan.

If you have questions regarding the above, please phone Andrew Couldridge on (02) 4224 4100.

Yours sincerely

11/01/2022

GREG NEWMAN
Unit Head Regulation

Phone 131 555
Phone 02 4224 4100
(from outside NSW)

Fax 02 4224 4110
TTY 131 677
ABN 43 692 285 758

PO Box 513
WOLLONGONG
NSW 2520

Level 3
84 Crown Street
WOLLONGONG
NSW 2500
AUSTRALIA

info@epa.nsw.gov.au
www.epa.nsw.gov.au

22 November 2021

Mary Kovac
Agriculture Landuse Planning Officer
NSW Department of Primary Industries - Agriculture
Locked Bag 21
Orange NSW 2800

Emailed to:
mary.kovac@dpi.nsw.gov.au
landuse.ag@dpi.nsw.gov.au

Dear Mary,

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Letter of Consultation

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- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

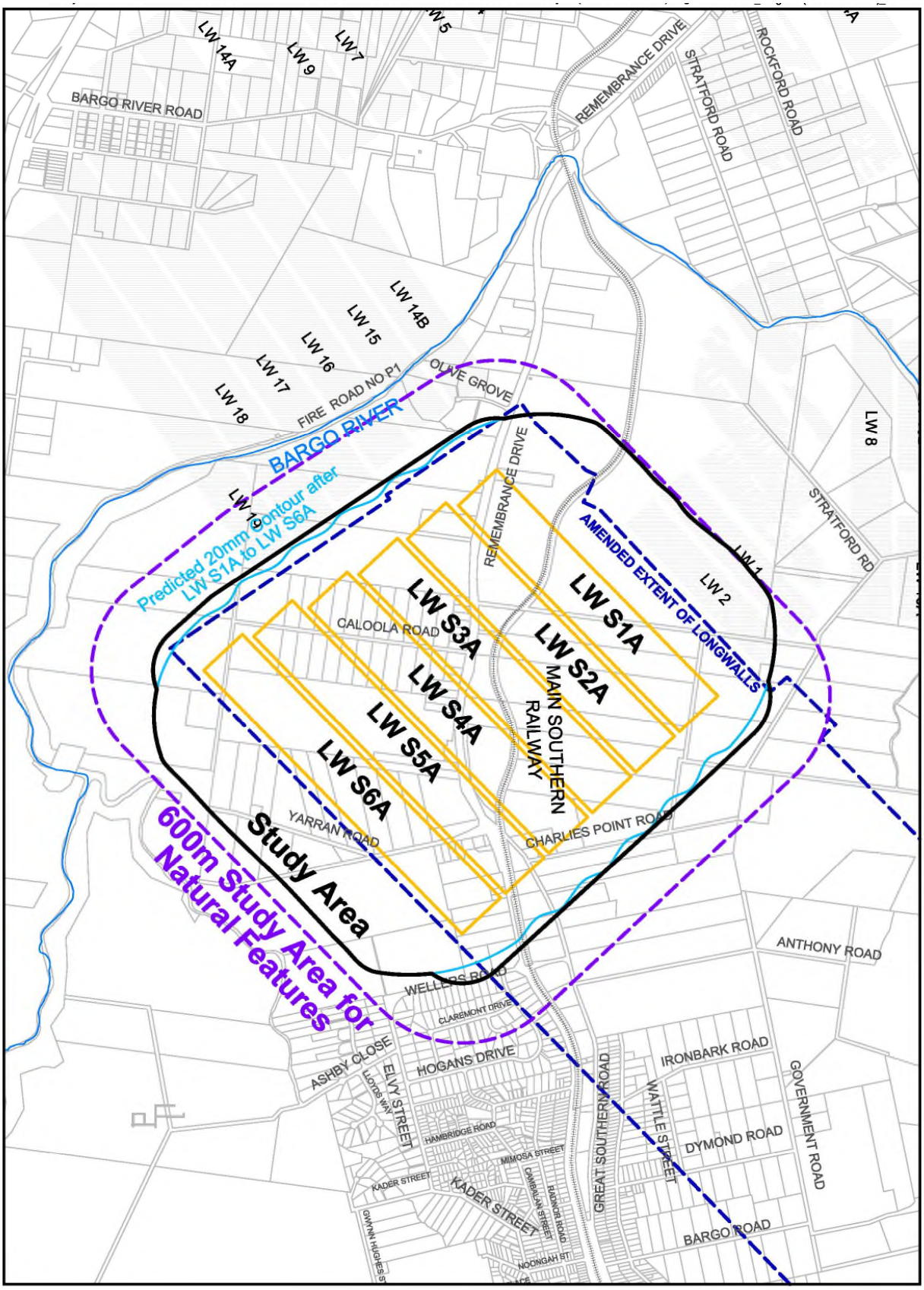
Tahmoor Coal would like to consult with the Department of Primary Industries - Agriculture regarding the LW S1A-S6A Extraction Plan currently in preparation. We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

NSW GOVERNMENT | Department of Primary Industries

OUT22/719

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining
Tahmoor NSW 2573

Email: zina.ainsworth@simecgfg.com

Dear Ms Ainsworth

Tahmoor South Longwalls South 1A to South 6A Extraction Plan Response to Consultation

Thank you for your correspondence dated 22 November 2021 about the invitation for consultation and any comments with the Department over the LW S1A-S6A Extraction Plan input

The NSW Department of Primary Industries (DPI) Agriculture is committed to the protection and growth of agricultural industries, and the land and resources upon which these industries depend.

The DPI understands that the company is seeking advice with respect to matters it should consider in the development of the extraction plan. While the DPI does not have any regulatory involvement in this project, we have undertaken a brief review of the agricultural industries in the area and recommend that the company consider the following comments related to agricultural landuses when developing the plan:

- A full assessment of the agricultural landuses in the area that may be potentially impacted so any agricultural developments and associated enterprises in the area are considered in terms of identified risks and economic disruption particularly with subsidence.
- Consult with the owners / managers of affected and adjoining neighbours and agricultural operations in a timely and appropriate manner about; the proposal, the likely impacts and suitable mitigation measures or compensation
- Consider possible cumulative effects to agricultural enterprises and landholders from subsidence/ other impacting events.
- An assessment of the monitoring regime that will identify any changes as a result of the effects of the long wall mining, especially subsidence, this may include impacts of farm infrastructure i.e. buildings, fences, slope changes, water supply infrastructure. (This may overlap with the other documents noted in your letter).

Specialist officers in the Department have also contributed the following that may also assist in the development of the extraction plan:

Poultry

In relation to the poultry enterprises that exist in the area, that these owner/ managers as well as the processors/owners of the birds be consulted to ensure that production plans can be adjusted if required. This should have at least for 12 month periods of mining activity.

Horticulture

For protected cropping enterprises (glasshouses) located in the impacted area, the slope of the glasshouses is critical for efficient irrigation so subsidence may be a potential issue. This may also be an issue for other open horticultural enterprises e.g. olives if they are irrigated with a dripper system.

Dust can also be an issue for greenhouse/glasshouse light transmission so this needs to be addressed if dust levels are an issue above ground.

With water quality any increase in the total dissolved salts (TDS) or an increase in sodium level will be a limitation to any horticultural system relying on hydroponics or fertigation.

Should you require clarification on any of the information contained in this response, please contact me on 0427949987 or by email at landuse.ag@dpi.nsw.gov.au

Yours sincerely

Mary Kovac
Agricultural Land Use Planning Officer
Central and Far West
3 February 2022

22 November 2021

John Johnston
Technical Manager
PO Box 488G
Newcastle NSW 2300

Emailed to:
John.Johnston@customerservice.nsw.gov.au
matthew.montgomery@customerservice.nsw.gov.au
subsidencetechnical@customerservice.nsw.gov.au

Dear John,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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Tahmoor Mine has been operating continuously since 1979, and longwall mining methods have been used since 1987. Tahmoor Coal has previously mined 34 longwalls to the north and west of the Tahmoor Mine's current pit top location.

Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

Tahmoor Coal is currently preparing an Extraction Plan for Longwalls South 1A to South 6A (LW S1A-S6A) in accordance with the condition C8 of the Development Consent (SSD 8445). The attached figure illustrates the location of the proposed longwalls, as well as the Study Area of this Extraction Plan and the predicted 20 mm subsidence contour.

The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

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- Graphical Plans.

Tahmoor Coal would like to consult with the Subsidence Advisory NSW regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of built features in the Study Area, which would be considered in the LW S1A-S6A Built Features Management Plan.

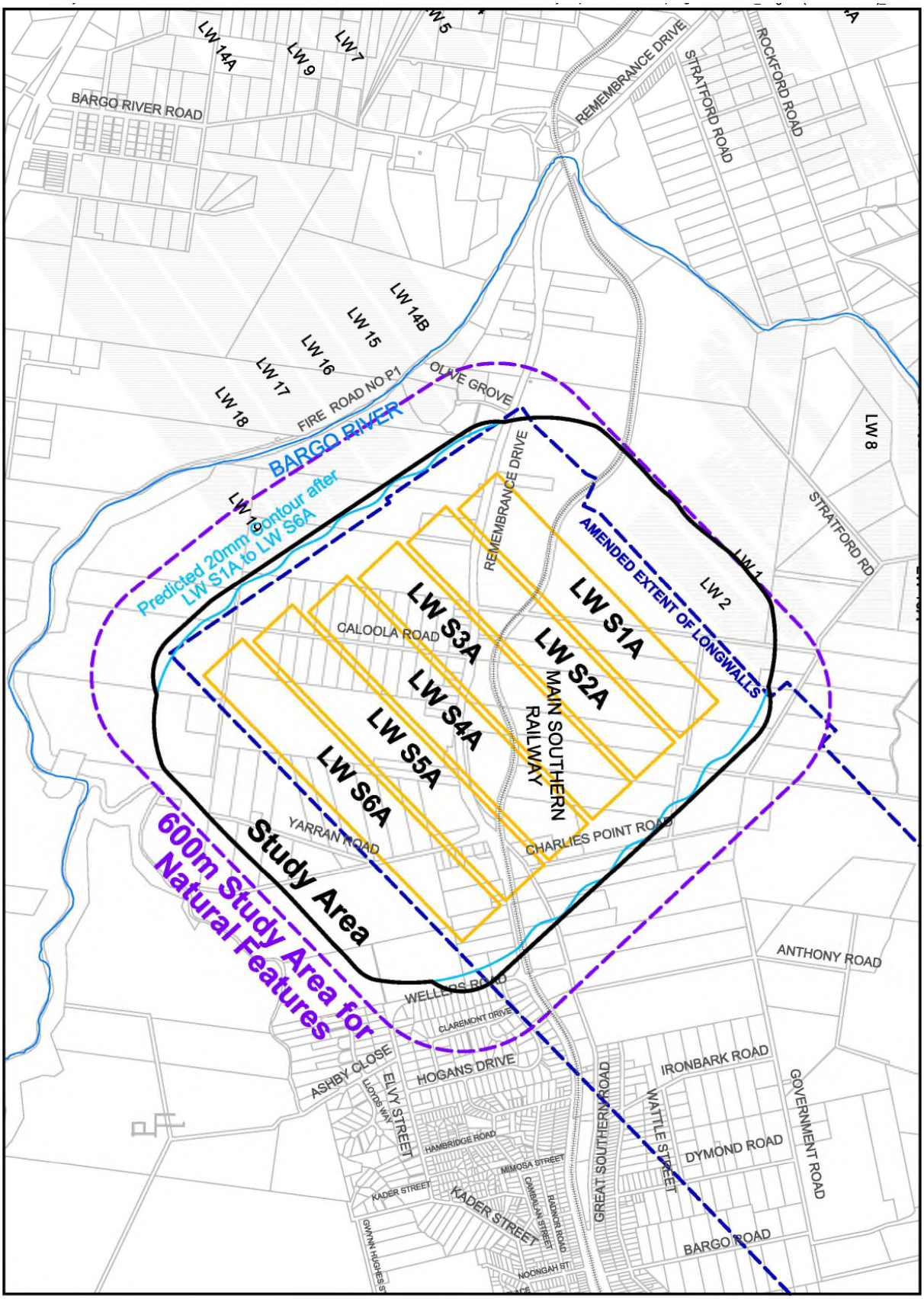
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Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

NSW GOVERNMENT

Subsidence Advisory

117 Bull Street, Newcastle West, NSW, 2302
T: (02) 4908 4300 | **24 Hour Emergency Service:** 1800 248 083 (Free Call)

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining

Dear Zina,

RE: Response to consultation letter showing extraction plan layout for Longwalls South 1A to South 6A – EPMI22-00001

Thanks for your letter requesting that Subsidence Advisory NSW (Subsidence Advisory) provide comment on a proposed layout for longwall's 1A to 6A at Tahmoor South. It is understood that the layout will form the basis of an application for secondary extraction approval.

Given that supporting documentation is not yet available, Subsidence Advisory is unable to provide specific feedback on the proposed application. It is recommended that SIMEC request comment when supporting documentation has been finalised.

It is noted that the proposed layout includes panels that are located further to the south and southwest and of greater length than those shown in the layout submitted as part of SIMEC's project approval. Supporting documentation should include a comparison between extraction and project approval regarding predicted impacts to residential dwellings.

If you would like more information, please contact SA NSW on 4908 4300 or subsidencedevelopment@customerservice.nsw.gov.au

Yours sincerely

Kieran Black
Technical Specialist

2 February 2022

22 November 2021

Zhaleh Alamouti
Land Use Assessment Coordinator
Transport for NSW
Locked Bag 5085
Parramatta NSW 2124

Emailed to:
development.southern@rms.nsw.gov.au
Martin.Cocca@rms.nsw.gov.au
Cyril.Gunaratne@transport.nsw.gov.au
Dony.D.Castro@transport.nsw.gov.au

Dear Zhaleh,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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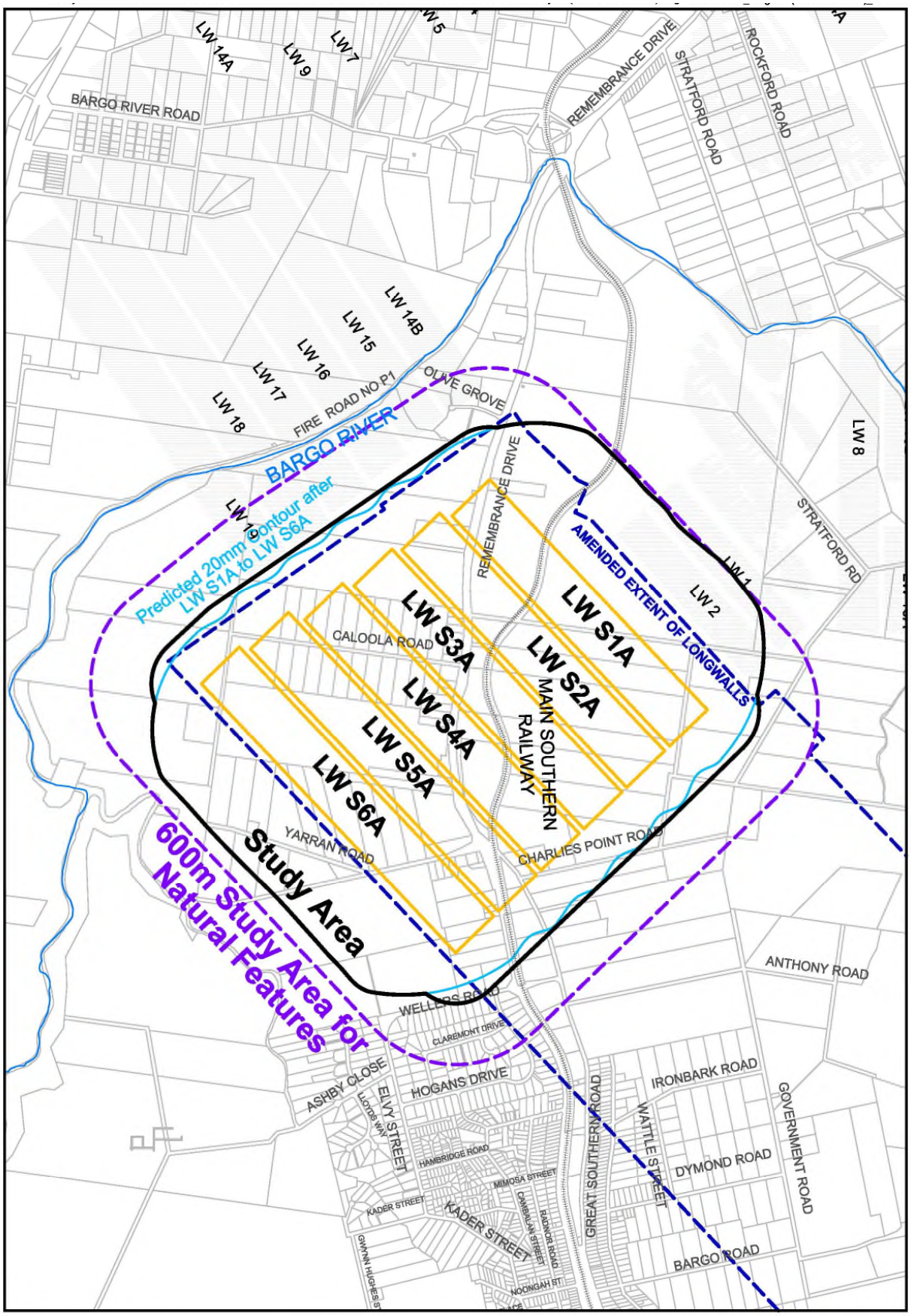
Tahmoor Coal would like to consult with Transport for NSW regarding the LW S1A-S6A Extraction Plan currently in preparation. The Study Area includes roads, bridges and culverts that are managed by Wollondilly Shire Council, which would be considered in the LW S1A-S6A Built Features Management Plan as well as the LW S1A-S6A Wollondilly Shire Council Management Plan. It is our understanding that no State roads managed by Transport for NSW are located within the Study Area.

