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Tahmoor Coal Pty Ltd

SIX MONTHLY SUBSIDENCE IMPACT REPORT

Tahmoor North, Western Domain Longwalls West 1 and West 2

8 April 2020 – 6 November 2020

Report 2 - November 2020

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Document Control

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Executive Summary

This report is the second six-monthly report to be submitted since the commencement of extraction of Longwall West 1 (LW W1), in accordance with the requirements of the Longwall West 1 and West 2 (LW W1-W2) Extraction Plan. The reporting period of this report is from 8 April 2020 to 6 November 2020.

LW W1 extraction commenced on 15 November 2019 and was completed on 6 November 2020. The extraction of Longwall West 2 is expected to commence on 5 December 2020.

During the reporting period, observed subsidence movements have been less than predicted, and no trends of definitive valley closure have been evident.

There were seven (7) occurrences where Trigger Action Response Plans (TARPs) triggers occurred and further actions were required, as well as a number of impacts to roads and built structures that required remediation. These TARP triggers included:

- Natural Drainage Behaviour TARP trigger due to gas emissions at Pool MR45. Gas emissions occurred between February to June 2020 and gas samples indicated that the gas originated from the shallow Hawkesbury Sandstone stratas and/or shallow anoxic muds;
- Groundwater Bore Level TARP trigger due to reduced water level elevation below the baseline range for a number of open standpipe piezometers (P12, P13 and P16). As the results are within predictions and are not connected with any surface water impacts, no actions are required other than the continuation of the exiting monitoring program;
- Shallow Groundwater Pressures TARP trigger due to depressurisation below the baseline range for shallow vibrating wire piezometer TNC36. As the results are within predictions and are not connected with any surface water impacts, no actions are required other than the continuation of the exiting monitoring program;
- Historical Heritage TARP trigger due to a small transverse crack in sandstone culvert at 89.629 km. This cracking is related to the minor opening of an existing crack and was not adversely affected the structural integrity of the culvert;
- Picton-Mittagong Loop Line TARP trigger due to a tension crack along the crest of the embankment at 88.384 km. It was determined that recent heavy vehicle traffic and the presence of an old steel water pipe buried beneath the crest may have influenced crack formation at this location, and there was no evidence of embankment instability. This issue was resolved by diverting the roadway to along the toe of the embankment;
- Picton-Mittagong Loop Line TARP trigger due to joint closures between 88.5 to 88.6 km. Adjustments of the track were completed on 12 October 2020, resolving the TARP trigger; and
- Main Southern Railway TARP trigger due to changes in distances across the Ballast Top Subway (86.838 km) abutment. The changes noted appeared to have been related to a continuation of pre-existing conditions and were unlikely to be mining induced.

During the reporting period, there were no exceedances of environmental performance measures or indicators, as adopted from DA 67/98 Modification 4 or the LW W1-W2 Extraction Plan Approval conditions.

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1 Introduction

This Six Monthly Subsidence Impact Report fulfils the reporting requirement of the Extraction Plan approved for Longwall West 1 and West 2 (LW W1-W2), and covers the period of 8 April 2020 to 6 November 2020.

This report provides the Secretary of NSW Department of Planning, Industry and Environment (DPIE) with a summary of subsidence and environment monitoring results, subsidence impacts and management actions undertaken during the reporting period.

1.1 Background

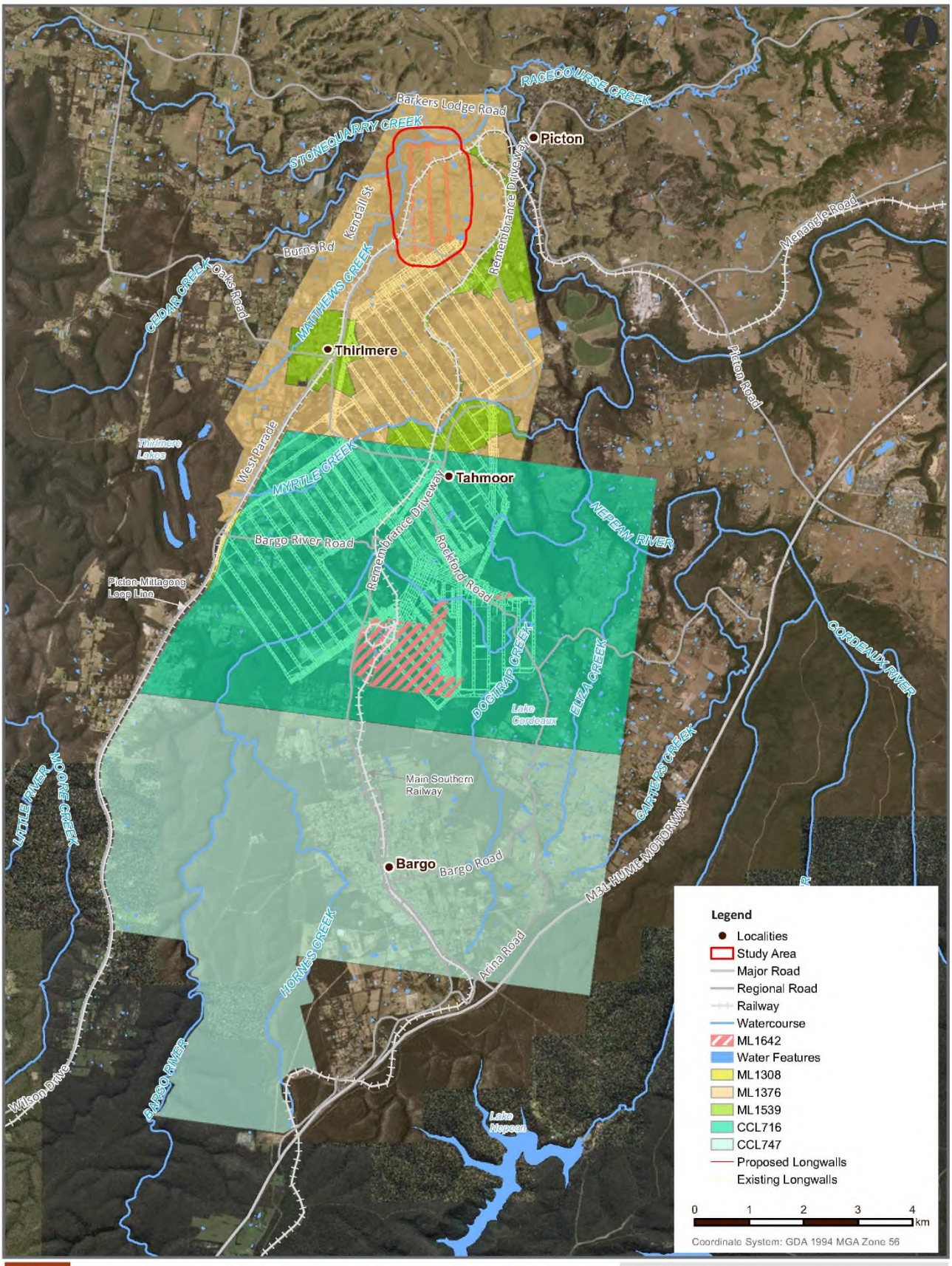
Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW) (refer to **Figure 1-1**). Tahmoor Mine produces up to three million tonnes of Run of Mine (ROM) coal per annum from the Bulli Coal Seam. Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Product coal is transported via rail to Port Kembla and Newcastle for Australian domestic customers and export customers.

Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, 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).

Tahmoor Coal has previously mined 32 longwalls to the north and west of the Tahmoor Mine's current pit top location (refer to **Figure 1-1**). Tahmoor Coal is currently mining in the 'Western Domain', an area located north-west of the Main Southern Railway. The Western Domain is within Mining Lease (ML) 1376 and ML 1539.

Tahmoor Coal prepared an Extraction Plan for the first two longwalls in the Western Domain (LW W1-W2), as illustrated in **Figure 1-2**. Extraction Plan approval was granted by DPIE on 8 November 2019. A copy of the Project Approval is available on the Tahmoor Coal website (http://www.simec.com/mining/tahmoor-coking-coal-operations/).

Longwall West 1 (LW W1) was the first longwall to be extracted in the Western Domain. LW W1 extraction commenced on 15 November 2019 and was completed on 6 November 2020. The extraction of Longwall West 2 is expected to commence on 5 December 2020. The active subsidence area of LW W1 for 8 November 2020 is illustrated in **Figure 1-3**.



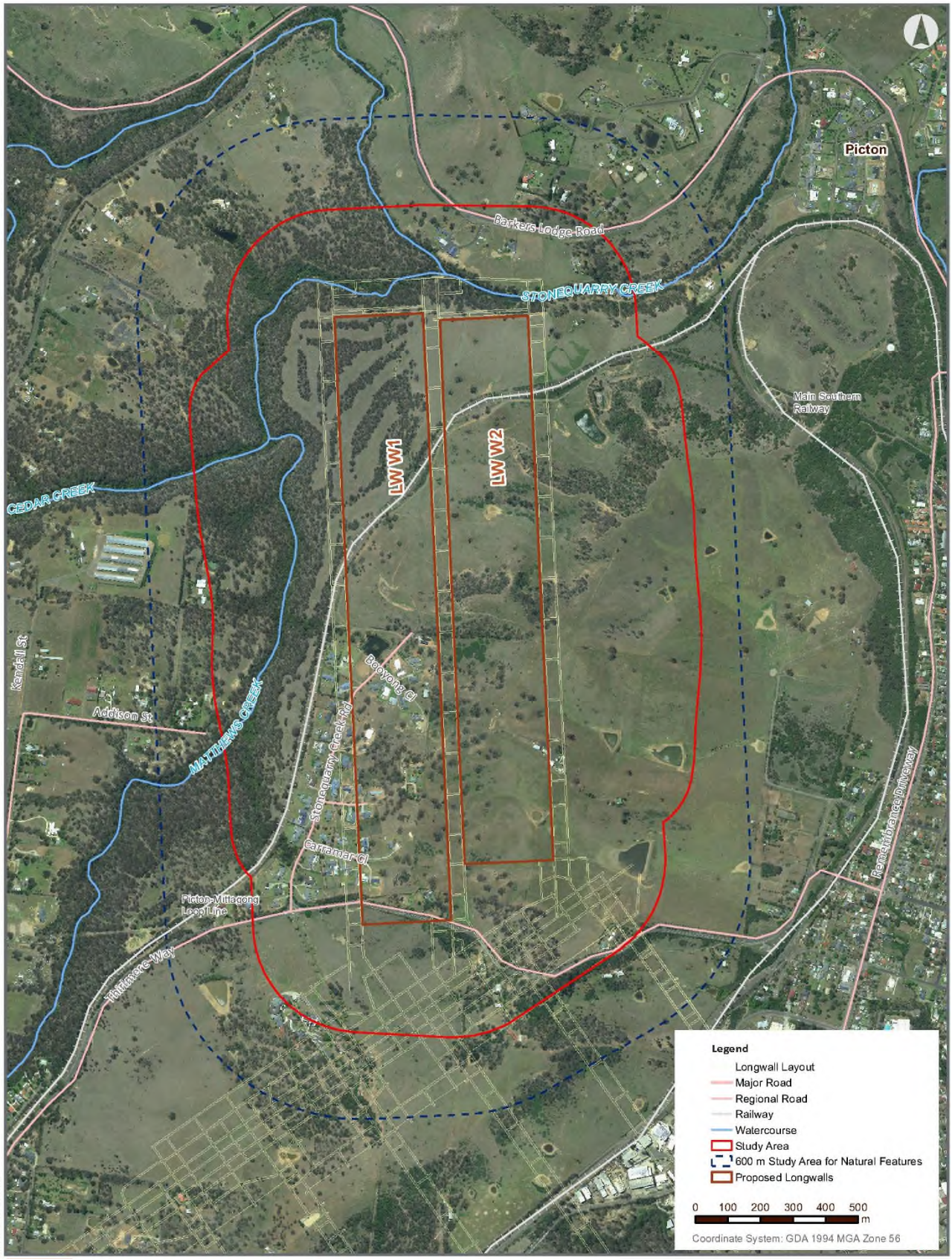
TAHMOOR MINING AREA AND TENURE

Tahmoor North Western Domain Longwalls West 1 and West 2 Extraction Plan

FIGURE 1-1

Date 27/05/2019

Data Sources:
© NSW DFSI (2019); © NSW Mining (2019); © SIMEC (2019)
Aerial Imagery: NSW DFSI MapServer (2019)



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EXTRACTION PLAN STUDY AREA

Tahmoor North Western Domain Longwalls West 1 and West 2
Extraction Plan

FIGURE 1-2

Date 4/07/2019

Data Sources:
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Aerial Imagery: © Photomapping Services (November 2018)

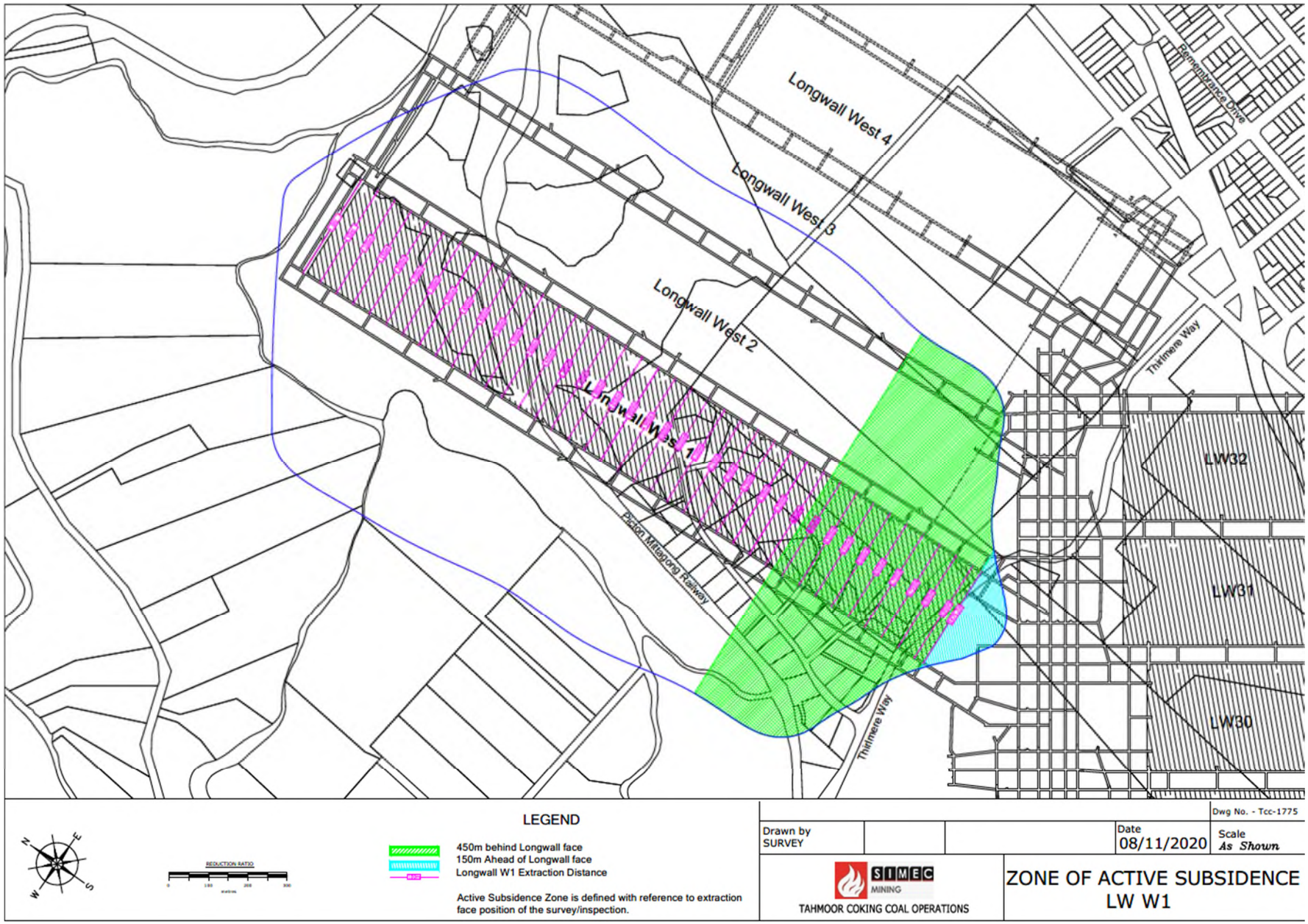

Figure 1-3 LW W1 Zone of Active Subsidence for 8 November 2020

1.2 Purpose

The purpose of this report is to address the requirements for six-monthly reporting on impacts and environmental monitoring results associated with the extraction of LW W1 and LW W2. These requirements are outlined in **Section 6.1.4** of the LW W1-W2 Extraction Plan, which are derived from the Section 6 of the NSW Department of Planning and Environment (DPE) *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015).

The requirements for this report are listed in **Table 1-1** below, together with the cross-reference where the requirements are addressed in this report.

Table 1-1 Six Monthly Subsidence Impact Report Requirements

Requirement No.	Requirement Description (as per Section 6.1.2 of the LW W1-W2 Extraction Plan)	Section Addressed
1	A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s);	Section 2.1
2	Any proposed actions resulting from triggers being met in the TARP, or other actions;	Section 2.2
3	An assessment of compliance with all relevant performance measures and indicators; and	Section 3
4	A comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and level data, piezometer readings.	Section 4

This report will be distributed to the stakeholders listed in **Section 5.4**.

1.3 Scope

The Tahmoor Coal Environmental Management Structure is shown in **Figure 1-4**.

The Extraction Plan Study Area is defined as the surface area that is likely to be affected by the extraction of LW W1-W2 from the Bulli Coal Seam. This Study Area has been calculated by combining the areas bound by the following limits:

- The predicted limit of vertical subsidence, taken as the 20 millimetre (mm) subsidence contour resulting from the extraction of LW W1-W2; and
- A 35° angle of draw line from the limit of proposed extraction for LW W1-W2.

