SIMEC

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Tahmoor Coal Pty Ltd

MINE OPERATIONS PLAN

Tahmoor Coking Coal Operations – SIMEC Mining

2020-2024

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PUBLICATION DATE:	28/08/2020
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Appendices

MOP Plans

MINE OPERATIONS PLAN
(MOP)

Name of Mine:	**Tahmoor Coal**
Name of Leaseholder:	Tahmoor Coal Pty Ltd
Name of Mine Operator:	Tahmoor Coal Pty Ltd
Titles / Mining Leases:	ML1376, ML1308, ML1539, ML1642, CCL716 and CCL747
MOP Commencement Date:	1 October 2020
MOP Completion Date:	16 June 2024
Mine Manager:	Malcolm Waterfall Manager of Mining Engineering (02) 4640 0100
Environmental Representative:	Zina Ainsworth Environment and Community Manager (02) 4640 0100
Authorisation Holder:	Tahmoor Coal Pty Limited
Authorisation Representative:	Peter Vale General Manager (02) 4640 0100
Reporting Officer:	Zina Ainsworth Environment and Community Manager (02) 4640 0100
Signature:	Peter Vale .....
Date:	28 August 2020

1 INTRODUCTION

Tahmoor Coal is located south of the township of Tahmoor approximately 80 kilometres (km) south-west of Sydney. Surface facilities are situated to the south of the Bargo River and adjacent to Remembrance Driveway (Old Hume Highway). The Refuse (Reject) Emplacement Area (REA) is located to the east of the main southern railway. The underground workings extend under the towns of Tahmoor and Picton. Two ventilation shafts are located on the outskirts of the town and one on the mine site.

Construction of the mine was commenced by Clutha Development in 1975. Mining commenced in 1980 and the Tahmoor Washery commissioned in 1981. In the mid 1980's, BP Coal acquired the mine from Clutha Development. In 1987 the gas extraction facility was commissioned, and longwall mining commenced. CRA acquired BP Coal's interest in Tahmoor Colliery in 1989. In 1997, Austral Coal Limited acquired Tahmoor Colliery from CRA. In 2005, Centennial Coal acquired a majority shareholding in Austral Coal Limited. In October 2007 Xstrata Coal Pty Ltd (Xstrata Coal) acquired 100% shareholding in Austral and Tahmoor Colliery. In 2013, Xstrata merged with Glencore and Tahmoor Colliery became known as Glencore's Tahmoor Underground. More recently Tahmoor Coal Pty Ltd was acquired on 20 April 2018 by the GFG Alliance's SIMEC Mining division, specifically SIMEC (Australia) Mining Pty Ltd, and now trades as Tahmoor Coal Pty Ltd (Tahmoor Coal).

The first Mining Operations Plan (MOP) for Tahmoor Coal was prepared for the period from June 2002 to April 2008. This plan was accepted in August 2002. The current plan has been amended on multiple occasions and the period of operation extended.

This MOP has been prepared generally in accordance the *ESG3 Mining Operations Plan (MOP) Guidelines (2013)*, and covers the period from 1 October 2020 to 16 June 2024.

Tahmoor Coal operates under a number of consents for the REA, and according to legal advice both consents are valid. These include the:

- 1979 Development Consent for the Coal Preparation Plant and Ancillary Washery and Reject Area
- Tahmoor North Consent approved by the Land and Environment Court in 1994

Refer to **Table 1.1** for a complete list of the development consents that relate to Tahmoor Coal operations.

In May 2018, Tahmoor Coal received a Section 240 Notice (Our Ref: DI0680 2018, ACES Ref: 0353-2016, OUT17/48999) from the DPIE NSW Resource Regulator. This direction outlined a number of actions, which included incorporation of the Corrective Management Action Plan (CMAP) for the rehabilitation of Myrtle Creek (Revision B, Version 1, dated 16 June 2017 No. TAHUG-2119843053-10). This further addressed in Section 5.5 and a copy of the Myrtle Creek CMAP is included as **Appendix 6**.

In addition, in May 2018 the NSW Resource Regulator conducted an inspection of the REA. Actions that resulted from this inspection included:

- Stabilisation of the earth drains at the REA.
- Review the topsoil depth checking process.

These actions are addressed in Section 6.1 and a copy of correspondence addressing these actions is included as Appendix 8.

1.1 CONSENTS, AUTHORISATIONS AND LICENSES

Tahmoor Coal has been in operation for over 30 years, during which time a number of major and minor changes to planning, development and mining legalisation have occurred. As a result, the consents and approvals for Tahmoor Coal are large in number and cover a variety of land areas and successive mine developments.

A summary of Tahmoor Coal Development Consents is provided in **Table 1.1**.

A summary of Tahmoor Coal Leases and Exploration Authorisations is provided in **Table 1.2**.

A summary of Tahmoor Coal licences is provided in **Table 1.3**, including the site Environment Protection Licence (EPL), Water Licences and Dangerous Goods Licence.

Other approvals issued by government agencies include the site's Subsidence Management Plans; a summary of these is provided in **Table 1.4**.

Table 1.1 Tahmoor Coal Development Consents

Consent Number	Consent Description	Date Granted	Expiry Date
DA 1975	Underground Mine	26/03/1975	No expiry
DA 1979 (as modified)	Coal Preparation Plant Stockpiles and Refuse Emplacement Area. Road haulage of trial coal shipments. Upgrades for Longwall Mining. Road haulage in Wollondilly Shire and when rail unavailable. Road haulage to Corrimal and Coal Cliff Coke Works.	23/08/1979	No expiry
DA 190/85	Surface Works for Gas Extraction.	16/12/1985	No expiry
DA 57/93 (as modified)	Tahmoor North Project. Modification for heritage approval condition.	7 /09/1994	No expiry
DA 67/98 (as modified)	Tahmoor North Extension Project. Additional areas to be subsided. Redbank Tunnel Subsidence Management. Redbank Tunnel Subdivision of Land. Expanded Subsidence Footprint.	25/02/1999	16/06/2024

Table 1.2 Tahmoor Coal Pty Limited Mining Leases and Exploration Authorisations

Title Lease/ Authorisation	Lease/Authorisation Description	Date Granted	Expiry Date
Consolidated Coal Lease 716	Original Tahmoor Leases	15/06/1990	13/3/2021 Renewal pending.
Mining Lease 1376	Tahmoor North Lease	28/08/1995	28/08/2016 (Renewal Pending)
Mining Lease 1308	Small Western lease to west of CCL716	02/03/2014	02/03/2035
Mining Lease 1539	Tahmoor North Extension Lease	16/06/2003	16/06/2024
Mining Lease 1642	Surface Freehold Areas	27/08/2010	27/08/2031
Consolidated Coal Lease 747	Shaft site	23/5/1990	06/11/2025
Exploration Authorisation 206	Exploration Authorisation 206 - coincides with CCL 716	21/01/1981	10/05/2019 (expired)
Exploration Authorisation 410	Exploration Authorisation 410 - coincides with ML 1376 and ML 1539	26/04/1989	9/05/2019 (expired)

Table 1.3 Summary of Tahmoor Coal Pty Ltd Licences

Licence Title	Date Granted	Expiry Date
Environment Protection Licence 1389	1/05/2012	Renewed Annually
Water Access Licence (WAL) 36442	06/12/2013	Renewed Annually
Water Supply Works Approval 10WA118745	01/07/2012	30/06/2025
Water Access Licence (WAL) 25777	27/10/2014	Renewed Annually
Water Supply Works Approval 10WA103026	01/07/2011	24/09/2024

Table 1.4 Extraction Plan Approval Status

Extraction Approval	Approval Status
LW W1-W2	Approved 8/11/2019
LW W3-W4	To be submitted

1.2 LAND OWNERSHIP

For the purpose of this document, all references to Tahmoor Colliery, infer Tahmoor Coal. A schedule of land owned by Tahmoor Coal is provided in Table 1.5 below.

All properties listed are freehold land and are consistent with Map 1 – Pre-Mining Environment.

Table 1.5 Schedule of Land Ownership

Lot	DP	Physical Address	Tenure Type	Occupancy Description
170	751250	Kader Street, Bargo	Freehold	Bargo Colliery Site
35	751250	Kader Street, Bargo	Freehold	Bargo Colliery Site
1	120968	Remembrance Driveway, Bargo	Freehold	Tahmoor Coal Mine Site
162	1054184	Remembrance Driveway, Bargo	Freehold	Tahmoor Coal Mine Site
13	3306	Stratford Rd, Tahmoor	Freehold	Tahmoor Coal No.1 Shaft
441	751270	275 Rockford Rd, Tahmoor	Freehold	Tahmoor Coal No.2 Shaft
248	751250	Charlies Point Road, Bargo	Freehold	Refuse Emplacement Area
217	751250	115 Charlies Point Road, Bargo	Freehold	House occupied by tenant
2232	787222	225 Charlies Point Road, Bargo	Freehold	Refuse Emplacement Area

Lot	DP	Physical Address	Tenure Type	Occupancy Description
21	776716	80 Innes Street, Thirlmere	Freehold	Property has been sold. Sale process will be completed in October 2020.
245	751250	125 Anthony Road, Bargo	Freehold	House occupied by tenant
132	879762	4 Hodgson Grove, Tahmoor	Freehold	House occupied by tenant
134	879762	7 Hodgson Grove, Tahmoor	Freehold	House occupied by tenant
1&2	1037712	260 Rockford Rd, Tahmoor	Freehold	House occupied by tenant
45	751270	250 Rockford Road, Tahmoor	Freehold	House
2231	787222	215 Charlies Point Road Bargo	Freehold	House occupied by tenant

1.3 STAKEHOLDER CONSULTATION

Tahmoor Coal has developed a Social Involvement Plan (SIP) to assist in the process of continually improving and maintaining Tahmoor Coal's role as a responsible corporate citizen and to assist with the implementation of appropriate communication strategies to promote positive and long-term relationships with our community.

The objectives of this plan include but are not limited to:

- Identify key stakeholders;
- Identify and document key community risks and opportunities including methods to manage them effectively so as to prevent adverse impacts;
- Establish and document consultation strategies;
- Deliver sustainable benefits to the community in which Tahmoor Coal operates by building local capacity via the community support programs; and
- Comply with the requirements of TCCCs Standards, Business Principles and Policies.

The SIP covers all stakeholder engagement, including neighbouring land holders, community members from the local area and wider region, and engagement with various government agencies. Tahmoor Coal engages with the Tahmoor Coal Community Consultation Committee (TCCCC) on matters relating to mine rehabilitation and closure, through quarterly reporting and annual site inspections of the site (including mine rehabilitation areas at the site Refuse Emplacement Area). The TCCCC includes Councillors from Wollondilly Shire Council and representatives of the local community, as well representatives from non-government organisations involved in environmental management.

Stakeholder consultation is an ongoing process that takes place throughout the life of the project. Tahmoor Coal has established a good working relationship with the local community and seeks to continue this as we continue our operations. A list of the key stakeholders is provided in **Table 1.6**.

Table 1.6 Tahmoor Coal Key Stakeholder List

Stakeholder	Information requirements and Method of Consultation
Local community **Stakeholders within 100 m buffer of pit top operations** **Stakeholders in active subsidence zone**	Ongoing consultation with stakeholders within local community before, during and after mining operations will be undertaken by various methods including community information sessions, monthly newsletters, face to face meetings and newspaper articles. They will be informed and provided with the opportunity to provide feedback in relation to mining operations, rehabilitation objectives/criteria and progress throughout the life of the mine and at mine closure.
NSW Department of Planning, Industry and Environment	Ongoing consultation for management of statutory matters. Liaise for lease relinquishment. Address matters raised in guidelines, policies and project approval before, during and after mining operations. Review Closure Decommissioning and Rehabilitation MOP.
NSW Resources Regulator	Consultation in regards to exploration licencing and reporting. Address matters raised in guidelines, policies and project approval before, during and after mining operations.
Office of Environment and Heritage / Environment Protection Authority	Liaise regularly to attend to licence management matters. Ongoing consultation for management of statutory matters. Liaise for lease relinquishment. Review Closure Decommissioning and Rehabilitation MOP.
WaterNSW	Ongoing consultation to manage water during mining operations including mine dewatering and discharge boreholes sealed as required. WaterNSW kept informed of developments and process.
Natural Resources Access Regulator	Ongoing consultation to manage water licencing and water access agreements.
Wollondilly Shire Council	Ongoing consultation with respect to development consent matters and project planning before, during and after mining operations.
Subsidence Advisory NSW	Ongoing consultation before, during and after mining operations with Subsidence Advisory representatives. Face to face engagement with Subsidence Advisory representative and local residents impacted or potentially impacted by subsidence.
SIMEC	As per SIMEC internal communication standards.
Potential final land user	If identified, the final land user should be consulted (where appropriate) through the detailed mine closure development process in order to maximise potential opportunities to value add to the land.
Aboriginal groups	Consultation as required pertaining to the management of Aboriginal heritage sites. Where appropriate, consultation will be conducted via site inspections/meetings.

Stakeholder	Information requirements and Method of Consultation
Local business community	Ongoing updates of mining operations via newsletters, information sessions and newspaper articles. To be consulted regarding any Social Impact Assessments that may be undertaken prior to mine closure. Methods for consultation with businesses will be developed as part of the assessment process.
Community Groups	Financial and in kind support for local community groups via Tahmoor's Corporate Social Involvement community support program. Community support programmes focus on enhancing socio-economic capacity, prosperity and environmental health of stakeholder communities. They are aimed at sustainable enhancements that do not remain dependent on the operation beyond its expected life.

2 PROPOSED MINING ACTIVITIES

2.1 PROJECT DESCRIPTION

Tahmoor Coal is currently extracting Longwall West 1 (LW W1). Current mining activities are completed in accordance with the Longwall W1-W2 Extraction plan approved by DPIE on 08/11/2019. Progressive first workings and extraction approvals are expected over time for future workings beyond Longwall W1 – W2 during the MOP reporting period (i.e. Longwall West 3 to 4). The general sequence and staging of longwall extraction for Life of Mine (which includes the MOP period) is provided in Table 2.1. Tahmoor Mine's expected Life of Mine currently extends to around 2024 depending on mining extraction rates and resource recovery options. Tahmoor Coal has submitted the Tahmoor South Coal Project development application, which if granted will extend the mine life beyond 2024.

Table 2.1 Proposed longwall mining sequence for Life of Mine

Longwall Panel	Proposed Start	Proposed Completion
Longwall West 1	15/11/2019	12/11/2020
Longwall West 2	10/12/2020	15/08/2021
Longwall West 3	12/09/2021	13/04/2022
Longwall West 4	11/05/2022	15/09/2022

Tahmoor Coal processes Run of Mine (ROM) Coal at an on-site Coal Handling and Preparation Plant (CHPP). The CHPP utilises crushing and screening, primary and secondary cyclones, and a flotation circuit to produce coking and thermal coal product which is stockpiled, before being loaded and transported by rail to Port Kembla Coal Terminal.

Fine reject from the coal washing process is dried using a belt press filter and mixed with coarse reject before being conveyed to the on-site Refuse Emplacement Area (REA). Refuse is emplaced using haul trucks and reshaped by dozers, before being capped with topsoil and progressively rehabilitated.

All coal and reject handling is by a fully enclosed conveyor system, with the exception of the tripper conveyor to the primary product stockpile.

All operations described in this section are expected to remain for the Life of Mine.

2.2 ACTIVITIES OVER THE MOP TERM

2.2.1 Construction Activities

Actions to be completed during the MOP period include:

- Continue Myrtle Creek CMAP schedule and works program;
- Continue Redbank Creek CMAP schedule and works program;
- Continue update and revision of Environmental Management Framework;

- Continue improvements and updates to WWTP in accordance with PRP22 of EPL1389;
- Extraction Plan for Longwalls West 3 and West 4;
- Obtain approval for Modification 5 of DA67/98;
- Geotechnical investigations over Western Domain for Height of Fracture (HoF) determination;
- Extension of the Reject Emplacement area to incorporate a new water management dam and
- Before activities commence on the above projects, the necessary consents and approvals will be gained, if not already held, as required.

2.2.2 Long term Drainage

It is envisaged that if the Tahmoor South Project is approved that the drainage of the entire REA will be modified, such that the majority of clean water drainage will be transferred in an easterly direction. In the event that the Tahmoor South Project is not approved a review of the long term drainage will be conducted to remove the long term need for the proposed underdrainage. This redesign will be conducted in consultation with the relevant agencies at that time.

2.2.3 Mine Development and Sequence

Current mining methods (continuous miners and longwall extraction) will continue for the term of the MOP, and generally in accordance with the sequencing information provided in Table 2.1.

2.2.4 Tailings/Reject Management Operations

Refuse emplacement activities as described in Section 2.2.1 will continue over the term of the MOP.

2.2.5 Overview of Rehabilitation Activities

Rehabilitation is undertaken in accordance with Tahmoor Coal's *Biodiversity & Land Management Plan*, with the annual program detailed each year in the site *Annual Rehabilitation Plan*. All disturbed areas are rehabilitated once they become available, with rehabilitation activities generally involving the application of topsoil (or other growth media), scarification and/or ripping to encourage drainage and create furrows for seed bed, the application of any required ameliorants or fertilizers, and finally direct seeding or planting with tubestock, depending on the rehabilitation objectives for the area. The majority of rehabilitation completed during the MOP term will be at the REA, as emplaced areas are progressively reshaped, topsoiled and rehabilitated.

2.2.6 Bargo Colliery - CCL 747

CCL 747 is associated with the Bargo Collieries shaft site, which is no longer in use. The shaft site is covered with a steel plate and fenced, with routine security and environmental inspection of the site undertaken to assess safety and security aspects. The shaft site is not expected to be used during the MOP term.

2.3 Proposed Exploration

Limited surface drilling exploration activities are proposed in the Tahmoor North Leases CCL716 and ML1376 to determine geological structure, coal quality and other investigatory purposes. This includes:

- Two geotechnical exploration boreholes in CCL716 related to the proposed vent shafts (TSC-1 and TSC-2) for the Tahmoor South Project. Both boreholes will be surface to seam.
- Pre and Post mining height of fracture boreholes for the Western Domain mining area. These will be located in ML1376.

Multi-string Vibrating Wire Piezometers will be installed in selected holes as required.

ESF4 Form Applications will be submitted prior to the exploration of all boreholes. The application will detail the specifics of each exploration borehole, as well as of clearing and rehabilitation requirements.

Surface seismic or other surface exploration is not currently proposed in the Tahmoor North Leases however it may be undertaken for similar purposes as exploration drilling. Extensive underground exploration is undertaken by in-seam drilling and will continue throughout the MOP period.

2.3.1 Production and Waste Schedule

A summary of the expected production and waste schedule is provided in **Table 2.2**.

This production schedule does not include the Tahmoor South project, which is currently under assessment by the DPIE. If approved, mining is expected to commence in 2021 and will extend the life of the mine beyond 2024 and also change the production schedule. If approval of the Tahmoor South project is delayed, Tahmoor Coal may slow the current production schedule to extend the mine life to 2023 or 2024 to minimise the risks associated with a disruption of operations.

Table 2.2 Production and Waste Schedule for the MOP Term

Material Production Schedule during MOP Term						
Material	**Unit**	**2020**	**2021**	**2022**	**2023**	**2024**
ROM Coal	t	2,376,249	2,620,486	1,599,832	TBA	TBA
Reject	t	1,057,987	961,789	453,980	TBA	TBA
Product Coal (Coking)	t	1,318,261	1,745,239	1,198,647	TAB	TAB

3 ENVIRONMENTAL ISSUES MANAGEMENT

3.1 RISK ASSESSMENT

Tahmoor Coal has developed an Environment and Community Broad Brush Risk Assessment (ECBBRA), which identifies environmental hazards and controls associated with Tahmoor's surface and underground operations. Each year, the ECBBRA is reviewed and updated to capture any changes to internal or external environment. Actions from the ECBBRA are documented in the site action register so progress can be tracked by mine management.

The ECBBRA was developed and is reviewed in accordance with AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines, and the annual ECBBRA review involves a cross section of personnel from Tahmoor Coal including staff from environment and community, health and safety, coal handling and preparation plant, engineering and mine operations.

The Tahmoor Coal complete an annual review of the ECBBRA. The most recent ECBBRA was undertaken on 31 July 2020 and identified only low to medium ranked risks (i.e. no risk with a "high" ranking were identified). Management plans and/or procedures are currently in place for all risks with a medium ranking.

3.2 ISSUES MANAGEMENT DOCUMENTATION

In accordance with the *ESG3 Mining Operations Plan (MOP) Guidelines (2013)*, a list of environmental issues relevant to Tahmoor and management plans required by the consents is provided in **Table 3.1**. Tahmoor Coal management plans are developed to comply with development consent and approval requirements, relevant regulation and legislation, relevant Australian and International standards and guidelines, and internal sustainable development standard requirements.

In addition to the management plans required by the consents, Tahmoor Coal Environment and Community Manager has the following management plans in place:

- Soil and Water Management Plan
- Groundwater Management Plan
- Waste Management Plan
- Biodiversity and Land Management Plan
- Rehabilitation Monitoring Procedure
- Cultural Heritage Management Plan
- Bushfire Management Plan (draft)

Table 3.1 Relevant Environmental Issues & Applicable Management Plans

Relevant Environment Issues (MOP Guideline)	Tahmoor Coal Management Plan	Version	Approval Authority or External Agency	Submission or Approval Date
Air Quality	Air Quality and Greenhouse Gas Management Plan	8	Department of Planning, Industry and Environment	28 June 2020
Noise	Noise Management Plan	8	NSW Environment Protection Authority Department of Planning, Industry and Environment	28 June 2020
General	Environmental Management Plan Framework	9	Department of Planning, Industry and Environment	28 June 2020

3.2.1 Other Risks

Contamination

A Stage 1 Preliminary Contamination Investigation was completed by GHD in 2017. This investigation found that the overall likelihood for the presence of significant chemical contamination was low. The actions from that investigation have been closed out, including removal of former underground storage tanks and remediation works around the waste oil tanks and above ground diesel storage tanks.

Tahmoor operates a variety of bulk oil and chemical storage areas which are generally bunded with in-ground sumps which minimises the contamination risk. Routine visual inspections of these areas for leaks, evidence of poor practices is undertaken, etc with corrective actions implemented as needed.

Spontaneous Combustion

The potential for the coal mined at Tahmoor to spontaneous combust was assessed by the UniQuest in 2007. This assessment found that the R70 values of Tahmoor Colliery coal samples were the lowest recorded for the Sydney Basin coals to date in the UQ database. With values in excess of 20 time less than the coal in the Hunter Valley seams which have a documented history of spontaneous combustion. During the MOP period Tahmoor will be mining the same coal seam tested by UniQuest and as such spontaneous combustion is not expected to occur or pose a risk that could not be managed if required using standard management approaches.

Waste Rock Geochemistry / Acid Mine Drainage

The surface water / runoff generated from the mines pit top facilities, stockpile and reject emplacement areas is managed via a connected network of drainage lines, dams etc, with all the surface water reporting to licenced discharge point 1. (Dam M4).

Historically, acid mine drainage has not been an issue at the mine. The 2019 monthly surface water monitoring results for licenced discharge point 1 (Dam M4) supports the absence of acid mine drainage occurrence, with pH values ranging in between 8.2 and 8.7. During the MOP period Tahmoor will be mining the same stratigraphy using the same methods of mining. Acid mine drainage is therefore not anticipated to be an issue during the MOP term.

Old Mining Areas – Bargo Colliery (CCL 747)

The shaft site provides access to the underground working which were mined using the bore and pillar method. The shaft opening has been secured with a steel plate and a perimeter security fence installed (See **Section 2.2.6**). Neither the shaft site or the bore and pillar mine working present risks that cannot be easily managed if required using standard management approaches to achieve the final land-use goals.

4 POST MINING LAND USE

4.1 REGULATORY REQUIREMENTS

Tahmoor Coal has several Development Consent conditions related to mine closure, including some detail on post-mining land use and rehabilitation outcomes. These conditions are detailed in **Table 4.1**.

Table 4.1 Tahmoor Coal Development Consent conditions related to Mine Closure

Approval Title	Condition
DA 1975 (26th Mar 1975)	C1 On completion of mining activities the site shall be left safe, clean and tidy to the satisfaction of Council and including the following requirements: (i) where required by Council all buildings shall be either removed or satisfactorily covered; (ii) the site shall be so treated that all batters area at a safe angle of repose; (iii) exclusive only of sealed access roads, the surface area shall be satisfactorily graded, top-dressed to a depth of not less than 6" and established with approved trees and grasses; and (iv) the mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. C2 Where required by Council all buildings shall be either remove or satisfactory covered. C3 The site shall be so treated that all batters are at a safe angle of repose. C4 Exclusive only of sealed access roads, the surface area shall be satisfactorily graded, top-dressed to a depth of not less than 6" (152mm) and established with approved trees and grasses. C5 The mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. C6 *Reference to lease conditions related to shaft sealing and closure*.
DA 1979 (23rd Aug 1979)	7) Rehabilitation and re-vegetation of the rejects area to be undertaken to the satisfaction of the Commission. Such satisfaction may be assumed if agreement is reached with the Wollondilly Shire Council and with the Lands Department, the Soil Conservation Service and the National Parks and Wildlife Service to the extent that their jurisdiction applies.
DA 1979 (M2) (5th Nov 1986)	7) Rehabilitation and re-vegetation of the rejects area to be undertaken to the satisfaction of the Commission etc (as per Condition 7 – 23 August 1979).
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. 22) Upon completion of operations on the surface of the subject area or upon the expiry or sooner determination of this authority or any renewal thereof, the lease holder shall remove from such surface such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister.

Approval Title	Condition
	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.
ML 1642	7) Disturbed land must be rehabilitated to a sustainable/agreed end land use to the satisfaction of the Director-General.

4.2 POST MINING LAND USE VISION

There are a number of post mining land use options that may be applicable to the Tahmoor Coal domains including residential, light industrial or a return to native bushland. Currently, it is considered that the likely final land use option for most all of the Tahmoor Coal closure domains will be a return to native bushland. However, the final land use options will be confirmed in the detailed closure planning process, which involves undertaking a final land use analysis.

4.3 PROJECT REHABILITATION OBJECTIVES

The general rehabilitation objectives shared by the Tahmoor Coal closure domains are:

- Remove infrastructure and services;
- Level, re-contour and grade areas to achieve safely battered slopes and surfaces;
- Apply topsoil for rehabilitation where required;
- Establish native bushland vegetation, or other type dependent on selected final land use;
- Develop self-sustaining native bushland which requires minimal ongoing care and maintenance.

More detailed rehabilitation objectives will be included in the detailed mine closure plan. The ultimate goal of achieving these project rehabilitation objectives and final land use goals is to satisfy regulatory requirements for closure and successfully relinquish mining tenements, and return the associated securities. More detailed preliminary closure criteria for each of the domains is provided in **Section 5.5**.

5 REHABILITATION PLANNING

5.1 DOMAIN SELECTION

Tahmoor Coal has six (6) identified primary closure domains based on operational function and geography. Most of these domains are connected or within close proximity of one another, and will therefore share similar final landforms and rehabilitation objectives. A schedule of these domains, with the rehabilitation status and the start and end of the MOP term, is provided in **Table 5.1** and shown graphically in **Appendix 1 Plan 2A**.

Table 5.1 Tahmoor Coal Closure Domains

Domain	Description	Rehabilitation Status	
		MOP Commencement	MOP Completion
1	Tahmoor Main Pit Top Area	-	-
1A	CHPP	Active Area	Active Area
1B	Rail Loading Facility	Active Area	Active Area
1C	Main Workshop and Administration Area	Active Area	Active Area
1D	No.3 Shaft and Gas Drainage Plant	Active Area	Active Area
1E	Sewage/Water Treatment Plant	Active Area	Active Area
2	Product Stockpile Area	Active Area	Active Area
3	Refuse Emplacement Area	Active Area, Ecosystem Est., and Ecosystem Dev.	Active Area, Ecosystem Est., and Ecosystem Dev.
4	No.1 Ventilation Shaft	Active Area	Active Area
5	No.2 Ventilation Shaft	Active Area	Active Area
6	Off Title Subsidence Area	Active Area	Active Area

5.2 DOMAIN REHABILITATION OBJECTIVES

Rehabilitation objectives for each specific closure domain are provided in **Table 5.2**.

Table 5.2 Tahmoor Coal Domain Rehabilitation Objectives

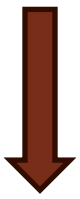
Domain	Rehabilitation Objective	Source of Domain Rehabilitation Objectives Link to Project Rehabilitation Objectives and Final Land Use Outcomes
1A CHPP	Infrastructure and services will be removed from the CHPP area.	1979 EIS CCL716
1B Rail Loading Facility	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	DA1975 CCL716
1C Main Workshop and Admin Area	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	DA1975 CCL716
1D No.3 Shaft and Gas Plant	Mine shaft to be sealed, or fenced depending on DPIE requirement. Infrastructure and services will be removed, and buildings at the No.3 shaft area removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation.	DA1975 CCL716

Domain	Rehabilitation Objective	Source of Domain Rehabilitation Objectives Link to Project Rehabilitation Objectives and Final Land Use Outcomes
1E Sewage and Water Treatment Plants	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	DA1975 CCL716
2 Product Stockpile Area	Infrastructure and services will be removed from the CHPP area.	1979 EIS CCL716
3 Refuse Emplacement Area	Infrastructure and services will be removed from the REA site. Achieve design height and ensure maximum capacity is achieved. Landform established to support native ecosystem. Prevent erosion from stormwater runoff following rehabilitation of external batters. Apply topsoil for rehabilitation. Reduce erosion on slopes, and provide furrows for seed beds. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	1979 EIS 1993 EIS CCL716 REA Rehabilitation & Water Management Plan
4 No.1 Ventilation Shaft	Mine shaft to be sealed, or fenced depending on DPIE requirement. Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	DA1975 CCL716

Domain	Rehabilitation Objective	Source of Domain Rehabilitation Objectives Link to Project Rehabilitation Objectives and Final Land Use Outcomes
5 No.2 Ventilation Shaft	Mine shaft to be sealed, or fenced depending on DPIE requirement. Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy. Landform to be recontoured to achieve safe angle of repose slopes (or flatter). Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion. Grade surface areas. Apply topsoil for rehabilitation. Establish native bushland rehabilitation. Self-sustaining native bushland rehabilitation.	DA1975 CCL716
6 Off Title Subsidence Area	Area to be rehabilitated in line with the Myrtle Creek and Redbank CMAP's (see **Appendix 5 and 6** respectively)	ML1376 ML1539

5.3 REHABILITATION PHASES

Tahmoor Coal has adopted the DPIE rehabilitation phases for mine closure in accordance with the *ESG3 Mining Operations Plan (MOP) Guidelines (2013)*. The following rehabilitation phases are used throughout this MOP to describe the status of each closure domain:



- Decommissioning
- Landform Establishment
- Growth Medium Development
- Ecosystem Establishment
- Ecosystem Development.

5.4 REHABILITATION INDICATORS AND COMPLETION CRITERIA

The preliminary rehabilitation indicators and completion criteria detailed in **Section 5.5** have been developed to meet the domain rehabilitation objectives from the site's various consents and approvals. These criteria will continue to be refined throughout the MOP term, following the implementation of rehabilitation and biodiversity monitoring programs, as part of the site's continue improvement process. Closure criteria will be refined for each specific rehabilitation domain in accordance with SIMEC Rehabilitation Monitoring Procedure (TAH-HSEC-00012). For a detailed breakdown of rehabilitation indicators and completion criteria, including link and reference to the relevant source approvals, refer to **Section 5.5**.

5.5 REHABILITATION TABLE

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
Domain 1A: Coal Handling and Preparation Plant (CHPP)	Decommissioning	Plant will be eliminated when operations cease at the completion of mine life. 1979 EIS Section 5.4	Infrastructure and services will be removed from the CHPP area.	All services to be removed from CHPP area.	Yes	1979 EIS CCL716	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22		CHPP buildings, offices and infrastructure to be removed.			
				Underground reagent storage tanks to be removed.			
				Written approval from the Minister or delegate from the NSW Resources Regulator to confirm satisfaction.			
	Landform establishment	No specific regulatory requirement.	*Rehabilitation to be consistent with Domains 1B, 1C, 1D & 1E (see **Appendix 1 Plan 4A**).* Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
			Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
			Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	(not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Growth medium development	No specific regulatory requirement.	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Ecosystem establishment	No specific regulatory requirement.	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
Domain 1B: Rail Loading Facility (rail spur)	Decommissioning	Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy.	All services, track and associated infrastructure to be removed.	Yes	DA1975	No
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)		Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	DA1975 CCL716	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22					
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					
		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6” (152mm)…” DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No
	Ecosystem development	No specific regulatory requirement	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 1C: Workshops & Administration	Decommissioning	Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy.	All services to be removed from main administration, and from the workshop areas.	Yes	DA1975	No
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)		Workshop buildings removed or covered.	Yes	DA1975	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22		Administration building removed or covered.	Yes	DA1975	No
				Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	DA1975 CCL716	No
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					
		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6" (152mm)…" DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No
	Ecosystem development	No specific regulatory requirement	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 1D: No.3 Shaft & Gas Extraction Plant	Decommissioning	The mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. DA1975 Condition (C5)(iv)	Mine shaft to be sealed, or fenced depending on DPIE requirement.	No.3 Ventilation Shaft sealed in accordance with applicable DPIE guideline, or fenced in accordance with DPIE instruction.	Yes	DA1975	No
		Upon abandonment of operations on the subject area… the holder shall cause the top of every shaft to be sealed to the satisfaction of the Minister for Mines. Provided however that the Minister may, in circumstances he considers appropriate, require any shaft to be fenced in lieu of being sealed. DA1975 Condition (C6)					
		Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure and services will be removed, and buildings at the No.3 shaft area	All services and any buildings at the No.3 shaft area to be removed.	Yes	DA1975	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)	removed or covered to ensure the site is safe, clean and tidy.	Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	DA1975 CCL716	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22					
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					
		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	No.3 shaft unsealed areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6” (152mm)…” DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
Domain 1E: Sewage & Water Treatment Facilities	Ecosystem development	No specific regulatory requirement	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
	Decommissioning	Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure and services will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy.	All services and infrastructure associated with the sewage and water treatment facilities to be removed.	Yes	DA1975	No
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)		Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	DA1975 CCL716	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22					
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
Domain 2: Product Coal Stockpile Area		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	No.3 shaft unsealed areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6" (152mm)…" DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
	Decommissioning	Plant will be eliminated when operations cease at the completion of mine life. 1979 EIS Section 5.4	Infrastructure and services will be removed from the CHPP area.	All services to be removed from CHPP area.	Yes	1979 EIS	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22		CHPP buildings, offices and infrastructure to be removed.	Yes		
				Written approval from the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	CCL716	
	Landform establishment	No specific regulatory requirement.	Rehabilitation to be consistent with Domains 1B, 1C, 1D & 1E (see **Appendix 1 Plan 4A**). Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
			Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
			Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	(not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Growth medium development	No specific regulatory requirement.	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Ecosystem establishment	No specific regulatory requirement.	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975 (not applicable to CHPP but consistent rehabilitation approach adopted)	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation.	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 3: Refuse Emplacement Area	Decommissioning	Plant will be eliminated when operations cease at the completion of mine life. 1979 EIS Section 5.4	Infrastructure and services will be removed from the REA site.	All services related to refuse emplacement activities to be removed from the REA.	Yes	1979 EIS CCL716 OUT 18/3606	No
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22		REA site offices and any other infrastructure to be removed (note 3R conveyor and reject bin is captured by Domain 1A).			
		Requirement to have a diversion drain (or equivalent) around the REA to mitigate the risk of failure of the concrete pipes under the REA in the future DRG Requirement OUT 18/3606		Written approval from the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.			
				No clean water diversions pipelines in service beneath the REA at time of closure			
	Landform establishment	No specific regulatory requirement	Achieve design height and ensure maximum capacity is achieved.	Average depth of fill (height of refuse emplacement) will be 12m.	12m	REA Rehabilitation & Water Management Plan / 1993 EIS	No
			Landform established to support native ecosystem.	Maximum slope on final landform external batters will be 1:4 (generally will be 1:8).	1:4	REA Rehabilitation & Water Management Plan / 1993 EIS	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
			Prevent erosion from stormwater runoff following rehabilitation of external batters.	External batters should have gently sloping contour drains, reporting to water storage dams.	Yes	REA Rehabilitation & Water Management Plan / 1993 EIS	No
	Growth medium development	No specific regulatory requirement	Apply topsoil for rehabilitation.	Topsoil placement depth.	>200mm	REA Rehabilitation & Water Management Plan / 1993 EIS	No
			Reduce erosion on slopes, and provide furrows for seed beds.	All final landform slopes to be contour ploughed.	Yes	REA Rehabilitation & Water Management Plan / 1993 EIS	No
	Ecosystem establishment	No specific regulatory requirement	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	REA Rehabilitation & Water Management Plan / 1993 EIS	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation (REA Rehabilitation & Water Management Plan).	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 4: No.1 Ventilation Shaft	Decommissioning	The mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. DA1975 Condition (C5)(iv)	Mine shaft to be sealed, or fenced depending on DPIE requirement.	No.1 Ventilation Shaft sealed in accordance with applicable DPIE guideline, or fenced in accordance with DPIE instruction.	Yes	DA1975	No
		Upon abandonment of operations on the subject area… the holder shall cause the top of every shaft to be sealed to the satisfaction of the Minister for Mines. Provided however that the Minister may, in circumstances he considers appropriate, require any shaft to be fenced in lieu of being sealed. DA1975 Condition (C6)					
		Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy.	All services and any buildings at the No.1 shaft site to be removed.	Yes	DA1975	No
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)		Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.	Yes	DA1975	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22				CCL716	
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					
		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6" (152mm)…" DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation (REA Rehabilitation & Water Management Plan).	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 5: No.2 Ventilation Shaft	Decommissioning	The mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. DA1975 Condition (C5)(iv)	Mine shaft to be sealed, or fenced depending on DPIE requirement.	No.2 Ventilation Shaft sealed in accordance with applicable DPIE guideline, or fenced in accordance with DPIE instruction.	Yes	DA1975	No
		Upon abandonment of operations on the subject area… the holder shall cause the top of every shaft to be sealed to the satisfaction of the Minister for Mines. Provided however that the Minister may, in circumstances he considers appropriate, require any shaft to be fenced in lieu of being sealed. DA1975 Condition (C6)					
		Site shall be left safe, clean and tidy to the satisfaction of Council. DA1975 Condition (C1)	Infrastructure will be removed, and buildings removed or covered to ensure the site is safe, clean and tidy.	All services and any buildings at the No.2 shaft site to be removed.	Yes	DA1975 CCL716	No
		Where required by council all buildings will be either removed or satisfactorily covered. DA1975 Condition (C2)(i)					
		…the lease holder shall remove…such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. CCL716 Condition 22		Written approval from Council, and the Minister or delegate from the NSW Resources Regulator, to confirm satisfaction.			
	Landform establishment	The site shall be so treated that all batters are at a safe angle of repose. DA1975 Condition (C3)(ii)	Landform to be recontoured to achieve safe angle of repose slopes (or flatter).	Maximum slope on final landform.	Yes - angle of repose slopes on recontoured landform.	DA1975	No
		Upon abandonment of operations on any site, the holder shall batter the sides of each excavation… to a safe low angle… DA1975 Condition (C6)(18)(xi)					

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
		Upon abandonment of operations on any site… excavations shall be effectively drained to the satisfaction of the Minister for Mines. DA1975 Condition (C6)(18)(xi)	Excavations shall be drained, and any run off from depressions or ponded areas must be managed so it does not cause erosion.	Water to be drained (where practical) from excavations. Drainage from depressions or ponds should not cause erosion.	Yes	DA1975	No
		Ensure run off from any disturbed area including the overflow from any depression or ponded area is discharged in such a manner that it will not cause erosion. DA1975 Condition (C6)(18)(xi)					
		Exclusive only of sealed access roads, the surface area shall be satisfactorily graded… DA1975 Condition (C4)(iii)	Grade surface areas.	Surface hardstand, workshops and administration building areas to be graded.	Yes – surface area graded.	DA1975	No
	Growth medium development	Exclusive only of sealed access roads, the surface area shall be… top-dressed to a depth of not less than 6" (152mm)…" DA1975 Condition (C4)(iii)	Apply topsoil for rehabilitation.	Topsoil placement depth.	>152mm	DA1975	No
	Ecosystem establishment	Exclusive only of sealed access roads, the surface area shall be… established with approved trees and grasses. DA1975 Condition (C4)(iii)	Establish native bushland rehabilitation.	Conduct seeding and/or planting.	Yes – seeding and/or planting completed.	DA1975	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation (REA Rehabilitation & Water Management Plan).	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No
Domain 6 Off Title Subsidence Area		Myrtle Creek CMAP	Rehabilitate in accordance with Myrtle Creek CMAP (See **Appendix 5**).	CMAP		Section 240 Notice	No
Domain 6 Off Title Subsidence Area		Redbank CMAP	Rehabilitate in accordance with Redbank CMAP (See **Appendix 6**).	CMAP		Section 240 Notice	No

6 REHABILITATION IMPLEMENTATION

6.1 STATUS AT MOP COMMENCEMENT

A summary of the status of each closure domain at the commencement of the MOP is provided below, including the activities which have occurred in each domain up to this stage. The Domain areas are shown in **Appendix 1 Plan 2A** and the associated infrastructure shown in **Appendix 1 Plans 2B, 2C** and **2D**.

Domain 1A – CHPP

Domain 1A is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 1B – Rail Loading Facility

Domain 1B is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 1C – Main Workshop & Administration Area

Domain 1C is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 1D – No.3 Shaft & Gas Drainage Plant

Domain 1D is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 1E – Sewage & Water Treatment Plants

Domain 1E is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 2 – Product Stockpile Area

Domain 2 is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 3 – Refuse Emplacement Area

Rehabilitation within Domain 3 has commenced, with several parts of the Refuse Emplacement Area (REA) progressing through the nominated rehabilitation phases (see **Section 6.3** for area detail). The rehabilitation phases at the REA at the commencement of this MOP are Active Area, Ecosystem Establishment and Ecosystem Development. The Active area is composed of the active refuse emplacement area including haul roads and infrastructure. Ecosystem Establishment describes rehabilitation that is less than 12 months old, and Ecosystem Development describes the previously rehabilitated areas which continue to develop over time.

All Rehabilitation will occur in line with Rehabilitation and Topsoil Management Procedure TAH-HSEC-00053 (See **Appendix 4**).

Physical & Chemical Characteristics of Reject

Refuse (also known as reject) is the waste rock from the coal washing process. The raw coal produced at the mine consists of coal from the full seam, diluted with a proportion of shale and claystone from the roof and floor. This refuse emplaced at the REA consists mostly of the dilution material with a small proportion of carbonaceous material from the seam. The percentage of carbon in the refuse is dependent upon the thickness and quality of the seam being mined, the mining techniques being used and the quality requirements of the coal product. The refuse material is generally sized at <35mm, dark grey to black in colour and is inert.

Method of Landform Establishment

Refuse is transported by haul truck from the reject loading bin to the emplacement area. Dumped reject is shaped using a dozer to achieve the final landform profile generally in accordance with the Tahmoor North Environmental Impact Statement (1993).

Final Landform Profile & Slopes

Final landform profile is a battered refuse emplacement, approximately 12m high with external batters ranging from 1:4 to 1:8 (maximum design slope is 1:4), generally in accordance with the Tahmoor North Environmental Impact Statement (1993).

Characteristics of Cover Material

A review of the *Soil Landscapes of the Wollongong – Port Hacking 1:100 000 Sheet* identified the soils occurring at the Tahmoor Coal and REA as part of the Lucas Heights Soil Landscape and occurring adjacent to the Gymea Soil Landscape.

The Lucas Heights Soil Landscape is a residual soil landscape characterised by gently undulating crest, ridges and plateau surfaces of the Mittagong Formation. The landscape has been extensively to completely cleared, with natural vegetation existing as a dry sclerophyll low open forest and low woodland. Soils of the Lucas Heights Soil Landscape include:

- Shallow to moderately deep Yellow Podzolic Soils and Yellow Soloths (strong texture contrast with light textured surface soils overlying tough hard and dense B Horizons on ridges and plateau surfaces;
- Lateritic Podzolic Soils on crests
- Yellow Earths (massive, porous earthy materials and gradual increase in clay with depth) on shoulders of plateau and ridges; and
- Earthy Sands (deep uniform sand texture) in valley flats.

Soil limitations of the landscape include stoniness, hard setting surfaces and low soil fertility. Erosion on the landscape is generally low. Where possible, deeper soil horizons are reserved for subsoil and capping material, while the topsoil horizons with the highest organic content is reserved to rehabilitation and direct seeding/planting.

Thickness of Cover Layers & Methods of Laying

Topsoiled is applied at the REA to a nominal depth of 300mm by scraper and spread by dozer generally in accordance with the Tahmoor North Environmental Impact Statement (1993).

Drainage & Erosion Control Methods

Erosion and sediment control measures are incorporated into all stages of the REA operation. Features such as sedimentation and retention ponds, clean and contaminated water table and diversion drains, scour protection and sediment fencing along with other basic sediment controls are used across the REA. Contour drains are installed as required to design intervals on slopes to prevent downslope flow and erosion generally in accordance with the Tahmoor North Environmental Impact Statement (1993). Drains that are not rock lined will be hydromulched to ensure the landform is stable.

Vegetation Species & Establishment Techniques

A combination of sterile cover crops and native grass, shrub and tree seed mixes are used at the REA to achieve the rehabilitation objective of native bushland. A species list has been developed and refined based on the Tahmoor North Environmental Impact Statement (1993), accompanying REA Management, Rehabilitation and Water Monitoring Plan (1995), and more recent rehabilitation monitoring of both rehabilitation and analogue sites, to determine the most appropriate seed mix. The initial seed mix utilised in 2011 for rehabilitation included the following species:

- *Acacia decurrens*
- *Acacia longifolia*
- *Acacia falcata*
- *Acacia suaveolens*
- *Acacia terminalis*
- *Eucalyptus globoidea*
- *Eucalyptus eugenoides*
- *Eucalyptus punctata*
- *Eucalyptus scerophylla*
- *Eucalyptus moluccana*
- *Eucalyptus tereticornis*
- *Eucalyptus rossii*
- *Angophora floribunda*
- *Allocasuarina littoralis*
- *Banksia spinulosa*
- *Dodonaea cuneata*
- *Leptospermum flavescens*
- *Leptospermum juniperinum*
- *Hakea dactyloides*
- *Hakea sericea*
- *Kunzea ambiqua*
- *Hardenbergia violaceae*
- *Kennedia rubicunda*
- *Lomandra longifolia*
- *Lomandra obliqua*
- *Dianella revoluta*
- *Cassinia aculeata*
- Sterile cover crop (Japanese Millet) and light pasture mix for stabilisation.

This species list and seed mix has continued to be refined based on the survival rates and success of these species in rehabilitated areas. The rehabilitation monitoring program detailed in this MOP (Section 7.1) will monitor this success over time, and trigger adjustments as necessary.

Habitat Establishment Techniques

Hollow bearing trees and timber logs from clearing activities at the REA have been salvaged and stockpiled for use throughout rehabilitation areas. Logs and hollows are spread throughout rehabilitation areas where access permits, to provide structure and encourage colonisation by fauna.

Maintenance Activities

Care and maintenance activities include basic earthwork repairs to erosion as required, and maintenance of sediment controls such as drainage lines, ponds and sediment fencing. Further information on care & maintenance is provided in Section 7.2.

Domain 4 – No.1 Ventilation Shaft

Domain 4 is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 5 – No.2 Ventilation Shaft

Domain 5 is in the active phase at commencement of this MOP and is yet to be rehabilitated.

Domain 6 – Off Title Subsidence Area

Domain 6 relates to Myrtle Creek. The rehabilitation scope of works for Myrtle Creek and Redbank Creek are detailed in the respective CMAP's. These works have commenced and will be ongoing during the term of this MOP.

6.2 PROPOSED REHABILITATION ACTIVITIES THIS MOP PERIOD

A summary of the planned rehabilitation activities that are proposed to be implemented over the MOP term (2020 – 2024) for each domain is provided below. The Domain areas are shown in **Appendix 1 Plan 2A** and the associated infrastructure shown in **Appendix 1 Plans 2B, 2C** and **2D** and the final rehabilitation and post mining landuse shown in **Appendix 1 Plan 4A**.

Domain 1A – CHPP

Nil – Domain 1A remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 1B – Rail Loading Facility

Nil – Domain 1B remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 1C – Main Workshop & Administration Area

Nil – Domain 1C remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 1D – No.3 Shaft & Gas Drainage Plant

Nil – Domain 1D remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 1E – Sewage & Water Treatment Plants

Nil – Domain 1E remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 2 – Product Stockpile Area

Nil – Domain 2 remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 3 – Refuse Emplacement Area

Progressive rehabilitation of the remaining active areas at the REA will continue throughout the MOP reporting period as stages become available. Most of the available rehabilitation has already been completed. Rehabilitation of the remaining exposed areas are awaiting determination of the Tahmoor South Coal Project. Depending on the timing of the determination, Tahmoor Coal may undertake temporary rehabilitation of the REA areas. Rehabilitation methodology will be completed as described in **Section 6.1** of this MOP, and generally in accordance with the Tahmoor North Environmental Impact Statement (1993).

The majority of clearing for the expansion of the refuse emplacement was completed in 2018, with one small area remaining to be cleared in 2020. The area is expected to be filled by 2024. Due to the expected nature of filling in layers in this area, with the requirement for flexibility in dumping, rehabilitation will occur in one phase in 2024. However, Tahmoor Coal is committed to rehabilitating areas as they become available. This will include the regular turning and maintenance of the topsoil stockpiles.

All management of clearing of vegetation will occur as per the directions in a site specific report completed by qualified ecologist.

Domain 4 – No.1 Ventilation Shaft

Nil – Domain 4 remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 5 – No.2 Ventilation Shaft

Nil – Domain 5 remains in the active phase and is not available during the MOP term for rehabilitation.

Domain 6 – Off Title Subsidence Area

Rehabilitation will occur as per the approved Myrtle Creek and Redbank Creek CMAP's (refer to **Appendix 5** and **6**).

6.3 REHABILITATION SUMMARY TABLE

In accordance with the *ESG3 Mining Operations Plan (MOP) Guidelines (2013)*, a summary of the rehabilitation status for each domain including area in hectares for the MOP term is provided in **Table 6.3**.

Table 6.3 Tahmoor Coal Rehabilitation Summary Table

Domain Label	Domain Name	Rehabilitation Phase	Total Domain Area	
			MOP Commencement	MOP Completion
1A	CHPP	Active Area	0.44	0.44
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
1B	Rail Loading Facility	Active Area	0.02	0.02
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
1C	Main Workshop & Admin Area	Active Area	0.43	0.43
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
1D	No.3 Shaft & Gas Drainage Plant	Active Area	0.07	0.07
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0

Domain Label	Domain Name	Rehabilitation Phase	Total Domain Area	
			MOP Commencement	MOP Completion
1E	Sewage & Water Treatment Plant	Active Area	0.04	0.04
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
2	Product Stockpile Area	Active Area	16.40	16.40
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
3	Refuse Emplacement Area	Active Area	9.5	9.5
		Decommissioning	0	0
		Landform Establishment	34.6	34.6
		Growth Medium Development	0	0
		Ecosystem Establishment	1.4	0
		Ecosystem Development	45.4	46.8
		Rehabilitation Complete	0	0
4	No.1 Ventilation Shaft	Active Area	0.70	0.70
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0

Domain Label	Domain Name	Rehabilitation Phase	Total Domain Area	
			MOP Commencement	MOP Completion
5	No.2 Ventilation Shaft	Active Area	2.90	2.90
		Decommissioning	0	0
		Landform Establishment	0	0
		Growth Medium Development	0	0
		Ecosystem Establishment	0	0
		Ecosystem Development	0	0
		Rehabilitation Complete	0	0
6	Off Title Subsidence Area		0	As per approved Myrtle Creek and Redbank Creek CMAP's Schedule included in **Appendix 5** and **6**.

7 REHABILITATION MONITORING AND ONGOING MAINTENANCE

7.1 REHABILITATION MONITORING

Tahmoor Coal has developed and implemented an annual rehabilitation monitoring program in accordance with our internal company annexure (SIMEC standard TAH-HSEC-00117 – *Biodiversity and Land Management*), which has been developed based on various Australian government guidelines for mine closure and rehabilitation, and various scientific research papers on soil science and rehabilitation.

The annual rehabilitation program consists of two main parts:

- Annual Rehabilitation Inspection (assessment of rehabilitated areas in general to confirm trajectory towards completion criteria).
- Long-term Rehabilitation Monitoring Sites (detailed evaluation of permanent monitoring transects located throughout rehabilitated areas to monitor progress over time towards achieving completion criteria).

The intent of Tahmoor's rehabilitation monitoring program is to measure the success of rehabilitation, using consistent methods year to year, so results are comparable and improvement actions can be tracked over time. Rehabilitation monitoring is conducted over all phases of rehabilitation, with the greatest emphasis on the Ecosystem Development stage of the MOP rehabilitation phase.

Outcomes of the annual rehabilitation monitoring inspections are recorded and compiled into a report, with improvement actions that are identified as part of the inspection entered into the site action database for tracking and implementation. Improvement actions include care and maintenance activities such as additional seeding or fertilizer, weed management, and erosion repair to improve the quality of rehabilitation areas where deficiencies are identified during the annual monitoring. Improvement actions may also trigger changes to rehabilitation procedures, so rehabilitation methods and standards can be continually improved.

The Annual Rehabilitation Inspection includes an assessment of the following broad indicators:

- Evidence of soil profile development;
- Visual assessment of surface materials;
- Evidence of erosion;
- Stability and function of erosion and sediment control structures;
- Growth rates;
- Evidence of plant mortality or dieback;
- Species diversity, including both native and weed species;

- Presence of overstorey, midstorey and understorey species;
- Evidence of reproductive potential;
- Evidence of biological nutrient cycling;
- Occurrence of potholing or slumping;
- Evidence of spontaneous combustion; and
- Evidence of contamination or other limitations to vegetative establishment.

The Long-term Rehabilitation Monitoring includes an assessment of the following indicators at permanently established monitoring transects each year:

- General site description of vegetation;
- Assessment of reproductive potential of the existing vegetation and soils (soil sampling and lab analysis);
- Number of plants of all species (excluding grasses);
- Measure live vegetation cover for under storey and grasses (separately) using a line intercept method;
- Record details of ground cover (leaf litter, logs and rocks);
- Tag and measure DBH of trees >1.6 m tall, to a maximum of 10 for any one species
- Record canopy cover over 20 m centreline (when trees are tall enough);
- Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack as percentage;
- Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds;
- Record the location, number and dimension of all gullies, rill and slope wash features; and
- Photographic monitoring of all sites and repair to permanent transect markers (star pickets) as required.

7.2 Rehabilitation Trials

7.2.1 Creek / Pool Restoration Trial

Myrtle Creek and Redbank Creek restoration works were scheduled in a staged approach, such that learnings from Myrtle Creek can be leveraged at Redbank Creek. The first stage of Myrtle Creek restoration works involved the characterisation of the fracture network, a trial grout curtain wall at Site 23, and three pool remediation trials, involving surface treatments.

The trial at Site 23 involved the injection of polyurethane injection resin (PUR) to effect a grouted curtain wall to provide a barrier for subsurface stream flow, with the objective to reduce subsurface flow pathways promoting surface flow and pool holding capacity. The Site 23 trial will be used to confirm and refine the methodology to subsequent pools within Myrtle and Redbank Creek.

Three pool remediation trials were also conducted at Myrtle Creek, including a shallow curtain wall (<2m) at a rock bar using colloidal silica, surface rendering using a clay/cement mix, and shallow drilling and grouting using a clay/cement mix. Learnings from these trials have been implemented in the development of Myrtle Creek CMAP Stage 2 and subsequent restoration works at Redbank Creek. **Appendices 5** and 6 contain detailed CMAP's for Myrtle Creek and Redbank Creek.

The key performance indicators for measuring the success of the trial relate to the functioning of the creek and are:

- Reduction in pool water level recession rates.
- Measurement of the extent of fracture in-filling.
- Measurement of reduction in rock mass permeability.

7.2.2 Grass Planting Trials

Grass planting trials where the survival and growth of planted grass species in areas where the existing vegetation (within revegetation areas) was sparse will continue to be assessed as part of the annual rehabilitation monitoring program. The findings will be used to develop and refine seed mixes and completion criteria as an ongoing process.

7.3 CARE AND MAINTENANCE ACTIVITIES

Maintenance of rehabilitated areas potentially includes fertilising, sediment and erosion control and re-planting or re-seeding as required. The intensity of these activities will be highest over a likely period of two (2) years following Ecosystem Establishment, however depending on the success of rehabilitation, care and maintenance may be required beyond this period to achieve the identified completion criteria for Ecosystem Development for each closure domain.

7.4 TRIGGER ACTION RESPONSE PLAN (TARP)

A Trigger Action Response Plan (TARP) has been developed to manage unexpected variations in rehabilitation outcomes, in accordance with the *ESG3 Mining Operations Plan (MOP) Guidelines (2013)*. Tahmoor's Rehabilitation Monitoring TARP is provided in **Table 7.1** below.

Table 7.1 Tahmoor Coal Rehabilitation TARP

ROLES & RESPONSIBILITIES	MINIMUM REQUIREMENTS	LEVEL 1 – NORMAL Rehabilitation Monitoring and Inspections indicate compliance with rehabilitation objectives and completion criteria	LEVEL 2 - ELEVATED Rehabilitation Monitoring and Inspections indicate minor, non-urgent variance from rehabilitation objectives and completion criteria (e.g. additional seeding, or fertilizer application required within 12 months)	LEVEL 3 - CRITICAL Rehabilitation Monitoring and Inspections indicate significant or urgent variance from rehabilitation objectives and completion criteria (e.g. significant erosion or civil repairs required to prevent within 3 months)
TAHMOOR COAL REHABILITATION MONITORING TARP				
Reject Supervisor **CHPP Production Coordinator**	Understand this TARP. Provide feedback to Environment Coordinator as required.	Conduct operations in accordance with work instructions and landform design criteria.	Report identified issues through to Environment Coordinator in timely manner.	Immediately report identified issues through to Environment Coordinator for action.
Rehabilitation Monitoring Consultant	Understand this TARP. Report improvement actions following rehabilitation monitoring.	Conduct operations in accordance with rehabilitation monitoring as per the Biodiversity and Land Management Procedure.	Report identified issues through to Environment Coordinator in timely manner.	Immediately report identified issues through to Environment Coordinator for action.
Environment Coordinator	Coordinate rehabilitation activities in accordance with rehabilitation objectives towards achieving completion criteria.	Implement improvement actions beyond compliance as appropriate.	Coordinate improvement works as part of care & maintenance program detailed in the Annual Rehabilitation Plan.	Coordinate immediate repairs and improvement works as required.

8 REPORTING

The Annual Review (AR) (previously referred to as Annual Environmental Management Report) is the primary MOP reporting mechanism. The AR will be completed to satisfy the development consent and mining lease requirements and will detail activities undertaken during the report period that support progression towards the final land use. The AR will include:

- summary of operations and rehabilitation undertaken during the report period
- monitoring results against key performance indicators, including:
  - operational noise
  - air quality
  - biodiversity
  - Aboriginal Cultural and Historical heritage
  - erosion and sediment control
  - contaminated land
  - bushfire management
  - mine subsidence
  - natural heritage
  - water management
  - rehabilitation performance
  - weed control and
  - community engagement
- summary of complaints and incidents during the report period
- analysis of all monitoring results
- key trends in monitoring results
- non-compliance; and
- any other environmental aspects required by the NSW Resources Regulator.

In addition to this reporting process, Tahmoor Coal also maintains a website which also provides updates on the operations status and environmental monitoring program results.