We would be pleased to incorporate your organisation's preliminary comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,

Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

9 March 2022

TfNSW Reference: SYD21/01634/01
Council Reference: SSD 8445

The General Manager
SIMEC Mining
2975 Remembrance Road
TAHMOOR NSW 2574

Attention : Zina Ainsworth

Dear Sir/Madam,

REQUEST FOR INPUT PREPARATION OF EXTRACTION PLAN, TAHMOOR COAL, LONGWALLS SOUTH 1A TO SOUTH 6A EXTRACTION PLAN

Transport for NSW (TfNSW) refers to your correspondence dated 22 November 2021 regarding the subject Extraction Plan.

TfNSW has reviewed the information provided and acknowledges the proposals requirement to prepare an Extraction Plan to support the proposed extension of underground mining operations. The proposed extension into the identified Long Walls South 1A to South 6A does not appear to directly impact TfNSW infrastructure and thus no further requirements are recommended.

It is noted that consent under Section 138 of the Roads Act, 1993 would be required for any proposed longwall extension adjacent to or under the Hume Highway, or any road/rail within the TfNSW network, as well as any works within the classified reserve. It should be noted that where such works are proposed the proponent would need to enter into a Deed of Agreement to manage the mining impacts and relationships where;

1. Any longwall is within a distance of 5 times the seam depth to an TfNSW asset as this would need to be submitted to TfNSW for risk assessment of subsidence impacts and far-field effects; and
2. Consideration of subsidence impacts on TfNSW infrastructure must include consequential impacts on functionality and user safety, as well as far fields effects.

In addition, TfNSW further advises that :

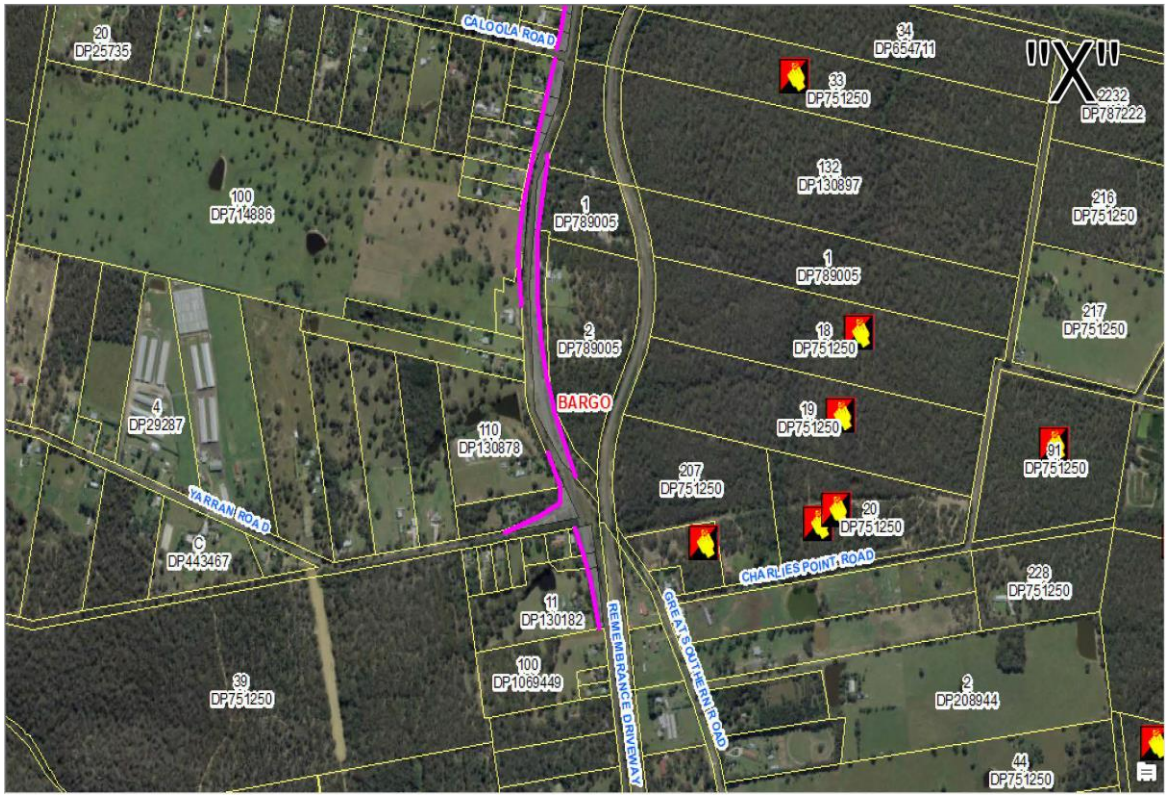
- consideration should be given to the impacts of any additional traffic generated by the proposed extension of long wall mining operations; and

- further comments may be provided when the LW S1A-S6A Built Features Management Plan is made available as these works may impact Remembrance Driveway and the nearby school zone associated with Wollondilly Anglican College.
- Transport for NSW (Roads) (formerly, Roads and Maritime Services of New South Wales) has previously resumed & dedicated a strip of land as road along the Remembrance Driveway frontage of the subject property, as shown by grey colour on the attached Aerial – "X"
- No objections are raised to the development proposal on property grounds provided all buildings and structures, together with any improvements integral to the future use of the site are wholly within the freehold property (unlimited in height or depth), along the Remembrance Drive boundary.

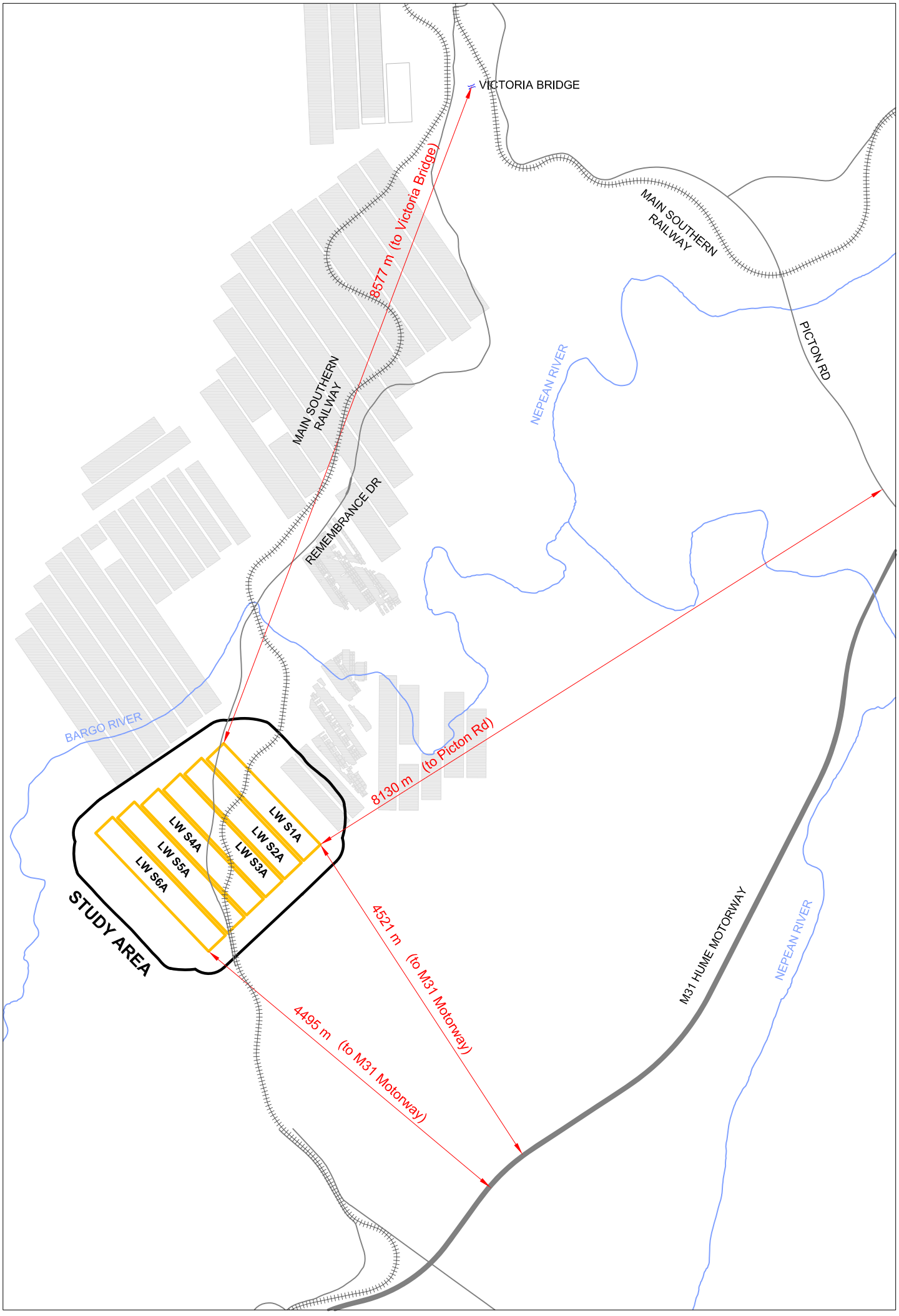
TfNSW welcomes further consultation in relation to these impacts and If you have any further questions, Mr Chris King would be pleased to take your call on 0419 484 667 or please email development.sydney@rms.nsw.gov.au. I hope this has been of assistance.

Yours sincerely

Laura van Patten
A/Senior Land Use Assessment Coordinator



I:\Projects\Tahmoor South\MSEC1192 - Extraction Plan for LW S1A-S6A\AcadData\MSEC1192_Diagram_RMS.dwg



22 November 2021

Ian Cochran
Technical Specialist
Office of the National Rail Safety Regulator
Level 4, 309 Kent Street
Sydney NSW 2000

Emailed to:
ian.Cockran@onrsr.com.au

Dear Ian,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

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- Graphical Plans.

Tahmoor Coal would like to consult with the Office of the National Rail Safety Regulator regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of the Main Southern Railway, which would be considered in the LW S1A-S6A Built Features Management Plan as well as the LW S1A-S6A Main Southern Railway Management Plan.

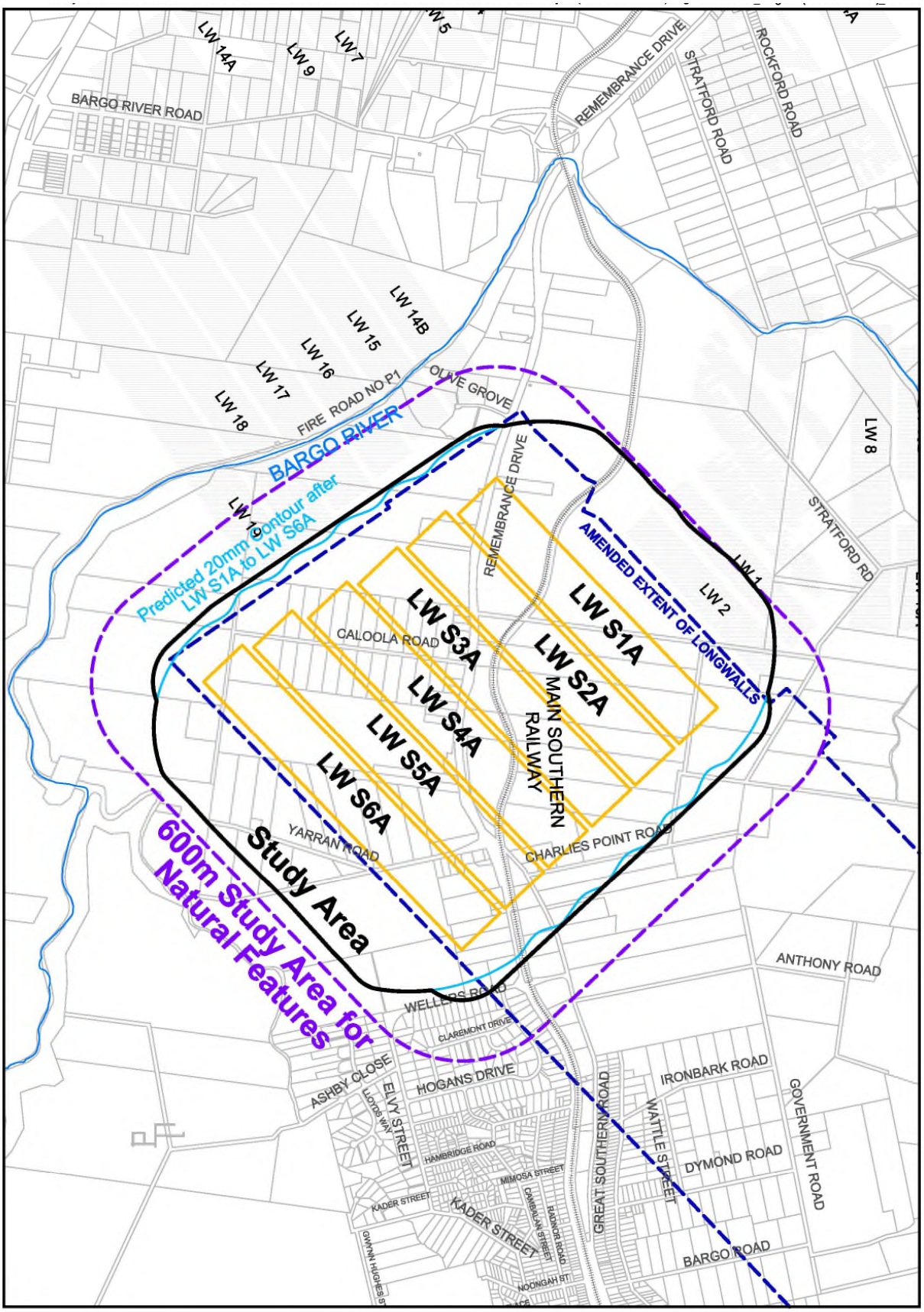
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Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

Archived: Tuesday, 1 March 2022 7:51:12 AM
From: Ross Barber
Sent: Thursday, 13 January 2022 8:38:00 AM
To: Ian Cochran
Cc: robinsonrail100@gmail.com; Amanda Bateman
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation
Sensitivity: Normal

Hi Ian

The Tahmoor Coal Dec 23rd Letter was just a standard notification letter to all stakeholders within the 20mm subsidence area for the new block development at Tahmoor South Lw1a-6a
It is a consent requirement to notify all stakeholders

You are already across the Tahmoor South development from your involvement in the Tahmoor South Rail Risk Assessment
The investigation actions from that Risk Assessment are currently planned to start in the late Jan 22 possession
The signed Tahmoor South Rail Management Plan is planned for delivery by 500ms of extraction of LW1a – Estimate Jan 23

I believe the next action would be a site visit once Tahmoor Coal have completed the rail Investigation Works to inspect the proposed site / surface features for LW1a to 6a

Gang LI from the Resource Regulator will also want to inspect the rail and major surface features in the Subsidence area

When practical to do so, I will arrange a site visit – (March/April)

Please let me know if you need more information

Kind regards

Ross Barber
Project Manager Subsidence

T: +61-2-4640-0028
M: +61-0419 466 143
E: Ross.Barber@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Bargo NSW 2574
simec.com







From: Ian Cochran <Ian.Cochran@onrsr.com.au>
Sent: Wednesday, 12 January 2022 11:56 AM
To: Ross Barber <ross.barber@simecgfg.com>; robinsonrail100@gmail.com
Subject: FW: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Ross,

With regard to your email of 23 December 2021, will you please send me the draft plan to review.

Note: we cannot access most file transfer applications, please send me the file.

cc Graeme Robinson

Regards,

Ian Cochran
Technical Specialist - Bridges & Structures
Technical Division

onrsr Office of the National Rail Safety Regulator

PO Box 3461, Rundle Mall, Adelaide SA 5000
Level 4, 309 Kent Steet, Sydney NSW 2000
m 0414 840 400

e ian.cochran@onrsr.com.au

onrsr.com.au

From: Ross Barber <Ross.Barber@simecgfg.com>
Sent: Thursday, 23 December 2021 9:10 AM
To: Ian Cochran <Ian.Cochran@onrsr.com.au>; RRD OCI Subsidence Monitoring Mailbox <subsidence.monitoring@planning.nsw.gov.au>
Cc: Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; April Hudson <April.Hudson@simecgfg.com>
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

[**EXTERNAL E-MAIL:** This email originated outside of the organisation. Do not click on links or open attachments unless you recognise the sender and know the contents is safe.]

Hi Ian

Please see attached a letter regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Kind regards,

PS. Thanks for your support in 2021

Ross Barber
Project Manager Subsidence

T: +61-2-4640-0028
M: +61-0419 466 143
E: Ross.Barber@simecgfg.com

SIMEC Mining

2975 Remembrance Driveway
Bargo NSW 2574
simec.com







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Any opinions contained in this message are those of the author and are not provided or endorsed by ourselves unless clearly indicated and the authority or the author to so bind is duly verified.

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22 November 2021

Michael Irons
Property Manager Wagga Wagga
Australian Rail Track Corporation
PO Box 2150
Wagga Wagga NSW 2650

Emailed to:
mirons@ARTC.com.au

Dear Michael,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

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Tahmoor Coal would like to consult with the Australian Rail Track Corporation regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments regarding the management and monitoring of the Main Southern Railway, which would be considered in the LW S1A-S6A Built Features Management Plan as well as the LW S1A-S6A Main Southern Railway Management Plan.