The Study Area is illustrated in **Figure 1-1** and **Figure 1-2**.

As part of the LW W1-W2 Extraction Plan, a set of management plans have been prepared to manage particular environment or built features with the LW W1-W2 Study Area, which consists of the following:

- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan, with a number of sub-plans to manage potential environmental consequences to infrastructure and specific building structures as a result of secondary extraction; and

- Public Safety Management Plan.

The overall framework for subsidence monitoring and management of impacts of the LW W1-W2 Extraction Plan is provided in the Subsidence Monitoring Program.

It is noted that the management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan.

Monitoring of environmental and built features has been completed by Tahmoor Coal and its consultants in accordance with management plans listed above.

This report is the second six-monthly report to be submitted since the commencement of extraction of LW W1, in accordance with the requirements of the LW W1-W2 Extraction Plan. The reporting period of this report is from 8 April 2020 to 6 November 2020.

Table 1-2 summarises the monitoring and reporting completed during the reporting period, as well as the timeframe of data reviewed for each monitoring component.

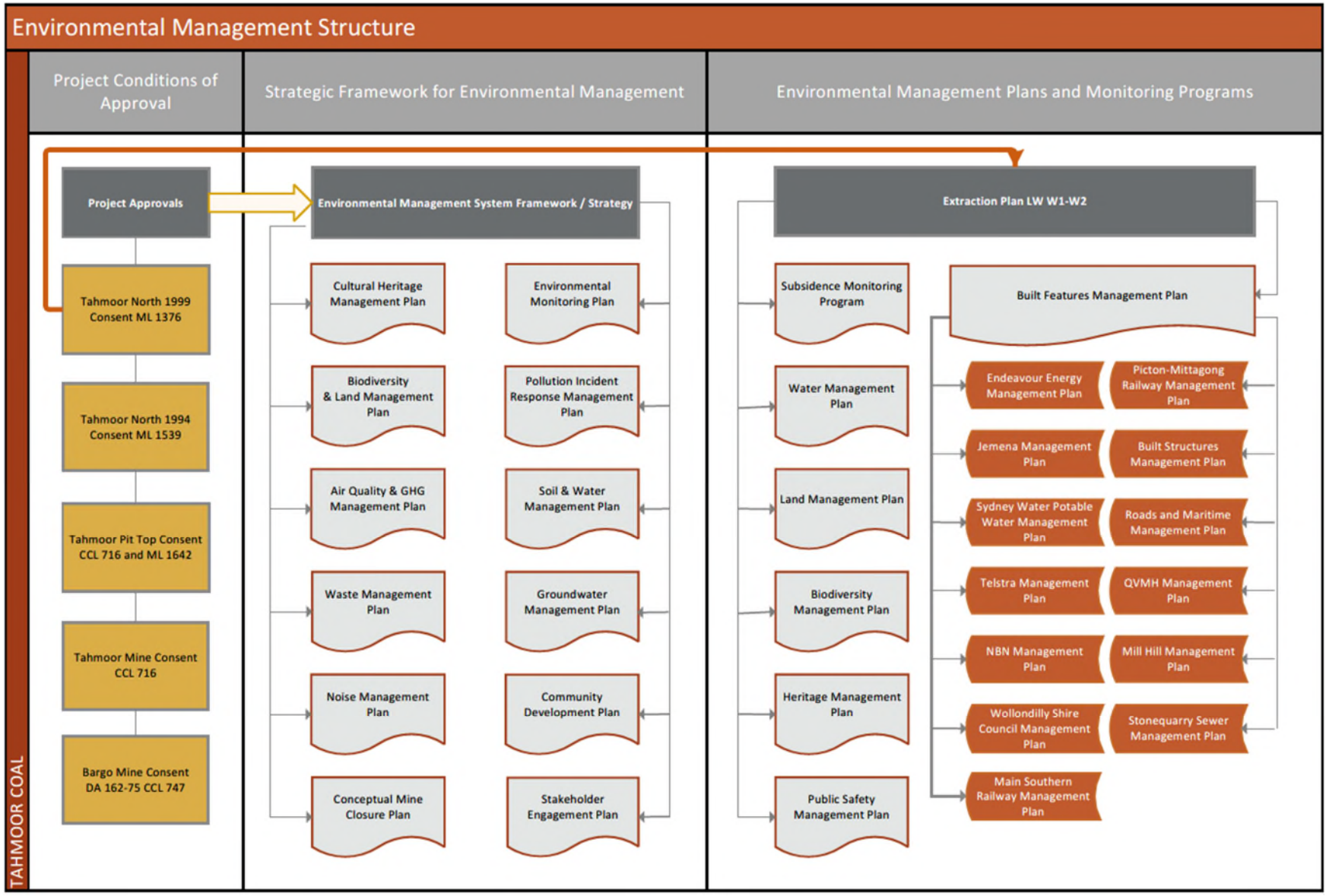

Figure 1-4 Overview of Environmental Management Structure for Tahmoor Coal

Table 1-2 Monitoring and Reports Reviewed for this Reporting Period

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Reporting Frequency	Reference
Subsidence Monitoring Program	Subsidence	General subsidence	• SMEC • Building Inspection Service • Comms Network Solutions	Mine Subsidence Engineering Consultants (MSEC)	Subsidence Monitoring Reports 5-29 reviewing data collected from 8 April 2020 to 6 November 2020.	Monthly (Report 5-6) Weekly (Reports 7-29)	Appendix A (referenced reports only)
Water Management Plan	Surface Water	Stonequarry Creek flow	• WaterNSW	• Hydro Engineering and Consulting (HEC)	Surface Water Monitoring Reports 2-7 reviewing data collected from 14 April 2020 to 12 October 2020, and 6 monthly summary report.	Monthly	Appendix B (referenced reports only)
		Pool water level	• Hydrometric Consulting Service (HCS)				
		Stream water quality					
		Natural drainage behaviour	• GeoTerra	• GeoTerra	Creek Monitoring Reports 6-11 reviewing data collected from 26 May 2020 to 20 October 2020.	Monthly	Appendix C (referenced reports only)
	Groundwater	Groundwater quality	• GeoTerra	• GeoTerra	Groundwater Monitoring Reports 5-10 reviewing data collected (noting these collection dates include the collection of continuous monitoring data) from 27 May 2020 to 27 October 2020.	Monthly	Appendix D (referenced reports only)
		Groundwater bore level	• GeoTerra				
		Shallow groundwater pressures					
		Deep groundwater pressures	• Groundwater Exploration Services				
		Groundwater Inflow	• GeoTerra		Included in Groundwater Monitoring Report 10 reviewing data collected from 8 April 2020 to 1 November 2020.	6-Monthly	

Land Management Plan	Landscape	Cliff lines Steep Slopes Surface cracking (excluding railway corridor) Dams	• Douglas Partners	• Douglas Partners	Geotechnical Monitoring Reports 5-10 reviewing data collected from 18 May 2020 to 26 October 2020.	Monthly	Not provided (no reports referenced)
		Dams	• Bloor Rail • Newcastle Geotechnical	• MSEC • Bloor Rail • Newcastle Geotechnical	Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports 26-50 reviewing data collected from 6 May 2020 to 27 October 2020.	Weekly	Appendix E (referenced reports only)
		Dams	• Building Inspection Service (BIS)	• BIS	Dam inspection reports reviewing data collected from 8 May 2020 to 4 November 2020.	Weekly	(Available on request)
	Agricultural Land	Agricultural Land	• Tahmoor Coal • BIS	• BIS	Agricultural Subsidence Monitoring Reports 6-11 reviewing data collected from 21 May 2020 to 30 October 2020.	Monthly	(Available on request)
Biodiversity Management Plan	Aquatic Ecology	Macroinvertebrates	• Niche	• Niche	Aquatic Ecology Monitoring Letter Report – Preliminary Survey Results for Spring 2020 AUSRIVAS Monitoring. The full Aquatic Ecology Monitoring Report for Spring 2020 was not available in time for this report. However, sufficient information was provided in the letter report to report on TARP for this six month period.	Six Monthly	(Available on request)
	Terrestrial Ecology	Amphibians Riparian Vegetation	• Niche	• Niche	Spring 2020 Terrestrial Ecology Monitoring Report - not available in time for this report. TARP Performance for this six month period will be reported in the next report.	Six Monthly	(Available on request)
Heritage Management Plan	Aboriginal heritage	Rock shelters	• GeoTerra	• GeoTerra	Creek Monitoring Reports 6-11 reviewing data collected from 26 May 2020 to 20 October 2020.	Monthly	Appendix C (referenced reports only)

			• EMM Consulting	• EMM Consulting	Aboriginal heritage monitoring report after 1,000 m extraction, recorded on 19 August 2020.	Once after 1,000 metres of LW W1 extraction	Appendix G
		Grinding Grooves	• SMEC	• MSEC	Subsidence Monitoring Reports 5-29 reviewing data collected from 8 April 2020 to 6 November 2020.	Monthly (Report 5-6) Weekly (Reports 7-29)	Appendix A (referenced reports only)
			• EMM Consulting	• EMM Consulting	Aboriginal heritage monitoring report after 1,000 m extraction, recorded on 19 August 2020.	Once after 1,000 metres of LW W1 extraction	Appendix G
	Historical heritage	Railway culverts	• Newcastle Geotechnical	• Newcastle Geotechnical	PMLL Weekly Detailed Reports 26-50 reviewing data collected from 6 May 2020 to 27 October 2020.	Weekly	Appendix E (referenced reports only)
Built Features Management Plan	Built Features	Electricity Infrastructure	• SMEC • BIS • Comms Network Solutions	• MSEC	Subsidence Monitoring Reports 5-29 reviewing data collected from 8 April 2020 to 6 November 2020.	Monthly (Report 5-6) Weekly (Reports 7-29)	Appendix A (referenced reports only)
		Gas Infrastructure					
		Potable Water					
		Sewerage Infrastructure					
		Telecommunications					
		Local roads, bridges and culverts					
		Built Structures					
		Picton-Mittagong Loop Line	• Southern rail Services • Bloor Rail	• MSEC	PMLL Weekly Status Reports 26-51 reviewing data collected from 6 May 2020 to 3 November 2020.	Weekly	Appendix F (referenced reports only)

		Roads and Maritime Services (RMS) Infrastructure	• SMEC • Southern Rail Services • BIS	• MSEC	RMS Status Reports 4-9 reviewing data collected from 8 April 2020 to 13 October 2020.	Monthly	(Available on request)
		Main Southern Railway (MSR)	• SMEC • Southern rail Services • Bloor Rail • BIS • Comms Network Solutions • Newcastle Geotech	• MSEC	MSR Weekly Status Reports 22-47 reviewing data collected from 6 May 2020 to 3 November 2020.	Weekly	(Available on request)
		Queen Victoria Memorial Home (QVMH)	• Veris • ENRS	• MSEC	QVMH Status Reports 1-4 reviewing data collected from 30 September 2020 to 28 October 2020.	Weekly	(Available on request)
		Mill Hill	• SMEC • BIS	• MSEC	Mill Hill Status Reports 1-4 reviewing data collected from 7 October 2020 to 28 October 2020.	Weekly	(Available on request)

2 Overview of Impacts and Actions

2.1 Summary of Impacts

This section provides a comprehensive summary of all impacts during the reporting period, including a revised characterisation according to the relevant Trigger Action Response Plan (TARP)(s) (if required).

A summary of monitoring results for relevant TARP's is given in **Table 2-3**. Triggers that were activated are denoted in **Table 2-3** with colours defined in **Table 2-1** and **Table 2-2**. A full list of TARPs for environmental features that are applicable is provided in Appendix D of the LW W1-W2 Extraction Plan.

Table 2-1 Risk Levels for Environmental Feature TARPs

Risk Level	Trigger Description
Level 1	Normal – Operations within predicted impacts.
Level 2	Within Prediction - Operations within predicted impacts but exceeds or potentially exceeds predictions.
Level 3*	Almost Exceeds Prediction - Operations within predicted impacts but are likely to almost exceed predictions.
Level 4	Exceeds Prediction - Operations exceed predicted impact.

Note: * Level 3 is only used in the Water Management Plan TARPs.

Table 2-2 Trigger Levels for Railway Features (applicable to Picton-Mittagong Loop Line and Main Southern Railway features)

Trigger Level	Trigger Description
Green	Observations within predictions. Operate as normal.
Blue	Observations outside predictions but within operating tolerance. Investigate cause. Some action may be required to prevent operating restrictions.
Yellow	Restrictions on operations. Action required. Appropriate speed restriction applied until altered to Green or Blue level.
Red	Stop trains until altered to Green or Blue level.

As all results during this report period are consistent with the current TARPs, a revision of the TARPs for environmental features is not considered necessary at this point in time.

Table 2-3 Summary of TARP Triggers for the Current Reporting Period

Aspect	Feature	Corresponding Management Plan and TARP	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020	October 2020	November 2020
Surface Water	Stonequarry Creek flow	Water Management Plan - Downstream reduction in catchment flow rate in Stonequarry Creek at Picton Gauging Station (GS212053)	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	LEVEL 2 TRIGGERED The ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, however the same also occurred at the control / reference sites.[1]	NA Monitoring data for October 2020 to be summarised in next report.	NA Monitoring data for November 2020 to be summarised in next report.
	Pool water level	Water Management Plan - Impact to pool water level	No pool water level triggers occurred.	No pool water level triggers occurred.	LEVEL 2 TRIGGERED Pool water level trigger occurred at site CB.[2]	LEVEL 2 TRIGGERED Pool water level trigger occurred at site CB.[2]	No pool water level triggers occurred.	LEVEL 2 TRIGGERED Pool water level trigger occurred at site CB.[2]	NA Monitoring data for October 2020 to be summarised in next report.	NA Monitoring data for November 2020 to be summarised in next report.
	Stream water quality	Water Management Plan - Stream water quality impact	No surface water quality triggers occurred.	No surface water quality triggers occurred.	LEVEL 2 TRIGGERED Stream water quality trigger occurred at Site CB (dissolved zinc).[3]	No surface water quality triggers occurred.	No surface water quality triggers occurred.	No surface water quality triggers occurred.	NA Monitoring data for October 2020 to be summarised in next report.	NA Monitoring data for November 2020 to be summarised in next report.
	Natural drainage behaviour	Water Management Plan - Impact to pool level, natural drainage behaviour or overland connected flow	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG.[4]	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG.[4]	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG.[4]	No impacts to natural drainage behaviour observed.	No impacts to natural drainage behaviour observed.	No impacts to natural drainage behaviour observed.	No impacts to natural drainage behaviour observed.	NA Monitoring data for November 2020 to be summarised in next report.
	Flood levels	Water Management Plan - Impact to flood levels	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.	NR Flood modelling required after completion of LW W2.
Groundwater	Groundwater quality	Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores	No observable change in salinity or pH (field results only) outside of the baseline variability.	No observable change in salinity or pH (field results only) outside of the baseline variability.	No observable change in salinity or pH (field results only) outside of the baseline variability.	No observable change in salinity, pH or metals outside of the baseline variability.	No observable change in salinity, pH or metals outside of the baseline variability.	No observable change in salinity, pH or metals outside of the baseline variability.	LEVEL 2 TRIGGERED Groundwater quality triggers occurred in P12A (pH), P12B (pH), P13A (pH), P13B (pH), P16A (zinc), and P16B (pH and zinc).	NA Monitoring data for November 2020 to be summarised in next report.
	Groundwater bore level	Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores	No observable change in groundwater level outside of baseline variability.	No observable change in groundwater level outside of baseline variability.	LEVEL 3 TRIGGERED Water level trigger occurred at piezometer P12 (intake P12C only).[5]	LEVEL 3 TRIGGERED Water level trigger occurred at piezometer P12 (intake P12C only).[5]	LEVEL 3 TRIGGERED Water level trigger occurred at piezometer P12 (intake P12C only).[5]	LEVEL 3 TRIGGERED Water level trigger occurred at piezometers P12 (intake P12), P13 (intake P13C) and P16 (intakes P16B and P16C).[5]	LEVEL 3 TRIGGERED Water level trigger occurred at piezometers P12 (intake P12), P13 (intake P13C) and P16 (intakes P16B and P16C).[5]	NA Monitoring data for November 2020 to be summarised in next report.
	Shallow groundwater pressures	Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034	No observable mining induced change at VWP intakes at or above 200 m depth.	No observable mining induced change at VWP intakes at or above 200 m depth.	LEVEL 3 TRIGGERED Depressurisation trigger occurred at TNC36 (intakes 97 and 169 metres below ground level (mbgl)).[6]	LEVEL 3 TRIGGERED Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl).[6]	LEVEL 3 TRIGGERED Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl).[6]	LEVEL 3 TRIGGERED Depressurisation trigger occurred at TNC36 (intakes 65, 97 and 169 mbgl).[6]	LEVEL 3 TRIGGERED Depressurisation trigger occurred at TNC36 (intakes 65, 97 and 169 mbgl).[6]	NA Monitoring data for November 2020 to be summarised in next report.
	Deep groundwater pressures	Water Management Plan – Deep groundwater pressures at VMPs TNC036, TNC040, and TNC043	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	No observable mining induced change at VWP intakes below 200 m depth.	NA Monitoring data for November 2020 to be summarised in next report.