The following reporting will also be undertaken by Tahmoor Coal:

- Quarterly Myrtle and Redback Creek Reporting. From December 2019 onwards a report will be provided for the Redbank and Myrtle Creeks CMAPs
- Incident reporting.
- Independent Environmental Audit (2020 – triennial basis)
- Compliance reporting. (Six monthly extraction plan reporting)

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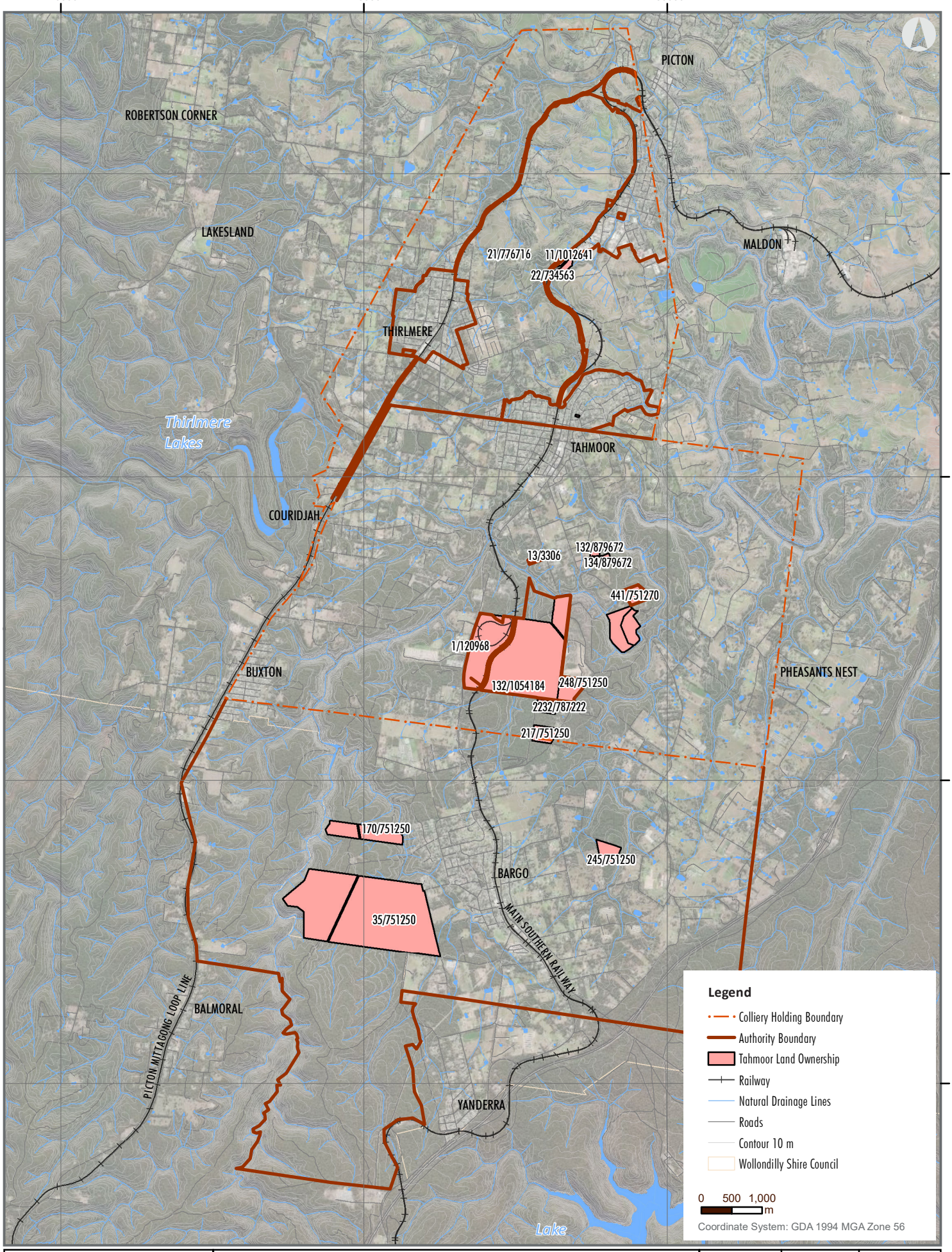
Appendix 1
Rehabilitation Maps



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TITLE

MOP Pre-mining Environment Part 1

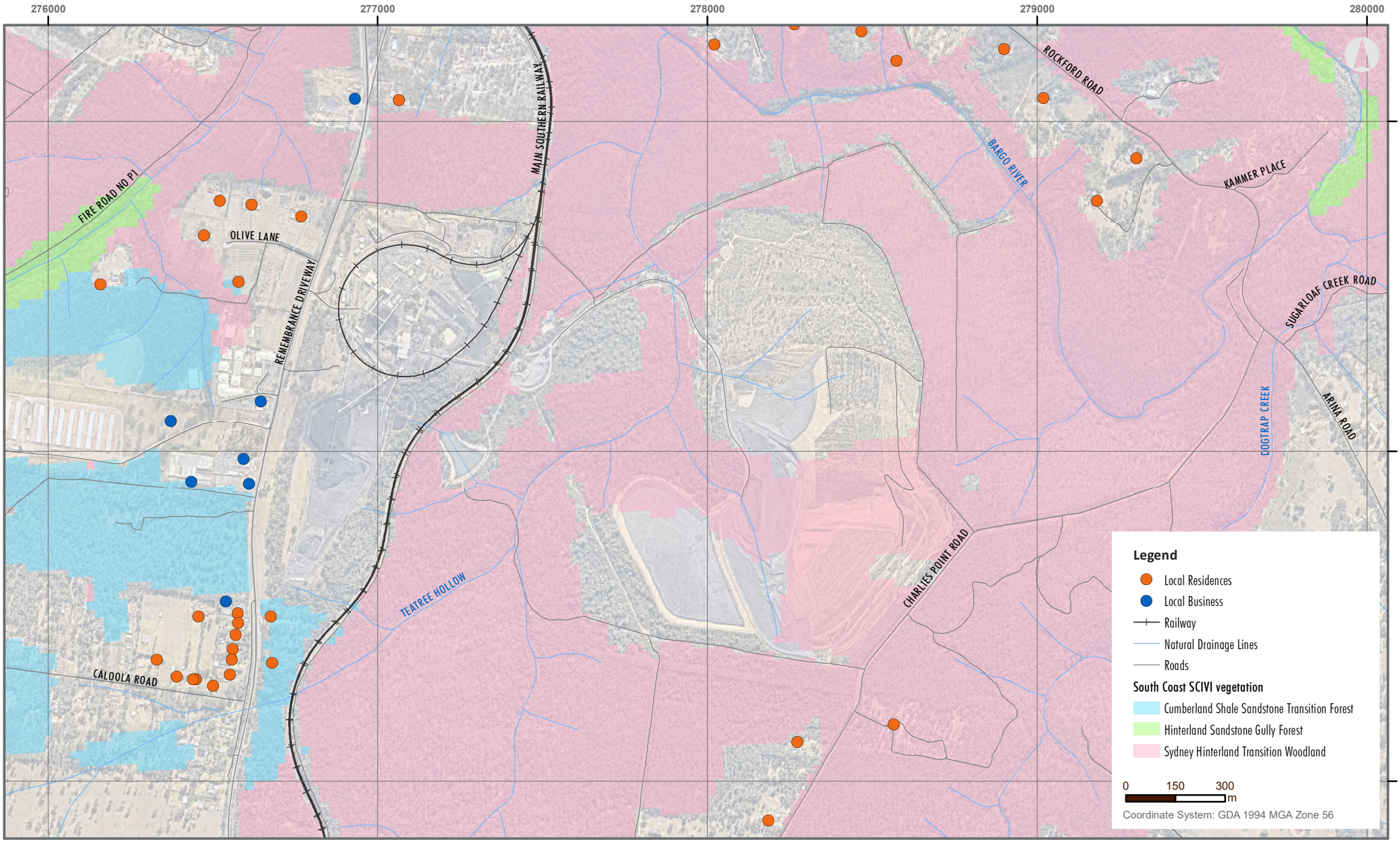
SIMEC

PROJECT **Tahmoor Colliery** DRAWING NO. **PLAN 1A**

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle) Dated 10/08/2020

DRAWN	MO	10.08.20
REVIEWED		
A4	SHEET 1/10	REV A



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SIMEC

TITLE

MOP
Pre-mining Environment
Part 2

PROJECT

Tahmoor Colliery

DRAWING NO.

PLAN 1B

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

MR

Signed (M Rundle)

10/08/2020

Dated

DRAWN	MO	10.08.20
REVIEWED		
A4	SHEET 2/10	REV A

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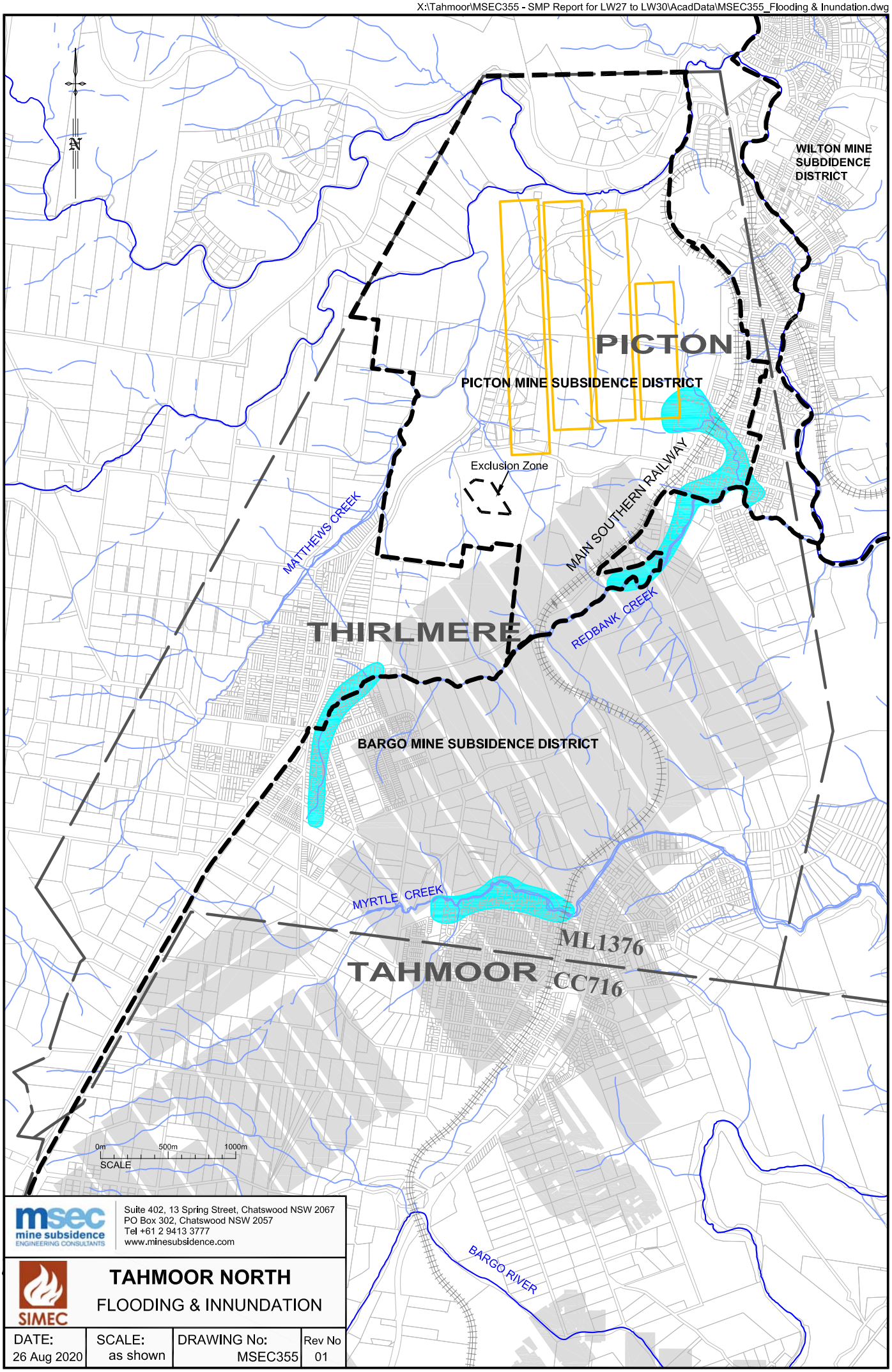

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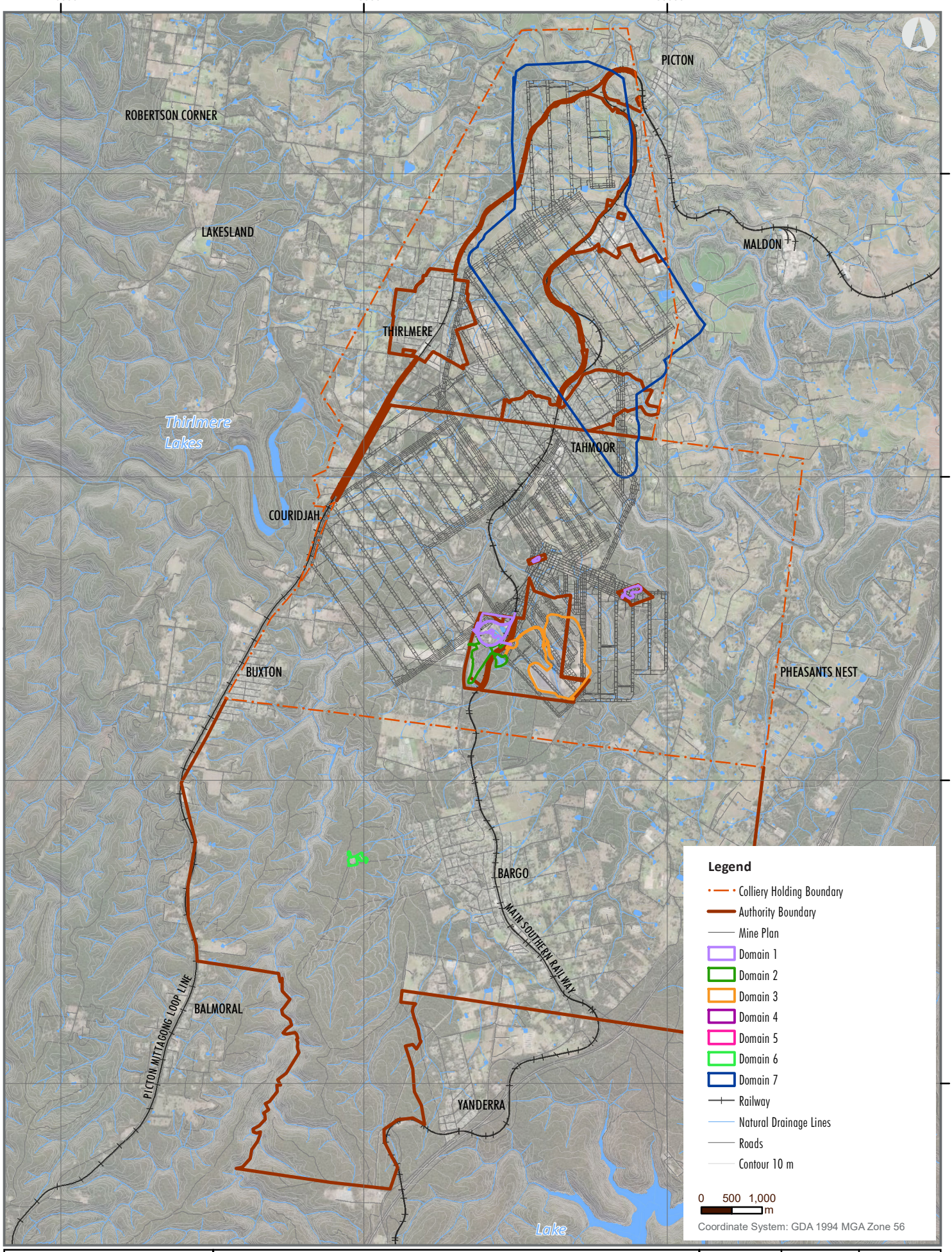
TAHMOOR NORTH

FLOODING & INNUNDATION

DATE:	SCALE:	DRAWING No:	Rev No
26 Aug 2020	as shown	MSEC355	01



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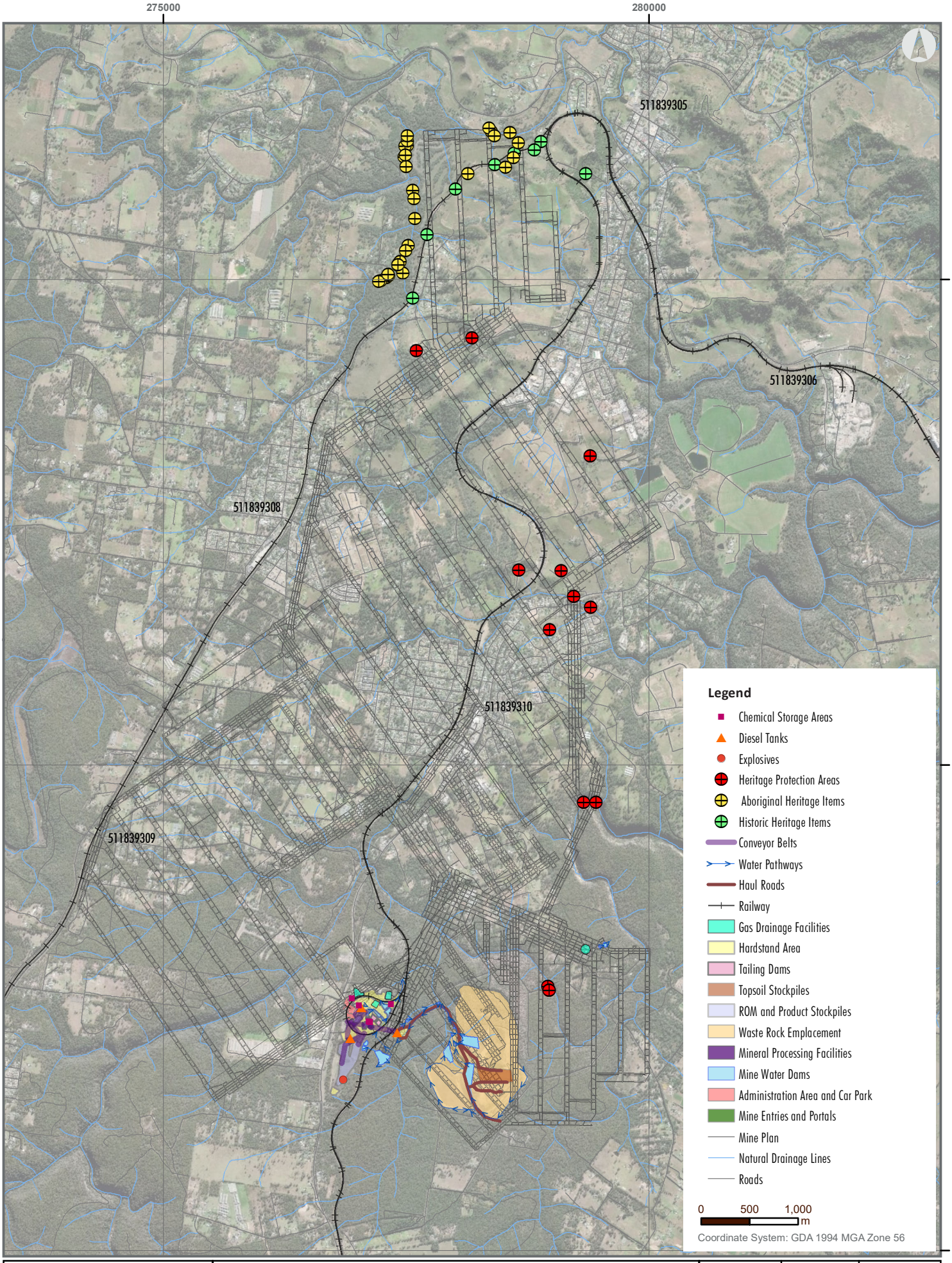
TITLE: MOP Mining Domains Domains and Approved Boundaries	PROJECT: Tahmoor Colliery	DRAWING NO.: PLAN 2A	DRAWN: MO	10.08.20
	I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.		REVIEWED:	
	Signed (M Rundle)	Dated 10/08/2020	A4	SHEET 4/10 / REV A
			(C) SIMEC 2020	



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TITLE

SIMEC

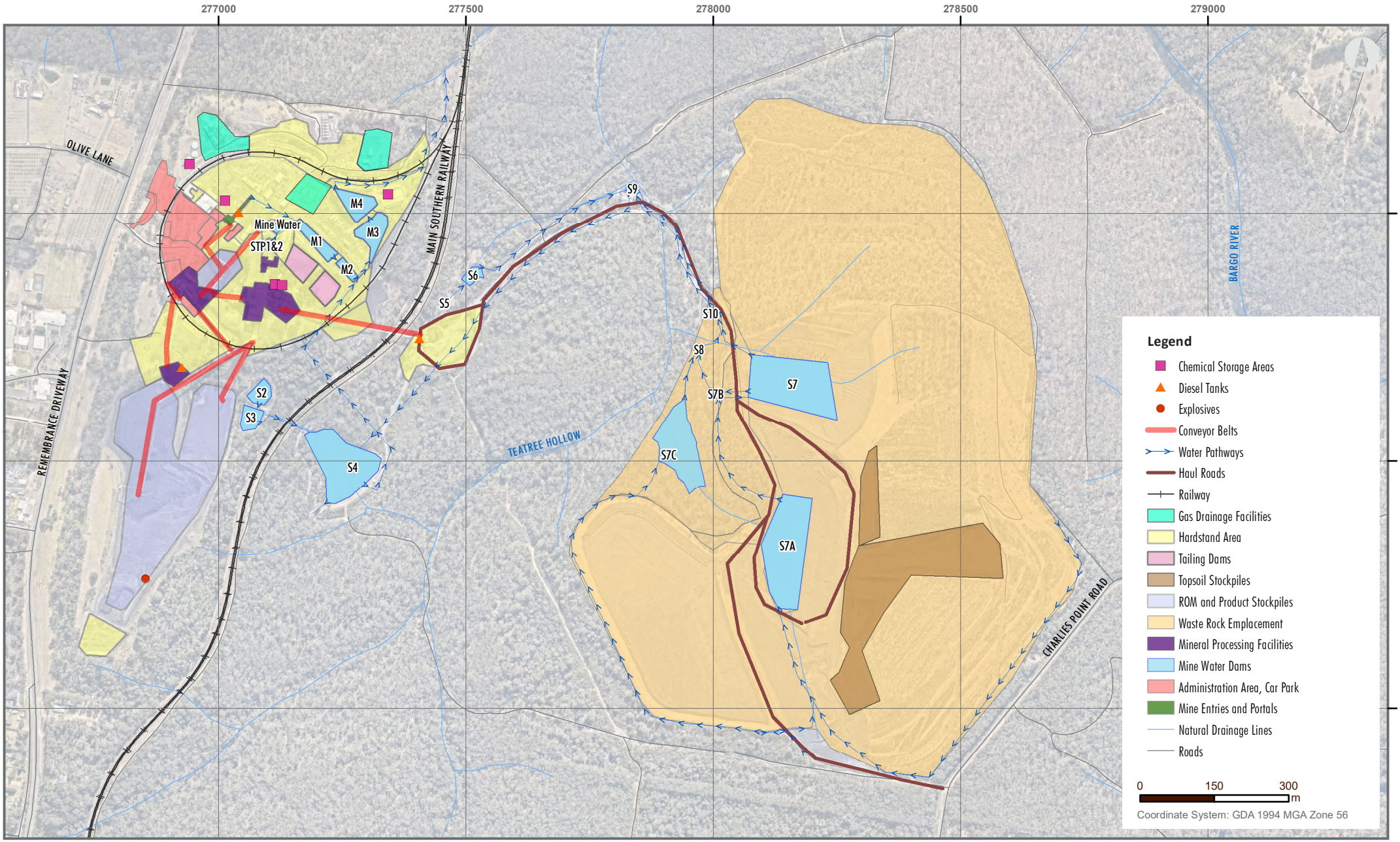
MOP
Mining Domains
Mine Plans and
Infrastructure

PROJECT Tahmoor Colliery DRAWING NO. PLAN 2B

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle) Dated 10/08/2020

DRAWN	MO	12.08.20
REVIEWED		
A4	SHEET 5/10	REV A



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TITLE

MOP
Mining and Rehabilitation
Pit-top Infrastructure

PROJECT

Tahmoor Colliery

DRAWING NO.

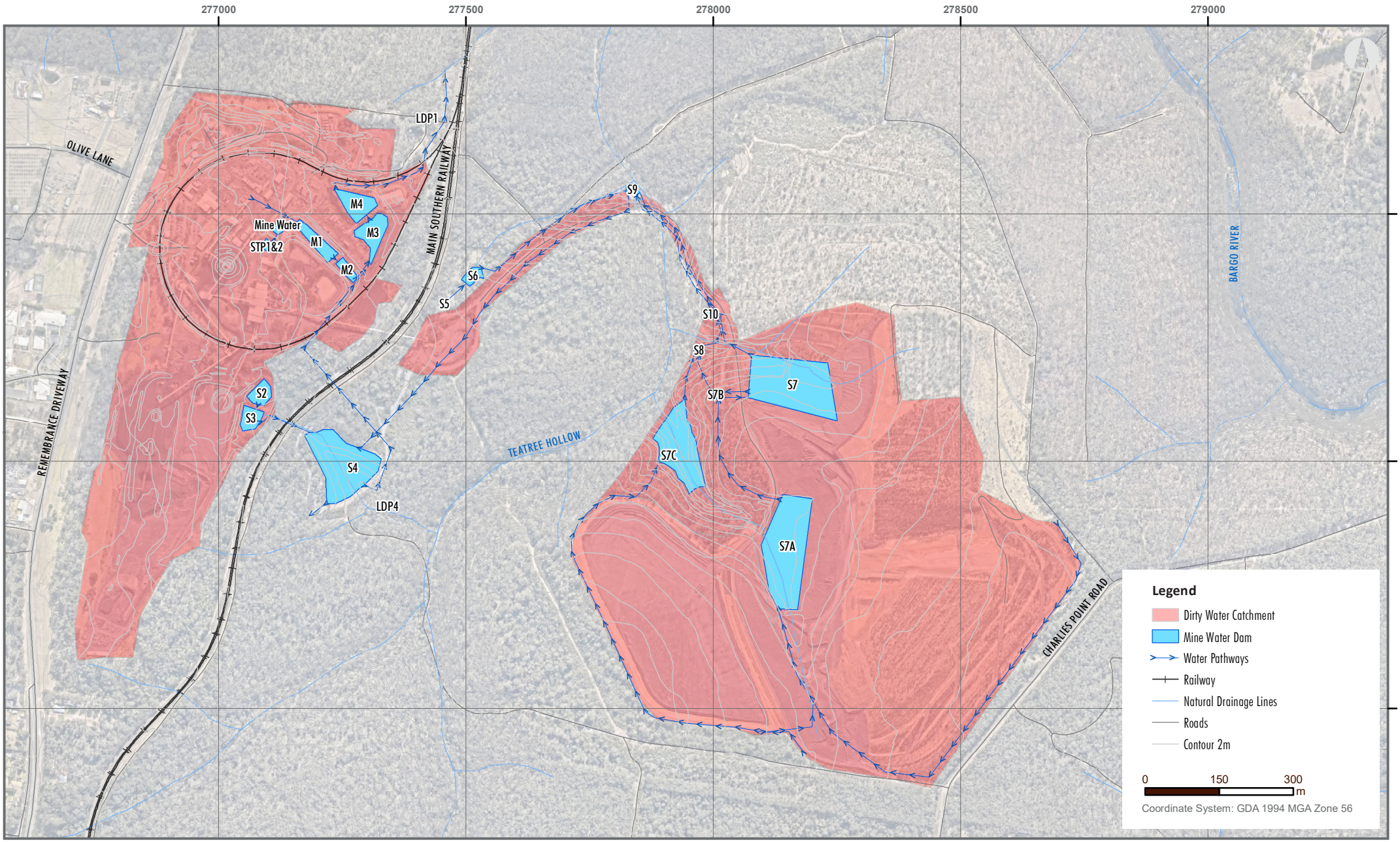
PLAN 2C

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle)

Dated 10/08/2020

DRAWN	MO	10.08.20
REVIEWED		
A4	SHEET 6/10	REV A



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TITLE

MOP
Pre-mining Environment
Part 2

PROJECT

Tahmoor Colliery

DRAWING NO.

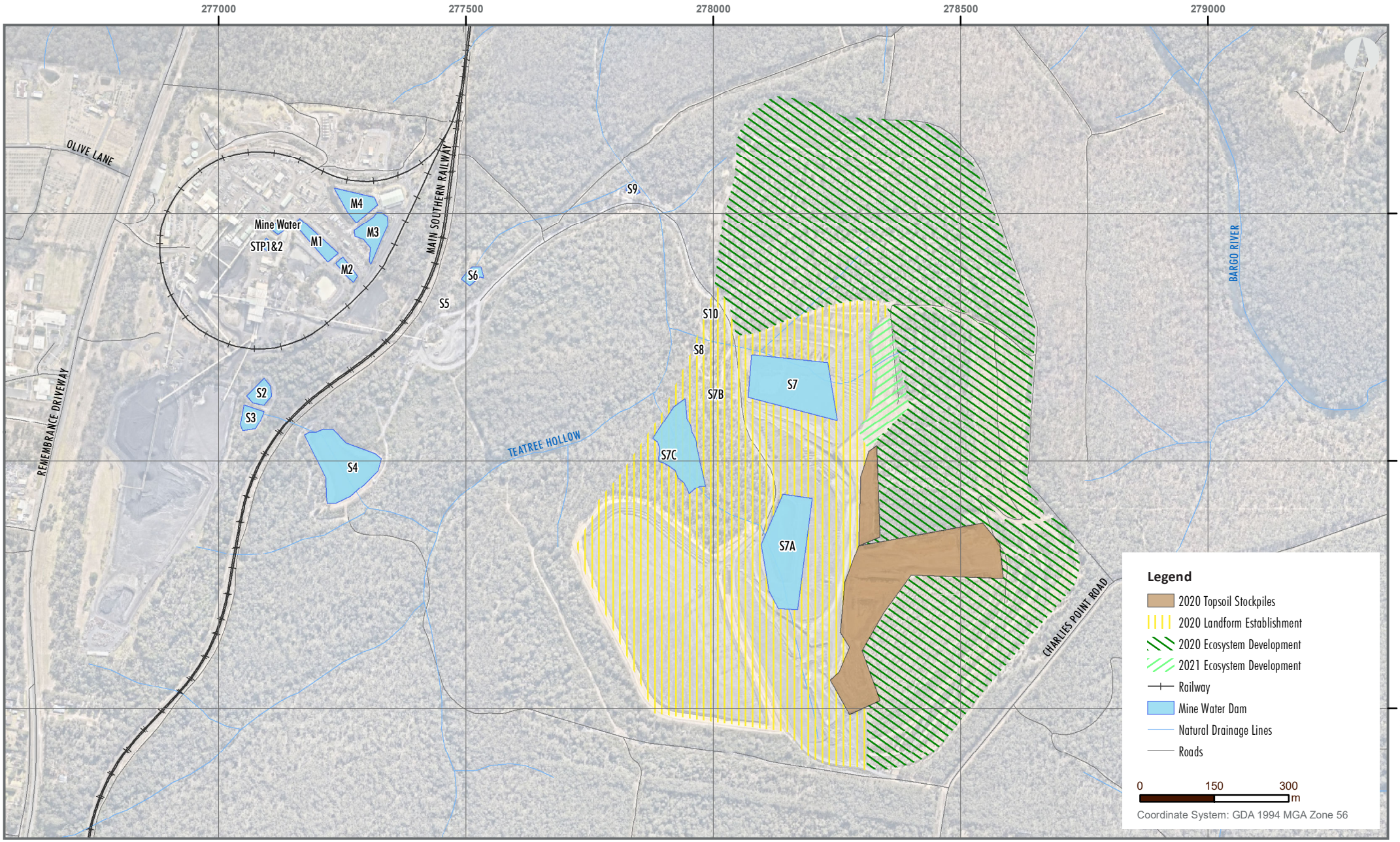
PLAN 2D

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle)

Dated 10/08/2020

DRAWN	MO	10.08.20
REVIEWED		
A4	SHEET 7/10	REV A



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SIMEC

TITLE

MOP
Mining and Rehabilitation
Year 1 - 2020

PROJECT

Tahmoor Colliery

DRAWING NO.

PLAN 3A

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

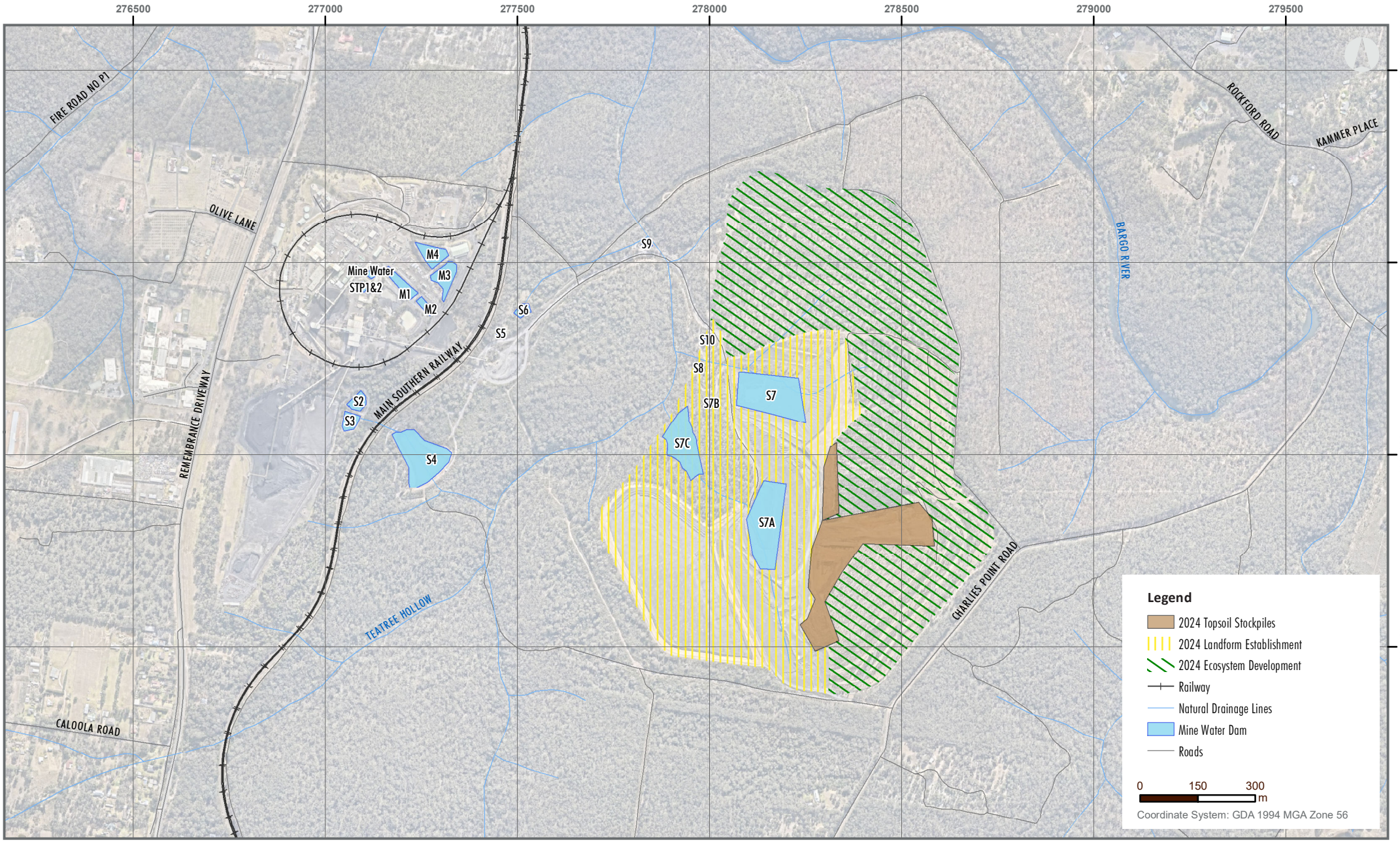
MR

Signed (M Rundle)

10/08/2020

Dated

DRAWN	MO	12.08.20
REVIEWED		
A4	SHEET 8/10	REV A



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SIMEC

TITLE

MOP
Mining and Rehabilitation
Year 5 - 2024

PROJECT

Tahmoor Colliery

DRAWING NO.

PLAN 3B

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle)

Dated 10/08/2020

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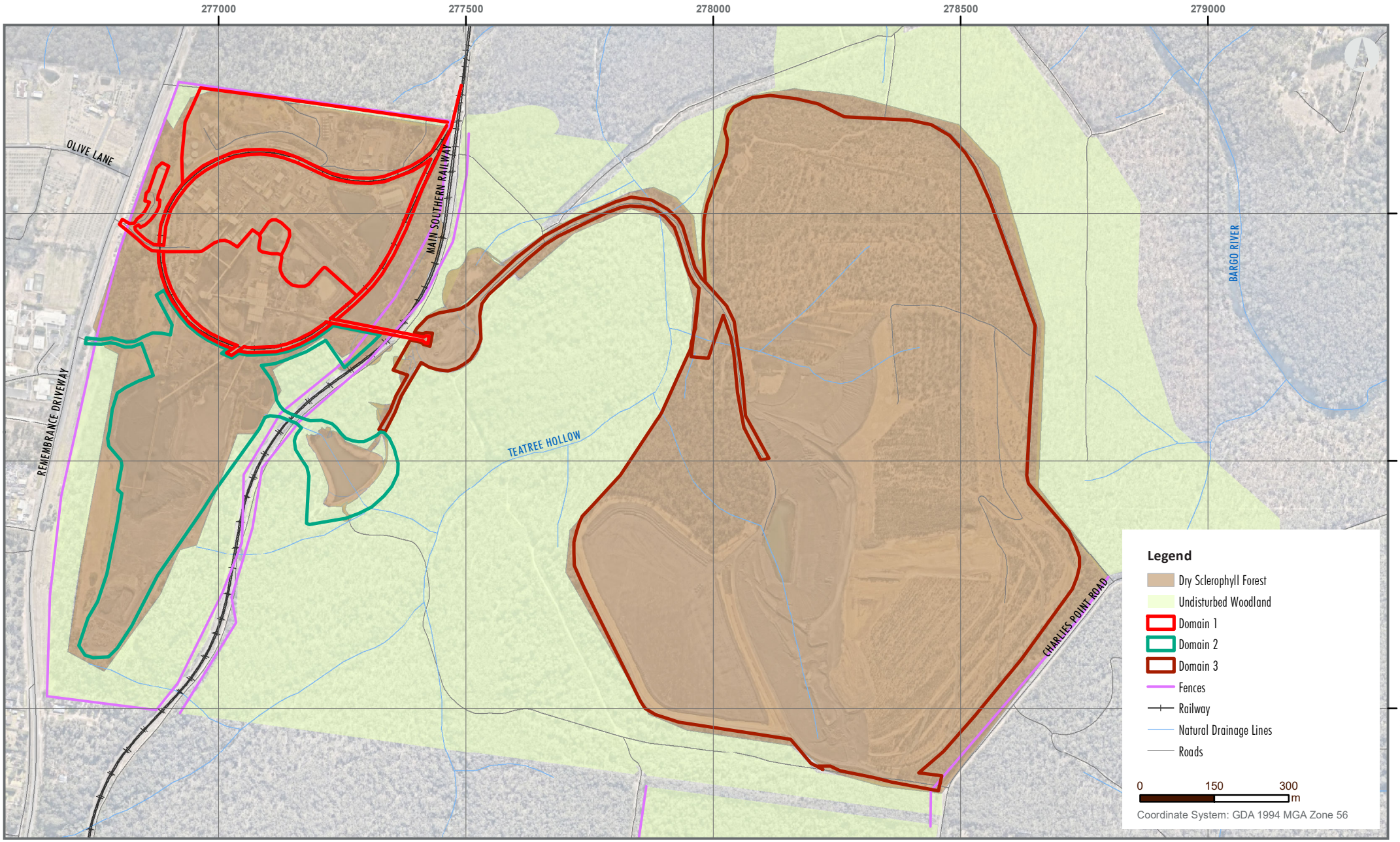
REVIEWED		
A4	SHEET 9/10	REV A



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SIMEC

TITLE

MOP
Final Rehabilitation and Post-mining Land Use

PROJECT

Tahmoor Colliery

DRAWING NO.

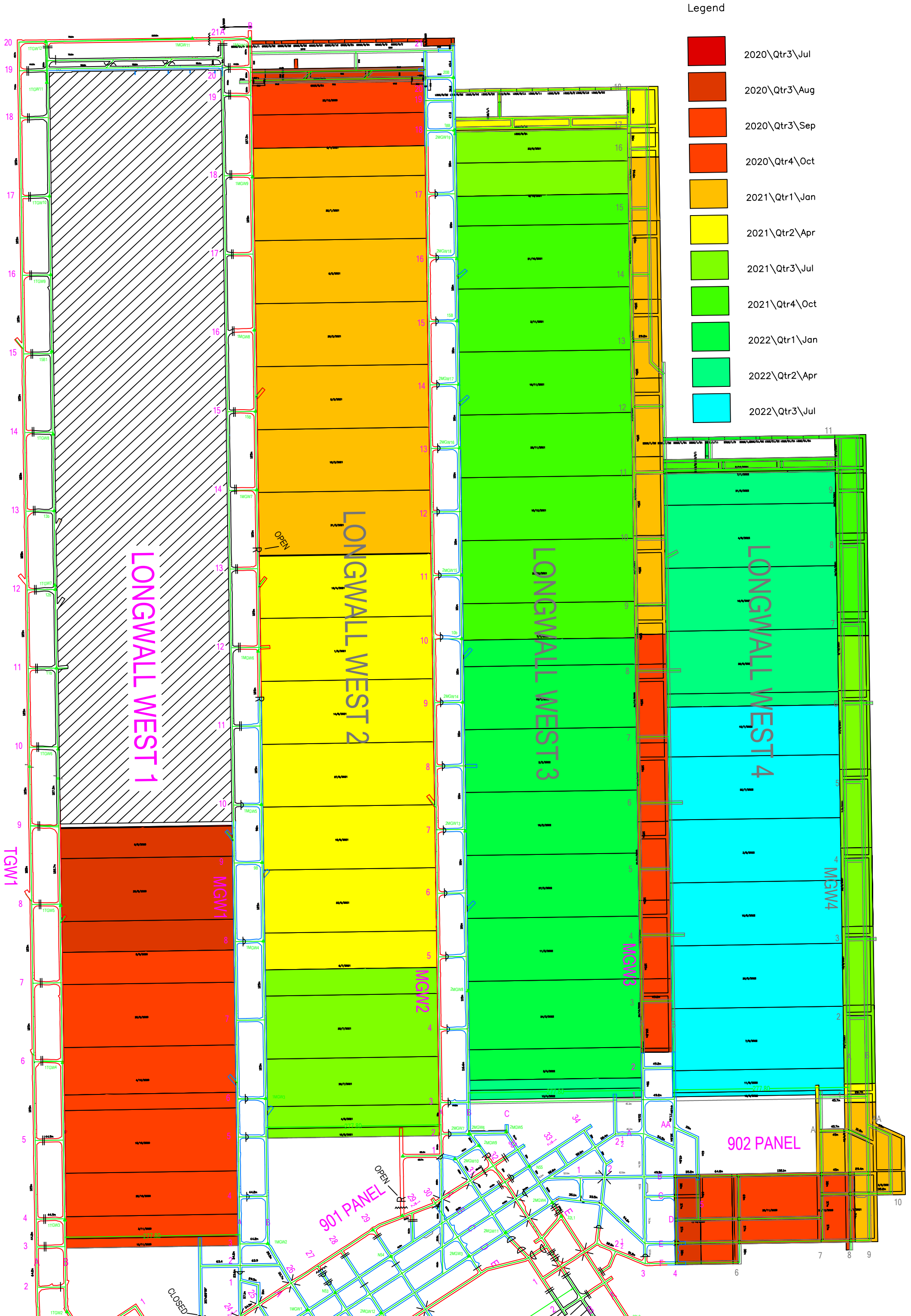
PLAN 4A

I, Mark Rundle, Registered Mine Surveyor, certify that the workings regarding the Tahmoor Surface and Underground Operations shown on this plan are true and correct.

Signed (M Rundle)

Dated 10/08/2020

DRAWN	MO	10.08.20
REVIEWED		
A4	SHEET 10/10	REV A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2022\Qtr2\Apr
2022\Qtr3\Jul
LONGWALL WEST 1
LONGWALL WEST 2
LONGWALL WEST 3
LONGWALL WEST 4
TGW1
MGW1
MGW2
MGW3
MGW4
901 PANEL
902 PANEL
OPEN
CLOSED

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Appendix 2
Reject Area Extension

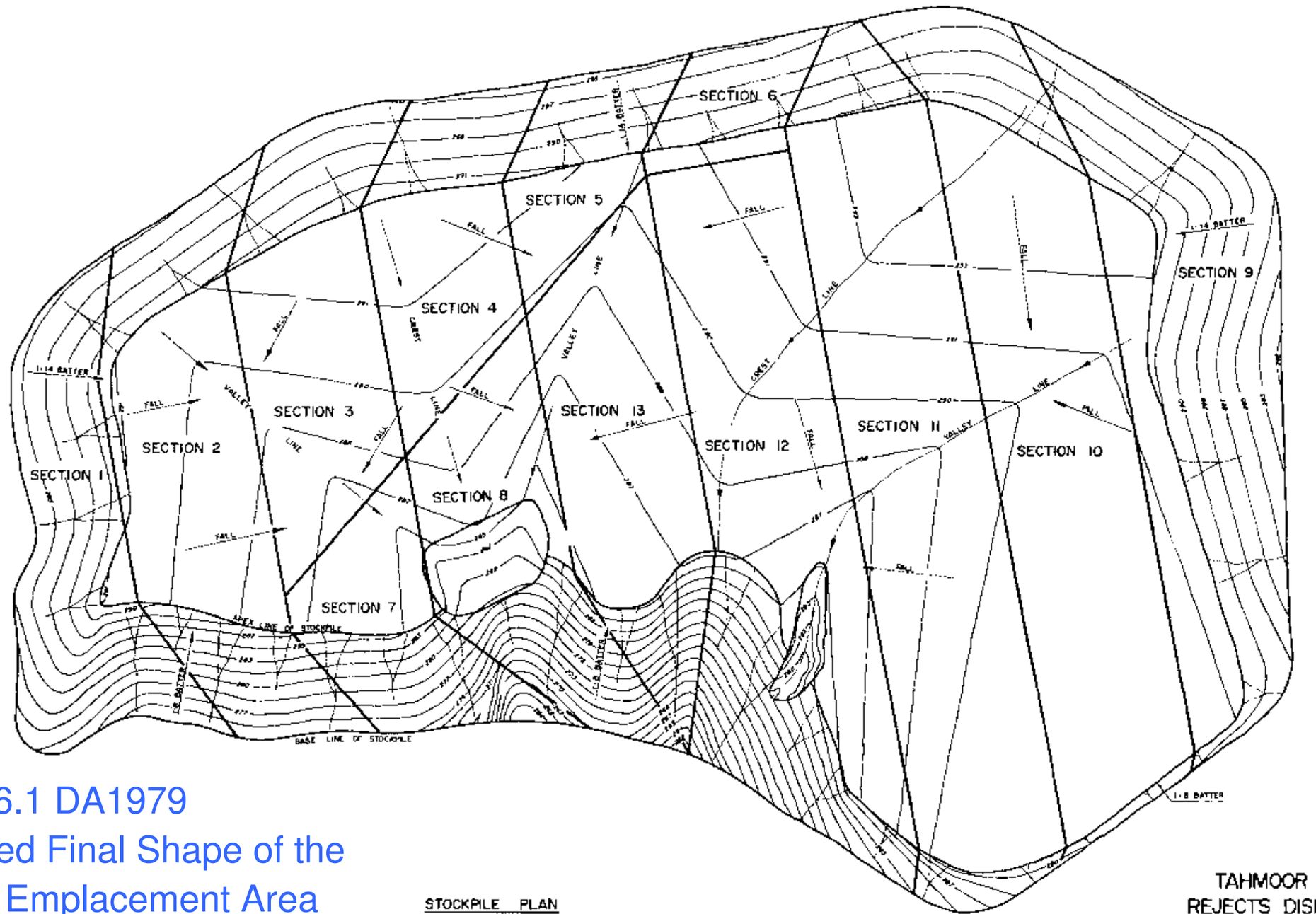


Figure 6.1 DA1979
Approved Final Shape of the
Refuse Emplacement Area

STOCKPILE PLAN
VOLUME - 7,000,000m³

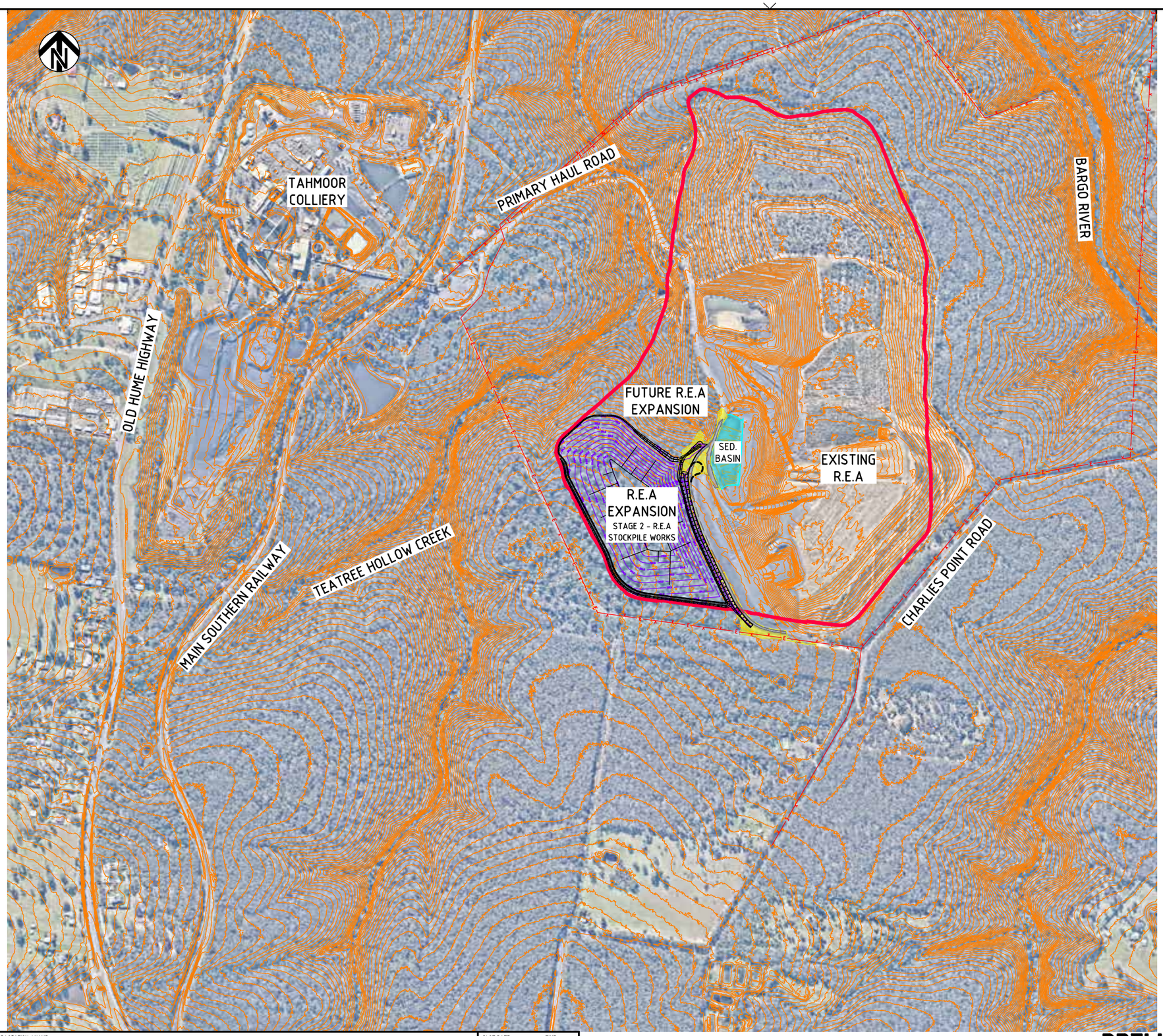
SCALE
0 125 250m

NOTE: ELEVATIONS SHOWN IN METRES
(converted from feet)

TAHMOOR COLLIERY
REJECTS DISPOSAL AREA
ELEVATION CONTOUR PLAN

DAMES & MOORE

FIGURE 12



LEGEND

- EXISTING R.E.A. CONSENT BOUNDARY (1979)
- EXISTING LIDAR CONTOUR (1m INTERVAL)
- EXTENT OF DETAIL SURVEY
- EXISTING OVERHEAD POWER
- EXISTING SEDIMENT BASIN S7a (APPROXIMATE)

EXISTING R.E.A CONSENT BOUNDARY (1979)

THE EXISTING R.E.A BOUNDARY (1979) HAS BEEN INTERPRETED BY SMEC NOVEMBER 2017.
IT IS THE RESPONSIBILITY OF TAHMOOR COLLIERY TO CONFIRM THE BOUNDARY

EXISTING LIDAR SURVEY

EXISTING LIDAR CONTOURS (1m INTERVALS) DERIVED FROM LIDAR SURVEY OBTAINED FROM NSW GOVERNMENT'S SPATIAL SERVICES RESOURCE ON 26/10/17. THE SURVEY WAS CONDUCTED ON 04/05/14.

DETAIL TOPOGRAPHICAL SURVEY

ONLY IN AREA SHOWN (SEE LEGEND)
PRODUCED BY 'SMEC' DATED 26/04/2018

AERIAL IMAGE

AERIAL IMAGE OBTAINED FROM © NEARMAP 2017 ON 20/11/17.
THE IMAGES WERE CAPTURED ON 28/05/17.

DIAL 1100 BEFORE YOU DIG

WARNING
"DIAL BEFORE YOU DIG" - 1100
IT IS ESSENTIAL THAT BEFORE ANY EXCAVATION WORK IS UNDERTAKEN, FURTHER INVESTIGATION INTO THE LOCATION OF SERVICES SHOULD BE CARRIED OUT WITH THE RELEVANT AUTHORITY.

DISCLAIMER

WHILE EVERY CARE IS TAKEN TO ENSURE THE ACCURACY OF THE SURVEY DATA, SMEC MAKES NO REPRESENTATIONS OR WARRANTIES ABOUT ITS ACCURACY, RELIABILITY, COMPLETENESS OR SUITABILITY FOR ANY PARTICULAR PURPOSE AND DISCLAIM ALL RESPONSIBILITY AND ALL LIABILITY WHETHER IN CONTRACT, NEGLIGENCE OR OTHERWISE FOR ALL EXPENSES, LOSSES, DAMAGES (INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGE) AND COSTS WHICH MAY BE INCURRED AS A RESULT OF DATA BEING INACCURATE OR INCOMPLETE IN ANY WAY AND FOR ANY REASON.

PRELIMINARY

DRAWING FILE LOCATION / NAME: T:\Projects\30012098\CAD\DWG\30012098-2001_[01].dwg
PLOT DATE: 24 May 2018 TIME: 18:20:35

EXTERNAL REFERENCE FILES: X_Newc_a1_30012098, X_ECW_LRG, X_LIDAR, X_1_DSGN_ADDL, X_2_DSGN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	24.06.18	ISSUED FOR CLIENT REVIEW	05	E.W

TITLE	NAME
DRAFTER	M.SKINNER
DRAFTING CHECK	N.HOLE
DESIGNER	N.HOLE
DESIGN CHECK	E.WINGATE
PROJECT MANAGER	L.COOK
PROJECT DIRECTOR	E.WINGATE

SCALES AT A1 SIZE DRAWING: SCALE 1:5000 (50 0 100 200)

DESIGNER
SMEC
SMEC AUSTRALIA PTY LTD
© ABN 47 065 475 149
74 HUNTER STREET
NEWCASTLE NSW 2300
PH +61 2 4925 9600 FAX +61 2 4925 3888
SMEC PROJECT No 30012098

CLIENT: TAHMOOR UNDERGROUND GLENCORE

PROJECT TITLE
TAHMOOR COLLIERY
REFUSE EMPLACEMENT AREA UPGRADE
STAGE 2 - R.E.A STOCKPILE WORKS SITE PLAN & GENERAL NOTES

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS NOTED	PRELIMINARY	30012098-2001	01

150 mm ON ORIGINAL
A1
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150

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Appendix 3
Reject Emplacement Area Extension Drainage Model

TAHMOOR UNDERGROUND - REA EXTENSION PROJECT

DRAINAGE MODEL & PRELIMINARY RISK ASSESSMENT

Drainage Model:

Flow design calculations were undertaken using DRAINS software, where the following details determined the preliminary sizing of pipes:

- Models and data:
  - Hydrological Model (ILSAX):

    Paved area depression storage = 1mm

    Supplementary area depression storage = 1mm

    Grassed area depression storage = 5mm

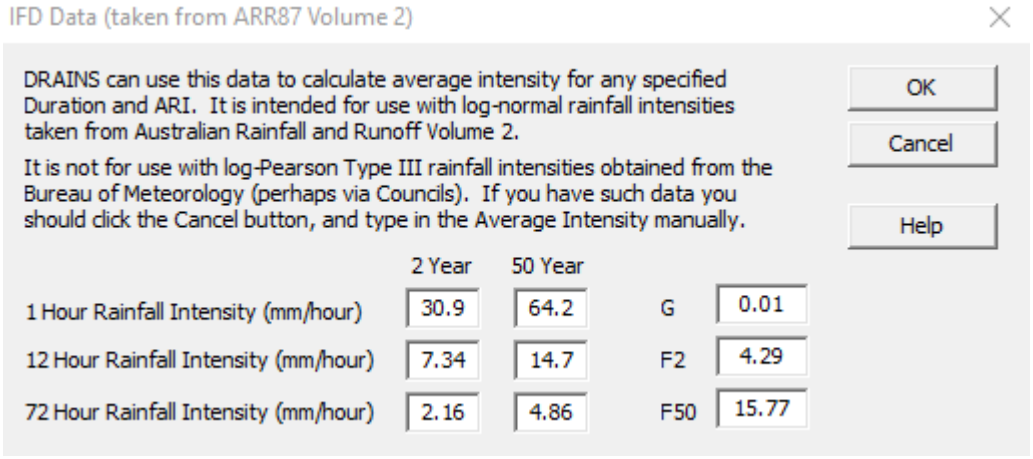
    Soil Type = 3

    Overland flow equation = Friend's Equation

  - Rainfall Data:

    Design level = 100yr ARI (major storm)

    IFD Data = ARR87 (obtained from Bureau of Meteorology). See below.



- Clean drainage:
  - Catchment: Area = 61.33ha of which is 100% grassed. See shape in figure below.

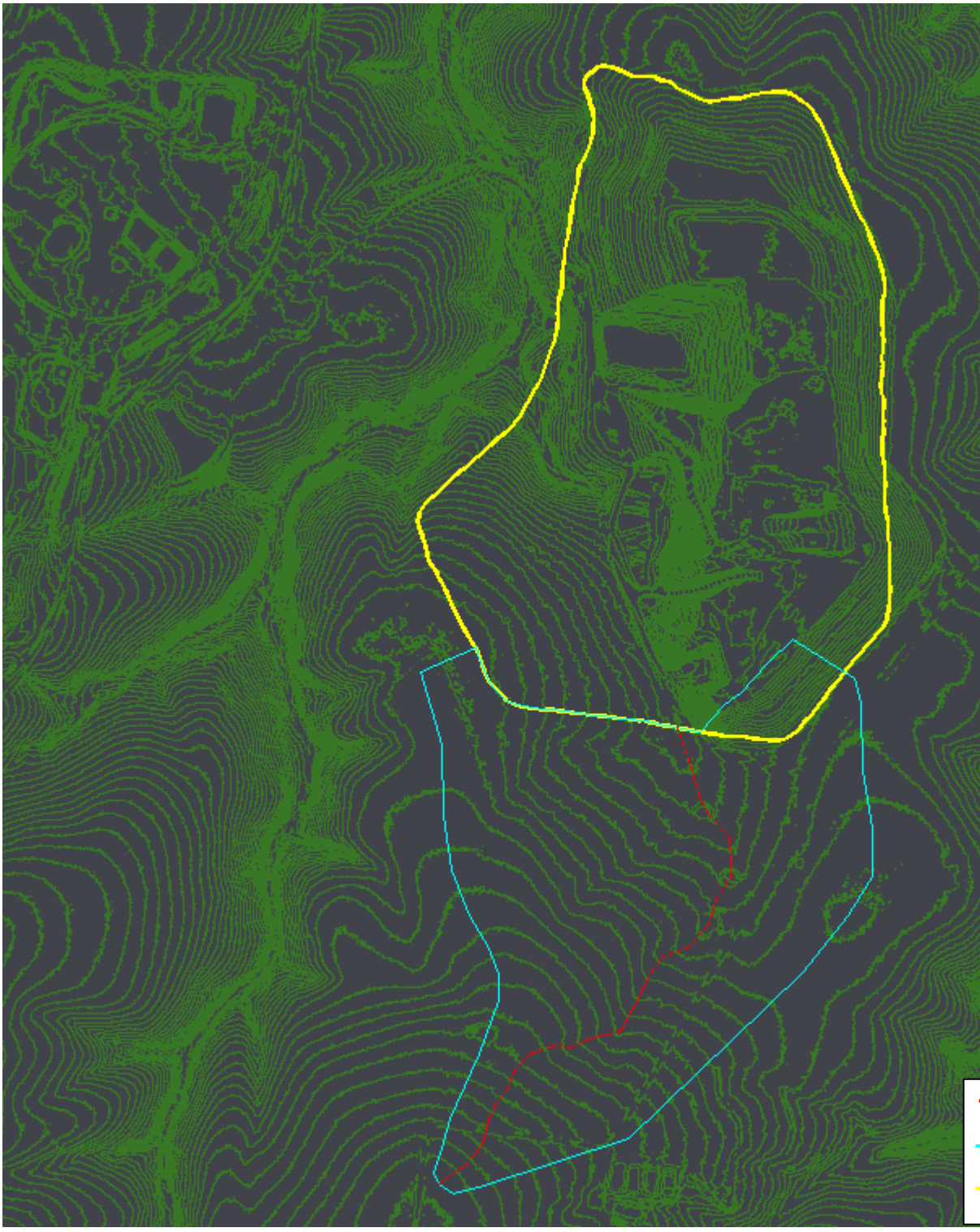
    Overland concentrated flow time = 34mins (based on average flow velocity = 0.6m/s)

    Flow path = 1215m with an average slope of 2.44%.

    Horton roughness n = 0.3

    Q_{100} = 5.15m^3/s

    Critical storm duration = 6hrs



- Piping: Pipe length = 500m
  Upstream invert level = 280m AHD
  Downstream invert level = 267.5m AHD
  Pipe slope = 2.50%
  Pipe roughness = 0.013
  Pipe dimensions = 3 x 900mm diam. (2700W x 1200H box culvert equiv.)
  (**Note:** A conservative approach was taken when sizing pipes).

Min. crown cover = 0.9m

Approx. upstream road crown level at pipe crossing = 284m AHD providing approx. 2.5m freeboard from max. upstream headwater level of 281.5m AHD. Note: road levels subject to change upon receipt of detailed survey.

Please note that the 100yr ARI results in maximum flow velocities of up to 4.7m/s for stormwater in the clean water piping – scour protection/energy dissipaters will need to be implemented as a result.