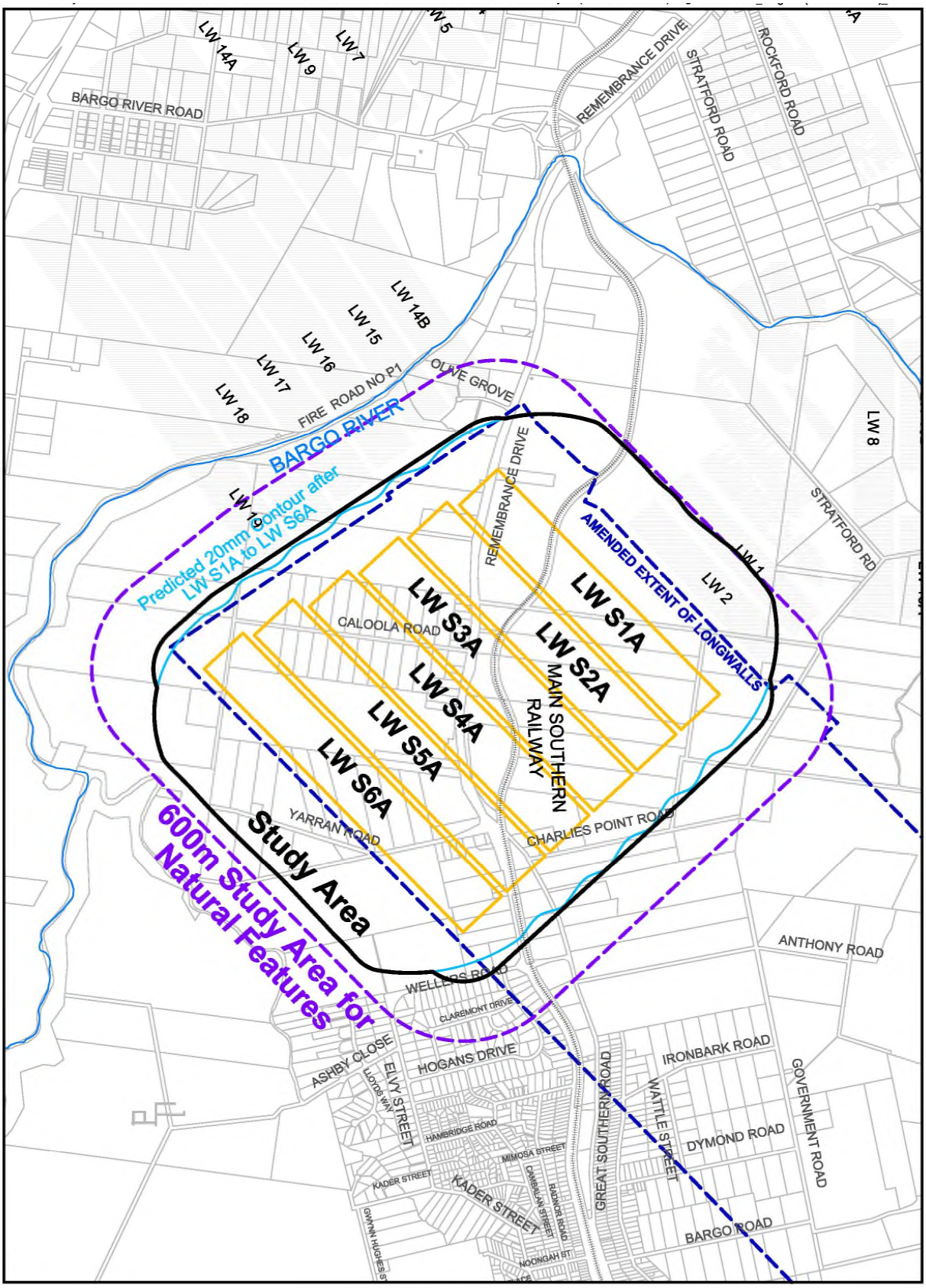
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Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

MINUTES OF MEETING

10 December 2021

Project	Tahmoor Coal MSR Mine Subsidence Management Western Domain_LW W3	From	Graeme K Robinson
Subject	Weekly Rail Management Group Meeting	Tel	0410 455 911
Venue/Date/Time	Teleconference 1000 on Friday 10 December 2021	Job No	
Copies to	Michael Irons (MI)		

Attendees				Apologies or Absent	Nil
	Ross Barber	RB	SIMEC		
	Steve Chance	SC	ARTC		
	Kevin Golledge	KG	SIMEC		
	Allan Pidgeon	AP	PCE		
	Daryl Kay	DK	MSEC		
	Greme Robinson	GR	RR		
	Kyle Coffee	KC	Globetech		
	Mark Delaney	MD	Newcastle Geotech		
	John Matheson	JM	JMA		
	Rod Sweeting	RS			
	Chris Bloor	CB	Bloor Rail		
	John Rolles	JR	SRS		

Safety, Security and Rail Operations

- Nil.

Corona (COVID-19) Status and Impact

- There were no reportable COVID-19 issues this week.

Longwall Status and MP Progress

- LW W3 commenced operation on Tuesday 14 September 2021 and travelled 71 m during the week since 30 November. LW W3 is ahead of schedule finishing in April 2022 with planning for LW W3 commencing today.
- The LW has completed mining beneath the track and has now retreated by 510 m away from the corridor at 88.440 km.
- The maximum increase in subsidence along the track this week as a result of LW W3 was 5 mm at 87.500 km as at 7 December 2021. The maximum incremental subsidence along the track since the start of LW W3 was 2 mm.

- RB advised that LW W4 has been shortened by 300 m due to poor ground (mushy coal) and is due to commence in April 2022 and finish in July 2022.

Track

- AP reported only minor changes in minor changes in subsidence and in 100 m long bays from 2-D Survey during the week.
- AP reported that, based on the results of the latest full Krab runs on 7 December 2021, that Track Geometry exceeds trigger levels at several locations in the Picton Tunnel Section but this condition pre-exists the mining of LW W3.
- Variations in Cant were noted along the Down Main from 87.850 km to 88.200 km. This section of track is in poor condition due to formation issues (bog holes). A detailed inspection of this section of track, plus poor track condition in the vicinity of Connellan Crescent overbridge, was carried out by AP/GR/CB on Monday 15 November and a report sent to RB on findings. RB forwarded a copy of the report to SC for review and recommendations.
- AP noted some minor changes in Cant at 87.663 km on the Down Main (<2 mm).
- No issues with Picton Tunnel clearances. All within 3 mm range.
- ARTC are planning to carry out re-railing at various locations within the mine site during the upcoming January possession. The RMG reviewed the proposed locations and RB instructed KC to remove all cables from the track and for JR to remove prisms from track in the tunnel that would likely be affected by the project to give ARTC a clear run. Equipment will be reinstated ASAP following the work.

Monitoring Systems

Ground Survey Monitoring

- Weekly ground survey results are within survey tolerances.
- Subsidence (Approx. 305 mm) is developing above the centreline of the (GNSS Site 23) with minor movements starting to the south and west.
- Results of the weekly long bay length survey completed on 7 December observed that minor ground shortening of 7 mm is developing between 87.300 km and 87.400 km, no change this week. The results do not appear to correlate with 2D surveys.

Remote Electronic Monitoring

- The latest BLUE test alarm was successfully carried out at R_DD_87_200 on 18 November with all systems working OK, including the TCCC who responded very quickly.
- KC reported a gauge issue (drift) at R_UU_88.040 that will be replaced.
- KC advised that testing would now commence for gauges installed to accommodate LW W4 during the week. Will need to LS on board for the download process.
- No other issues to report at this stage.

Structures

Bridge Street Overbridge (91.030 km)

- Only minor changes during the month in 3D survey carried out on 11 November.
- No measurable changes in distances across the abutments undertaken on monthly survey carried out on 10 November.

Thirlmere Way Underbridge (89.326 km)

- Only minor changes as a result of monthly survey carried out on 11 November.
- No measurable changes in distances across the base of the arch on 10 November.
- Very minor changes observed laser disto readings across the top of the arch. There is a need to clean prisms over roads at TWU, Argyle St UB and Victoria Rd bridge, as data is becoming unstable. Proposed road closure in mid-January to clean. RS will liaise with CB.
- Inspections commence during Stage 2 management.

Connellan Crescent Overbridge (89.080 km)

- Only minor changes since the last survey 11 November.
- No measurable changes in distances across the base of the arch on 10 November.
- Crack gauges were measured on 15 November with minor changes in widths less than trigger level.

Ballast Top Subway (88.133 km)

- Only minor changes since last far-field monthly 3D survey on 11 November.
- No measurable changes in distances across tops of the abutments on 10 November.
- Small increase in closure at the base of the arch on the Down side this month, exceeding the 5 mm monitoring review point trigger. Heavy rainfall prior to survey was noted.
- A structural inspection was completed by JM on 30 November, with no immediate concerns. JM advised that there were no changes in crack widths, and the report concluded that the probable cause of movement of the structure at this point is likely due to buildup of moisture behind the wingwall, exacerbated by recent heavy rains.
- A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall.
- The RMG has reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm.
- Additional survey was carried out by JR during the week with no change.
- RB issued a report and recommendations to ARTC (Tony Godfrey) on 8 December following MD's inspection.

Picton Tunnel (87.85 km)

- Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Small movements to the east and south.
- Monthly and weekly 3D survey results of prisms within the tunnel revealed only minor changes in horizontal openings and closures across the arch. Changes in vertical alignments and changes in track centres are less than trigger levels.
- Monthly and weekly 3D surveys of prisms outside the tunnel results are within survey tolerances. However, some of the low prisms are in need of cleaning. CB will do.
- Only minor changes in laser disto results with changes in horizontal openings and closures across the arch are less than trigger levels. Prisms were cleaned during the November track possession.
- No measurable changes to track centres or tunnel clearances observed within the tunnel. JR conducted an additional kinematic envelope survey at the Sydney portal during last weekend's track possession to reconfirm baseline conditions. Results will be available next week.
- JR noted that one of the trackside prisms (87.783 km) attached to a sleeper had been struck by dragging equipment from a train. The prism was replaced and results normalized.
- No measurable changes in inclinometer readings during the month. Only minor changes since LW W2 was completed.
- Daily visual inspections reported no changes with no new cracks observed.

Mushroom Tunnel

- Only minor changes in distances across the base of the arch and along the tunnel on 10 November.
- Daily visual inspections reported no changes.

Ballast Top Subway (86.838 km)

- Only minor changes last survey 11 November. Very minor changes this month.
- The local 3D survey carried out on 10 November this month observed minor changes across the abutments.

Argyle Street Underbridge (86.16 km)

- Only minor changes noted following last survey on 11 November.
- No measurable changes in distances across the base of the arch on 10 November.
- Only minor changes in Disto readings this month with results showing signs that prisms require cleaning.
- RS reported that sensors UBA-D-US-DS and UBA-D-US-DC are showing signs that they need cleaning. RS will discuss with CB for prism cleaning in mid-January 22.

Pedestrian Overbridge (86.100 km)

- Very minor changes on 10 November.

Pedestrian Overbridge (85.846 km)

- Minor changes on 10 November.

Picton Viaduct (85.42km)

- Minor ongoing trend of movement to the west towards LW W1-W2 from GNSS Units at Site 0 and 2. Minor changes this week.
- Only minor changes during the month in Far-field survey results carried out on 11 November.
- Results of weekly 'precision' survey carried out on 29 November noted that horizontal openings and closures between ends of Viaduct are less than trigger level.
- Monthly local 3D survey results indicated that there were minor changes between abutments and bases of piers on 10 November. Horizontal openings and closures between ends of Viaduct are less than trigger level.
- Irregular inclinometer movements (5 m and 8 m) observed in first re-survey at PVD1 on 28 October. The survey result did not correlate with other monitoring results, including inclinometers PVD2 and PVD3. The survey was checked and there has been no change in readings from last week. MD believes that it is possible that a vehicle has driven over the cover due to its location near the access gate. All other inclinometers are OK. Will continue to monitor.
- Weekly visual inspection and track geometry inspection results revealed no issues.
- MN carried out the latest drone (UAV) inspection of crack gauges on 16 November. Changes in crack widths were less than trigger level. JM reviewed the data to check if any movement/changes and reported no issues.

Prince Street Overbridge (85.17 km)

- Far field survey carried out on 11 November and local 3D survey carried out on 10 November showed only minor changes this month.

Retaining wall (84.867 km)

- Minor changes in tilt noted from the top to base of wall on 10 November.

Matthews Lane Overbridge (84.551 km)

- Far field survey carried out on 11 November and local 3D survey carried out on 10 November showed only minor changes this month.

Victoria Bridge over Stonequarry Creek

- Minor ongoing trend of movement to the west towards LW W1-W2 noted from GNSS Unit at Site 3, but only minor changes since LW W2 was completed.
- Monthly Local 3D survey carried out on 9 November noted only minor changes between abutments this month. Maintenance works are obstructing views to some marks. VBP2 could not be measured this month due to bridge abutment works.
- Noted that bridge jacking by RMS carried out for the Western Abutment repairs is having an impact on survey readings.

Abbotsford Road Bridge over Stonequarry Creek

- Minor changes from far-field survey on 11 November.

Embankments and Cuttings

Embankment and Culvert at 87.331 km

- Minor changes were observed following monthly survey on 29 November. Some pegs on Down crest at B260, B300 and B32 appear to have been slightly disturbed. Further surveys required to confirm.
- Negligible changes in exto readings.
- No issues following visual inspection on 22 November.

Embankment and Culvert at 88.100 km

- Detailed weekly inspections and surveys commenced this week with only minor changes observed.
- No issues following visual inspection on 22 November.

Embankment and Culvert at 88.500 km

- Detailed weekly surveys commenced this week with results within survey tolerances.
- Weekly inspection revealed no issues.

Embankment and Culvert at 89.216 km

- Detailed weekly inspections and surveys commence during Stage 2 management.

Embankment and Culvert at 89.300 km

- Detailed weekly inspections and surveys commence during Stage 2 management.

Cutting at 87.600 km

- No issues following visual inspection on 22 November.

Cutting at 88.300 km

- No issues following visual inspection on 22 November.

ARTC/Regulatory/MSB/Approval Issues

- DK issued an Addendum to the Management Plan (Updated Risk Control Procedures for Picton Viaduct Report No. MSEC1163-02 Revision A, 2 December 2021) to confirm the outcomes of trigger levels discussed as a result of the meeting held on 19 October between the Regulators and Tahmoor Coal regarding planned risk controls for the Picton Viaduct for review by the RMG. RB will send the Addendum to ARTC (WN, cc SC) for review and approval prior to sending to the Regulators for advice.

General

Possessions

Future planned possession dates (subject to final approval and confirmation) as follows:

Fri 28 Jan 22 to Mon 31 Jan 22

Fri 13 May 22 to Mon 16 May 22

Fri 2 Sep 22 to Mon 5 Sep 22

Fri 11 Nov 22 to Mon 14 Nov 22

Fri 13 Jan 23 to Mon 16 Jan 23

Fri 21 Apr 23 to Mon 24 Apr 23

Tahmoor South Project (TSP)

- RB has arranged a PO to enable expansion switches to be bent to suit work track geometry requirements for the TSP that has been issued to PRE to allow the work to proceed.
- CB will remove remaining concrete bearers from track at Douglas Park and deliver to TSP site as soon as practicable. Those requiring bending by PRE will be delivered to their factory in Sydney next month by CB.

- RB advised that LW W4 has now been reduced ion length by 300 m. This means an accelerated program for TSP now programmed to commence in mid-August to September 2022 following approvals.
- CB will carry out a KRAB run along the track shortly for AP to review track condition. This will be carried out in conjunction with devegetation to enable inspections and ground survey to commence.
- KC has commenced work required to fabricate containers for monitoring system.
- DK is preparing the new subsidence modelling that will be completed soon to suit the new layout.

Next Monthly Meeting

The next weekly RMG meeting will be held as a teleconference at ***1000 on Friday 17 December 2021***.

The next ARTC Governance Meeting will be held as a teleconference at ***1230 on Friday 17 December 2021***.

Action Summary List:

ITEM	ACTION	BY	WHEN	CLOSED
1.				
2.				
3.				

Microsoft Teams Link and contact details as follows:

Join Microsoft Teams Meeting

+61 2 8318 0024 **Australia, Sydney (Toll)**

Conference ID: 431 265 826#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

Join with a video conferencing device

522596193@t.plcm.vc **VTC Conference ID: 1399409847**

Alternate VTC dialing instructions

22 November 2021

Bianca Klein
Manager Environmental Outcomes
Wollondilly Shire Council
PO Box 21
Picton NSW 2571

Emailed to:
Bianca.klein@wollondilly.nsw.gov.au
david.henry@wollondilly.nsw.gov.au
bruce.devonport@wolondilly.nsw.gov.au

Dear Bianca,

Tahmoor South Longwalls South 1A to South 6A Extraction Plan
Letter of Consultation

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates the Tahmoor Mine, an existing coal mine approximately 80 kilometres south-west of Sydney between the towns of Tahmoor and Bargo. Tahmoor Coal is a wholly owned entity within the SIMEC Mining division of the GFG Alliance group.

Tahmoor Mine has been operating continuously since 1979, and longwall mining methods have been used since 1987. Tahmoor Coal has previously mined 34 longwalls to the north and west of the Tahmoor Mine's current pit top location.

Tahmoor Coal obtained approval for the Tahmoor South Project on 23 April 2021, which was assessed as State Significant Development under the provision of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will extend underground coal mining at Tahmoor Mine, to the south of Tahmoor Coal's existing mining area (referred to as the Tahmoor South Domain).

Tahmoor Coal is currently preparing an Extraction Plan for Longwalls South 1A to South 6A (LW S1A-S6A) in accordance with the condition C8 of the Development Consent (SSD 8445). The attached figure illustrates the location of the proposed longwalls, as well as the Study Area of this Extraction Plan and the predicted 20 mm subsidence contour.

The Extraction Plan will provide an overview of the project, details of the development of the Extraction Plan, details on how subsidence impacts and environmental consequences will be monitored and managed during and after mining, and details on how the Extraction Plan will be implemented.

The Extraction Plan will be supported by the following key documents:

- Subsidence Prediction and Impact Assessment Report;
- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan;
- Public Safety Management Plan;
- Subsidence Monitoring Program; and
- Graphical Plans.

Tahmoor Coal would like to consult with Wollondilly Shire Council regarding the LW S1A-S6A Extraction Plan currently in preparation. In particular, Tahmoor Coal are seeking preliminary comments, in particular regarding the management and monitoring of roads, bridges and culverts that are managed by Wollondilly Shire Council, which would be considered in the LW S1A-S6A Built Features Management Plan as well as the LW S1A-S6A Wollondilly Shire Council Management Plan.