Aspect	Feature	Corresponding Management Plan and TARP	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020	October 2020	November 2020
Landscape	Cliff lines	Land Management Plan – Cliff line damage or instability	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.
	Steep Slopes	Land Management Plan – Steep slope damage or instability	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.	No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence.	No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence.	No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence.	No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence.	No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence.	NA Monitoring data for November 2020 to be summarised in next report.
	Surface cracking	Land Management Plan – Surface cracking (excluding railway corridor)	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	NA Monitoring data for November 2020 to be summarised in next report.
	Dams (monthly)	Water Management Plan – Impacts to dams	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	NA Monitoring data for November 2020 to be summarised in next report.
	Dams (weekly)	Water Management Plan – Impacts to dams	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.	No signs of change to farm dams inspected that could be attributed to mine subsidence.
Agricultural Land	Agricultural Land	Land Management Plan – Agricultural land	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	No signs of change since baseline at sites inspected.	NA Monitoring data for November 2020 to be summarised in next report.
Aquatic Ecology	Macroinvertebrates	Biodiversity Management Plan – Decline or significant negative change in macroinvertebrate indicators.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	Monitoring macroinvertebrate indicators are within range of baseline data as supported by statistical analysis.	NR Monitoring next required in Autumn 2021.	NR Monitoring next required in Autumn 2021.
		Biodiversity Management Plan – Reduction in aquatic habitat through loss of pools or associated reduction in water quality (AURIVAS habitat assessment)	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	NR Monitoring next required in Spring 2020.	Monitoring macroinvertebrate indicators are within range of baseline data as supported by statistical analysis.	NR Monitoring next required in Autumn 2021.	NR Monitoring next required in Autumn 2021.
Terrestrial Ecology	Amphibians	Biodiversity Management Plan – Decline in amphibian populations within watercourses of the Study Area	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).
	Riparian Vegetation	Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).	NR Monitoring next required in Spring 2020 (to be sampled in November 2020).

Aspect	Feature	Corresponding Management Plan and TARP	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020	October 2020	November 2020
Aboriginal Heritage	Rock shelters and grinding grooves	Heritage Management Plan – Aboriginal heritage	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	NA Monitoring data for November 2020 to be summarised in next report.
Historical Heritage	Railway Culverts	Heritage Management Plan – Historical heritage (culverts only)	No signs of change to culverts inspected.	No signs of change to culverts inspected.	No signs of change to culverts inspected.	No signs of change to culverts inspected.	No signs of change to culverts inspected.	LEVEL 2 TRIGGERED Sandstone Culvert (89.629 km) - Pre-existing crack opened up to 1 mm, however does not exceed subsidence predictions (first reported in PMLL Detailed Report 46).[7]	LEVEL 2 TRIGGERED Sandstone Culvert (89.629 km) - Pre-existing crack opened up to 1 mm, however does not exceed subsidence predictions (first reported in PMLL Detailed Report 46).[7]	NA Monitoring data for November 2020 to be summarised in next report.
Built Features	Picton-Mittagong Loop Line	Picton-Mittagong Railway Management Plan	BLUE TRIGGER Embankment and Culvert (88.400 km) – tension crack along the crest of the embankment on down side at 88.387 km noted on 16 April 2020.	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues.	BLUE TRIGGER Track between 88.5 km and 88.6 km - More than 50% of joints have closed where ground shortening has occurred (first reported in PMLL Status Report 44).	BLUE TRIGGER Track between 88.5 km and 88.6 km - More than 50% of joints have closed where ground shortening has occurred (First reported in PMLL Status Report 44).	NA Monitoring data for November 2020 to be summarised in next report.
	Main Southern Railway	Main Southern Railway Management Plan	BLUE TRIGGER Ballast Top Subway (86.838 km) – changes in distances across the abutments exceeded the monitoring review point trigger level.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	NA Monitoring data for November 2020 to be summarised in next report.
	Electricity Infrastructure	Endeavour Energy Management Plan	NR No electrical infrastructure located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Gas Infrastructure	Jemena Management Plan	NR No gas infrastructure located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Potable Water	Sydney Water Potable Water Management Plan	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Sewerage Infrastructure	Stonequarry Creek Sewer Management Plan	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Telecommunications	Telstra Management Plan	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.

Aspect	Feature	Corresponding Management Plan and TARP	April 2020	May 2020	June 2020	July 2020	August 2020	September 2020	October 2020	November 2020
		NBN Co Management Plan	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Local roads, bridges and culverts	Wollondilly Shire Council Management Plan	NR No local roads located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	**Impacts to stormwater drain on Stoneqaurry Creek Road near Pegs S40 and S41 (Report 17) and Peg S39 (Report 19).**	**Further impacts to stormwater drains near Pegs S39, S40 and S41 (Reports 21 and 22), and new impacts to stormwater drain on Stonequarry Creek Road near Peg S37 (Report 22).**	**Further impacts to stormwater drains near Pegs S39, S40 and S41 (Report 26).**	**Impacts to road on Carramar Close (Report 29).**
	Built Structures	Built Structures Management Plan	NR No structures located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	**Impacts to houses on Stonequarry Creek Road and Booyong Close (Reports 21, 22, 23 and 24), and pool gates on Stonequarry Creek Road (Reports 21 and 22).**	**Impacts to houses on Stonequarry Creek Road and Attunga Close (Report 25 and Report 28), and a pool gate on Carramar Close (Report 26).**	**Impacts to houses on Attunga Close and Carramar Close (Report 29), and pool pavers at a property on Carramar Close (Report 29).**
	RMS Infrastructure	RMS management Plan	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Queen Victoria Memorial Home (QVMH)	QVMH Management Plan	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Mill Hill	Mill Hill Management Plan	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.

Notes:

NR – Monitoring not required this month.

NA – Monitoring data not available as monitoring not completed this month.

[1] Level 2 TARP description: The median of the ratios falls below the 40th percentile but does not fall below the 20th percentile of the baseline data at GS212053.

[2] Level 2 TARP description: The recorded water level has dropped below the previously recorded minimum level AND the above has occurred at one of the upstream pools (beyond mining effects) AND visual monitoring of pools has not noted any mining related impacts.

[3] Level 2 TARP description: The trigger for pH, EC or dissolved metals defined below occurs in one month and there is no visual evidence of an increase in iron staining that was not observed in the baseline period.

[4] Level 3 TARP description: Rock bar and/or stream base cracking, or gas release, or iron precipitation noted during visual inspection AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during baseline monitoring period.

[5] Level 3 TARP description: Up to 2 m water level reduction over a period of up to 3 months following the commencement of extraction at LW W1. Negligible water level rise in response to a significant rainfall recharge event AND/OR the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

[6] Level 3 TARP description: Up to 5 m water level reduction in VWP intakes located at or around (i.e. shallower than) 200 m depth over a period of up to 3 months following the commencement of extraction at LW W1. Negligible response following a significant rainfall recharge event AND/OR the reduction in water level is determined not to be controlled by climatic or anthropogenic factors.

[7] Historical Heritage TARP descriptions:

- Level 1 and Level 2 TARP description: Historical heritage site monitoring indicates no detectable environmental consequences.
- Level 3 TARP description: Historical heritage site monitoring indicates environmental consequences exceeds predictions.

2.2 Summary of Actions

During the reporting period, there were seven (7) TARP triggers that required further actions, as well as a number of impacts to roads and built structures that required remediation.

This section provides a summary of actions resulting from triggers being met in the TARPs, as well as required remediation actions.

2.2.1 Natural Drainage Behaviour TARP - Level 3 Trigger for Gas Emissions

Background

As discussed in the previous Six Monthly Subsidence Impact Report, gas bubbling has been observed at Stonequarry Creek (Pool SR17) and Matthews Creek (Pool MR45) as detailed below:

- 24 February 2020 - Stonequarry Creek (Pool SR17) and Matthews Creek (Pool MR45):
  - Air bubbles rising to the surface along sections of Stonequarry Creek and Mathews Creek. In Stonequarry Creek, there were 7 – 8 locations where bubbles were observed rising at intervals of 1 – 3 minutes. At the junction of Matthews Creek and Cedar Creek, continuous streams of bubbles were observed at 4 – 5 locations;
- 27 February 2020 - Matthews Creek (Pool MR45):
  - Evidence of three adjacent, reasonably persistent, although small, gas emissions were observed in Pool MR45;
  - Gas bubbling in Pool SR17 (Stonequarry Creek) was not noted by GeoTerra. It is also noted that gas bubbling was observed in Pool SR17 (Stonequarry Creek) by Tahmoor Coal on 6 June 2019 prior to the commencement of LW W1 extraction. Gas bubbling in Pool SR17 was therefore concluded to most likely be as a result of gas release from anoxic muds rather than as a result of longwall mining.
- 24 March 2020 – Matthews Creek (Pool MR45):
  - Evidence of at least six adjacent, reasonably persistent, although small, gas emissions were observed in Pool MR45.

During the current reporting period, the following observations of gas bubbling have been made:

- 24 April 2020, 26 May 2020 and 25 June 2020 – Matthews Creek (Pool MR45):
  - Gas bubbling has decreased to two small and infrequent sites (refer to Creek Monitoring Reports 5, 6 and 7; Appendix C);
- 24 July 2020 – Matthews Creek (Pool MR45):
  - No observed discharge of gas (refer to Creek Monitoring Report 8, Appendix C).

A Level 3 TARP trigger for gas bubbling occurred due to gas release in Matthews Creek (Pool MR45) from February to June 2020.

Actions Completed

As discussed in the previous Six Monthly Subsidence Impact Report, actions completed included the discussion of the TARP trigger at the Tahmoor Coal Environmental Response Group (ERG) on 10 March 2020 and the completion of gas sampling on 2 April 2020. The gas composition report for the sample indicated that the gas originated from the shallow Hawkesbury Sandstone stratas and/or shallow anoxic muds. It was not possible to definitively determine that gas release at Pool MR45 was related to longwall mining in the local area.

As gas bubbling frequency did not increase during the current reporting period, the ERG agreed no further actions (e.g. further gas sampling) were required.

Proposed Actions

If gas bubbling is noted to restart, further gas sampling at Pool MR45 (or any other affected pools) may be completed. The purpose of future gas sampling would be to determine the composition of gases, a change in which could indicate a change in gas source and/or impacts from longwall mining.

As a consent condition for the commencement of Longwall West 2 (LW W2) extraction, DPIE have requested that the frequency of visual inspection of MR45 is increased from monthly to fortnightly during the active subsidence period of LW W2 extraction. In addition, DPIE have also requested that the frequency of flow monitoring in proximity to MR45 to increase from monthly to fortnightly. Tahmoor Coal have proposed that this increase in flow monitoring occur at the site 'MG'. These requirements have been incorporated into the Water Management Plan and the monitoring program.

Monitoring of flow and visual inspection of pools will continue under the existing monitoring program.

2.2.2 Groundwater Bore Level TARP – Level 3 Trigger for Open Standpipe Piezometer Groundwater Levels

Background

During this reporting period, a number of groundwater intakes in open standpipe piezometers (OSPs) have recorded a trend of reducing water level elevation below the baseline range. This trend has been noted in the following OSP intakes, as summarised below:

- 29 June 2020, 23 July 2020 and 19 August 2020 – deepest intake at P12 (intake P12C) (refer to Groundwater Monitoring Reports 6-8; Appendix D); and
- 15 September and 26 October 2020 – deepest intakes at piezometer P12 (intake P12C) and P13 (intake P13C), as well as two deepest intakes at P16 (intakes P16B and P16C) (refer to Groundwater Monitoring Reports 9 and 10; Appendix D).

This trend has resulted in the triggering of a Level 3 TARP trigger for OSP groundwater level from June 2020 to October 2020.

Actions Completed

This TARP trigger was discussed during the ERG meeting on 14 July 2020. As the results for OSP groundwater levels are within predictions and are not connected with any surface water impacts, it was concluded that the current groundwater monitoring frequency would be maintained, and future results monitored closely.

Proposed Actions

As a consent condition for the commencement of LW W2 extraction, DPIE have requested that the monitoring frequency of OSP groundwater level at P12C is increased from monthly to fortnightly for the duration of LW W2 extraction. This requirement has been included in the Water Management Plan and the monitoring program.

Groundwater monitoring will continue under the existing monitoring program.

2.2.3 Shallow Groundwater Pressures TARP – Level 3 Trigger for Shallow Vibrating Wire Piezometer Groundwater Pressure

Background

During this reporting period, a number of groundwater intakes in shallow (<200 mbgl) Vibrating Wire Piezometers (VWPs) have recorded a trend of depressurisation below the baseline range. This trend has been noted in the following VWP intakes, as summarised below:

- June 2020, July 2020 and August 2020 – intakes at 97 and 169 mbgl in TNC36 (refer to Groundwater Monitoring Reports 6-8; Appendix D); and
- September and October 2020 – intakes at 65, 97 and 169 mbgl in TNC36 (refer to Groundwater Monitoring Reports 9 and 10; Appendix D).

This trend has resulted in the triggering of a Level 3 TARP trigger for shallow VWP groundwater pressure in June 2020 to October 2020.

Actions Completed

This TARP trigger was discussed during the ERG meeting on 14 July 2020. As the results for VWP groundwater pressure are within predictions and are not connected with any surface water impacts, it was concluded that the current groundwater monitoring frequency would be maintained, and future results monitored closely.

Proposed Actions

As a consent condition for the commencement of LW W2 extraction, DPIE have requested that the monitoring frequency of VWP groundwater pressure at TNC36 is increased from monthly to fortnightly for the duration of LW W2 extraction. This requirement has been included in the Water Management Plan and the monitoring program.

Groundwater monitoring will continue under the existing monitoring program.

2.2.4 Historical Heritage TARP – Level 2 Trigger for Sandstone Culvert Impacts

Background

In the Picton-Mittagong Loop Line Monitoring Report 46 (refer to Appendix F), it was noted that visual inspections of the sandstone culvert at 89.629 km in late August to early September 2020 had noted that a small transverse crack up to 1 mm in width had become evident across the downside culvert overt about 0.4 – 0.5 m inside the headwall (refer **Figure 2-1**).

This minor crack was pre-existing and had been observed due to minor opening of the aperture (refer **Figure 2-1**). It is likely that the minor pre-existing crack is related to the construction of the brick wall founded on the sandstone culvert headwall crest and associated lateral loading from the retaining wall and steep batter slope (refer **Figure 2-2**). It is possible that the recent minor subsidence effect may have resulted in slight opening of the crack.

It was highlighted in the report that the crack was minor and was not adversely affecting the structural integrity of the culvert. No further developments of this crack had been noted in subsequent weekly reports during this reporting period.

However, this observation triggered a Level 2 TARP trigger for historical heritage in September 2020 to October 2020.

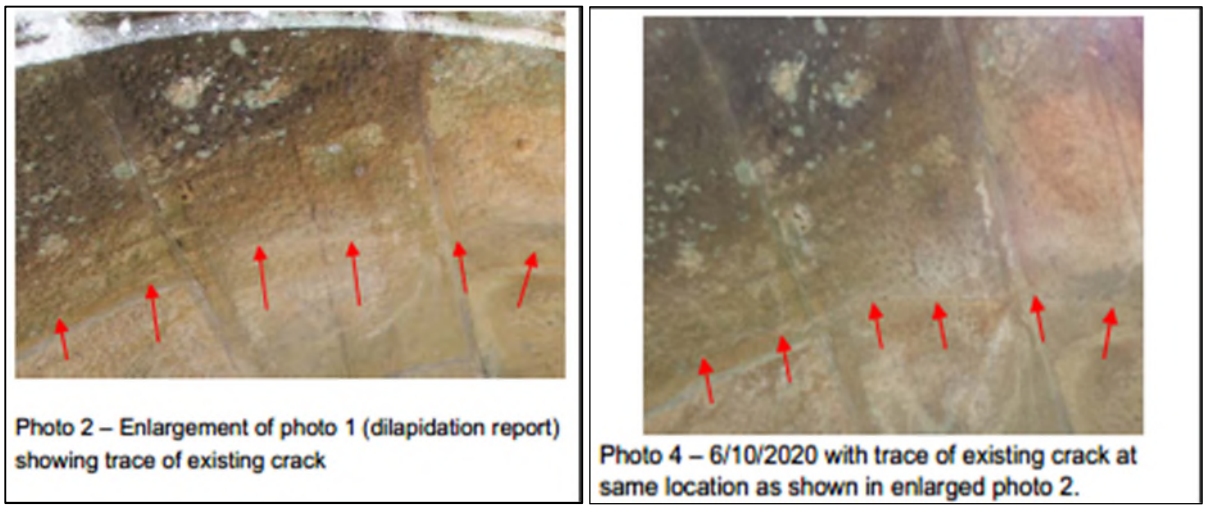

Figure 2-1 Pre-mining and current photos of the crack at culvert 89.629 km (source: PMLL Detailed Monitoring Report 47, **Appendix E**).

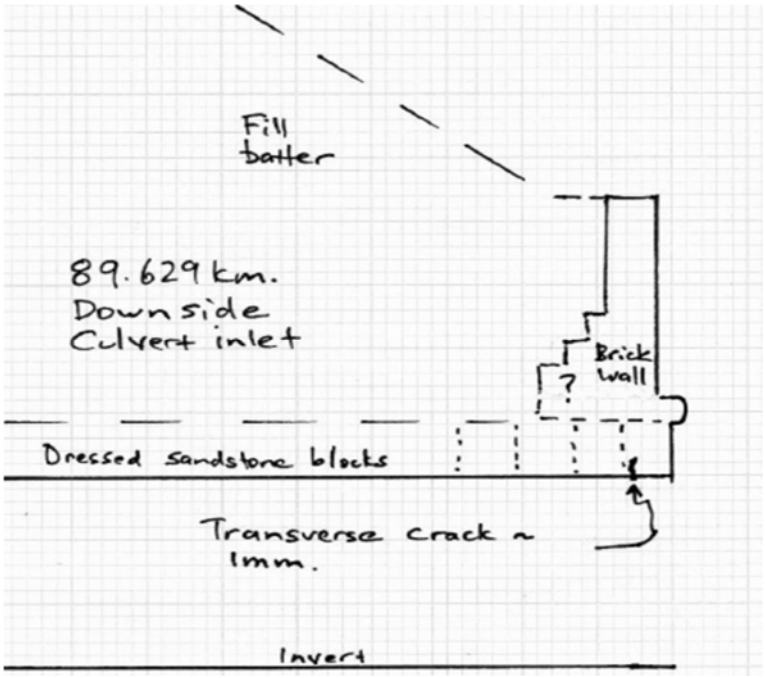

Figure 2-2 Sketch of the cross-section of the culvert 89.629 km headwall (source: PMLL Detailed Monitoring Report 46, **Appendix E**).