- Dirty drainage:
  - Catchment (the REA extension was separated into six sub-catchments – see shapes in figure below):
    - Sub-catchment 1: Area = 1.41ha
      Overland concentrated flow time = 6mins
      Flow path = 153m with an average slope of 8.5%.
      Horton roughness n = 0.25
      Q_{100} = 0.16m^3/s
    - Sub-catchment 2: Area = 2.04ha
      Overland concentrated flow time = 6mins
      Flow path = 153m with an average slope of 10.3%.
      Horton roughness n = 0.25
      Q_{100} = 0.235m^3/s
    - Sub-catchment 3: Area = 2.29ha
      Overland concentrated flow time = 6mins
      Flow path = 150m with an average slope of 13.8%.
      Horton roughness n = 0.25
      Q_{100} = 0.271m^3/s

      Total draining south = 0.647m^3/s
    - Sub-catchment 4: Area = 2.26ha
      Overland concentrated flow time = 6mins
      Flow path = 138m with an average slope of 8%.
      Horton roughness n = 0.25
      Q_{100} = 0.258m^3/s
    - Sub-catchment 5: Area = 1.91ha
      Overland concentrated flow time = 6mins
      Flow path = 126m with an average slope of 18.3%.
      Horton roughness n = 0.25
      Q_{100} = 0.245m^3/s
    - Sub-catchment 6: Area = 1.44ha
      Overland concentrated flow time = 6mins
      Flow path = 182m with an average slope of 13.2%.
      Horton roughness n = 0.25
      Q_{100} = 0.165m^3/s

Total draining north = 0.639m^3/s

- Piping (for dirty water draining south):

  Pipe length = 285m

  Upstream invert level = 279.2m AHD
  Downstream invert level = 274.88m AHD
  Pipe slope = 1.52%
  Pipe roughness = 0.013
  Pipe dimensions = 1 x 750mm diam. (**Note:** A conservative approach was taken when sizing pipes).

  Min. crown cover = 0.9m

Note: Piping already in place for sub-catchments draining north towards sediment basin s7A.

Please note that all drainage calculations are preliminary and therefore may not be of the highest level of accuracy, particularly without any survey of the area. These will be subject to change after receipt of survey during the revised detailed design.

PRELIMINARY RISK ASSESSMENT – PIPELINE MANGEMENT

Activity *Break the job down into steps*	**Hazard** *What could cause harm?*	**Existing Controls** *Identify the existing controls to manage the identified risk.*	**Risk Assessment On Current Controls**			**Additional Controls**	**Responsibility for Controls** *Who will make sure it happens*
			L-hood	**Cons**	**Risk**		
Operation of a clean water diversion pipeline beneath the Refuse Emplacement Area (REA)	Pipe blockage – due to natural debris (branches), causing locailised flooding nearby pipe inlet.	Grill spacing, shaping and lining of inlet structure, armoured (rock) inlet. Experienced designer. Design for Q_{100} flow.	A	1	1		Community & Environment Manager
	Pipe blockage due to excessive sediment caused by erosion of REA stockpile toe, or erosion of watercourse upstream of pipe inlet, causing localised flooding nearby pipe inlet.	Erosion control – shaping and lining of inlet structure, armoured (rock) inlet	C	2	8		Community & Environment Manager
	Pipe blockage due to rubbish collecting at inlet causing localised flooding nearby pipe inlet.	Grill spacing, shaping and lining of inlet structure, armoured (rock) inlet	D	2	5		Community & Environment Manager
	Blocakage of water course upstream from the inlet (branches and trees) causing water to be diverted away from pipes.	Clearing and shaping water course immediately upstream of pipe inlet	C	1	4		Community & Environment Manager
	Unauthorised entry to pipe	Site security. Grillage fixed in place at pipe entry.	D	3	9		Coal Handling Plant Manager
	Pipe collapse + storm event, causing localised flooding nearby pipe inlet	Experienced designer, Built to design specifications.	E	3	6		Community & Environment Manager

Activity *Break the job down into steps*	**Hazard** *What could cause harm?*	**Existing Controls** *Identify the existing controls to manage the identified risk.*	**Risk Assessment On Current Controls**			**Additional Controls**	**Responsibility for Controls** *Who will make sure it happens*
			L-hood	Cons	Risk		
Mine closure - existing pipeline beneath the REA beyond Mine Closure	As above		C	2	8		Community & Environment Manager
	Extend REA – increase catchment due to change in mine plan	Decommission pipeline. Commission new water management infrastructure with approval of Tahmoor South EIS	B	1	7		Community & Environment Manager
	Significant Rainfall Events causing overflow of pipe, damage to existing controls	Model flows based on catchment shapes, sizes, flow paths for a flood discharge having a AEP of 1% or 1 in 100 year flood	D	4	14		Community & Environment Manager
Operation of the Pipeline	Breach of Legislative requirements	SEPP (Mining) 2007 Under Part 2 – Permissible Development, Section 10A	D	3	9		Community & Environment Manager
	Breach of Consent Approval	DA 57/93 Condition 41 relates to the Management Plan for REA, specifically pipe sizes and placement	D	3	9		Community & Environment Manager

Name:	**Signature**
Andrew Reid (Tahmoor)	
Bill Rhodes (Project Manager)	

Likelihood Criteria

LIKELIHOOD [of the event occurring with that consequence]

Basis of Rating	E - Rare	D - Unlikely	C - Possible	B - Likely	A – Almost Certain
LIFETIME OR PROJECT OR TRIAL OR FIXED TIME PERIOD OR NEW PROCESS / PLANT / R&D	Unlikely to occur during a lifetime OR Very unlikely to occur OR No known occurrences in broader worldwide industry	Could occur about once during a lifetime OR More likely NOT to occur than to occur OR Has occurred at least once in broader worldwide industry	Could occur more than once during a lifetime OR As likely to occur as not to occur OR Has occurred at least once in the mining / commodities trading industries	May occur about once per year OR More likely to occur than not occur OR Has occurred at least once within Glencore	May occur several times per year OR Expected to occur OR Has occurred several times within Glencore
5 Catastrophic	15 (M)	19 (H)	22 (H)	24 (H)	25 (H)
4 Major	10 (M)	14 (M)	18 (H)	21 (H)	23 (H)
3 Moderate	6 (L)	9 (M)	13 (M)	17 (H)	20 (H)
2 Minor	3 (L)	5 (L)	8 (M)	12 (M)	16 (M)
1 Negligible	1 (L)	2 (L)	4 (L)	7 (M)	11 (M)

Risk Matrix

		Likelihood Rating				
		E	D	C	B	A
Consequence Rating	5	15	19	22	24	25
	4	10	14	18	21	23
	3	6	9	13	17	20
	2	3	5	8	12	16
	1	1	2	4	7	11

Consequences Table

	CONSEQUENCE [potential foreseeable outcome of the event]				
	Health & Safety	**Environment**	**Financial Impact**	**Image & Reputation / Community**	**Legal & Compliance**
5 Catastrophic	• Multiple fatalities • Multiple cases of permanent total disability / health effects	• Environmental damage or effect (permanent; >10 years) • Requires major remediation	• >$600M investment return • >$100M operating profit • >$20M property damage	• Negative media coverage at international level • Loss of multiple major customers or large proportion of sales contracts • Loss of community support • Significant negative impact on the share price	• Major litigation / prosecution at Glencore corporate level • Nationalisation / loss of licence to operate
4 Major	• Fatality or permanent incapacity / health effects	• Long-term (2 to 10 years) impact • Requires significant remediation	• $60-600M investment return • $20-100M operating profit • $2-20M property damage	• Negative media coverage at national level • Scrutiny from government and NGOs • Complaints from multiple "final" customers • Loss of major customer • Loss of community support • Negative impact on share price	• Major litigation / prosecution at Division level
3 Moderate	• Lost time / disabling injury / occupational health effects / multiple medical treatments	• Medium-term (<2 years) impact • Requires moderate remediation	• $6-60M investment return • $2-20M operating profit • $200K-2M property damage	• Negative media coverage at local / regional level over more than one day • Complaint from a "final" customer • Off-spec product • Community complaint resulting in social issue	• Major litigation / prosecution at Operation level
2 Minor	• Medical Treatment Injury (MTI) / occupational health effects • Restricted Work Injury (RWI)	• Short-term impact • Requires minor remediation	• $600K-6M investment return • $200K-2M operating profit • $10-200K property damage	• Complaint received from stakeholder or community • Negative local media coverage	• Regulation breaches resulting in fine or litigation
1 Negligible	• First Aid Injury (FAI) / illness	• No lasting environmental damage or effect • Requires minor or no remediation	• <$600K investment return • <$200K operating profit • <$10K property damage	• Negligible media coverage	• Regulation breaches without fine or litigation

THE HIERARCHY OF CONTROLS

MOST EFFECTIVE	**ELIMINATION**	This is the most effective form of control. The hazard is eliminated. Typical examples are removing dangerous equipment from the site or ceasing certain activities such as re-fuelling vehicles over stormwater drains
	SUBSTITUTION	The dangerous process is substituted with a less dangerous method. A typical example is the use of water-based paint instead of solvent (oil) based paint.
	ISOLATION	The hazard is isolated. i.e. so that staff or environmental receptors are physically separated from the hazard. Typical examples of this method are the installation of a noise reduction enclosure around a machine, fitting guard rails/fences to elevated walkways, insulating electrical equipment and the provision of secondary containment for bulk storage tanks.
	ENGINEERING CONTROLS/ MODIFICATION	The risk is 'engineered out' so that the hazard is significantly reduced. Processes or equipment design can be modified so that the operation does not present a hazard or so that the hazard is controlled. Typical examples are the use of physical lockout devices, machine guarding or the installation of a silt trap for stormwater discharges.
	ADMINISTRATIVE CONTROLS	Administrative controls use management systems to minimise workplace risks and promote workplace safety and environmental protection. The primary administrative control is the use of Safe Work Procedures (SWP). Other administrative controls include: • Job rotation, to reduce workers' exposure • Rescheduling operations so that the minimum number of employees are present • Instituting purchasing controls on hazardous materials • Providing adequate training and supervision • Developing a spill response plan
LEAST EFFECTIVE	**PERSONAL PROTECTIVE EQUIPMENT (PPE)**	Use of PPE involves the provision of some form of equipment, which is worn by employees to shield their bodies from harm. Typical examples are the use of helmets, gloves, safety glasses and ear muffs/plugs. The use of PPE is the lowest level of control but if used sensibly can be effective. In some instances PPE can be the interim method of hazard control until a more permanent method is found/installed. In some cases it is the only method available. If PPE is provided, employees must be trained in its use, fit, selection and maintenance.

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Appendix 4
Rehabilitation and Topsoil Management Procedure

Tahmoor Coal PROCEDURE	Rehabilitation and Topsoil Management Procedure				
Site	Tahmoor Mine	**Department**	HSEC	**Doc #**	TAH-HSEC-00053
Approver/Owner	Fiona Robinson		**Due for Review**		Saturday, 27 February 2021

1 Purpose

The purpose of this document is to guide the salvage, management and use of topsoil and rehabilitation activities at Tahmoor Coal to help achieve Mining Operation Plan (MOP) objectives, the post mining land use vision for the site and completion criteria.

2 Scope

This document applies to the Reject Emplacement Area at Tahmoor Coal and covers the following rehabilitation stages:

a) Land Preparation

b) Landform Establishment

c) Growth Medium Development

d) Ecosystem Establishment

e) Ecosystem Development

3 Objectives

The objectives of the Rehabilitation and Topsoil Management Procedure are to:

a) Provide guidance for clearing of vegetation, topsoil and subsoil materials including options for mulching, temporary storage, re-spreading, amelioration, surface preparation and revegetation.

b) Maximise topsoil resource recovery (including reuse, reprocessing, recycling and stockpiling)

c) Provide for appropriate segregation, storage and transportation of topsoil

d) Provide guidance as to how topsoil should be used at the Reject Emplacement Area and where to source it from

e) ensure proper management of topsoil in regard to vegetation and rehabilitation such as methods of ripping, depth of cover etc.

4 Major Hazards

a) Breach of Regulatory environmental approvals.

b) Unsatisfactory rehabilitation resulting in delay to relinquishment of the mining lease at the end of the Life of Mine.

c) Poor reputation within the community for rehabilitation.

d) Risk to future approvals and projects from poor environmental performance.

5 Regulatory Requirements

Approval Title	Conditions
DA 1975 (26th Mar 1975)	C1 - On completion of mining activities the site shall be left safe, clean and tidy to the satisfaction of Council and including the following requirements: i. Where required by Council all buildings shall be either removed or satisfactorily covered; ii. The site shall be so treated that all batters area at a safe angle of repose; iii. Exclusive only of sealed access roads, the surface area shall be satisfactorily graded, top dressed to a depth of not less than 6" and established with approved trees and grasses, and iv. The mine shaft shall be sealed in a substantial manner with adequate provision for drainage of the mine. C6 - Reference to lease conditions related to shaft sealing and closure.
DA 1979 (23rd Aug 1979)	7) Rehabilitation and re-vegetation of the rejects area to be undertaken to the satisfaction of the Commission. Such satisfaction may be assumed if agreement is reached with the Wollondilly Shire Council and with the Lands Department, the Soil Conservation Service and the National Parks and Wildlife Service to the extent that their jurisdiction applies.
DA 1979 (M2) (5th Nov 1986)	Rehabilitation and re-vegetation of the rejects area to be undertaken to the satisfaction of the Commission etc (as per Condition 7 – 23 August 1979).
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. 22) Upon completion of operations on the surface of the subject area or upon the expiry or sooner determination of this authority or any renewal thereof, the lease holder shall remove from such surface such buildings, machinery, plant, equipment, constructions and works as may be directed by the Minister and such surface shall be rehabilitated and left in a clean, tidy and safe condition to the satisfaction of the Minister. 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.
ML 1642	7) Disturbed land must be rehabilitated to a sustainable/agreed end land use to the satisfaction of the Director-General.
Mine Operations Plan 2012 – 2019	Operate in accordance with the 2012-2019 Tahmoor Colliery MOP, land use vision, rehabilitation objectives and completion criteria

6 Post Mining Land Use

6.1 Vision

There are a number of post mining land use options that may be applicable to the Tahmoor Coal domains including residential, light industrial or a return to native bushland. Currently, it is considered that the likely final land use option for most all of the Tahmoor Colliery closure domains will be a return to native bushland. However the final land use options will be confirmed in the detailed closure planning process, which involves undertaking a final land use analysis. The detailed closure plan, to be developed within five (5) years of mine closure, will be prepared using the selected final land use at that time.

6.2 Rehabilitation Objectives

The general rehabilitation objectives shared by the Tahmoor Coal closure domains are:

a) Remove infrastructure and service;

b) Level, re-contour and grade areas to achieve safely battered slopes and surfaces;

c) Apply topsoil for rehabilitation where required;

d) Establish native bushland vegetation, or other type dependent on selected final land use;

e) Develop self-sustaining native bushland which requires minimal ongoing care and maintenance.

6.3 Completion Criteria

The preliminary rehabilitation indicators and completion criteria have been developed to meet the domain rehabilitation objectives from the site's various consents and approvals. These criteria will continue to be refined throughout the MOP term, following the implementation of rehabilitation and biodiversity monitoring programs, as part of the site's continue improvement process. Closure criteria will be refined for each specific rehabilitation domain..

Tahmoor Coal has adopted the DRE rehabilitation phases for mine closure in accordance with the ESG3 Mining Operations Plan Guideline. The following rehabilitation phases are used to describe the status of each closure domain:

a) Decommissioning

b) Landform Establishment

c) Growth Medium Development

d) Ecosystem and land use establishment

e) Ecosystem and land use sustainability

f) Relinquished lands

The table shows the relevant closure criteria for the Reject Emplacement Area.

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
Domain 3 Refuse Emplacement Area	Decommissioning	Plant will be eliminated when operations cease at the completion of mine life. 1979 EIS Section 5.4	Infrastructure and services will be removed from the REA site.	All services related to refuse emplacement activities to be removed from the REA.	Yes	1979 EIS CCL716	No
	Landform establishment	No specific regulatory requirement	Achieve design height and ensure maximum capacity is achieved.	Average depth of fill (height of refuse emplacement) will be 12m.	12m	REA Rehabilitation & Water Management Plan / 1993 EIS	No
			Landform established to support native ecosystem.	Maximum slope on final landform external batters will be 1:4 (generally will be 1:8).	1:4	REA Rehabilitation & Water Management Plan / 1993 EIS	No
			Prevent erosion from stormwater runoff following rehabilitation of external batters.	External batters should have gently sloping contour drains, reporting to water storage dams.	Yes	REA Rehabilitation & Water Management Plan / 1993 EIS	No
	Growth – Medium Development	No specific regulatory requirement	Apply topsoil for rehabilitation.	Topsoil placement depth.	>300mm	REA Rehabilitation & Water Management Plan / 1993 EIS	No
			Reduce erosion on slopes, and provide furrows for seed beds	All final landform slopes to be contour ploughed.	Yes	REA Rehabilitation & Water Management Plan / 1993 EIS	No

Domain	Rehabilitation Phase	Regulatory Requirement	Domain Objective	Indicator	Completion Criteria	Justification/Source	Complete (Yes/No)
	Ecosystem establishment	No specific regulatory requirement	Establish native bushland rehabilitation.	Conduct seeding and/or planting	Yes – seeding and/or planting completed	REA Rehabilitation & Water Management Plan / 1993 EIS	No
	Ecosystem development	No specific regulatory requirement.	Self-sustaining native bushland rehabilitation (REA Rehabilitation & Water Management Plan).	Presence of weeds in monitoring transects (%).	<10%	Analogue sites 1 & 2	No
				Evidence of second generation flora germination in monitoring transects.	Yes	Analogue sites 1 & 2	No
				Rehabilitation monitoring transects contain flora species and structural characteristics similar to the desired vegetation communities at the analogue sites.	Yes	Analogue sites 1 & 2	No

7 Landform Establishment

7.1 Vegetation and Topsoil Removal

The following summarises the process of vegetation and topsoil stripping and salvaging for new REA areas.

a) Clear the area of vegetation. The removed timber and brush vegetation is spread immediately over freshly topsoiled areas to assist the revegetation process and to prevent soil erosion. Logs should be placed along the contour where possible

b) Mulching of the standing timber/brush material prior to collection of topsoil is likely to increase the organic matter in the topsoil and will result in a greater volume of 'topsoil' and allow rehabilitation of greater areas with this precious resource as well as minimising erosion impacts. Once topsoil is obtained the mulch should be mixed into the topsoil during scraper operations. However, hollow bearing trees should be kept as habitat features and strategically placed throughout the REA, where practicable

c) Prior to capping and establishment of revegetation layers, construct slopes, drainage system, and diversion channels, etc, as directed by the Environmental Coordinator. The ideal slope profile will be roughly S Shaped, Convex in the upper 20-30% and concave for the lower 70 to 80% of its length.

d) Strip the area of topsoil and subsoil and rock to refusal. Where possible, use this material immediately to cover completed areas or stockpile along the proposed reject batter toe line.

e) Separate rock, subsoil and topsoil.

f) Cover new emplacement area with about 1m depth of reject to form a stable 'all-weather' working surface.

7.2 Emplacement of refuse

Refuse emplacement will be conducted in accordance with TAH-CHPP-00002 Reject Disposal Procedure. The design and landform of the emplacement are will be in accordance with the Tahmoor Mine – Refuse Emplacement Area Management, Rehabilitation and Water Monitoring Plan.

7.3 Topsoil Management

The stockpiling and management of excavated and disturbed soils should be undertaken in accordance with Landcom – Managing Urban Stormwater: Soils and Construction – Volume 1 (2004) and should be implemented using appropriate erosion and sedimentation controls.

The topsoil should be removed immediately following flowering where possible. This will ensure that the seed stock is highest in the topsoil material and provide the greatest opportunity for rehabilitation. This represents the period January-April in the local region. Topsoil stripping should also be avoided during excessively wet or dry periods as this can lead to compaction, loss of structure and loss of viability of seed stock. Topsoil is best collected when moist (not wet) to retain soil structure and minimise dust.

The following methods should be employed during the stockpiling activities to minimised erosion and maintain soil and seed integrity:

7.3.1 Stockpile Management

a) Stockpiles must be seeded no less than three months after placement.

b) Stockpiling longer than twelve months causes a gradual deterioration in quality due to the death of seeds and a shift in the dominance of mycorrhizal fungi and other soil micro-organisms. If stockpiles are to be kept for longer than twelve months a process of management is required to ensure anoxic conditions are not reached within the stockpile depleting it of nutrients:

i. Stockpiles are to be shaped, deep ripped (to 300 mm) where practicable and seeded with a suitable cover crop to minimise erosion and dust generation and to prolong the fertility of the in-situ seed bank.

ii. Weed growth should be monitored and subsequently controlled as required. Maintenance fertilising should also be conducted as required.

iii. Stockpiles are to be appropriately signposted to identify the area and minimise the potential for unauthorised use or disturbance.

c) Topsoil stockpiles should be as low as possible with a large surface area, constructed with gentle batters, and be less than 3m in height for stability

d) Topsoil stockpiles should be finished with rough surfaces to encourage germination and reduce erosion.

e) Stockpiles should be orientated lengthwise to the dominant wind direction so they offer minimal cross sectional area prevailing winds where possible.

f) Topsoil stockpiles should be revegetated / seeded to protect from erosion, discourage weeds and maintain active soil microbes. Japanese millet may be used in spring/summer and Rye Corn in autumn/winter at a rate of 40 kg/ha.

g) Topsoil stockpiles should be located in areas where they will not be disturbed by future activities or subject to erosion.

7.4 Drainage Strategy and Waterway Design

Graded banks and contour drains should be utilised throughout the REA to minimise erosion, divert run-off water around the disturbed areas and re-direct contaminated runoff into sediment control dams. Clean water diversion banks should be constructed to separate clean run-on water from contaminated catchments, thus minimising the extent of dirty water catchments.

Graded banks should be constructed at intervals down the slope of the reject emplacement rehabilitation area to control surface flow velocities and minimise erosion on the emplacement batters. As the slope angle increases, the banks should be spaced closer together –stopping before the point is reached where they are no longer effective. Engineered waterways using rip rap should be constructed to safely dispose of runoff down slope.

Permanent or temporary waterways located within or adjacent to the REA are to be managed in accordance with the Landcom – Managing Urban Stormwater: Soils and Construction – Volume 1 (2004) to comply with relevant standards and minimise erosion and sedimentation potential. This may include the placement of geotechnical material, rip rap or other armouring materials.

7.4.1 Contour Development and Clean Water Drainage

Contour development and clean water drainage will be undertaken as depicted in the Environmental Impact Statement for the 1994 Tahmoor North Development Consent. Armouring material and rip rap will be utilised to achieve the clean water design parameters. In order to achieve the desired drainage pathways these controls will be placed at points structures and should be designed by appropriately qualified consultants, with their locations determined by them. These structures will be incorporated into the rehabilitation progression plan for each stage of the REA, and be implemented as a stage is to be rehabilitated

7.4.2 Ripping

Prior to top soiling and seeding the REA rehabilitation site, the underlying material (reject or subsoil) is to be contour ripped down to the first graded bank to between 400 and 500mm depth. This method is shown in Figure 1 below and is undertaken in this sequence to avoid reject material being brought to the surface.

Following the placement of topsoil, it may be lightly scarified (i.e. less than 200mm) using agricultural equipment (e.g. harrows or shallow chisel plough) to improve the seedbed.

8 Growth Medium Development

8.1 Placement and Improvement of Topsoil

Soil is sampled prior to rehabilitation to assess its suitability as a growth medium and any ameliorants required. Analysis includes:

a) pH (acidity - 1 soil : 5 water)

b) EC (salinity – 1 soil : 5 water)

c) ESP (sodicity)

d) CEC (cation exchange capacity)

e) Available N

f) Available P

g) Available K

h) Available S

i) Total organic %

As required, a range of techniques may be considered to improve the condition of soils available for rehabilitation, including:

a) Application of organic matter;

b) Chemical improvements (gypsum / lime);

c) Soil conditioners;

d) Growing green manure crops;

e) Use of nitrogen fixing species (legumes); and

f) Application of mulch.

Based on experience at Tahmoor, typical fertiliser application rates used are as follows.

Some subsoil material available on site may be suitable for ripping into the coal washery reject as a base layer or mixing with topsoil material in base layers over the coal washery reject. However, the suitability of the subsoil material will be based on sampling of its physical and chemical properties prior to use, as required. A variety of options for the use of the subsoil material are provided in Table 3.

Activity	Rate (kg/ha)
Tree seeding	100
Pasture seeding	200
Maintenance fertilising	150

8.1.1 Topsoil Benchmark Value

Topsoil is to be assessed and tested prior to distribution onto rehabilitation areas. The derived completion criteria for topsoil are taken from the baseline monitoring sites in the long-term rehabilitation inspection. Soil testing is undertaken for each rehabilitation area. A report interpreted by a consultant will be used to identify which parameters should be adjusted for the top soil in order to meet the soil completion criteria. Rehabilitated areas are continually tested during annual and long-term inspections to identify if further action is required to build up nutrient levels.

Completion criteria have been derived from long term, off-site reference sites around the REA as the rehabilitation progresses the values will be refined with further research, capturing data obtained from annual and long tern inspections of the rehabilitation sites. The completion criteria are design to be achieved through monitoring over a prolonged period of time, the purpose is to derive suitability of topsoil prior to its application onto prepared rehabilitation areas.

The completion criteria for topsoil is as follows:

Assessment Criteria	Comments
Soil pH	pH of replaced topsoil to be in the range of 5.5 to 7.5 after 5 years (or within half a pH unit of the average of the off-site (analogue) reference sites.
Soil Conductivity	The EC of replaced topsoil to be below 900 µS/cm after 5 years (or no more than 10% higher compared to the average EC value of the off-site reference sites.
Soil Fertility	Nitrogen, phosphorous, potassium and sulphur levels to be no lower than 20% of levels in the off-site reference sites after 10 years.
Soil Biota	Presence of micro and macro organisms after 5 years.
Soil loss	Soil loss to be less than 40 t/ha/year after 5 years.
Runoff water quality	To be less than 600 µS/cm after 5 years. Also, surface water quality in main streams to meet ANZECC guideline water quality criteria for upland rivers during all time periods.
	guideline water quality criteria for upland rivers during all time periods
Soil Sodicity	Sodicity levels (ESP – Exchangeable Sodium Percentage) to be no higher than 5 after five years

Assessment Criteria	Comments
Soil organic %:	To be no lower than 20% of the average for off-site reference sites after 10 years

9 Ecosystem and Land use Establishment

9.1 Cleared Timber Placement

After the topsoil has been placed and graded banks and scarification completed, cleared timber removed from the new sections of the REA may be placed in clumps around the area. The cleared timber is distributed using a long-reach excavator (or similar) to create microhabitats for native plants and animals and to assist in erosion control.

Cleared logs will also to be placed on contours to minimise erosion and capture seed and topsoil runoff from slopes in high rain events, where available and practicable.

9.2 Direct Seeding

9.2.1 Native Tree and Shrubs

Native tree and shrub seeds are directly seeded at a rate of between 7-10 kg/ha and jointly applied with fertilizer (Granulock 15 or equivalent) at a rate of 100 kg/ha on the top (flat) section of the completed REA down to the first Graded Bank with a quad-mounted spreader or by hand. Seed is mixed with a cover of crop oats.

Examples of suitable native species are provided in list below however other native grasses and other groundcover species may be sown to complement species diversity.

Native tree and shrub species used in direct seeding

a) Acacia decurrens
b) A. longifolia
c) A. falcata
d) A. suaveolens
e) A. terminalis
f) Eucalyptus globoidea
g) E. eugenoides
h) E. punctata
i) E. scerophylla
j) E. moluccana
k) E. tereticornis
l) E. rossii
m) Angophora floribunda
n) Allocasuarina littoralis
o) Banksia spinulosa
p) Dodonaea cuneata
q) Leptospermum flavescens
r) Loptospermum juniperinum

s) Hakea dactyloides

t) Hakea sericea

u) Kunzea ambiqua

v) Hardenbergia violaceae

w) Kennedia rubicunda

x) Lomandra longifolia

y) Lomandra obliqua

z) Dianella revoluta

aa) Cassinia aculeate

9.2.2 Pasture Mix

Pasture seeding is aimed at producing ground cover to stabilise the batters and reduce erosion. The steeper sloped sections of the REA are typically sown with pasture seed at rates shown in Table 6 below:

Species	Sowing Rates
Oats	20 kg/ha
Couch	10 kg/ha
Perennial rye grass	10 kg/ha
Lucerne	5 kg/ha
Haifa White Clover	5 kg/ha
Fertilizer (Granulock 15)	200 kg/ha

10 Ecosystem and Land Use Sustainability

10.1 Maintenance and Monitoring

Permanent monitoring sites have been established throughout the REA and are monitored in accordance with TAH-HSEC-00012_Rehabilitation Monitoring Procedure. In addition to the rehabilitation monitoring program:

a) All rehabilitation activities undergo an as constructed survey to ensure construction to design;

b) An annual rapid style walkover inspection is completed in line with TAH-HSEC-00012_Rehabilitation Monitoring Procedure.

10.1.1 Annual Rehabilitation Inspections

Annual rehabilitation inspections are conducted to evaluate the success of annual rehabilitation works, and to assess the general trajectory of all existing rehabilitation towards completion criteria. The scope of the inspection includes all existing and recently completed rehabilitation areas on site.

10.1.2 Long Term Rehabilitation Monitoring

The long-term monitoring evaluate progress of rehabilitation towards fulfilling long term Post Mining Land use, any agreed completion criteria and the statutory requirements that apply to the site. Outcomes and recommendations are provided in an annual monitoring report to Tahmoor. The report compares the following:

a) outline compliance against Approval conditions and other statutory commitments;

b) compare results for landform, soil, water, flora and fauna aspects against completion criteria;

c) report key trends in monitoring results and progression towards achievement of rehabilitation objectives and completion criteria (see recommended performance categories below);

d) assess effectiveness of rehabilitation methods implemented;

e) identify any opportunities for continual improvement in rehabilitation practices or additional trials or research; and

f) Where required, identify modifications required for the monitoring program.

Adaptive Management is utilised supplementing the monitoring strategy as required. This enables Tahmoor to respond to rehabilitation performance and implement changes when necessary. The focus areas include the following:

a) Nutrient availability;

b) PH, salinity and metal toxicity;

c) Suitability of the species used;

d) Seeding time;

e) Moisture availability;

f) Shallow root depth;

g) Other soil limitations;

h) Insect attack;

i) Lack of N-fixing legumes;

j) Lack of organisms involved in litter breakdown (e.g. fungal fruiting bodies) and nutrient cycling (e.g. puff balls);

k) Excessive grazing;

l) Predation;

m) Evidence of drought effects or storm damage;

n) Poor soil preparation; and

o) Weed competition

10.2 Water Monitoring Program

A water monitoring programme associated with the REA has been established. The programme monitors the effectiveness of runoff water management and treatment measures on the site and to satisfy EPA requirements for runoff water analysis. Sampling and analysis is undertaken by qualified consultants using methods in accordance with Schedule 1 of the Clean Waters Act 1970 and current code of practice. Consultants engaged in monitoring activities are required to report to the Environmental Coordinator before taking each series of samples and continue that liaison during the analysis and until the results are available. The Water Monitoring Procedure is outlined in the 'Reject Emplacement Area Management Strategy'.

10.3 Completion Criteria

Rehabilitation closure criteria have been developed in line with rehabilitation indicators and completion criteria, contained within the Tahmoor Coal Mine Operations Plan. Rehabilitation progress across the REA is evaluated in line with defined criteria, and progress is summarised in an Annual Monitoring report.

11 Document Information

Relevant legislation, standards and other reference information must be regularly reviewed and monitored for updates and should be included in the site management system. Related documents and reference information in this section provides the linkage and source to develop and maintain site compliance information.

11.1 Related Documents

Related documents, listed in the below table, are internal documents directly related to or referenced from this document.

Number	Title
TAH-HSEC-00117	Biodiversity and Land Management Plan
TAH-HSEC-00012	Rehabilitation Monitoring Procedure
TAH-CHPP-00002	Reject Disposal Procedure

11.2 Reference Information

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

Number	Title
	EPA (1995) 'Rehabilitation and Revegetation' Best Practice Environmental Management in Mining. Commonwealth of Australia
	Landcom – Managing Urban Stormwater: Soils and Construction – Volume 1 (2004)

12 Document Change Information

Full details of the document history are recorded in the document control register, by version. A summary of the current change is provided in the table below.

12.1 Document History

Version	Date Reviewed	Review Team (consultation)	Change Summary
1.0	27th August 2014	F Robinson, C Standing	Previously named Topsoil Management Plan Review to include improvements identified in the 2013 AEMR Inspection
2.0	23rd September 2014	F Robinson, C Standing, W Mitry (DRE)	Incorporation of comments from DRE and development of monitoring scope and soil completion criteria.
3.0	20th January 2015	F Robinson, C Standing, N Charnock	Incorporation of comments from GCAA Manager – Land and Property, finalisation of document for submission to DRE.
4.0	29th December 2015	F Robinson, Ian Sheppard	Increase to 300mm of topsoil as per request from DRE Remove contour drains drawing
5.0	14th October 2019	Abby Uljanic	No changes made to document content. Document updated to new template.
6.0	27th August 2020	D Talbert, A Parro	In-document references to Glencore removed, document IDs updated to reference SIMEC documents.
7.0	27th August 2020	D. Talbert, A. Parro	No changes made – minor formatting corrections.

12.2 Document Review & Change Request

Please record any changes required to this document when in use and forward to your line manager for review and actioning

Review Details			
Reviewer Details	Full Name	Role Title	Signature
Changes Required	☐ No Changes ☐ Change Required		
Details of Change			
Authoriser Details	Full Name	Role Title	Signature

SIMEC

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Appendix 5
Myrtle Creek CMAP

Tahmoor Coal Pty Ltd

MYRTLE CREEK

Corrective Management Action Plan – Stage 2

August 2020

simecgfg.com

Document Control

PUBLICATION DATE:	7/08/2020
AUTHOR:	**Andrew Stuart** **Environmental Project Coordinator** **Tahmoor Coking Coal Operations – SIMEC Mining**
VERSION NUMBER:	**Ver2**
COMMENTS:	**Final**

Table of Contents

1 Executive Summary

This report details Stage 2 of the Myrtle Creek Corrective Management Action Plan (**CMAP**), following works as part of the Myrtle Creek CMAP. Key learnings were made during the implementation of Myrtle Creek CMAP, which have been adopted in Stage 2. This include vital information regarding the fracture network at Myrtle Creek, and advancements in remediation methods. Stage 2 aims to remediate rock bars downstream of Pools 10, 11, 12a, 14, 18 and 20.

2 Introduction

The NSW Resources Regulator issued Tahmoor Coal with a Notice under Section 240(1)(b) of the Mining Act 1992 on 5 December 2016 that required the lodgement of a Corrective Management Action Plan (**CMAP)** for Myrtle Creek, following subsidence impacts from longwall mining.

The CMAP and associated schedule was submitted on 10 October 2018 and approved by the Resources Regulator on 11 October 2018. It contains an extensive environmental study and background into subsidence impacts to Myrtle Creek. The CMAP is the primary remediation document and details:

- Physical characteristics of Myrtle Creek;
- Rainfall;
- Monitoring;
- Geomorphology;
- Vegetation;
- Hydrology;
- Valley closure;
- Fracture distribution; and
- Impact monitoring.

The approved CMAP schedule provided for the following:

- Approvals – approval required under the Fisheries Act, etc;
- Creek mapping – detailed LiDAR and pool photogrammetry;
- Creek characterisation drilling and testing – drilling at 12 sites to determine the creek fracture development and stream bed permeability;
- Site 23 Trial – grout curtain wall trial;
- Pool remediation trials – hand grouting trials at 3 pools; and
- Trial Outcomes Report.

Following the completion of the CMAP works as outlined in the schedule, numerous learnings were made to assist in the development of Myrtle Creek CMAP Stage 2 Plan (**Stage 2**). This document outlines remediation works to be carried out to meet the objectives first set out in the CMAP.

Stage 2 consists of 3 phases:

i. Phase 1 - targeted characterisation of specific remediation sites;
ii. Phase 2 - a rock bar grout curtain wall trial using sand and colloidal silica; and
iii. Phase 3 - a series of rock bar grout curtain walls at the rock bars downstream of Pools 10, 11, 12a, 14 and 18.

2.1 Scope

The scope for Stage 2 applies for the remediation works at Myrtle Creek in accordance with Tahmoor Coal's Environmental Management Plan (**EMP**) for Longwalls 27-30, as detailed in the CMAP.

2.2 Aims and Objectives

In accordance with the Longwall 27-30 EMP, the objectives of the Myrtle Creek CMAP are to conduct rehabilitation works when required, including:

a) Conducting remediation works that protect to the greatest practicable extent the ecological values of the area;
b) Repairing aesthetic values where necessary;
c) Reducing the interaction of surface and groundwater flow where enhanced through mining;
d) Having creeks and pools function in a similar manner to the pre-impact state;
e) Having surface flows and pool water quality continue to provide suitable aquatic habitat;
f) Re-establishing the ecological values to a similar state to before mining;
g) Creeks and catchments yielding similar water quantity and quality following mining; and
h) Monitoring and reporting effectiveness of the program

3 Environmental Monitoring

This section provides an overview environmental considerations relevant to Stage 2. A comprehensive environmental study is detailed in Myrtle Creek CMAP.

3.1 Longwall Dates

Table 1 details the dates for each longwall mining period for Longwalls 25 to 32.

Table 1: Longwall Dates

Longwall	Longwall Start	Longwall Finish	Depth of Cover (mbgl)
25	22/08/2008	27/02/2011	440-460
26	30/03/2011	11/10/2012	440-470
27	10/11/2012	22/03/2014	420-495
28	20/04/2014	01/05/2015	420-500
29	29/05/2015	03/04/2016	425-490
30	20/06/2016	28/05/2017	425-490
31	29/06/2017	17/08/2018	425-490
32	30/10/2018	22/09/2019	425-490

3.2 Water Level Monitoring

Level monitoring are conducted at various locations along Myrtle Creek (refer to **Figure 1**).

Figure 1: Myrtle Creek Surface Water Monitoring Locations

Level monitoring is conducted at 10 sites, including:

- Myrtle 1;
- Myrtle 3;
- Myrtle 4;
- Myrtle 5;
- Myrtle 6;
- Myrtle 7;
- Myrtle 20;
- MYC1;
- MYC2; and
- MYC3.

MYC1, MYC2 and MYC3 were historical water flow monitoring sites that were removed when Myrtle Creek 1-7 were installed in 2010. These sites were reinstated in 2019.

3.3 Water Flow Monitoring

Flow monitoring are conducted at various locations along Myrtle Creek (refer to **Figure 1**).

Flow monitoring is conducted at 8 sites at Myrtle Creek, including:

- Myrtle 1;
- Myrtle 3;
- Myrtle 4;
- Myrtle 6;
- Myrtle 7;
- MYC1;
- MYC2; and
- MYC3.

The pools that contain *Myrtle 20* and *Myrtle 5* are planned to be surveyed so flow monitoring can then be conducted. *MYC1, MYC2* and *MYC3* were historical sites that were removed in 2010 and were reinstated in 2019.

3.4 Groundwater Monitoring

Figure 2 illustrates locations of groundwater monitoring bores along the banks of Myrtle Creek that were installed following characterisation drilling as part of the CMAP. Further piezometers were also installed to the first water intersection depth, as observed where dust cut out during the open hole PCD drilling process, plus an additional 5m (P18A, P20A, P21A, P21A, P24A and P28A). Piezometers monitor standing water levels within the groundwater system. Additional groundwater monitoring bores (MB-01 to MB-04) were installed as part of the Pool 23 Trial Project. Groundwater monitoring at all sites at Myrtle Creek will continue during Stage 2.

Figure 2: Myrtle Creek Groundwater Monitoring Piezometers

3.5 Aquatic Ecology

Aquatic ecology monitoring has been conducted at Myrtle Creek. An aquatic monitoring survey conducted at Myrtle Creek prior to mining that provides a useful reference point for determining subsidence impacts of mining. Subsequent monitoring has been conducted as part of End of Panel reporting.

Further aquatic ecology monitoring will be conducted following remediation as a measure of ecological values at Myrtle Creek to compare pre and post remediation.

4 Myrtle Creek CMAP – Stage 1 Review and Learnings

4.1 Characterisation Study

Twelve boreholes were drilled along the banks of Myrtle Creek and geotechnical testing conducted to characterise the near surface strata (see **Figure 3**). Testing involved using a borehole camera to observe borehole conditions and water flow, a borehole calliper to measure changes in borehole diameter and lugeon packer testing to measure hydraulic conductivity. Testing indicated that open fractures were present in all twelve boreholes, and the open fractures consistently coincided with intervals of increased hydraulic conductivity. No consistent pattern of fracturing with depth below the water level in the adjacent Myrtle Creek was found. Groundwater flow out of fracture zones was evident in some boreholes.

Figure 3: Location of Characterisation Boreholes

Ten characterisation boreholes were also drilled as part of the Pool 23 Trial Project. **Figure 4** shows an illustrative cross section based on observations of the characterisation holes and an interpretation of the fracture network. These boreholes and testing indicated that a fracture network extends below the rock bar to a depth of approximately 6m, with the most intense fracturing directly below the rock bar between the surface and a depth of approximately 3.5m.

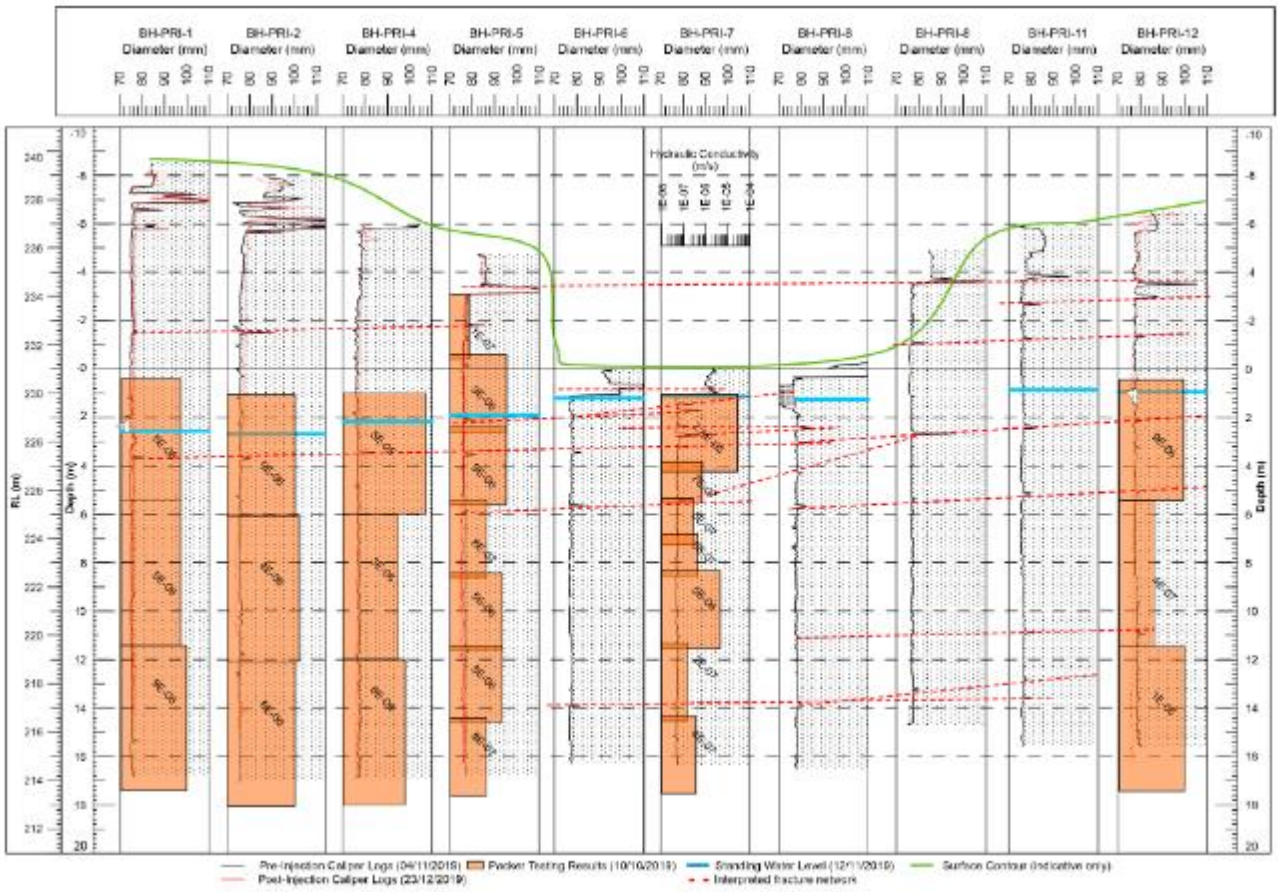


Figure 4: Cross-section through Pool 23 Rock Bar showing fracture pattern

4.1.1 Groundwater Level Observation

Piezometers established along the bank of Myrtle Creek are used to monitor standing water level (refer to **Figure 3**). Initial assessment indicated that all piezometers within Longwalls 26 to 28 (plus associated gate roads) are lower than the basal elevation of the creek bed at their respective locations, suggesting a “losing” groundwater system. A “losing” groundwater system loses its stream flow to the underlying groundwater system, rather than a groundwater system providing baseflow recharge to the stream (“gaining”).

Piezometers along Myrtle Creek were established between June and November 2019 after a sustained period of low rainfall. **Figure 5** shows the standing groundwater at P22, which has responded to rainfall in January and February 2020, resulting in a shift from a “losing” system to a “gaining” system. This demonstrates that in times of prolonged rainfall, it is possible for Myrtle Creek to become a gaining system with the groundwater rising above the creek level.

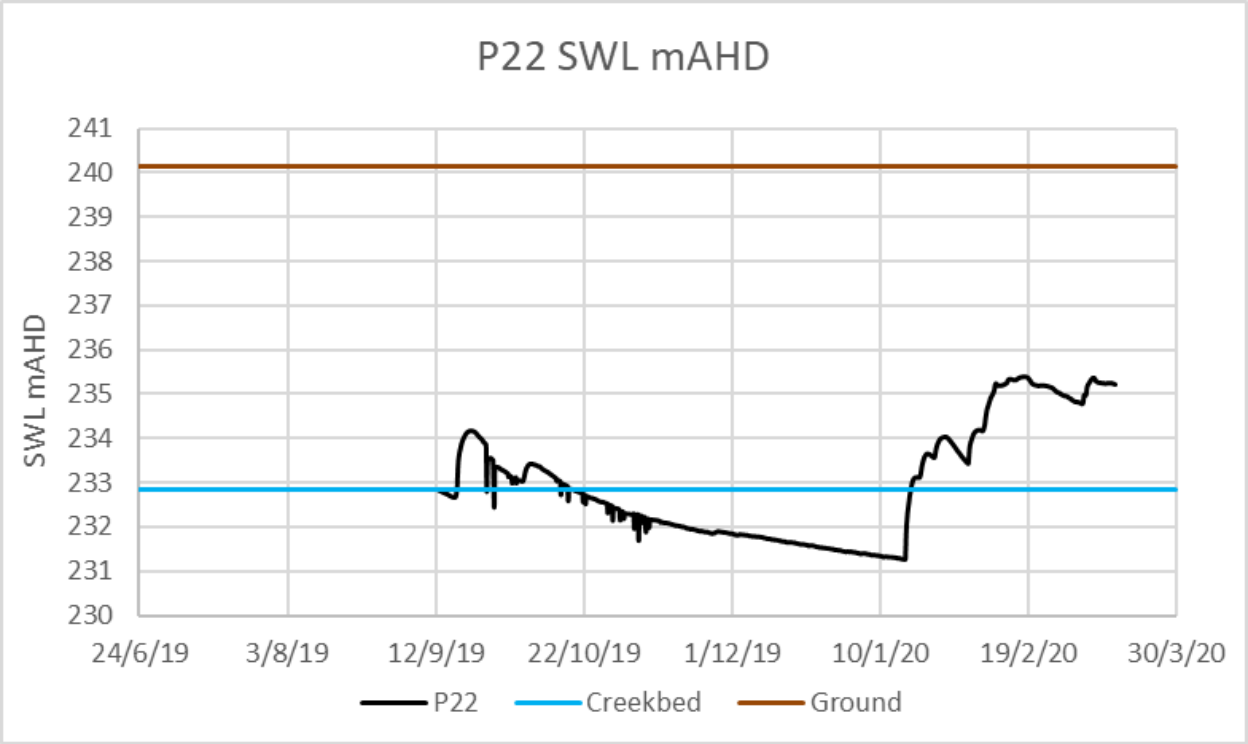


Figure 5: Standing Water Level at P22

Figure 6 shows initial groundwater monitoring data in MB-02, MB-03 and MB-04, installed as part of the Pool 23 Trial Project. MB-01 is located approximately 15m upstream of MB-02 and shows a groundwater level approximately 4m higher than MB-02. The gradient on Myrtle Creek at this location is approximately 1 in 30, so the difference in groundwater level due to stream gradient alone would be only 0.5m. The elevated water level indicates that MB-01 suggests that the section of Myrtle Creek upstream of Pool 23 may be a gaining water from the surrounding groundwater system. The presence of a permanent seep immediately upstream of Pool 23 is also consistent with a locally gaining system.

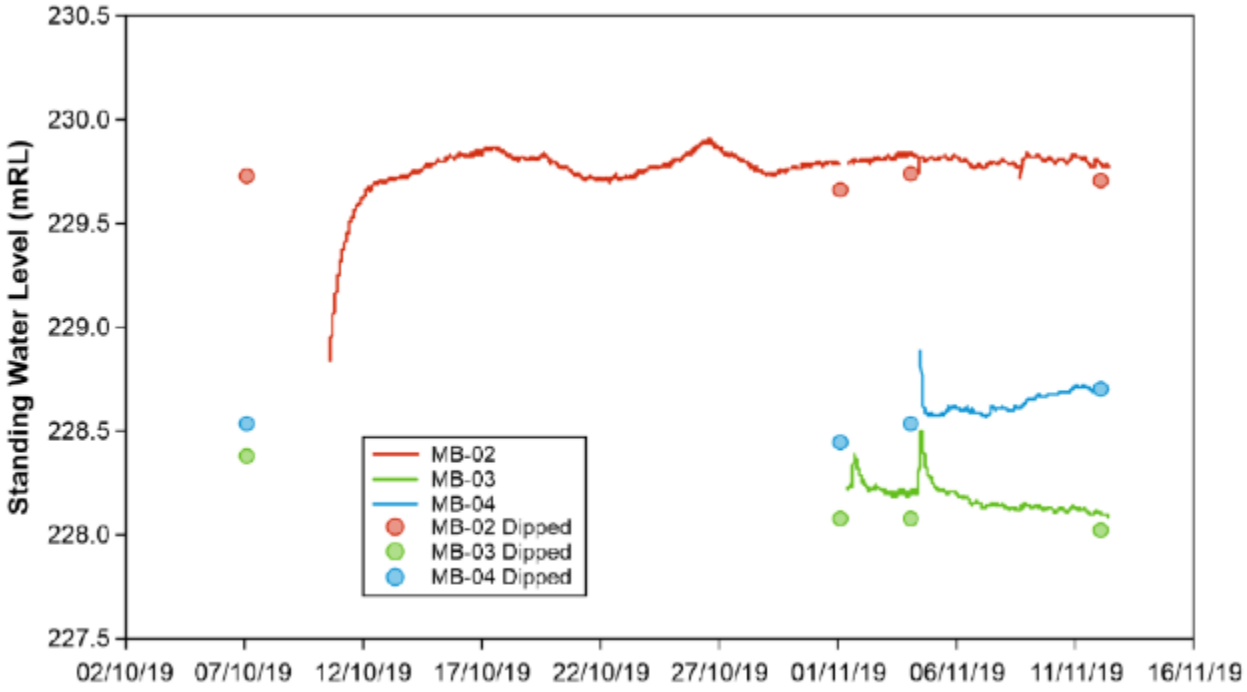


Figure 6: Water level monitoring in MB-02, MB-03 and MB-04

The observed standing water level in the boreholes was deeper upstream and to the west. Borehole P20 has the deepest water level in relation to the creek and the water level progressively becomes shallow to the east through boreholes, P28, P27, P26 and P21. Boreholes further to the east of P21 (P22, PRI5, PRI7, P25, P24, P23 and P18) all show water levels within close proximity to the creek bed level.

Groundwater monitoring data has been utilised to plan Stage 2 works. Remediation works will start at the downstream end of Myrtle Creek (e.g. Pool 20) where the water level is within close-proximity to the creek bed level, and target areas that display features of locally gaining systems, to increase recharge rates at remediated pools.

4.2 Pool 23 Trial Project

4.2.1 Overview

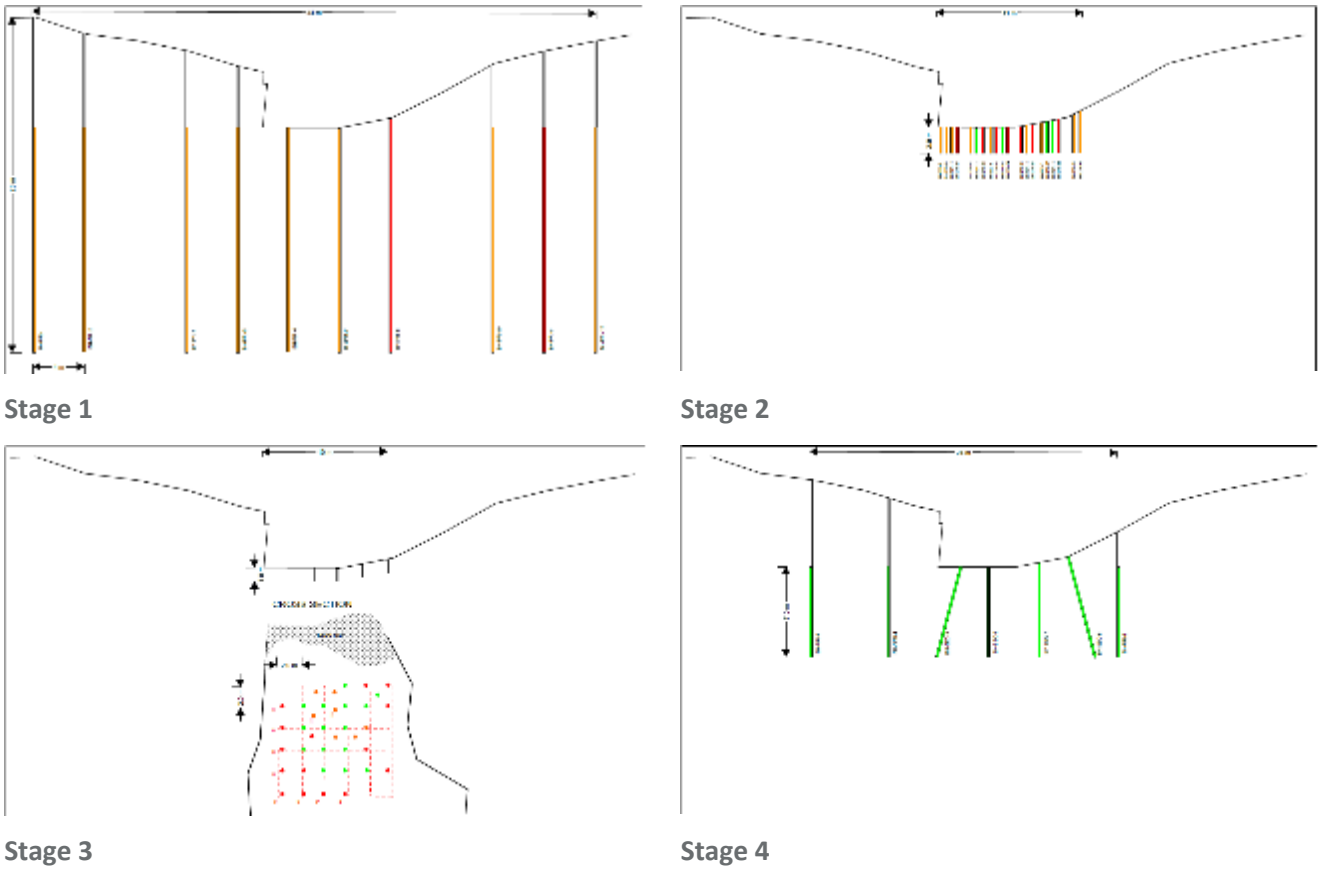
Pointe Engineering Pty Ltd (**Pointe**) was engaged by Tahmoor Coal to undertake a staged drill and injection approach with the aim to return Pool 23 holding capacity with a grout curtain wall using polyurethane injection resin (**PUR**). Pool 23 is a large pool containing a sandstone base and alluvium deposit on the southern bank and vertical sandstone wall on the northern bank. The pool has a controlling rock bar that sits approximately 1m above the base of the pool.

Four water level monitoring boreholes (MB01-MB04) were drilled to monitor the groundwater level on the northern side of Myrtle Creek and upstream and downstream of the remediation works. They were primarily intended to confirm whether Myrtle Creek is gaining water from or losing water into the surrounding groundwater system, the relative responses of the groundwater and creek to significant rainfall events and the effect of the works on groundwater levels away from the creek.

Ten cored boreholes were drilled and tested using calliper logging, borehole camera and packer testing. Testing results indicated:

- A fracture network extending below the rock bar to a depth of approximately 6m;
- The most intense fracturing was located directly below the rock bar between the surface and a depth of approximately 3.5m;
- The fracture at 3-3.5m appears to be the basal shear plane extending beyond the limit of the investigation boreholes and most likely for a considerable distance to either side of Myrtle Creek;
- Fractures in the 10-12m interval appear to be primarily located below the southern bank; and
- The fractures dip gently to the north.

Remediation activities involved four stages of grouting, as shown in **Figure 7**. Remediation aimed to form a deep curtain in Stage 1, a shallow curtain to 2m below the rock bar in Stage 2, a seal in the floor at the downstream end of Pool 23 in Stage 3, and further infilling of the curtain to 7m in Stage 4.



Stage 1 Stage 2

Stage 3 Stage 4

Figure 7: Staged drill and injection at Pool 23

A Pool Recession Rate (**PRR**) test was used as a measure of effectiveness of the grouting program because it directly measured the effect that grouting was intended to achieve, i.e. an increase in pool holding capacity. In each PRR test, 13,000 litres of water was discharged from a water truck into the pool over a period of approximately 20 minutes. The water level in the pool was measured over time to determine the recession rate of the pool. A PRR test was conducted prior to the commencement of remediation and at the completion of each stage of grouting.

Following the completion of Stage 4 in February 2020, Pool 23 has filled and overtopped its rock-bar. At the time of writing this report there has been no observable drop in pool level and long-term monitoring will continue to inform the remediation of Pool 23. **Figure 8** demonstrates the pre and post remediation impact at Pool 23.

Pre-remediation – 05/03/2019

Pre-remediation - 01/05/2019

Post-remediation – 21 January 2020

Post-remediation – 8 March 2020

Figure 8: Pool 23 pre and post remediation

4.2.2 Learnings

Numerous learnings from the Pool 23 Trial Project have been adopted in Stage 2. Key learnings include;

- Using a top-down drill and inject method, as opposed to down-up method;
- A reduction in the number of characterisation holes;
- No coring of characterisation holes;
- Pool recession rate testing to measure success of remediation activities.

The Pool 23 Trial Project trialled the use of various methods of drill and injection. PPR tests demonstrated the greatest improvements were observed after Stage 2 – drill and injection to 2m below the rock bar, and Stage 4, drill and injection to 7m below the rock bar and laterally outward.

Figure 9 illustrates the top-down, staged approach, whereby grouting starts close to the surface, followed by stages moving down and outward. Grouting efficiency is then reviewed after each stage using grout takes and hydraulic testing. This method increases engineering efficiency and encourages the opportunity for works to be completed ahead of schedule if results are better than anticipated. This method will be utilised in Stage 2.

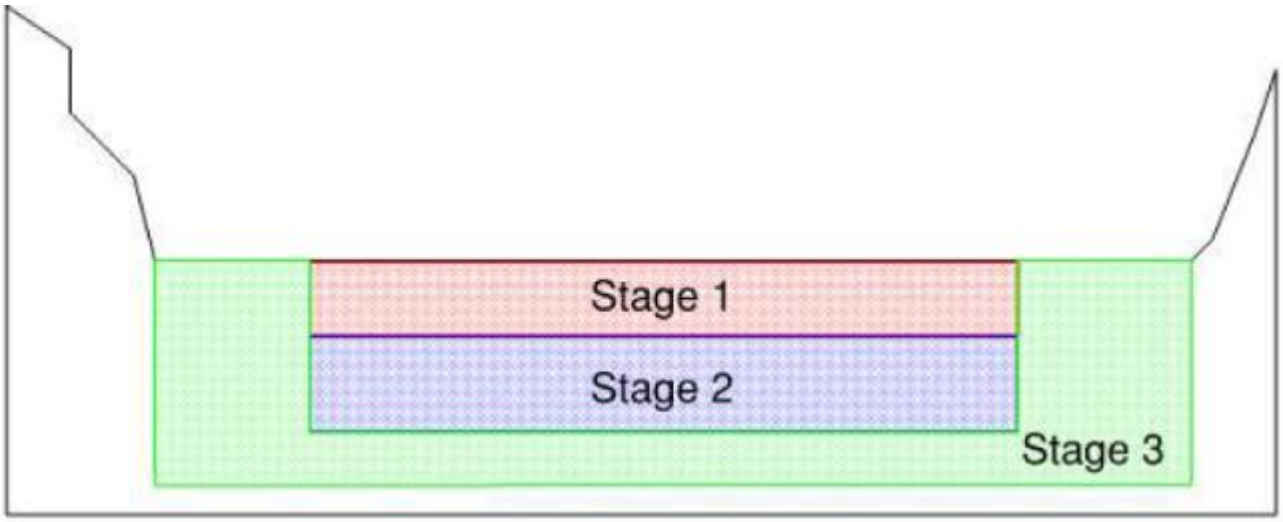


Figure 9: Staged Grout Curtain Methodology

Characterisation of Pool 23 using a line of pre-drilled holes proved useful for defining the location and depth of mining induced fractures across the rock bar. For any remediation strategy based on forming a grout curtain at a rock bar, characterisation holes are required so that information on fracture location and depth can be obtained to provide a guide to where remediation efforts should be directed. Ten (10) characterisation holes were drilled at Pool 23 however this number may be reduced to only a few to obtain the relevant information.