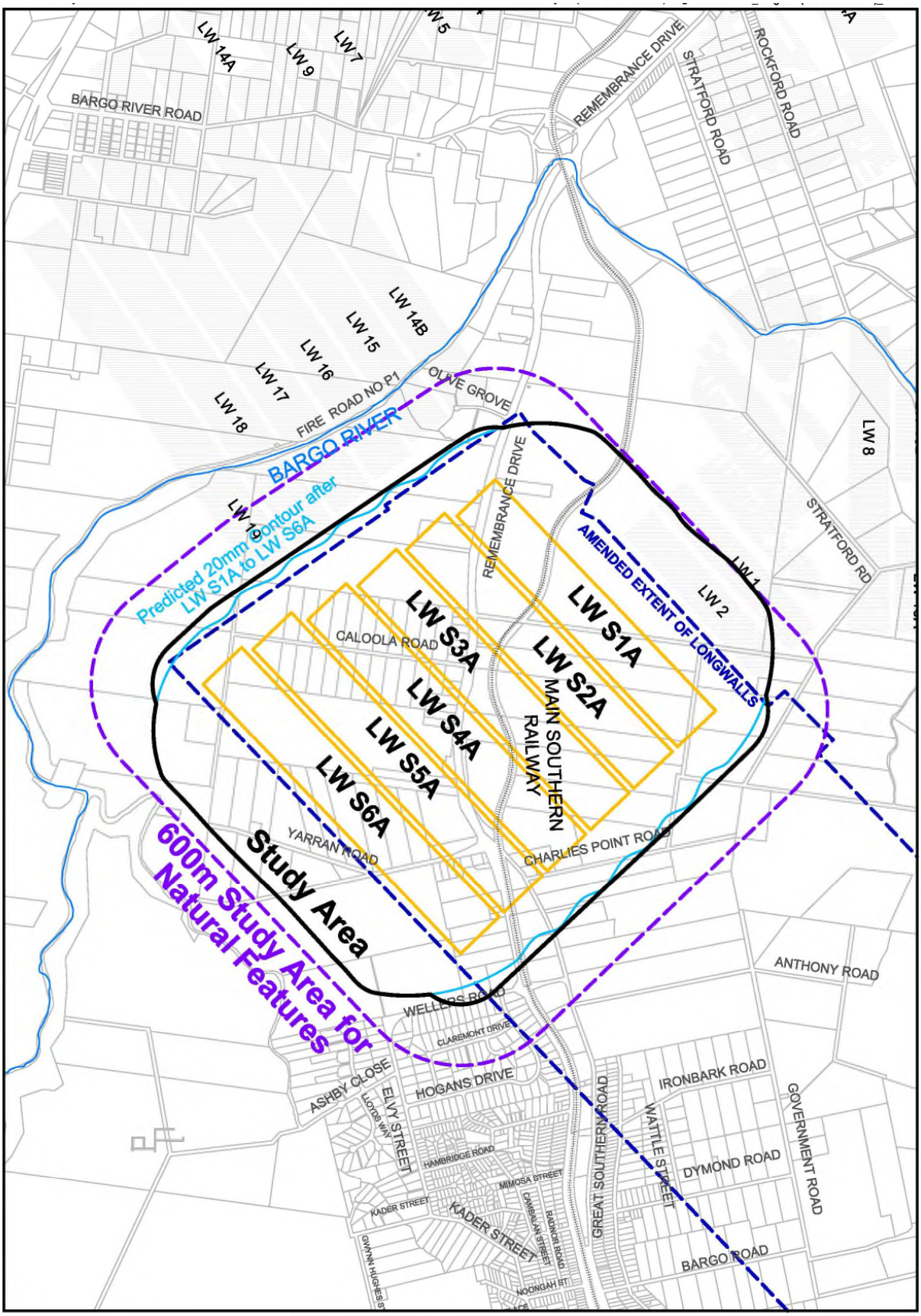
We would be pleased to incorporate your organisation's comments into the Extraction Plan, and to facilitate this we would appreciate receiving your comments by **Friday 4 February 2022.**

Please do not hesitate to contact me if you have any questions or concerns regarding the above on 0438 284 106 or at zina.ainsworth@simecgfg.com or contact April Hudson, Approvals Specialist, on 0466 380 992 or at april.hudson@simecgfg.com.

Yours sincerely,



Zina Ainsworth
Manager Environment and Community
Tahmoor Coal Pty Ltd
SIMEC Mining



Extraction Plan LW S1A-S6A Study Area

April Hudson

From: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>
Sent: Friday, 21 January 2022 10:24 AM
To: April Hudson
Cc: David Henry; Zina Ainsworth; Norma Toweel; Nafizul Akash
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi April

Comments from Council's Assets and Transport team are below:

Wollondilly can only effect repairs to road pavement in the event of an emergency. All other repairs are required to be carried out by Tahmoor Coal to the satisfaction of Wollondilly Shire Councils Construction Specification. Suitably qualified civil contractors employed by Tahmoor Coal must be available to complete temporary restoration works as required, and after to complete the final restoration works.
All cracks/damage to kerb & gutter, footpaths, drainage structure and property entrances are the responsibility of Tahmoor Coal and must be managed throughout the length of the mining activity, and permanent repairs carried out to the satisfaction of the property owner (either Council or a private party) upon the completion of any subsidence activity.

Kind regards

Bianca Klein
Acting Manager Waste and Environment Services

T 0246779610
A P.O. Box 21 Picton, NSW, 2571
E Bianca.Klein@wollondilly.nsw.gov.au
W http://www.wollondilly.nsw.gov.au



From: April Hudson [mailto:April.Hudson@simecgfg.com]
Sent: Tuesday, 4 January 2022 8:37 AM
To: Bianca Klein
Cc: David Henry; Zina Ainsworth; Norma Toweel
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Hi Bianca,

Yes, that will be fine.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

From: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>
Sent: Thursday, 23 December 2021 2:52 PM
To: April Hudson <April.Hudson@simecgfg.com>
Cc: David Henry <david.henry@wollondilly.nsw.gov.au>; Zina Ainsworth <Zina.Ainsworth@simecgfg.com>; Norma Toweel <Norma.Toweel@wollondilly.nsw.gov.au>
Subject: RE: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

You don't often get email from bianca.klein@wollondilly.nsw.gov.au. Learn why this is important

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Hi April/Zina

Is it possible to receive an extension on the 4th February date to provide preliminary comments? An extra fortnight will be appreciated given the Christmas/New Year closure period.

Thanks

Bianca Klein
Acting Manager Waste and Environment Services

T 0246779610
A P.O. Box 21 Picton, NSW, 2571
E Bianca.Klein@wollondilly.nsw.gov.au
W http://www.wollondilly.nsw.gov.au



From: April Hudson [mailto:April.Hudson@simecgfg.com]
Sent: Wednesday, 22 December 2021 6:19 PM
To: Bianca Klein
Cc: David Henry; bruce.devonport@wolondilly.nsw.gov.au; Zina Ainsworth
Subject: Tahmoor Coal - Longwalls South 1A to South 6A Extraction Plan consultation

Dear Bianca,

Please see attached a letter regarding consultation for Tahmoor Coal's Longwalls South 1A to South 6A Extraction Plan.

Kind regards,

April Hudson
Approvals Specialist

T: +61 2 4640 0022
M: +61 466 380 992
F: +61 2 4640 0140
E: April.Hudson@simecgfg.com

SIMEC Mining
2975 Remembrance Driveway
Tahmoor NSW 2574
simec.com

SIMEC

MEMBER OF GFG ALLIANCE

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Wollondilly Shire Council

Frank McKay Building 62-64 Menangle Street, Picton NSW 2571
All Correspondence to PO Box 21, Picton NSW 2571
Telephone: 02 4677 1100 Fax: 02 4677 2339
Email: council@wollondilly.nsw.gov.au Web: www.wollondilly.nsw.gov.au
ABN: 93 723 245 808

Your Ref: 1148-3#2087

Ms A Hudson
Approvals Specialist
SIMEC Mining
2975 Remembrance Driveway
TAHMOOR NSW 2574

14TH February 2022

Dear Ms Hudson

ENVIRONMENTAL COMMENTS ON EXTRACTION PLAN 1A TO 6A

Thank you for the opportunity provided to Wollondilly Shire Council to provide comment during the preparation of the first Extraction Plan associated with the Tahmoor South Project.

The SIMEC correspondence dated 22nd November 2021 is noted to state that *"in particular, Tahmoor Coal are seeking preliminary comments, in particular regarding the management and monitoring of roads, bridges and culverts that are managed by Wollondilly Shire Council".* Previous comments from Council's Assets and Transport team regarding this matter were provided in my e-mail correspondence dated 21st January 2022.

The following provide comments and requested items for investigation by the Extraction Plan on residual concerns of the Project Application expressed in regard to the Response to Submission Report, Second Amendment Assessment Report and to the Independent Planning Commission (IPC). It is understood that the longwalls covered by the Extraction Plan are at a sufficient distance to not result in any subsidence induced impacts to the operation of the Bargo Waste Management Centre. However, clarification by SIMEC of this understanding would be appreciated**.**

(i) Subsidence impacts to dwellings

Council's submission to the IPC welcomed the 80 percent reduction in directly undermined residential dwellings but requested a detailed consultation program be implemented with affected landowners over the full cycle of the current process overseen by Subsidence Service. Council would expect in this regard that the Extraction Plan involve a detailed consultation program as well as identification to the greatest accuracy possible likely subsidence-related impacts to dwellings over the full duration of a particular longwall.

The IPC is noted to have included a condition in the Determination "*for the voluntary acquisition rights for properties affected by certain types of damage that are impacted by more than one longwall"* as an alternative to this process. It is requested to be noted Council does not have a formal position over such acquisition. However, the offering of this process as an alternative and detailed explanation of its potential negative and positive implications to landowners would be expected.

(ii) Subsidence impacts to surface and groundwaters

Council's submission on the Second Amendment Assessment Report raised residual concerns over potential impacts to water sources. The Determination issued by the IPC has been viewed as not adequately addressing this residual concern apart from the condition referring to the requirement for updated groundwater modelling. The following items consistent with issues previously raised including amendments to draft conditions issued by the NSW Department of Planning, Industry and Environment (DPIE) are requested to be included in the Extraction Plan:

- An assessment of impacts to surface and groundwaters be consistent with all current scientific research that includes the Characterisation and Modelling of Geological Fault Zones Guideline publication available on the Commonwealth Independent Expert Scientific Committee (IESC) website at https://iesc.environment.gov.au/consultation/iesc-en-characterisation-and-modelling-of-geological-fault-zones
- A detailed geological model that identifies the likely interaction of subsidence induced fractures with the modelled groundwater environment as part of complying with the above IESC publication.
- A scientific based investigation over the establishment of Risk Management Zones for third order watercourses for the purposes of identifying and managing impacts associated with subsidence to the ecological health of waterways within a catchment context.
- An assessment of potential impacts of mining activities to the operation of private bores and mitigation measures to address any identified potential adverse implications.
- Trigger Response Action Plans and related monitoring programs that are developed as part of the Extraction Plan and Water Plan are to be scientifically based, supported by commensurate data. They are requested in this regard to include appropriate ecological focussed indicators to monitor any impacts to the ecological health of waterways at a suitable timeframe that would restrict the need for Creek Management Action Plans.

Please contact Council's Acting Team Leader Environmental Services, David Henry on (02) 4677 9687 or via e-mail David.henry@wollondilly.nsw.gov.au for any enquiries regarding this correspondence

Yours faithfully

BKlein

Ms Bianca Klein
Acting Manager Waste and Environmental Services

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 2 December 2021

Name	Role
Attendees	
Michael Muston (MM)	Independent Chairperson
James Johnson (JJ)	Community Representative
Col Mitchell (CM)	Community Representative
David Auchterlonie (DA)	Community Representative
Bob Clayton (BC)	Community Representative
David Henry (DH)	Wollondilly Shire Council Representative (online)
Peter Vale (PV)	Tahmoor Coal Representative
Zina Ainsworth (ZA)	Tahmoor Coal Representative
Amanda Bateman (AB)	Tahmoor Coal Representative (minute taker)
Invitees	
Natalie Brumby (NB)	Tahmoor Coal Representative
April Hudson (AH)	Tahmoor Coal Representative (online)
Thomas O'Brien (TO)	Tahmoor Coal Representative
Nick Le Baut (NLB)	Tahmoor Coal Representative (online)
Apologies	
Greg Kininmonth (GK)	Resources Regulator
Robert Khan (RK)	Wollondilly Shire Council Representative
Ana Gracanin (AG)	Community Representative
Matthew Montgomery (MMt)	Subsidence Advisory NSW
Ross Barber (RB)	Tahmoor Coal Representative

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 2 December 2021

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised
1. Welcome and Introductions				
1.1.	Michael Muston is the Independent Chairperson. He acknowledged the Traditional Owners of the land on which we met and paid respects to their Elders, past and present.	NOTE		02/12/21
2. Declarations of Interest				
2.1.	MM is paid by Tahmoor Coal.	NOTE		02/12/21
2.2.	Tahmoor Coal Apprentice Engagement Program purchase barbeque items from Khan Supa IGA Picton, which is owned and operated by RK.			
3. Apologies				
3.1.	As per list above.	NOTE		02/12/21
4. Confirmation of Minutes of Previous Meeting				
4.1.	Change requested by BC to section 7.7 – a community member asked about former SA NSW staff working for Tahmoor Coal. ***Action: AB to amend minutes and redistribute.***	AB	**10/12/21**	
4.2.	Confirmation of Minutes from 2 September 2021 accepted with change made. Note: Q3 minutes to be added to the Tahmoor Website.	NOTE		02/12/21
5. Business Arising from Previous Minutes				
5.1.	Committee requested a mine plan be distributed showing the Tahmoor South first working development mining in relation to the mine site and surrounding properties. ***AB emailed mine plan to members on 6 September 2021 – Completed and closed.***	CLOSED		02/12/21
5.2.	Committee asked do water quality limits change with the implementation of the Waste Water Treatment Plant? Tahmoor to provide a brief explanation of ANZECC Guidelines as well as EPL limit next meeting – ***included in meeting presentation.***	CLOSED		
5.3.	Committee requested acronyms throughout presentation be spelt out in full to assist going forward – ***Completed and closed.***	CLOSED		
6. Correspondence - update as per the agenda				
6.1.	Tahmoor South First Workings Mine Plan – Emailed by Amanda Bateman 06/09/2021	NOTE		02/12/21
6.2.	Western Domain Newsletter #4 Sep 2021 – Emailed by Amanda Bateman 14/09/2021			
6.3.	Q3 TCCCC Chair invoice submitted for payment - Emailed by Michael Muston 15/09/2021			
6.4.	Q3 Draft TCCCC Meeting Minutes – Emailed by Amanda Bateman 23/09/2021			
6.5.	Q3 TCCCC Meeting Minutes confirmed – Emailed by Michael Muston 23/09/2021			
6.6.	Q3 TCCCC Meeting Minutes distributed – Emailed by Amanda Bateman 24/09/2021			
6.7.	CMAP Sep 2021 Newsletters – Emailed by Amanda Bateman 29/09/2021			
6.8.	Draft Air Quality & Greenhouse Gas Management Plan – Sent by Amanda Bateman 08/10/2021			
6.9.	Response to Draft Air Quality & Greenhouse Gas Management Plan – Emailed by Ana Gracanin 23/10/2021			
6.10.	Response to Draft Air Quality & Greenhouse Gas Management Plan – Emailed by David Henry 29/10/2021			
6.11.	Six Monthly Subsidence Report LW W1-W4 – Emailed by Amanda Bateman 16/11/2021			
7. Committee Members Reports				
7.1.	**David Auchterlonie**	DA		02/12/21

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised
	• Does Tahmoor know about the tippers and trucks coming in and out of Kader Street Bargo? o PV advised that Tahmoor will investigate but unlikely related to mining operations.	TO	**10/12/21**	
7.2.	**Col Mitchell** • Nil	CM		02/12/21
7.3.	**David Henry** • Provided an update regarding the Thirlmere Lakes Research Program meeting which SIMEC Mining representatives, Natalie Brumby and Tom O'Brien attended. Researchers to continue monitoring the hydrology of the lakes. A report is due to be released in December or January from the Department of Planning, Industry & Environment (DPIE) Science Division. • Local council election being held on Saturday 4 December 2021. Following the election results, a new council representative for the TCCCC will be selected and notification will be provided in early February 2022. ***Action: DH to notify MM and AB of the new representative once known.***	DH	**11/02/22**	02/12/21
7.4.	**Robert Khan** • Apologies	RK		02/12/21
7.5.	**Ana Gracanin** • Apologies – sent message seeking an update on the Air Quality & Greenhouse Gas Management Plan o AB advised the feedback received on the plan was consolidated and the plan was submitted to Department of Planning, Industry & Environment (DPIE) for endorsement. ***Action: AB to email final version to AG***	AG AB	**03/12/21**	02/12/21
7.6.	**James Johnson** • Nil	JJ		02/12/21
7.7.	**Bob Clayton** • Nil	BC		02/12/21
8.	**Mining Operations Update** – Mine Update (presented by Peter Vale)			

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised

8.1. Mine Update:

- Tahmoor Colliery officially turned 40 on 23 October 2021.
- Funding for Australian Mining and Primary Steel (MPS) Australian business secured through Credit Suisse Asset Management (CSAM), who originally funded through Greensil. Wind up application withdrawn when deal was secured.
- Funding for the greater business ongoing
- Major Fraud office investigation in UK – no update
- Coal price – rose to historical high above $400/t, has reduced recently to around $315/t for Hard Coking Coal (HCC) (Tahmoor 89% of HCC).
- Iron ore prices have fallen, mainly driven by oversupply as steel making in China has slowed.

8.2. Western Domain:

- Longwall West 3 commenced on 14 September 2021.
- Start delayed by finalisation of Management Plans and Trigger Action Response Plans (TARPs) for monitoring of Stonequarry Creek Rockbar.
- Excellent performance to date, including daily and weekly production records.
- Development in Main Gate West 4 (MGW4) delayed by difficult geotechnical conditions requiring additional support.

8.3. Tahmoor South:

- Development mining ongoing in Tail Gate 1A (TG1A) for longwall South 1A (S1A) (no subsidence)
- Commenced development mining in Main Gate 1A (MG1A), installing conveyor for ongoing mining (no subsidence)
- Ongoing rehabilitation and construction works – ventilation, conveyors, gas drainage, etc.

NOTE — 02/12/21

9. Mining Operations Update – Tahmoor South (presented by April Hudson, Zina Ainsworth and Amanda Bateman)

9.1. Tahmoor South consent:

- Developing 13 Environmental Management Plans, status of each provided in table below.