Actions Completed

This TARP trigger was discussed during the ERG meeting on 20 October 2020 and during the weekly Rail Management Group (RMG) meetings during October 2020. As the results are within predictions and the cracking is minor and existed prior to mining, it was concluded that the current rail monitoring program would be maintained, and future results monitored closely.

Proposed Actions

Visual inspection of the location will continue under the existing monitoring program.

2.2.5 Picton-Mittagong Loop Line TARP – Blue Trigger at Embankment and Culvert (88.387 km)

Background

On 16 April 2020, a tension crack was observed along the crest of the embankment on Down side at 88.387 km during an inspection of the Embankment and Culvert (88.400 km) on the Picton-Mittagong Loop Line, as discussed in the previous Six Monthly Subsidence Impact Report. It was determined that recent heavy vehicle traffic and the presence of an old steel water pipe buried beneath the crest may have influenced crack formation at this location, and there was no evidence of embankment instability.

Actions Completed

This issue was resolved by diverting the roadway to along the toe of the embankment. Further actions have not been required as the issue was resolved by May 2020.

Proposed Actions

Visual inspection of the location will continue under the existing monitoring program.

2.2.6 Picton-Mittagong Loop Line TARP – Blue Trigger at for Joint Closure (88.5 – 88.6 km)

Background

On 14 September 2020, detailed measurements were completed between 88.35 km and 88.65 km where expected ground shortening has occurred. More than 50% of joints have closed between 88.5 km and 88.6 km triggering a blue TARP trigger (refer to PMLL Status Report 44; Appendix F).

Actions Completed

Adjustments of the track between 88.5 km and 88.6 km were completed on 12 October 2020, resolving the TARP trigger.

Proposed Actions

Visual inspection of the location will continue under the existing monitoring program.

2.2.7 Main Southern Railway TARP – Blue Trigger at Ballast Top Subway (86.838 km)

Background

Changes in distances across the Ballast Top Subway (86.838 km) abutment exceeded the monitoring review point trigger level during the local 3D survey of the structure in March 2020, as discussed during the previous Six Monthly Subsidence Impact Report.

Actions Completed

Further actions have not been required as the issue was reviewed by the RMG and resolved by May 2020. Following inspection by a structural engineer, the changes noted appeared to have been related to a continuation of pre-existing conditions and were unlikely to be mining induced.

Proposed Actions

Visual inspection of the structure will continue under the existing monitoring program.

2.2.8 Impacts to Built Structures and Local Roads

Background

A number of impacts to local roads and built structures occurred during August to November 2020 as a result of subsidence from LW W1 extraction. These impacts can be summarised as:

- Impacts to stormwater drains along Stonequarry Creek Road (August to October 2020);
- Impacts to houses on Stonequarry Creek Road (September to October 2020);
- Impacts to houses on Booyong Close (September 2020);
- Impacts to houses on Attunga Close (October 2020 and November 2020);
- Impacts to a house on Carramar Close (November 2020);
- Impacts to the road pavement on Carramar Close (November 2020);
- Impacts to pool gates on Stonequarry Creek Road (September 2020); and
- Impacts to a pool gate and pool pavers on Carramar Close (October 2020, November 2020).

Actions Completed

Where appropriate, Tahmoor Coal has completed temporary repairs to roads and built structures within the Stonequarry Estate. All residential impacts have been referred to SA NSW.

Proposed Actions

Visual inspection of the roads and structures will continue under the existing monitoring program, and repair of damages and interaction with SA NSW will also continue as required.

3 Assessment of Environmental Performance

This section provides an assessment of compliance with all relevant performance measures and indicators.

3.1 Environmental Performance Measures and Indicators

The following development consents include subsidence impact performance measures as conditions for the extraction of LW W1-W2:

- DA 67/98 Modification 4:
  - Condition 13A – Performance Measures for Natural and Heritage Features;
  - Condition 13E – Performance Measures for Built Features;
- LW W1-W2 Extraction Plan Approval:
  - Condition 1 – Performance Measures for Stonequarry Creek, Cedar Creek and Matthews Creek.

The subsidence impact performance measures were adopted as part of the LW W1-W2 Extraction Plan and associated management plans. To assist in defining the performance measures, each measure has been assigned subsidence performance indicator(s).

These performance measures and indicators are provided in **Table 3-1**, as well as an assessment of performance.

Table 3-1 Assessment of Environmental Performance

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Subsidence Performance Measure Exceeded?	Section Discussed
Water Management				
Stonequarry Creek, Cedar Creek and Matthews Creek (LW W1-W2 Extraction Plan Approval)	No subsidence impact or environmental consequence greater than minor*	This performance indicator will be considered to be exceeded if mining-induced fracturing in a rockbar or stream bed results in a reduction in pool water level below historically recorded water levels, taking into account rainfall and observations during the baseline monitoring period, for: • More than 10% of pools located within the 600 m Study Area for Natural Features; and/or • Pool SR17.	**No**	Sections 4.2.2 and 4.2.3
	No connective cracking between the surface, or the base of the alluvium, and the underground workings.	This performance indicator will be considered to be exceeded if analysis of inflow data suggests high correlation to rainfall events and significant departure from recent groundwater model predictions. This would be supported by analysis of pre- and post-mining goaf centreline bore data.	**No** *Note: Pre-mining and post-mining goaf centreline bore data not yet available.*	Section 4.2.8
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	Flooding This performance indicator will be considered to be exceeded if subsidence results in the post-mining 1% AEP flood level being above the floor level of one or more dwelling.	**No** *Note: LW W1-W2 mining is still in progression, and therefore post-mining flood modelling has not been completed.*	Not applicable
Land Management				
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	Landscape Features This performance indicator will be considered to be triggered if subsidence impacts to landscape features result in the collapse of cliffs, rock outcrops or steep slopes in proximity to members of the public.	**No**.	Section 4.3.1 and 4.3.2

Biodiversity Management				
Threatened species, threatened populations, or endangered ecological communities (DA 67/98 Condition 13A)	Negligible environmental consequences***.	This performance indicator will be considered to be triggered if: • Changes in macroinvertebrate and stream health indicators are statistically significant; • If visual assessment of aquatic habitat identifies mining subsidence induced impacts. • Statistically significant changes in amphibian diversity is detected toward baseline attributed to mining, as detected during amphibian monitoring; and/or • Statistically significant changes in riparian vegetation is detected toward baseline attributed to mining, as detected during riparian monitoring.	**No** *Note: AUSRIVAS results indicate that the performance indicators for aquatic ecology have not been triggered. Riparian vegetation and amphibian monitoring has not been completed during this reporting period and will be confirmed in the next Six Monthly Subsidence Impact Report.*	Section 4.4.1 and 4.4.2
Heritage Management				
Heritage sites show in the figures in Appendix 7** (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences***.	<u>Isolated finds/artefact scatters (AHIMS items)</u> No performance indicators are currently established as impacts are predicted to be negligible.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to isolated finds / artefact scatters from the proposed longwall mining as very unlikely. Impacts to open sites, such as artefact scatters, are limited to cracking in the surface soils which is unlikely to affect the artefacts. Therefore monitoring of these sites have not been included in the monitoring program.*	Not applicable
		<u>Scarred tree (AHIMS item)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to the scarred tree from the proposed longwall mining as very unlikely.*	Not applicable

		• subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage	*Impacts to open sites, such as scar trees, are limited to cracking in the surface soils which is unlikely to affect the item. Therefore monitoring of this item has not been included in the monitoring program.*	
		<u>Grinding grooves (AHIMS item)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking; and • these subsidence impacts result in impacts to the heritage values of the site.	**No**	Section 4.5.1
		<u>Rockshelters (AHIMS items)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies visible perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and • these subsidence impacts result in impacts to the heritage values of the sites.	**No** *Note: It should be noted that only external visual inspections of rockshelters has been able to be completed during the reporting period due to safety concerns. Internal inspections of the rockshelters will be completed following the completion of the longwalls.*	Section 4.5.1
	Negligible loss of heritage value***.	<u>Queen Victoria Memorial Hospital (local heritage significance)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the building, measurable tilt and internal damage, or cracks in foundations.	**No**	Section 4.5.2 and 4.6
		<u>Mill Hill, Miller's House and archaeological relics (local heritage significance)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies damage to external cladding or internal finishes.	**No**	Section 4.5.2 and 4.6

		Harmony House archaeological site (local heritage significance) No performance indicators are currently established as impacts are predicted to be negligible. However, if the pre-mining assessment identifies that the cistern is located within the Study Area, this may need to be re-evaluated.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to this heritage item from the proposed longwall mining as very unlikely. Therefore monitoring of this site has not been included in the monitoring program.*	Not applicable
		Rural landscape – Thirlmere Way (local heritage significance) No performance indicators are currently established as impacts are predicted to be negligible.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to this heritage item from the proposed longwall mining as very unlikely. Therefore monitoring of this site has not been included in the monitoring program.*	Not applicable
Other Aboriginal and heritage sites (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences***.	Sandstone culverts (local heritage significance) This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, block movement or block fall.	**No**	Section 4.5.2 and 4.6
		Brick culverts (local heritage significance) This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.	**No**	Section 4.5.2 and 4.6

Built Feature Management				
Key Public Infrastructure: • Main Southern Railway; • Picton-Mittagong Loop Line; and • Electricity transmission lines and towers. (DA 67/98 Condition 13E)	Always safe and serviceable.	None allocated.	**No**	Section 4.6
	Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.	None allocated.	**No**	Section 4.6
Other Infrastructure: • Electricity distribution lines, poles and associated towers; • Unsealed roads and road culverts, fire trails, fences and other built features; and • Other public infrastructure. (DA 67/98 Condition 13E)	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		
	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Privately-owned residences (DA 67/98 Condition 13E)	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		
	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Other privately-owned built features and improvements, including farm dams, swimming pools, tennis	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		

courts, roads, tracks and fences (DA 67/98 Condition 13E)	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	None allocated.	**No**	Section 4.6
Mine workings				
First workings (DA 67/98 Condition 13A)	To remain long term stable and non-subsiding.	None allocated.	**No**	Not applicable
Second workings (DA 67/98 Condition 13A)	To be carried out only within the approved mine plan, in accordance with an approved Extraction Plan.	None allocated.	**No**	Not applicable

NOTES:

* minor is defined as *not very large, important or serious* by DPIE.

** As there is no Appendix 7 in DA 67/98 Modification 4, it is interpreted that this refers to the Aboriginal heritage sites listed on the Aboriginal Heritage Information Management System, *Wollondilly Local Environmental Plan 2011*, State Heritage Register, and the Australian Heritage Database.

*** For the purpose of this Extraction Plan and associated documents, 'negligible' is defined as being 'so small and insignificant as to not be worth considering'. A negligible impact is viewed with regards to a long term context, causing little or no impact. If a short term impact causes a greater than negligible impact, the impact can still be considered negligible if the impacts are of a limited duration and are considered negligible when considered over the long term.

4 Summary of Environmental Monitoring Results

This section provides a comprehensive summary of all quantitative and qualitative environmental monitoring results.

4.1 Subsidence Monitoring

4.1.1 General Subsidence Observations

During the reporting period, the LW W1-W2 Subsidence Monitoring Program has been implemented to monitor subsidence impacts within the Study Area. The details of the Subsidence Monitoring Program are illustrated in **Figure 4-1**. The Subsidence Monitoring Program includes thirteen (13) Global Navigation Satellite System (GNSS) units measuring absolute horizontal and vertical positions in real time installed directly above and adjacent to LW W1.

A summary of all surveys and inspections completed during the reporting period is provided in Figure A and Table A of the MSEC LW W1 Subsidence Monitoring Report 29 (refer **Appendix A**). A weekly review of the subsidence survey results during the reporting period has been completed by MSEC.

As of 6 November 2020 (the end of this reporting period), 1876 m of LW W1 had been extracted and extraction of LW W1 has been completed. The active subsidence area of LW W1 for 8 November 2020 is illustrated in **Figure 1-3**.

Table 4-1 summarises the maximum observed ground movements within the active subsidence zone at the start and end of this reporting period. During the reporting period, a maximum of 233 mm of vertical subsidence was measured within the active subsidence zone at Stonequarry Creek Road.

Table 4-1 Subsidence Monitoring Observations for the start and end of this Reporting Period (source: MSEC, Subsidence Monitoring Reports 5 and 29, Appendix A)

	Report 5		Report 29	
General Information				
Monitoring Period	8/4/2020 – 5/5/2020 (monthly reporting)		29/10/2020 – 6/11/2020 (weekly reporting)	
Length of extraction	747 m		1876 m	
Distance travelled by longwall since previous report	109 m since 7/4/2020		7 m since 28/10/2020	
Observed Ground Movement Parameters	**Maximum Observed**	**Location**	**Maximum Observed**	**Location**
Subsidence (mm)	83	PMLL	233	Stonequarry Creek Road
Tilt (mm/m)	0.9	PMLL	1.9	Stonequarry Creek Road
Hogging Curvature (km^{-1})	0.07	PMLL	0.12	Booyong Close
Sagging Curvature (km^{-1})	-0.06	PMLL	-0.08	Booyong Close
Tensile Strain (mm/m)	0.6	PMLL	0.6	PMLL
Compressive Strain (mm/m)	-0.9	PMLL	-1.2	LW W1-W2 Crossline
Subsidence since previous survey (mm)	55	PMLL	5	PMLL

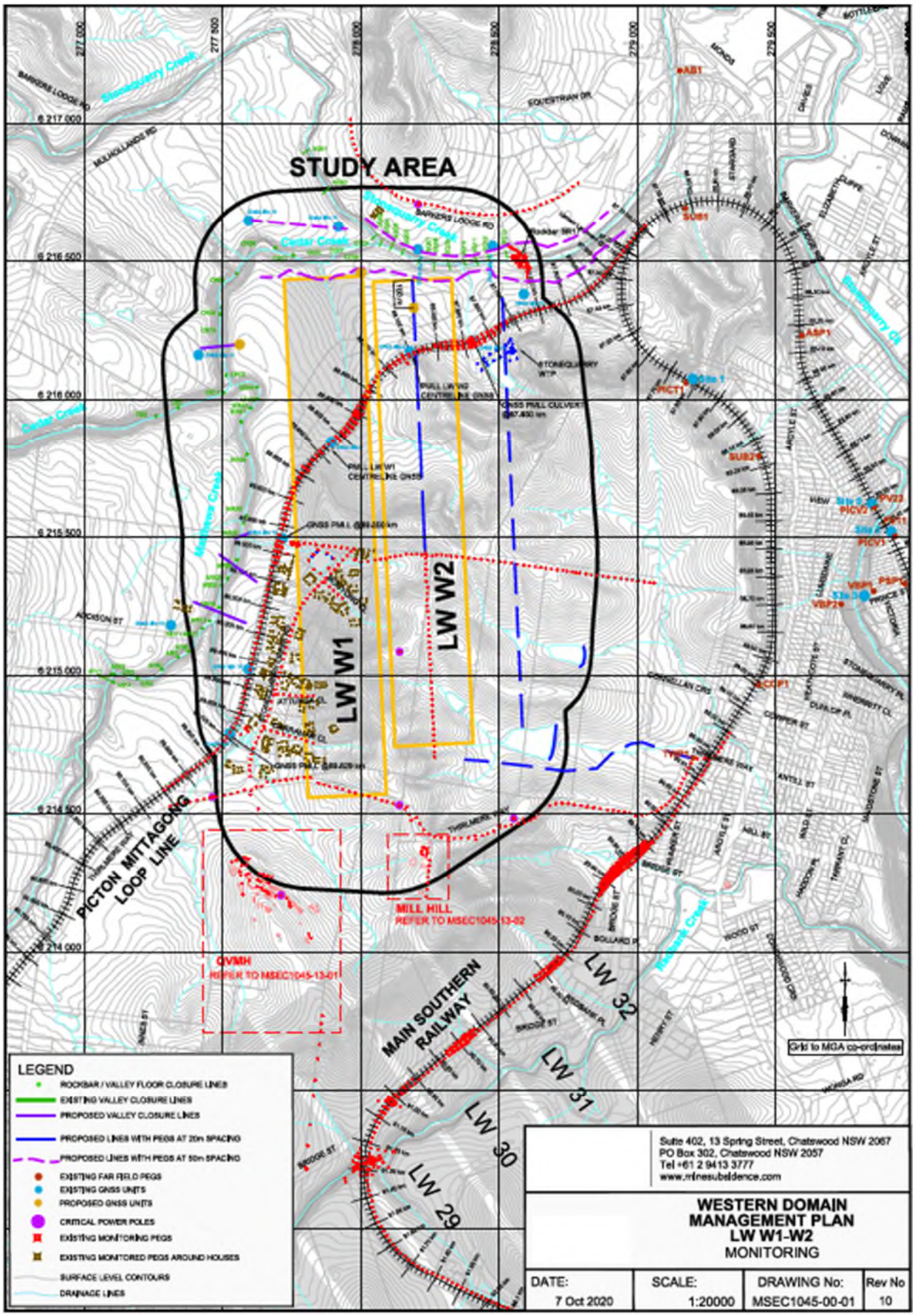

Figure 4-1 LW W1-W2 Subsidence Monitoring Program (source: LW W1-W2 Subsidence Monitoring Program)

The development of subsidence at pegs and GNSS units located on the LW W1 centreline that have been mined directly beneath by LW W1 are illustrated in **Figure 4-2**. This figure shows that subsidence currently observed along the centreline of LW W1 are similar to that observed during the extraction of Appin LW901, which was a similar single panel extraction.