Coring was found to significantly slow drilling rates for limited benefit. Information required for characterisation can be captured using calliper logging, borehole camera and packer testing. Future characterisation holes will be drilled using a rotary spade bit with a reamer behind to speed up drilling time.

4.2.3 Completion Criteria

The Pool 23 Trial Project demonstrated that the completion criteria originally set out did not effectively assess the success of remediation works. Three completion criteria were set as part of the Pool 23 Trial Project, including:

i. Reduction in pool water level recession rates.
ii. Measurement of the extent of fracture in-filling.
iii. Measurement of reduction in rock mass permeability.

The Pool 23 Trial Outcomes Report (Tahmoor Coal, 2020) discussed the effectiveness of the completion criteria against the overall objectives of remediating Myrtle Creek.

Measuring fracture in-filling using geophysical logging, including calliper logging and borehole camera observations were not convincing methods to confirm the completion criterion requiring 95% of fractures to be filled. Compliance with 95% fracture filling cannot be measured with any confidence and the completion criterion is not closely related to achieving an effective outcome. Nearly 100% of fractures would need to be filled across a continuous barrier to reduce the pool recession rates to pre-mining rates or as near as practicable to pre-mining rates.

Measuring a reduction in rock mass permeability of at least three orders of magnitude was required to meet another completion criteria. Packer testing was not found to be useful to confirm grouting effectiveness and is a time-consuming practice.

Based on experience from Myrtle Creek CMAP works Tahmoor Coal are proposing to use pool recession rate testing to satisfy completion criteria in future remediation works.

4.3 Pool Trials

4.3.1 Overview

Pointe was engaged to conduct three pool remediation trials at Myrtle Creek, trialling the use of innovative and low-risk methods and materials. The aim of the pool remediation trials was to increase pool holding capacity by sealing surface and sub-surface cracks. Three trials were conducted across two pools. The pool remediation trials are listed below, included:

1. A shallow curtain wall, using colloidal silica at the rock bar controlling pool 18 (which is likely to also increase pool holding capacity at Pools 16 and 17);
2. Surface rendering, using clay/cement mixture at Pool 20-U; and
3. Shallow drill and injection grid, using clay/cement mixture at Pool 20-U.

Works were tested using pool recession testing where possible, or hydraulic testing in the form of constant rate injection testing prior to and following grouting. Each trial had various levels of success, however further works are required to refine the methodology and material selection/use.

4.3.2 Learnings

Numerous learnings were made following the pool trials. These included:

a) Colloidal silica is not effective as a single source material for grouting fractures
   - Colloidal silica was not found to effectively seal subsidence fractures, following repeated injection. Additional fill material (e.g. sand) must be first injected to fill voids, prior to colloidal silica injection.

b) Surface rendering is not practical as a remediation method
   - For surface rendering to be successful, near 100% of all surface fractures must be completely sealed, requiring large amounts of disturbance on the surface. To adequately seal all surface fractures, large volumes of material must be used which is not aesthetically pleasing.

c) Clay-cement grout is not optimal as a render
   - Material easily washed out of surface fractures. Cement-based grouts containing large amounts of cement would be required to adequately seal surface fractures.

5 Remediation Strategy

5.1 Aim

The primary aim of the Myrtle Creek CMAP is to develop and manage a remediation process to restore Myrtle Creek stream flow in the medium term (5 years) to as close to pre-mining conditions as reasonably practical.

The secondary aim of the Myrtle Creek CMAP is to establish longer term (+5 years) ecological values within Myrtle Creek as close as reasonably practical to pre-mining conditions. Additionally, a secondary aim of the Myrtle Creek CMAP is to re-establish public amenity and creek visual component as close to pre-mining conditions or selected reference site as reasonable practical.

5.2 Remediation Methods

The Pool 23 Trial Project demonstrated that deep and shallow grout curtain walls and pattern grouting can be effective to return pool holding capacity and surface flow. A combination of these methods will be implemented throughout Myrtle Creek CMAP Stage 2, depending on pool conditions.

5.2.1 Deep Grout Curtain Walls

Deep grout curtain walls involve sealing subterranean fractures at defined locations to provide a barrier to subsurface stream flow, to force water to the surface. The aim of deep grout curtain walls is to reduce subsurface flow pathways and promote surface flow and pool holding capacity. The Pool 23 Trial Project demonstrated a staged approach is most effective. It involves a series of shallow holes drilled across a controlling structure and injected with grout. Progressive stages aim to seal fractures lower and wider from the middle of the controlled structure. Grouting efficiency is reviewed after each stage. This method increases engineering efficiency and encourages the opportunity for works to be completed ahead of schedule if results are better than anticipated.

Deep grout curtain walls have the potential to return surface flow to multiple pools if they are strategically placed. They do however, require large drilling equipment and are pre-defined to locations that have primary access.

Geotechnical testing conducted as part of the Pool 23 Trial Project indicated that a fracture network exists below the creek bed to a depth of approximately 6m. The most intense fracturing appeared to be to a depth of 3.5m. This fracture network is anticipated to be consistent throughout the reach of Myrtle Creek that has been mined beneath. The Pool 23 Trial Project demonstrated that a deep grout curtain wall to 7m can have a substantial effect in returning surface water and pool holding capacity.

5.2.2 Shallow Grout Curtain Walls

Shallow grout curtains involve sealing subterranean fractures at defined locations to provide a barrier to subsurface stream flow, to force water to the surface. Shallow grout curtain walls may be effective where the groundwater is close to the surface, or there is regular flow upstream. Shallow grout curtain walls may be effective immediately downstream of deep grout curtain walls, where surface flow is observable.

The Pool 23 Trial Project demonstrated that fracture in-filling of the upper 2m of a rock bar can have a substantial effect to return surface flow. Shallow grout curtain walls may be constructed where deep curtain walls are not suitable due to access constraints, or where pool holding capacity is only impeded by fracturing in the upper strata of a rock bar.

5.2.3 Pattern Grouting

Pattern grouting involves grouting the upper 1-2m of the bottom of a pool to create a dish. The aim of pattern grouting is to seal fractures to prevent surface flow from entering subterranean flow pathways, to create a dish. This process may also increase surface flow pathways between large pools that hold water.

5.3 Remediation Materials

There are numerous options for fill materials ranging from synthetic materials to natural materials, from solid materials, through unbound granular materials to liquids such as water. The benefits and limitations of these materials is discussed in this section.

Tahmoor Coal was committed in the CMAP Stage 1 to use PUR at Pool 23. A wider range of materials is able to be trialled at the rock bar downstream of Pool 20. These materials have been used with varying levels of success depending on the application. If other materials can be safely and effectively used at Pool 20, they will be considered for use at other remediation sites. A range of materials have been used in the Southern Coalfield to fill mining-induced fractures in creek beds:

a) Sand - is the most natural of the filling materials. The main advantages of using a fine clayey sand are that filling effectively replicates the natural processes of fracture infilling and large fracture volumes can be filled at relatively low cost. Sand stabilised with colloidal silicon or silica fume has less tendency to be washed out of fracture networks. Loss of excess sand into the creek is not typically an issue. One of the main limitations of sand is that access to small fractures such as basal shear fractures can be challenging because sand only flows easily into fractures wider than about 5mm. Fractures of this width are still capable of carrying flows of 0.2Ml/day.

b) Cementitious grouts - have been successfully used to grout fracture networks using a process of repeated injections of small volumes. Once cured, the cement is effectively a rock like material with low hydraulic conductivity capable of penetrating into fine fractures. One of the main limitations of grout products in a flowing water environment is that the grout becomes diluted by the flow before it can cure. The diluted grout then has potential to wash downstream and pollute the water way. Locally pumping down the water level to bypass the site can reduce this potential.

c) Polyurethane Injection Resin (PUR) - Spetec H100 was used successfully at Pool 23 and elsewhere within the Southern Coalfields for creek remediation. It is a single part hydrophobic polyurethane grout suitable for potable water use. It comes in liquid form and an accelerator (Spetec H100 Acc) is added prior to injection. When the accelerated polyurethane is injected it comes into contact with groundwater, which is the catalyst for the grout to begin setting. Spetec H100 then foams and expands filling voids and pushing itself further into the formation. It has no particles, is of medium viscosity, expands to volumes up to four times and has an adjustable gel time. It is suitable in a full range of rock fractures with or without flowing water. It can be pumped over vast distances making it an ideal material for sites with poor access.

d) Hydrophilic materials - react with water to form a gel or similar. There may be a place for these materials, but their usefulness needs careful assessment. The fracture network is expected to extend down to 6m or so below the surface. Most of this network is likely to be submerged. The rest is likely to be above the water level. The process by which water-activated material is placed within this partly submerged fracture network needs to be considered.

e) Granular materials - are expected to be suitable for filling voids within the fracture network. These materials have the advantage that they are natural, readily available and relatively inexpensive to source.

f) Unbound materials - such as fine-grained sand and silt mixes may be suitable in circumstances of a losing groundwater system where voids need to be filled along an extended section of the creek.

g) Bound granular materials - are expected to be more suitable to use for filling short sections of the creek, such as within rock bar fracture networks, because they are less likely to migrate downstream through the fracture network and back to the surface. Cement grout, silica fume and colloidal silica are materials likely to be suitable as binding agents. Colloidal silica is considered likely to be more effective.

   Unbound granular materials can be graded to suit the fracture size. Ideally, granular materials should be graded such that the diameter of 10% of the particles (D10) is equal to about one fifth of the smallest width of the fracture width being filled so that the material can access the fracture but become blocked where the fracture width narrows further.

5.4 Characterisation Investigation

During this stage of the program, characterisation holes will be drilled at remediation sites to characterise the fracture network using a rotary spade bit with a reamer behind. Characterisation holes will not be cored, as coring has been found to significantly slow drilling rate with limited benefit. Geotechnical testing can be conducted without cored holes.

Geotechnical testing will be conducted to determine the fracture network to provide a guide to where remediation efforts should be directed. Testing will likely include calliper logging, borehole camera survey, packer testing and Acoustic Tele Viewer (ATV) testing. ATV testing allows the investigation to quantify fracture dip, orientation, aperture and infill. Dip and orientation can be used to optimise drilling orientation and aperture and infill are important when selection grout viscosity and gel set times.

This investigation will be conducted prior to remediation works, to ensure adequate time to plan the most appropriate method and material for remediation works at specific sites. It is anticipated that the fracture network will be consistent with that of Pool 23.

5.5 Remediation Sites

Pool mapping was completed as part of Myrtle Creek CMAP works, which included photo reference points, Thalweg and photogrammetry (at selected sites). Remediation sites have been chosen using a variety of factors including:

- Pool geometry;
- Control geometry;
- Control type;
- Access; and

- Location of pool in reference to the stream.

Figure 10 illustrates the locations of pools identified as suitable for remediation for Stage 2 works. This section outlines location of rock bars and pools selected for remediation, as well as the remediation method considered. It is expected that these remediation works will not only improve the pools being targeted but also pools upstream and downstream of the remediated rock bar.

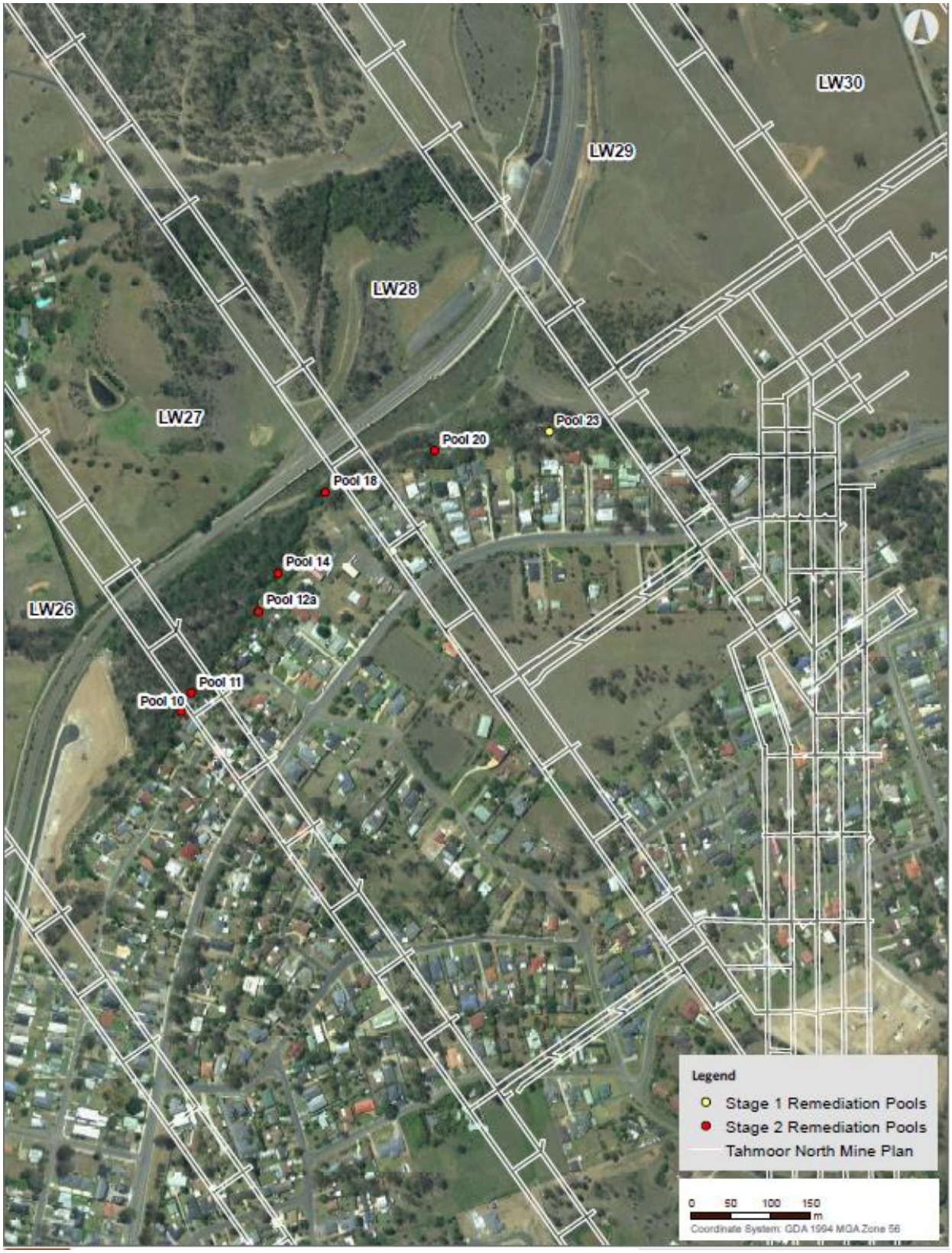


Figure 10: Remediation Sites at Myrtle Creek

Appendix A is a thalweg of Myrtle Creek with pools. It shows pools have been strategically selected for remediation, based on their potential to increase pool holding capacity and return surface flow to large reaches of Myrtle Creek.

5.6 Pool 20

5.6.1 Site Description

Pool 20 is a large, elongated pool with a strong controlling rock bar. It is approximately 24m long, 4m wide and 1.4m at its deepest point. The rock bar is comprised of sandstone. Pool 20 was impacted by subsidence such that it does not hold water effectively.

Pool 20 is located within Longwall 28, approximately 40m east of the western border of the chain pillar between Longwall 27 and Longwall 28.

5.6.2 Subsidence Impacts

Cracking and loss of flow was first observed during LW27 and 13 June 2014. The TARP was triggered on 20 August 2014. **Figure 11a** is a photograph of Pool 20 pre-mining, and **Figure 11b** shows the typical condition of Pool 20 post-mining. **Figure 12** shows subsidence related cracks observed on the controlling rock bar at Pool 20. Prior to impacts, Pool 20 was observed to hold water during normal environmental conditions.

Figure 11a: Pool 20 Pre-Mining (23/03/2012)

Figure 11b: Pool 20 Post-Mining (April 2020)

Figure 12: Pool 20 Controlling Rock Bar

5.6.3 Site Access

The southern bank is bound by residential dwellings. The northern bank allows for a laydown area and space for a site compound. Tahmoor Coal has previously secured land access via a property to the north of Pool 20 for previous remediation works and it is anticipated this will continue for this project. **Figure 13** shows the northern banks, which is anticipated to set up a small Site Compound for remediation works at Pool 20 and Pool 18, and possibly further upstream.

Figure 13: Northern bank of Pool 20

5.6.4 Strategy

Pool 20 is proposed to be remediated by constructing a deep grout curtain wall at its controlling rock bar. Void filling will trial the use of injecting a slurry of natural materials ranging from fine gravel, sand and eventually some finer grained material. The materials are anticipated to be held in place using colloidal silica. Characterisation drilling prior to remediation will determine the location, extent and depth of the fracture network, which will direct specific materials and proportions to be injected.

A risk assessment will be conducted to assist in the development of a specific methodology that considers practicality and engineering using natural materials.

5.6.5 Monitoring

A level monitoring device was installed in Pool 20 in June 2019 (see **Figure 14**). This will be used to determine the recession rate using natural and artificial pool testing.

Figure 14: Water Level Monitoring Device at Pool 20 (M20)

5.7 Pool 18 Rock Bar

5.7.1 Site Description

Pool 18 is a long narrow pool lined with sands and gravels. The pool is controlled by a narrow sandstone rock bar with a height of approximately 1.2 above the pool base. The pool contains vegetation of both banks.

Pool 18 is located within Longwall 27, approximately 22m west of the chain pillar between Longwall 27 and Longwall 28. **Figure 15** shows the typical condition of Pool 18 following subsidence impacts.

5.7.2 Subsidence Impacts

Prior to mining, Pool 18 was observed to hold water during normal environmental conditions. It was observed to be losing water (with no obvious cracking) on 22 March 2013 and the TARP was triggered on 23 May 2013. Pool 18 only holds water following large rain events following mining.

Figure 15: Pool 18 Post-Mining

Figure 16: Proposed access way to Pool 18

5.7.3 Site Access

The southern bank at Pool 18 is bound by residential dwellings, while the northern bank is bound by the Great Southern Railway rail corridor. **Figure 16** illustrates the narrow access path to the proposed Pool 20 Site Compound. Access is proposed using the railways corridor access path, using the Pool 20 Site Compound at land with which Tahmoor Coal has a land access agreement.

5.7.4 Strategy

A shallow curtain using colloidal silica, followed by PUR was constructed at Pool 18 in December 19 and January 2020. Stage 2 works will focus on deepening the curtain at Pool 18 to below the standing groundwater level so that subterranean flow paths are blocked and ultimately force water to the surface. If natural materials prove to be successful at Pool 20, then this concept will be adapted at Pool 18. Pumping distance may be a determining factor in the type of material used to fill voids.

5.7.5 Monitoring

A level monitoring device will be installed in Pool 18 prior to remediation works to determine the Pool Recession Rate during and following remediation.

5.8 Pool 14

5.8.1 Site Description

Pool 14 is a long pool lined with sands and gravels. The pool is controlled by a narrow sandstone rock bar with a height of approximately 1.0m above the pool base. It is approximately 18m long and 4m wide and contains vegetation on both banks.

Pool 14 is located in the centre of Longwall 27, approximately 140m east of the western border of the chain pillar between Longwall 26 and Longwall 27. **Figure 17** and **Figure 18** shows the typical condition of Pool 14 following subsidence impacts.

Figure 17: Pool 14 Post-Mining (facing downstream)

Figure 18: Pool 14 (facing upstream)

5.8.2 Subsidence Impacts

Prior to mining, Pool 14 was observed to hold water during normal environmental conditions. It was observed to be losing water due to cracking on 5 March 2013 and the TARP was triggered on 10 May 2013. Pool 14 only holds water following large rain events following mining.

5.8.3 Site Access

Pool 14 is heavily vegetated on both banks and access is poor. **Figure 19** illustrates the heavily vegetated and steep northern bank. Access is proposed via the north bank, through a narrow pathway and onto landowner's property with whom Tahmoor Coal has a land access agreement.

Figure 19: Northern banks at Pool 14

5.8.4 Strategy

A deep curtain wall is proposed at Pool 14. Due to the access constraints, an injection material that can be pumped over vast distances is likely to be most suitable.

5.8.5 Monitoring

A level monitoring device will be installed in Pool 14 prior to remediation works to determine the Pool Recession Rate during and following remediation.

5.9 Pool 12A Rock Bar

5.9.1 Site Description

Pool 12a is a small round pool at the end of Pool 12; which is a long, narrow pool that is typically dry. Its controlling structure is a large sandstone rock bar with a height of approximately 2m above the base of the pool base. **Figure 20** shows the typical pool holding capacity at Pool 12a, while **Figure 21** shows Pool 12. Pool 12a is located approximately 96m east of the eastern roadway of the chain pillar between LW26 and LW27.

Figure 20: Pool 12a

Figure 21: Pool 12

5.9.2 Subsidence Impacts

Prior to mining, Pool 12 and Pool 12a were observed to hold water during normal environmental conditions. Subsidence cracking and pool water loss was observed at Pool 12 and Pool 12a on 5 March 2013, however a TARP was triggered for Pool 12 only on 23 May 2013. Following subsidence impacts, it has been observed that Pool 12 only holds water following large rain events. Pool 12a however, holds water similar to its pre-mining state and currently holds water during normal environmental conditions.

It is assumed that the upper strata of the controlling rock bar of Pool 12 and 12a has sustained fracturing while the lower strata is relatively unimpacted.

5.9.3 Site Access

The northern bank of Pool 12a is heavily vegetated. The southern bank backs onto residential dwellings. Access is preferred via the southern bank as it would allow for drilling equipment to easily be transported to site (see **Figure 22**). Land access with the landowner will be required. Alternatively, access will be restricted via the centre of Myrtle Creek. If this option is required, specialised equipment will be required.

Figure 22: Southern banks at Pool 12a

5.9.4 Strategy

A shallow curtain wall is proposed at Pool 12a. It is hypothesised that infilling the fractured upper strata of the controlling rock bar will raise the pool holding capacity of Pool 12a, and ultimately Pool 12, such that it holds water during normal environmental conditions.

5.9.5 Monitoring

A level monitoring device will be installed in Pool 12a prior to remediation works to determine the Pool Recession Rate during and following remediation.

5.10 Pool 11

5.10.1 Site Description

Pool 11 is a long, narrow pool with a sandstone bed. It is approximately 28m long and 2-3m wide. It is controlled by a narrow sandstone rock bar with a height of approximately 0.6m above the pool base. **Figure 23** and **Figure 24** show Pool 11. Pool 11 is located within the chain pillar between Longwall 26 and Longwall 27.

Figure 23: Pool 11 (facing upstream)

Figure 24: Pool 11 (facing downstream)

5.10.2 Subsidence Impacts

Prior to subsidence impacts, Pool 11 was observed to hold water during normal environmental conditions. Gradual water loss was observed with no obvious cracking during extraction of LW26. As a result of water loss during the mining of LW27 a TARP was triggered on 10 May 2013. Pool 11 currently holds water, however not to the extent it did prior to mining.

5.10.3 Site Access

The northern bank at Pool 11 is heavily vegetated. The southern bank is confined by residential dwellings. Tahmoor Coal proposes to negotiate a land access agreement with the resident on the southern bank of Pool 11 and gain access via the residence (see **Figure 25**).

Figure 25: Southern banks at Pool 11

5.10.4 Strategy

The controlling rock bar at Pool 11 has observable subsidence fractures within its upper strata. Remediation works at Pool 11 are aimed to infill the fracture network within the upper strata of the controlling rock bar at Pool 11 by constructing a shallow curtain wall. Due to constraints with storage area at Pool 11, it is likely a material that can be pumped long distances will be required.

5.10.5 Monitoring

A level monitoring device has been installed and monitored level at Pool 11 since 2010. It will be used to determine pool recession rate during and following remediation.

5.11 Pool 10 Rock Bar

5.11.1 Site Description

Pool 10 is a long pool with lined with sediment and sand. It is approximately 20m long and 4m wide (see **Figure 26**). The pool is controlled by a sandstone rock bar with a height of approximately 1.0 above the pool base. The pool contains vegetation on both banks. Pool 10 is located approximately 10m east of the eastern roadway of the chain pillar between LW26 and LW27.

Figure 26: Pool 10 (facing downstream)

5.11.2 Subsidence Impacts

Prior to subsidence impacts, Pool 10 was observed to hold water during normal environmental conditions. It was observed to be drying out with no obvious cracking during extraction of LW26 and a TARP was triggered during the extraction of LW27 on 10 May 2013. Pool 10 currently only holds water after large rain events.

5.11.3 Site Access

The northern bank at Pool 10 is heavily vegetated. The southern bank is confined by residential dwellings. Tahmoor Coal proposes to negotiate a land access agreement with the resident on the southern bank of Pool 11 and gain access via the residence.

5.11.4 Strategy

A deep curtain wall is proposed at Pool 10. Specialised drilling equipment will be required to pass through the residential property and into the creek. Due to the access constraints, an injection material that can be pumped over vast distances is likely.

5.11.5 Monitoring

A level monitoring device will be installed in Pool 10 prior to remediation works to determine the Pool Recession Rate during and following remediation.

5.12 Completion Criteria

The intent of the remediation is to return water to surface pools for extended periods consistent with the pre-mining state of Myrtle Creek. The flow regime in Myrtle Creek is such that there are times when there is very low flow and under these conditions evaporation rates are recognised as sufficient to reduce pool levels. The challenge for determining remediation effectiveness is finding a completion criterion that achieves the intent of the remediation effort.

Learnings from Myrtle Creek CMAP demonstrated that indirect methods based on hydraulic conductivity measurements or percentage fracture filling are not able to be measured reliably and do not directly indicate successful remediation.

SCT have recommended that the most effective criterion for determining remediation effectiveness is pool recession rate because this rate directly measures whether the intent of the remediation has been met. Pool recession rate testing involves part filling the pool with a large sum of water, nominally 10,000 litres (l) and measuring the rate at which the water level recedes. When the recession rate is low enough that water is retained within the pool for extended periods, the remediation can be considered effective.

Pool recession rate testing is complicated by the background flow in the creek. If the flowrate is high, even pools that have not been remediated run full. However, when the flowrate drops, leakage through subsurface fracture networks accounts for a larger proportion of total flow and eventually all flow is accommodated within the fracture network and surface pools no longer contain water.

Reducing the pool recession rate of a pool to a level where the pool remains full most of the time provides a good environmental outcome. To confirm this success over a longer term, remediated pool levels will be monitored over an extended period of approximately two (2) years against normal or above average historical rainfall.

Experience in the Bargo River and at other sites indicates that pools that hold water for extended periods tend to self-seal. If a pool can be remediated to the extent that it holds water most of the time, its ability to hold water is likely to improve further with time.

5.13 Reporting

5.13.1 Quarterly Reporting

Tahmoor Coal has committed to Quarterly Progress Reports for the CMAP (31 March, 30 June, 30 September, and 31 December). This reporting regime will continue for Stage 2. The Quarterly Progress Report will include information, such as:

- Works completed in previous period;
- Works proposed in next period;
- Review against program;
- Monitoring results; and

- Stakeholder consultation (including complaints and incident management).

5.13.2 Completion Report

A Completion Report will be submitted following the completion of Stage 2.

5.14 Land Access

Land access is required to complete remediation works. Land access agreements may be negotiated with property owners for the following reasons:

- To gain access to sites; and
- For drilling and injection at curtain wall sites.

The requirement for a land access agreement will be determined after characterisation on a site by site basis as it is dependent upon the footprint of drilling activities.

5.15 Environmental Management

5.15.1 Erosion and Sediment Control Plan

The Myrtle Creek CMAP Erosion and Sediment Control Plan (**ESCP**) was prepared to meet Condition 13 of The Tahmoor North Development Consent DA 67/98, states the following:

> *For longwalls up to and including Longwall 32, if determined necessary by the Secretary in consultation with Council and DoI, the Applicant must carry out works in accordance with an Erosion and Sediment Control Plan, prepared to the requirements of DoI, to restore any damage to watercourses (including the banks) resulting from the mining operations, subject to any other necessary approvals.*

The ESCP was prepared to meet the satisfaction of NSW Department of Planning and Environment and was approved for use on 4 June 2019. The Erosion and Sediment Control Plan **(ESCP)** outlines strategies to minimise soil, erosion and the discharge of sediment to waterways as a result of the CMAP works. It will be consulted during Stage 2.

5.16 Risk Management

A risk assessment was conducted as part of the Site 23 Trial Project.. This risk assessment will be consulted for similar projects as part of Stage 2. If different methods or fill materials are utilised in Stage 2, a further risk assessment will be conducted.

5.16.1 Key Risks

Based on learnings from Myrtle Creek CMAP, anticipated key risks specific to Stage 2 include the following:

1. Land Access agreements (**LAA**) - LAA's are required to be able to conduct works at sites for Stage 2. LAA's are made by way of bipartisan agreement between Tahmoor Coal and the land owner. The timing of previous Myrtle Creek CMAP works were heavily impacted by issues negotiating and ultimately securing land access agreements with key land owners. Tahmoor Coal will give regular updates of the progress of securing and alert the Resources Regulator if delays to the schedule are likely due to land access negotiations.
2. Curtain Wall Width - It is highly likely that the effectiveness of works will be determined by the depth and width of grout curtain walls. Myrtle Creek is very tightly bounded by residential properties to the south. It is likely drilling will need to take place inside residential properties,

which will require a consent and a land access agreement. Without adequate width to the curtain wall, groundwater may move around the wall and will not be pushed towards the surface, and thus not return pool holding capacity and surface flow.

3. Access to Remediation Sites – as indicated earlier in this report some sites are difficult to access which may have an impact on efficiency of works to be completed. Tahmoor Coal will identify difficult access sites and develop and action plant to provide safe and suitable access on a site by site basis.

5.17 Stakeholder Consultation

Stakeholder consultation will be carried out as outlined in the CMAP. This includes regular communication with identified key stakeholders, continuation of the project newsletter and the community phone line for enquiry management.

6 Programme and Timeframes

Stage 2 programme is separated into three phases. Estimated timeframes are discussed in this section.

6.1 Phase 1 – Ground Characterisation

Phase 1 consists of characterisation of the fracture network at selected sites to assist in planning the materials, type and depth of remediation works to take place. Phase 1 is anticipated to take 80 working days to complete. **Table 2** outlines the estimated timeframe for Phase 1.

Table 2

Key Milestone	Estimated Duration (days)
Phase 1	
Planning	20
Mobilisation	10
Pool 20 Characterisation	10
Pool 18 Characterisation	10
Pool 12a Characterisation	10
Pool 14 Characterisation	10
Pool 10 Characterisation	10
Total	**80**

6.2 Phase 2 – Pool 20 Trial

Phase 2 consists of a trialling sand and other natural materials as fill at the rock bar downstream of Pool 20. It is hypothesised that colloidal silica will be used to set the sand in place. If the method can be shown to be efficient as a remediation strategy, it may be utilised at subsequent sites. Phase 2 is anticipated to take 210 working days to complete. **Table 3** outlines the estimated timeframe for Phase 2.

Table 3

Key Milestone	Estimated Duration (days)
Phase 2	
Planning	100
Mobilisation	10
Pool 20 Stage 1 (top layer)	20
Pool 20 Stage 2 (middle layer)	20
Pool 20 Stage 3 (bottom layer)	20
Pool 20 Reporting	40
Total	**210**

6.3 Phase 3 – Remediation Works

Phase 3 consists of utilising learnings from Stage 1 and 2 to implement efficient and timely remediation strategies at Pools 18, 10, 11, 12a and 14. Phase 3 is anticipated to take 210 working days to complete. **Table 4** outlines the estimated timeframe for Phase 3.

Table 4

Key Milestone	Estimated Duration (days)
Phase 3	
Pool 18 Stage 2	20
Mobilisation	10
Pool 10 Stage 1	20
Pool 10 Stage 2	30
Pool 11 Stage 1	10
Mobilisation	10
Pool 12a Stage 1	20
Mobilisation	10
Pool 14 Stage 1	20
Pool 14 Stage 2	30
Demobilisation	10
Reporting	20
Total	**210**

Appendix B outlines the proposed schedule with key milestones. Key milestones are anticipated to be:

- Phase 1 – 26 October 2020 to 12 February 2021;
- Phase 2 – 4 January 2021 to 22 October 2021; and
- Phase 3 – 25 October 2021 to 12 August 2022.

6.4 Contingency

Outcomes will be continuously monitored throughout the implementation of Stage 2. The programme may be adjusted based on progressive learnings to reflect efficiencies, changes in processes or unscheduled delays. Tahmoor Coal will notify key stakeholders if the programme is to be adjusted.

7 References Consulted

Pointe 2020 “Pool 23 Completion Report, Rev 2” Pointe Engineering Pty Ltd Report to Tahmoor Coal 18 February 2020

Pointe 2020 “Pool 18 Completion Report Rev 2” Pointe Engineering Pty Ltd Report to Tahmoor Coal 22 March 2020

Pointe 2019 “Completion Report: Myrtle Creek CMAP Trial Project” Pointe Engineering Pty Ltd Report to Tahmoor Coal PE-P1913 23 December 2019

SCT 2019 “Myrtle Creek and Redbank Creek Remediation Investigations” SCT Report TAH4987 4 June 2019

SCT 2019 “Myrtle Creek Characterisation Boreholes” SCT Report TAH5004a 24 December 2019

SCT 2020 “Myrtle Creek Site 23 CMAP Outcomes Report” SCT Report TAH5123 3 January 2020

SCT 2020 “Myrtle Creek CMAP Pool 23 Trial: Update on Meeting Completion Criteria” SCT Report TAH5123B

SCT 2020 “Myrtle Creek Corrective Management Plan: Stage 2” SCT Report TAH5179

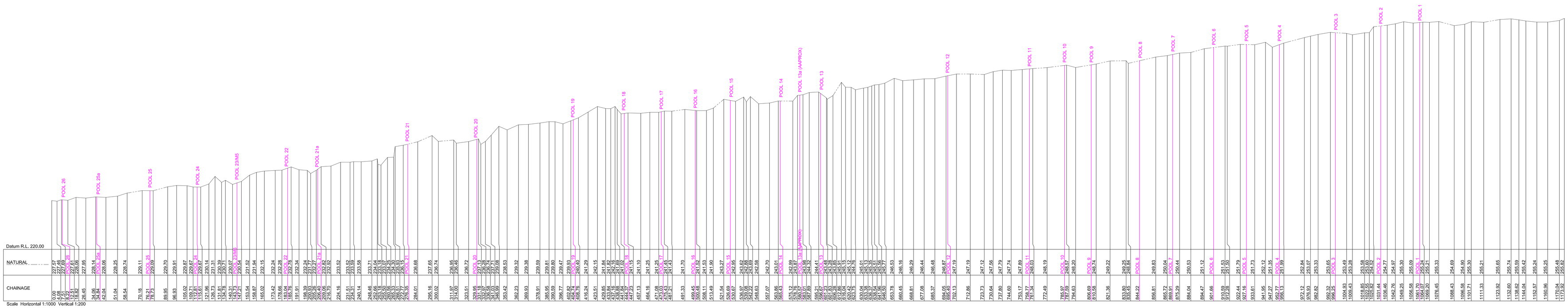
Tahmoor Coal 2017 “Corrective Management Action Plan” 16 June 2017

Tahmoor Coal 2019 “Myrtle Creek CMAP, Erosion and Sediment Control Plan”

Tahmoor Coal 2019 “Redbank Creek: Corrective Management Action Plan” June 2019

8 Appendix

8.1 Appendix A – Myrtle Creek Thawleg

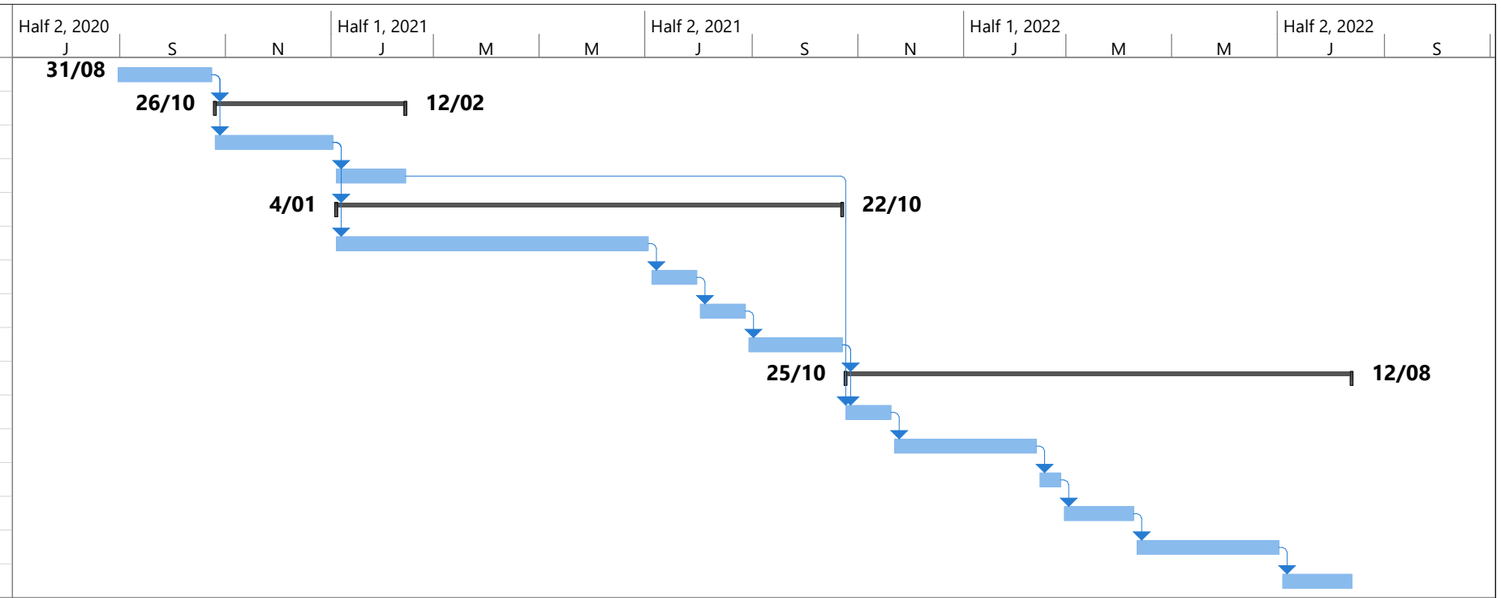


MYRTLE CREEK BED LONG-SECTION SHOWING POOLS

LONG SECTION DETAILS SHOWN HEREON AS PER THALWEG SURVEY FOR TAHMOOR COAL DATED FEBRUARY 2017.
THE POSITIONS OF THE POOLS SHOWN HEREON HAVE BEEN PROVIDED BY TAHMOOR COAL AND HAVE NOT BEEN VERIFIED BY SMEC AUSTRALIA
THE CHAINAGES FOR POOL POSITIONS PROPVIDED HAVE BEEN CALCULATED AT SQUARE TO THE LINE OF THE THALWEG SURVEY & SHOULD BE CONSIDERED AS APPROXIMATE ONLY.
THIS NOTE FORMS AN INTEGRAL PART OF THIS LONG SECTION PLAN.
DATE OF PLAN: 12/04/2019
SMEC FILE REFERENCE: 76280.MYRTLE CREEK BED LONG SECTION~POOLS.dwg

8.2 Appendix B – Stage 2 Schedule

ID	Task Mode	Task Name	Start	Finish
1		Contract / Tender	Mon 31/08/20	Fri 23/10/20
2		**Phase 1**	**Mon 26/10/20**	**Fri 12/02/21**
3		Pool 20, Pool 18 Characterisation	Mon 26/10/20	Fri 1/01/21
4		Pool 12a, Pool 14, Pool 10 Characterisation	Mon 4/01/21	Fri 12/02/21
5		**Phase 2**	**Mon 4/01/21**	**Fri 22/10/21**
6		Pool 20 Stage 1	Mon 4/01/21	Fri 2/07/21
7		Pool 20 Stage 2	Mon 5/07/21	Fri 30/07/21
8		Pool 20 Stage 3	Mon 2/08/21	Fri 27/08/21
9		Reporting	Mon 30/08/21	Fri 22/10/21
10		**Phase 3**	**Mon 25/10/21**	**Fri 12/08/22**
11		Pool 18	Mon 25/10/21	Fri 19/11/21
12		Pool 10	Mon 22/11/21	Fri 11/02/22
13		Pool 11	Mon 14/02/22	Fri 25/02/22
14		Pool 12a	Mon 28/02/22	Fri 8/04/22
15		Pool 14	Mon 11/04/22	Fri 1/07/22
16		Reporting	Mon 4/07/22	Fri 12/08/22



Project: Myrtle Creek CMAP Sta
Date: Thu 16/07/20

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

SIMEC

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Appendix 6
Redbank CMAP

SIMEC

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Tahmoor Coal Pty Ltd

REDBANK CREEK

Corrective Management Action Plan

June 2019

simecgfg.com

Tahmoor Coal Pty Ltd

REDBANK CREEK

Corrective Management Action Plan

June 2019

simecgfg.com

Document Control

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VERSION NUMBER:	**Rev 2**
COMMENTS:	**Final**

Table of Contents

1 Introduction

1.1 Overview

The Tahmoor Coal Mine (**Tahmoor Mine**) has been operated by Tahmoor Coal Pty Ltd (**Tahmoor Coal**) since the mine commenced in 1979 and via longwall mining methods since 1987.

Tahmoor Coal, trading as Tahmoor Coking Coal Operations (**TCCO**) is a subsidiary within the SIMEC Mining Division (**SIMEC**) of the GFG Alliance (**GFG**).

Redbank Creek is a tributary of the Nepean River and its headwaters are located before Longwall 25. It generally consists a Hawkesbury Sandstone bedrock stream with a progressive series of rock bars and pools. Redbank Creek, from Longwall 25 progressively becomes deeper, wider and more incised down to Longwall 32.

Redbank Creek was first undermined by Longwall 25 and is currently being undermined by Longwall 32, as outlined on **Plan 1**.

This Redbank Creek Corrective Management Action Plan (**Redbank Creek CMAP**) has been prepared for the Tahmoor Mine in response to a Section 240(1)(d) Notice (*DI 0680 2018 ACES Ref: 0353-2016 Out17/48999*), dated 4 May 2018, under the *Mining Act 1992* requiring submission of a CMAP for Redbank Creek.

This Redbank Creek CMAP has been prepared to comply with the requirements of the Section 240(1)(d) Notice (*DI 0680 2018 ACES Ref: 0353-2016 Out17/48999*), dated 4 May 2018.

This Redbank Creek CMAP has been prepared to comply with the requirements of the Section 240(1)(d) Notice (*Our Ref:NTCE0002519, ACES Ref:ASMT0003922*), dated 22 May 2019.

1.2 Purpose

This Redbank Creek CMAP outlines and provides details and program for TCCO's management actions for remediation of subsidence impacts on Redbank Creek that have been identified to be caused by Longwalls 27 to 30.

It is noted that subsidence impacts to Redbank Creek have also been experienced from Longwall 31 and it is possible that subsidence impacts may also be experienced from the mining of Longwall 32.

1.3 Scope

The scope pf this Redbank Creek CMAP applies for the remediation works at Redbank Creek in accordance with TCCO's Environmental Management Plan (**EMP**) for Longwalls 27-30.

Plan 1 Redbank Creek and Longwall Extent

2 Background

2.1 Notices under Section 240(1)(b)

2.1.1 December 2016 Section 240(1)(b) Notice

Between March 2013 and June 2016, TCCO submitted 13 Subsidence Event Notifications, where exceedances of the impact assessment criteria or predictions occurred for either Myrtle Creek or Redbank Creek. Under the LW27-30 EMP TARP, TCCO was required to prepare and implement a site mitigation or action plan within 1 month of the date of each notification but failed to do so.

An inspection of Myrtle Creek and Redbank Creek was conducted on 2 June 2016 by Inspectors of the NSW Resources Regulator to review subsidence impacts to these creeks and TCCO's remediation strategy and works. The NSW Resources Regulator Inspectors identified the following subsidence impacts:

- Loss of flow connectivity within the flowing ephemeral stream; and
- Ground cracking or buckling in stream bed or bank.

A Draft Notice under Section 240(1)(b) of the Mining Act 1992 was issued on 17 November 2016 and a Final Notice (*Our Ref: DI 0272 2016)* (**Notice 1**) was issued on 5 December 2016.

A copy of Notice 1 is contained within **Appendix 1**.

The Notice directed Tahmoor Coal to address the adverse impact that activities carried out under, or purportedly carried out under CCL716 (1973), ML1376 (1992), ML1308 (1992) and ML1539 (1992) have had on the environment.

Specifically, Notice 1 required the following to the completed:

1. *Prepare corrective management action (**CMA**) plans where any exceedance of the impact assessment criteria or predictions have occurred in relation to the Trigger Action Response Plans (**TARPs**) identified in the:*
   a) *Tahmoor Colliery Longwalls 27 to 30 Environmental Management Plan. Revision D February 2013 (Longwall 27-30 EMP)*
2. *CMA plans must include:*

a) *Description of the impact/issue to be managed;*

b) *Results of investigations;*

c) *Aims and objectives for the plan;*

   i. *CMA plans, where exceedances of the impact assessment criteria or predictions have occurred for Myrtle Creek and Redbank Creek must include the aims referred to in:*
      - *Section 5.5 Stream Mitigation and Remediation, Longwall 27-30 EMP*

a) *Specific actions required to mitigate/manage the impact/issue:*

   i. *CMA plans, where exceedances of the impact assessment criteria or predictions have occurred for Myrtle Creek and Redbank Creek must include, but not be limited to:*
      - *An environmental study, including pool mapping, hydrology assessment and ground/strata characterisation;*
      - *Rehabilitation objectives and completion criteria;*
      - *Methods of rehabilitation, including options analysis for the different methods;*
      - *Site access;*

- *Materials required;*
- *Equipment to be used;*
- *Environmental controls to be used during rehabilitation works;*
- *Timeframes for implementation;*
- *Roles and responsibilities;*
- *Identification of and gaining appropriate approvals from government agencies; and*
- *A consultation and communications plan.*

TCCO submitted the following to the NSW Resources Regulator on 28 April 2017:

- Corrective Management Action Plan. Final Rev A. Dated 28 April 2017.

The NSW Resources Regulator reviewed the document submitted and found it did not completely meet the requirements of the Notice and required the document to be revised to address these deficiencies.

TCCO submitted the following to the NSW Resources Regulator on 16 June 2017:

- Corrective Management Action Plan. Final Rev B. Dated 16 June 2017.

The NSW Resources Regulator approved the Corrective Management Action Plan. Final Rev B. within correspondence dated 4 May 2018, which stated:

> *I wish to also confirm that the Department approves the implementation of the Corrective Management Action Plan Revision B, Version 1, dated 16 July 2017 Number TAHUG2119832053-10 provided in response to 240(1)(b) Notice DI 0272-2016.*

This correspondence also included a Penalty Notice.

2.1.2 May 2018 Section 240(1)(b) Notice

A further Notice (*DI 0680 2018 ACES Ref: 0353-2016 Out17/48999*) (**Notice 2**) was issued on 4 May 2018.

A copy of Notice 2 is contained within **Appendix 2**.

The Notice directed Tahmoor Coal to take steps to conserve the environment, protect it from harm as a result of activities under CCL716 (1973), ML1376 (1992), ML1308 (1992) and ML1539 (1992) or to prevent, control or mitigate any such harm.

Specifically, Notice 2 required the following to the completed:

1. *Review and update, by no later than 31 August 2018:*

   1.1 The current Tahmoor Colliery Mining Operations Plan to incorporate the:

   A. *Corrective Management Action Plan Final Revision B. Version 1, Dated 16 June 2017 Number TAHUG-2119843053-10 provided in response to 240(1)(b) Notice No. DI 0272-2016.*

2. *Amend and submit for approval of the Department an updated timeline providing dates the various stages for implementation of action as listed in Table 14 of Section 9.2.1 Timeframes for Implementation of Corrective Management Action Plan Final Revision B. Version 1, Dated 16 June 2017 by no later than 31 August 2018.*
3. *Take all reasonable steps to implement the works outlined in amended and approved timeline (as listed at point 2) to remediate Myrtle Creek as per the Corrective Management Action Plan Final Revision B. Version 1, Dated 16 June 2017.*
4. *Plan, draft and submit for review a Corrective Management Action Plan for Redbank Creek by no later than 31 December 2018.*
5. *Review and update, by no later than 31 July 2019:*

5.1 The current Tahmoor Colliery Mining Operations Plan to incorporate a Corrective Management Action Plan for Redbank Creek.

Items 1 and 2 of Notice 2 were completed on 31 August 2018.

The NSW Resource Regulator required further review and amendment to the submitted updated Myrtle Creek CMAP timeline on 5 October 2018 due to its concerns that the submitted timeline had excessive delays before any remediation works were commenced. A revised timeline was submitted on 10 October 2018 and approved by the NSW Resource Regulator on 11 October 2018.

The updated Myrtle Creek CMAP timeline, approved by the NSW Resources Regulator, required under Item 2 of Notice 2 is contained within **Appendix 3**

This Redbank Creek CMAP has been prepared to meet the requirements of Item 4 of Notice 2.

2.1.3 May 2019 Section 240(1)(b) Notice

A further Notice (*Our Ref:NTCE0002519, ACES Ref:ASMT0003922*) (**Notice 3**) was issued on 22 May 2018.

A copy of Notice 3 is contained within **Appendix 4**.

Specifically, Notice 3 required the following to the completed:

1) *Update the "Redbank Creek Corrective Management Action Plan" prepared by SIMEC dated December 2018 ("CMAP") to address the items listed within the Notice.*

3 SMP Approval

3.1 SMP Approvals

TCCO received Subsidence Management Plan (**SMP**) approvals for Longwalls 27 to 30, Longwall 31 and Longwall 32 on the following dates:

- Longwalls 27 to 30 on 31 October 2012;
- Longwall 31 on 3 May 2017; and
- Longwalls 32 on 14 September 2018 for the initial 1,100 metres.

3.2 SMP Environmental Management Plan

Condition 13 of the Longwalls 27 to 30 SMP Approval and Condition 12 of Longwall 31 SMP Approval requires an Environmental Management Plan (**EMP**) to be prepared.

These two EMP Conditions are the same and state the following:

The Leaseholder must submit to the Director Environmental Sustainability & Land Use for approval an Environmental Management Plan (EMP) for the panels which are the subject of this Approval. This plan must address subsidence impacts on:

a) Surface and groundwater (quality and quantity), including Myrtle and Redbank Creeks.

b) Flora and fauna.

c) Heritage sites including Aboriginal heritage sites.

d) Geomorphology, including rock bars and cliff lines.

e) Surface and groundwater (quality and quantity); including groundwater bores on privately owned land within a 3 kilometre radius of the limit of mining.

The Leaseholder must not operate other than in accordance with an EMP approved by the Director Environmental Sustainability & Land Use. This Plan must address subsidence impacts above and must include:

a) A detailed monitoring programme.

b) Trigger levels for subsidence impacts that require actions and responses.

c) The procedures that would be followed in the event that the monitoring indicates an exceedance of trigger levels.

d) Measures to mitigate, remediate and/or compensate any identified impacts.

e) A protocol for the notification of identified exceedances of the trigger levels.

f) A contingency plan.

The Leaseholder shall ensure that underground mining does not cause the performance outcomes in Table 1 from the SMP Approval to be exceeded.

Condition 12 of Longwall 32 SMP Approval is slightly different and states:

The Leaseholder must submit to the Director ESU for approval an Environmental Management Plan (EMP) for the panels which are the subject of this Approval.

This plan must address subsidence impacts on:

a. surface and groundwater (quality and quantity);

b. flora and fauna

c. archaeological sites; and

d. any other significant environmental features that may be effected by subsidence resulting from the proposed longwall extraction

The leaseholder must not operate other than in accordance with an Environmental Management Plan (EMP) approved by the Director Environmental Sustainability. This plan must address subsidence impacts above and must include:

a. a detailed monitoring programme;

b. trigger levels for subsidence impacts that require actions and responses;

c. the procedures that would be followed in the event that the monitoring indicates an exceedance of trigger levels;

d. measures to mitigate, remediate and/or compensate any identified impacts;

e. a protocol for the notification of identified exceedances of the trigger levels; and

f. a contingency plan.

g. annual reporting procedures

This plan must be prepared in consultation with relevant landholders and government agencies.

The Leaseholder must not cause subsidence impacts prior to the Environmental Management Plan being approved.

3.3 Trigger Action Response Plan

Trigger, Action, Response Plans (**TARPs**) are a common management tool used to manage risk in many industries, including the underground coal mining industry in NSW.

TARPs involve a set of clear and quantifiable triggers. When any one monitoring trigger is met, it automatically leads to a pre-defined management action and to any pre-agreed mitigatory or remedial response. Once a subsidence impact or environmental consequence is identified, it triggers a series of actions according to the level or significance of the impact. TARP triggers are

typically sequential, so that, subsidence impacts or environmental consequences may initially be reported as Level 1 and later progress to Level 2 and maybe Level 3 if successive triggers are exceeded.

Each of the Longwall 27 to 30 and Longwall 31 SMP Approval EMPs provides a TARP that describes monitoring and management actions that will be undertaken in respect to potential subsidence effects and impacts.

The TARP system provides a simple, transparent and useable reference of the monitoring of environmental performance and the implementation of management and/or contingency measures. It provides a transparent method to monitor the environmental performance and, where required, implement management and/or contingency measures where the components of the proposed monitoring will serve to alert the mine if an abnormal problem does, or potentially may, exist.

The TARP is designed with consideration of baseline conditions and predicted subsidence impacts and comprises the following:

- Trigger levels from monitoring to assess performance; and
- Triggers that flag implementation of contingency measures.

The TARP is designed to identify, assess and respond to impacts, including impacts greater than predicted, in the proposed mining area.

The TARP outlines what actions will be taken in the case where exceedance of the approved impact assessment criteria occur.

Site specific mitigation, or corrective management action plans (**CMAP**), can be required, and may include:

- Description of the impact to be managed;
- Results of the investigations;
- Aims and objectives for the Plan;
- Specific actions required to mitigate/manage the issue;
- Timeframes for implementation;
- Roles and responsibilities;
- Identification of and gaining appropriate approvals from key government agencies; and
- Providing a consultation and communication plan.

The proposed triggers are based on baseline monitoring and predicted subsidence impacts, with monitoring changes and/or specific triggers continuing to be developed as monitoring matures and is refined.

Where a trigger is exceeded, the cause and effect can be investigated and a CMAP developed if the cause is directly related to mining. Refined triggers can be proposed within End of Panel (**EOP**) reports or TCCO Annual Environmental Management Report (**AEMR**).

3.4 Mitigation or Remediation Plans

The SMP Approval EMPs describes a number of potential mitigation or remediation plans and methods to ensure that ongoing impacts reduce to levels below the impact assessment criteria as soon as reasonably possible.

3.4.1 Stream Remediation Aims

The SMP Approval EMPs outline the aims of stream mitigation and remediation measures to include:

- Conducting remediation works that protect to the greatest practicable extent the ecological values of the area;
- Repairing aesthetic values where necessary;
- Reducing the interaction of surface and groundwater flow where enhanced through mining;
- Ensuring creeks and pools function in a similar manner to the pre-impact state;
- Ensuring surface flows and pool water quality continue to provide suitable aquatic habitat;
- Re-establishing the ecological values to a similar state to before mining;
- Ensuring creeks and catchments yielding similar water quantity and quality following mining; and
- Monitoring and reporting effectiveness of the program.

3.4.2 Stream Remediation Techniques

The SMP Approval EMPs describes a number of potential remedial stream mitigation and remediation techniques with may be appropriately considered and deployed where approved environmental performance outcomes are exceeded.

These include:

- Natural stream remediation;
- Hand mortaring;
- Injection grouting;
- Pattern grouting;
- Deep angled hole grouting;
- Permeation grouting;
- Impermeable blankets and linings;
- Curtain grouting; and
- Stream surface treatment.

3.5 Subsidence Event Notifications

TCCO has submitted Subsidence Event Notifications related to Redbank Creek in relation to TARP trigger subsidence related impacts to Redbank Creeks, as outlined with **Table 1**.

Date	Longwall	Subsidence Impact Observed
11/03/2013	LW27	Cracks observed from LW26
31/06/2014	LW28	Water quality exceed baseline
06/03/2014	LW28	Crack at sites RC31 and RC33. Pool level decrease for site RB3
19/03/2015	LW28	Pool level decrease for sites RC37, RC2 and R6
11/12/2015	LW29	Crack at site RBCC
21/12/2015	LW29	Crack at site RR9
11/01/2016	LW29	Crack at sites RR10 and RR11
22/01/2016	LW29	Separation of sandstone sheets
28/01/2016	LW29	Crack at sites RR10, RR11 and RR12
01/03/2016	LW29	Zinc exceeded baseline at site 37
02/02/2017	LW30	Creek dry from site RW13
03/03/2017	LW30	Crack at site RB28
10/03/2017	LW30	Crack at sites RR7, RR15, Weir 26, RR27 and RB28. Pool level decrease for sites RB14 and RB23
25/05/2018	LW31	Pool level decrease for sites RB14, RB 20, RB21, RB 22 and RB 26
12/06/2018	LW31	Pool level decrease for sites RR13, RB23, RR27 and RB29
25/06/2018	LW31	Pool level decrease for sites RR15, RR16, RR17, RR18, RR19, RB24, RB25 and RB26A

Table 1 Redbank Creek Subsidence Event Notifications

4 Subsidence Processes

4.1 Subsidence Mechanisms

Following the Southern Coalfield Inquiry in 2008, it has become common practice in NSW to differentiate between subsidence effects, subsidence impacts and the resulting environmental consequences.

- Subsidence Effect - the nature of mining-induced deformation of the ground mass. This includes all mining-induced ground movements such as vertical and horizontal displacements and their expression as ground curvatures, strains and tilts.
- Subsidence Impact - any physical change caused by subsidence effects to the fabric of the ground, the ground surface, or a structure. In the natural environment these impacts are principally tensile and shear cracking of the rock mass, localised buckling of the strata and changes in ground profile.
- Environmental Consequence - any change caused by a subsidence impact to the amenity, function or risk profile of a natural or constructed feature. Some consequences may give rise to secondary consequences. Environmental consequences of subsidence could include the redirection of surface water to the subsurface through mining-induced fractures may be a primary consequence for water inflow and result in secondary consequences for

surface ecology. Additionally, could also include loss of stream flow, loss of vegetation and faunal habitat, erosion, scouring, ponding and development of iron staining.

4.1.1 Subsidence Effects

The term subsidence effects to describe subsidence itself, that is, deformation of the ground mass caused by mining, including all mining-induced ground movements such as vertical and horizontal displacements and curvature as measured by tilts and strains.

Maximum subsidence varies and is directly dependent on a number of factors, including:

- Depth of cover;
- Panel width;
- Pillar width;
- Panel width to depth ratio;
- Seam thickness extracted;
- Proximity of adjacent previously mined panels in current seam; and
- Proximity of adjacent previously mined panels in other seams under multi-seam conditions.

The overburden is usually comprised of near-horizontally bedded strata. Sag results in each stratum being 'stretched' and placed into tension. Because rock is very weak when under tension, this is conductive to the opening up of existing geological joints and the formation of fresh near vertical fractures. In the process of sagging, shearing also occurs along the bedding planes between and within the various strata. Fresh near-horizontal fractures may also be formed. These sliding surfaces can develop into open cracks, which may become quite wide if the lower bed of rock sags more than the adjacent upper bed. Hence, a well developed and connected vertical and horizontal fracture network is likely to exist in the rock mass immediately overlying the caved material in a goaf. This network defines the fractured zone.

The caved material bulks and occupies a greater volume when it falls. A point is reached where, with increasing excavation width (W), the roof fall will choke itself off and act as a cushion to the overlying strata. It is known from theoretical calculations and field measurements that this caving height typically ranges from 3 to 10 times the mining height, depending on the nature of the roof strata. Highly-laminated strata tend to fall like a deck of cards and so have a low bulking factor, resulting in the caved zone extending to a considerable height. Falls comprising blocky material, such as sandstone, tend to bulk up and choke off quickly. The caving height defines the limit of the caved zone shown on **Figure 1**.