Management Plan	Required Approval Timing	Status
Air Quality and Greenhouse Gas	Prior to Construction	Submitted to DPIE for endorsement
Noise Management Plan	Prior to Construction	Submitted to DPIE for endorsement
Traffic Management Plan	Prior to Construction	Submitted to DPIE for endorsement
Water Management Plan	Prior to Construction	Drafted, awaiting finalised Surface Water Management Plan
Surface Water Management Plan	Prior to Construction	HEC draft received, being reviewed by Tahmoor
Groundwater Management Plan	Prior to Construction	Submitted for agency comment
Biodiversity Management Plan	Prior to Construction	Agency comments received, final draft in preparation
Bushfire Management Plan	Prior to Construction	Submitted for agency comment
Spontaneous Combustion Management Plan	Prior to Second Workings	Drafted, awaiting Tahmoor comments
Social Impact Management Plan	Prior to Second Workings	Draft underway
Rehabilitation Strategy	Within 6 months of date of commencement of second workings	Agency comments received, final draft in preparation
Rehabilitation Management Plan	12 months from Regulations	Draft underway
Waste Management Plan	Update Only	Plan updated with Tahmoor South commitments

9.2. Tahmoor South Longwalls South 1A to South 6A (LW S1A-S6A) Extraction Plan:

- Mine plan recently confirmed
- Government agency and community consultation yet to commence
- Submission of LW S1A-S6A Extraction Plan anticipated April 2022

NOTE — 02/12/21

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised

	• Document preparation has commenced:
	  ○ Extraction Plan main document
	  ○ Water Management Plan
	  ○ Biodiversity Management Plan
	  ○ Land Management Plan
	  ○ Heritage Management Plan
	  ○ Built Features Management Plan
	  ○ Public Safety Management Plan
	  ○ Subsidence Monitoring Program
	• MM asked if Picton Wier was within the Study Area and if it would be impacted. ZA responded that it was not, however in accordance with the precautionary approach, a management plan for this structure will be prepared as part of the Extraction Plan.
	9.3. Tahmoor South Major Projects:
	• Mine site entrance upgrade (commencing April 2022)
	• Site noise mitigation works (to be completed by February 2024)
	• Sewage Treatment Plant (to be completed by September 2022)
	• Upgrade of air monitoring equipment
	• Gas Plant upgrade
	• Booster fan installation
	• Extensive surface and groundwater monitoring
	  ○ ***Action: AB to arrange presentation from Project Manager at next meeting***
	9.4. Tahmoor South Business Property Subsidence Management Plans:
	• 11 business/commercial properties have been identified in the A series longwalls requiring an individual Property Subsidence Management Plan (PSMP)
	• Consultation meetings have commenced with business owners
		AB	**03/03/22**	

10. Mining Operations Update - Western Domain (presented by April Hudson, Zina Ainsworth and Amanda Bateman)				

	10.1. Western Domain update – Longwall West 3 (LW W3)
	• Tahmoor Coal received Department of Planning, Industry & Environment (DPIE) approval for the commencement of LW W3 on Monday 13 September.
	• LW W3 is currently at 645m at COB 30/11/21 and the northern end of Stonequarry Estate will be in the Active Subsidence Zone this week.
	10.2. Subsidence Monitoring Observations
	• 407mm maximum observed incremental vertical subsidence at LW W3 centreline.
	• LW W2 centerline monitoring data indicates observed subsidence to be less than 650mm predicted maximum incremental vertical subsidence.
	• MM asked whether the predicted LW W2 maximum observed incremental vertical subsidence was the same as that for LW W3. AH responded that it was less than the predicted LW W3 amount, and the LW W2 measurements were less than predicted.
	10.3. Western Domain - Environmental
	• Latest Six-Monthly Subsidence Impact Report completed 15 November 2021.
	• No observed subsidence-related impacts to surface water level and quality, pools, dams, ecology, cliffs, steep slopes, agricultural land, Aboriginal heritage.
	• Surface water level:
	  ○ Level 3 TARP trigger for Pool CR14 in September 2021.
	  ○ Relatively small water level decline most likely related to prevailing below average rainfall conditions.
	  ○ Trigger resolved naturally.
		NOTE		02/12/21

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised

	• Historical heritage:
	  ○ Rail sandstone culverts at 88.400 km and 88.980 km experienced cracking and spalling of sandstone blocks in the headwalls, culverts stable.
	  ○ Inspected by a heritage consultant at end of LW W2, Level 3 TARP trigger confirmed.
	  ○ Notification to Department of Planning, Industry & Environment (DPIE) on 21 September 2021.
	  ○ Advice being sought from heritage stonemason regarding remediation of the sandstone, to be completed after full effects of LW W3-W4 completed.
	• Groundwater quality:
	  ○ 'Potential' Level 4 Trigger Action Response Plan (TARP) trigger at P13C for Lithium – result of variation in natural groundwater condition rather than mining. Trigger level revised.
	  ○ Level 3 TARP trigger for Strontium and Barium at 2 private groundwater bores – likely due to pumping operations or natural variation rather than mining. Ongoing monitoring.
	• Groundwater level:
	  ○ Recovery from depressurization impacts from extraction of LW W1 and LW W2 noted in 4 shallow groundwater bores and 3 intakes in one deep groundwater bores – reduction in TARP trigger levels over last 6 months.
	  ○ Retained Level 4 TARP trigger at one intake in deep groundwater bore TNC036, however expected to reduce to Level 3 soon.
		NOTE		02/12/21

	10.4. Stonequarry Creek Rockbar
	• Extensive monitoring program:
	  ○ Real-time subsidence monitoring
	  ○ Manual surveying by two independent consultants
	  ○ Visual inspections
	  ○ Joint measurements
	  ○ Stress cell monitoring
	  ○ Inclinometer (monitoring underground movements)
	  ○ Groundwater monitoring
	  ○ Surface water monitoring
	  ○ Specialist Technical Committee
	  ○ Steering Committee
	• Rockbar fracture and actions taken:
	  ○ No impact to Aboriginal Heritage Axe Grinding Grooves
	  ○ No impact to pool water holding capacity
	  ○ Stopped Longwall West 3 mining (4 days non-operational)
	  ○ Thorough Technical Specialist Committee investigation
	  ○ Geotechnical engineering inspection
	  ○ Site inspection with Heritage Consultant and Registered Aboriginal Party (RAP) representative
	  ○ Increased frequency of monitoring and visual inspections
	  ○ Increased Specialist Technical Committee & Steering Committee meetings
	  ○ Recommended to recommence longwall at reduced extraction rates
	  ▪ DH requested a summary of the Stonequarry Creek Rockbar monitoring report findings. ***Action: ZA to include for March meeting.***
		ZA	**03/03/22**	

	10.5. Heritage Rail and Main Southern Rail Update • Final Far Field preparation works for LW W4 on the Main Southern Railway (MSR) to be completed and commissioned by mid-December 2021.			

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised
	• LW W3 has passed beneath the Picton Mittagong Loop Line with no impact to date. • LW W3 is running parallel to the Main Southern Railway line with no impact to date.			
11. Environment Update (presented by Natalie Brumby, Tom O'Brien and Amanda Bateman)				
11.1. Environmental Incidents	• There were no Environmental Incidents reported since the previous meeting. **Month** / **Environmental Incidents** September 2021 / 0 October 2021 / 0 November 2021 / 0	NOTE		02/12/21
11.2. Community Complaints	• There was one community complaint reported since the previous meeting. **Month** / **Community Complaints** September 2021 / 1 October 2021 / 0 November 2021 / 0	NOTE		02/12/21
11.3. Depositional Dust	• Deposited dust levels continue to be well below EPA target levels of 4mg/m^2 per month.	NOTE		02/12/21
11.4. Water – *License Discharge Point 1*	• There were nil exceedances since the last meeting. • MM asked if the new parameters that come into effect following the implementation of the Waste Water Treatment Plant (WWTP) can be added to the LDP1 graphs. The committee noted that these new parameters will likely reflect as exceeded on the graphs, but it will demonstrate the new limits Tahmoor is working towards. ○ ***Action: NB to include the new parameter line on the LDP1 graphs going forward.***	NOTE NB	**03/03/22**	02/12/21
11.5. Waste Water Treatment Plant	• Reverse Osmosis (RO) Plant is designed to meet Australian & New Zealand Environment Conservation Council (ANZECC) Guidelines as per Environment Protection Licence (EPL) conditions (EC, Ba, Ni, As, Zn, Cu, N, Al, pH, $CaCO_3$). • Pilot plant began quality trials on 18 October 2021. • Trials due for completion on 10 December 2021. • Pilot plant performing well and permeate largely meeting ANZECC guidelines apart from: ○ Nitrogen levels - Plant undergoing some fine tuning. ○ Nitrogen levels are reducing steadily – Sewage Treatment Plant (STP) upgrades will further reduce Nitrogen levels.	NOTE		02/12/21
12. Myrtle and Redbank Creek Remediation Plan Update (presented by Nick Le Baut)				
12.1. Remediation Works Schedule:				

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised

	Schedule	Completed	In Progress	Remaining
Myrtle Creek – Pools	7 Pools	3	3	1
Redbank Creek – Pools	15 Pools	11	1	3
Redbank Creek - Rock Bars	6 Rock Bars	2	1	3

NOTE — 02/12/21

- Schedule approved by the Resources Regulator.
- Works to be completed by August 2022 for Myrtle Creek and December 2022 for Redbank Creek per schedule.

12.2. Myrtle Creek Pool 18:

- Remediation strategy:
  - 32m curtain wall to a depth of 6m below creek level using Polyurethane Resin (PUR).
  - Two stage process including shallow curtain wall to 2m and deeper curtain to 6m.
  - Completed in October 2021.
- Outcome:
  - Improvement in pool holding capacity following completion of Stage 2 (6m depth)
  - Further monitoring required to assess the effectiveness of the remediation strategy (Recession testing following rain events)

12.3. Myrtle Creek Pool 20: — NOTE — 02/12/21

- Return of water in pool following completion of Stage 2 remediation.
- Ongoing surface and groundwater water monitoring to assess effectiveness of remediation.
- Spring Aquatic survey completed. Report to be completed.

12.4. Myrtle Creek Pool 23:

- Surface water level has remained constant since completion of remediation in February 2020.
- Ongoing surface and groundwater water monitoring.
- Latest aquatic ecology survey – Improved habitat from remediation works due to the return of water (similar or better compared to reference sites not impacted by mining).

12.5. Redbank Creek Rockbar RB6

- Remediation strategy:
  - 50m curtain wall to a depth of 18m.
  - Four stage process including shallow curtain wall to 2m and deeper curtain in 6m increments.
  - Expected completion end of December 2021.
- Progress:
  - Stage 1 (2m) completed
  - Stage 2 (6m) completed
  - Stage 3 (12m) completed
  - Stage 4 (18m) in progress
  - Improvement in pool holding capacity however more monitoring data required
- RB6 Modelling – additional tool:
  - Assess the potential change in water level associated with the remediation of RB6.

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised
	○ Added tool to increase visibility by running different remediation scenario. ○ Model can be recalibrated using monitoring data to increase confidence. ○ Assist in revising remediation strategy at RB6 following review of monitoring data. **12.6. Redbank Creek Rock Bar 19 and 26:** • Spring aquatic monitoring survey completed (awaiting report) • Ground water and surface water monitoring ongoing • Further recession analysis required to confirm the effectiveness of the remediation strategy • Creek flowing over recent rain events **12.7. Future Works:** • Myrtle Creek Pool 14: ○ Remediation works to commence December 2021. ○ Methodology: 26m curtain wall at 16m depth. • Redbank Creek Pool RB6: ○ Curtain wall Stage 4 in progress. ○ Potential review of RB6 remediation strategy following early monitoring and modelling results. • Future sites: Planning for remediation works at Pool RB5 and 37 at Redbank Creek.			
13. Community Update (Presented by Amanda Bateman)				
13.1. Community Sponsorships: • **Cancer Council – Shitbox Rally 2022 -** provided a grant of $500 for the Roadrunner Team competing in the rally from Wollongong to Mackay via Innamincka in a car worth less than $1,000. This rally aims to raise $2.5M for Cancer Council research projects. • **Wollondilly Women in Excellence Awards 2022 -** sponsored $1,250 for the Wollondilly Women in Excellence Awards scheduled for March 2022. • **Great Cycle Challenge – Riding to fight kids cancer -** provided a grant of $1,035 for the Awesome Kids4Kids Team riding 500kms to raise funds for the Children's Medical Research Institute. • **Wollondilly Community Links Christmas Hampers -** provided a grant of $5,000 for the Community Links Christmas Hampers distributed to Wollondilly vulnerable families. • **Cancer Council – Walk for Sheree -** provided a grant of $1,000 for the 'Walk for Sheree' Cancer Council walks taking place in Picton and Wollongong in December 2021 in memory of an employee's late wife. • **One Stop Community Assistance (OSCA) – Christmas Hampers -** a grant of $5,000 for OSCA to purchase Christmas Hampers for Wollondilly vulnerable families and residents still recovering from the Green Wattle Creek bushfire.	NOTE		02/09/21
13.2. Community – Western Domain Newsletter 4 • Western Domain Newsletter 4 issued to residents in November 2021 • LW W3 commenced 14 September 2021 • Western Domain Newsletter 5 to be distributed mid-December 2021 • Some property claim assessments from LW W1 will commence early in 2022.	NOTE		02/12/21
14. Subsidence Advisory NSW Update				

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 2 December 2021

SIMEC

Time Location Date	5.00pm to 6.40pm Conference Room 1 & Microsoft Teams Meeting 2 December 2021	Minute Taker		AB
		Who	When Req'd	Date Raised

14.1. Residential Claim Status

Residential Claim Status	Active mining claims (TC)
Total number of open claims	23
Preliminary assessment	1
Claims on hold	18
Review requested	1
Land & Environment Court Appeal (L&EC)	2
Determination issued	1

NOTE — 02/12/21

14.2. Picton Industrial Area

Picton Light Industrial Area	
Total number of claims	28
Review requested	4
Claims accepted	24

15. TCCCC Finance

15.1.	The TCCCC bank balance is currently $29,902.37, statement end 30 September 2021.	NOTE		02/12/21

16. General Business

16.1.	MM to draft TCCCC Annual Report with the aim to table the draft at the March 2022 meeting.	MM	**03/03/22**	
16.2.	MM raised the potential of filling the vacant position on the committee and possibly extending an invite to the local indigenous community. MM asked all members to consider this for tabling at the March 2022 meeting.	ALL	**03/03/22**	
16.3.	AB advised the committee that the apprentices will be bracing the culturally significant scar tree at Thirlmere Lakes on 7 December 2021.	NOTE		02/12/21
16.4.	**MM closed the meeting.**			

Meeting Closed	*6:40 pm*	Next Meeting	*Thursday 3 March 2022*	Time	*5:00pm*	Location	*Conference Room 1*

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 3 March 2022

Name	Role
Attendees	
Michael Muston (MM)	Independent Chairperson
James Johnson (JJ)	Community Representative
Col Mitchell (CM)	Community Representative
Ana Gracanin (AG)	Community Representative (online)
Bob Clayton (BC)	Community Representative (online)
Paul Rogers (PR)	Wollondilly Shire Council Representative (online)
David Henry (DH)	Wollondilly Shire Council Representative (online)
Michael Banasik (MB)	Wollondilly Shire Council Representative (online)
Peter Vale (PV)	Tahmoor Coal Representative
Zina Ainsworth (ZA)	Tahmoor Coal Representative (online)
Amanda Bateman (AB)	Tahmoor Coal Representative (minute taker)
Invitees	
Natalie Brumby (NB)	Tahmoor Coal Representative (online)
April Hudson (AH)	Tahmoor Coal Representative (online)
Thomas O'Brien (TO)	Tahmoor Coal Representative
Nick Le Baut (NLB)	Tahmoor Coal Representative (online)
Ross Barber (RB)	Tahmoor Coal Representative (online)
Allen Bond (ABond)	Tahmoor Coal Representative
Apologies	
Greg Kininmonth (GK)	Resources Regulator
David Auchterlonie (DA)	Community Representative
Matthew Montgomery (MMt)	Subsidence Advisory NSW

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 3 March 2022

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised
1. Welcome and Introductions				
1.1.	Michael Muston is the Independent Chairperson. He acknowledged the Traditional Owners of the land on which we met and paid respects to their Elders, past and present.	NOTE		03/03/22
1.2.	MM welcomed newly appointed Wollondilly Shire Council Representative, Councillor Paul Rogers and Wollondilly Shire Council attendee (alternate Council Representative), Councillor Michael Banasik.			
2. Declarations of Interest				
2.1.	MM is paid by Tahmoor Coal.	NOTE		03/03/22
3. Apologies				
3.1.	As per list above.	NOTE		03/03/22
4. Confirmation of Minutes of Previous Meeting				
4.1.	Confirmation of Minutes from 2 December 2021 accepted. Note: Q4 minutes to be added to the Tahmoor Website.	NOTE		03/03/22
5. Business Arising from Previous Minutes				
5.1.	Committee requested a change to section 7.7 of the Q3 meeting minutes. ***AB amended the minutes and redistributed – Completed and closed.***	CLOSED		03/03/22
5.2.	Committee asked if Tahmoor knows about the tippers and trucks coming in and out of Kader Street Bargo. ***Tahmoor investigated and it is unrelated to mining operations – Completed and closed.***	CLOSED		
5.3.	DH to notify MM and AB of new council representative once known following the election. ***Email received from WSC confirming Paul Rogers as the new council representative – Completed and closed.***	CLOSED		
5.4.	AB to email final version of the Air Quality and Greenhouse Gas Management Plan to AG – ***Completed and closed.***	CLOSED		
5.5.	AB to arrange presentation from Tahmoor South Project Manager on project update at next meeting – ***included in meeting presentation with Project Manager, Allen Bond.***	CLOSED		
5.6.	Committee requested a summary of the Stonequarry Creek Rockbar monitoring report findings – ***included in meeting presentation.***	CLOSED		
5.7.	Committee asked Tahmoor to include the new parameter line on the LDP1 graphs going forward, noting they will likely reflect as exceeded on the graphs but will demonstrate the new limits Tahmoor is working towards – ***included in meeting presentation.***	CLOSED		
5.8.	MM asked all committee members to consider the potential for filling the vacant position on the committee and possibly extending an invite to the local community groups – ***included in General Business for discussion.***	CLOSED		
6. Correspondence - update as per the agenda				
6.1.	Tahmoor South First Workings Mine Plan – Emailed by Amanda Bateman 06/09/2021	NOTE		03/03/22
6.2.	Q4 TCCCC Meeting invitation distributed – Emailed by Amanda Bateman 19/11/2021			
6.3.	Q4 TCCCC Meeting agenda distributed – Emailed by Amanda Bateman 24/11/2021			
6.4.	Apology received from Robert Khan due to council election – Emailed by Kristy Peters 25/11/2021			
6.5.	SA NSW claim statistics issued – Emailed by Matthew Montgomery 02/12/2021			
6.6.	CIP Grant Form sent to DA – Emailed by Amanda Bateman 03/12/2021			