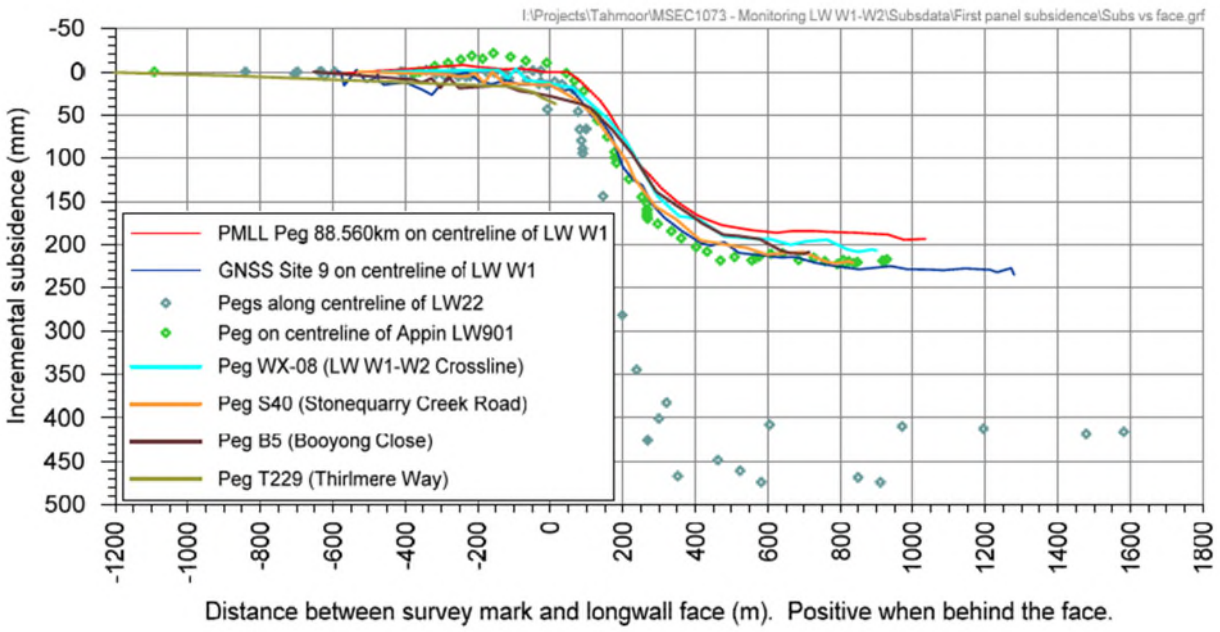

Figure 4-2 Development of subsidence along centreline of LW W1 compared to previously extracted single panels (source: MSEC, Subsidence Monitoring Report 29, **Appendix A**).

Observed subsidence movements have been less than predicted. Subsidence is currently developing along the LW W1-W2 Cross Line, Stonequarry Creek Road, Booyong Close, Attunga Close and Carramar Close. The results show that the monitoring lines are following similar trends as observed along the PMLL during the previous Six Monthly Subsidence Impact Report.

Small compressive strains are developing in the active subsidence zone, and some minor impacts to stormwater drains and built structures have been noted in the Stonequarry Estate during the current monitoring period (refer to **Table 2-3** for more details).

A comparison between assessed and observed impacts to surface features is summarised in Table 2 of the MSEC Subsidence Monitoring Report 29 (refer to **Appendix A**).

4.1.2 GNSS Monitoring Observations

Observed GNSS movements are at the lower end of the observed range in the survey database from the Southern Coalfields at similar depths of cover. Results from all GNSS units, including incremental horizontal movements, are presented in the MSEC Subsidence Monitoring Reports (refer **Appendix A**). Some trends can be seen from the results, with the closest GNSS units generally moving towards the extracted panel.

Changes in horizontal distances between GNSS units that are station near each other and on opposite sides of a waterway indicate that no apparent valley closure has occurred during the extraction of LW W1 (refer **Figure 4-3**).

Site 12 and Site 13 are located across Stonequarry Creek at Rockbar SR17. Site 12 appeared to have been affected by the heavy rainfall event between 7 and 9 February 2020, resulting in swelling of clay soils around the unit and movement of the sensor. If the movements during the week after the wet weather event on 7 and 9 February 2020 are removed from the results, the resultant movements at Site 12 would be similar in magnitude to the movements measured at Site 13. No measurable changes have been observed since this event (refer **Figure 4-3**).

The LW W1 face passed Site 18 in early August 2020 and passed Site 19 in late August 2020, resulting in Site 18 moving towards LW W1 earlier than Site 19. This resulted in an apparent closure between the two sites between June and late August 2020, and an apparent reduction in closure between September to mid-October 2020 (refer **Figure 4-3**).

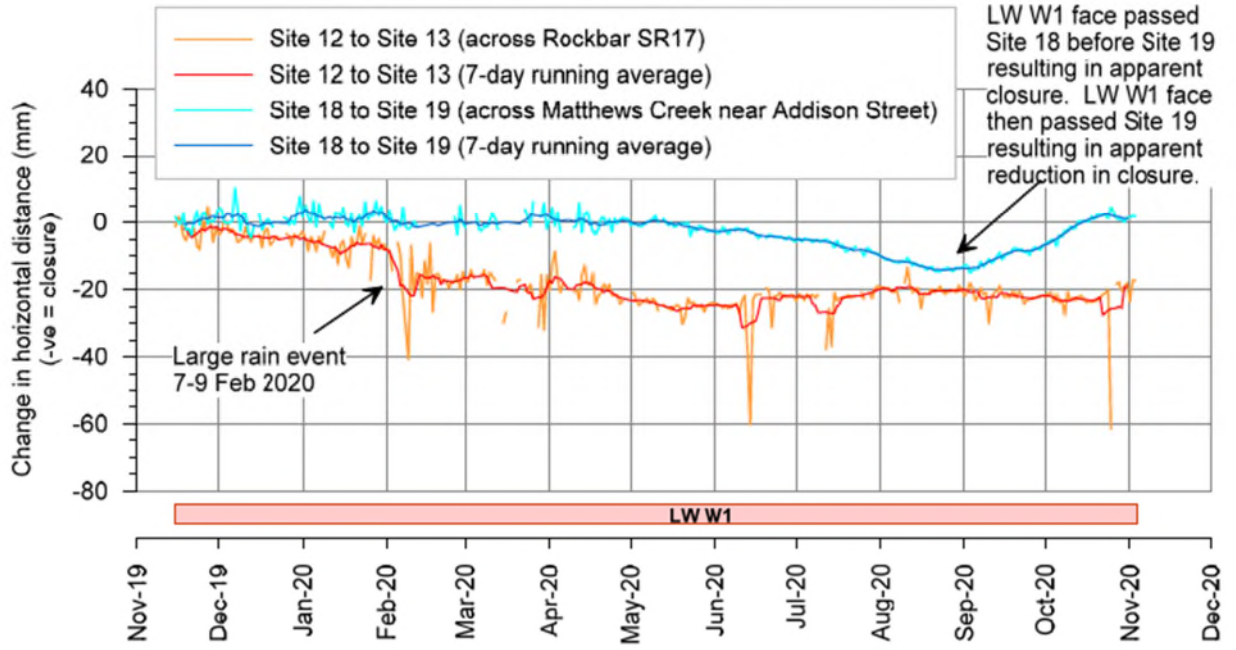

Figure 4-3 Observed changes in horizontal distances between GNSS units (source: MSEC, Subsidence Monitoring Report 29, **Appendix A**).

4.1.3 Valley Closure in Creeks

Survey marks installed across rockbars in Stonequarry Creek, Cedar Creek and Matthews Creek prior to the commencement of LW W1 are illustrated in **Figure 4-1**. During the current reporting period, very little change (if any) in closure has been observed in any of the creek systems.

4.2 Water Monitoring

The Tahmoor Coal LW W1-W2 Water Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on surface water and groundwater systems in accordance with Condition 13H(vii)I of DA 67/98.

During this reporting period, the LW W1-W2 Water Management Plan has been implemented to monitor the following surface water and groundwater systems:

- Surface Water:
  - Stonequarry Creek flow, pool water level and surface water quality – monitoring data reviewed and reported by Hydro Engineering & Consulting (refer to **Appendix B** for referenced reports).
  - Creek monitoring for natural drainage behaviour – visual inspections and reporting by GeoTerra (refer to **Appendix C** for referenced reports);
- Groundwater:
  - Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monitoring data reviewed and reported by GeoTerra (refer to **Appendix D** for referenced reports); and
  - Mine water intake – data for this reporting period reviewed and reported by GeoTerra (refer to Report 10 in **Appendix D**).

Performance against all Water Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarise the observations made during the reporting period for each surface water and groundwater category.

4.2.1 Stonequarry Creek Flow

Streamflow data has been analysed to assess whether a statistically significant reduction in the quantity of water recorded at Stonequarry Creek at Picton (GS212053) in the period post-mine commencement relative to the pre-mine period has occurred, that has not also occurred in the control catchment(s). The locations of GS212053 is illustrated in **Figure 4-5**.

Measured flows versus modelled flows at Stonequarry Creek at Picton (GS212053) have been analysed using a catchment model calibrated to data from the period pre-mine commencement. **Figure 4-4** shows a plot of the sliding 12-month median of the ratio of 14-day sums of filtered monitored flow at Stonequarry Creek at Picton (GS212053) to flows simulated via the catchment model to 12 October 2020.

The results show that the moving 12-month median of the 14-day filtered low flow ratio of monitored to modelled flow was below the 40th percentile and close to the 20th percentile during the reporting period. Similar flow conditions occurred at the reference sites at Bargo River (Site 300061) and Hornes Creek (Site 300062). As such, a Level 2 TARP significance in relation to catchment streamflow applies for the current review period.

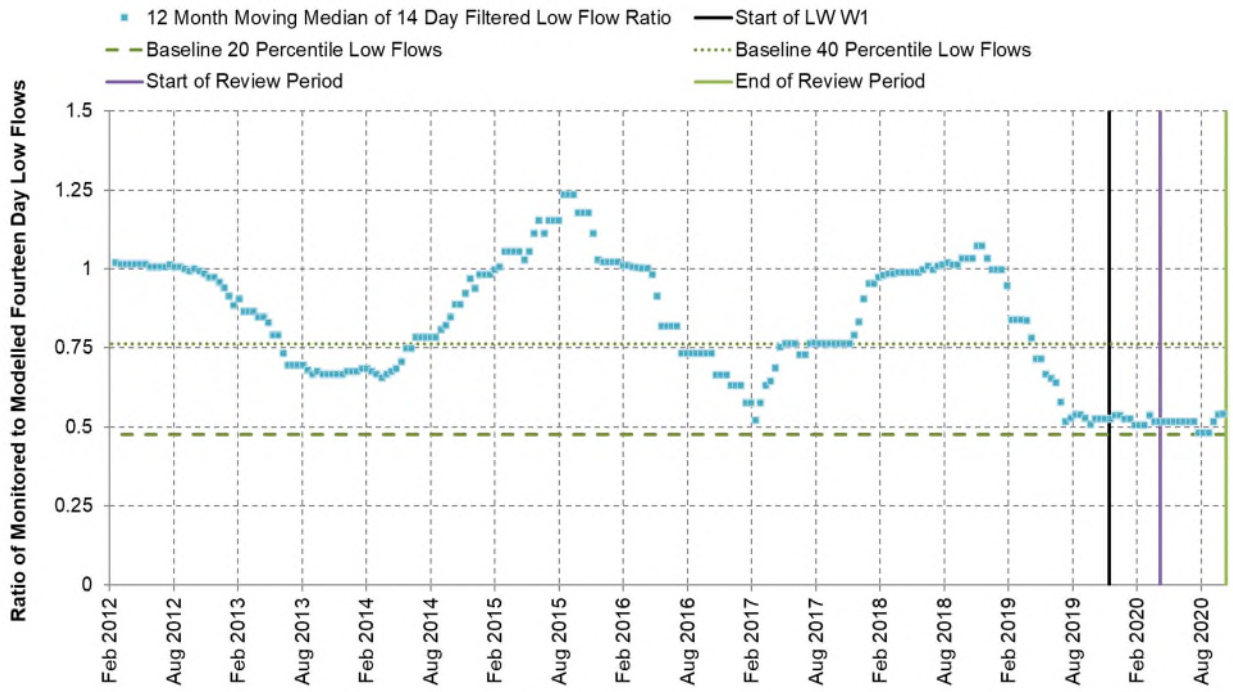

Figure 4-4 One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Stonequarry Creek at Picton (GS212053) (source: HEC, Surface Water Review Summary Report, **Appendix B**).

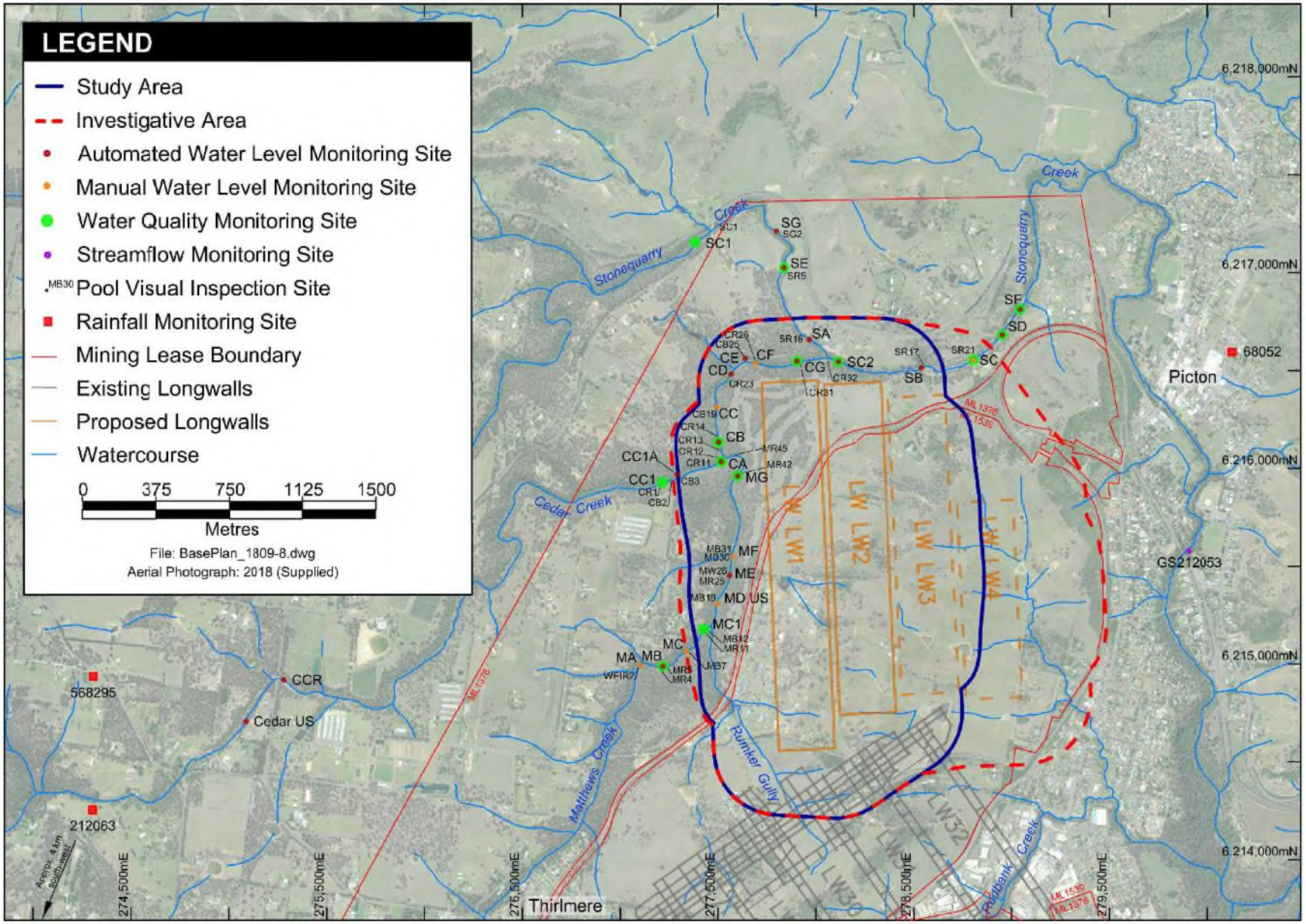

Figure 4-5 LW W1-W2 Surface Water Monitoring Locations (source: HEC, Surface Water Monitoring Report 7, **Appendix B**)

4.2.2 Pool Water Level

Surface water level data has been recorded at the pool monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in **Figure 4-5**. Continuous surface water level data has been recorded at three pool monitoring sites on Matthews Creek, six monitoring sites on Cedar Creek and seven monitoring sites on Stonequarry Creek. Manual water level measurements have also been undertaken monthly at the sites shown in **Figure 4-5**.

One additional water level monitoring site has recently been installed on Cedar Creek – Cedar US. However little water level data has been recorded at this site to date and, as such, data from this site has not been included in this review report.

During the reporting period, monitoring sites on Matthews Creek, Stonequarry Creek, and Cedar Creek were generally consistent with those recorded during the baseline period prior to the commencement of mining of LW W1. The water level rose consistently in response to rainfall events at each site and water level decline was recorded during period of low rainfall. The lowest water levels recorded at the majority of sites occurred during September and October 2020, which was consistent with a period of low rainfall.

For monitoring site CB on Cedar Creek, the water level fell below the baseline minimum in July, September and October 2020. The lowest water level was recorded at monitoring site CB in October 2020, when the water level fell below the baseline minimum by only 16 millimetres (mm). Review of the water level records for monitoring site CB indicates that the water levels at this site are inconsistent with the majority of other monitoring sites. In addition, direct comparison with the water level records for CB compared to reference sites and other potential impact sites is of limited relevance due to the difference in the apparent water level behaviour at monitoring site CB. Although water levels lower than the previously recorded minimum were not recorded at an upstream pool (beyond mining effects) in July, September and October 2020, a Level 2 TARP significance in relation to pool water level at monitoring site CB was assigned as there was no visual evidence of mining related impacts at this site.

Charts illustrating monitored pool water level hydrographs for pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts A1-23 in Attachment A of the Surface Water Monitoring Reports (refer to **Appendix B**).

4.2.3 Natural Drainage Behaviour

Visual and photographic surveys for subsidence impacts on creeks have been completed monthly for pools on Stonequarry Creek, Cedar Creek and Matthews Creek within the active subsidence zone of LW W1 (refer to **Appendix C**). The purpose of these surveys is to note whether change has occurred to pool level, drainage or overland flow, and to assist in determining if any change can be attributed to mining impacts. Surveys are carried out to identify rock bar and/or stream base cracking, gas release, or increased iron precipitation.