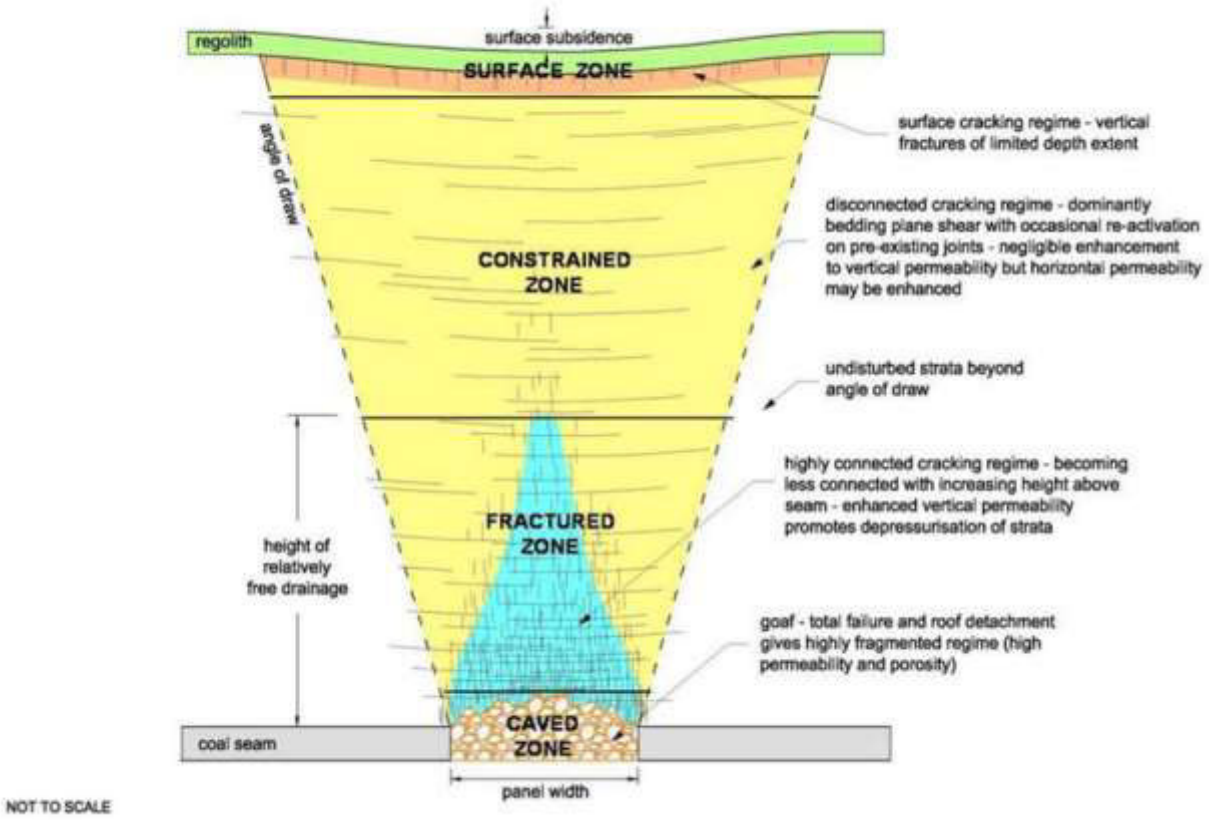


Figure 1 Conceptual Model of Caving and Fracturing

The lateral extent of sag increases with distance above the excavation. This results in a decreasing rate of deflection, or curvature, in the upper strata and a corresponding reduction in shear and tensile stresses. Given sufficient depth, a point is reached where the tensile stresses become too low in the upper strata to cause joints to open or new vertical fractures to develop on a regular or continuous basis. Horizontal fracture planes may still be activated as a result of sagging strata sliding past each other but the magnitude of these displacements also reduces as curvature decreases. The zone in which this behaviour occurs is referred to as the constrained zone. It is characterised by strata which have not suffered significant alteration of their physical properties, and therefore there is negligible change in vertical permeability and only a slight increase in horizontal permeability. The surface zone lies above the constrained zone.

The surface above coal mine workings usually subsides in the form of a subsidence trough, taking on a saucer-shaped appearance. The angle of draw is a subsidence engineering term used to define the limits of the subsidence trough. It is the angle between two lines drawn from the edge of the mine workings, one a vertical line and the other a line to the limit of vertical displacement on the surface. Because surface movements can also be caused by natural effects such as seasonal variations or drought leading to swelling or shrinkage of near-surface soil and sediment, it can be very difficult to identify where vertical movement due to mining ceases. It is standard practice to specify a limiting value for vertical displacement which might be attributable to mining and this value is usually 20 mm of vertical subsidence.

Curvature in an outwards direction results in the ground ‘stretching’ or ‘hogging’ and is referred to as convex curvature. Curvature in an inwards direction causes the ground to sag and move closer together and is referred to as concave curvature.

Features of curvature include:

- Curvature results in points on the surface moving in both a vertical direction and a horizontal direction as they subside into a subsidence trough;

- Curvature changes the slope, or horizontal level, of the surface which, in turn, changes the tilt, or vertical level, of surface features;
- Convex curvature induces tension on the surface;
- Concave curvature induces compression on the surface;
- Bending is induced in long features located on curvature surfaces; and
- Near-surface strata may shear along bedding planes and fresh fracture surfaces as they bend and subside into the subsidence trough.

As mining approaches a site, the site will begin to tilt towards the excavation. Maximum tilt occurs at the point of inflection between concave and convex curvature. The amount of horizontal extension or compression induced over a given distance on the surface is expressed in terms of strain, as shown on **Figure 2**.

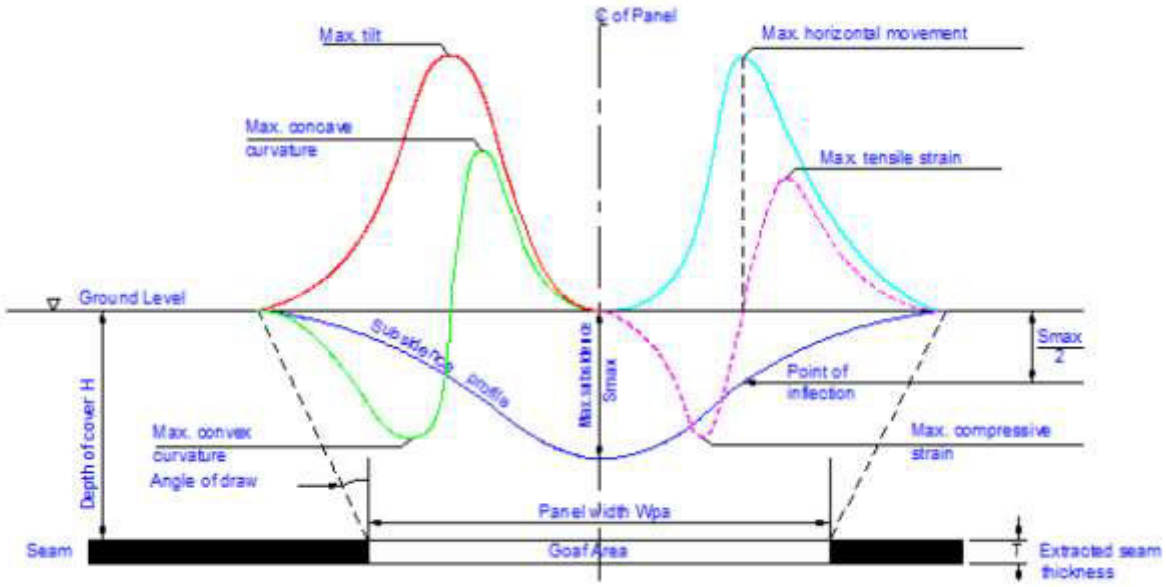


Figure 2 Subsidence Parameters

Strain is also expressed in terms of mm/m, that is, millimetres of stretch or millimetres of shortening per metre of distance. As the edge of an excavation is approached from the solid side, tensile strain begins to increase and builds up to a maximum value which usually occurs over the excavation. From that point, there is a graduation from the point of maximum tensile strain, through a point of zero strain, to a point of maximum compressive strain. Surface strain changes from tensile to compressive at the point of inflection.

The near surface rocks over coal mine workings are usually comprised of laminated strata. In order for the strata to sag and subside, the individual strata have to slide past each other, as shown in **Figure 3**. This shear movement may or may not significantly enhance horizontal permeability. Additionally, when one face of a stratum is subjected to tension, its opposite face is subjected to compression. Because rocks have very low tensile strength (rocks are typically 10 to 30 times weaker in tension than compression), surfaces in tension are susceptible to fracturing and to the opening of pre-mining fractures.

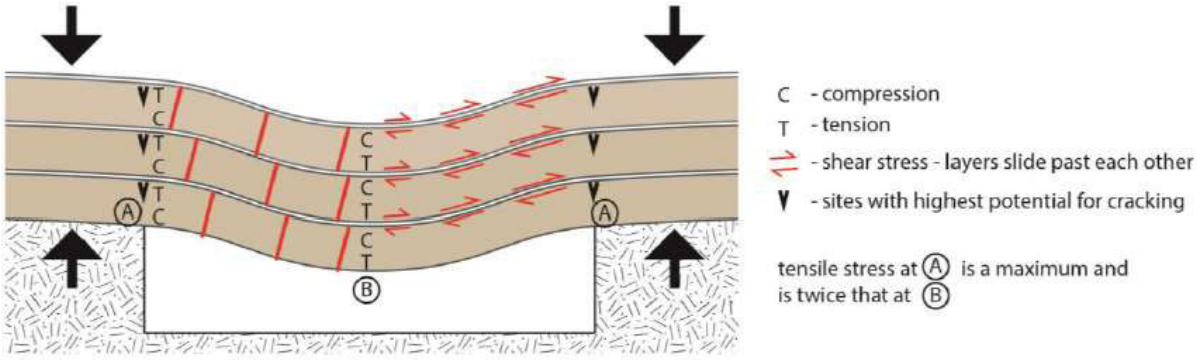


Figure 3 Shear Diagrammatic Representation

4.1.2 Subsidence Impacts

The term subsidence impacts is then used to describe the physical changes to the ground and its surface caused by these subsidence effects.

These impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and upsidence but also include subsidence depressions or troughs. The environmental consequences of these impacts include loss of surface flows to the subsurface, loss of standing pools, adverse water quality impacts, development of iron bacterial mats, cliff falls and rock falls, damage to Aboriginal heritage sites, impacts on aquatic ecology and ponding.

4.2 Valley Closure

4.2.1 Valley Closure Mechanics

As erosion has taken place over geologic time, the vertical (loading) stresses have been relieved but a component of the horizontal stress remains locked in the seams and surrounding strata. Tectonic processes associated with the movement of continental plates may have imprinted additional horizontal stresses, which are often strongly directional. Therefore, it is not uncommon in coalfield strata for the horizontal stress in at least one direction to be up to three times greater than the vertical stress.

Steep, incised topography interrupts the transmission of horizontal stress, causing it to be redirected from the hills and into the floor of the valleys or gorges. This can lead to overstressing of valley floors, with the near-surface rock strata uplifting under the effects of bending and buckling. The valley is deepened which, in turn, causes an increase in the horizontal stress redirected into the floor of the valley. This very slow, self-perpetuating natural process is referred to as valley bulging.

Mining causes further disruptions to this natural regional horizontal stress system because:

- Causes a void which then redirects horizontal stress into the roof and floor of the void. The effective height of the void is increased if fracturing and/or caving of the undermined strata occur. If a constrained zone exists above the mine workings, some of the horizontal stress will be redistributed through this zone. This increases the horizontal stress acting across the valley floor; and
- Removes or reduces the resistance to horizontal movement in the zone comprised of caved and fractured material, thereby permitting the surrounding rock mass to relax and to move towards the excavation.

When mining-induced fractures are created within the overburden strata more generally during the incremental vertical subsidence that is characteristic of longwall mining, the volume occupied by the fractures is additional to the original volume of the rock strata so there is an overall increase in volume called dilation. Mining-induced horizontal compression across the creek

channel is generated by dilation (volume increase) of the overburden strata located to either side of the channel.

The dilation of the strata on either side of a topographic low point, such as creek channels, becomes concentrated at these topographic low points because there is freedom for the valley sides to move toward the valley and the confining pressures provided by the overburden strata to either side are not present at the creek line, as shown on **Figure 4.**

Two responses arising from these mining-related stress behaviours are:

- Valley closure, whereby the two sides of a valley move horizontally towards the valley centreline; and
- Uplift of the valley floor, as a result of valley bulging and buckling and shearing of the valley floor and near surface strata.

The ground movements that occur around excavations in steeply incised terrain in a high horizontal stress environment are complex and it is difficult to identify the individual contribution of the various components to these movements, which include:

- Conventional subsidence movements;
- Elastic ground movements associated with redistribution of horizontal stress on a regional
- basis;
- Movements associated with localised buckling and shear failure; and
- Gravity-induced downhill slippage.

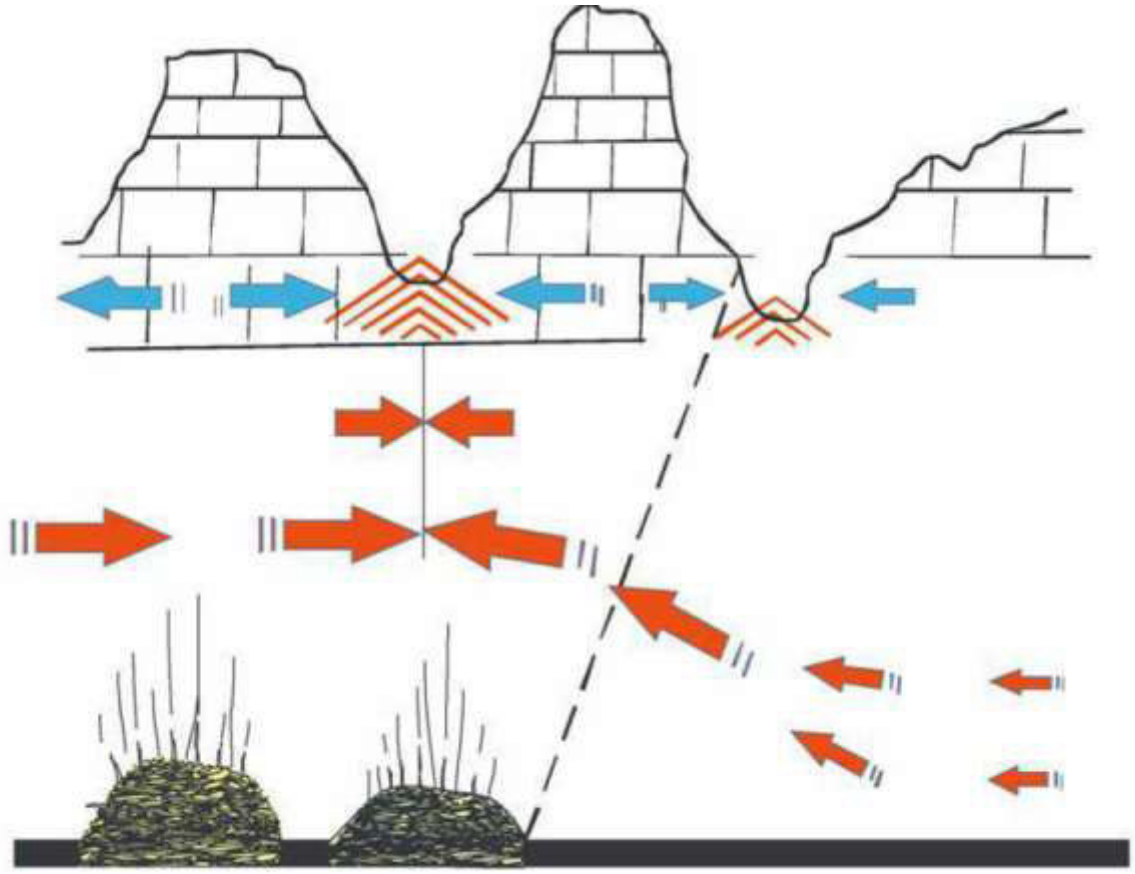


Figure 4 Valley Closure Conceptualisation

4.2.2 Valley Closure Impacts

Buckling and shear in the near-surface strata, which leads to upsidence, can also generate an extensive network of fractures and voids in the valley floor. Ground movements due to

conventional subsidence can also contribute to the formation of this network if the upsidence occurs within the angle of draw of the mine workings. The main fracture network extends to a depth of about 12 metres and bed separation extends to a depth of some 20 metres, as shown on **Figure 5**.

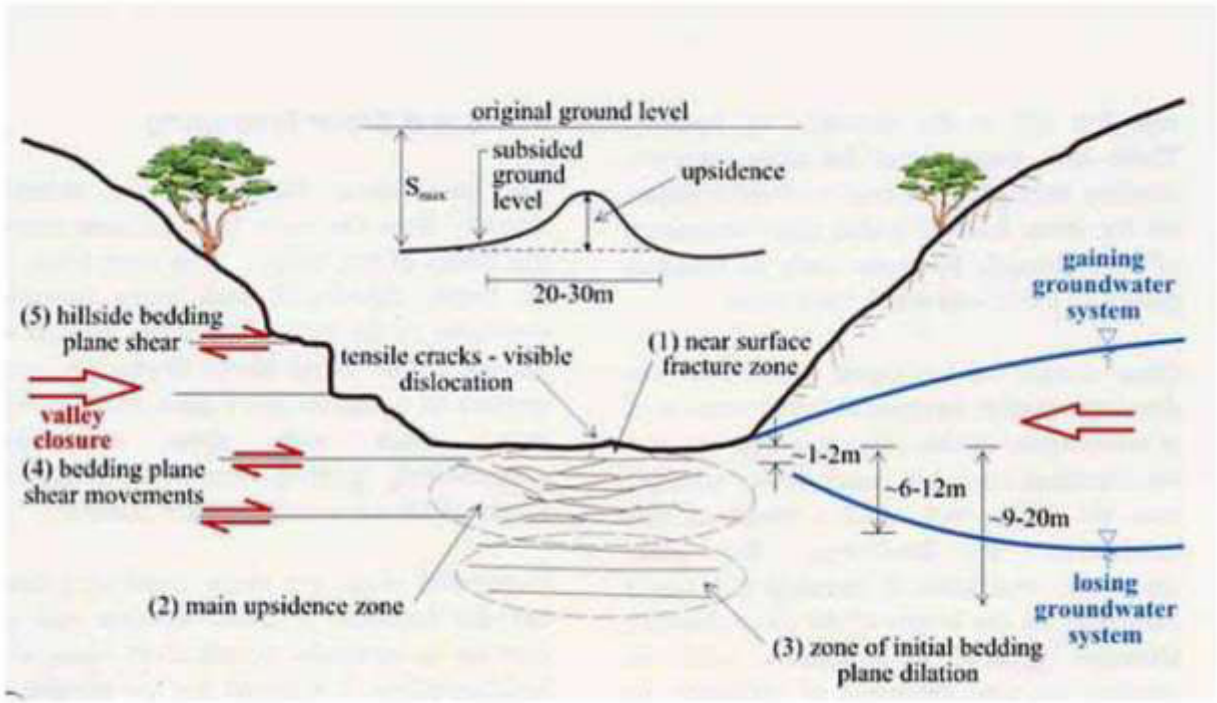


Figure 5 Mechanisms of Valley Closure and Upsidence

4.2.3 Valley Closure Consequences

The process of valley closure occurs naturally as valleys are cut down into the host rock by the erosive action of the creek. The interaction of vertical stress relief and diurnal and annual temperature variations causes rock close to the surface to become overloaded and fractured. Generally, the rates of natural processes are slow enough that sufficient sediment is deposited within the fracture network to maintain a high proportion of the total flow as surface flow.

However, subsidence effects can enhance the impacts of valley closure once compression movements increase sufficiently, fresh fractures are created within the sandstone strata in the bed of the creek and existing fractures that may have become sealed with sediment over time are remobilised. Open fractures within the near surface strata provide an alternative pathway for surface flow. Flow that previously flowed on the surface can now flow through this sub-surface fracture network, at least during periods of low flow.

Mining-induced surface flow diversion into subterranean flows occurs where there is an upwards thrust of bedrock, resulting in fracturing of the rock and redirection of surface water through the dilated strata beneath it. The water reappears downstream of the fractured zone as the water is only redirected below the river bed for the extent of the subsidence induced fracturing, as outlined on **Figure 6**.

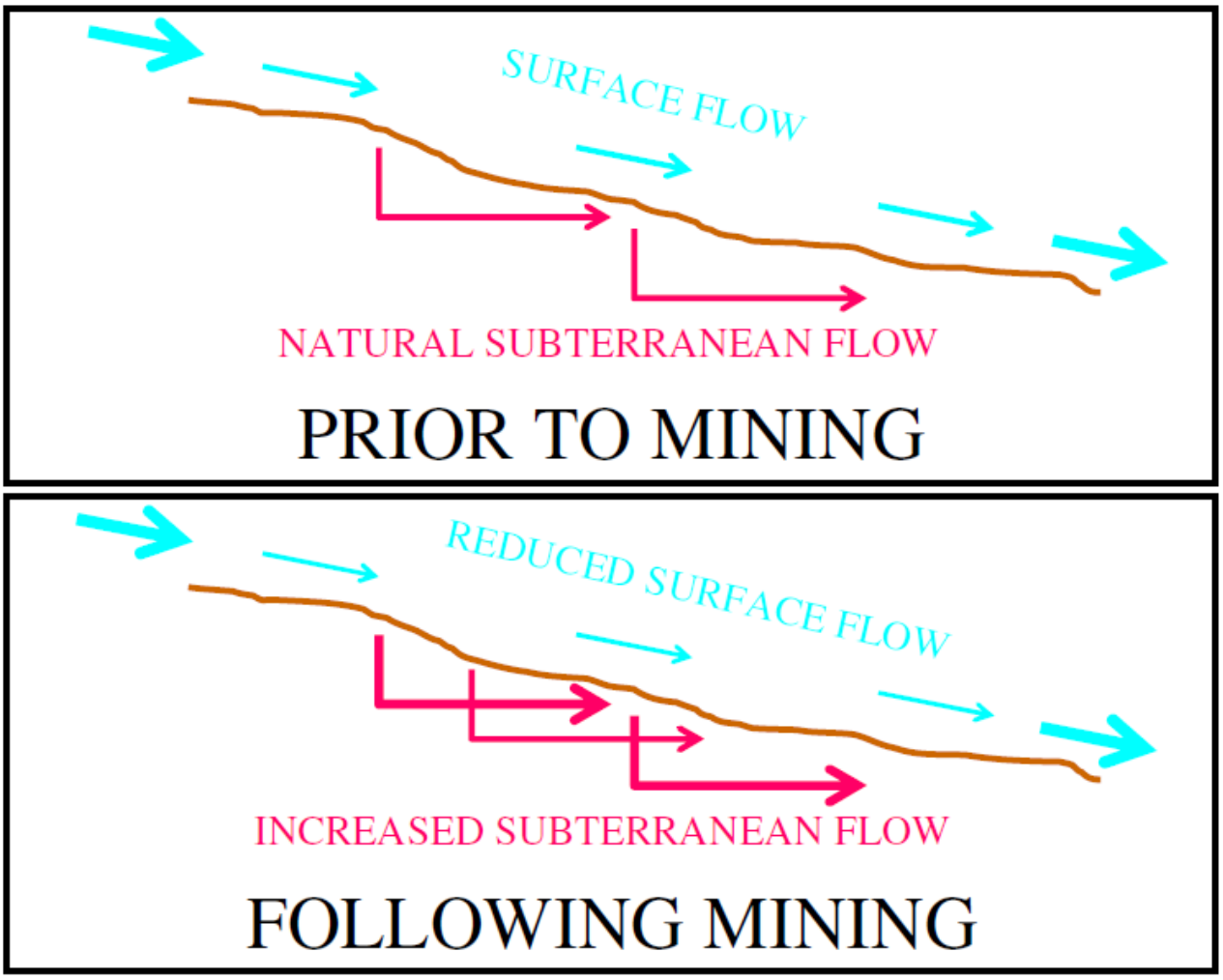


Figure 6 Diagrammatic Representation of Subterranean Flows

During periods of high flow such as immediately after heavy rain, frictional resistance requires an increase in head to drive the additional flow through the sub-surface fracture network. With sufficient flow, as occurs after heavy rain, this head increases to reach the surface and gives the appearance that flow has returned to the surface.

As the flow reduces again, the fracture network becomes able to accommodate all the flow without the need for the hydraulic gradient to rise above the surface. Although water is still flowing in the creek system, the surface pools appear to have dried out.

The fracture network is generally a zone of intense fracturing below the creek bed. This zone is typically evident to a depth of less than 6 metres, but has been observed to range up to about 12 to 20 metres below the surface. The intense fracturing is evident as open fractures of up to several hundred millimetres wide. These develop as low angle conjugate fractures to form wedges that lift the surface causing localised upward movement or upsidence directly above the zone of intense fracturing.

A basal shear plane extends outward from the base of the zone of intense fracturing on either side of the river channel. Shear on this basal plane enables horizontal movement of the valley sides inward toward the creek to generate the zone of intense fracturing. Measurements at various sites indicate that basal shear planes are likely to follow bedding and may extend hundreds of metres either side of the valley. They may be formed as part of natural valley forming processes and are then remobilised by the dilation associated with mining subsidence.

Depending on the magnitude of valley closure, both the zone of intense fracturing and the basal shear plane have potential to be hydraulically conductive. At low flows, all the flow in the creek can flow through these fracture networks without appearing on the surface.

Mining-induced surface flow diversion due to rockbar leakage occurs in a similar manner to the above mechanism, except that the rockbar is elevated above the rest of the river bed and the general water table. The rate of leakage is dependent, among other things, on the extent of horizontal fracturing within the depth of the rock bar and the water level. The rockbar leaks at a higher rate when the pool is full as there is access to all drainage paths and the water pressure is at its highest. However, as the pool level falls, the drainage rate reduces as the water pressure falls and access is restricted to drainage paths near the base of the rockbar, as outlined on **Figure 7**.

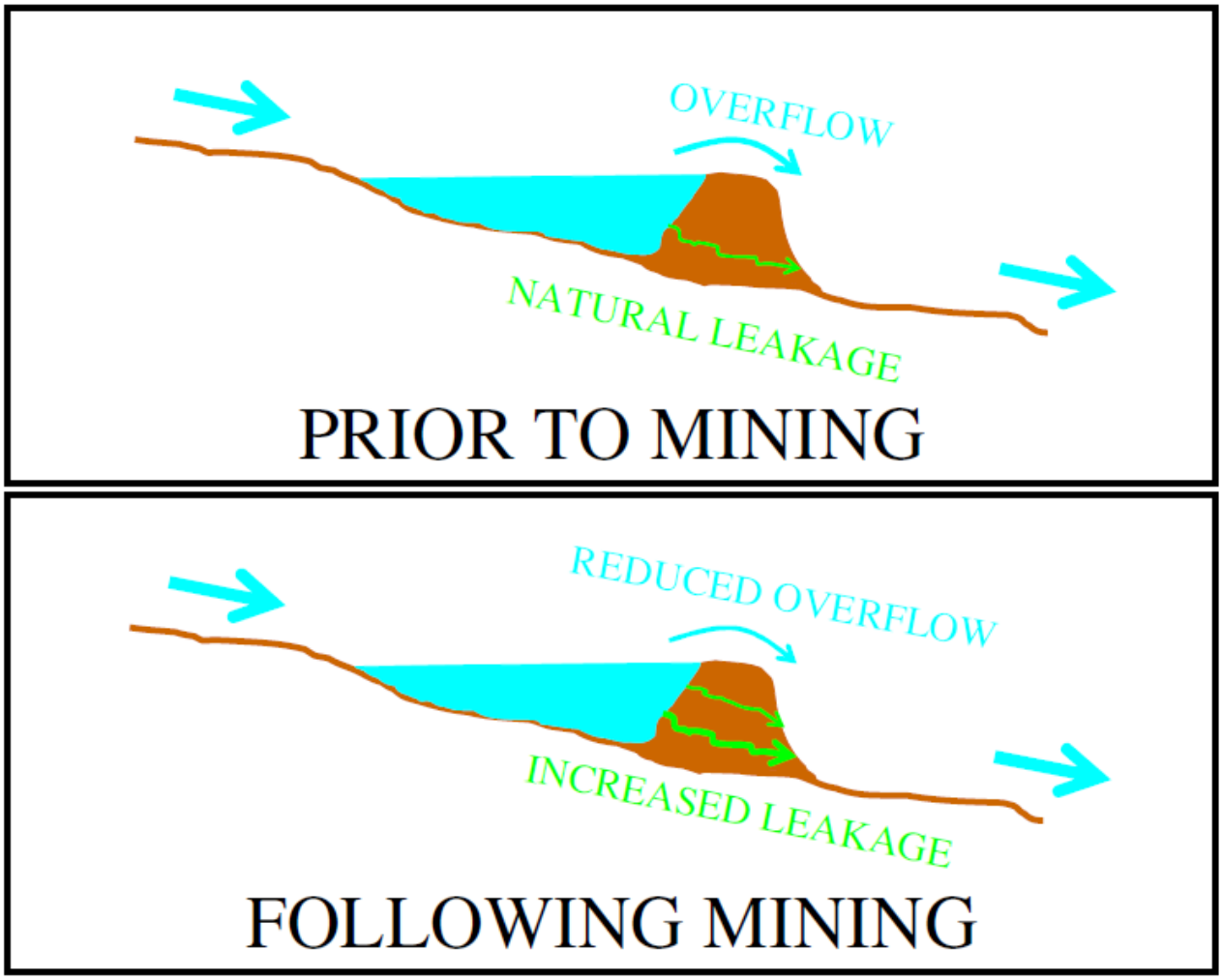


Figure 7 Diagrammatic Representation of Rockbar Leakage

5 Subsidence Management

5.1 Subsidence Risk Management

5.1.1 Surface and Subsurface Features

Surface and subsurface features refer to 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.

TCCO and its consultants undertake extensive mapping of all natural, built structure and infrastructure items to provide information on these features to inform subsidence risk assessment.

5.1.2 Extent of Subsidence

The area requiring risk management is defined by the areal distribution of relevant and appropriate components of subsidence.

TCCO use the extent of the 20 mm subsidence line, which is the predicted 20 mm subsidence contour, to define the extent of subsidence assessment for each longwall. All subsidence risk assessment is conducted using the predicted 20 mm subsidence line as the basis for extent of subsidence.

When defining the area where risk management is required, consideration should be given to any factors that may cause the development of far-field subsidence, such as:

- Overlying or underlying mine workings, in particular, old pillar workings;
- Topographic characteristics of the land;
- Nature and magnitude of horizontal stress field;
- Geological structures; and
- Complexities or anomalies in overburden geological or geotechnical conditions.

The intensity of risk management across the subsidence area may vary depending on the nature, likelihood, potential consequences and complexity of subsidence hazards at any particular location within the area where risk management is required.

5.1.3 Time Period of Subsidence

The time period for subsidence is typically the period nominated as the Active Subsidence Zone, which covers the following:

- 150 metres ahead of the longwall face;
- Longwall face being extracted; and
- 450 metres behind the longwall face.

5.2 End of Panels Reviews

5.2.1 Longwall 25

Longwall 25 was approximately 3,592 metres long and 283 metres wide, rib to rib. The pillar width was approximately 34.5 metres, rib to rib. The depth of cover over the panel varied from 420 metres to 460 metres. The seam thickness over the panel varied from 1.7 metres to 2.2 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 25 are shown in **Table 2**.

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW25 only	1,234	11.9	3.4	-4.8
Total after LW25	1,364	12.7	3.4	-4.8

Table 2 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 25 (beyond creeks).

There has been no adverse effect on stream bed stability, steam bank stability or water quality in Redbank Creek during the monitoring period. Subsidence within the creek has generated limited short term flow diversion through exposed sandstone at one location above Longwall 25. One isolated, 6 metre long section of exposed sandstone in Redbank Creek was observed to have a short term reach of through flow, however, no cracks were observed in the sandstone and no change in water quality or generation of ferruginous seepage has been observed.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Limited short term surface flow diversion observed in bedrock in Redbank Creek at one location. No increased ponding or impacts to water quality observed.

There has been no adverse effect on stream bed stability, steam bank stability or water quality in Redbank Creek during the monitoring period. Subsidence within the creek has generated limited short term flow diversion through exposed sandstone at one location above Longwall 25. One isolated, 6 metre long section of exposed sandstone in Redbank Creek was observed to have a short term reach of through flow, however, no cracks were observed in the sandstone and no change in water quality or generation of ferruginous seepage has been observed.

5.2.2 Longwall 26

Longwall 26 was approximately 3,484 metres long and 283 metres wide, rib to rib. The pillar width was approximately 34.5 metres, rib to rib. The depth of cover over the panel varied from 415 metres to 470 metres. The seam thickness over the panel varied from 1.8 metres to 2.25 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 26 are shown in **Table 3**.

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW26 only	893	8.0	2.8	-4.4
Total after LW26	1,382	11.7	2.8	-6.6

Table 3 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 26 (beyond creeks)

Valley closure movements were also observed across Redbank Creek.

Valley closure developed across Redbank Creek, particularly where the longwall face passed directly beneath the creek. Maximum predicted valley closure due to extraction of Longwall 26 was 120 mm. Observed valley closure was slightly greater than predicted closure at this stage of mining at 160 mm.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Cracks found in stream bed at one location and in rockbars at two locations in Redbank Creek. Pool desiccation observed in Redbank Creek at 6 locations above LW25. No effect on water quality has been found.

No adverse effect observed on stream bed stability, steam bank stability or water quality in Redbank Creek. Subsidence effects have been observed in Redbank Creek at following locations:

- RC1 - limited extent of pool desiccation in a clay incised section of the creek that contains some cobbles over Longwall 25;
- Photo Sites 5 – 10 – Pool desiccation in a clay incised section of the creek that contains cobbles and limited exposed sandstone rockbars over Longwall 25;
- Photo Site 12 (above Longwall 26) – Sandstone stream bed cracking, with no obvious effect on pool holding capacity during the weekly monitoring period;
- Photo Site 23 (above Longwall 27) – Sandstone rock bar cracking, with reduced overland flow over rock bar, although no observed effect on downstream pool holding capacity; and
- Photo Site 26 (above Longwall 27) – sandstone rock bar cracking, with reduced overland flow over rockbar, although no observed effect on downstream pool holding capacity.

The observed impacts have been compared against the TARP triggers and are outlined on **Table 4**.

Trigger	Redbank Creek
Observable increase from baseline in iron or salinity staining (e.g. orange or white staining in water or on banks / seeps) in excess of pre-mining conditions determined from comparison of pre-mining and post-mining monitoring and photographs	Trigger not exceeded during mining of LW26
Observation of loss of flow connectivity within a flowing ephemeral stream	Localised loss of flow at Sites 5-10, 23 and 26. No overall loss of stream flow.
Observation of areas of flooded stream in excess of baseline conditions – identified by extended flooding within a terrestrial habitat and from comparison of pre-mining and post-mining photographs	Trigger not exceeded during mining of LW26
Observation of erosion of stream and dam banks in excess of baseline conditions identified from comparison of pre-mining and post-mining photographs	Trigger not exceeded during mining of LW26

Table 4 Comparison against Triggers for Redbank Creek during Longwall 26

There was a reasonable correlation between predicted and observed incremental valley closure movements for Redbank Creek due to the mining of Longwall 26. While observed valley closure slightly exceeded predictions in some locations, observed total closure have not been exceeded.

Overall, there has been no adverse effect on overall stream flow, water quality and bed or bank stability in Redbank Creek or the small unnamed gullies over the subsided longwalls during the monitoring period.

Cracks were observed in the bedrock of Redbank Creek at isolated locations. Pool desiccation was observed in Redbank Creek at 6 locations above Longwall 25. No observable adverse effects on stream water quality due to subsidence following extraction of Longwalls 22 to 26 have been observed in Redbank Creek.

5.2.3 Longwall 27

Longwall 27 was approximately 3,040 metres long and 283 metres wide, rib to rib. The pillar width was approximately 39 metres, rib to rib. The depth of cover over the panel varied from 420 metres to 490 metres. The seam thickness over the panel varied from 1.9 metres to 2.2 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 27 are shown in Table 5.

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW27 only	856	5.7	2.1	-4.9
Total after LW27	1,367	8.0	4.1	-6.3

Table 5 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 27 (beyond creeks)

Valley closure movements were also observed across Redbank Creek.

Valley closure was greater for a temporary period of time, when the transient effects of the subsidence travelling wave passing through the valley. As the longwall face moved away from Redbank Creek by more than 400 metres, the additional compressive strains from the travelling wave reduced.

Maximum predicted valley closure due to extraction of Longwall 27 was 155 mm. The observed maximum incremental valley closure at the completion of Longwall 27 was 151 mm.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Stream bed cracking and loss of pool holding capacity has been observed in numerous pools and stream reaches over LW's 25 to 27. Increased salinity has been observed downstream of Redbank Creek subsidence zones, along with elevated nickel, zinc, iron and manganese in Redbank Creek due to subsidence.

During the mining of Longwall 27, new or additional subsidence effects were observed at Sites 13 to 15 above Longwall 26, Sites 17 to 21A above Longwall 26 and the chain pillar between Longwalls 26 and 27, at Site 24 directly above Longwall 27, and at Sites 29 to 33 above future Longwall 28.

Cracking was observed at the above sites and pools were observed to drain at times of low flow, though trigger levels were not exceeded during the mining of Longwall 27. The sub-surface flow diversion was observed to re-emerge downstream of Longwall 27.

Increased salinity has been observed downstream of the subsidence zone. Elevated levels of iron, manganese, zinc and nickel were observed during the mining of Longwall 27. No observable trend or change in levels of aluminium or copper was observed during the mining of Longwall 27.

No new springs have been generated, or reduced, due to subsidence due to the mining of Longwalls 22 to 26.

The observed impacts have been compared against the TARP triggers and are outlined on **Table 6.**

Trigger	Redbank Creek
Redirection of surface water flows and pool level / flow decline of >20% during mining compared to baseline for > 2 months, considering rainfall / runoff variability	Trigger not exceeded during mining of LW27
Significant reduction compared to baseline, predicted impacts last over 2 months and exceed 2 standard deviations compared to baseline	Trigger exceeded at Site 37 over LW29 for zinc on an after 12 February 2014, in association with an extended period of drying out of pools between Sites 20 and 29.

Table 6 Comparison against Triggers for Redbank Creek during Longwall 27

There was a reasonable correlation between predicted and observed incremental valley closure movements for Redbank Creek due to the mining of Longwall 27.

Cracking was observed in both creeks and pools were observed to drain at times of low flow, with subsurface flow diversion observed to re-emerge downstream of Longwall 27. Some adverse changes in water quality were observed at times of low flow. The observed impacts are within predictions.

5.2.4 Longwall 28

Longwall 28 was approximately 2,630 metres long and 283 metres wide, rib to rib. The pillar width was approximately 39 metres, rib to rib. The depth of cover over the panel varied from 420 metres to 490 metres. The seam thickness over the panel varied from 1.9 metres to 2.1 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 28 are shown in **Table7**.

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW28 only	774	5.6	2.5	-4.3
Total after LW28	1,082	6.3	4.7	-5.2

Table 7 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 28 (beyond creeks)

Valley closure movements were also observed across Redbank Creek.

There has been a reasonable correlation between predicted and observed closure at the completion of Longwall 28. Observed total closure from the mining of Longwalls 26, 27 and 28 is less than predicted. Above the chain pillar between Longwalls 27 and 28, the incremental of valley closure during the mining of Longwall 28 is similar in magnitude to observed valley closure above Longwall 27.

Maximum predicted valley closure due to extraction of Longwall 28 was 167 mm. Observed maximum incremental valley closure at the completion of Longwall 28 was 177 mm.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Stream bed cracking and loss of pool holding capacity has been observed in numerous pools and stream reaches in Redbank Creek over LW's 25 to 28. Increased ferruginous and salinity levels have been observed downstream of Redbank Creek subsidence zones, along with elevated nickel, zinc, iron and manganese in Redbank Creek due to subsidence.

During the mining of Longwall 28, new or additional subsidence effects were observed at Site 24 directly above Longwall 27, and at Sites 29 to 33 above Longwall 28. Re-emergence of the stream "through-flow" has been observed downstream of Longwall 28.

Increased salinity has been observed downstream of the subsidence zone. Elevated levels of iron, manganese, zinc and nickel were observed during the mining of Longwall 28. No observable trend or change in levels of aluminium or copper was observed during the mining of Longwall 28.

A number of seeps were identified in Redbank Creek prior to mining. No new springs have been generated, or reduced, due to subsidence due to the mining of Longwalls 22 to 28.

The observed impacts have been compared against the TARP triggers and are outlined on **Table 8**.

Trigger	Redbank Creek
Redirection of surface water flows and pool level / flow decline of >20% during mining compared to baseline for > 2 months, considering rainfall / runoff variability	Trigger exceeded during mining of LW28 at Sites 21/21A and Site 24 above LW27.
Significant reduction compared to baseline, predicted impacts last over 2 months and exceed 2 standard deviations compared to baseline	Trigger exceeded at Site 37 over LW29 on 5 March 2015.

Table 8 Comparison against Triggers for Redbank Creek during Longwall 28

There was a reasonable correlation between predicted and observed incremental valley closure movements for Redbank Creek due to the mining of Longwall 28.

Cracking was observed in both creeks and pools were observed to drain at times of low flow, with subsurface flow diversion observed to re-emerge downstream of Longwall 28. Some adverse changes in water quality were observed at times of low flow. The observed impacts are within predictions.

5.2.5 Longwall 29

Longwall 29 was approximately 2,320 metres long and 283 metres wide, rib to rib. The pillar width was approximately 39 metres, rib to rib. The depth of cover over the panel varied from 430 metres to 500 metres. The seam thickness over the panel was approximately 2.1 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 29 are shown in **Table 9.**

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW29 only	737	5.9	2.8	-3.9
Total after LW29	1,124	6.3	2.1	-7.7

Table 9 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 29 (beyond creeks)

Valley closure movements were also observed across Redbank Creek.

Maximum predicted valley closure due to extraction of Longwall 29 was 200 mm. The observed maximum incremental valley closure at the completion of Longwall 29 was 179 mm. Valley closure was slightly greater for a temporary period of time, when the transient effects of the subsidence travelling wave passed through the valley. Maximum observed closure above Longwall 29 was greater than above Longwalls 27 and 28. This was predicted as the valley is deeper and more incised above Longwall 29.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Stream bed cracking and loss of pool holding capacity has been observed in numerous pools and stream reaches in Redbank Creek over LW's 25 to 30. Increased ferruginous and salinity levels have been observed in Redbank Creek over LW's 29 and 30. Increased salinity has been observed downstream of Redbank Creek subsidence zone, along with elevated nickel, zinc, iron and manganese.

During the mining of Longwall 29, new or additional subsidence effects were observed at Sites RB6 to RR11 tailgate section of future Longwall 30 (upstream half of Longwall 30). Re-emergence of the stream "through-flow" has been observed downstream of Longwall 29, at site RR11 that is approximately above the mid reach section of future Longwall 30.

Increased salinity has been observed downstream of the subsidence zone. Elevated levels of iron, manganese, zinc and nickel were observed during the mining of Longwall 29. No observable trend or change in levels of aluminium or copper was observed during the mining of Longwall 29.

A number of seeps were identified in Redbank Creek prior to mining. No new springs have been generated, or reduced, due to subsidence due to the mining of Longwalls 22 to 29, though increased ferruginous and salinity levels have been observed over Longwalls 29 and 30.

The observed impacts have been compared against the TARP triggers and are outlined on **Table 10**.

Trigger	Redbank Creek
Redirection of surface water flows and pool level / flow decline of >20% during mining compared to baseline for > 2 months, considering rainfall / runoff variability	Trigger exceeded during mining of LW29 at Sites 26A and RC2/37 above LWs 28 and 29, Sites RR2 and RB5 above LW29, and Site RR9 above LW30.
Significant reduction compared to baseline, predicted impacts last over 2 months and exceed 2 standard deviations compared to baseline	Trigger exceeded at Site RC2/37 over LW29.

Table 10 Comparison against Triggers for Redbank Creek during Longwall 29

In relation to and Redbank Creek, there was a reasonable correlation between predicted and observed incremental valley closure movements due to the mining of Longwall 29.

Cracking was observed in both creeks and pools were observed to drain at times of low flow, with subsurface flow diversion observed to re-emerge downstream of Longwall 29. Some adverse changes in water quality were observed at times of low flow. The observed impacts are within predictions.

5.2.6 Longwall 30

Longwall 30 was approximately 2,320 metres long and 283 metres wide, rib to rib. The pillar width was approximately 39 metres, rib to rib. The depth of cover over the panel varied from 430 metres to 500 metres. The seam thickness over the panel was approximately 2.1 metres.

Maximum observed incremental and total subsidence parameters during or after the mining of Longwall 30 are shown in **Table 11**.

Monitoring Line	Maximum Observed Subsidence (mm)	Maximum Observed Tilt (mm/m)	Maximum Observed Tensile Strain (mm/m)	Maximum Observed Comp. Strain (mm/m)
Incremental due to LW30 only	765	6.1	1.6	-1.8
Total after LW30	1,041	6.3	1.6	-4.5

Table 11 Summary of Maximum Incremental and Total Subsidence Parameters due to the mining of Longwall 30 (beyond creeks)

Valley closure movements were also observed across Redbank Creek and its tributaries.

Maximum observed valley closure above Longwall 30 was similar to maximum observed valley closure above Longwalls 27 and 28 and less than maximum observed valley closure above Longwall 29. This was predicted as the valley is deeper and more incised above Longwall 29.

Maximum predicted valley closure due to extraction of Longwall 30 was 186 mm. The observed maximum incremental valley closure at the completion of Longwall 30 was 173 mm.

Redbank Creek predicted and observed subsidence impacts were:

- **Predicted Impacts**: Potential cracking in creek bed. Potential surface flow diversion. Potential reduction in water quality during times of low flow. Potential increase in ponding.
- **Observed Impacts**: Stream bed cracking and loss of pool holding capacity has been observed in numerous pools and stream reaches in Redbank Creek over LW's 25 to 30 and future LW 31. Changes observed in salinity levels downstream of Redbank Creek subsidence zone, along with elevated nickel, zinc, iron and manganese. These observations have been reported in ferruginous pools since LW29.

During the mining of Longwall 30, new or additional subsidence effects were observed at Sites RB6, over the maingate section of Longwall 29, to RR28, over the maingate section of future Longwall 31. Upstream of the centre of Longwall 30 is dry, and re-emergence of the connected stream "through-flow" has been observed above the mid reach section of Longwall 30, at site RW13.

Changes observed in salinity levels downstream of the subsidence zone. Elevated levels of iron, manganese, zinc and nickel were observed during the mining of Longwalls 29 and 30 and are observed in ferruginous pools. No observable trend or change in levels of aluminium or copper was observed during the mining of Longwall 30.

A number of seeps were identified in Redbank Creek prior to mining. No new springs have been generated, or reduced, due to subsidence due to the mining of Longwalls 22 to 30, though increased ferruginous and salinity levels have been observed in the stream over Longwalls 29 and 30 and future Longwall 31.

A large storm occurred on 5 and 6 June 2016 after the completion of Longwall 29 and prior to the commencement of Longwall 30, resulting in significant water flows in Redbank Creek. Many of the previously cracked, lifted or delaminated rock slabs in the stream bed were washed downstream.

The observed impacts have been compared against the TARP triggers and are outlined on **Table 12.**

Trigger	Redbank Creek
Redirection of surface water flows and pool level / flow decline of >20% during mining compared to baseline for > 2 months, considering rainfall / runoff variability	Trigger exceeded during mining of LW30 at Site RR10 above LW30, and at Sites RR7 to RR11 above the chain pillar between LW29 and LW30.
Significant reduction compared to baseline, predicted impacts last over 2 months and exceed 2 standard deviations compared to baseline	No new triggers exceeded.

Table 12 Comparison against Triggers for Redbank Creek during Longwall 30

There was a reasonable correlation between predicted and observed incremental valley closure movements for Redbank Creek due to the mining of Longwall 30. Cracking was observed in Redbank Creek and pools were observed to drain at times of low flow, with subsurface flow diversion observed to re-emerge downstream of Longwall 30. Some adverse changes in water quality were observed at times of low flow. The observed impacts are within predictions.

6 Enviromental Study

6.1 Longwall Dates

The dates for each longwall mining period for Longwalls 25 to 32 are outlined within **Table 13**.

Longwall	Longwall Start	Longwall Finish	Depth of Cover (mbgl)
25	22/08/2008	27/02/2011	440-460
26	30/03/2011	11/10/2012	440-470
27	10/11/2012	22/03/2014	420-495
28	20/04/2014	01/05/2015	420-500
29	29/05/2015	03/04/2016	425-490
30	20/06/2016	28/05/2017	425-490
31	29/06/2017	17/08/2018	425-490
32	30/10/2018	Ongoing	425-490

Table 13 Longwall Dates

6.2 Geomorphology

6.2.1 Regional Catchment

The Nepean River rises in the Great Dividing Range to the west of Picton. Its headwaters also lie in the coastal ranges to the east of Picton. Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, operated by WaterNSW that incorporates four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers. Releases from the Cordeaux, Avon and Nepean Dams are made to enable withdrawal for water supply purposes from the Pheasant's Nest Weir located further downstream on the Nepean River. The Nepean Dam is situated some 18 km upstream of the Bargo River confluence, while the Pheasant's Nest Weir is located approximately 7 km upstream of the confluence. Flows in the Nepean River near and downstream of the Project Area (downstream of the Peasant's Nest Weir) are not part of a WaterNSW Drinking Water Catchment Area.

Further downstream, the Nepean River has been extensively modified by the construction of a series of in-stream weirs which have created a series of pondages, such as the Maldon Weir. Ponding behind the Maldon Weir does not affect water levels far upstream.

The Nepean River flows into the Warragamba River near Wallacia downstream of which it is referred to as the Hawkesbury-Nepean River. The Hawkesbury- Nepean catchment is one of the largest coastal catchments in NSW with an area of some 21,400 km^2 at its mouth in Broken Bay on the northern side of the Sydney Metropolitan area.

Stonequarry Creek, Cedar Creek, Matthews Creek and Redbank Creek, which all traverse the local area, are tributaries of the Nepean River.

6.2.2 Redbank Creek Catchment

Redbank Creek is a Category 2 stream with a 3rd order or higher channel, whilst its tributaries are Category 1 streams, being 1st or 2nd order channels.

The topography in the vicinity of Redbank Creek is varied, ranging from gently undulating plateaux, ridges and low hills in the upland areas, to a rugged landscape of deeply dissected valleys and gorges in Hawkesbury Sandstone.

Redbank Creek flows roughly west to east through the township of Thirlmere before joining Stonequarry Creek just south of Picton, approximately 2.5 km upstream of the junction with the Nepean River. The Redbank Creek total catchment covers an area of approximately 8 km^2 and incorporates areas of both Thirlmere and Picton townships. The remainder of the catchment is undeveloped or agricultural land or mixed industrial/residential urban area.

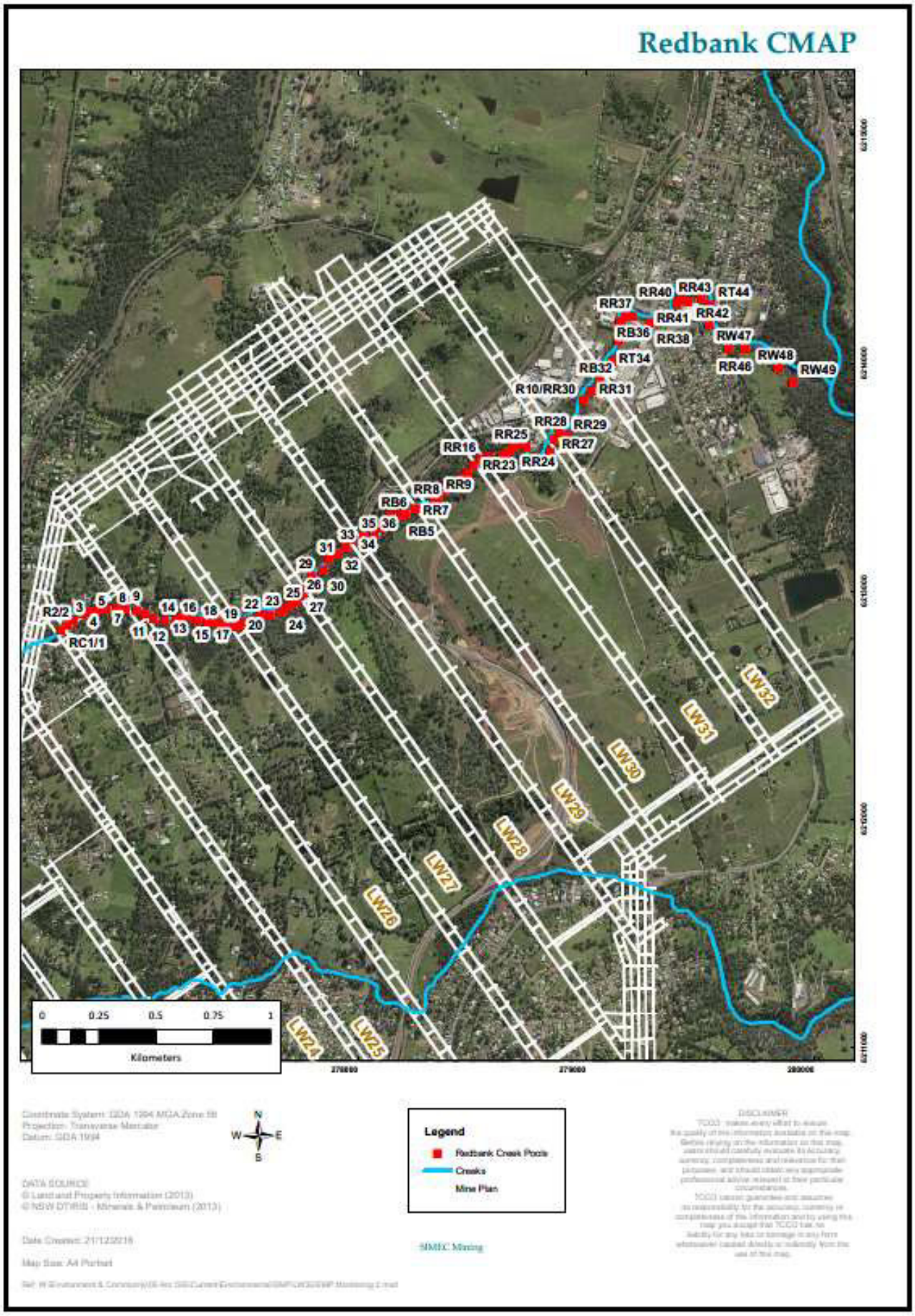
Redbank Creeks contain a sequence of clay /sand based alluvial pools, exposed sandstone rock bars and creek beds, boulder fields and gravel / cobble riffles, with varying degrees and types of riparian and stream bed vegetative cover. Mapped pools along Redbank Creek are shown on **Plan 2**.

Flooding in Redbank Creek is typically contained in the creek channel with the exception of overbank flow located in the north-eastern extent of the hydraulic model downstream of the Antill Street culvert and in the vicinity of the Argyle Street Bridge. Depths in these areas range between 0.2 m and 1.0 m. Depths in the creek channel are significant in places with flood depths in excess of 4.0 m located downstream of the Argyle Street bridge.

Stream velocities in Redbank Creek are high (point velocities greater than 2.5 m/s) during the 1% the AEP design event. The velocities in the overbank flow path downstream of Antill Street and in the vicinity of the Argyle Street Bridge are slightly lower (less than 2.0 m/s).

6.3 Rainfall

Regional rainfall monitoring stations in the vicinity of the Redbank Creek have varying periods of record, as outlined on **Table 14**. The Buxton and Picton stations are the closest BoM stations with long term records without significant gaps in the data record.



Plan 2 Redbank Creek Pools

BoM Station Number	Station Name	Year of Establishment & Closure	Percent Complete Record	Latitude (degrees south)	Longitude (degrees east)	Elevation (m AHD*)	Distance from Pit Top (km)
068166	Buxton	1967 - Open	92%	34.24	150.52	420	5.5
068052	Picton	1880 - Open	91%	34.17	150.61	165	9.3
068016	Cataract Dam	1904 - 2013	93%	34.26	150.81	340	21.3
068159	Wedderburn	1964 - Open	62%	34.17	150.81	250	23.1
068122	Cawdor	1962 - Open	88%	34.1	150.64	132	17.6
068216	Menangle Bridge	1963 - Open	94%	34.12	150.74	-	20.7
068200	Douglas Park	1974 - Open	98%	34.21	150.71	165	12.9

* Australian Height Datum. The existing Tahmoor pit top is at approximately 290m AHD.

Table 14 Summary of Regional Rainfall Monitoring Stations

Monthly long-term average rainfalls for the BoM stations and the record obtained for the Project site from the SILO Data Drill are summarised in **Table 15**. A comparison of monthly average rainfall totals from the Data Drill and local BoM rainfall data sites indicates that the Data Drill data are similar to nearby BoM station records.

Data Source	Data Drill for Project Site	Picton Council Depot	Buxton	Douglas Park
Number of Years of Record	129	116	51	44
BoM Station Number	-	068052	068166	068200
	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)
January	89.5	87	92.2	69.6
February	95.4	89.9	125.5	88.1
March	89.3	89.3	82.2	85.4
April	74.5	69.6	74	64.2
May	64.0	55.8	51.6	57.4
June	77.9	67.6	67.3	70.8
July	55.1	49.4	35.8	41
August	50.0	44.8	51.2	43.8
September	47.0	43.7	44.4	41.2
October	60.4	62.7	62	54.9
November	70.0	71.6	90.2	72.3
December	72.1	70.1	78	57.1
Annual Average	845.2	805	858.8	758.6

Table 15 Summary of Mean Rainfall Statistics

Rainfall data for the Picton Council Depot BoM station is shown on **Figure 8**.

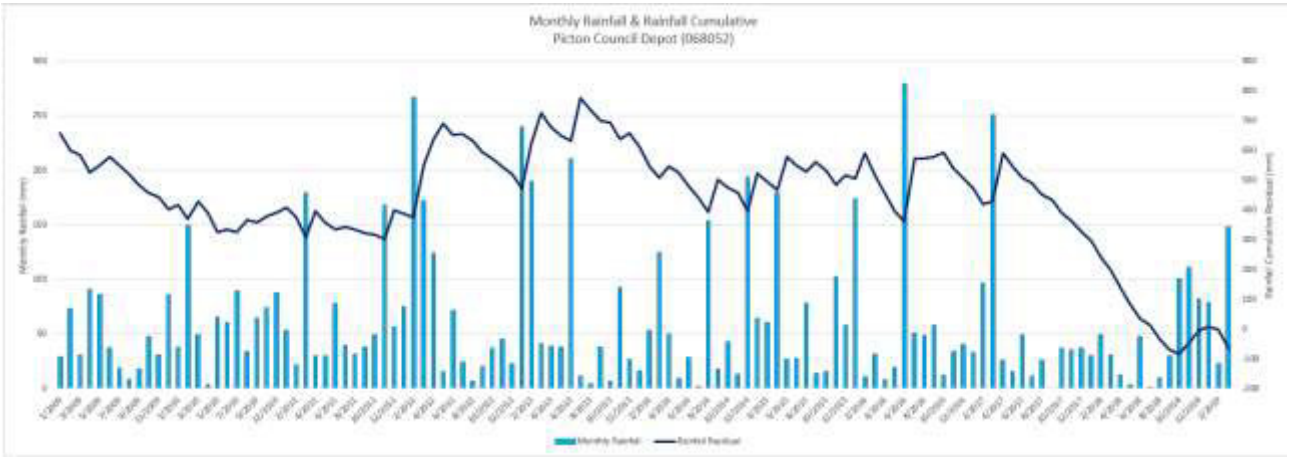


Figure 8 Picton Council Depot BoM Station Rainfall

The probability of low rainfall has been assessed using the Data Drill data suite, which shows, in **Figure 9**, the probability of low rainfall periods as the percentage of time that the total rainfall for different numbers of consecutive day periods has been less than or equal to the amount shown.

There is a 50% chance that 20mm of rainfall or less will fall in any 30 day period. There is also a 30% chance that 5mm or less will fall in any 10 day period. This indicates that the area in the vicinity of Redbank Creek has a relatively low probability of persistent dry/low rainfall.

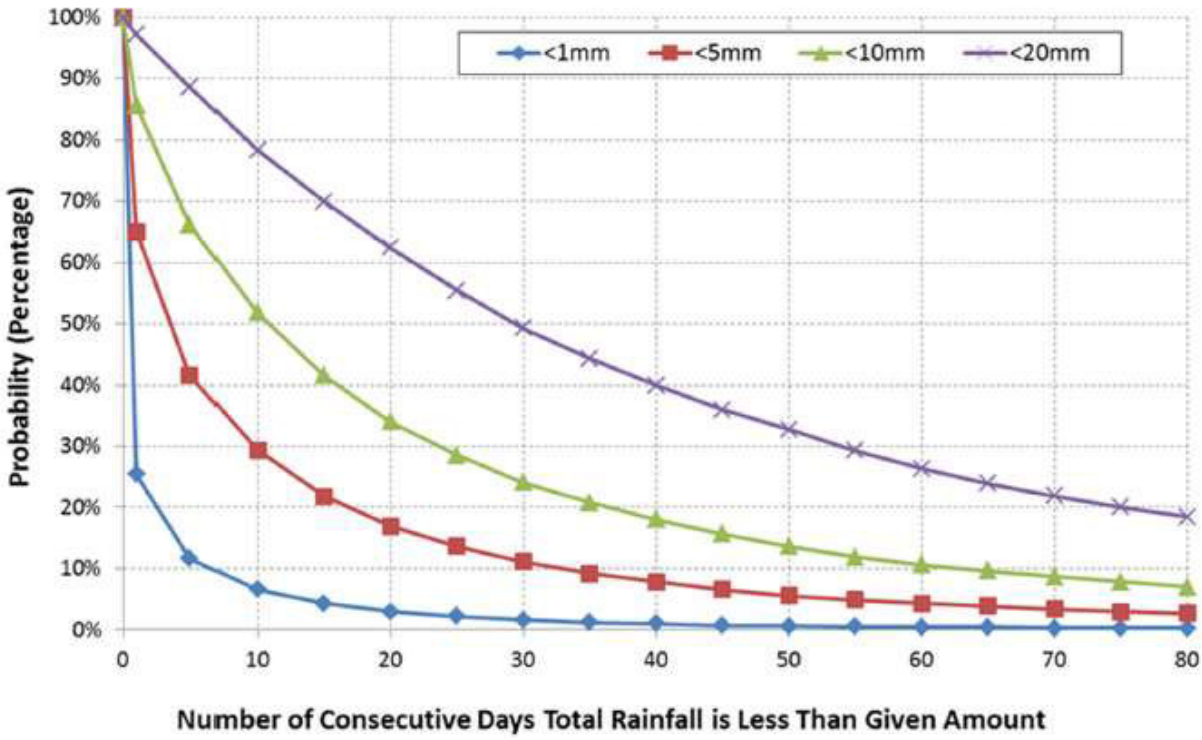


Figure 9 Low Rainfall Persistence Characteristics

6.4 Evaporation

The closest BoM climate station with pan evaporation (**PE**) data is Prospect Reservoir (0670191), which is located about 40 km to the northeast of Redbank Creek. Mean annual pan evaporation at Prospect is 1,314 mm.