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised
6.7.	Final Air Quality & Greenhouse Gas Management Plan sent to AG – Emailed by Amanda Bateman 06/12/2021			
6.8.	Revised Q3 TCCCC Meeting Minutes distributed – Emailed by Amanda Bateman 09/12/2021			
6.9.	Q4 TCCCC Chair invoice submitted for payment - Emailed by Michael Muston 09/12/2021			
6.10.	CMAP Quarterly Progress Report Dec 2021 distributed – Emailed by Amanda Bateman 24/12/2021			
6.11.	Q4 TCCCC Meeting Minutes distributed – Emailed by Amanda Bateman 06/01/2022			
6.12.	Councillor Paul Rogers appointed as the Council Delegate for TCCCC – Emailed by Kristy Peters 21/01/2022			
6.13.	Notification to MM of Councillor Paul Rogers appointment as WSC rep for TCCCC – Emailed by Amanda Bateman 27/01/2022			
6.14.	Draft Annual Report 2021 for review – Emailed by Michael Muston 11/02/2022			
6.15.	Western Domain Newsletter #1 Feb 2022 – Emailed by Amanda Bateman 15/02/2022			
6.16.	Q1 TCCCC Meeting invitation distributed – Emailed by Amanda Bateman 15/02/2022			
6.17.	Draft Annual Report 2021 distributed for committee review – Emailed by Michael Muston 17/02/2022			
7.	**Committee Members Reports**			
7.1.	**James Johnson** • Advised one neighbour raised issues with water testing of his bore. Community Liaison, Amanda Bateman confirmed contact had been made regarding this.	JJ		03/03/22
7.2.	**Col Mitchell** • Nil	CM		03/03/22
7.3.	**David Henry** • Thirlmere Lakes Research Program report delayed – 3-4 weeks with ministerial approval. Martin Krogh from DPE will notify Council once report is approved and DH will circulate the report to the committee.	DH		03/03/22
7.4.	**Ana Gracanin** • Nil	AG		03/03/22
7.5.	**David Auchterlonie** • Apologies	DA		03/03/22
7.6.	**Bob Clayton** • Nil	BC		03/03/22
7.7.	**Paul Rogers** • Pleased to have joined the committee as the new Council Representative and as a local resident of Bargo with the upcoming Tahmoor South mining domain.	PR		03/03/22
7.8.	**Michael Banasik** • Appreciated the invitation to attend and noted that communication and consultation with the community is paramount regarding the Tahmoor South mining domain.	MB		03/03/22
8.	**Mining Operations Update** – Mine Update (presented by Peter Vale)			

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 3 March 2022

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised

8.1. Mine Update:
• Coal price – rose to historical high above $400/t for Hard Coking Coal (HCC), reduced to around $315/t, then rose again above $450/t. New record high of $475/t USD.
• Iron ore prices holding at a reasonable level for the business after hitting historical highs last year.
• Advantageous position for Tahmoor as we invest in Tahmoor South, the future of the mine.
• Major projects underway:
  ○ Waste Water Treatment Plant
  ○ Sewerage Treatment Plant
  ○ Noise mitigation works
  ○ Front entrance roadworks
  ○ Underground booster fans
8.2. Western Domain:
• Longwall West 3 commenced on 14 September 2021.
• Excellent performance including daily and weekly production records.
• Approaching bolt-up then removal, scheduled for completion 16 March 2022.
• Longwall West 4 shortened due to difficult geotechnical conditions in development roadways Main Gate West 4.
• Installation roadways still being completed for Longwall West 4.
8.3. Tahmoor South:
• Development mining ongoing in Tail Gate 1A (TG1A) for longwall South 1A (S1A) (no subsidence)
• Commenced development mining in Main Gate 2A (MG2A), whilst installing conveyor for ongoing mining in Main Gate 1A (MG1A) (no subsidence)
• Ongoing rehabilitation and construction works – ventilation, conveyors, gas drainage, etc.
• Question asked regarding whether Tahmoor South will extract consistent coal to what is currently being extracted. Response was yes, as indicated by coal quality from old longwalls adjacent to the Tahmoor South proposed longwalls.
	NOTE		03/03/22

9. Tahmoor South – Major Projects update (presented by Allen Bond)				

9.1. Noise mitigation:
• Noise surveys to form base lines for the site and surrounding areas have been completed.
• Progressing with the design and installation of noise reduction covers to the stockpile dozers.
• Coal Handling Prep Plant (CHPP) noise reduction progressing in two stages:
  1. installation of noise dampening cladding (investigation completed, scope of works (SOW) being developed and issued for tender).
  2. closure of openings on the external CHPP walls (contractors engaged, SOW developed and issued for tender).
9.2. Vent shafts:
• Ventilation review has been undertaken.
• No new ventilation shafts are required for Tahmoor South – Continued use of existing shafts.
• The clearing of Critically Endangered Ecological Communities – Shale Sandstone Transition Forest is now not required.
	NOTE		03/03/22

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised
	• Only clearing will be of the rehabilitated area on the Reject Emplacement Area (REA). **9.3. Gas drainage plant upgrade:** • Plant capacity (3,000L/s), interim upgrade complete (4,500L/s). • Tenders evaluated. • Contract agreed to increased capacity to around 6,500L/s. • This will optimise gas capture, reduce Greenhouse Gas emissions, and provide opportunity for Tahmoor to eliminate the use of electricity from the grid through expansion of the gas-powered electricity generation plant. **9.4. Mine site entrance:** • Construction to commence April 2022 (WSC Traffic Committee approval received on 02/03/2022). • Approx. 3 months for construction. • The localised drainage and widening work on the Tahmoor side will be done during day shifts. • Tahmoor will seek the necessary approvals to complete the resheeting of the pavement on nightshift to mitigate disruptions to traffic during the school hours (similar to every other road works on major roads). • MB asked about Wollondilly Anglican College (WAC) road upgrade. ABond advised Tahmoor has been consulting closely with WAC with the design, but our implementation timeframes unfortunately didn't align. • CM raised lighting options at the intersection as a safety requirement. ○ ***ABond to investigate this further and discuss with WSC Traffic Committee.*** **9.5. Sewage Treatment Plant:** • On schedule for commissioning prior to September 2022.	**ABond**	**02/02/22**	03/03/22
10. Tahmoor South (presented by April Hudson and Zina Ainsworth)				
	10.1. Tahmoor South Longwalls South 1A to South 6A (LW S1A-S6A) Extraction Plan: • Government agency and community consultation has commenced • Submission of LW S1A-S6A Extraction Plan anticipated April 2022 • Anticipated extraction September 2022 to October 2026 for A-Series • Document preparation has commenced: ○ Extraction Plan main document ○ Water Management Plan ○ Biodiversity Management Plan ○ Land Management Plan ○ Heritage Management Plan ○ Built Features Management Plan ○ Public Safety Management Plan ○ Subsidence Monitoring Program **10.2. Tahmoor South consent:** • Developing 13 Environmental Management Plans, status of each provided in table below.	NOTE		03/03/22

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised

Management Plan	Required Approval Timing	Status
Air Quality and Greenhouse Gas	Prior to Construction	DPIE Comments with Tahmoor to Action
Noise Management Plan	Prior to Construction	Submitted to DPIE for Approval
Traffic Management Plan	Prior to Construction	Approved
Water Management Plan	Prior to Construction	DPIE Comments with Tahmoor to Action
Surface Water Management Plan	Prior to Construction	DPIE Comments with Tahmoor (ATC Williams) to Action
Groundwater Management Plan	Prior to Construction	DPIE Comments with Tahmoor (SLR) to Action
Biodiversity Management Plan	Prior to Construction	DPIE Comments with Tahmoor (Niche) to Action
Bushfire Management Plan	Prior to Construction	Submitted to DPIE for Approval
Spontaneous Combustion Management Plan	Prior to Second Workings	Submitted to DPIE for Comment
Social Impact Management Plan	Prior to Second Workings	Draft underway
Rehabilitation Strategy	Within 6 months of date of commencement of second workings	DPIE Comments with Tahmoor to Action
Rehabilitation Management Plan	12 months from Regulations	Draft underway
Waste Management Plan	Update Only	Plan updated with Tahmoor South commitments.

11. Mining Operations Update - Western Domain (presented by April Hudson, Zina Ainsworth and Amanda Bateman)

11.1. Western Domain update – Longwall West 3 (LW W3)

- Tahmoor Coal received Department of Planning & Environment (DPE) approval for the commencement of LW W3 on Monday 13 September 2021.
- LW W3 is currently at 1475m at COB 01/03/2022 (total length 1544m).

11.2. Subsidence Monitoring Observations

- 581mm maximum observed incremental vertical subsidence at LW W3 centreline.
- Very little change in measurements within the creek systems.

11.3. Western Domain - Environmental

- No observed subsidence-related impacts to surface water level and quality, pools, dams, ecology, cliffs, steep slopes, agricultural land or Aboriginal heritage in last 3 months.
- Historical heritage:
  - Rail sandstone culverts at 88.400 km and 88.980 km experienced cracking and spalling of sandstone blocks in the headwalls, culverts stable.
  - Rail sandstone culverts at 88.400 km and 88.980 km experienced cracking and spalling of sandstone blocks in the headwalls, culverts stable.
  - Department of Planning, Industry & Environment (DPIE) notified on 21 September 2021.
  - No further impacts noted since.
  - Remediation of culverts in preparation, and advice from heritage stonemason being sought.
  - LW W3 end of panel inspection to be completed shortly.
- Surface water level:
  - All sites at Level 1 (within natural parameters) due to high rainfall and correlating high water level.
  - Pool CR14 (Monitoring Site CB) has been at Level 1 since 6 November 2021, attributed to recovering groundwater system feeding back into the creek.
- Surface water quality:
  - Negligible evidence of influence of LW W3 mining on water quality.
- Pool observations:
  - Level 3 TARP triggered due to surficial fracturing of Rockbar SR17 (first observed October 2021).
  - All other sites at Level 1.
- Groundwater level:

NOTE

03/03/22

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised
	○ Slight decrease in GW level due to LW W3 mining, however most groundwater levels are stable. ○ Retained Level 4 TARP trigger at one intake in deep groundwater bore TNC036. ○ Retained Level 3 TARP triggers at two shallow bores (P12C and P16C). ○ Shallow and deep groundwater bores are expected to recover from depressurisation impacts following LW W3 and LW W4 extraction. • Groundwater quality: ○ Level 3 TARP trigger for Lithium at P14A and Strontium at a private groundwater bore (GW115860), however levels have since dissipated. ○ Electrical conductivity (EC) spike at P15B in December 2021 determined to be related to grout / cement contamination rather than mining effect. **11.4. Stonequarry Creek Rockbar** • Extensive monitoring program: ○ Real-time subsidence monitoring ○ Manual surveying by two independent consultants ○ Visual inspections ○ Joint measurements ○ Stress cell monitoring ○ Inclinometer (monitoring underground movements) ○ Groundwater monitoring ○ Surface water monitoring ○ Specialist Technical Committee ○ Steering Committee • Rockbar fracture update: ○ A new fracture was detected on the southeast corner - 28 October 2021. ○ Fracture location was 40m downstream of the closest heritage site across the highly disturbed access track. ○ LW W3 stopped on 28 October 2021 for investigation by Technical Committee. ○ Approved restart at reduced extraction rates with increased controls – 1 November 2021. ○ Fracturing associated with geology of thinly bedded laminated sandstone with very low resistance to compressive strain (different to grinding groove sites). ○ Further localised fracturing has occurred within the same area, as forecast by the Technical Committee. ○ Fracturing is typical of previous naturally induced failures as a result of thinly bedded laminated sandstone. ○ No loss of water or heritage value of the rockbar. ○ LW W3 is currently >1.5km from the rockbar and no visual or measurable changes have been detected for approximately 2 months. ○ The management plan for LW W3 will be extended to cover LW W4 (noting start position is >900m from rockbar). ○ Heritage consultants are part of Technical Committee and Registered Aboriginal Parties (RAPs) have been informed throughout mining. ○ Remediation (if required) will be determined at the end of LW W4. **11.5. Heritage Rail and Main Southern Rail Update** • LW W3 has passed beneath the Picton Mittagong Loop Line with no impact to date. • LW W3 is running parallel to the Main Southern Railway line with no impact to date.	NOTE		03/03/22

Tahmoor Colliery Community Consultative Committee
Minutes of Meeting – Tahmoor Coal Conference Room & Microsoft Teams
Thursday 3 March 2022

<table>
<tr><th>Time
Location
Date</th><th>5.00pm to 7.08pm
Conference Room 1 & Microsoft Teams Meeting
3 March 2022</th><th colspan="2">Minute Taker</th><th>AB</th></tr>
<tr><th></th><th></th><th>Who</th><th>When Req'd</th><th>Date Raised</th></tr>
<tr><td colspan="5">12. Environment Update (presented by Natalie Brumby, Tom O'Brien and Amanda Bateman)</td></tr>
<tr><td colspan="3">12.1. Environmental Incidents
There were no Environmental Incidents reported since the previous meeting.
<table><tr><th>Month</th><th>Environmental Incidents</th></tr><tr><td>December 2021</td><td>0</td></tr><tr><td>January 2022</td><td>0</td></tr><tr><td>February 2022</td><td>0</td></tr></table></td><td>NOTE</td><td></td><td>03/03/22</td></tr>
<tr><td colspan="3">12.2. Community Complaints
There were two community complaints reported since the previous meeting.
<table><tr><th>Month</th><th>Community Complaints</th></tr><tr><td>December 2021</td><td>2</td></tr><tr><td>January 2022</td><td>0</td></tr><tr><td>February 2022</td><td>0</td></tr></table></td><td>NOTE</td><td></td><td>03/03/22</td></tr>
<tr><td colspan="3">12.3. Depositional Dust
Deposited dust levels continue to be well below EPA target levels of 4mg/m^2 per month.</td><td>NOTE</td><td></td><td>03/03/22</td></tr>
<tr><td colspan="3">12.4. Water – License Discharge Point 1
There were nil exceedances since the last meeting.</td><td>NOTE</td><td></td><td>03/03/22</td></tr>
<tr><td colspan="3">12.5. Waste Water Treatment Plant
Pilot Plant trial operated for 8 weeks and was successfully completed in December 2021, ensuring that Reverse Osmosis technology is fit for purpose.
Output water achieved compliance with ANZECC Guidelines for all specified analytes within the Environment Protection Licence (EPL).
Total Nitrogen gradually achieved compliant levels in weeks 7 and 8 with chemical dosing adjustments.
Based on the proven piloting process, contract awarded for Main Plant in December 2021.
Cost of Plant in order of $20M.
Action: Provide update on WWTP schedule at next meeting.</td><td>NOTE

TO</td><td>

02/06/22</td><td>03/03/22</td></tr>
<tr><td colspan="5">13. Myrtle and Redbank Creek Remediation Plan Update (presented by Nick Le Baut)</td></tr>
<tr><td colspan="3">13.1. Remediation Works Schedule:<table><tr><th></th><th>Schedule</th><th>Completed</th><th>In Progress</th><th>Remaining</th></tr><tr><td>Myrtle Creek – Pools</td><td>7 Pools</td><td>3</td><td>4</td><td>0</td></tr><tr><td>Redbank Creek – Pools</td><td>15 Pools</td><td>12</td><td>0</td><td>3</td></tr><tr><td>Redbank Creek - Rock Bars</td><td>6 Rock Bars</td><td>2</td><td>1</td><td>3</td></tr></table>
Schedule approved by the Resources Regulator.
Schedule variation approved by Resources Regulator for Redbank Creek (extension of 6 months to carry out further characterisation)
Works to be completed by August 2022 for Myrtle Creek and June 2023 for Redbank Creek per schedule</td><td>NOTE</td><td></td><td>03/03/22</td></tr>
</table>

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised

13.2. Myrtle Creek Pool 10 and 11 – Stage 1:

- Remediation strategy:
  - Main fracture network 1m below creek level
  - Shallow curtain wall to 2m depth below creek level using Polyurethane Resin (PUR)
  - Stage 1 completed in December 2021
- Outcome:
  - Improvement in pool holding capacity following the completion of Stage 1
  - Further monitoring required to assess the effectiveness of the remediation strategy (Recession testing following rain events)

13.3. Myrtle Creek Pool 14:

- Remediation strategy:
  - 26m wide curtain wall to a 16m depth
  - Four stage process including shallow curtain wall to 2m and deeper curtain in 6m increments
  - Expected completion end of March 2022
- Progress:
  - Stage 1 (2m) completed
  - Stage 2 (5m) completed
  - Stage 3 (10m) completed
  - Stage 4 (16m) in progress
  - Surface water will be monitored following completion of the works to assess the effectiveness of the remediation strategy

13.4. Myrtle Creek Pool 20 and Pool 18:

- Pool 20 and Pool 18 have been holding water since the completion of the remediation works (previously holding water for a short time after major rain events)
- Ongoing surface and groundwater water monitoring to assess effectiveness of remediation

13.5. Myrtle Creek Pool 23:

- Surface water level has remained constant since completion of remediation in February 2020
- Ongoing surface and groundwater water monitoring
- Latest aquatic ecology survey – Improved habitat from remediation works due to the return of water (similar or better compared to reference sites not impacted by mining)