Creek monitoring locations are illustrated on **Figure 4-6**.

During the reporting period, pool water level and overland connective flow was influenced by rainfall events in August and September 2020 and resulting catchment base-flow recharge.

The large pondage between SR16 and SR17 on Stonequarry Creek remained full. All pools along Cedar Creek maintained water and overland connective flow. Upstream pools in Matthews Creek generally had lower (or no) water level and overflows compared to downstream pools in Matthews Creek.

Small yet reasonably persistent gas emissions have been observed at Pool MR45 between February 2020 and June 2020. Gas analysis indicated that the gas originated from shallow Hawkesbury Sandstone and/or shallow anoxic muddy alluvium rather than deeper Hawkesbury Sandstone strata. The data does not enable a definitive assessment to be made of the potential linkage between LW W1 extraction and subsidence impacts in the area. A Level 3 TARP trigger for gas bubbling occurred due to gas release in Matthews Creek (Pool MR45).

To date, there have been no observable mining subsidence related impacts such as creek bed cracking or increased iron hydroxide precipitation evident in Cedar Creek, Matthews Creek or Stonequarry Creek.

A summary of creek observations for the reporting period is provided in **Table 4-2**.

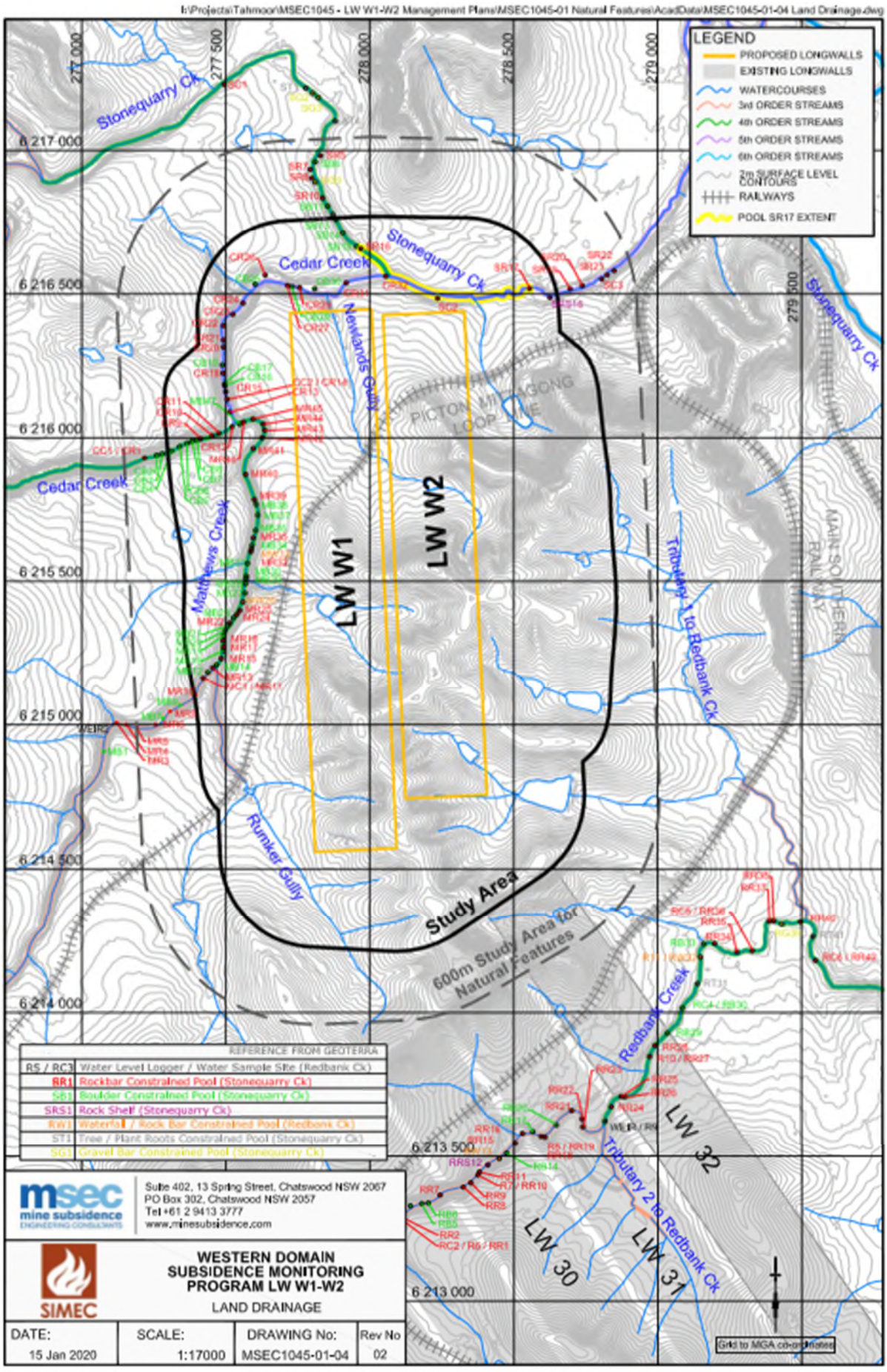

Figure 4-6 LW W1-W2 Creek Monitoring Locations (source: MSEC, 2019; LW W1-W2 Subsidence Predictions and Impact Assessment Report)

Table 4-2 Creek Monitoring Observations for the Reporting Period (source: GeoTerra, Creek Monitoring Reports, **Appendix C**)

	Report 6 **26 May 2020**	**Report 7** **25 June 2020**	**Report 8** **24 July 2020**	**Report 9** **24 August 2020**	**Report 10** **21 September 2020**	**Report 11** **19-20 October 2020**
Stonequarry Creek (SR16 and SA monitored during the reporting period)						
Observations of individual pool water level and flow	• Large / long pondage between SR16 and SR17 is full and overflowing.	• Large / long pondage between SR16 and SR17 is full.	• Large / long pondage between SR16 and SR17 is full.	• Large / long pondage between SR16 and SR17 is full.	• Large / long pondage between SR16 and SR17 is full.	• Large / long pondage between SR16 and SR17 is full.
Surface cracking	No surface cracking was reported during the review period.					
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.					
Gas Releases	No gas releases were observed in pools on Cedar Creek.					
Cedar Creek (CR1-CR32 monitored during the reporting period)						
Observations of individual pool water level and flow	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • Sandy based pools between CR31-CR32 have continued flow and slightly lower pool levels.	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge.	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge.	• Slightly higher pool levels and more overland connective flow due to increased catchment base-flow recharge following a rain event.	• All pools contained water.	• All pools contained water. • Similar pool levels and overland connective flows compared to previous month.
Surface cracking	No surface cracking was reported during the review period.					
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.					
Gas Releases	No gas releases were observed in pools on Cedar Creek.					

	Report 6 26 May 2020	Report 7 25 June 2020	Report 8 24 July 2020	Report 9 24 August 2020	Report 10 21 September 2020	Report 11 19-20 October 2020
Matthews Creek (MR11-MR46 monitored during the reporting period)						
Observations of individual pool water level and flow	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • MR32-MR37 contains low interconnected flow. • MR39-MR46 increased pool depths and overflows compared to upstream pools. • MR38 contains no visible ponded water.	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • MR32-MR37 contains low interconnected flow. • MR39-MR46 increased pool depths and overflows compared to upstream pools. • MR38 contains no visible ponded water.	• Slightly lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • MR9-MR46 contained variable water levels with low to no interconnected flow between pools. • MR39-MR46 increased pool depths and overflows compared to upstream pools.	• Slightly higher pool levels and more overland connective flow due to increased catchment base-flow recharge following a rain event. • MR9-MR46 contained variable water levels with higher pool depths and flow compared to last month. • Pools MR27-MR23 and MR35-MR39 were low or dry. • Pools MR21, MR23 and MR38 were dry.	• Pools had elevated pool levels and overland connective flow due to catchment base-flow recharge following a rain event. • MR9-MR28 contained variable water levels with higher pool depths and flow compared to last month. • All pools contained water, and only MR21 was low but flowing.	• Similar pool levels and overland connective flows compared to previous month. • Pools MR6 – MB12, MB15 – MB32, MB38, MR39 and MR44 were either very low or dry.
Surface cracking	No surface cracking was reported during the review period.					
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.					
Gas Releases	• Two infrequent gas emissions observed at MR45, gas discharge has almost stopped.	• Two infrequent gas emissions observed at MR45, gas discharge has almost stopped.	• None observed.	• None observed.	• None observed.	• None observed.

4.2.4 Surface Water Quality

Surface water quality data has been recorded at the following sites (refer to **Figure 4-5**):

- Cedar Creek: CC1, CA, CB and CG;
- Matthews Creek: MB, MC1 and MG; and
- Stonequarry Creek: SC1, SC2, SC, SD, SE, SF and SG.

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen, temperature and oxidation reduction potential. Laboratory analyses are undertaken for pH, EC, total dissolved solids, alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, fluoride, nitrate and nitrite, total kjeldahl nitrogen, phosphorus and the following total and dissolved metals: aluminium, arsenic, barium, copper, lead, lithium, manganese, nickel, selenium, strontium, zinc and iron.

For monitoring site CB, the historically high dissolved zinc concentration recorded in July 2020 resulted in an exceedance of the site adjusted mean plus two standard deviations, and no similar exceedance was observed at reference sites. As such, the dissolved zinc concentration recorded at CB in July 2020 equates to a Level 2 TARP significance.

Although the concentrations of dissolved iron were higher than those previously recorded at monitoring site SC2 in May and June 2020, and concentrations of dissolved zinc were higher than those previously recorded at monitoring site CA in July 2020, the concentrations did not result in an exceedance of the site adjusted mean or the reference mean plus two standard deviations for these parameters. As such, these observations equated to a Level 1 TARP significance.

To date, there have been no observable mining subsidence related impacts to the water quality of Cedar Creek, Matthews Creek or Stonequarry Creek.

A summary of observations for the reporting period is provided in **Table 4-3**.

Charts illustrating water quality results for monitored pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts B1-9 in Attachment B of the Surface Water Monitoring Reports (refer to **Appendix B**).

Table 4-3 Summary of Notable Results for Key Water Quality Parameters for the Reporting Period

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
pH	• Near neutral pH conditions at all sites for the duration of the reporting period, consistent with baseline values.	• Slightly acidic to near neutral pH conditions at all sites for the duration of the reporting period, consistent with baseline values.	• Near neutral to alkaline pH conditions at all sites for the duration of the reporting period, consistent with baseline values.
Electrical Conductivity	• Consistent with baseline values (< 500 µS/cm) at all sites for the duration of the reporting period.	• Consistent with baseline values (< 1000 µS/cm) at all sites for the duration of the reporting period. • Increased EC values were recorded during lower rainfall periods and declining EC values were recorded during higher rainfall periods.	• Consistent with baseline values (< 1000 µS/cm) at all sites for the duration of the reporting period. • Increased EC values were recorded during lower rainfall periods and declining EC values were recorded during higher rainfall periods.
Dissolved Aluminium	• Concentrations recorded at all sites were low (≤ 0.06 mg/L) for the duration of the reporting period and consistent with baseline values.	• Concentrations recorded at all sites were low (≤ 0.04 mg/L) for the duration of the reporting period and consistent with baseline values.	• Concentrations recorded at all sites were low (≤ 0.06 mg/L) for the duration of the reporting period and consistent with baseline values.
Dissolved Iron	• Generally declined at all sites during the reporting period and were consistent with baseline values.	• Generally declined at all sites during the reporting period and were consistent with baseline values.	• Elevated concentration of 3.26 mg/L was recorded at SC2 in May and 4.92 mg/L at SC2 in June 2020. • Thereafter, concentrations at SC2 declined to within baseline concentrations though an increasing trend in dissolved iron concentration has been recorded since August 2020. • Concentrations at all other monitoring sites were consistent with baseline concentrations during the reporting period.
Dissolved Manganese	• Concentrations were less than 0.44 mg/L at all sites during the reporting period and were consistent with baseline values.	• Concentrations were less than 0.8 mg/L at all sites during the reporting period and were consistent with baseline values.	• Concentrations were less than or equal to 0.86 mg/L at all sites during the reporting period and were consistent with baseline values.
Dissolved Zinc	• Concentrations recorded at all sites were low (≤ 0.01 mg/L) for the duration of the reporting period and consistent with baseline values.	• Elevated concentrations recorded at CA and CB (0.045 mg/L and 0.059 mg/L respectively) in July 2020 during a period of below average rainfall.	• Concentrations recorded at all sites were low (≤ 0.007 mg/L) for the duration of the reporting period and consistent with baseline values.

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
		• Thereafter, concentrations at CA and CB declined following rainfall events to within baseline concentrations though an increasing trend in concentration has been recorded since August 2020.	

4.2.5 Groundwater Quality

A total of 14 open standpipe piezometers (OSPs) have been installed at five locations in the Western Domain – P12, P13, P14, P16, and P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W1-W2. The locations of these groundwater bores are illustrated in **Figure 4-9**.

With the exception of October, 2020, there were no observable changes in salinity, pH or metals outside of the baseline variability. During October 2020, groundwater quality results from P12, P13 and P16 resulted in a Level 2 TARP trigger. These results included lower pH in comparison to the baseline variability at P12, P13 and P16, and elevated dissolved zinc levels at P16 (refer to **Figure 4-7** and **Figure 4-8**). These groundwater quality results have been attributed to piezometer casing used.

Graphs showing progressive groundwater quality results for pH, electrical conductivity and selected metals are presented in the GeoTerra Groundwater Monitoring Report 10 (**Appendix D**).

Four (4) private bores were inspected on 24 July 2020 and 20 October 2020, and an additional private bore (GW72402) was inspected on 30 October 2020 following finalisation of an access agreement with the landowner. Where a pump was installed, field measurements for pH, salinity and yield data were collected after the pump had flowed for at least 15 minutes. Field and laboratory results are provided in Appendix A of Groundwater Monitoring Report 10 (refer to **Appendix D**).

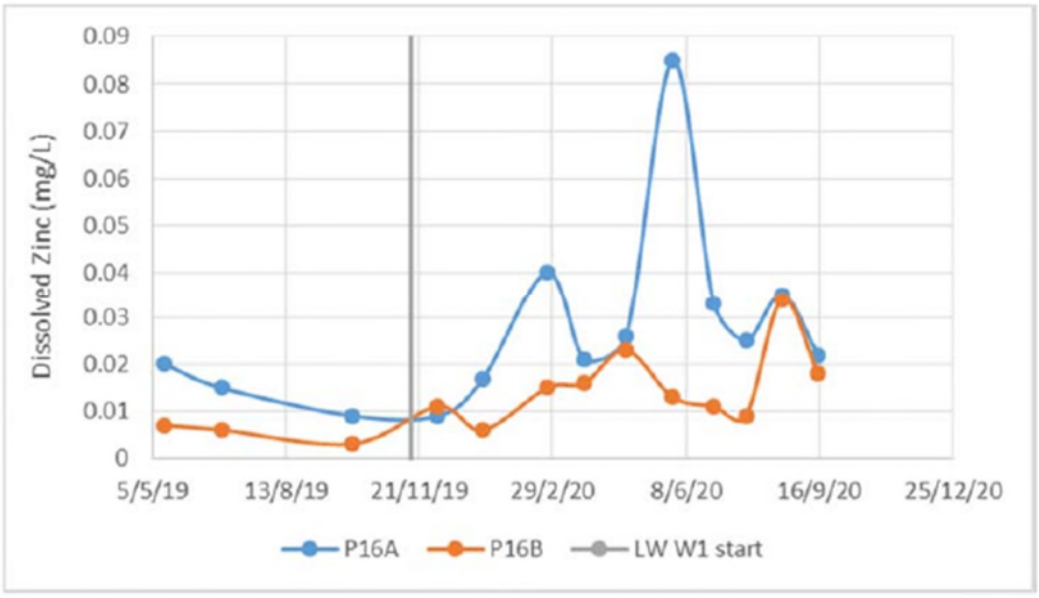

Figure 4-7 Groundwater quality for reporting period – dissolved zinc at P16 (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