Pan evaporation data was obtained from the SILO Data Drill for the site location and monthly estimates of point potential evapotranspiration2 were also taken from BoM mapping. A summary of monthly average Data Drill estimated pan evaporation and average monthly point potential

evapotranspiration from BoM mapping are presented in **Table 16** along with the average monthly rainfall derived from the nearest Data Drill point.

The average site evaporation from the SILO Data Drill is consistently lower than the point potential evapotranspiration taken from the Climatic Atlas of Australia. Average evaporation exceeds average rainfall in all months except June when there is an average excess of rainfall. The greatest evaporation deficit occurs in June and the greatest excess occurs in December.

Month	Average Evaporation Data Drill	Climate Atlas of Australia (Point Potential Evapotranspiration)	Average Data Drill Rainfall
January	177.7	195	89.5
February	154.7	160	95.4
March	127.7	150	89.3
April	94.9	105	74.5
May	65.0	75	64.0
June	55.7	60	77.9
July	56.3	60	55.1
August	79.8	90	50.0
September	107.3	120	47.0
October	133.0	160	60.4
November	162.2	180	70.0
December	181.6	195	72.1
Annual Average	1,368	1,500	845.2

Table 16 Summary of Average Rainfall and Evaporation (mm)

6.5 Redbank Creek Stream Monitoring Sites

TCCO established gauging stations along Redbank Creek at 11 sites, as shown on **Plan 3**, and has undertaken a flow gauging program to develop flow ratings for each station. A baseline water quality monitoring program has also been undertaken at each gauging station, such that gauging station sites are paired with water quality monitoring sites.

In terms of gauging stations locations, the sites are categorised as the following:

- Control site (R1 and R11): a site which is to provide control data against which future subsidence impacts can be compared; or
- Baseline/impact site (R2 to R10): a site which is to be used to compare conditions before, during and after subsidence.

Rating curves needed to convert the recorded water levels at these sites to flow rate have been established for low flows at sites R4 and R7. A more complete rating relationship has been established for site R11.

With the extraction of LW32, R11 will become impacted and a new downstream control site has been established at RC6 as shown on **Plan 3**.

Site R4 has a reliable low flow rating and is within the potentially subsidence affected reaches of Redbank Creek. Site R11 is the site which is furthest downstream of the potential impacts of longwall mining and has the most reliable rating. The potential effects of subsidence on streamflow would affect low flows. If longwall mining in the Redbank Creek catchment has had a measurable effect on flows it would be detectable as a change to low flows and low flow recessionary behaviour. It has been observed at other locations where surface flows are lost to subsidence induced subsurface fracture systems that the subsurface flow “reappears” at the

surface further downstream. These observations suggest that at these sites the localised impacts do not affect the overall catchment yield.

Plan 3 Redbank Creek Monitoring Gauge Stations

The flow record at site R4 provides the opportunity to assess whether there has been a detectable change in low flow and low flow recessionary behaviour in Redbank Creek in the reach immediately overlying Longwall 27 (mined from November 2012 to March 2014) and some 500m downstream of Longwall 26 (mined from March 2011 to October 2012). By contrast the flow record at site R11 provides the opportunity to assess whether there has been a detectable change in flows in Redbank Creek at a location which is some two kilometres downstream of Longwall 26.

Because flow in natural watercourses is highly variable in response to climatic events, it is difficult to assess whether low flow behaviour is changing over time by examining a flow record in isolation. What is required is some means of assessing whether, given the climatic conditions, the catchment response has changed over time. This has been achieved by using a fitted catchment flow model, such as the Australian Water Balance Model (**AWBM**) to provide a time invariant predictor of flows. Comparing modelled to recorded flow over time provides the opportunity to assess, in a systematic way, whether low flow is changing over time and whether this change indicates an increased loss of flow.

Examination of the flow record from monitoring site R4 and monitoring site R11 on Redbank Creek suggest that mining of Longwalls 25, 26 and 27 within the Redbank Creek catchment, including mining directly beneath Redbank Creek itself, has not affected flows and low flows at site R11 downstream. There is some evidence that flows at site R4 have been reduced during the periods of low flow.

6.6 Redbank Creek Water Levels

6.6.1 Monitoring Sites Water Level Statistics

Redbank Creek stream monitoring sites water level statistics for the period December 2009 to November 2018 are outlined within **Table 17**.

	Mean Gauge Height (water Level) (metres) for Period 25 December 2009 to 6 November 2018										
Station No.	**300038**	**300039**	**300040**	**300041**	**300042**	**300043**	**300044**	**300045**	**300046**	**300047**	**300048**
Station Reference No.	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**R11**
Maximum	0.45	1.61	1.50	1.05	1.35	1.45	1.15	1.69	1.25	1.62	11.46
Average	0.02	0.66	0.27	0.29	0.32	0.55	0.59	0.69	0.84	0.85	0.53
Median	0.00	0.85	0.00	0.00	0.00	0.89	0.85	0.74	0.97	0.87	0.50
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 17 Redbank Creek Monitoring Sites Water Level Statistics.

The Redbank Creek stream monitoring network is operated on behalf of TCCO by trained hydrographic staff from Hydrometic Pty Ltd. Streamflow measurements are an integral part of monitoring, with water levels measured using a water level senor set within a metal pipe housing and calibrated to the pool to record pool level changes.

Streamflow is additionally measured monthly where there is flow, using a current meter. The current meter is a versatile instrument with a long history of accuracy, reliability, and durability. The current meter consists of a precisely balanced bucket wheel mounts on a vertical pivot inside a yoke and rotates by water flow, with each rotation monitored by digital equipment. Rotation rate is proportional to water velocity.

Stream gaugings are taken throughout a full range of low and high flow conditions to enable derivation of accurate streamflow volumes.

6.6.2 Monitoring Site R1

Redbank Creek monitoring site R1 water level for the period December 2009 to November 2018 are outlined within **Figure 10**.

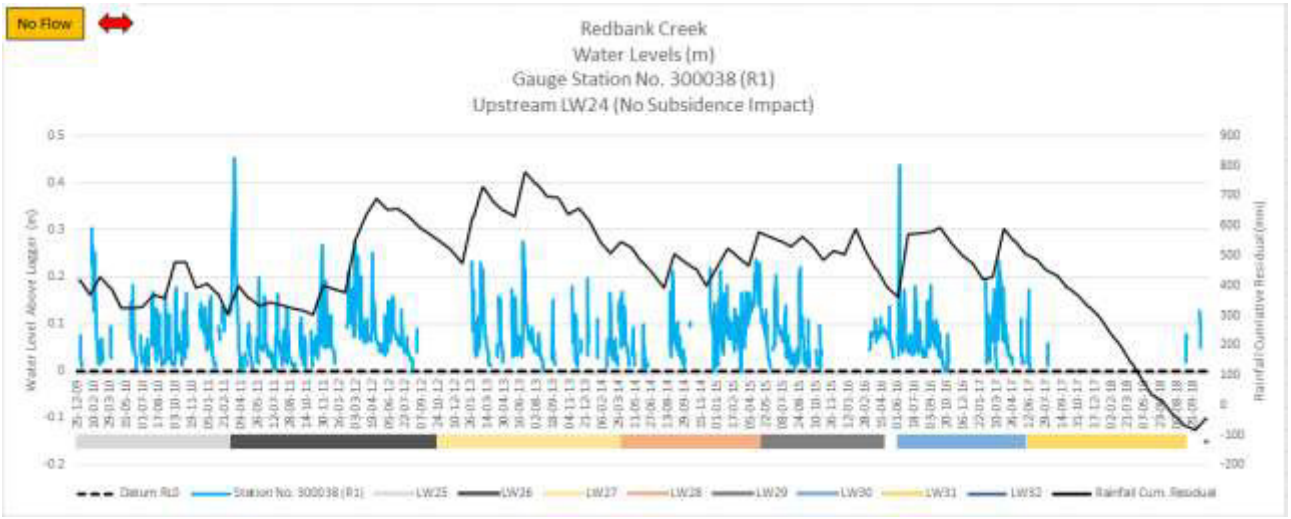


Figure 10 Redbank Creek Monitoring Site R1 Water Level

6.6.3 Monitoring Site R2

Redbank Creek monitoring site R2 water level for the period December 2009 to November 2018 are outlined within **Figure 11**.

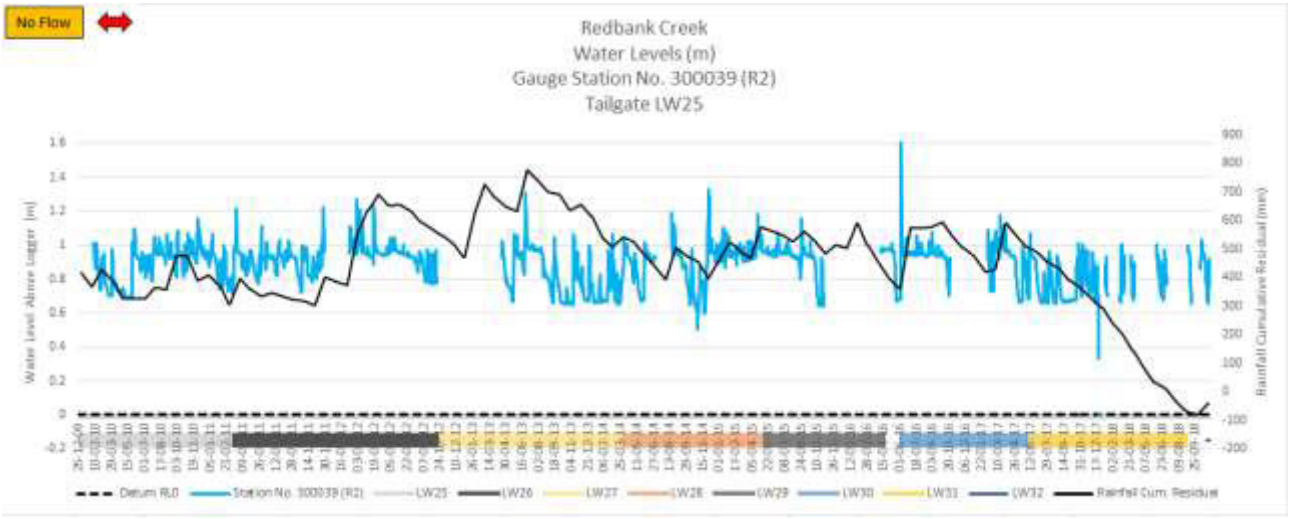


Figure 11 Redbank Creek Monitoring Site R2 Water Level

6.6.4 Monitoring Site R3

Redbank Creek monitoring site R3 water level for the period December 2009 to November 2018 are outlined within **Figure 12**.

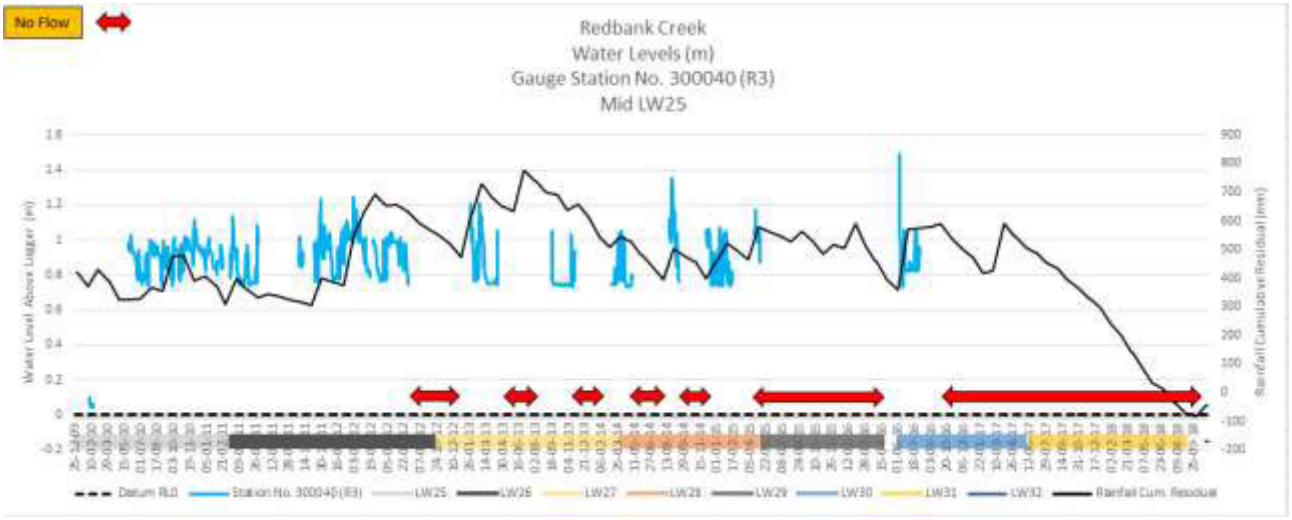


Figure 12 Redbank Creek Monitoring Site R3 Water Level

6.6.5 Monitoring Site R4

Redbank Creek monitoring site R4 water level for the period December 2009 to November 2018 are outlined within **Figure 13**.

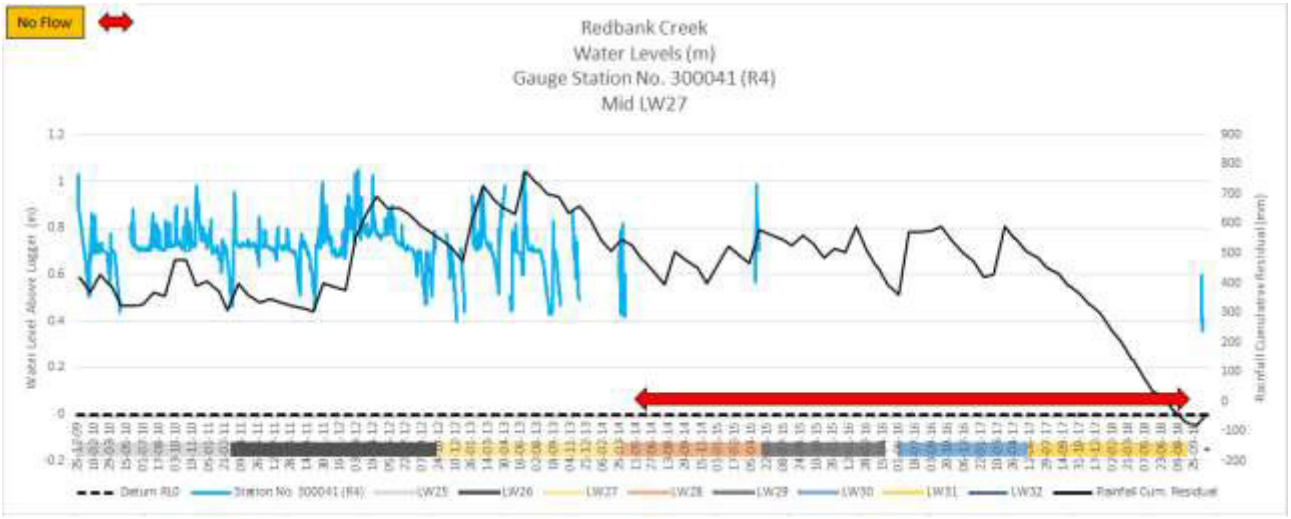


Figure 13 Redbank Creek Monitoring Site R4 Water Level

6.6.6 Monitoring Site R5

Redbank Creek monitoring site R5 water level for the period December 2009 to November 2018 are outlined within **Figure 14.**

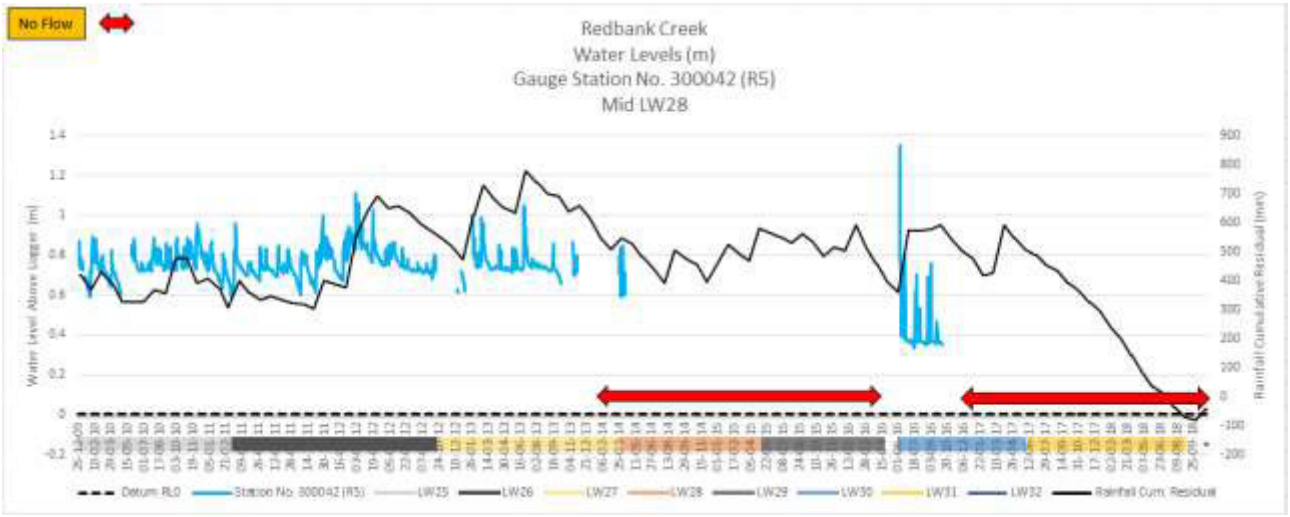


Figure 14 Redbank Creek Monitoring Site R5 Water Level

6.6.7 Monitoring Site R6

Redbank Creek monitoring site R6 water level for the period December 2009 to November 2018 are outlined within **Figure 15**.

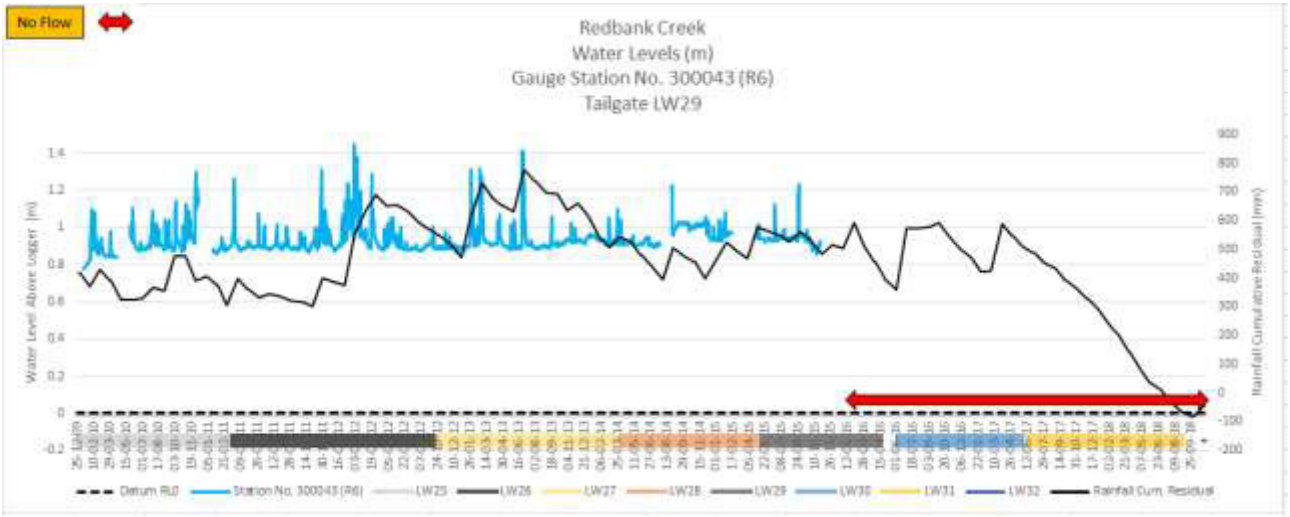


Figure 15 Redbank Creek Monitoring Site R6 Water Level

6.6.8 Monitoring Site R7

Redbank Creek monitoring site R7 water level for the period December 2009 to November 2018 are outlined within **Figure 16**.

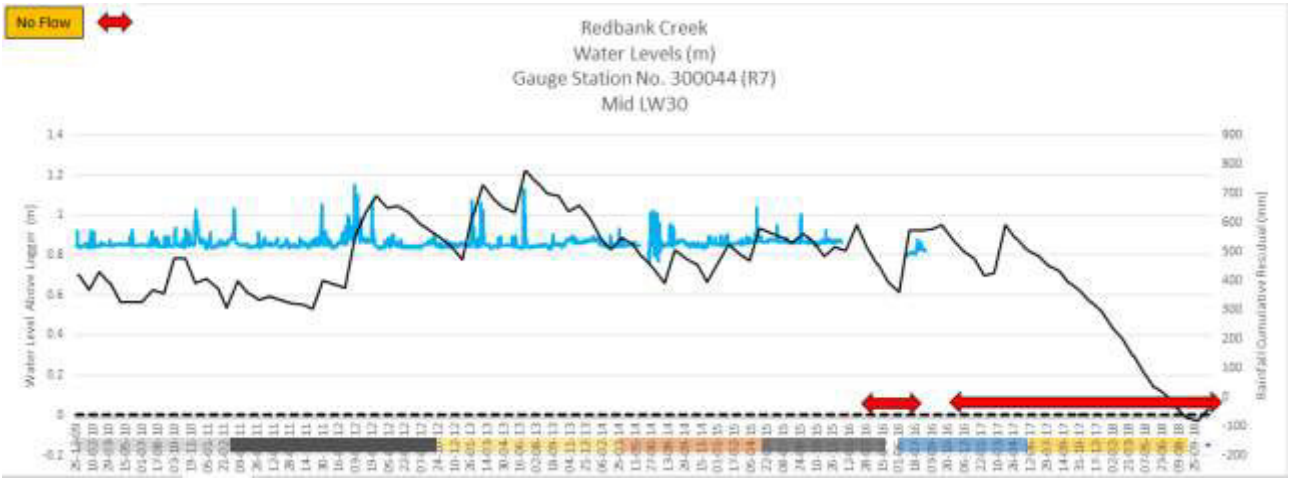


Figure 16 Redbank Creek Monitoring Site R7 Water Level

6.6.9 Monitoring Site R8

Redbank Creek monitoring site R8 water level for the period December 2009 to November 2018 are outlined within **Figure 17**.

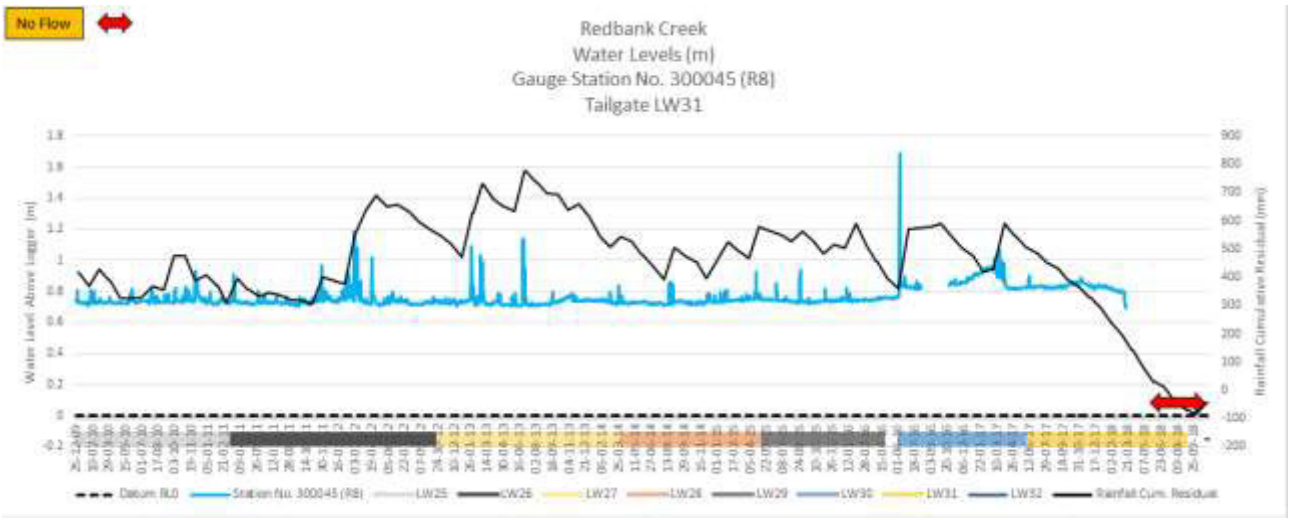


Figure 17 Redbank Creek Monitoring Site R8 Water Level

6.6.10 Monitoring Site R9

Redbank Creek monitoring site R9 water level for the period December 2009 to November 2018 are outlined within **Figure 18**.

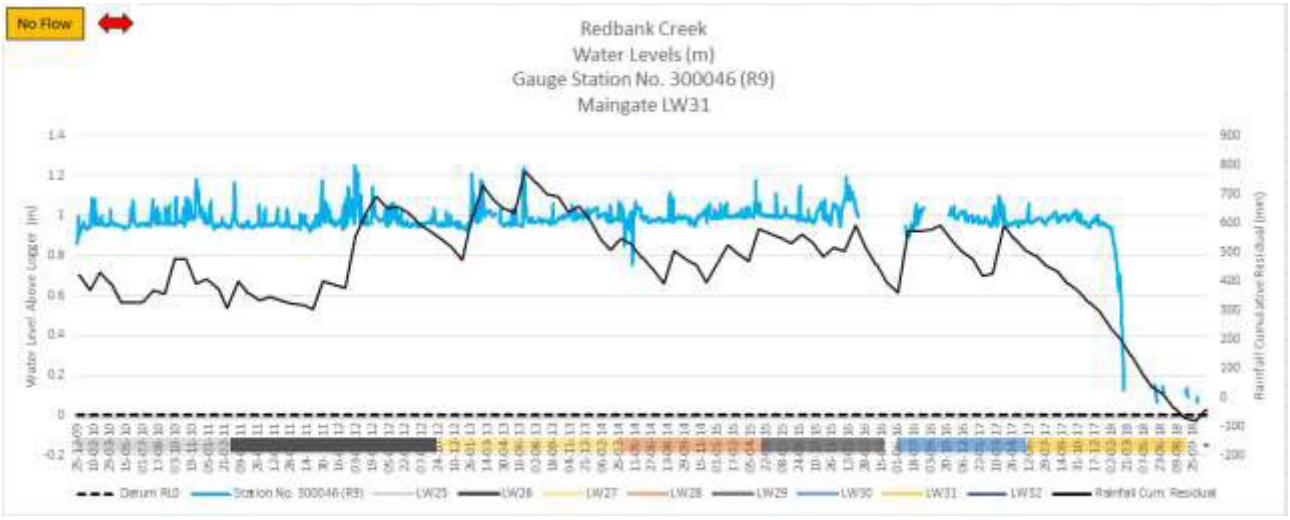


Figure 18 Redbank Creek Monitoring Site R9 Water Level

6.6.11 Monitoring Site R10

Redbank Creek monitoring site R10 water level for the period December 2009 to November 2018 are outlined within **Figure 19.**

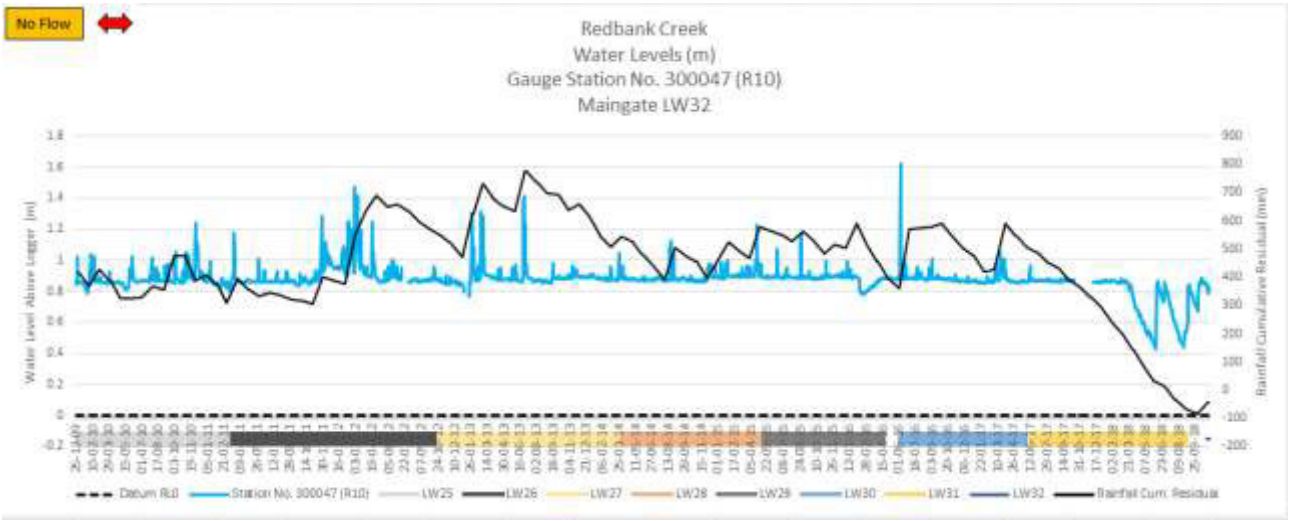


Figure 19 Redbank Creek Monitoring Site R10 Water Level

6.6.12 Monitoring Site R11

Redbank Creek monitoring site R11 water level for the period December 2009 to November 2018 are outlined within **Figure 20**.

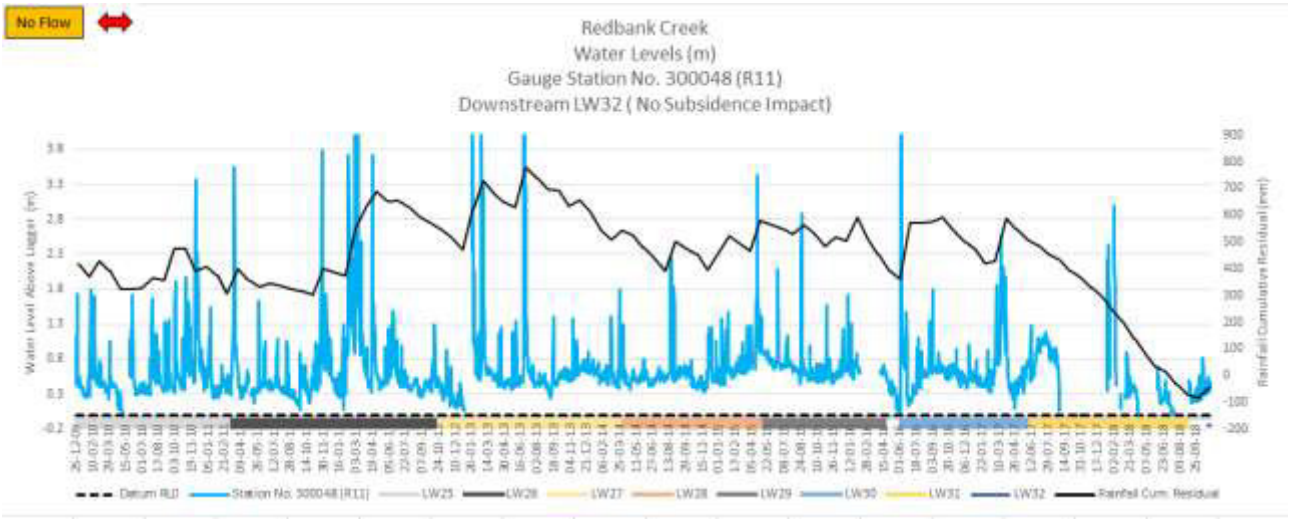


Figure 20 Redbank Creek Monitoring Site R11 Water Level

6.7 Redbank Creek Flows

6.7.1 Monitoring Sites Flow Statistics

Redbank Creek stream monitoring sites water flow statistics for the period December 2009 to November 2018 are outlined within **Table 18**.

Flow ML/day for Period 25 December 2009 to 6 November 2018

Station No. / Station Reference No.	300038 R1	300040 R3	300041 R4	300042 R5	300044 R7	300045 R8	300047 R10	300048 R11
% Days Flow	50%	18%	31%	35%	60%	24%	89%	85%
Maximum	17	62	50	111	3	915	360	668
Average	0.6	1.9	2.2	1.0	0.4	5.1	2.0	2.0
Median	0.1	1.3	0.1	0.1	0.3	0.3	0.4	0.2
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 18 Redbank Creek Monitoring Sites Water Flow Statistics.

Redbank Creek stream monitoring sites water flow daily average and median flow statistics for the period December 2009 to November 2018 are outlined within **Table 19**.

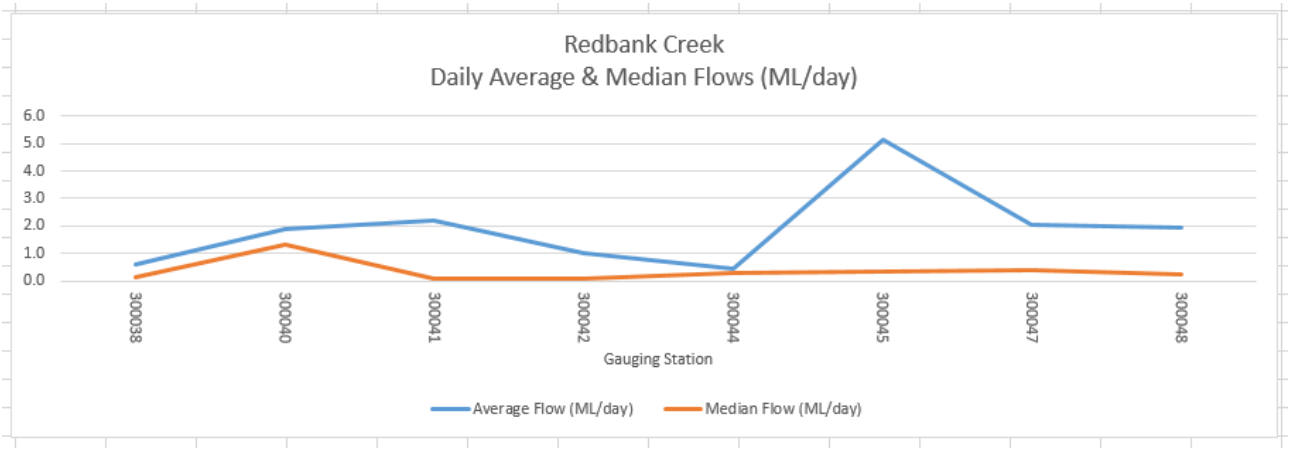


Table 19 Redbank Creek Monitoring Sites Water Flow Daily Average and Median Flows.

6.7.2 Monitoring Site R1

Redbank Creek monitoring site R1 water flow for the period December 2009 to November 2018 are outlined within **Figure 21**.

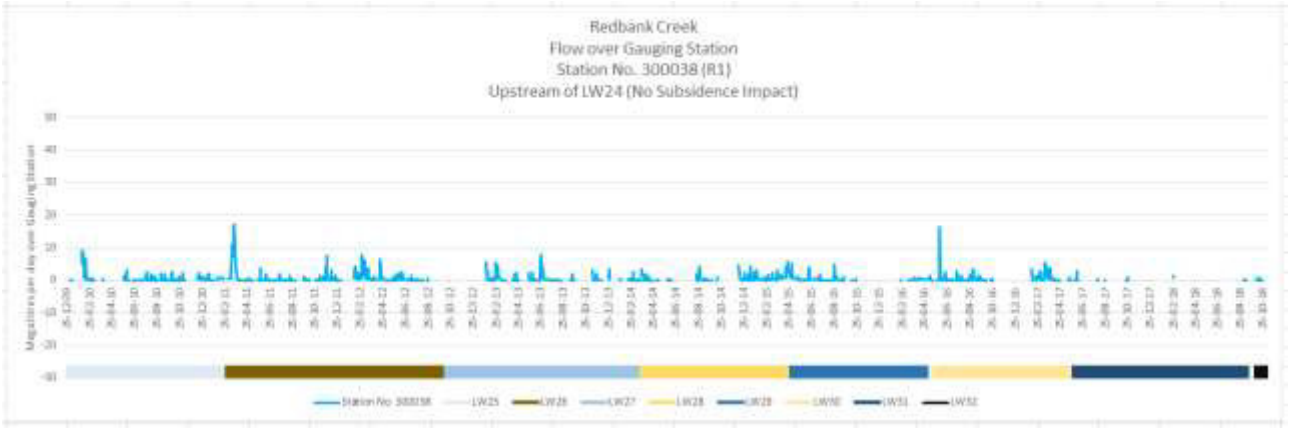


Figure 21 Redbank Creek Monitoring Site R1 Water Flow

6.7.3 Monitoring Site R3

Redbank Creek monitoring site R3 water flow for the period December 2009 to November 2018 are outlined within **Figure 22**.

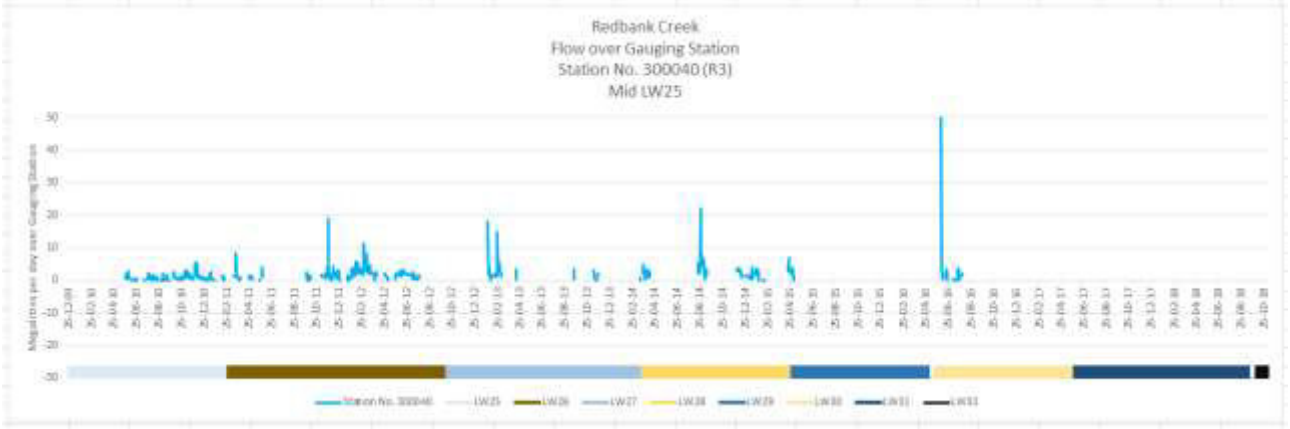


Figure 22 Redbank Creek Monitoring Site R3 Water Flow

6.7.4 Monitoring Site R4

Redbank Creek monitoring site R4 water flow for the period December 2009 to November 2018 are outlined within **Figure 23**.

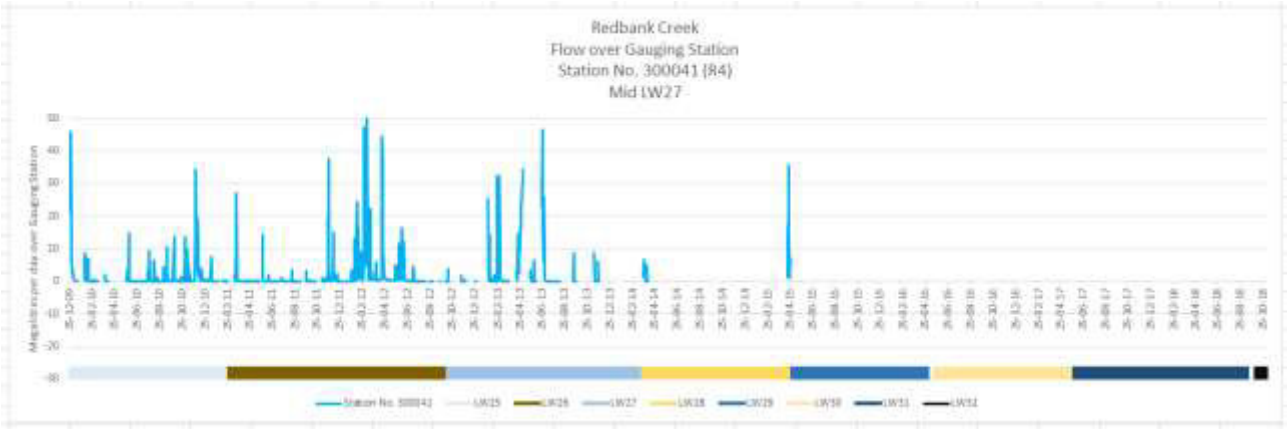


Figure 23 Redbank Creek Monitoring Site R4 Water Flow

6.7.5 Monitoring Site R5

Redbank Creek monitoring site R5 water flow for the period December 2009 to November 2018 are outlined within **Figure 24.**

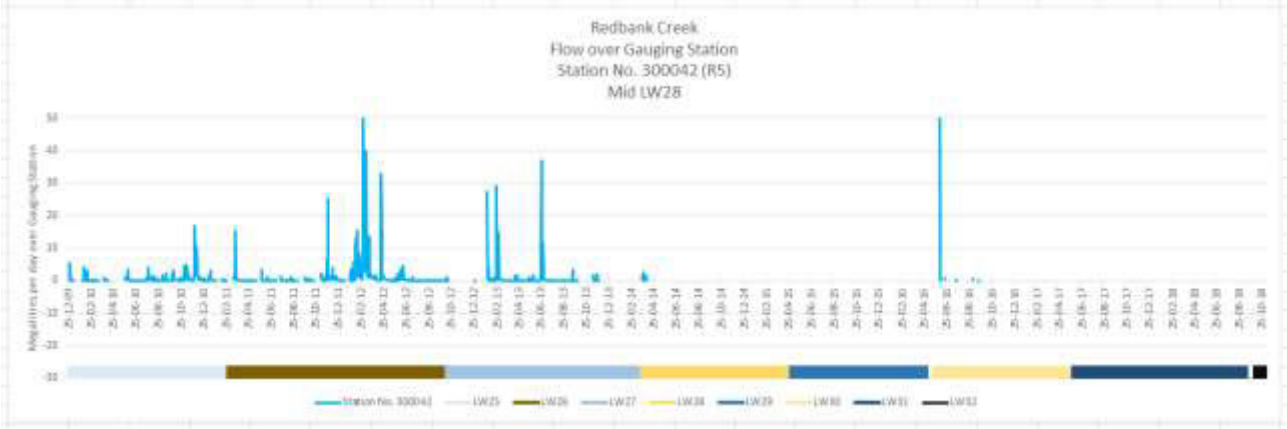


Figure 24 Redbank Creek Monitoring Site R5 Water Flow

6.7.6 Monitoring Site R7

Redbank Creek monitoring site R7 water flow for the period December 2009 to November 2018 are outlined within **Figure 25.**

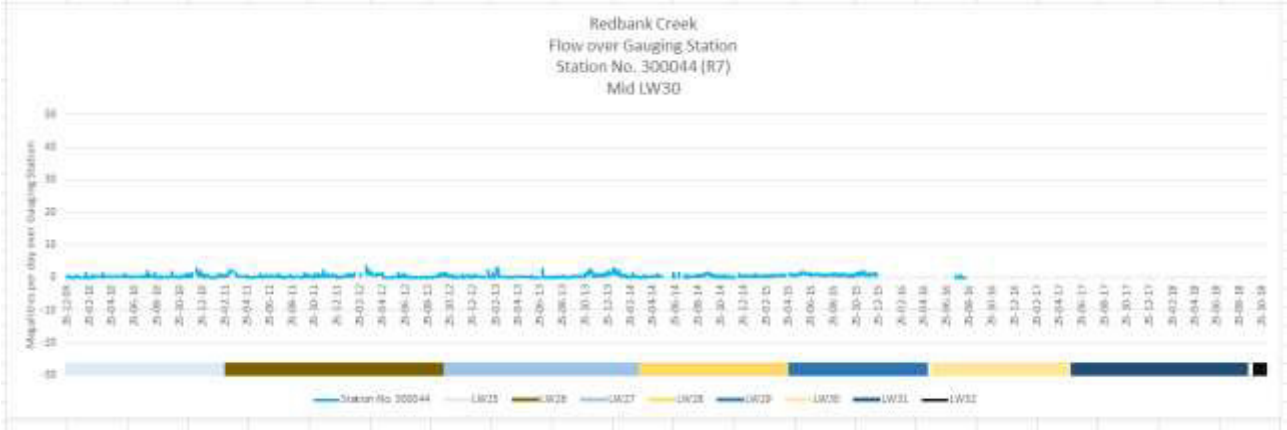


Figure 25 Redbank Creek Monitoring Site R7 Water Flow

6.7.7 Monitoring Site R8

Redbank Creek monitoring site R8 water flow for the period December 2009 to November 2018 are outlined within **Figure 26**.

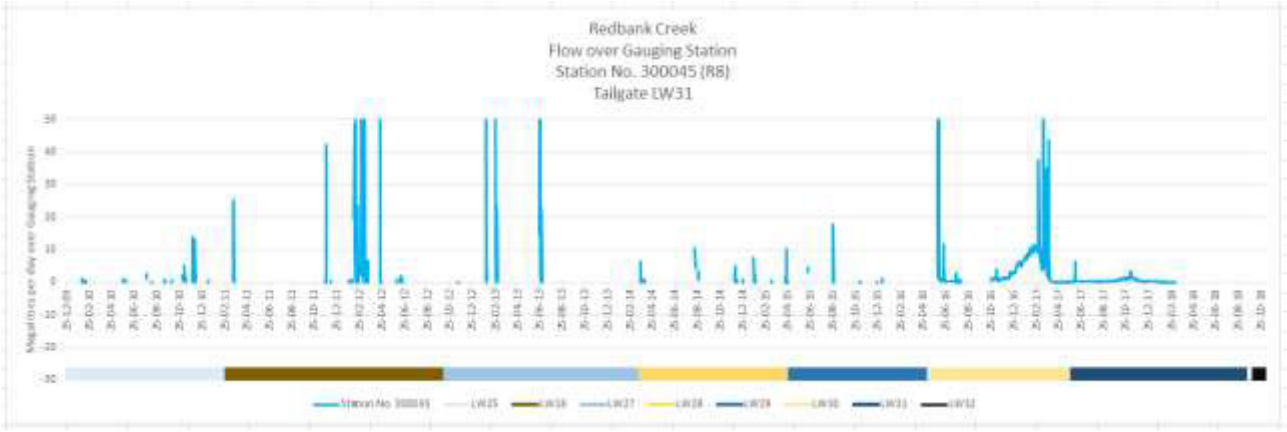


Figure26 Redbank Creek Monitoring Site R8 Water Flow

6.7.8 Monitoring Site R10

Redbank Creek monitoring site R10 water flow for the period December 2009 to November 2018 are outlined within **Figure 27**.

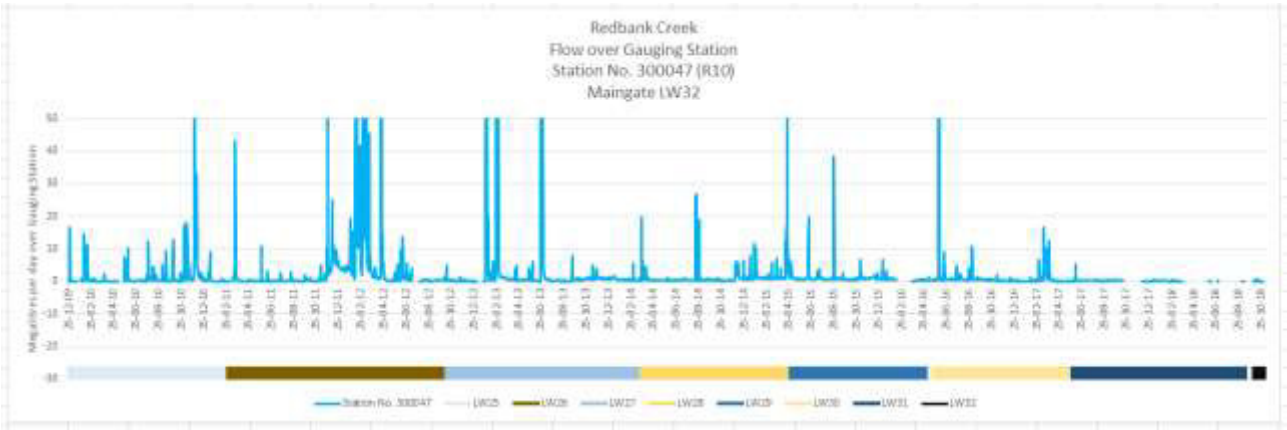


Figure 27 Redbank Creek Monitoring Site R10 Water Flow

6.7.9 Monitoring Site R11

Redbank Creek monitoring site R11 water flow for the period December 2009 to November 2018 are outlined within **Figure 28.**

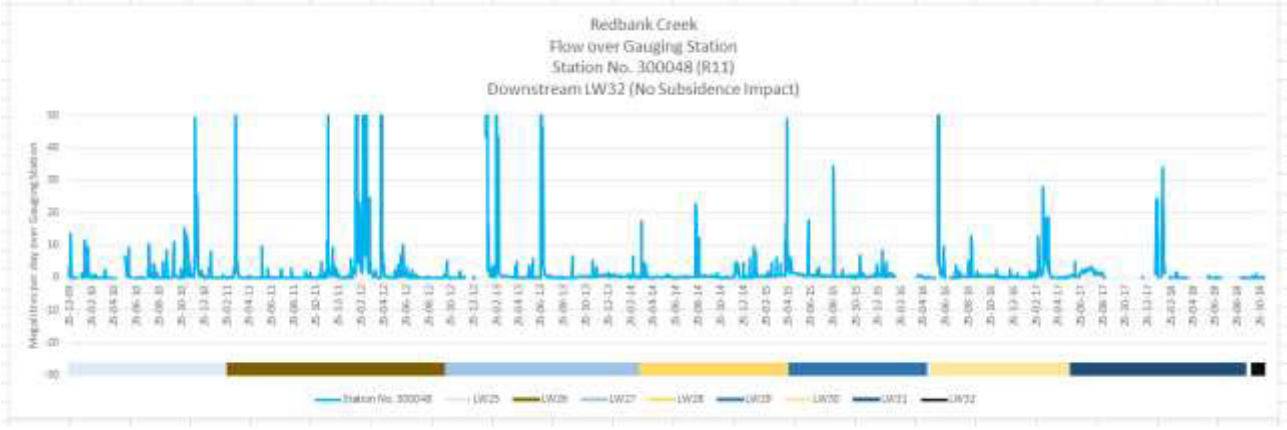


Figure 28 Redbank Creek Monitoring Site R11 Water Flow

6.8 Subsidence Impact on Pool Levels and Flow

Redbank Creek monitoring sites percentage days water flow for the period December 2009 to November 2018 are outlined within **Table 20**.

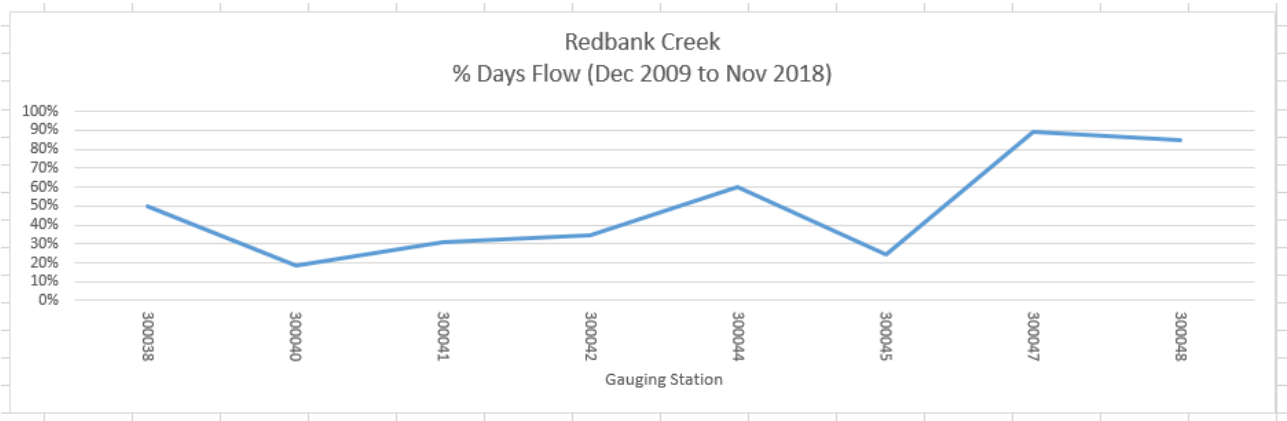


Table 20 Redbank Creek % Days Flow

Pool height and water flows at monitoring sites R1 and R2 indicates that Redbank Creek at these locations are not observed to be impacted by subsidence, with typically ephemeral flows with pool height influenced mainly by rainfall events. Both monitoring sites R1 and R2 have low % days flow compared to other monitoring sites.

Pool height and water flows at monitoring sites R3, R4, R5, R6 and R7 show distinguishable loss of pool height and water flow. There is a probable linkage to the loss of pool height and water flow from impacts from subsidence from Longwall 27, Longwall 28 and Longwall 29.

Redbank Creek monitoring sites subsidence impacts before and after longwalls for water flow for % days flow for the period December 2009 to November 2018 are outlined within **Table 21**.

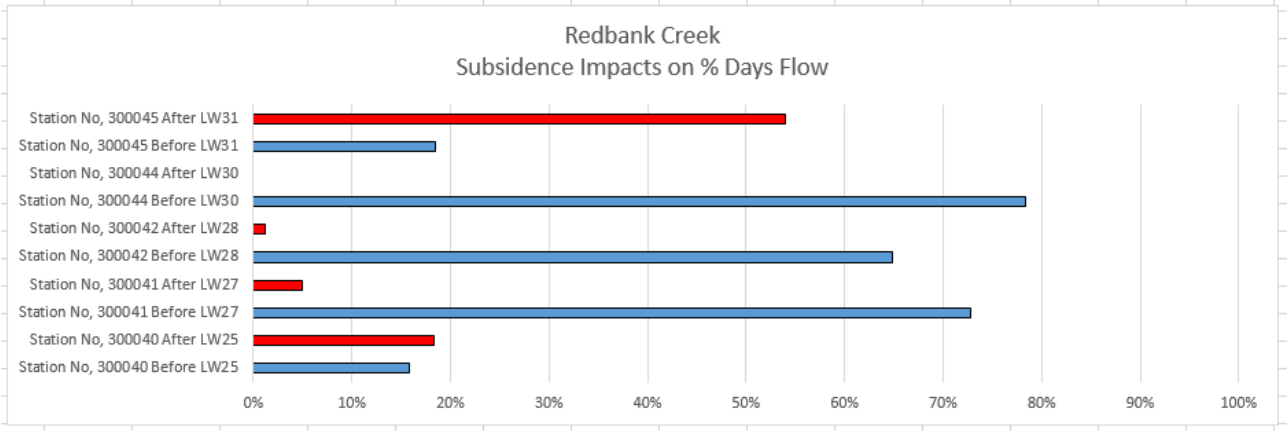


Table 21 Redbank Creek Subsidence Impacts on Flows by Longwalls

Pool height and water flows at monitoring sites R8, R9, R10 and R11 do not appear to be impacted by subsidence. Some minor loose of pool height is observed at R9 from probable subsidence impact from Longwall 31 although there are signs that there has been some recovery. It is noted that the active subsidence zone for Longwall 32 has not yet influenced Redbank Creek. Both monitoring sites R10 and R11 have high % days flow compared to other monitoring sites.

6.9 Redbank Creek Water Quality

6.9.1 pH

Redbank Creek monitoring site data for pH for the period December 2009 to November 2018 are outlined within **Figure 29**.

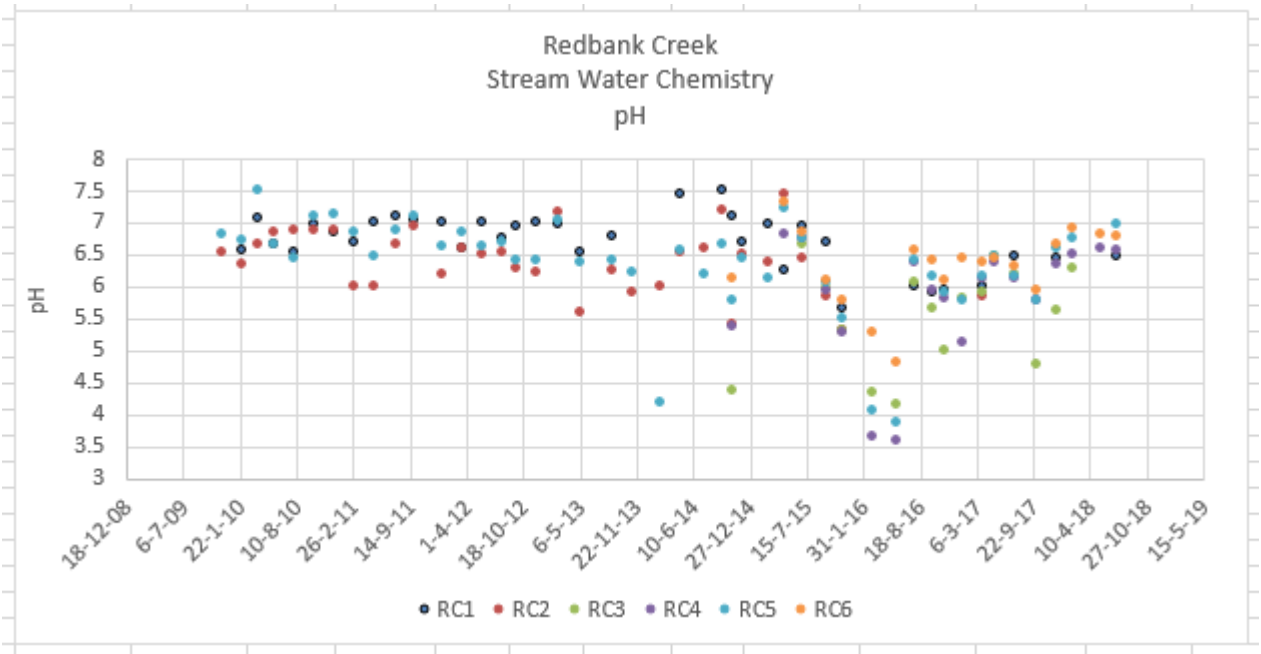


Figure 29 Redbank Creek Monitoring data - pH

6.9.2 Electrical Conductivity

Redbank Creek monitoring site data for electrical conductivity for the period December 2009 to November 2018 are outlined within **Figure 30**.

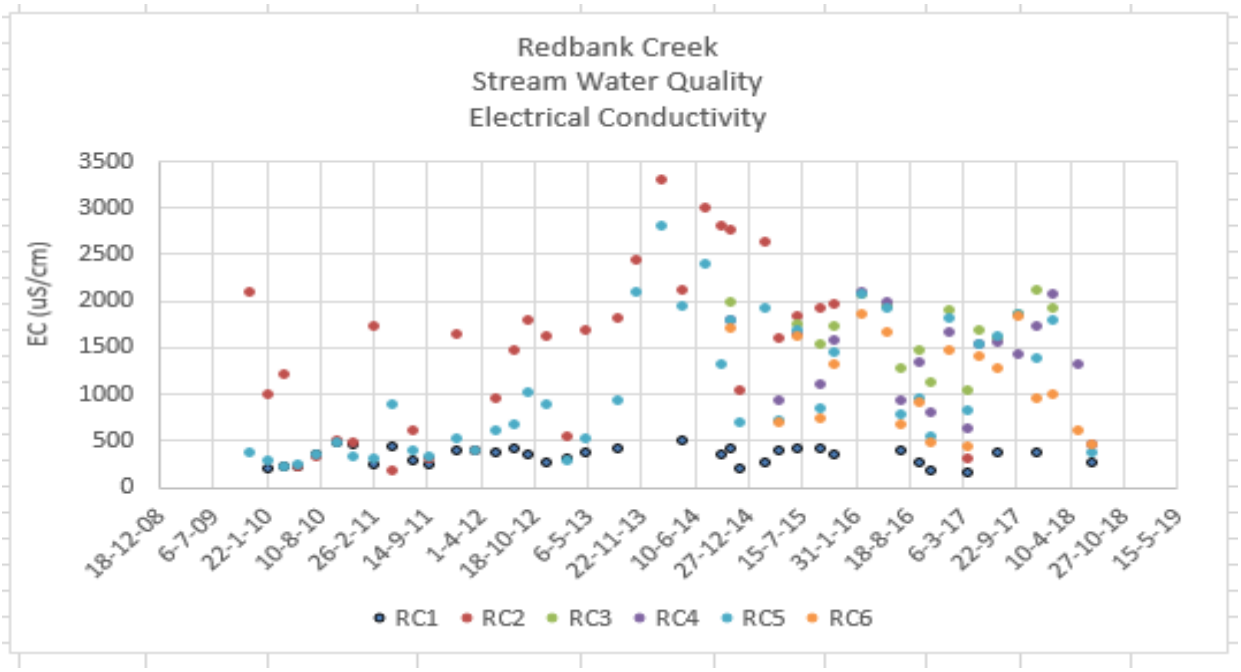


Figure 30 Redbank Creek Monitoring data - EC

6.9.3 Iron

Redbank Creek monitoring site data for iron for the period December 2009 to November 2018 are outlined within **Figure 31**.