13.6. Redbank Creek Rockbar RB6

- Remediation strategy and outcome:
  - 50m wide curtain wall to a depth of 18m
  - Four stage process including shallow curtain wall to 2m and deeper curtain in 6m increments
  - Current scope completed end of December 2021
  - Early positive outcome with return of surface water
- RB6 additional characterisation
  - Variation to schedule approved by Resources Regulator
  - Additional ground characterisation to assess if further remediation is required at Pool RB6
  - Characterisation data and monitoring data to be used to recalibrate groundwater model
  - Assist in revising remediation strategy at RB6 following review of monitoring data

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker		AB
		Who	When Req'd	Date Raised

13.7. Future Works:
• Myrtle Creek Pool 12a:
  ○ Remediation works Stage 2 – 4 to commence March 2022
  ○ Methodology: 40m curtain wall at 15m depth.
• Redbank Creek Pool RB6:
  ○ Additional characterisation and monitoring in progress
  ○ Potential review of RB6 remediation strategy following additional modelling results.
  ○ Review with Resources Regulator in May-June 2022
• Redbank Creek Pool RB5:
  ○ Planning for characterisation in March 2022				

14. Community Update (Presented by Amanda Bateman)				
14.1. Community Sponsorships: • **Australian Wildlife Sanctuary (AWS) – Woodlands pond** • Provided a grant of $17,700 for AWS to install a pond in the Woodlands area for the endangered wildlife species • **His House Church Christmas Hampers** • Provided a grant of $2,000 for Christmas hampers distributed to Wollondilly vulnerable families • **Thirlmere Festival of Steam** • Provided a grant of $3,000 for the parade sponsorship at the Thirlmere Festival of Steam to be hold on Sunday 13 March 2022 • **SOTC Inc Chapel Run Car Show & Shine** • Provided a grant of $2,000 for the Shine & Show event to raise funds for the Autism and Special Needs Unit at Tahmoor Primary School • **Tharawal Local Aboriginal Land Council – NAIDOC Fun Day** • Provided a grant of $1,500 for the TLALC NAIDOC Fun Day to be held on Saturday 9 July 2022 at the TLALC Cultural Centre in Couridjah		NOTE		03/03/22
14.2. Community – Apprentices project at Thirlmere Lakes • Two media articles were printed in the Campbelltown Macarthur Advertiser and Wollondilly Advertiser local papers regarding the recent SIMEC Mining Apprentices community project at Thirlmere Lakes. • The apprentices sourced engineered bands to brace a culturally significant scar tree that was struck by lightning in 2019 resulting in a large split down its entire trunk.		NOTE		03/03/22
14.3. Community – Western Domain Newsletters • Western Domain Newsletter 6 was issued to residents in December 2021 • Western Domain Newsletter 1 for 2022 was issued to residents in February 2022		NOTE		03/03/22
14.4. Community – Tahmoor South engagement • For Longwalls S1A to S3A - 11 of 20 landowners have registered for Pre-Mining Inspections (PMI), 3 completed to date • Consultation commenced this week with the remaining 9 landowners to encourage PMI take up • Baseline geotechnical inspections of 52 farm dams in the vicinity of the A-Series longwalls was completed in January and February 2022		NOTE		03/03/22

Time Location Date	5.00pm to 7.08pm Conference Room 1 & Microsoft Teams Meeting 3 March 2022	Minute Taker Who	 When Req'd	AB Date Raised
	• Baseline bore surveys were completed in February for 39 of 54 landowners who took up the offer of the survey • Land access requests have commenced for surface and groundwater monitoring activities for the A-Series longwalls			
15. Subsidence Advisory NSW Update				
15.1.	**Residential Claim Status** Residential Claim Status: Total number of open claims 25; Preliminary assessment 0; Claims on hold 10; Under investigation 9; Land & Environment Court Appeal (L&EC) 2; Determination issued 3; Review requested 1	NOTE		03/03/22
15.2.	**Picton Industrial Area** Picton Light Industrial Area: Total number of claims 28; Claims accepted & finalised 25; Determination issued 3			
16. TCCCC Finance				
16.1.	The TCCCC bank balance is currently $29,872.37, statement end 31 December 2021.	NOTE		03/03/22
17. General Business				
17.1.	MM circulated draft TCCCC Annual Report 2021 to committee members for feedback. Committee confirmed agreement to finalise the report and submit.			03/03/22
17.2.	***MM to send letter of thanks to long-term committee member Robert Khan.***	**MM**	**02/06/22**	
17.3.	Committee discussed the opportunity to fill the vacant position on the committee, considering factors such as succession planning, Tahmoor South mining location (Bargo), gender balance, notifying local community groups. ***AB to review CCC advertising requirements and prepare draft advertisement.***	**AB**	**02/06/22**	
17.4.	***AB to update committee member contact list and circulate.***	**AB**	**02/06/22**	
17.5.	MM closed the meeting.	NOTE		

Meeting Closed	*7:08 pm*	Next Meeting	*Thursday 2 June 2022*	Time	*5:00pm*	Location	*Conference Room 1*

24 August 2021

Dear Resident,

Re: Tahmoor South update

I am writing on behalf of Tahmoor Coal to provide an update on the Tahmoor South mine plan. As you are likely aware, the Independent Planning Commission (IPC) approved the Tahmoor South Project on 23 April 2021 with conditions of consent.

Tahmoor Coal is reviewing the IPC's conditions of consent, while maintaining operations in the Western Domain (Picton) area where we are currently mining until approximately August 2022.

Over the coming 12 months our community team will continue to provide more details on the preparation and timing of mining activities for Tahmoor South. This process includes reaching out to residents in the area of mining, specifically:

- Letters (or written communications) and door-knocks (COVID-19 permitting)
- Information about pre-mining inspections
- Information about the mining process
- Information about monitoring activities before mining commences.

Enclosed is the latest Resident Information Pack which details the current anticipated mining schedule and longwall mine plan labled for your reference.

Request a free Pre-Mining Inspection

Tahmoor Coal encourages all property owners located in the subsidence zone of the planned mining to request a free pre-mining inspection (PMI). The purpose of a PMI is to determine the condition of your property prior to mining. It provides an added protection for you to ensure you receive adequate compensation to return your property to its pre-mining condition should it be impacted by subsidence.

PMIs are free of charge and help facilitate a straightforward claims process if you need to make a compensation claim for mine subsidence damage. If you would like to register for a pre-mining inspection, please email tahmoorenquiries@simecgfg.com with your name, address and contact number and we will add you to the register. Please be advised pre-mining inspections will be undertaken from early to mid 2022.

Tahmoor Coal Community Consultative Committee

The Tahmoor Coal Community Consultative Committee (TCCCC) provides a forum for open discussion between representatives of Tahmoor Coal Mine, the community, council and other stakeholders on issues directly relating to the mine's operations, environmental performance and community relations.

The TCCCC is independently chaired and membership consists of up to seven representatives from the local area, who meet on a quarterly basis. Should you wish to contact a TCCCC member, the contact information is available at www.tahmoorcoal.com.au.

SIMEC
2975 Remembrance Drive, Bargo 2574
P.O Box 100, Tahmoor NSW 2571
Tahmoor Coal Pty Ltd ABN: 97 0766 639 68

T: +61 (02) 4640 0100
E: tahmoorenquiries@simecgfg.com
simec.com

MEMBER OF GFG ALLIANCE

To stay up to date about Tahmoor South mining, please visit: www.tahmoorcoal.com.au. If you have any questions, please contact us on phone: 02 4640 0100 or email: tahmoorenquiries@simecgfg.com.

Yours sincerely,



Amanda Bateman
Community Liaison Specialist
Tahmoor Coal Pty Ltd

SIMEC

MEMBER OF GFG ALLIANCE

Resident Information Pack

Tahmoor South Information Pack

Mining

Resident Information Pack

Tahmoor Coal Pty Ltd (Tahmoor Coal) is committed to ensuring the community is informed and up to date with our mining operations. Tahmoor Coal is planning to commence mining in an area known as Tahmoor South Domain in October 2022.

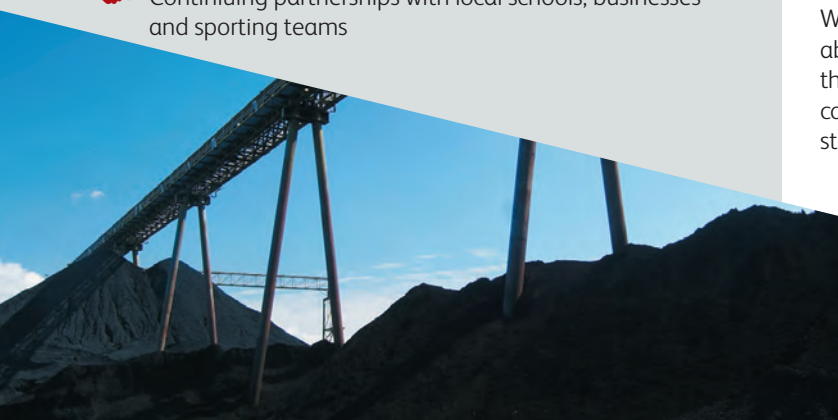
The purpose of this Resident Information Pack is to help answer any questions you may have regarding mine subsidence and your property. The Information Pack contains the following information:

- Tahmoor Coal's current mine plan.
- Information about longwall mining and subsidence management by Tahmoor Coal.
- How to arrange a pre-mining inspection (at no cost to the property owner) prior to mining commencing.
- An outline of the claims process for any potential damages that may occur due to longwall mining.
- Frequently asked questions.

Should you have any further questions a Tahmoor Coal representative would be happy to answer and discuss with you directly.

Tahmoor South Snapshot

- Inject $137.5 million into the local economy
- Continued stable employment in the region
- Reduced impact to native vegetation and water sources
- Continuing participation in community initiatives
- Continiuing partnerships with local schools, businesses and sporting teams



Tahmoor Coal Operations

Tahmoor Coal Mine is an underground coal mine that began operations in 1979. The Mine has approval to produce up to four million tonnes of Run of Mine (ROM) coal per annum.

Coal is mined from within the Bulli seam, producing coking coal for steel production. Product coal is transported via rail to Port Kembla for Australian domestic customers and export customers. The current mining operations, in the Tahmoor North lease area, are forecast to continue until August 2022, when the mining operations will move to a new mining domain (Tahmoor South) near Bargo.

Tahmoor Coal currently employs approximately 400 employees and contractors. The operation supports many local and regional businesses and services.

Tahmoor Coal is a proud supporter of local charities and service organisations through its sustainable development program and sponsorships.

Longwall Mining

Coal is extracted at Tahmoor Coal by a longwall shearer and conveyed to the surface by a series of conveyors. A typical schematic diagram of longwall mining at Tahmoor Coal is shown on Figure 1.

The area immediately in front of the coal face is supported by a series of hydraulic roof supports, which temporarily hold up the roof and provides a working space for the shearing machinery and the face conveyor. After each slice of coal is removed, the hydraulic roof supports, the face conveyor and the shearing machinery is moved forward.

When coal is extracted using this method, the roof immediately above the seam is allowed to collapse into the void that is left as the face retreats. This void is referred to as the goaf. As the roof collapses into the goaf behind the roof supports, the overlaying strata collapses and results in subsidence of the surface area above.

Annual Production For Tahmoor Coal

2020 SALEABLE COAL

1.345 million tonnes

Underground Coal Mining Terms

The coal mining industry has a number of mining specific terms and phrases that are commonly used. Below is a brief introduction to some of these common terms at Tahmoor Coal.

Block	A dimensional delineation of the mineral deposit; as in "a block of coal" or, "coal blocked out for extraction".
Coal face	The current working place for coal extraction.
Coal Preparation Plant (CPP)	Processing plant where coal is sized, washed and prepared for the market.
Coal seam	Naturally formed underground layer of coal.
Continuous miner	The electric powered cutting machine used to remove coal from the active mining face and load it into the shuttle car.
Conveyor	The means of transporting coal from the coal face to the underground bin or surface. It consists of a belt being driven by a motor over a roller assembly.
Cover depth	The depth from the surface to the mine workings.
Development	The operations involved in preparing the coal seam for extraction.
Downcast	A shaft or other mine opening down to the underground workings in which fresh air from the surface passes.
Drift	An inclined access opening from the surface to the coal seam.
Exploration	The search for mineral deposits and the work done to prove or establish the extent of a mineral deposit.
First workings	The driving of headings (underground roadways) in the solid coal seam prior to the commencement of extraction.
Gate Road	An underground roadway leading to a working place in longwall mining.
Goaf	The underground area abandoned and left to collapse after the extraction of coal.
Heading	An underground roadway formed in the direction of a development panel.
Longwall	A system of mining coal in which the seam is extracted on a broad front or long face using a coal shearer and the roof is supported by hydraulic roof supports.
Longwall Panel	A block of coal to be mined by longwall defined by gate roads and coal seam thickness.
Panel	Underground workings are broken up into a number of panels which are working places for each mining crew.
Run of mine (ROM)	Raw coal production; the unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock.
Shaft	A vertical opening connecting the surface with the underground workings.
Subsidence	The vertical lowering or collapse of the ground surface following coal extraction.
Upcast	A shaft or other mine opening through which air returns to the surface after ventilating the underground workings.



Figure 1: Schematic diagram of longwall mining

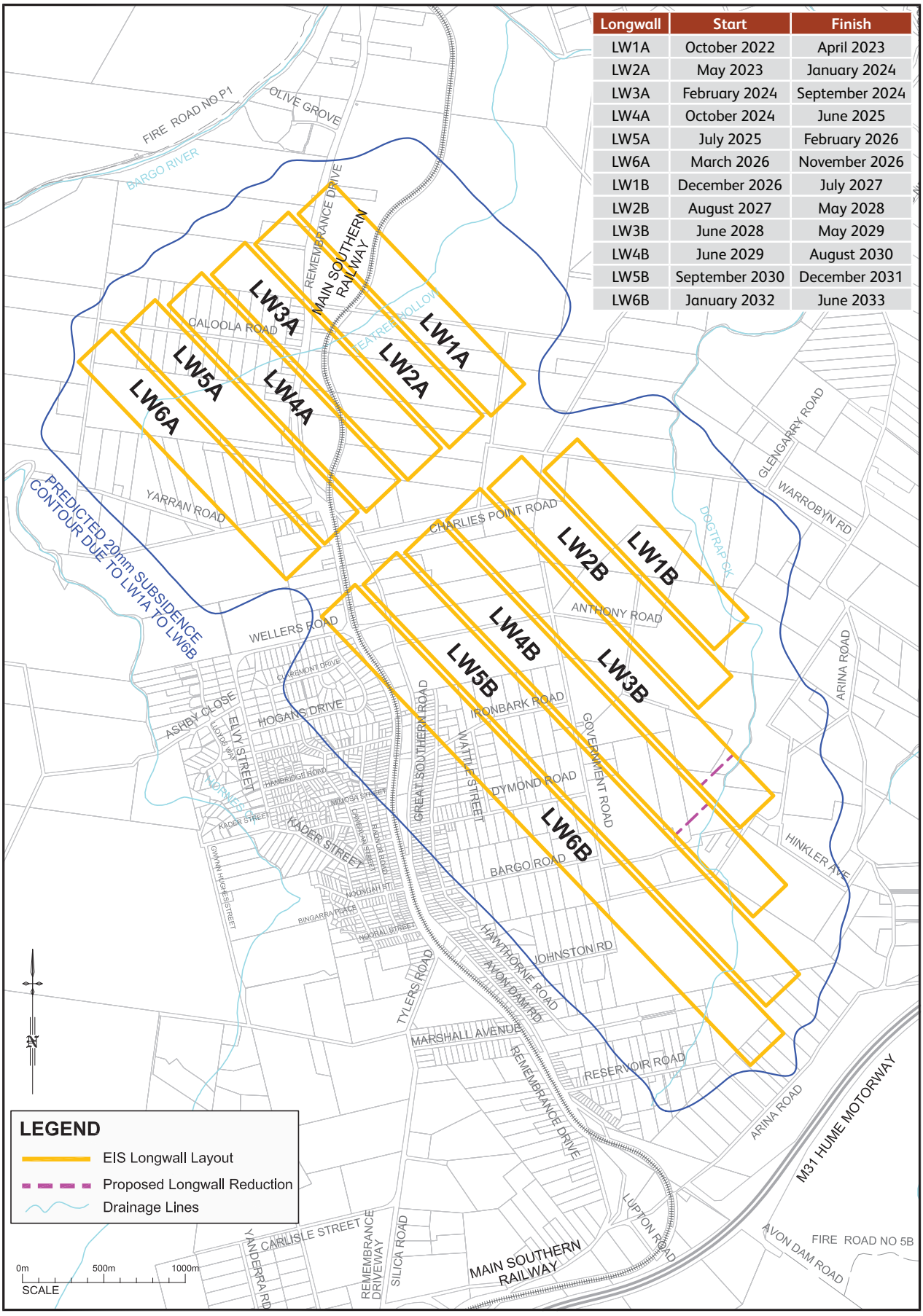
Tahmoor South Mine Plan

Figure 2 outlines the proposed longwalls and mining timeframes for Tahmoor South. Please note this is subject to change pending relevant approvals and operations.

The predicted 20mm Subsidence Area outlines the area that may be potentially impacted by subsidence from the mining of the longwalls. If you live within the predicted 20mm Subsidence Area (blue line in figure 2 below) please contact us to arrange a free pre-mining inspection.

The pink hashed line in figure 2 demonstrates the possible set back commencement location of LW3B and LW4B to avoid mining directly under Dog Trap Creek.

Figure 2: Tahmoor South Mine Plan



What is Subsidence?

Mine subsidence refers to any surface ground movements associated with underground mining. Typically, mine subsidence refers to a vertical movement at a particular point. This occurs when material is removed from an underground mine and the earth above the mine adjusts to the altered landscape. Figure 3 below demonstrates a cross view of mine subsidence effects.

The amount of subsidence varies across the area mined beneath, with greatest subsidence occurring towards the centre of the mined area, and gradually reducing to outside the mined area. If subsidence occurs uniformly across an area, it is unlikely that any impacts would be noticed. However, differential subsidence results in tilting and bending of the ground. These differential movements can result in mine subsidence-related impacts to surface features.