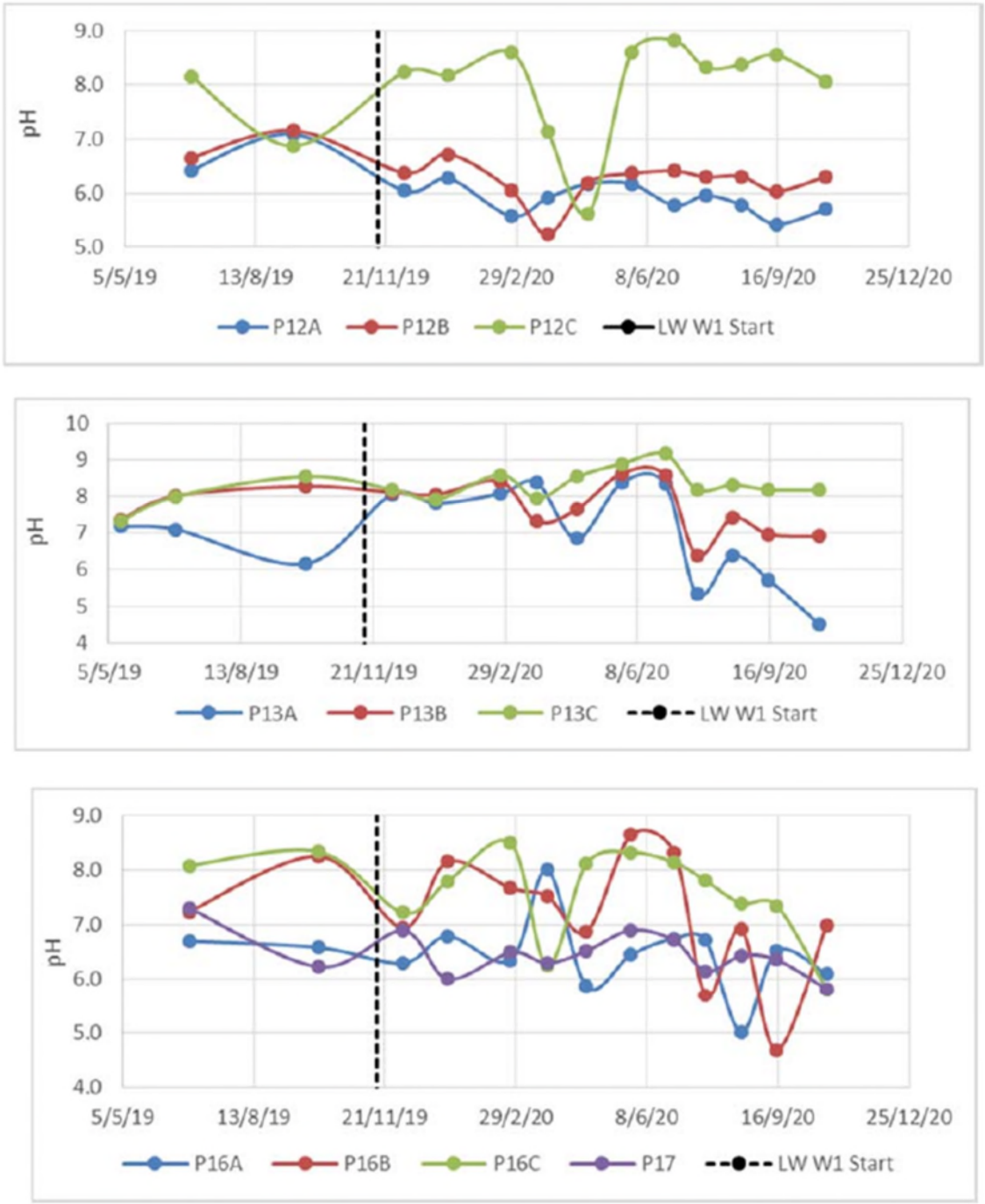

Figure 4-8 Groundwater quality for reporting period – pH at P12, P13 and P16 (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

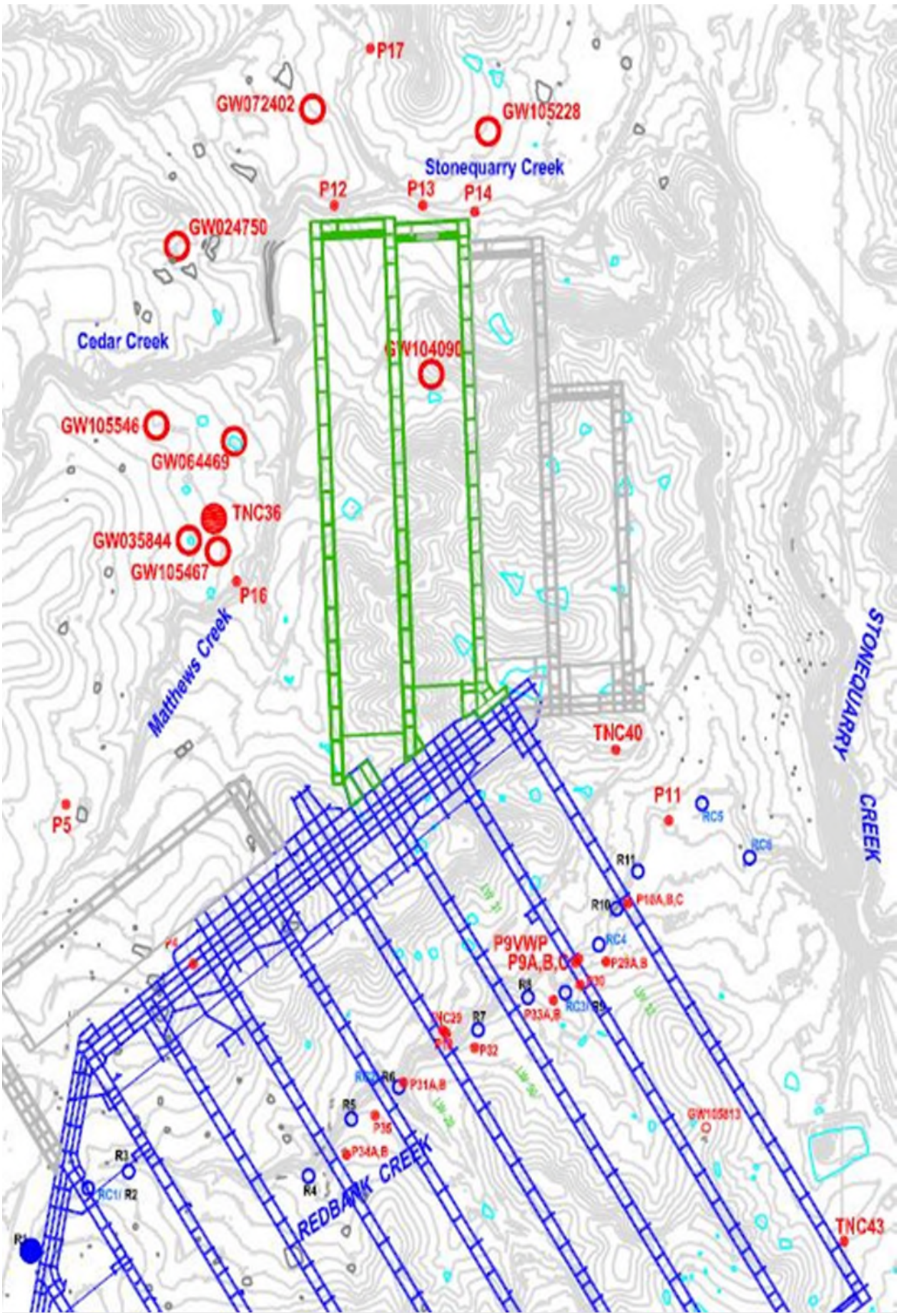

Figure 4-9 LW W1-W2 Groundwater Monitoring Bores (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

4.2.6 Groundwater Bore Levels

A total of 14 open standpipe piezometers (OSPs) have been installed at five locations in the Western Domain – P12, P13, P14, P16, and P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W1-W2. The locations of these groundwater bores are illustrated in **Figure 4-9**.

During this reporting period, a number of groundwater intakes in open standpipe piezometers (OSPs) have recorded a trend of reducing water level elevation below the baseline range. The deepest intake in piezometer P12 (intake P12C) has triggered the Level 3 TARP for OSP groundwater level from June 2020 onwards (refer to **Figure 4-10**). From September 2020 onward, other intakes in P13 (intake P13C) (refer to **Figure 4-11**) and P16 (intakes P16B and P16C) (refer to **Figure 4-12**) also triggered a Level 3 TARP trigger (refer to Groundwater Monitoring Reports in **Appendix D**).

These trends have been attributed to mining induced regional depressurisation of deeper groundwater aquifers. At this stage, groundwater depressurisation in the deeper aquifers is not influencing the shallow aquifers or the surface water system.

Graphs showing progressive groundwater bore levels are presented in the GeoTerra Groundwater Monitoring Report 10 (**Appendix D**).

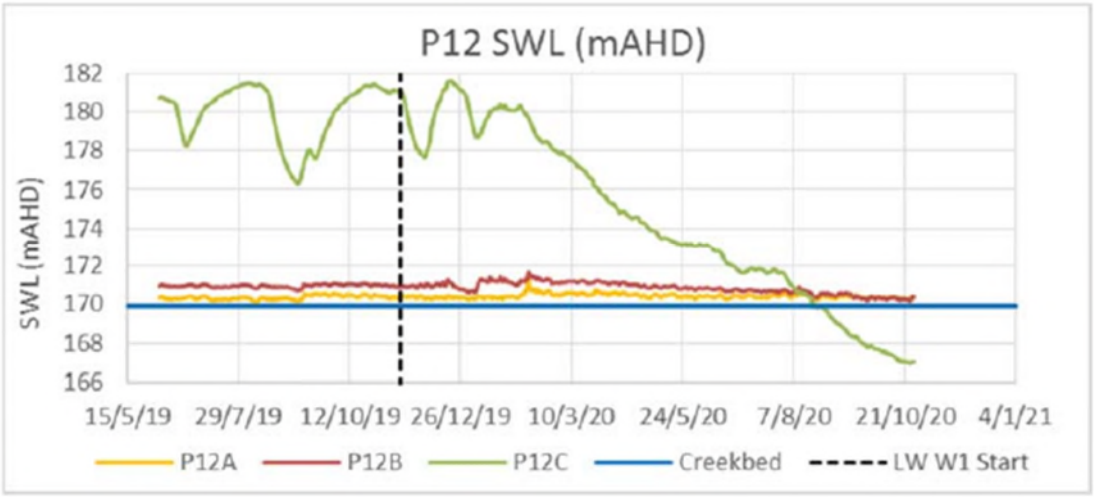

Figure 4-10 Groundwater bore levels during the reporting period – P12 (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

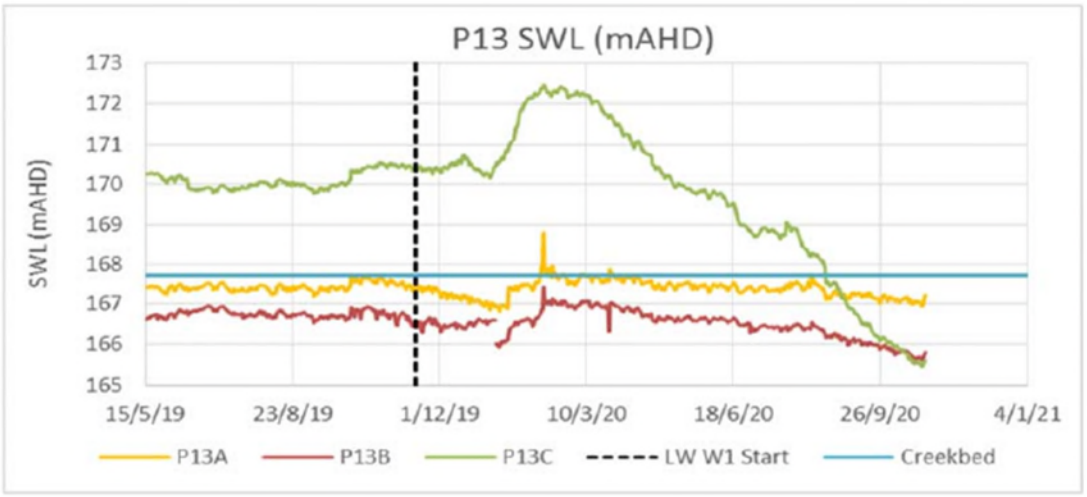

Figure 4-11 Groundwater bore levels during the reporting period – P13 (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

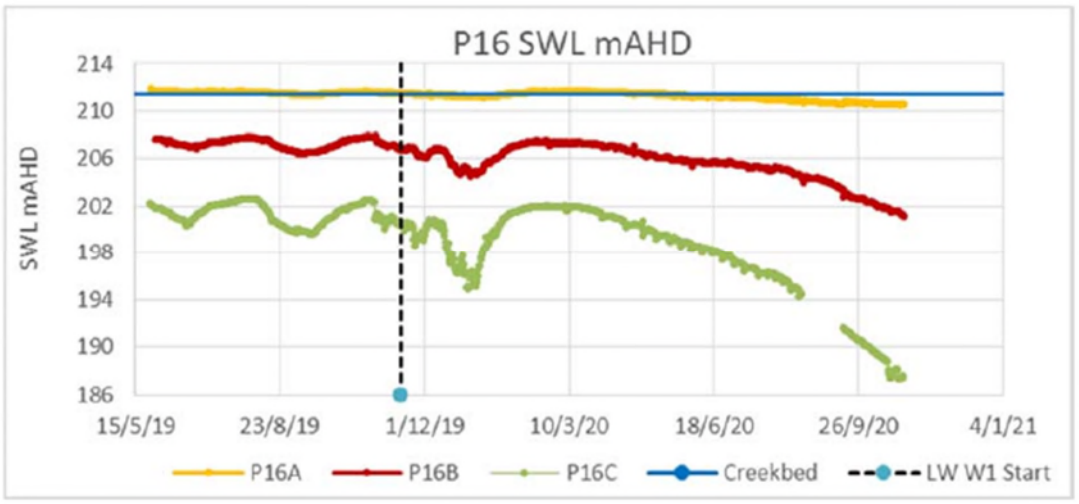

Figure 4-12 Groundwater bore levels during the reporting period – P16 (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

4.2.7 Groundwater Pressures

A combination of OSP and Vibrating Wire Piezometer (VWP) arrays were installed at location P9 over the previously mined longwall LW32, however these arrays no longer provide data since the commencement of LW W1. Three additional VWP arrays have been installed at locations TNC36, TNC40 and TNC43. The locations of these groundwater bores are illustrated in **Figure 4-9**.

During the reporting period, there were no observable mining induced changes at VWP intakes above, at or below 200 m depths (excluding those monitoring the Bulli Coal Seam). However a number of groundwater intakes in the shallow (<200 mbgl) VWPs of TNC36 have recorded a trend of depressurisation below the baseline range. The intakes at 97 mbgl (Hawkesbury Sandstone) and 169 mbgl (Bulgo Sandstone) have triggered the Level 3 TARP for shallow VWP groundwater pressure from June 2020 onwards. In addition, the intake at 65 mbgl (Hawkesbury Sandstone) also triggered the Level 3 TARP trigger from September 2020 onwards.

These trends have been attributed to mining induced regional depressurisation of deeper groundwater aquifers. At this stage, groundwater depressurisation in the deeper aquifers is not influencing the shallow aquifers or the surface water system.

Graphs showing progressive groundwater pressures are presented in the GeoTerra Groundwater Monitoring Report 10 (**Appendix D**).

4.2.8 Mine Water Intake

Tahmoor Coal have a Groundwater Licence to extract 1642 ML/year of groundwater make from underground.

The inferred water make (groundwater that has seeped into the mine from the strata) is calculated from the difference between total mine inflows and total mine outflows. This calculation is assisted by input from flow meters installed on fresh water supply lines that pump water into the mine (mine inflow from Sydney Water supply to underground workings), and flow meters on three pipelines that extract water from underground (mine outflow). In addition, mine inflow and outflow also includes a measurement of water that enters and exits the mine through other means such as moisture in air pumped in and out of the mine (water in vented air), and moisture in coal extracted from the mine.

GeoTerra completed an analysis of water make for Tahmoor Mine recorded between 1 January 2009 to 1 November 2020 (results summarised in Groundwater Monthly Report 10 (**Appendix D**)). Although this water make calculation does not just measure water make from the Western Domain, it provides an indication of the groundwater pumped out of the total Tahmoor Mine underground workings.

Water make into the Tahmoor Mine underground workings (as plotted in **Figure 4-13**) indicates a rise in groundwater inflow to the mine from around late June 2020. This increased groundwater pump out for the mine would most likely be due to an increased groundwater make associated with extraction of LW W1 within the previously unmined Western Domain mining area, with the newly goafed, subsided, fractured and delaminated overburden depressurising and dewatering the area for the first time.

In addition, **Figure 4-14** illustrates that there does not appear to be a definitive correlation between rainfall and the increased pump out from the mine.

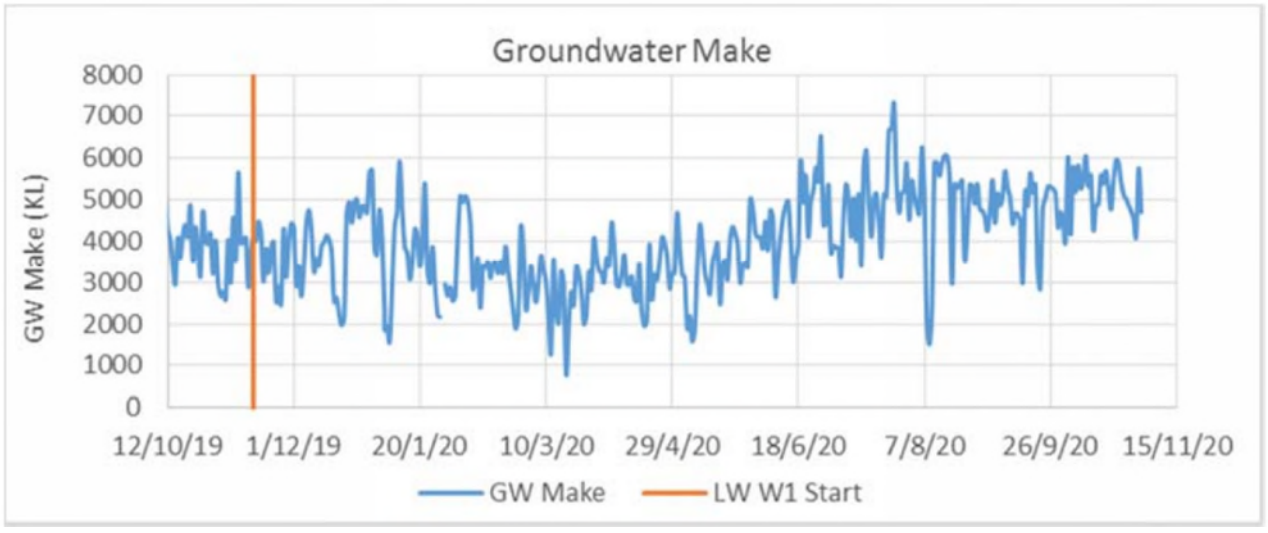

Figure 4-13 Tahmoor Mine daily water make since LW W1 extraction commencement (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

Figure 4-14 Tahmoor Mine Groundwater Inflow and Rainfall Residual comparison (source: GeoTerra, Groundwater Monitoring Report 10, **Appendix D**)

4.3 Land Monitoring

The Tahmoor Coal LW W1-W2 Land Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on cliffs, rock outcrops, steep slopes, dams, agricultural land, and land in general in accordance with Condition 13H(vii)I of DA 67/98.