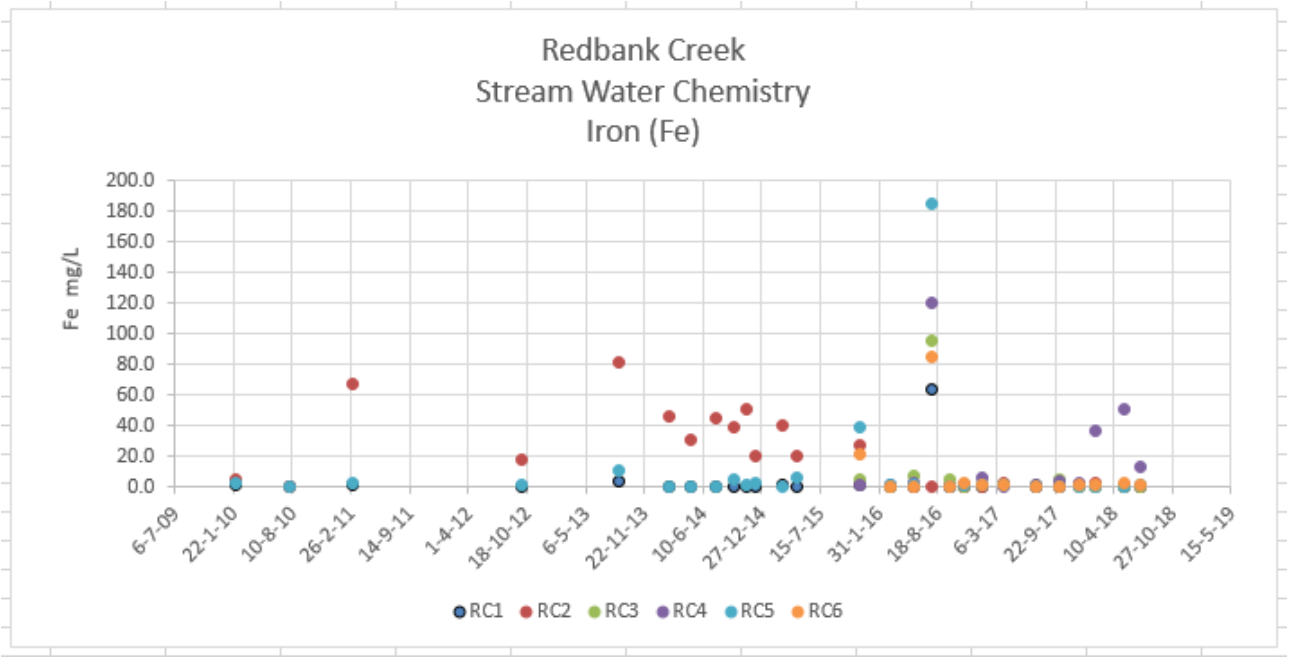


Figure 31 Redbank Creek Monitoring data - Iron

6.9.4 Manganese

Redbank Creek monitoring site data for manganese for the period December 2009 to November 2018 are outlined within **Figure 32**.

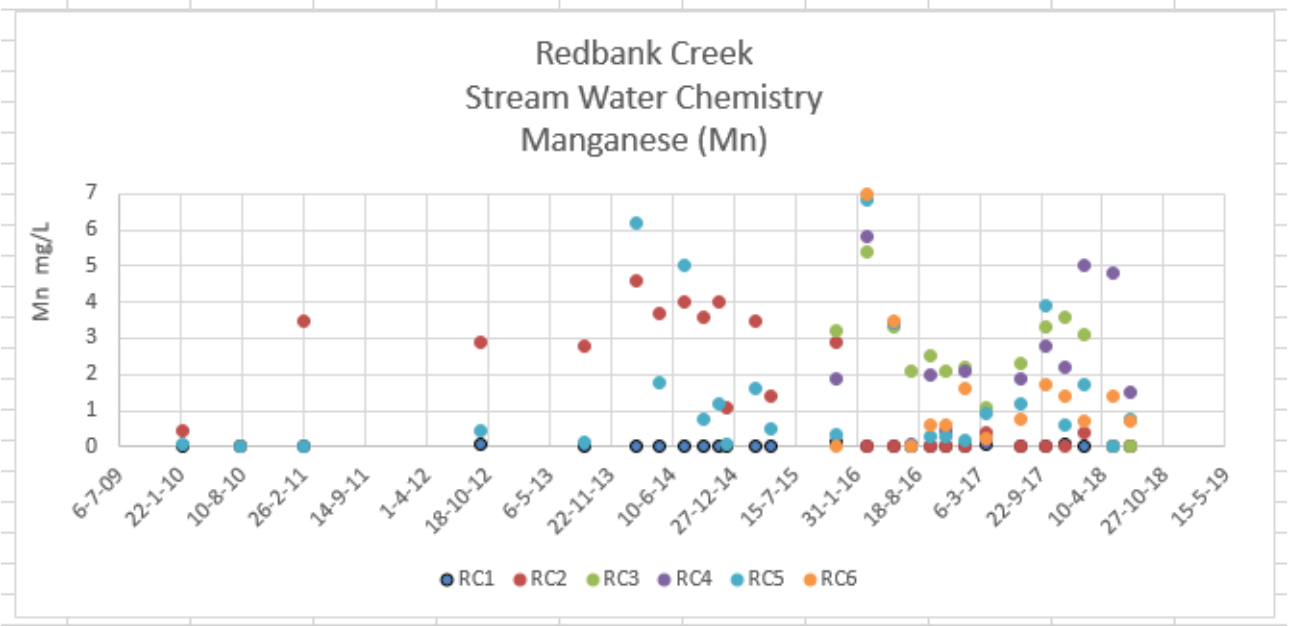


Figure 32 Redbank Creek Monitoring data - Manganese

6.9.5 Aluminium

Redbank Creek monitoring site data for aluminium for the period December 2009 to November 2018 are outlined within **Figure 33**.

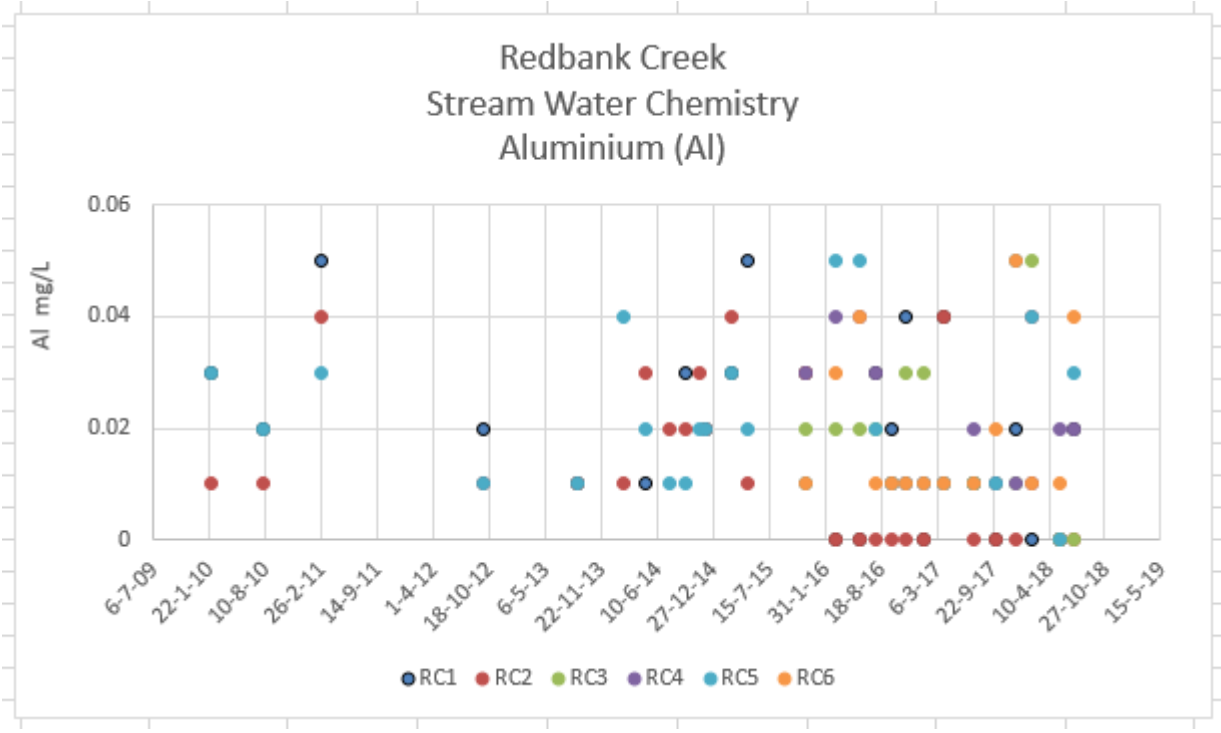


Figure 33 Redbank Creek Monitoring data - Aluminium

6.9.6 Zinc

Redbank Creek monitoring site data for zinc for the period December 2009 to November 2018 are outlined within Figure 34.

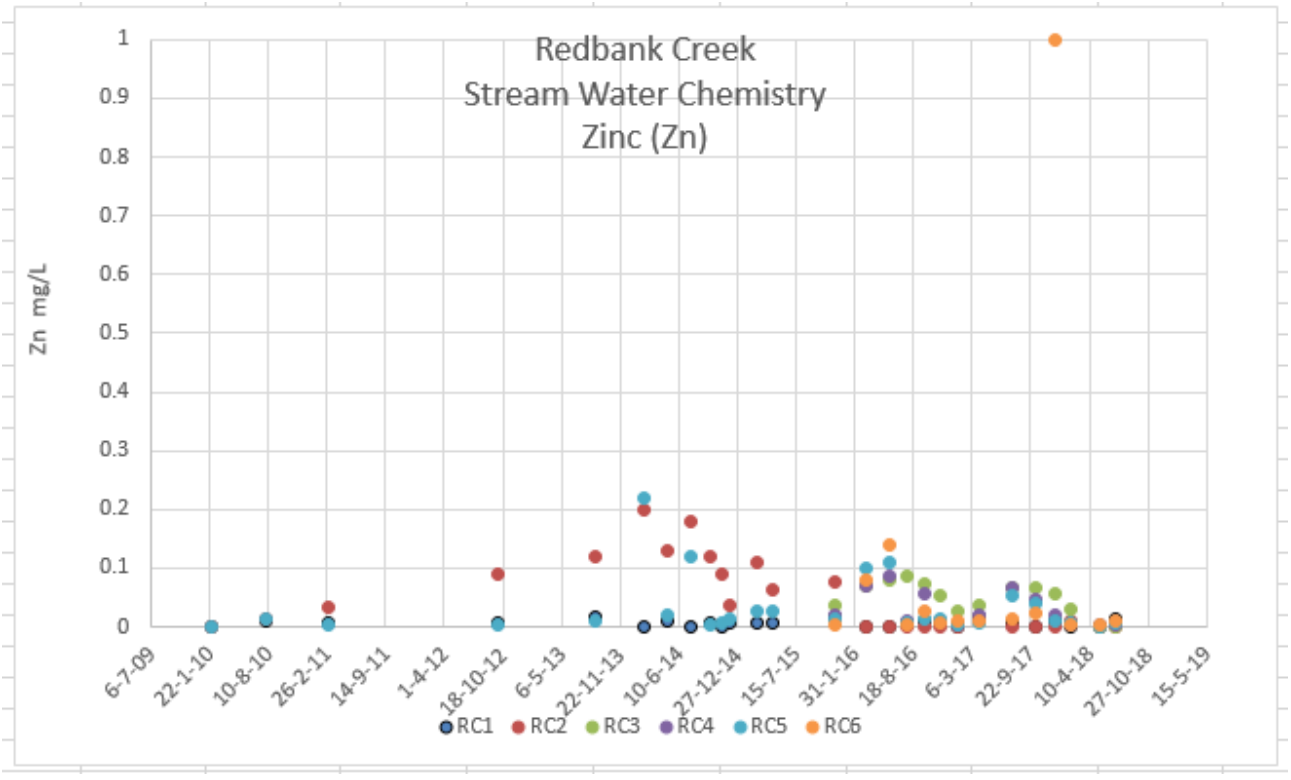


Figure 34 Redbank Creek Monitoring data - Zinc

6.9.7 Nickel

Redbank Creek monitoring site data for nickel for the period December 2009 to November 2018 are outlined within **Figure 35**.

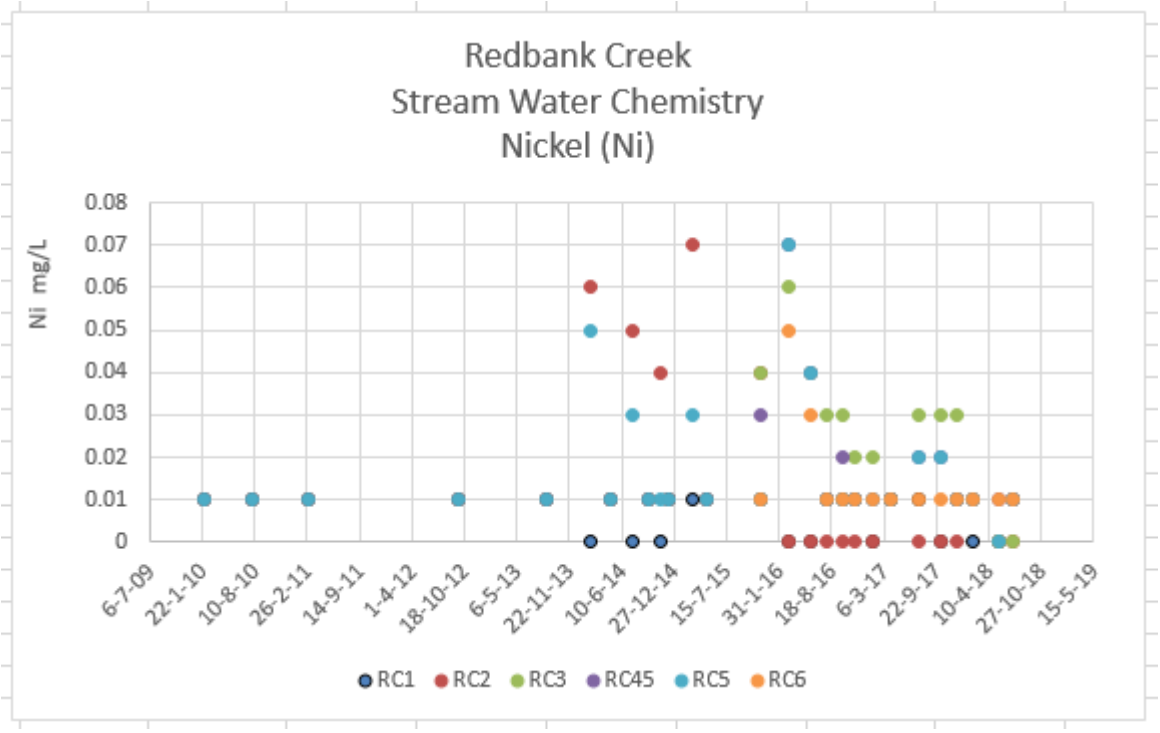


Figure 35 Redbank Creek Monitoring data - Nickel

6.10 Subsidence Impact on Stream Water Chemistry

Monitoring data of water chemistry within Redbank Creek indicates probable subsidence impact causing lowering of the pH from about 2016 and increasing EC, iron and manganese from about 2014. A high spike for EC, iron and manganese was observed in 2016.

Monitoring data for aluminium, zinc and nickel indicate fairly consistent results with moderate increasing trend from about 2014.

6.11 Aquatic Ecology

Aquatic monitoring has been conducted on Redbank Creek, with an aquatic ecology monitoring survey conducted on Redbank Creek pre-mining that provides a useful reference point for determining subsidence impacts of mining.

6.11.1 2009 Survey

An aquatic ecology monitoring survey conducted within Redbank Creek in 2009 noted that Redbank creeks were assessed as being in poor condition with sparse riparian vegetation, narrow riparian zones and a general paucity of aquatic habitat diversity. These habitat conditions were due to surrounding rural and urban activities, which are unlikely to dissipate over time.

The 2009 AUSRIVAS results indicated that Redbank Creek was in a moderate ecological condition, with the relatively low diversity of taxa and pattern of the observed taxa being highly pollution-tolerant. This was considered probably due to the ecological condition of the stream and the impacts of surrounding rural and urban development.

It is noted that this aquatic ecology survey was conducted on Redbank Creek before the creek experienced any subsidence effects or impacts.

6.11.2 2014 Survey

An aquatic ecology survey was conducted in 2014 that included Redbank Creek and creeks with TCCO proposed Western Domain, including Cedar creek, Matthews Creek and Stonequarry Creek. AUSRIVAS results from the 2014 survey indicated that three (3) of the four (4) Redbank Creek monitoring sites scored in Band B, indicating that these sites are significantly impaired.

However, the other sites monitored during the survey in the unimpacted by mining or subsidence in TCCO proposed Western Domain also scored Band B, indicating that they are also significantly impaired. Additionally, one (1) downstream monitoring site on Redbank Creek and two monitoring sites within creeks in TCCO Proposed Western Domain scored Band C, indicating a severely impaired.

The Redbank Creek monitoring sites scored low SIGNAL values indicating that sites are severely polluted as they contain pollution tolerant macroinvertebrate families. The creeks in TCCO proposed Western Domain scored SIGNAL scores of >4, which indicates that there are more pollution sensitive invertebrates at these sites and the presence of these fauna infer that these streams are unlikely to be severely affected by pollution.

One family in particular, *Leptophlebiidae* was notably absent from all Redbank Creek sites which was relatively abundant within the TCCO proposed Western Domain monitoring site creeks. The family is common among the ephemeral streams in the area and its absence may show that Redbank Creek is under natural or anthropogenic stress.

6.11.3 2015 Survey

Riparian habitat inventory scores categorises Redbank Creek as being in moderate condition. Although Redbank Creek has some riparian vegetation and stable stream morphology, sites were: dominated by weeds, contained rubbish (plastic and car parts), and exhibited some sedimentation. Redbank Creek was assessed as being highly disturbed.

The mayfly *Leptophlebiidae* and other species of this family are most vulnerable to pollution. This family is very common in ephemeral streams and are present in nearby similar streams. This family was previously recorded in Redbank Creek in 2009, however, was not recorded in any of the four sampling occasions in Redbank Creek in the 2015 survey. This may indicate either natural or anthropogenic stress in this system and is possibly related to the elevated levels of salinity observed in Redbank Creek particularly >900 (µS/cm).

6.12 Ecology

The environmental impacts for riparian ecology observed in relation to mining Longwall 27, Longwall 28, Longwall 29 and Longwall 30 are within the predicted level assessed in the Tahmoor Colliery Longwalls 27 - 30 Impacts of Subsidence.

The ecology assessments conducted at the end of each longwall, each concluded that there were no significant impacts to threatened flora and fauna or their habitats as outlined in the TARPs.

6.13 Groundwater Monitoring Bores

TCCO has nine (9) piezometers (P1 to P9) where regular manual and data logger based standing water level monitoring has been conducted since June 2004 for some locations.

P4 and P9 are the closest standpipe piezometers to Redbank Creek, as shown on **Plan 4**.

P4 is located within an undeveloped, unsecured block of land, 300 metres northeast of Longwall 26.

P9 is located within the Hanson concrete plant site over the Longwall 31/32 chain pillar. P9 consists of an open standpipe piezometer, screened at approximately 22.5 mbgl and a VWP with 3

strings at 28, 40 and 68 mbgl. During the mining of Longwall 31 the two upper VWP intake strings were sheared, as shown on **Figure 36**. Two open standpipe piezometers were drilled at this location to replace these loss VWP intake strings.

Groundwater monitoring data for P4 and P9 is outlined on **Figure 37** and indicates that the standing water level at both piezometers is stable over time and does not appear to be influenced by the passage of Longwalls 26 to 31 extraction.

Two additional open standpipe piezometers, P10, over the chain pillar of LW32 and P11, downstream of LW32, were installed during November 2018.

Plan 4 Redbank Creek groundwater Monitoring Bores

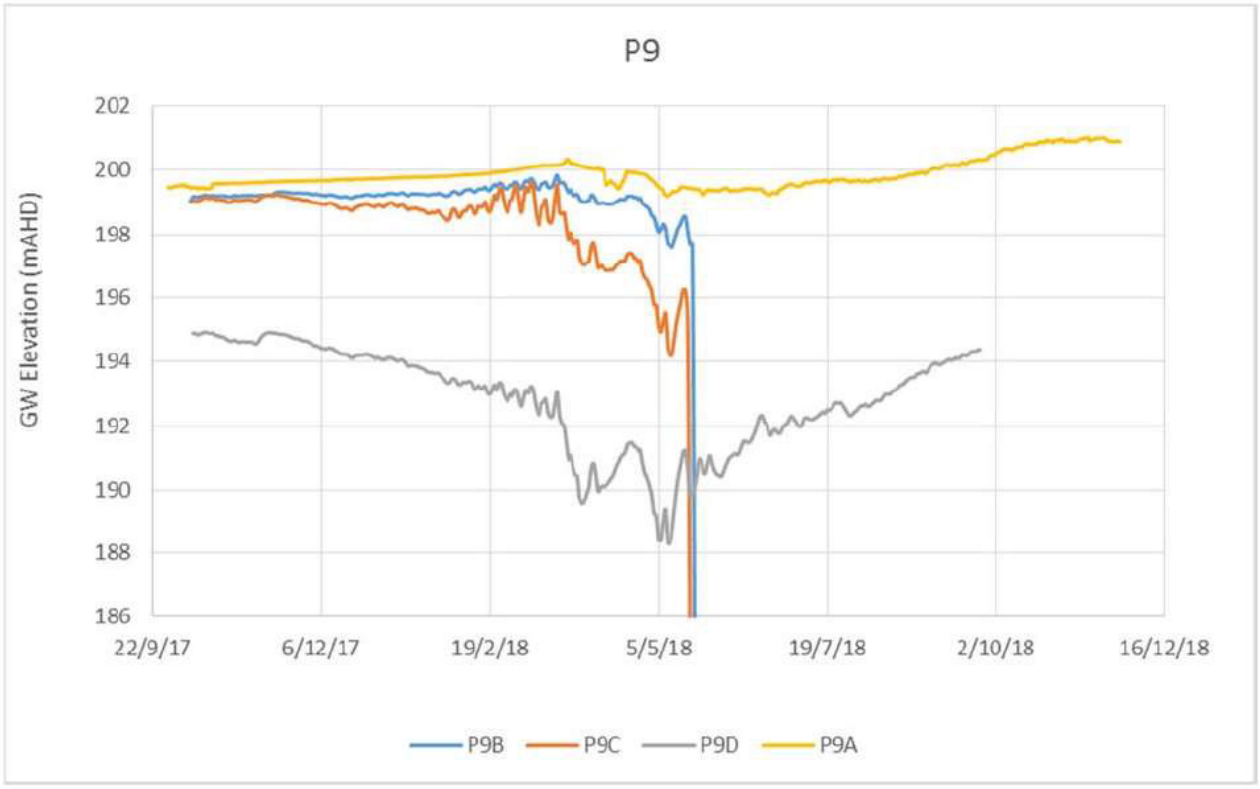


Figure 36 P9 Groundwater Monitoring Bore

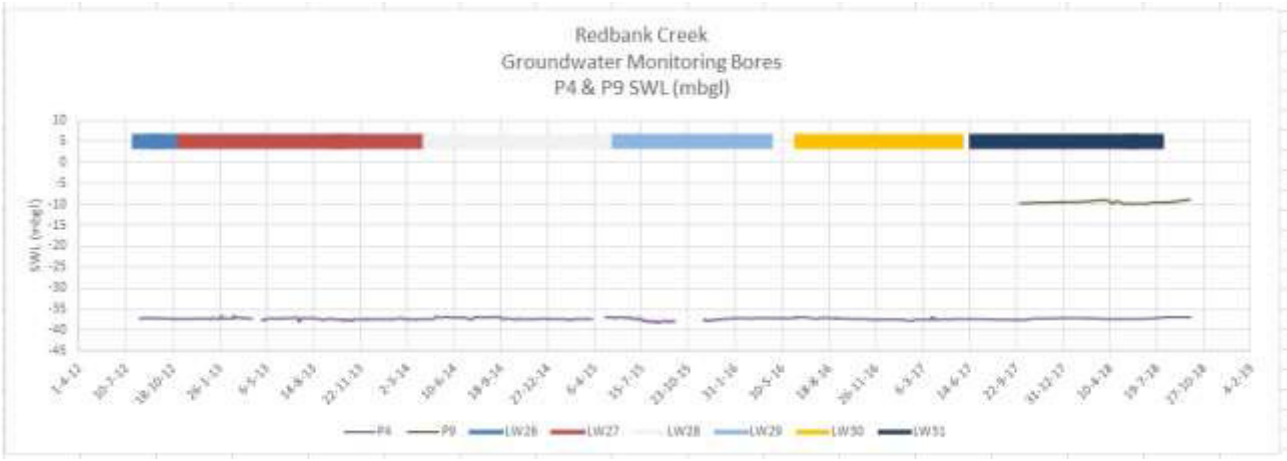


Figure 37 Groundwater Monitoring Bores Near Redbank Creek

7 Myrtle Creek CMAP

The approved Myrtle Creek CMAP schedule is outlined within **Appendix 3**.

The Myrtle Creek CMAP methodology will form the basis for that implemented for the Redbank Creek CMAP.

The Myrtle Creek CMAP involves two distinct stages of work and project elements.

The outcomes from the Myrtle Creek CMAP Stage 1 will be applied to the remediations works proposed for the Redbank Creek CMAP and as such a short summary of the Myrtle Creek CMAP is provided to provide context for the remediation works proposed under the Redbank Creek CMAP.

7.1 Myrtle Creek CMAP Approvals

During this stage of works program any required regulatory approvals are prepared and lodged, such as a Part 7 permit with NSW Fisheries.

7.2 Myrtle Creek CMAP Land Access

During this stage of work program detailed scoping and inspection of the proposed work sites is conducted so that properties that were access will be required can be identified.

Land access agreements with individual property owners can then be negotiated to enable the specific site works to commence.

7.3 Myrtle Creek CMAP Environmental Management

During this stage of the work program the following site specific documentation is prepared:

- Erosion and Sediment Control Plan;
- Construction Environmental Management Plans;
- Project Safety Plan;
- Site Induction Protocol;
- Site Access Protocol;
- Equipment Entry Protocol;
- Communications Protocol; and
- Stakeholder Engagement Plan.

7.4 Myrtle Creek Pool Mapping

During this stage of the work program the following will be prepared:

- Acquisition of updated LiDAR and orthorectified imagery;
- High resolution 3D CAD stream and pool imagery and photogrammetry;
- Detail geomorphology pool mapping to characterisation of the hydraulic controls along Myrtle Creek, with identification of each rock bar that control the ponding and pooling of water; and
- Stream centre line survey.

The high resolution 3D CAD data will enable detailed pool and rock bar mapping to be conducted to enable accurate volume estimation of each individual pool and rock bar over flow point.

An example of the high resolution 3D pool model is outlined within **Figure 38**.

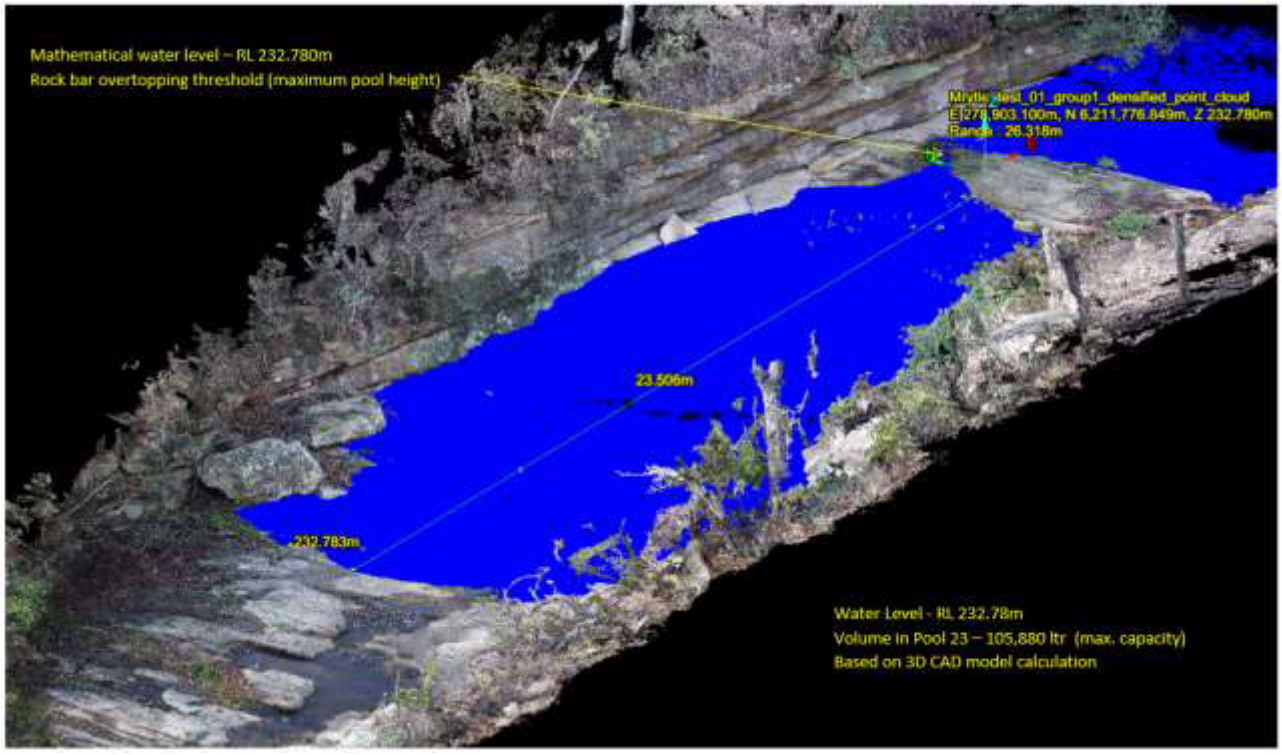


Figure 38 High Resolution 3D Creek Model

7.5 Myrtle Creek Characterisation Study

During this stage of the work program bores will be drilled at 12 locations to enable characterisation of the fracture network along the length of Myrtle Creek stream bed and subsurface down to approximately 30 metres below the stream bed. The characterisation will enable the permeability characteristics of the subsurface to be explored.

Each drill hole will include the following:

- Review of drilling process noting any water loss zones or voids;
- Cored holes to enable detailed geotechnical logging of fracture zones and fracture parameters;
- Bore hole camera to provide a visual scan of the borehole and identification of any voids or fractures;
- Caliper tool logging to detect variations in borehole diameter;
- Packer testing at regular intervals to determine changes in permeability with depth;
- Installation of open standpipe piezometer to enable water level and water quality to be monitored.

A Characterisation Report will be prepared at the completion of the drilling program providing information of the fracture characterisation, bore permeability with depth, groundwater levels and groundwater chemistry. The report will aim to provide interpretations on any specific fractured or sheared zones with higher rock permeability will be identified.

7.6 Myrtle Creek Site 23 Trial

Trial remediation of a rock bar at Site 23 using polyurethane (**PUR**) injection to effect a grouted curtain wall to provide a barrier for subsurface stream flow, with the objective to reduce subsurface flow pathways promoting surface flow and pool holding capacity.

Shallow pattern and deep curtain grouting techniques would be used for the injection of PUR products was undertaken to reduce the permeability of the subsided rock mass by filling voids.

Grouting is used for groundwater control by ground penetrating grouts for a cut-off beneath a rock bar to seal and control subsurface water flows.

Remediation design will be undertaken against agreed rehabilitation criteria. Remediation design includes:

- Technical analysis and modelling;
- Product selection - grout type;
- Product application methodology;
- Site specific plan; and
- Test specifications for completion reporting.

Undertake a remediation grouting trial at Site 23 to demonstrate the efficacy of the design. The grouting trial will include:

- Engagement of technical specialist consultant(s) to assist with technical aspects of the Site 23 grout trial;
- Engagement of a specialist drilling sub-contractor;
- Engagement of a specialist grout application sub-contractor;
- Procurement of the PUR grouting product (likely Spetec H100) through a specialist supplier;
- Management and supervision of grouting injection, utilising specialist equipment and experienced grouting engineers;
- Ongoing geophysical and hydrogeological testing of ground conditions to verify and inform the works;
- Construction management; and
- Risk assessments for key tasks and change management.

A Completion Report will be prepared and will outline the following:

- Activities conducted during the works;
- Results of the investigation;
- Materials used;
- Review of trial success with demonstration of:
    - Reduction in permeability of rock mass;
    - Pool holding capacity and flow;
    - Standing water restoration;
- Unforeseen issues that affected the effective use of drilling/grouting/site management and environmental controls; and
- Recommendations for and location of future pool rehabilitation works.

7.7 Myrtle Creek Pool Remediation Trials

Pool remediation trials using hand grouting and mortaring methods are proposed to be conducted at 3 selected pools to trial hand grouting as a methodology to increase holding capacity of subsidence impacted pools. Hand grouting or mortaring as a methodology aims to seal joints or fractures using a single sourced material with or without the addition of a bonding agent.

Grout and/or mortar materials proposed to be trialled include:

- Brickies sand derived from friable Hawkesbury Sandstone source consisting clayey fine sand with added sealing/bonding agent;

- Clay tailings from crushed Hawkesbury Sandstone source consisting of kaolinite/illite clay material with added sealing/bonding agent;
- Kaolinite clayey ultra-fine sand (-150 µm) with added sealing/bonding agent;
- Portland and other cementitious grout sourced from a commercial supplier;
- Silica fume grout sourced from a commercial supplier;
- PUR sourced from a commercial supplier;
- Collodial silica sourced from a commercial supplier;
- Sand stabilised with colloidal silica sourced from a commercial supplier; and
- Hydrophilic filling materials.

A range of commercially available bonding and /or sealing agents are proposed to be trialled. Careful review of these products material safety and environmental impacts will be reviewed before they are proposed to be used in the trial.

The intent is to select several small pools and trial various grout or mortar materials and application methods to determine if any of these can be further developed to seal larger pools to improve the holding capacity of the pools.

Preparation works with the pools subject to these hand grouting or mortaring trials may be required such as weed and leaf litter removal to expose the fractures to be sealed.

7.8 Myrtle Creek Stage 1 Report

The results, findings and conclusions of the Stage 1 Myrtle Creek CMAP works will be brought together in a Stage 1 Myrtle Creek CMAP Report that will provide background, recommendations and conclusions for the Stage 1 works.

This report will be used to plan Stage 2 works for Myrtle Creek and also remediation works for Redbank Creek CMAP.

7.9 Myrtle Creek Stage 2 Plan

Planning for further remediation works proposed along Myrtle Creek including:

- Stage 2 grout curtain walls at an additional 6 sites; and
- Stage 2 pool remediation at an additional 15 sites.

7.10 Myrtle Creek CMAP Resourcing

A full time Environmental Projects Coordinator with full time dedication to both the Myrtle Creek and Redbank Creek CMAPs has been recruited and commenced with TCCO in late January 2019.

The primary role of this position is to project manage the CMAP creek remediation works.

The Environmental Projects Coordinator will manage and co-ordinate site works.

This includes:

- Preparation of a daily works diary to document construction works;
- Materials management;
- Safety management;
- Environmental management;
- Oversight of design requirements and performance criteria;
- Preparation of weekly reporting and cost tracking/control; and
- Quality Control and Assurance protocols.

8 Redbank Creek CMAP Remediation Strategy

8.1 Aims

The primary aim of the Redbank Creek CMAP is to develop and manage a remediation process to restore Redbank Creek stream flow in the medium term (5 years) to as close to pre-mining conditions as reasonable practical.

The secondary aim of the Redbank Creek CMAP is to establish longer term (+5 years) ecological values within Redbank Creek as close to pre-mining conditions or selected reference site as reasonable practical. Additionally, a secondary aim of the Redbank Creek CMAP is to re-establish public amenity and creek visual component as close to pre-mining conditions or selected reference site as reasonable practical.

8.2 Objectives

The objectives of the Redbank Creek CMAP are to:

- Plan remediation program to leverage the successful outcomes and learnings of the Myrtle Creek CMAP Stage 1 remediation works;
- Complete investigation works stage, including stream and pool mapping and stream bed characterisation;
- Complete remediation works stage including up to 6 grouting sites and up to 15 pool remediation sites;
- Undertake ongoing water flow and water quality monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria;
- Undertake aquatic ecology monitoring at Redbank Creek to provide adequate data for subsidence impact analysis and close out of completion criteria;
- Implement stakeholder and community consultation strategy to keep interested parties informed on the progress of the remediation works.

8.3 Risk Assessment

Key risks identified for the Redbank Creek CMAP are:

- Land access;
- Operational risk associated with drilling and drilling operations pollution control;
- Drill rig access;
- Management of environmental controls;
- Cost controls;
- Technological issues;
- Regulatory environment.

A detail risk assessment for the Redbank Creek CMAP using the TCCO risk control template is proposed to be conducted in March 2019, following the commencement of the dedicated Redbank Creek CMAP project management resource (Environmental Projects Coordinator) in late January 2019.

8.4 Land Access

Detailed scoping and inspection of the proposed work sites is conducted so that properties that were access will be required can be identified.

Land access agreements with individual property owners can then be negotiated to enable the specific site works to commence.

8.5 Remediation Methods

8.5.1 Redbank Creek CMAP Approvals

During this stage of works program any required regulatory approvals are prepared and lodged, such as a Part 7 permit with NSW Fisheries.

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8.5.3 Redbank Creek CMAP Environmental Management

During this stage of the work program the following site specific documentation is prepared:

- Erosion and Sediment Control Plan;
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- Equipment Entry Protocol;
- Communications Protocol; and
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During this stage of the work program the following will be prepared:

- High resolution 3D CAD stream and pool imagery and photogrammetry;
- Detail geomorphology pool mapping to characterisation of the hydraulic controls along Redbank Creek, with identification of each rock bar that control the ponding and pooling of water; and
- Stream centre line survey.

The high resolution 3D CAD data will enable detailed pool and rock bar mapping to be conducted to enable accurate volume estimation of each individual pool and rock bar over flow point.

8.5.5 Redbank Creek Characterisation Study

During this stage of the work program bores will be drilled at 12 locations to enable characterisation of the fracture network along the length of Redbank Creek stream bed and subsurface down to approximately 30 metres below the stream bed. The characterisation will enable the permeability characteristics of the subsurface to be explored.

Each drill hole will include the following:

- Review of drilling process noting any water loss zones or voids;

- Cored holes to enable detailed geotechnical logging of fracture zones and fracture parameters;
- Bore hole camera to provide a visual scan of the borehole and identification of any voids or fractures;
- Caliper tool logging to detect variations in borehole diameter;
- Packer testing at regular intervals to determine changes in permeability with depth;
- Installation of open standpipe piezometer to enable water level and water quality to be monitored.

A Characterisation Report will be prepared at the completion of the drilling program providing information of the fracture characterisation, bore permeability with depth, groundwater levels and groundwater chemistry. The report will aim to provide interpretations on any specific fractured or sheared zones with higher rock permeability will be identified.

8.5.6 Redbank Creek Grout Curtain Wall Sites

Remediation of up to six (6) rock bars using grout injection to effect a grouted curtain wall to provide a barrier for subsurface stream flow will be established along Redbank Creek. The aim of the grout curtain wall is to reduce subsurface flow pathways promoting surface flow and pool holding capacity.

8.5.7 Redbank Creek Pool Remediation Sites

Pool remediation trials using hand grouting and mortaring methods are proposed to be conducted at up to 15 selected pools to increase holding capacity of subsidence impacted pools. Hand grouting or mortaring as a methodology aims to seal joints or fractures using a single sourced material with or without the addition of a bonding agent.

8.6 Program & Timeframes

The programme and timeframes for the Redbank Creek CMAP implantation is outlined within **Appendix 5**.

Pool remediation and rock bar grout curtain wall works will be initially, were possible, targeted along Redbank Creek over Longwall 27, Longwall 28 and Longwall 29, where the most significant evidence for subsidence impact is evident.

In summary, the program provides for the following works at the specified timeframes:

- **Stage 1** (July 2019 to October 2019)
  - Redbank Creek CMAP approvals completed
  - Redbank Creek CMAP EMP & Safety Plan completed
  - Stream Mapping completed
  - Characterisation Sites 1 to 7 completed
- **Stage 2** (November 2019 to June 2020)
  - Characterisation Sites 8 to 12 completed
  - Characterisation Report completed
  - Five (5) pool remediation sites completed
- **Stage 3** (July 2020 to December 2021)
  - Two (2) rock bar grout curtain walls completed
  - Five (5) pool remediation sites completed
- **Stage 4** (January 2022 to June 2022)

    - Two (2) rock bar grout curtain walls completed
    - Five (5) pool remediation sites completed
- **Stage 5** (July 2022 to December 2022)
    - Two (2) rock bar grout curtain walls completed

8.7 Environmental & Safety Management

8.7.1 Erosion and Sediment Control Plan

The Redbank Creek CMAP will draw upon the experiences and resources of the Myrtle Creek CMAP and develop environmental control similar to those used for the Myrtle Creek CMAP, including development of an Erosion and Sediment Control Plan.

8.7.2 Construction EMP

The Redbank Creek CMAP will draw upon the experiences and resources of the Myrtle Creek CMAP and develop environmental control similar to those used for the Myrtle Creek CMAP, including development of a Construction EMP.

8.7.3 Safety and Induction Plan

The Redbank Creek CMAP will draw upon the experiences and resources of the Myrtle Creek CMAP and develop safety and induction procedures similar to those used for the Myrtle Creek CMAP.

8.8 Completion Criteria

8.8.1 Design Principles

Completion criteria are required to follow the Specific-Measurable-Achievable-Realistic-Timely (**SMART**) and Before-After-Control-Impact (**BACI**) design principles.

The SMART design principles involves the following:

- **Specific** - refers to the target of rehabilitation, e.g. the stream geomorphology to be restored;
- **Measurable** - indicates that the expected outcome (e.g. quantity of habitat being restored and/or target species population change) should be able to be measured compared to some baseline state;
- **Attainable/Achieveable** - recognises that setting project goals goes beyond just stream geomorphology considerations. Social and economic factors also need to be considered. Thus the goal-setting process should involve input from representatives of all key stakeholders who may be involved in, affected by, or benefit from the project to manage expectation of the rehabilitation process;
- **Realistic** - means that the goal should be feasible to achieve; and
- **Timely** - means that there should be an expectation given of how long it will take to reach the goal.

What should be rehabilitated depends on why it is perceived that rehabilitation is necessary. A rehabilitation goal is a description of the desired outcome of rehabilitation.

Rehabilitation goals are developed in the context of the site. A site assessment and the baseline data collected at the beginning of the stream rehabilitation, can inform the development of appropriate goals for the site.

The SMART rehabilitation goals for the Redbank Creek CMAP can be described as:

Rehabilitate Redbank Creek stream flow, pool holding capacity and water quality to conditions that support aquatic biodiversity and visual stream aesthetics similar to benchmark (analogue to pre-mining conditions) sites by 2025.

The purposes of impact assessment are to evaluate whether or not a stress has changed the environment, to determine which components are adversely affected, and to estimate the magnitude of the effects. Evaluating change in environmental conditions is often difficult, due to several factors. When information is available prior to the potential impact, the design is often referred to as a BACI design. The BACI design is a statistically powerful experimental design in environmental impact studies. If the timing and location of the impact are known and adequate pre-data is collected, the BACI design is considered useful to isolate the effect of development from natural variability.

If a spatial control is lacking, the effects must be inferred from sampling both Before and After an impact, but this design necessarily assumes that an unaffected site would not have changed in a similar fashion. If the impact occurred before any monitoring began, the Impact site can be compared to a nearby Control site, but this design is suboptimal because it assumes the Control and Impact sites were similar prior to the impact.

The BACI design principles involves the following:

- Before;
- After;
- Control; and
- Impact.

The aquatic ecology of the Redbank Creek will be assessed against BACI design principles using baseline before (albeit limited) Before data available for Redbank Creek, Control sites with the Western Domain (Stonequarry, Matthews and Cedar Creeks) and Tahmoor South (Dry, Eliza, Dog Trap and Hornes Creeks) and Impact sites along Redbank Creek.

8.8.2 Primary Completion Criteria

TCCO propose that the high resolution 3D pool model data, pool volume estimates and rock bar over flow levels will be used to formulate completion criteria based on pre and post remediation water holding capacity of each pool. The detailed pool mapping and photogrammetry linked to CAD software will enable accurate estimations of pool holding capacity.

With the establishment of the 3D pool mapping to establish the pool holding capacity, it is proposed that pool holding capacity and hydraulic conductivity for pre and post pool remediation be established by filling the pool with imported water and recording the time taken for the pool to be drained.

It is proposed that the primary completion criteria be a quantitative means to assess the pre-mining and post restoration aspects that relate to the functioning of the creek, rock bars and pools.

The Stage 1 Completion Report for the Myrtle Creek CMAP will outline proposed Completion Criteria to be agreed and adopted for both the Myrtle Creek and Redbank Creek CMAPs.

It is anticipated that the Completion Criteria would be based upon successful demonstration of a range the following factors, including:

- Demonstration of theoretical pool holding capacity of a pool with successfully remediated pools being demonstrated to hold a percentage of the theoretical holding capacity of a pool for an agreed minimum period;
- Demonstration of pool flow over pool controls in higher flow periods;

- Demonstration of stream flow over whole length of stream;
- Demonstration of aquatic ecology species diversity at an agreed percentage of Before or Control levels;
- Demonstration of stream water quality at an agreed percentage of Before or Control levels; and
- Demonstration of stream system visual and aesthetic values compared to Before or Control levels.

8.8.3 Secondary Completion Criteria

Secondary completion criteria include interim or short term criteria for specific CMAP works and medium to longer term completion criteria that restore Redbank Creek stream parameters close to pre-mining conditions:

- **Short Term**
  - Measurement of the extent of fracture in-filling at rock bar grout sites;
  - Measurement of reduction in rock mass permeability at rock bar grout sites;
- **Medium Term**
  - Reduction in pool water level recession rates; and
- **Long Term**
  - Restoration of the ecological value;
  - Restoration of creek flow;
  - Restoration of pool water quality; and
  - Restoration of stream visual and aesthetic values.

8.9 Reporting

TCCO will prepare and provide the following reporting for the Redbank Creek CMAP:

- Quarterly Progress Report (31 March, 30 June, 30 September; 31 December)
- Remediation Stage Completion Reports; and
- Final Completion Report.

The reports will be submitted to the following stakeholders:

- NSW Resources Regulator;
- DPE – DRG;
- Wollondilly Shire Council;
- TCCC; and
- Other stakeholders as directed by NSW Resources Regulator.

TCCO will prepare a Redbank Creek CMAP Progress Report quarterly every three (3) months on the following dates:

- 31 March;
- 30 June;
- 30 September; and
- 31 December.

The Quarterly Redbank Creek CMAP Progress Report will include the following information:

- Work completed in previous period;
- Work proposed in next period including:

    - Detailed program for next period for review and approval by Resources Regulator;
    - Schedule of works proposed in next period for review and approval by Resources Regulator;
- Review against program;
- Community and stakeholder consultation undertaken;
- Monitoring results;
- Assessment against Completion Criteria; and
- Complaints and incident management.

On completion of each separate Remediation Stage of Redbank Creek CMAP, a Stage Completion Report will be prepared and will outline the following:

- Definition and description of Remediation Stage;
- Work completed during Remediation Stage;
- Results of work completed during Remediation Stage;
- Monitoring Results;
- Materials and methods used and outline of procedures used/developed;
- Assessment against Completion Criteria;
- Complaints and incident management; and
- Recommendations and conclusions.

At the completion of the final remediation of Redbank Creek in accordance with the Redbank Creek CMAP, a Final Completion Report will be prepared and will outline the following:

- Definition and description of remediation works;
- Results of work completed;
- Monitoring Results;
- Materials and methods used and outline of procedures used/developed;
- Assessment against Completion Criteria;
- Complaints and incident management; and
- Recommendations and conclusions.

9 Stakeholder Consultation

9.1 Key Stakeholders

TCCO is committed to consultation with all key stakeholders regarding the implementation of the Redbank Creek CMAP.

A Redbank Creek CMAP Stakeholder and Consultation Plan will be prepared and implemented by the TCCO Community Coordinator with assistance as required from the TCCO Environment Coordinator and/or Environment Projects Coordinator. The Redbank Creek CMAP Stakeholder and Consultation Plan will be completed by 31 March 2019.

Table 22 outlines an overview of key external stakeholders that have been identified by TCCO and the consultation and engagement methods to be employed throughout the implementation of the Redbank Creek CMAP.

Stakeholder	Consultation	Consultation Documents
NSW Resources Regulator	Approval of Redbank Creek CMAP	Redbank Creek CMAP
	Consultation regarding implementation of Redbank Creek CMAP	Project Newsletter
Department of Planning & Environment - Division of Resources and Geoscience	Consultation during the development of the E&SCP	Redbank Creek Erosion and Sediment Control Plan (**E&SCP**)
	Consultation regarding implementation of Redbank Creek CMAP	Project Newsletter
Wollondilly Shire Council	Consultation during the development of the E&SCP	Redbank Creek Erosion and Sediment Control Plan (**E&SCP**)
	Consultation regarding implementation of Redbank Creek CMAP	Project Newsletter
Department of Planning & Environment	Consultation during the development of the E&SCP	Redbank Creek Erosion and Sediment Control Plan (**E&SCP**)
	Consultation regarding implementation of Redbank Creek CMAP	Project Newsletter
NSW Fisheries	Consultation during the development of the Permit	Part 7 Permit Project Newsletter
Environment Protection Authority	Consultation regarding implementation of Redbank Creek CMAP	EPL 1389
		Project Newsletter
Residents	Consultation with residents before and during Redbank Creek CMAP implementation and works	Project Newsletter
TCCO Community Consultative Committee (**TCCCC**)	Consultation ongoing with updates at quarterly meetings	Project Newsletter
		TCCCC Presentation
Environmental Groups	Consultation with residents before and during Redbank Creek CMAP implementation and works	Project Newsletter

Table 22 Stakeholder Communications

9.2 Communications & Consultation

A crucial aspect to the success of managing the community consultation aspects of the implementation of the Redbank Creek CMAP is ensuring that ongoing, transparent and two way communication is adopted between TCCO and relevant stakeholders with an ongoing interest in the successful implementation of the Redbank Creek CMAP.

Stakeholders that have been identified by TCCO with an interest in the Redbank Creek CMAP will be kept informed with a Redbank Creek CMAP Newsletter.

The Newsletter will be distributed on an as required basis, but at a frequency of not less than six monthly intervals.

The Redbank Creek CMAP Newsletter will be distributed via email to TCCO stakeholder database and hand delivered to all residential addresses that back onto Redbank Creek.

The Redbank Creek CMAP Newsletter will also be available on the TCCO website (http://www.simec.com/mining/tahmoor-coking-coal-operations/).

Preparation and distribution of the Redbank Creek CMAP Newsletter will be administered by the TCCO Community Coordinator with assistance as required from the TCCO Environment Coordinator and/or Environment Projects Coordinator.

9.3 Enquiry Management

TCCO has a 24 hour community phone line (**1800 154 415**) for community enquiries. This phone line will be utilised to manage all enquiries relating to the Redbank Creek CMAP. They will be recorded in the TCCO Environment & Community Stakeholder database, administered by the TCCO Community Coordinator.

TCCO has an enquiry email (tahmoorenquiries@simecgfg.com) and a TCCO website (http://www.simec.com/mining/tahmoor-coking-coal-operations/).

The TCCO Community Coordinator and/or the TCCO Environment Coordinator and/or the Environment Projects Coordinator will be responsible for responding to all email enquiries. An email response will be sent as soon as possible to all email enquiries.

10 Plan Administration

10.1 Roles and Responsibilities

All statutory obligations applicable to the Redbank Creek CMAP are identified and managed via the TCCO CMO compliance management system administered by the TCCO Compliance Coordinator.

The overall responsibility for the implementation of the Redbank Creek CMAP resides with the TCCO Environment & Community Manager who is the TCCO nominated Redbank Creek CMAP authorising officer.

The responsibilities of the following TCCO staff related to the management and implementation of the Redbank Creek CMAP are outlined on **Table 23**.

Role	Redbank Creek CMAP Accountabilities
General Manager	• Ensure that Redbank Creek CMAP implementation is managed and adequately resourced so that works can be completed in a manner that is safe and in compliance with the requirements of the Redbank Creek CMAP.
Environment and Community Manager	• Ensure sufficient resource allocation for the implementation of the Redbank Creek CMAP. • Ensure Redbank Creek CMAP implementation works are planned and budgeted within the TCCO LOM and budget planning process. • Ensure all internal and external reporting, reviews, audits, non-conformances and improvement requirements are met, including incident reporting. • Proactively engage government and community stakeholders as required. • Review and approve internal and external reports e.g. Annual Review. • Prepare and submit Quarterly progress reports.

	• Ensure effective management of all community complaints. • Review, approve and endorse any Redbank Creek CMAP amendments to DPE-RR (Environment) for approval.
Community Coordinator	• Preparation and management of the Redbank Creek CMAP Stakeholder and Consultation Plan. • Coordinate ongoing stakeholder consultation. • Preparation and distribution of the Redbank Creek CMAP Newsletters.
Environment Coordinator	• Redbank Creek CMAP implementation. • Preparation of Redbank Creek Erosion and Sediment Control Plan. • Preparation of Fisheries Part 7 permit. • Coordination of annual Redbank Creek CMAP training. • Preparation and implementation of Contingency Plan (if required). • Preparation and management of Redbank Creek CMAP reporting, audits and reviews for review and approval by the TCCO Environment & Community Manager. • Assist with the preparation and ongoing management of the Stakeholder and Consultation Plan, stakeholder consultation and Contingency Plan. • Assist in preparation and distribution of Redbank Creek CMAP Newsletters. • Identification and reporting of any incidents, non-conformances identified during the implementation of the Redbank Creek CMAP.
Environment Projects Coordinator	• Redbank Creek CMAP implementation. • Coordination and supervision of all works required for implementation of the Redbank Creek CMAP. • Supervision of site safety for all implementation works. • Coordination of Redbank Creek CMAP site specific training, safety and induction programs. • Coordination of environmental controls for all Redbank Creek CMAP implementation works. • Assist with the preparation and ongoing management of the Erosion and Sediment Control Plan and Fisheries Part 7 permit. • Assist with the preparation and ongoing management of the Stakeholder and Consultation Plan, stakeholder consultation, Contingency Plan, reporting requirements, audits and reviews. • Assist in preparation and distribution of Redbank Creek CMAP Newsletters. • Identification and reporting of any incidents, non-conformances identified during the implementation of the Redbank Creek CMAP.
Compliance Coordinator	• Administration of the TCCO CMO compliance management system. • Administration of the TCCO document control system.
Training Coordinator	• Administration of TCCO training records

Table 23 Redbank Creek CMAP Roles and Responsibilities

10.2 Training

TCCO staff with responsibilities under the Redbank Creek CMAP will undergo training, coordinated by the TCCO Environment Coordinator, at approximately 12 month intervals with the training including:

- The relevant sections of the Redbank Creek CMAP and the importance of compliance;

- Roles and responsibilities of persons in relation to the operation of the Redbank Creek CMAP;
- Reporting related to the Redbank Creek CMAP;
- Relevant standards and procedures associated with the Redbank Creek CMAP; and
- Conduct of internal and external audits.

Records of all training for each person shall be maintained by the TCCO Training Department administered by the TCCO Training Coordinator.

All staff and contractors working on the implementation of the Redbank Creek CMAP are required to complete the TCCO site specific training, safety and induction programs, coordinated by the TCCO Environment Projects Coordinator, which includes:

- An initial site induction (including aspects of environment, safety and community);
- Safe Work Methods Statements and Job Safety Analyses, Toolbox Talks and Pre-shift communications; and
- On-going job specific training and re-training (where required).

All training records are maintained by the TCCO Training Department administered by the TCCO Training Coordinator.

It shall be the responsibility of the TCCO Environment & Community Manager to ensure that all persons and organisations having responsibilities under this Redbank Creek CMAP are trained and understand their responsibilities.

The TCCO staff and/or contractors performing regular inspections shall be under the supervision of the Environment Coordinator and be trained in observation and reporting. The Environment Coordinator shall be satisfied that the TCCO staff and/or contractors performing the inspections are capable of meeting and maintaining required standards and reporting quality.

A site specific induction / training package will be developed outlining the key environmental / safety hazards and controls identified in the risk assessment and Redbank Creek CMAP as well as providing basic environmental awareness information.

It will be a site specific requirement that any TCCO staff, consultant or contractor working on the Redbank Creek CMAP will be inducted prior to any works commencing. Regular tool box talks will be provided to ensure that all environmental approvals are adhered to and reporting is captured.

10.3 Contingency Planning

In the event that any Redbank Creek CMAP implementation work parameters are considered to have been exceeded, or are likely to be exceeded, TCCO will implement a Contingency Plan to manage any unpredicted impacts and their consequences.

The Contingency Plan would involve the following actions:

- Capture record of the exceedance immediately;
- Notify relevant stakeholders as soon as practicable;
- Notify relevant agencies and specialists as soon as practicable;
- Conduct site visits with stakeholders as required;
- Contract specialists to investigate and report on identified impacts;
- Provide incident report to relevant agencies within seven days;
- Undertake a condition assessment to record impacts within 14 days;
- Establish weekly monitoring frequency until any unstable area/s are stabilised;
- Monthly updates from specialists on investigation process;

- Inform relevant agencies and stakeholders of results of investigation within 1 week of completion;
- Develop site Corrective Management Actions (**CMA**) in consultation with key stakeholders if required within 1 month, (pending stakeholder availability) and seek approvals;
- Implement CMA as agreed with stakeholders following approvals;
- Conduct initial follow up monitoring and reporting within two months of CMA completion;
- Review management and implementation controls for the Redbank Creek CMAP within three months; and
- Report results in regular reporting e.g. AEMR.

10.4 Incidents, Compliants, Non-Conformances & Corrective Actions

10.4.1 Incidents

TCCO will notify the NSW Resources Regulator and any other relevant agencies of any incident associated with the implementation of the Redbank Creek CMAP as soon as practicable after TCCO confirms the incident.

TCCO will provide the NSW Resources Regulator and any relevant agencies with a detailed report on the incident within seven days of confirmation of any event.

10.4.2 Compliants

To ensure any community complaints related to the Redbank Creek CMAP are addressed in a timely and satisfactory manner, TCCO will:

- Provide a readily accessible contact point through a 24 hour toll-free Community Call Line (**1800 154 415**) or TCCO enquiries email (tahmoorenquiries@simecgfg.com);
- The number will be displayed prominently on work sites in a position visible by the public as well as on publications provided to the local community, such as TCCO newsletters;
- Respond to complaints in accordance with the TCCO Community Complaints Procedure;
- Maintain good relations and communication lines between the community and TCCO staff; and
- Keep a register of any complaints, including the details of the complaint.

10.4.3 Non-Conformance Protocol

The requirement to comply with all approvals, plans and procedures is the responsibility of all personnel (staff and contractors) employed for or in association with the Redbank Creek CMAP. Regular inspections, internal audits and initiation of any remediation/rectification work in relation to the Redbank Creek CMAP will be undertaken by the TCCO Environment & Community Manager.

Non-conformities, corrective actions and preventative actions are managed in accordance with the TCCO Non-Conformance, Preventative and Corrective Action Procedure. This procedure details the processes to be utilized with respect to the identification of non-conformances, the application of appropriate corrective actions(s) to address non-conformances and the establishment of preventative actions to avoid non-conformances. The key elements of the process include:

- Identification of non-conformance and/or non-compliances;
- Recording of non-conformance and/or non-compliance;
- Evaluation of the non-conformance and/or non-compliance to determine specific corrective and preventative actions;

- Corrective and preventative actions to be assigned to the responsible person; and
- Management review of corrective actions to ensure the status and effectiveness of the actions.

The Redbank Creek CMAP will be administered in accordance with the requirements of the TCCO Environmental Management System (**EMS**) and all relevant Development Consent Conditions. An Annual Review will be undertaken to assess the Redbank Creek CMAP compliance with all conditions of the relevant Development Consent, mining leases and all other approvals and licenses.

10.4.4 Corrective Action

Non-conformances relating to the content of this Redbank Creek CMAP will be identified through the following methods:

- Weekly inspections:
- Monitoring and surveys:
- Reporting;
- Incident and hazard reporting; and
- Reviews and audits.

The TCCO Environment & Community Manager and/or other delegated TCCO senior Manager or TCCO Compliance Coordinator will investigate all non-conformances identified, and ensure corrective actions are defined, implemented and monitored.

Identifying and tracking of remedial corrective action will via the TCCO CMO compliance management system administered by the TCCO Compliance Coordinator.

Corrective action processes and/or investigations will be undertaken and recorded. Investigations will determine cause, corrective action, and action to prevent reoccurrence. Action plans will be developed and responsibilities defined and assigned. Results and action undertaken will be communicated back to the relevant stakeholders and recorded within CMO by the TCCO Compliance Coordinator.

10.5 Document Control

10.5.1 Document Control

The Redbank Creek CMAP, including all associated ancillary management plans, reports, monitoring, procedures and other documents, are subject to the TCCO document and record control system administered by the TCCO Compliance Coordinator.

The controlled document of this Redbank Creek CMAP is that document appearing on the TCCO electronic intranet.

10.5.2 Record Keeping

Records will be retained at the mine for a period of 7 years from the date the record was made.

Records related to the Redbank Creek CMAP include:

- Risk assessments;
- Reports and monitoring;
- Events;
- Non-conformances- corrective action;
- Audits; and
- Reviews.

10.6 Audit and Management Review

10.6.1 Audit

Audits of the Redbank Creek CMAP will be conducted by the TCCO Environment & Community Manager and/or other delegated TCCO senior Manager or TCCO Compliance Coordinator on an as required basis but with at least one audit conducted annually. Audits will be conducted in consultation with the relevant TCCO staff and will focus on the content and implementation of the Redbank Creek CMAP.