Mine subsidence commonly also results in horizontal movements. Differential horizontal movement causes ground strain. Small horizontal movements may be experienced at points on the surface that are some distance away from the mining activity.

Types of Subsidence

Mine subsidence movements can be described using the following parameters:

Vertical Subsidence – this is the lowering of the land and all surface infrastructure. If the infrastructure lowers by the same amount, it would have little or no effect on the structure, unless it is located in a flood prone area. Subsidence develops very gradually, and it is not readily apparent.

Tilt – a small change of slope on the surface arising from the surface lowering unevenly. Generally tilt does not lead to structural damage.

Strain – the tensile stretching or comprehensive squeezing of the land surface as it lowers to the new level, relative to the land surrounding it.

Curvature – the bending of the land surface as it lowers to the new level.

What does this subsidence mean at the surface?

Subsidence can result in a change to surface and sub-surface conditions. The effects of subsidence may not be noticeable because the undulation of the natural surface is much greater and tends to mask subsidence movements.

The level of impact that can occur to surface and sub-surface features depends on the magnitude of movement that occurs, and the sensitivity of each feature to these movements. Some features, such as houses, can be sensitive to ground tilt, curvature and strain.

Regulations

Mine subsidence is tightly regulated in NSW. During the assessment of the Tahmoor South longwalls the potential impacts of subsidence on surface features are to be assessed, including impacts on man-made features (e.g. buildings, pipelines, dams and bridges) and natural environmental features (e.g. rivers, cliffs, aquifers and ecosystems). Extraction Plans must be prepared and approved, outlining what management techniques will be used to keep impacts within acceptable levels.

Many government agencies are involved in the approval of an Extraction Plan including the NSW Department of Planning, Industry & Environment. This provides a whole-of-government approach, which allows all mine subsidence related issues to be considered in the process.

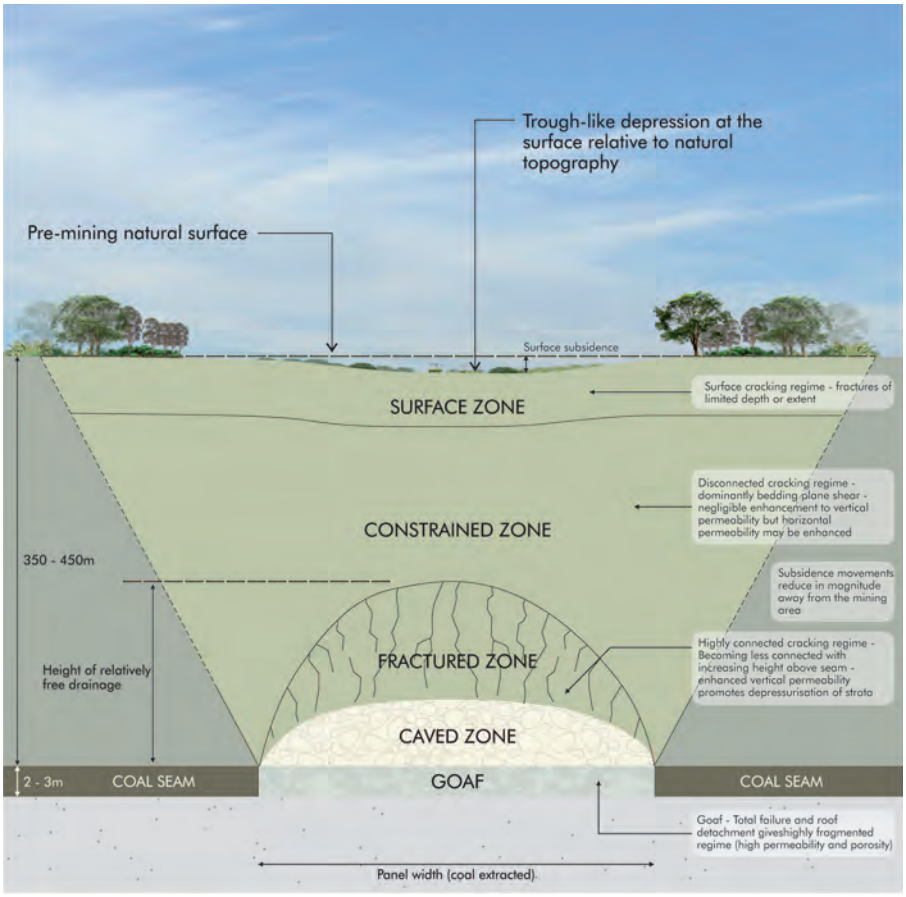


Figure 3: Cross view mine subsidence effects

Subsidence Management

Potential impacts from subsidence have been successfully managed by Tahmoor Coal for many years, including the Main Southern Railway, Picton Industrial Area, houses, shops, agriculture and infrastructure such as water, gas, power and telecommunications infrastructure. Subsidence can be managed in a number of ways, including;

- Mine Design;
- Pre-mining strengthening works;
- Monitoring during mining; and
- Post subsidence remediation works.

Subsidence Impacts from Tahmoor South Longwalls

Tahmoor Coal has previously mined longwalls 22 to 32 beneath the township of Tahmoor, Thirlmere and Picton, and observed subsidence impacts between 0.6m to 1.2m.

Following the completion of the Western Domain longwall mining in Picton, mining of Tahmoor South Longwall 1A is expected to commence in the Bargo area in October 2022.

The predicted maximum subsidence for the Tahmoor South longwalls is between 0.8m to 1.6m. Extensive ground monitoring and surveys will be undertaken before, during and after mining.

Possible Impacts on Houses & Other Structures

Vertical subsidence is the lowering of the land and the buildings on it. If a whole building lowers by the same amount, it has little or no effect on the building itself. Vertical subsidence varies from very small amounts (less than 20mm) more than 250m away from a mining area, to a maximum of about 1600mm near the middle of a longwall. These changes result in slight tilting and bending of the land and the buildings on it, as well as stretching and compressing.

These changes develop very gradually over many weeks, and they are not readily apparent to the naked eye.

The variation in subsidence movements does, at times result in impacts to houses and other structures, mainly in the form of cracks. The way a structure has been designed and built (for example, wooden house on piers or double brick on a concrete slab) will determine what impact subsidence may have on a structure.

Figure 4: Typical cross section of longwall and mine subsidence

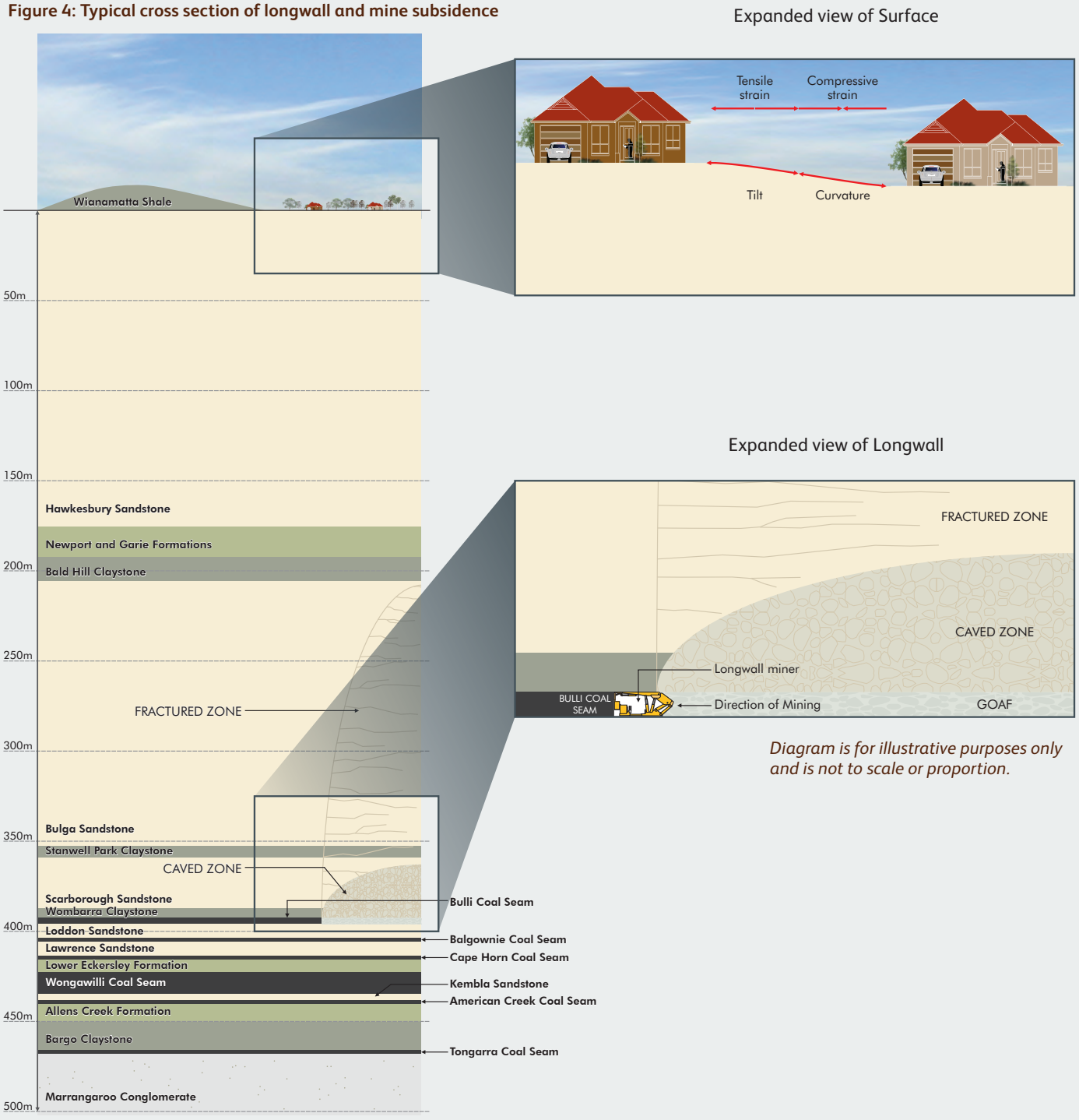


Diagram is for illustrative purposes only and is not to scale or proportion.

Subsidence Monitoring and Management

Tahmoor Coal has previously directly mined beneath or adjacent to more than 1,900 houses and civil structures, commercial and retail properties, the Main Southern Railway and local roads and bridges. Tahmoor Coal has implemented extensive measures prior to, during and after mining to ensure that the health and safety of people have not been put at risk due to mine subsidence. Management strategies for the successful mining beneath structures include:

- Regular consultation with the community before, during and after mining;
- Site-specific investigations for identified properties;
- Implementation of mitigation measures as suggested by specialist engineers;
- Ground surveys along streets; and
- Detailed visual inspections.

Tahmoor Coal has engaged a team of specialists to visually inspect, monitor and survey surface and below surface infrastructure to not only ensure there is no risk to public safety but also monitor change and discuss any concerns residents may have. Our dedicated team includes:

- Mine Subsidence Engineers;
- Structural Engineers;
- Geotechnical Engineers;
- Environmental Specialists;
- Surveyors; and
- Building Inspectors.

Pre-mining inspection

Tahmoor Coal encourages property owners in areas where underground mining is planned in the near future to have a Pre-Mining Inspection (PMI) carried out on their property.

PMIs are free of charge and facilitate a straight forward claims process if a property is impacted by subsidence.

The purpose of a PMI is to determine the condition of a property prior to mining. PMIs are an added protection for property owners to ensure they receive adequate compensation to return their property to its pre-mining condition should it be impacted by subsidence.

The inspector undertaking the PMI will document the condition of the property using photographs and survey levels. Once completed property owners are given a copy of the PMI detailed report. This report can be used as a reference to identify potential damage once mining has occurred.

Property Hazard Inspection

The *Work Health and Safety (Mines) Regulations 2014*, in relation to subsidence, requires Tahmoor Coal to identify and control hazards that may cause harm to people from subsidence. Tahmoor Coal risk management process includes hazard identification via a preliminary risk screening process that involves a visual inspection of each property within the active subsidence area from publicly accessible viewpoints and a more detailed property hazard inspection, where the consent of the property owner is provided.

Tahmoor Coal offers all property owners within the active subsidence area, a free property hazard inspection that will be undertaken by a qualified structural engineer.

How to request a pre-mining inspection and a Property Hazard Inspection

To request a PMI and/or a Property Hazard Inspection simply contact Tahmoor Coal. An inspection time will then be arranged.

Subsidence Damage

The signs of mine subsidence damage to buildings and other structures can range from cracking to walls and jammed doors to more significant structural issues. Generally, buildings damaged by mine subsidence remain safe and serviceable until they are repaired.

The extent of damage will vary depending on the location of the building in proximity to the mine workings and other subsidence related factors.

Duty to Disclose

Impacts to property improvements are covered by the *Coal Mine Subsidence Compensation Act 2017*, however, please consult with your insurance agency and mortgagee to determine if you have an obligation to disclose to them that mining will occur beneath your property.

Under the *Mining Act 1992*, Tahmoor Coal is responsible for providing compensation to property owners for compensable loss with the exception of compensation provided by Subsidence Advisory NSW (SA NSW). This means that Tahmoor Coal has the responsibility for providing compensation for impacts caused by mining within the Tahmoor Mining Leases upon property features that are not man-made. These features can include but are not limited to:

- **Surface of the land;**
- **Crops, trees, grasses and other vegetation;**
- **Stock;**
- **Other business usage; and**
- **Surface drainage.**



Subsidence Advisory NSW

Subsidence Advisory NSW (SA NSW) is the NSW Government Agency responsible for administering the *Coal Mine Subsidence Compensation Act 2017*. SA NSW has two core functions:

1. To provide compensation or manage the provision of compensation where surface developments are damaged by mine subsidence following extraction of coal or shale in NSW; and
2. To regulate surface development within mine subsidence districts to reduce the risk of mine subsidence damage.

SA NSW provides expert advice to property owners, government departments, councils, community organisations and industries within coal mining areas of NSW. This advice aims to provide compatibility between surface development and underground mining.

Changes to the Mine Subsidence Compensation Act 1961

Changes to the mine subsidence system in NSW took effect from 1 January 2018 following a review of the former ***Mine Subsidence Compensation Act 1961***. The changes make the mine subsidence compensation processes easier for property owners and provide a more equitable model for mining.



Figure 5: Mine Subsidence Claims Process

Subsidence Advisory NSW's online portal

SA NSW has an online portal for end-to-end management of claims, building and subdivision applications.

You can use the portal to lodge, track and manage compensation claims for subsidence damage and applications to build or subdivide in mine subsidence districts. Find out more at www.subsidenceadvisory.nsw.gov.au.

Claiming compensation for subsidence damage

If your home or structure is impacted as a result of subsidence your rights are protected under the *Coal Mine Subsidence Compensation Act 2017.*

An overview of the claims process is shown in Figure 5 above.

Subsidence Advisory NSW

www.subsidenceadvisory.nsw.gov.au

Picton Office
99 Menangle Street, Picton NSW 2571
PO Box 40, Picton 2571

Phone 02 4677 6500

Hours 8.30am-4.30pm Mon-Fri

24 Hour Emergency Call
1800 248 083

A free confidential counselling service is available for residents impacted by mining. For further details please contact Tahmoor Coal **(02) 4640 0100.**

Frequently Asked Questions

How do I find out when mining is occurring near my property?

To receive regular mining updates please contact Tahmoor Coal to be placed on our contact database.

What if I am a tenant?

If you are a tenant, please make sure you keep your landlord or managing agent informed if you notice any changes to your property that may be from mine subsidence.

Alternatively, if you receive information regarding your property from either Tahmoor Coal or SA NSW and you are a tenant please forward the information onto your landlord or managing agent.

It is important that not only the tenant receives information, but the owner and / or Managing Agent is also kept informed about mining operations.

What are the advantages of a pre-mining inspection?

The purpose of a PMI is to determine the condition of a property prior to mining. PMIs are an added protection for property owners to ensure they receive adequate compensation to return their property to its pre-mining condition should it be impacted by subsidence.

How do I arrange a pre-mining inspection?

To request a PMI simply contact Tahmoor Coal.
An inspection time will then be arranged with you.

What if I don't have access to the internet or a computer to lodge a claim online?

SA NSW will continue to accept claims for compensation and development applications in hardcopy. You can lodge hardcopy applications with SA NSW over the counter at its Picton office or via post.

Who manages my claim?

All claims are managed by a SA NSW Case Advisor who will provide property owners with focused support and a dedicated point of contact throughout the process.

What happens if the mine ceases to operate?

If the mine ceases to operate, claims for compensation would continue to be managed in accordance with the CSMC Act.

Mining companies are required to pay levies into a Coal Mine Subsidence Compensation Fund which is managed and controlled by SA NSW. Levy amounts are estimated and paid annually, with the value based on coal extraction rates. Any subsidence-related compensation to home owners would be paid by SA NSW via the fund, ensuring security to home owners, irrespective of the mine company financial status.

There is also a rehabilitation security deposit held by the Resources Regulator for Tahmoor Coal (as is required of all title holders), that ensures adequate funds are available to complete rehabilitation and subsidence repairs in the unlikely event of unexpected closure of the mine.

How to stay in touch & up to date with the latest information

Contact Us: 02 4640 0100 (within office hours)
1800 154 415 (after hours)

Email: tahmoorenquiries@simecgfg.com

Web: www.tahmoorcoal.com.au

Tahmoor Coal Environment and Community team:

- Zina Ainsworth
  Environment & Community Manager
- Amanda Bateman
  Community Liaison Specialist
- Ross Barber
  Project Manager
- April Hudson
  Approvals Specialist
- Thomas O'Brien
  Environmental Specialist

Emergency Numbers

Fire 000
Ambulance 000
Police 000
Gas 131 909
Electricity 131 002
Sydney Water 131 090
Telstra 132 203

MEMBER OF GFG ALLIANCE

T: (02) 4640 0100 **E:** tahmoorenquiries@simecgfg.com **W:** www.tahmoorcoal.com.au
SIMEC Mining Site Address: 2975 Remembrance Drive, Bargo | Postal Address: PO Box 100, Tahmoor NSW 2573, Australia

SIMEC