Audits on the content will consist of a determination of understanding of the Redbank Creek CMAP by the individual's allocated responsibility under the Redbank Creek CMAP.

Audits on the implementation shall consist of reviews of the safe working procedures and risk assessments developed to ensure safe operation of the Redbank Creek CMAP. These audits may also involve discussions with personnel involved in the management of works to determine understanding and compliance.

Should an audit of the Redbank Creek CMAP determine that a deficiency is evident in the content or implementation; a corrective action must be developed and implemented. Actions will be assigned to a nominated individual and tracked in CMO administered by the TCCO Compliance Coordinator.

Any changes Redbank Creek CMAP are to be managed and communicated to all personnel in line with the TCCO Change Management Process administered by the TCCO Compliance Coordinator.

10.6.2 Management Review

A comprehensive review of the objectives and targets associated with the TCCO LOM and budget process undertaken on an annual basis by the TCCO Environment & Community Manager.

The annual review will also examine the environmental performance of Redbank Creek CMAP will the results complied within the Annual Progress Report.

The Redbank Creek CMAP will also be reviewed in the following circumstances:

- **Event based**: a review will be triggered following any event or finding that identifies an inadequacy in the Redbank Creek CMAP, 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; or
- **Time based**: an annual review will be conducted to determine that there are not changes to the issues being managed in the Redbank Creek CMAP and that the objectives, procedures and environmental performance and detailed in the Redbank Creek CMAP are being managed and/or achieved.

If deemed appropriate by the TCCO Environment & Community Manager, external stakeholders may be included in the annual review process.

All reviews are to be documented within the Annual Progress Report.

If any deficiencies in the Redbank Creek CMAP are identified, the plan will be modified as required. This will ensure that all environmental documentation continues to meet current environmental requirements, including changes in technology and operational practice, and the expectations of stakeholders.

10.7 Change Information

10.7.1 Change Information

Full details of the document history are recorded in the document control register, by version is outlined on **Table 24**.

Version	Date Reviewed	Reviewer	Change Summary
1.0	31/12/2018	Ron Bush	New document
2.0	28/6/2019	Ron Bush	Updated to incorporate items requested by Resource Regulator following review of Version 1 and outlined with Notice 3

Table 24 Redbank Creek CMAP Document Control Register

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SIMEC

MEMBER OF GFG ALLIANCE

APPENDIX 1

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Department of Industry

NOTICE UNDER SECTION 240(1)(b) MINING ACT 1992

Adverse Impact on Environment

Our Ref: DI 0272 2016

ISSUED TO

Tahmoor Coal Pty Ltd . ACN: (076 663 968)

'Gateway'
Level 44, 1 Macquarie Place
Sydney NSW 2000
Australia

Attention: The Proper Officer

DIRECTION

In accordance with section 240(1)(b) of the *Mining Act 1992*, I, Scott Priestley, an Inspector duly appointed under Section 361 of the Mining Act 1992, direct Tahmoor Coal Pty Ltd, ACN: (076 663 968) ("you") to take the following steps to address the adverse impact that activities carried out under, or purportedly carried out under, CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) have had on the environment:

1) Prepare corrective management action ('CMA') plans where any exceedances of the impact assessment criteria or predictions have occurred in relation to the Trigger Action Response Plans (TARP's) identified in the;

   a) *Tahmoor Colliery. Longwalls 27 to 30 Environmental Management Plan. Revision D. February 2013* ("**Longwall 27-30 EMP**").

2) CMA plans must include;

   a) Description of the impact / issue to be managed;
   b) Results of the investigations;
   c) Aims and objectives for the plan;
      i.) CMA plans, where exceedances of the impact assessment criteria or predictions have occurred for Myrtle Creek and Redbank Creek must include the aims referred to in:
         - *'Section 5.5 Stream Mitigation and Remediation', Longwall 27-30 EMP.;*
   d) Specific actions required to mitigate/manage the impact / issue;
      i.) CMA plans, where exceedances of the impact assessment criteria or predictions have occurred for Myrtle Creek and Redbank Creek must include, but not be limited to:
         - an environmental study, including pool mapping, hydrology assessment and ground/strata characterisation;
         - rehabilitation objectives and completion criteria;
         - methods of rehabilitation, including options analysis for the different methods;
         - assessment of key risks to successful rehabilitation outcomes;
         - site access;
         - materials required;
         - equipment to be used;
         - environmental controls to be used during rehabilitation works;

- timeframes for implementation;
- roles and responsibilities;
- identification of and gaining appropriate approvals from government agencies, and;
- a consultation and communication plan.

The measure referred to above must be carried out by 31 March 2017

BACKGROUND

A) The Department of Industry, Skills and Regional Development ("the Department") has responsibility for the administration and enforcement of the Mining Act and associated regulations.

B) CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) are in force.

C) You are a responsible person in relation to CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) within the meaning of section 239E(1) of the *Mining Act 1992* because you are a holder of the authorisations.

D) In accordance with the provisions of Section 168(1) and 168(2) of the *Mining Act 1992,* on the 5 December 2014, the Minister suspended an Extraction Plan Condition relating to CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) and approved an alternative Extraction Plan Condition which states, inter alia;

(a) *In this condition*

(i) ***approved Extraction Plan*** *means a plan, being:*

A. an extraction plan or subsidence management plan approved in accordance with the conditions of a relevant development consent and provided to the Secretary; or

B. a subsidence management plan relating to the mining operations subject to this lease:

I. submitted to the Secretary; and

II. approved by the Secretary.

(ii) ***relevant development consent*** *means a development consent or project approval issued under the Environmental Planning & Assessment Act 1979 relating to the mining operations subject to this lease.*

E) On 31 October 2012 the Department approved the Subsidence Management Plan ('SMP') Application for Longwalls 27 – 30, dated August 2009, known as; "*Subsidence Management Plan Approval Tahmoor Colliery Longwalls 27 – 30. CCL716, ML1376 & ML 1539 File No. 11/3219. 31/10/12" ("*SMP Approval")

F) Condition 6 of the SMP Approval states:

"General Obligation to Minimise Harm to the Environment

The Leaseholder must implement the SMP (as amended by the conditions of this Approval) and carry out any additional practicable measures necessary to prevent any harm to the environment that may result from the construction, operation, or rehabilitation of the activity. Where prevention cannot be achieved the leaseholder is to demonstrate minimisation of harm to the environment that may result from the construction, operation, or rehabilitation of the activity".

G) Condition 13 of the SMP Approval states:

Environmental management

"The Leaseholder must submit to the Director Environmental Sustainability & Land Use for approval an Environmental Management Plan (EMP) for the panels which are the subject of this Approval. This plan must address subsidence impacts on:

a) surface and groundwater (quality and quantity), including Myrtle and Redbank Creeks;

b) flora and fauna;

c) heritage sites including Aboriginal heritage sites:

d) geomorphology, including rock bars and cliff lines; and

e) surface and groundwater (quality and quantity); including groundwater bores on privately owned land within a 3 kilometre radius of the limit of mining.

The leaseholder must not operate other than in accordance with an Environmental Management Plan (EMP) approved by the Director Environmental Sustainability & Land Use. This plan must address subsidence impacts above and must include:

a) a detailed monitoring programme;

b) trigger levels for subsidence impacts that require actions and responses;

c) the procedures that would be followed in the event that the monitoring indicates an exceedance of trigger levels;

d) measures to mitigate, remediate and/or compensate any identified impacts;

e) a protocol for the notification of identified exceedances of the trigger levels; and

f) a contingency plan

H) It is the Departments understanding the most recent EMP is "*Tahmoor Colliery Longwalls 27 to 30, Environmental Management Plan, Revision D - February 2013.*" ("**Longwall 27-30 EMP**")

I) The 'Longwall 27-30 EMP' contains a Trigger Action Response Plan (TARP) at Appendix A, page 53 and outlines what actions will be taken in the case where exceedances of the impact assessment criteria or predictions occur.

J) Departmental records show Subsidence Event Notifications have been reported regarding Longwalls 27, 28 and 29. The events observed and reported are likely to have been caused by subsidence impacts from the extraction of Longwalls 27, 28 or 29 and include, but are not limited to; impacts to 'Redbank Creek' and 'Myrtle Creek' at Thirlmire, NSW 2572.

K) On 11 January 2016 at 13:39 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*significant cracking at rock bars*' likely to have been caused by subsidence impacts from the extraction of Longwall 29.

L) On 22 January 2016 at 11:00 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*stream water inflow and associated wash away sediment and gravel in Redbank Creek*' and included '*increased separation of sandstone sheets'* in the bed of Redbank Creek, likely to have been caused by subsidence impacts from the extraction of Longwall 29.

M) On 28 January 2016 at 15:00 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*The stream bed at site RR10 is totally dry or has very low water levels with significant cracking in the pools'* and included '*additional movement and "sheeting" development in sites 37 to RR9",* likely to have been caused by subsidence impacts from the extraction of Longwall 29.

N) On 01 March 2016 at 09:02 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Zn has exceeded baseline parameters at site 37'* likely to have been caused by subsidence impacts from the extraction of Longwall 29.

O) On 06 March 2016 at 1012 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Minor crack at sites RC31 and RC33'* and included '*Pool levels at RB3 are noticeably less than last week*' likely to have been caused by subsidence impacts from the extraction of Longwall 29.

P) On 02 June 2016 departmental inspectors conducted an inspection of CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) and identified the following at 'Redbank Creek' and 'Myrtle Creek' Thirlmire, NSW 2572:

i. loss of flow connectivity within a flowing ephemeral stream; and
ii. ground cracking or buckling in creek bed or bank

The background above provides information on key relevant events. It is not intended to be a comprehensive summary of all communications between you and the Department. Other facts not recited above may be relevant.

ISSUE DETAILS

Issued By: Scott Priestley

an Inspector duly appointed under Section 361 of the Mining Act 1992

Dated this 5th day of December 2016.

Registered Post, Email

Maitland	Orange	Wollongong
516 High Street, Maitland NSW 2320 PO BOX 344, HRMC NSW 2310 Ph: 02 4931 6666	161 Kite Street, Orange NSW 2800 Locked Bag 21, Orange NSW 2800 Ph: 02 6360 5333	84 Crown Street, Wollongong NSW 2500 PO BOX 674, Wollongong NSW 2520 Ph: 02 4222 8333

Email: scott.priestley@industry.nsw.gov.au

Phone: 0419 865 413

WARNING AND INFORMATION

Failure to comply

- It is an offence under section 240C of the Mining Act to fail to comply with this direction without a reasonable excuse.
- The maximum penalty for this offence is, for a corporation, $1,100,000 and a further $110,000 for each day the offence continues, and, for a natural person, $220,000 and a further $22,000 for each day the offence continues.
- If you fail to comply with this direction, the Minister may take any action necessary to give effect to the direction including authorising another person to carry out those activities and recover the costs and expenses so incurred from you or applying to the Court for an injunction directing you to comply with this direction.

Other action

- The serving of this direction and the matters required of you pursuant to this direction in no way preclude, hinder or otherwise restrain the Minister, Secretary or Department from taking further action against you (and the holder of the authorisation to which this direction relates, if you are not the holder of the authorisation) including by commencing legal proceedings.

General

- The words and expressions used in this direction have the same meaning as they have in the Mining Act.
- Any information collected is for the purposes of the Mining Act

SIMEC

MEMBER OF GFG ALLIANCE

APPENDIX 2

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Planning & Environment
Resources Regulator

NOTICE UNDER SECTION 240(1)(d) MINING ACT 1992
Harm to the Environment

Our Ref: DI 0680 2018
ACES Ref: 0353 – 2016
OUT17/48999

ISSUED TO

Tahmoor Coal Pty Ltd
ACN: (076 663 968)
'Gateway' Level 44,
1 Macquarie Place
Sydney NSW 2000
Australia

Attention: The Proper Officers

DIRECTION

In accordance with section 240(1)(d) of the *Mining Act 1992*, I, David Muxlow, an Inspector duly appointed under Section 361 of the Mining Act 1992, direct Tahmoor Coal Pty Ltd ACN: (076 663 968) ("you") to take the following steps to conserve the environment, protect it from harm as a result of activities under Consolidated Coal Lease 716 (1973) and Mining Leases 1308, 1376, 1539 and 1642 or to prevent, control or mitigate any such harm.

1. Review and update, by no later than 31 August 2018:

   1.1. the current Tahmoor Colliery Mining Operations Plan to incorporate the:

      A. "*Corrective Management Action Plan Final Revision B. Version 1. Dated 16 June 2017 Number TAHUG-2119843053-10*" provided in response to 240(1)(b) Notice No. DI 0272 2016.

2. Amend and submit for approval of the Department an updated timeline providing dates the various stages for implementation of action as listed in Table 14 of Section 9.2.1 "Timeframes for implementation" of the "*Corrective Management Action Plan Final Revision B. Version 1. Dated 16 June 2017*", by no later than 31 August 2018,

3. Take all reasonable steps to implement the works as outlined in amended and approved timeline (as listed at point 2) to remediate Myrtle Creek as per the "*Corrective Management Action Plan Final Revision B. Version 1. Dated 16 June 2017*

4. Plan, draft and submit for review, a Corrective Management Action Plan for Redbank Creek by no later than 31 December 2018,

5. Review and update, by no later than 31 July 2019:

   5.1. the current Tahmoor Colliery Mining Operations Plan to incorporate a Corrective Management Action Plan for Redbank Creek.

DEFINITIONS

Environmental Management Plan (EMP) means a plan prepared and approved by the Department pursuant to:

i. condition 13 of the Subsidence Management Plan approved on 31 October 2012.

ii. condition 12 of the Subsidence Management Plan approved on 3 May 2017

Subsidence Management Plan (SMP) means a plan prepared and approved by the Department including:

i. Tahmoor Colliery Subsidence Management Plan Application, Longwalls 27 to 30 dated August 2009, and any supplementary supporting information provided to the Department approved 31 October 2012.

ii. Tahmoor Colliery Subsidence Management Plan Application, Longwalls 31 to 37 dated December 2014, Letter dated 22 December 2016 seeking approval for Longwall 31 only, and any supplementary supporting information provided to the Department approved 3 May 2017.

Mining Operations Plan means a plan prepared and approved by the Department pursuant to:

i. Authorisation known as Consolidated Coal Lease 716 (**CCL 716**), and

ii. Authorisation known as Mining Lease 1308 (**ML 1308**), and

iii. Authorisation known as Mining Lease 1376 (**ML 1376**), and

iv. Authorisation known as Mining Lease 1539 (**ML 1539**), and

v. Authorisation known as Mining Lease 1642 (**ML 1642**).

Tahmoor Colliery means CCL 716, ML 1579, ML 1685, ML 1376 and ML 1693.

Department means the NSW Department of Planning and Environment.

BACKGROUND

The Department has responsibility for the administration and enforcement of the Mining Act and associated regulations.

CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) are in force.

Tahmoor Coal Pty Ltd ACN: (076 663 968) (**Tahmoor Coal**) is a responsible person in relation to CCL 716 (1973), ML 1376 (1992), ML 1308 (1992) and ML 1539 (1992) within the meaning of section 239E(1) of the Mining Act because you are a holder of the authorisation.

On 18 March 2004, pursuant Section 239 of the Mining Act, CCL 716 (1973), ML 1308, ML 1376 and ML 1539 were amended with an additional Subsidence Management Condition requiring the preparation of a Subsidence Management Plan (**SMP**) as depicted in the Schedule A,

Condition (e) of Schedule A states;

"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 - Policy."

On 31 October 2012 the Department approved an SMP Application for Longwalls 27 – 30, dated August 2009, known as; "*Subsidence Management Plan Approval Tahmoor Colliery Longwalls 27 – 30. CCL716, ML1376 & ML 1539 File No. 11/3219. 31/10/12"* (**SMP Approval**).

Condition 6 of the SMP Approval states:

*"**General Obligation to Minimise Harm to the Environment***

The Leaseholder must implement the SMP (as amended by the conditions of this Approval) and carry out any additional practicable measures necessary to prevent any harm to the environment that may result from the construction, operation, or rehabilitation of the activity. Where prevention cannot be achieved the leaseholder is to demonstrate minimisation of harm to the environment that may result from the construction, operation, or rehabilitation of the activity

Condition 13 of the SMP Approval states:

Environmental management

"*The Leaseholder must submit to the Director Environmental Sustainability & Land Use for approval an Environmental Management Plan (EMP) for the panels which are the subject of this Approval. This plan must address subsidence impacts on:*

a) surface and groundwater (quality and quantity) , including Myrtle and Redbank Creeks;

b) flora and fauna;

c) heritage sites including Aboriginal heritage sites:

d) geomorphology, including rock bars and cliff lines; and

e) surface and groundwater (quality and quantity); including groundwater bores on privately owned land within a 3 kilometre radius of the limit of mining.

The leaseholder must not operate other than in accordance with an Environmental Management Plan (EMP) approved by the Director Environmental Sustainability & Land Use. This plan must address subsidence impacts above and must include:

a) a detailed monitoring programme;

b) trigger levels for subsidence impacts that require actions and responses;

c) the procedures that would be followed in the event that the monitoring indicates an exceedance of trigger levels;

d) measures to mitigate, remediate and/or compensate any identified impacts;

e) a protocol for the notification of identified exceedances of the trigger levels; and

f) a contingency plan

Condition 16 of the SMP Approval states:

Incident and Ongoing Management Reporting

"*The Leaseholder must, within 24 hours of becoming aware of the occurrence, notify:*

i. the Principal Subsidence Engineer;

ii. the Director, Environmental Sustainability & Land Use;

iii. the Mine Subsidence Board;

iv. the NSW Office of Water;

v. the operators of all infrastructure as listed in condition 14; and

vi. other relevant stakeholders and any Government Agency with a regulatory role if they request such notification, of the following:

(a) Any significant unpredicted and/or higher-than-predicted subsidence and/or abnormalities in the development of subsidence;

(b) Any exceedance of predicted impacts on groundwater resources and/or the natural environment that may have been caused (whether partly or wholly) by subsidence;

(c) Any observed subsidence impacts adverse to the serviceability and/or safety of infrastructure and other built structures that may be affected by longwall mining;

(d) Any significant subsidence-induced cracking and/or ground deformations observed in any surface areas within the SMP application area;

(e) Any buildings, structures and infrastructure, which have become or are likely to become hazardous as a result of subsidence, and

(f) Development of instability and/or falls of rocks within any areas with cliff formations and/or steep slopes that may have been affected by subsidence."

It is the Departments understanding the most recent EMP is "*Tahmoor Colliery Longwalls 27 to 30, Environmental Management Plan, Revision D - February 2013.*" ("**2013 Longwall 27-30 EMP**")

The '2013 Longwall 27-30 EMP' contains a Trigger Action Response Plan (**TARP**) at Appendix A, page 53 and outlines what actions will be taken in the case where exceedances of the impact assessment criteria or predictions occur

The relevant features in Appendix A of the TARP regarding Myrtle and Redbank Creek are stated at:

Page 57, Stream Water Quality for features MYC1, 2, 3 and 4 and RC1, 2 and 3 (**Stream Water Quality**), and

Page 58, Stream Flow / Water Level for features M1 – M6 and R1 – R11 (**Stream Flow / Water Level**), and

Page 59, General Stream Sites for features MYC1, 2, 3 and 4, M1 – M6, R1 – R11, RC1, 2 (**General Stream Sites**) and 3.

Stream Water Quality, Stream Flow / Water Level and General Stream Sites features have three management triggers:

i. Normal,

ii. Within Predictions, and

iii. Exceeds predictions.

The management actions against the features where the management trigger is classified as '*Exceeds Predictions*' includes;

"*Prepare and implement a site mitigation/action plan within 1 mth (pending stakeholder availability) and seek approvals from key agencies if required*"

The EMP also presents certain management actions that will be implemented if a subsidence impact exceeding the predictions has been identified. For example, the EMP states at:

1. Section 5.1, '*Trigger Action Response Plan*', page 41, Paragraph 1,

   "*The Trigger Action Response Plan (TARP), as presented in Appendix A, has been designed to illustrate how the various predicted or potential subsidence impacts, monitoring components, performance measures, and responsibilities are structured to achieve compliance with the relevant statutory requirements, and the framework for management and contingency actions*"

2. Section 5.1, '*Trigger Action Response Plan*', page 41, Paragraph 7,

   "*The Principal TARPs represent actions to be taken where a defined trigger is exceeded and requires corrective management in consultation with stakeholders to manage an observed impact in accordance with relevant approvals.*"

3. Section 5.1, 'Trigger Action Response Plan', page 41, Paragraph 11,

   "*Management actions will be implemented if a subsidence impact exceeding the predictions has been identified.*"

4. Section 5.3 '*Response to TARP Criteria Exceedances', page 42*

   "Where a trigger is exceeded, the cause and effect should be investigated and a management plan developed if the cause is directly related to mining."

Departmental records show 13 Subsidence Event Notifications were observed and or reported by Tahmoor Coal, regarding Longwalls 27, 28, 29 or 30, under condition 16 of the SMP Approval since 11 March 2013 where exceedances of the impact assessment criteria or predictions occurred.

The Subsidence Event Notifications were reported by Tahmoor Coal as likely or known to have been caused by subsidence impacts from the extraction of Longwalls 27, 28, 29 or 30 and include, but are not limited to impacts to 'Redbank Creek' and 'Myrtle Creek' at Thirlmire, NSW 2572.

On 11 March 2013, a Subsidence Event Notification was reported regarding 'Myrtle Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Longwall 26 subsidence impact. Trigger exceeded during mining of LW27 at a number of sites above LW's 26 and 27 (active subsidence zone).*

On 11 March 2013, a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Subsidence impacts from LW26. Cracks are present but no adverse effect on stream flow, pool level, water quality or bed/bank stability. Cracks were not identified during longwall 26 End of Panel inspection. Cracks identified at surface have occurred between the End of Panel inspection date and current period.'*

On 18 June 2014 at 1322 a Subsidence Event Notification was reported regarding 'Myrtle Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Loss of water in two (2) rock pools*'. The likely or known cause was subsidence impacts from mining of Tahmoor Colliery Longwall 28.

On 31 June 2014 at 0700 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Longwall 27 subsidence event. Water quality has exceeded baseline parameters as per LW27-30 SMP Environmental Management Plan TARP.*' The likely or known cause was subsidence impacts from Longwall 27.

On 31 June 2014 at 0700 a Subsidence Event Notification was reported regarding 'Myrtle Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Longwall 28 subsidence event. Pool in Myrtle Creek has been dry for greater than two (2) months and triggered TARP.*' The likely or known cause was subsidence impacts from Longwall 28.

On 6 March 2015 at 1012 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Minor crack at sites RC31 and RC33* and included '*Pool levels at RB3 are noticeably less than last week*'. The likely or known cause was subsidence impacts from the extraction of Longwall 29.

On 19 March 2015 at 1309 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Redirection of surface water flows and pool level decline during mining at sites RC37, RC2 and R6.*' The likely or known cause was subsidence impacts from the extraction of Longwall 28.

On 11 December 2015 at 0900 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Minor cracking of colluvial soil sandstone and in bedrock downstream of RBCC.*' The likely or known cause was subsidence impacts from the extraction of Longwall 29.

On 21 December 2015 at 1158 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Significant crack in rock bar observed at RR9.*' The likely or known cause was subsidence impacts from the extraction of LW29.

On 11 January 2016 at 1339 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*significant cracking at rock bars*'. The likely or known cause was subsidence impacts from the extraction of Longwall 29.

On 22 January 2016 at 1100 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*stream water inflow and associated was away sediment and gravel in Redbank Creek*' and included '*increased separation of sandstone sheets*' in the bed of Redbank Creek. The likely or known cause was subsidence impacts from the extraction of Longwall 29.

On 28 January 2016 at 1500 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*The stream bed at site RR10 is totally dry or has very low water levels with significant cracking in the pools'* and included '*additional movement and "sheeting" development in sites 37 to RR9".* The likely or known cause was subsidence impacts from the extraction of Longwall 29.

On 1 March 2016 at 0902 a Subsidence Event Notification was reported regarding 'Redbank Creek' at Thirlmire, NSW 2572. The event observed and reported was '*Zn has exceeded baseline parameters at site 37*'. The likely or known cause was subsidence impacts from the extraction of Longwall 29.

Between 11 March 2013 and 2 June 2016, Tahmoor Coal submitted 13 Subsidence Event Notifications where exceedances of the impact assessment criteria or predictions occurred but did not prepare and implement a site mitigation / action plan within 1 month of the notifications as required by the TARP in the 2013 Longwall 27-30 EMP.

On 2 June 2016, departmental inspectors conducted an inspection of Tahmoor Colliery and identified the following at 'Redbank Creek' and 'Myrtle Creek' Thirlmire, NSW 2572:

i. loss of flow connectivity within a flowing ephemeral stream; and
ii. ground cracking or buckling in creek bed or bank

On 17 November 2016, a draft 240(1)(b) Notice No DI 0272 2016 was issued to Tahmoor Coal (No. DI 0272 2016), for comment on a proposed timeframe to complete and submit a corrective management action plans (**CMA Plan**) where any exceedances of the impact assessment criteria occurred in relation to the TARP in the 2013 Longwall 27-30 EMP.

On 24 November 2016 Tahmoor Coal requested an extension to providing comment on draft 240(1)(b) Notice No. DI 0272 2016. An extension was provided and on 2 December 2016 Tahmoor Coal submitted a request to complete and submit the CMA Plans by 31 March 2017.

On 5 December 2016, a Final 240(1)(b) Notice was issued to Tahmoor Coal (No. DI 0272 2016) requiring the submission of the CMA Plan by 31 March 2017.

On 7 March 2017 Tahmoor Coal requested an extension to the 240(1)(b) Notice to 28 April 2017. An extension was provided and on 28 April 2017 Tahmoor Coal provided a response to the 240(1)(b) Notice with a **CMA Plan** (**CMA Plan Revision A**).

CMA Plan Revision A was assessed and found to be inadequate, deficient and not compliant with the 240(1)(b) Notice No DI 0272 2016.

CMA Plan Revision did not include exact actions required by Condition 2) d. i.) of the Notice and specifically the CMA Plan did not,

i. Identify the sites to be rehabilitated,
ii. Characterise or illustrate the fracture network or how the fracture network will be assessed,
iii. Provide an options analysis for rehabilitation, or
iv. Provide completion criteria.

On 23 May 2017 Tahmoor Coal were advised that CMA Plan Revision A was not compliant and requested to provide a compliant CMA Plan by 2 June 2017.

On 1 June 2017 Tahmoor Coal advised that a revised CMA Plan (**CMA Plan Revision B**) was in preparation and sought an extension to 16 June 2017. An extension was provided and on 16 June 2017 Tahmoor Coal provided a response to the 240(1)(b) Notice with a **CMA Plan** (**CMA Plan Revision B**).

The background above provides information on key relevant events. It is not intended to be a comprehensive summary of all communications between you and the Department. Other facts not recited above may be relevant.

ISSUE DETAILS

Issued By: David Muxlow

an Inspector duly appointed under Section 361 of the Mining Act 1992

Dated Friday, 4 May 2018

Registered Post, Email

Maitland

516 High Street, Maitland NSW 2320

PO BOX 344, HRMC NSW 2310

Ph: 02 4931 6666

Email: david.muxlow@industry.nsw.gov.au

WARNING AND INFORMATION

Failure to comply

- It is an offence under section 240C of the Mining Act to fail to comply with this direction without a reasonable excuse.
- The maximum penalty for this offence is, for a corporation, $1,100,000 and a further $110,000 for each day the offence continues, and, for a natural person, $220,000 and a further $22,000 for each day the offence continues.
- If you fail to comply with this direction, the Minister may take any action necessary to give effect to the direction including authorising another person to carry out those activities and recover the costs and expenses so incurred from you or applying to the Court for an injunction directing you to comply with this direction.

Other action

- The serving of this direction and the matters required of you pursuant to this direction in no way preclude, hinder or otherwise restrain the Minister, Secretary or Department from taking further action against you (and the holder of the authorisation to which this direction relates, if you are not the holder of the authorisation) including by commencing legal proceedings.

General

- The words and expressions used in this direction have the same meaning as they have in the Mining Act.
- Any information collected is for the purposes of the Mining Act

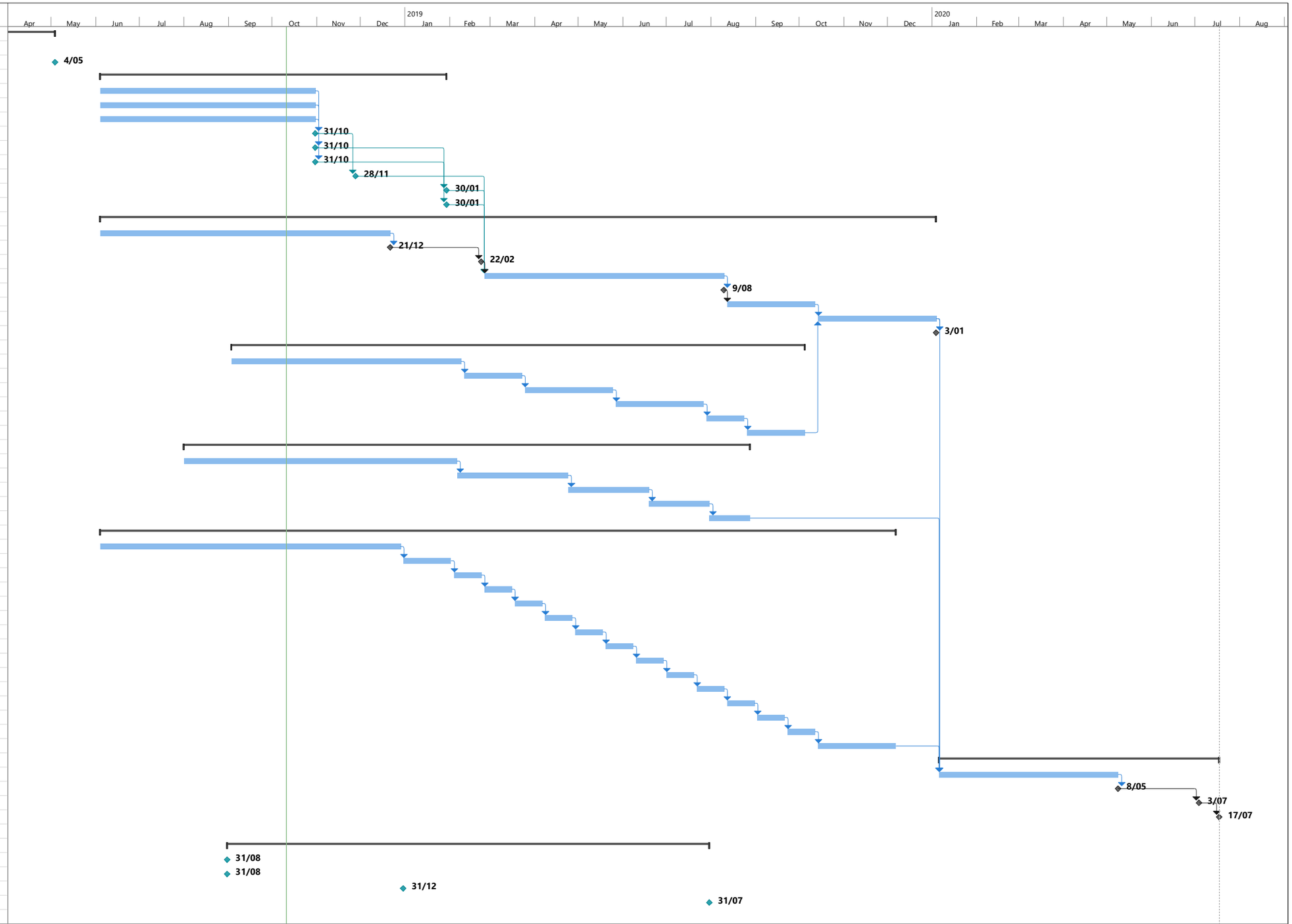
SIMEC

MEMBER OF GFG ALLIANCE

APPENDIX 3

simecgfg.com

ID	Task Name	Start	Finish
1	**Myrtle Creek CMAP**	**Fri 16/06/17**	**Fri 4/05/18**
2	Submit Revision B CMAP for Approval	Fri 16/06/17	Fri 16/06/17
3	Approval of CMAP	Fri 4/05/18	Fri 4/05/18
4	**Myrtle Creek Other Approvals**	**Mon 4/06/18**	**Wed 30/01/19**
5	Preparation of Erosion and Sediment Control Plan	Mon 4/06/18	Tue 30/10/18
6	Preparation of Part 7 Fisheries Permit	Mon 4/06/18	Tue 30/10/18
7	Preparation of EPL Application	Mon 4/06/18	Tue 30/10/18
8	Submit Erosion and Sediment Control Plan	Wed 31/10/18	Wed 31/10/18
9	Submit Part 7 Fisheries Permit	Wed 31/10/18	Wed 31/10/18
10	Submit EPL Application	Wed 31/10/18	Wed 31/10/18
11	Approval of Erosion and Sediment Control	Wed 28/11/18	Wed 28/11/18
12	Fisheries Permit Issued	Wed 30/01/19	Wed 30/01/19
13	EPL Issued	Wed 30/01/19	Wed 30/01/19
14	**Myrtle Creek Site 23 Approvals & Works**	**Mon 4/06/18**	**Fri 3/01/20**
15	Preparation of Site 23 Trial Plan	Mon 4/06/18	Fri 21/12/18
16	Submit Site 23 Trial Plan	Fri 21/12/18	Fri 21/12/18
17	Approval of Site 23 Trial Plan	Fri 22/02/19	Fri 22/02/19
18	Commence Site 23 Works	Mon 25/02/19	Fri 9/08/19
19	Completion of Site 23 Trial	Fri 9/08/19	Fri 9/08/19
20	Completion Criteria Testing Phase	Mon 12/08/19	Fri 11/10/19
21	Preparation of Site 23 Trial Outcomes Report	Mon 14/10/19	Fri 3/01/20
22	Submission of Site 23 Trial Outcomes Report	Fri 3/01/20	Fri 3/01/20
23	**Myrtle Creek Pool Remediation Trials**	**Mon 3/09/18**	**Fri 4/10/19**
24	Pool Remediation Trial Scoping & Preparation	Mon 3/09/18	Fri 8/02/19
25	Pool 1 Trial	Mon 11/02/19	Fri 22/03/19
26	Pool 2 Trial	Mon 25/03/19	Fri 24/05/19
27	Pool 3 Trial	Mon 27/05/19	Fri 26/07/19
28	Data Analysis	Mon 29/07/19	Fri 23/08/19
29	Reporting	Mon 26/08/19	Fri 4/10/19
30	**Myrtle Creek Pool Mapping**	**Wed 1/08/18**	**Tue 27/08/19**
31	Creek Mapping Scoping & Preparation	Wed 1/08/18	Tue 5/02/19
32	LiDAR Surveys	Wed 6/02/19	Tue 23/04/19
33	Pool Mapping & Photogrammetry	Wed 24/04/19	Tue 18/06/19
34	Data Analysis	Wed 19/06/19	Tue 30/07/19
35	Reporting	Wed 31/07/19	Tue 27/08/19
36	**Myrtle Creek Creek Characterisation**	**Mon 4/06/18**	**Fri 6/12/19**
37	Creek Characterisation Scoping & Preparation	Mon 4/06/18	Fri 28/12/18
38	Site Mobilisation	Mon 31/12/18	Fri 1/02/19
39	Characterisation - Site 1 Drilling & Testing	Mon 4/02/19	Fri 22/02/19
40	Characterisation - Site 2 Drilling & Testing	Mon 25/02/19	Fri 15/03/19
41	Characterisation - Site 3 Drilling & Testing	Mon 18/03/19	Fri 5/04/19
42	Characterisation - Site 4 Drilling & Testing	Mon 8/04/19	Fri 26/04/19
43	Characterisation - Site 5 Drilling & Testing	Mon 29/04/19	Fri 17/05/19
44	Characterisation - Site 6 Drilling & Testing	Mon 20/05/19	Fri 7/06/19
45	Characterisation - Site 7 Drilling & Testing	Mon 10/06/19	Fri 28/06/19
46	Characterisation - Site 8 Drilling & Testing	Mon 1/07/19	Fri 19/07/19
47	Characterisation - Site 9 Drilling & Testing	Mon 22/07/19	Fri 9/08/19
48	Characterisation - Site 10 Drilling & Testing	Mon 12/08/19	Fri 30/08/19
49	Characterisation - Site 11 Drilling & Testing	Mon 2/09/19	Fri 20/09/19
50	Characterisation - Site 12 Drilling & Testing	Mon 23/09/19	Fri 11/10/19
51	Characterisation Report	Mon 14/10/19	Fri 6/12/19
52	**Myrtle Creek Stage 2 Approvals & Works**	**Mon 6/01/20**	**Fri 17/07/20**
53	Preparation of Stage 2 Plan	Mon 6/01/20	Fri 8/05/20
54	Submit Stage 2 Plan	Fri 8/05/20	Fri 8/05/20
55	Approval of Stage 2 plan	Fri 3/07/20	Fri 3/07/20
56	Commence Stage 2 Works	Fri 17/07/20	Fri 17/07/20
57			
58	**Section 240 Notice Dates**	**Fri 31/08/18**	**Wed 31/07/19**
59	MOP updated with Myrtle Creek CMAP Rev B	Fri 31/08/18	Fri 31/08/18
60	Updated timeline for Myrtle Creek CMAP	Fri 31/08/18	Fri 31/08/18
61	Submit Redbank Creek CMAP	Mon 31/12/18	Mon 31/12/18
62	MOP updated with Redbank Creek CMAP	Wed 31/07/19	Wed 31/07/19
63			



Project: 201810 - Mytle Creek

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Manual Progress
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Progress	

SIMEC

MEMBER OF GFG ALLIANCE

APPENDIX 4

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Planning & Environment
NSW GOVERNMENT | Resources Regulator
FORM: MA s240(1)(d) v1.3

NOTICE UNDER SECTION 240(1)(d) MINING ACT 1992

Harm to the Environment

Our Ref: NTCE0002519
ACES Ref: ASMT0003922

ISSUED TO

Tahmoor Coal Pty Ltd (ACN: 076663968)
REMEMBRANCE DRIVE
TAHMOOR NSW 2573

Attention: The Proper Officer

DIRECTION

In accordance with section 240(1)(d) and section 240(2A) of the *Mining Act 1992* (Mining Act), I, Greg Kininmonth, an inspector duly appointed under Section 361 of the Mining Act 1992, direct Tahmoor Coal Pty Limited (ACN: 076 663 968)("You") to take the following steps to conserve the environment, protect it from harm as a result of activities under Consolidated Coal Lease (CCL) 716 (Act 1973) and Mining Leases 1308, 1376, 1539 and 1642 (all Act 1992), or to prevent, control or mitigate any such harm.

1) Update the "Redbank Creek Corrective Management Action Plan" prepared by SIMEC dated December 2018 ("CMAP") to address the following items:

a) On Page 35 - review for accuracy and update the rainfall graph. The current version does not identify a major rainfall event in 2016 which raises concerns about the accuracy of the graph.

b) On Page 36 - the control site R11 appears to be within the zone of influence of Longwall 32 and may be impacted by subsidence. If impacted this site will no longer function as a control site. Clarify in the CMAP that additional downstream control sites outside of the zone of influence will also be used for stream flow/water levels.

c) All graphs - revise vertical scale for graph axis to ensure trends are more clearly represented. Some graphs are too flat to visually show trends (e.g. Page 39)

d) Include residual rainfall mass curve on water and groundwater level graphs.

e) Ensure that data errors or no data obtained instances are noted on graphs, visually and/or as a footnote. These must be clearly differentiated from zero readings.

f) On Page 44 - provide clarification to explain negative and 5m+ readings for gauge station 11; Confirm/assess accuracy of all flow gauging stations including data readings and graph representations. Calibrate/confirm the flow volumes from the gauge stations with manual readings e.g. Volumetric Measurements (pipe and bucket) or via Area Velocity Measurements (manual flow measurements e.g. pygmy flow meter).

g) Page 60 – include in the Aims/Objectives (Section 8.1/8.2) a public amenity and visual component which will address applicable Stream Remediation Aims identified in Section 3.4.1.

h) Page 63 - 'Section 8.8 - Completion Criteria' - specify more detailed completion criteria. These should be SMART (Specific, Measurable, Attainable, Realistic and Timely), prepared using BACI (Before, After, Control, Impact) design principles, and relate to the 'stream mitigation and remediation measures' specified in Section 3.4.1 "Stream Remediation Aims".

i) Page 62 Section 8.6 (Program and Timeframes) and Appendix 4 (Schedule/Timeframes) - Provide a reduced timeframe for undertaking the works which is generally in accordance with the timeframes below:

FY2020 (July 2019 to Oct 2019)

o Redbank Creek CMAP approvals completed

o Redbank Creek CMAP EMP & Safety Plan completed

o Stream Mapping completed

o Characterisation Sites 1 to 7 completed

FY2021 (Oct 2019 – June 2020).

o Characterisation Sites 8 to 12 completed

o Characterisation Report completed

o Five (5) pool remediation sites completed

FY2022 (June 2020 – Dec 2021)

o Two (2) rock bar grout curtain walls completed

o Five (5) pool remediation sites completed

FY2023 (Dec 2021 – June 2022)

o Two (2) rock bar grout curtain walls completed

o Five (5) pool remediation sites completed

FY2024 (June 2022 – Dec 2022)

o Two (2) rock bar grout curtain walls completed

j) Page 64 - 'Section 8.9 Reporting' - include a commitment to provide Quarterly Progress Reports in lieu of the Six Monthly Progress reports proposed.

k) Page 65 - 'Section 8.9 Reporting' - include a commitment to provide a detailed program and schedule of works proposed in each period for the review and approval of the Resources Regulator as part of the Quarterly Progress Reports.

2) Submit a revised and updated version of the Redbank Creek CMAP to email address minres.environment@planning.nsw.gov.au by 5pm on 28 June 2019

BACKGROUND

a. The Resources Regulator within the NSW Department of Planning and Environment has responsibility for the administration and enforcement of the Mining Act and associated regulations.
b. Tahmoor Colliery operates under Consolidated Coal Lease (CCL) 716 (Act 1973), Mining Lease (ML) 1308 (Act 1992), ML 1376 (Act 1992), ML 1539 (Act 1992) and ML 1642 (Act 1992). These authorisations are currently in force.
c. You are a responsible person in relation to Tahmoor Colliery within the meaning of section 239E(1) of the Mining Act because you "Tahmoor Coal Pty Ltd" are the title holder of the authorisations referenced in (b), above.
d. Underground mining activities at Tahmoor Colliery have resulted in subsidence impacts on Redbank Creek.
e. The Resources Regulator, issued a Notice under Section 240(1)(d) of the Mining Act which required Tahmoor Coal Pty Ltd to "Plan, draft and submit for review, a Corrective Management Action Plan for Redbank Creek by no later than 31 December 2018" (Our Reference: DI 0680 2018, dated 4 May 2018. The Notice also requires the final Corrective Management Action Plan for Redbank Creek to be incorporated into the current Tahmoor Colliery Mining Operations Plan by no later than 31 July 2019.
f. A Redbank Creek Corrective Management Action Plan prepared by SIMEC and dated December 2018 was submitted to the Resources Regulator on 31 December 2018 (Our Reference: DOC19/52660)
g. The Redbank Creek Corrective Management Action Plan dated December 2018 was reviewed by the Resources Regulator and found to be inadequate.
h. This Notice specifies changes required in a revised version of the Redbank Creek Corrective Management Action Plan.
i. Pursuant to Item 5 of of the Notice under Section 240(1)(d) (Our Reference: DI 0680 2018, dated 4 May 2018) the final Redbank Creek Corrective Management Action Plan needs to be incorporated into an updated version of the current Tahmoor Colliery Mining Operations Plan by no later than 31 July 2019.

The background above provides information on key relevant events. It is not intended to be a comprehensive summary of all communications between you and the Department. Other facts not recited above may be relevant.

ISSUE DETAILS

Issued by: Gregory Kininmonth an inspector duly appointed under section 361 of the *Mining Act 1992.*
Manager Environmental Operations

Date this day of 22 May 2019 Greg Kininmonth
Manual Email
tahmoornotifications@simecgfg.com

Maitland
516 High Street, Maitland NSW 2320
PO BOX 344, HRMC NSW 2310
Ph: 02 4931 6666

Orange
161 Kite Street, Orange NSW 2800
Locked Bag 21, Orange NSW 2800
Ph: 02 6360 5333

Wollongong
84 Crown Street, Wollongong NSW 2500
PO BOX 674, Wollongong NSW 2520
Ph: 02 4222 8333

Email: greg.kininmonth@planning.nsw.gov.au
Phone: 02 42767428

WARNING AND INFORMATION

Failure to comply

- It is an offence under section 240C of the Mining Act to fail to comply with this direction without a reasonable excuse.

- The maximum penalty for this offence is, for a corporation, $1,100,000 and a further $110,000 for each day the offence continues, and, for a natural person, $220,000 and a further $22,000 for each day the offence continues.
- If you fail to comply with this direction, the Minister may take any action necessary to give effect to the direction including authorising another person to carry out those activities and recover the costs and expenses so incurred from you or applying to the Court for an injunction directing you to comply with this direction.

Other action

- The serving of this direction and the matters required of you pursuant to this direction in no way preclude, hinder or otherwise restrain the Minister, Secretary or Department from taking further action against you (and the holder of the authorisation to which this direction relates, if you are not the holder of the authorisation) including by commencing legal proceedings.

General

- The words and expressions used in this direction have the same meaning as they have in the Mining Act.
- Any information collected is for the purposes of the Mining Act

NSW GOVERNMENT

Notice under the *Mining Act 1992* section 240

A notice directing a responsible person in relation to an authorisation under the *Mining Act 1992* to carry out or stop carrying out particular activities, carry out activities in a particular manner or achieve specified outcomes, within such period (if any) as is specified in this direction or any condition specified in this direction

Resources Regulator

FORM: MA s240 vary v1.1

NTCE0003132

Issued to

Tahmoor Coal Pty Ltd (ACN: 076663968)

Attention: The Proper Officer

Variation to Notice

The notice(s) identified below are varied pursuant to section 240B of the *Mining Act 1992*. You are required to comply with the directions of this notice NTCE0003132, in place of the directions identified in the notice(s) below.

NTCE0002519 MA s240 1b Direction address adverse impact - Tahmoor Colliery (ASMT0003922)
Originally sent: 22 May 2019
Issued by: Gregory Kininmonth
Via Email:

Background

a. The Resources Regulator within the NSW Department of Planning and Environment has responsibility for the administration and enforcement of the Mining Act and associated regulations.
b. Tahmoor Colliery operates under Consolidated Coal Lease (CCL) 716 (Act 1973), Mining Lease (ML) 1308 (Act 1992), ML 1376 (Act 1992), ML 1539 (Act 1992) and ML 1642 (Act 1992). These authorisations are currently in force.
c. You are a responsible person in relation to Tahmoor Colliery within the meaning of section 239E(1) of the Mining Act because you "Tahmoor Coal Pty Ltd" are the title holder of the authorisations referenced in (b), above.
d. Underground mining activities at Tahmoor Colliery have resulted in subsidence impacts on Redbank Creek.
e. The Resources Regulator, issued a Notice under Section 240(1)(d) of the Mining Act which required Tahmoor Coal Pty Ltd to "Plan, draft and submit for review, a Corrective Management Action Plan for Redbank Creek by no later than 31 December 2018" (Our Reference: DI 0680 2018, dated 4 May 2018. The Notice also requires the final Corrective Management Action Plan for Redbank Creek to be incorporated into the current Tahmoor Colliery Mining Operations Plan by no later than 31 July 2019.
f. A Redbank Creek Corrective Management Action Plan prepared by SIMEC and dated December 2018 was submitted to the Resources Regulator on 31 December 2018 (Our Reference: DOC19/52660)
g. The Redbank Creek Corrective Management Action Plan dated December 2018 was reviewed by the Resources Regulator and found to be inadequate.
h. This Notice specifies changes required in a revised version of the Redbank Creek Corrective Management Action Plan.
i. Pursuant to Item 5 of of the Notice under Section 240(1)(d) (Our Reference: DI 0680 2018, dated 4 May 2018) the final Redbank Creek Corrective Management Action Plan needs to be incorporated into an updated version of the current Tahmoor Colliery Mining Operations Plan by no later than 31 July 2019.

j. A request to extend the due date for submission of a revised and updated version of the Redbank Creek Corrective Management Action Plan, from 28 June 2019 (NTCE0002519) to 1 July 2019 was received on 25 June 2019 (email from Ron Bush of Tahmoor Colliery, Our Reference: DOC19/544770).
k. This revised Notice (NTCE0003132) supersedes and replaces NTCE0002519 and extends the submission date for a revised and updated version of the Redbank Creek Corrective Management Action Plan to 1 July 2019. There are no other content changes in comparison to NTCE0002519.

The background above provides information on key relevant events. It is not intended to be a comprehensive summary of all communications between you and the Department. Other facts not recited above may be relevant.

The background above provides information on key relevant events. It is not intended to be a comprehensive summary of all communications between you and the Department. Other facts not recited above may be relevant.

New Directions

In accordance with section 240(1)(d) and section 240(2A) of the *Mining Act 1992* (Mining Act), I, Greg Kininmonth, an inspector duly appointed under Section 361 of the Mining Act 1992, direct Tahmoor Coal Pty Limited (ACN: 076 663 968)("You") to take the following steps to conserve the environment, protect it from harm as a result of activities under Consolidated Coal Lease (CCL) 716 (Act 1973) and Mining Leases 1308, 1376, 1539 and 1642 (all Act 1992), or to prevent, control or mitigate any such harm.

1 Pursuant to section 240 (1)(d) **Date for compliance:** 1 July 2019 5:00pm

Direction:

Update the "Redbank Creek Corrective Management Action Plan" prepared by SIMEC dated December 2018 ("CMAP") to address the following items:

a) On Page 35 - review for accuracy and update the rainfall graph. The current version does not identify a major rainfall event in 2016 which raises concerns about the accuracy of the graph.

b) On Page 36 - the control site R11 appears to be within the zone of influence of Longwall 32 and may be impacted by subsidence. If impacted this site will no longer function as a control site. Clarify in the CMAP that additional downstream control sites outside of the zone of influence will also be used for stream flow/water levels.

c) All graphs - revise vertical scale for graph axis to ensure trends are more clearly represented. Some graphs are too flat to visually show trends (e.g. Page 39)

d) Include residual rainfall mass curve on water and groundwater level graphs.

e) Ensure that data errors or no data obtained instances are noted on graphs, visually and/or as a footnote. These must be clearly differentiated from zero readings.

f) On Page 44 - provide clarification to explain negative and 5m+ readings for gauge station 11; Confirm/assess accuracy of all flow gauging stations including data readings and graph representations. Calibrate/confirm the flow volumes from the gauge stations with manual readings e.g. Volumetric Measurements (pipe and bucket) or via Area Velocity Measurements (manual flow measurements e.g. pygmy flow meter).

g) Page 60 – include in the Aims/Objectives (Section 8.1/8.2) a public amenity and visual component which will address applicable Stream Remediation Aims identified in Section 3.4.1.

h) Page 63 - 'Section 8.8 - Completion Criteria' - specify more detailed completion criteria. These should be SMART (Specific, Measurable, Attainable, Realistic and Timely), prepared using BACI (Before, After, Control, Impact) design principles, and relate to the 'stream mitigation and remediation measures' specified in Section 3.4.1 "Stream Remediation Aims".

i) Page 62 Section 8.6 (Program and Timeframes) and Appendix 4 (Schedule/Timeframes) - Provide a reduced timeframe for undertaking the works which is generally in accordance with the timeframes below:

FY2020 (July 2019 to Oct 2019)

o Redbank Creek CMAP approvals completed

o Redbank Creek CMAP EMP & Safety Plan completed

o Stream Mapping completed

o Characterisation Sites 1 to 7 completed

FY2021 (Oct 2019 – June 2020).

o Characterisation Sites 8 to 12 completed

o Characterisation Report completed

o Five (5) pool remediation sites completed

FY2022 (June 2020 – Dec 2021)

o Two (2) rock bar grout curtain walls completed

o Five (5) pool remediation sites completed

FY2023 (Dec 2021 – June 2022)

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o Five (5) pool remediation sites completed

FY2024 (June 2022 – Dec 2022)

o Two (2) rock bar grout curtain walls completed

j) Page 64 - 'Section 8.9 Reporting' - include a commitment to provide Quarterly Progress Reports in lieu of the Six Monthly Progress reports proposed.

k) Page 65 - 'Section 8.9 Reporting' - include a commitment to provide a detailed program and schedule of works proposed in each period for the review and approval of the Resources Regulator as part of the Quarterly Progress Reports.

2 Pursuant to section 240 (1)(d) **Date for compliance:** 1 July 2019 5:00pm

Direction:

Submit a revised and updated version of the Redbank Creek CMAP to email address minres.environment@planning.nsw.gov.au

Issue Details

Issued by: Gregory Kininmonth, an Inspector duly appointed under Section 361 of the *Mining Act 1992*

Dated this day of 28 Jun 2019 Greg Kininmonth 28/06/2019

Via Email:

Email sent to Ron Bush <Ron.Bush@simecgfg.com> on 28 June 2019

Warning and Information

Failure to comply

It is an offence under section 240C of the Mining Act to fail to comply with this direction without a reasonable excuse.

The maximum penalty for this offence is, for a corporation, $1,100,000 and a further $110,000 for each day the offence continues, and, for a natural person, $220,000 and a further $22,000 for each day the offence continues.

If you fail to comply with this direction, the Minister may take any action necessary to give effect to the direction including authorising another person to carry out those activities and recover the costs and expenses so incurred from you or applying to the Court for an injunction directing you to comply with this direction.

Other action

The serving of this direction and the matters required of you pursuant to this direction in no way preclude, hinder or otherwise restrain the Minister, Secretary or Department from taking further action against you (and the holder of the authorisation to which this direction relates, if you are not the holder of the authorisation) including by commencing legal proceedings.

General

The words and expressions used in this direction have the same meaning as they have in the Mining Act.

This notice does not exempt you from any requirement to obtain any further statutory approval, licence or permit that may be required to authorise the completion of the directions in this notice.

Any information collected is for the purposes of the Mining Act.

Regulator Contact Information

516 High Street, Maitland NSW 2320
PO BOX 344, HRMC NSW 2310
Ph: 02 4931 6666

Email: minres.environment@planning.nsw.gov.au

SIMEC

MEMBER OF GFG ALLIANCE

APPENDIX 5

simecgfg.com

ID	Task Name	Duration	Start	Finish
1	**Myrtle Creek CMAP**	**230 days**	**Fri 16/06/17**	**Fri 4/05/18**
4	**Myrtle Creek Other Approvals**	**172 days**	**Mon 4/06/18**	**Wed 30/01/19**
14	**Myrtle Creek Site 23 Approvals & Works**	**415 days**	**Mon 4/06/18**	**Fri 3/01/20**
23	**Myrtle Creek Pool Remediation Trials**	**285 days**	**Mon 3/09/18**	**Fri 4/10/19**
30	**Myrtle Creek Pool Mapping**	**280 days**	**Wed 1/08/18**	**Tue 27/08/19**
36	**Myrtle Creek Creek Characterisation**	**395 days**	**Mon 4/06/18**	**Fri 6/12/19**
52	**Myrtle Creek Stage 2 Approvals & Works**	**840 days**	**Mon 6/01/20**	**Fri 24/03/23**
58				
59	**Section 240 Notice Dates**	**238 days?**	**Fri 31/08/18**	**Wed 31/07/19**
60	MOP updated with Myrtle Creek CMAP Rev B	0 days	Fri 31/08/18	Fri 31/08/18
61	Updated timeline for Myrtle Creek CMAP	0 days	Fri 31/08/18	Fri 31/08/18
62	Submit Redbank Creek CMAP	0 days	Mon 31/12/18	Mon 31/12/18
63	MOP updated with Redbank Creek CMAP	0 days	Wed 31/07/19	Wed 31/07/19
64				
65				
66	**Redbank Creek CMAP**	**152 days?**	**Mon 31/12/18**	**Wed 31/07/19**
67	Submit Redbank Creek CMAP	0 days	Mon 31/12/18	Mon 31/12/18
68	Approval of Redbank Creek CMAP	90 days	Mon 31/12/18	Fri 3/05/19
69	Update MOP	62 days	Mon 6/05/19	Tue 30/07/19
70	Updated MOP submitted	0 days	Wed 31/07/19	Wed 31/07/19
71	**Redbank Creek Approvals**	**167 days**	**Wed 13/03/19**	**Thu 31/10/19**
72	Redbank Creek CMAP Risk Assessment	0 days	Wed 13/03/19	Wed 13/03/19
73	Preparation of Erosion and Sediment Control Plan	37 days	Wed 31/07/19	Thu 19/09/19
74	Preparation of Part 7 Fisheries Permit	37 days	Wed 31/07/19	Thu 19/09/19
75	Preparation of Redbank Creek CMAP EMP	37 days	Wed 31/07/19	Thu 19/09/19
76	Preparation of Redbank Creek CMAP Safety Plan	37 days	Wed 31/07/19	Thu 19/09/19
77	Submit Erosion and Sediment Control Plan	0 days	Thu 19/09/19	Thu 19/09/19
78	Submit Part 7 Fisheries Permit	0 days	Thu 19/09/19	Thu 19/09/19
79	Approval of Erosion and Sediment Control	0 days	Thu 31/10/19	Thu 31/10/19
80	Fisheries Permit Issued	0 days	Thu 31/10/19	Thu 31/10/19
81	**Redbank Creek Pool Mapping**	**89 days**	**Mon 1/07/19**	**Thu 31/10/19**
82	Creek Mapping Scoping & Preparation	20 days	Mon 1/07/19	Fri 26/07/19
83	Pool Mapping & Photogrammetry	30 days	Mon 29/07/19	Fri 6/09/19
84	Data Analysis	20 days	Mon 9/09/19	Fri 4/10/19
85	Reporting	19 days	Mon 7/10/19	Thu 31/10/19
86	**Redbank Creek Creek Characterisation**	**195 days**	**Mon 1/07/19**	**Fri 27/03/20**
87	Creek Characterisation Scoping & Preparation	10 days	Mon 1/07/19	Fri 12/07/19
88	Site Mobilisation	5 days	Mon 15/07/19	Fri 19/07/19
89	Characterisation - Site 1 Drilling & Testing	10 days	Mon 22/07/19	Fri 2/08/19
90	Characterisation - Site 2 Drilling & Testing	10 days	Mon 5/08/19	Fri 16/08/19
91	Characterisation - Site 3 Drilling & Testing	10 days	Mon 19/08/19	Fri 30/08/19
92	Characterisation - Site 4 Drilling & Testing	10 days	Mon 2/09/19	Fri 13/09/19
93	Characterisation - Site 5 Drilling & Testing	10 days	Mon 16/09/19	Fri 27/09/19
94	Characterisation - Site 6 Drilling & Testing	10 days	Mon 30/09/19	Fri 11/10/19
95	Characterisation - Site 7 Drilling & Testing	10 days	Mon 14/10/19	Fri 25/10/19
96	Characterisation - Site 8 Drilling & Testing	10 days	Mon 28/10/19	Fri 8/11/19
97	Characterisation - Site 9 Drilling & Testing	10 days	Mon 11/11/19	Fri 22/11/19
98	Characterisation - Site 10 Drilling & Testing	10 days	Mon 25/11/19	Fri 6/12/19
99	Characterisation - Site 11 Drilling & Testing	10 days	Mon 9/12/19	Fri 20/12/19
100	Characterisation - Site 12 Drilling & Testing	10 days	Mon 23/12/19	Fri 3/01/20
101	Characterisation Report	60 days	Mon 6/01/20	Fri 27/03/20
102	**Redbank Creek Pool Remdiation Sites**	**688 days**	**Mon 4/11/19**	**Wed 22/06/22**
103	Pool No. 1	30 days	Mon 4/11/19	Fri 13/12/19
104	Pool No. 2	30 days	Mon 16/12/19	Fri 24/01/20
105	Pool No. 3	32 days	Mon 27/01/20	Tue 10/03/20
106	Pool No. 4	40 days	Wed 11/03/20	Tue 5/05/20
107	Pool No. 5	40 days	Wed 6/05/20	Tue 30/06/20
108	Pool No. 6	45 days	Wed 1/07/20	Tue 1/09/20
109	Pool No. 7	45 days	Wed 2/09/20	Tue 3/11/20
110	Pool No. 8	60 days	Wed 4/11/20	Tue 26/01/21
111	Pool No. 9	63 days	Wed 27/01/21	Fri 23/04/21
112	Pool No. 10	45 days	Mon 26/04/21	Fri 25/06/21
113	Pool No. 11	45 days	Mon 28/06/21	Fri 27/08/21
114	Pool No. 12	45 days	Mon 30/08/21	Fri 29/10/21
115	Pool No. 13	60 days	Mon 1/11/21	Fri 21/01/22
116	Pool No. 14	63 days	Mon 24/01/22	Wed 20/04/22
117	Pool No. 15	45 days	Thu 21/04/22	Wed 22/06/22
118	**Redbank Creek Rock Bar Grout Curtain**	**640 days**	**Mon 6/07/20**	**Fri 16/12/22**
119	Rock Bar 1	120 days	Mon 6/07/20	Fri 18/12/20
120	Rock Bar 2	120 days	Mon 21/12/20	Fri 4/06/21
121	Rock Bar 3	120 days	Mon 7/06/21	Fri 19/11/21
122	Rock Bar 4	120 days	Mon 22/11/21	Fri 6/05/22
123	Rock Bar 5	100 days	Mon 9/05/22	Fri 23/09/22
124	Rock Bar 6	60 days	Mon 26/09/22	Fri 16/12/22

Project: 201906 - Redbank Cree
Date: Sun 30/06/19

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

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