During this reporting period, the LW W1-W2 Land Management Plan has been implemented to monitor the following landscape features:

- Cliffs, rock outcrops, steep slopes, and dams – monthly visual inspections and reporting by geotechnical engineers from Douglas Partners;
- Stonequarry Sewage Treatment Plan retention basin, or Dam FD7 – weekly visual inspections and reporting by Newcastle Geotechnical (refer to **Appendix E**); and
- Agricultural land – monthly visual inspections and reporting by Tahmoor Coal and Building Inspection Service.

Performance against all Land Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarised the observations made during the reporting period for each landscape feature.

4.3.1 Cliffs and Rock Outcrops

Visual and photographic surveys for subsidence impacts on cliffs have been completed monthly for features within the LW W1 active subsidence zone. The purpose of the surveys is to note any new instabilities in the cliff structures that have occurred since the commencement of LW W1 mining, including freshly exposed rock face, debris scattered around the base of a cliff or overhang, and tension cracks. Surveys were completed by a walk through along the valley bed was conducted from Stonequarry Creek to the intersection of Cedar Creek and Matthew Creek.

The locations of cliffs and rock outcrops within the Study Area are illustrated in **Figure 4-15**.

During the reporting period, cliffs C03 to C09 along Cedar Creek and M01 and M02 along Matthews Creek were inspected, and there were no indications of recent rockfalls or signs of stress relief (tension cracking) along the sections of cliff monitored.

4.3.2 Steep Slopes

Visual and photographic surveys for subsidence impacts on structures near steep slopes have been completed monthly for features within the LW W1 active subsidence zone. The locations of steep slopes within the Study Area are illustrated in **Figure 4-15**.

During the reporting period, structures located on Stonequarry Creek, Booyong Close, Attunga Close, Carramar Close, and Thirlmere Way were inspected. There were no signs of distress or changes in the areas inspected that could be attributed to mine subsidence.

4.3.3 Dams

Visual and photographic surveys for subsidence impacts on dams were completed on a weekly and monthly basis of dams within the LW W1 active subsidence zone.

The location of dams within the Study Area are illustrated on **Figure 4-16**.

During the reporting period, there were no observable changes to dams inspected in comparison to pre-mining baseline data.

4.3.4 Agricultural Land

Visual and photographic surveys for subsidence impacts on agricultural land have been completed monthly at inspection points within the LW W1-W2 Study Area. Inspections points were set up prior to the commencement of LW W1 mining to provide vantage of agricultural land within the Study Area. The purpose of the surveys is to note whether change has occurred to agricultural land, and to assist in determining if any change can be attributed to mining impacts. Surveys noted the presence of erosion, condition of boundary and internal fencing components, paddock gate condition, out-building condition, paddock dam condition, presence of any surface slumping or cracking, and the presence of vegetation dieback.

Agricultural land identified within the Study Area is illustrated on **Figure 4-17**.

During the reporting period, there were no observable changes to agricultural land in comparison to pre-mining baseline data.

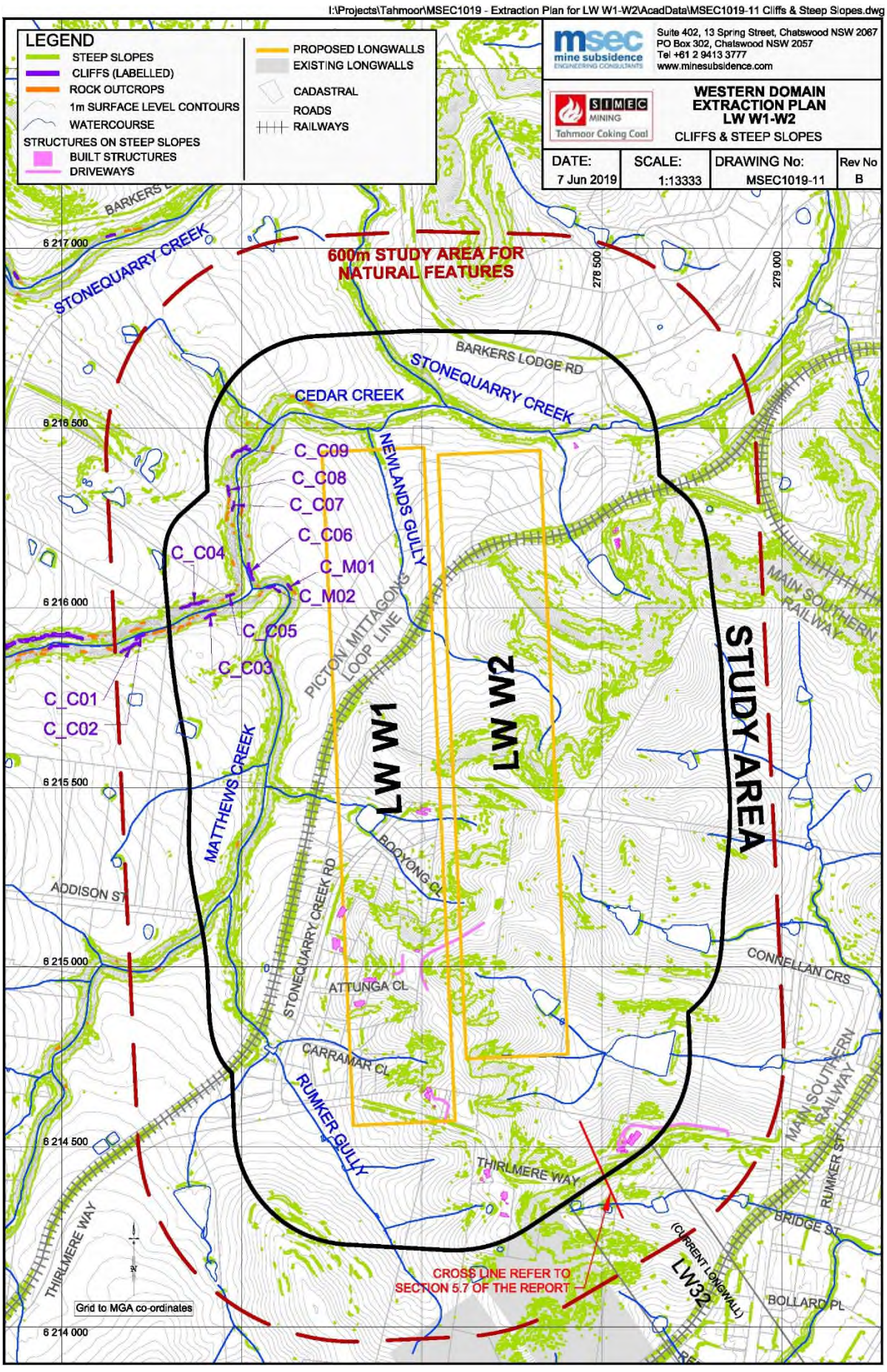

Figure 4-15 Cliffs, rock outcrops and steep slopes within the LW W1-W2 Study Area (source: MSEC, 2019; LW W1-W2 Subsidence Predictions and Impact Assessment Report)

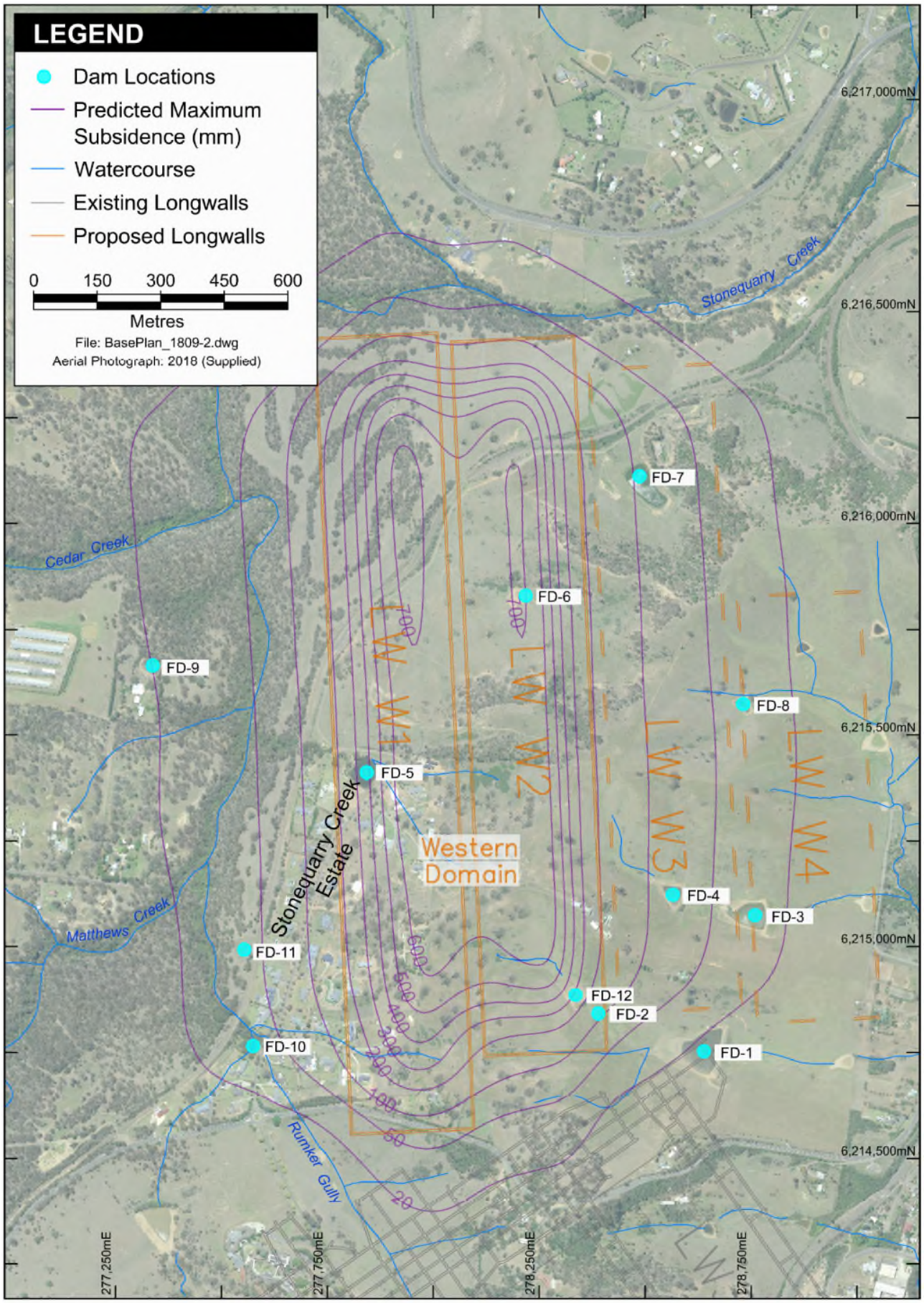

Figure 4-16 Dams within the LW W1-W2 Study Area (source: HEC, 2019; LW W1-W2 Surface Water Technical Report)

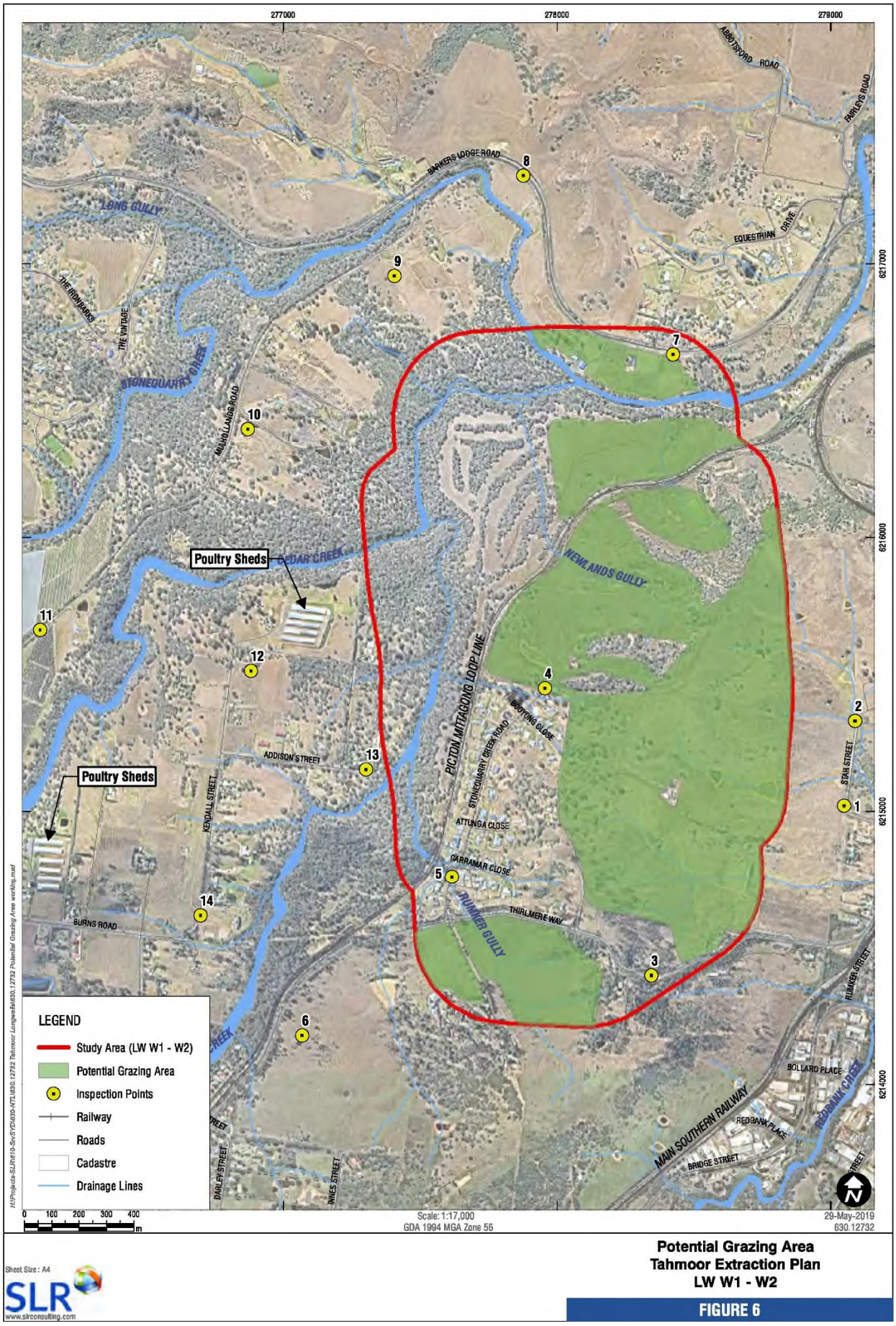

Figure 4-17 Agricultural land and inspection points within the LW W1-W2 Study Area (source: SLR, 2019; LW W1-W2 Land and Agricultural Resource Assessment)

4.4 Biodiversity Monitoring

The Tahmoor Coal LW W1-W2 Biodiversity Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on aquatic and terrestrial flora and fauna in accordance with Condition 13H(vii)(d) of DA 67/98.

During the reporting period, the LW W1-W2 Biodiversity Management Plan has been implemented to monitor ecology in the Study Area, as outlined below:

- Aquatic ecology – macroinvertebrate monitoring during Spring 2020 by Niche Environment and Heritage. A letter report summarising AUSRIVAS results for Spring 2020 has been provided by Niche, with the full report to be provided in the next month; and
- Terrestrial ecology – amphibian and riparian vegetation monitoring during Spring 2020 by Niche Environment and Heritage. It is noted that no reporting has been provided during this reporting period.

Performance against all Biodiversity Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarised the observations made during the reporting period.

4.4.1 Aquatic Ecology

The aquatic ecology monitoring program for LW W1-W2 has been designed to monitor subsidence-induced impacts on aquatic ecology. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Aquatic habitat assessment:
  - The Australian River Assessment System (AUSRIVAS);
  - Riparian Channel and Environment (RCE) Inventory;
- Macroinvertebrate survey:
  - AUSRIVAS macroinvertebrate sampling;
  - Quantitative benthic macroinvertebrate monitoring program; and
- Water quality sampling.

The aquatic ecology monitoring program is primarily focused on macroinvertebrate monitoring regimes including AUSRIVAS and quantitative using Before After Control Impact (BACI) design. A total of fifteen locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of seven impact sites and eight control sites. The locations of monitoring sites are illustrated in **Figure 4-18**.

A letter report summarising AUSRIVAS results for Spring 2020 monitoring has been prepared by Niche Environment and Heritage. Although only AUSRIVAS monitoring results were provided in this letter report, enough information is available to interpret whether there have been any triggers in accordance with the TARP and to determine whether associated actions were required.

During Spring 2020, it is unlikely that any Aquatic Ecology Biodiversity TARPs have been triggered. The following results were observed:

- Aquatic habitats were similar at most sites when compared to previous survey;
- AUSRIVAS results showed sites scoring in Band A and Band B.
- AUSRIVAS scores in spring 2020 were either comparable to previous results or higher than any scores observed pre-mining.

To date, there have been no observable mining subsidence related impacts to aquatic ecology of Cedar Creek, Matthews Creek or Stonequarry Creek.

4.4.2 Terrestrial Ecology

The terrestrial ecology monitoring program for LW W1-W2 has been designed to monitor subsidence-induced impacts on terrestrial ecology. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Riparian vegetation monitoring involving floristic surveys within established vegetation monitoring plots;
- Amphibian monitoring along established transects:
  - Spotlighing;
  - Call provocation;
  - Listening for diagnostic frog calls; and
  - Tadpole identification.

In particular, two threatened frog species – the Gian Burrowing Frog (*Heleioporus australiacus*) and the Red-crowned Toadlet (*Pseudophryne australis*) – were targeted in the amphibian monitoring.

At the time of reporting, riparian and amphibian monitoring was being undertaken for the Spring 2020 season. A total of eight locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of three impact sites and five control sites. The locations of monitoring sites are illustrated in **Figure 4-19**.

No reporting was available for the Spring 2020 season during this reporting period.

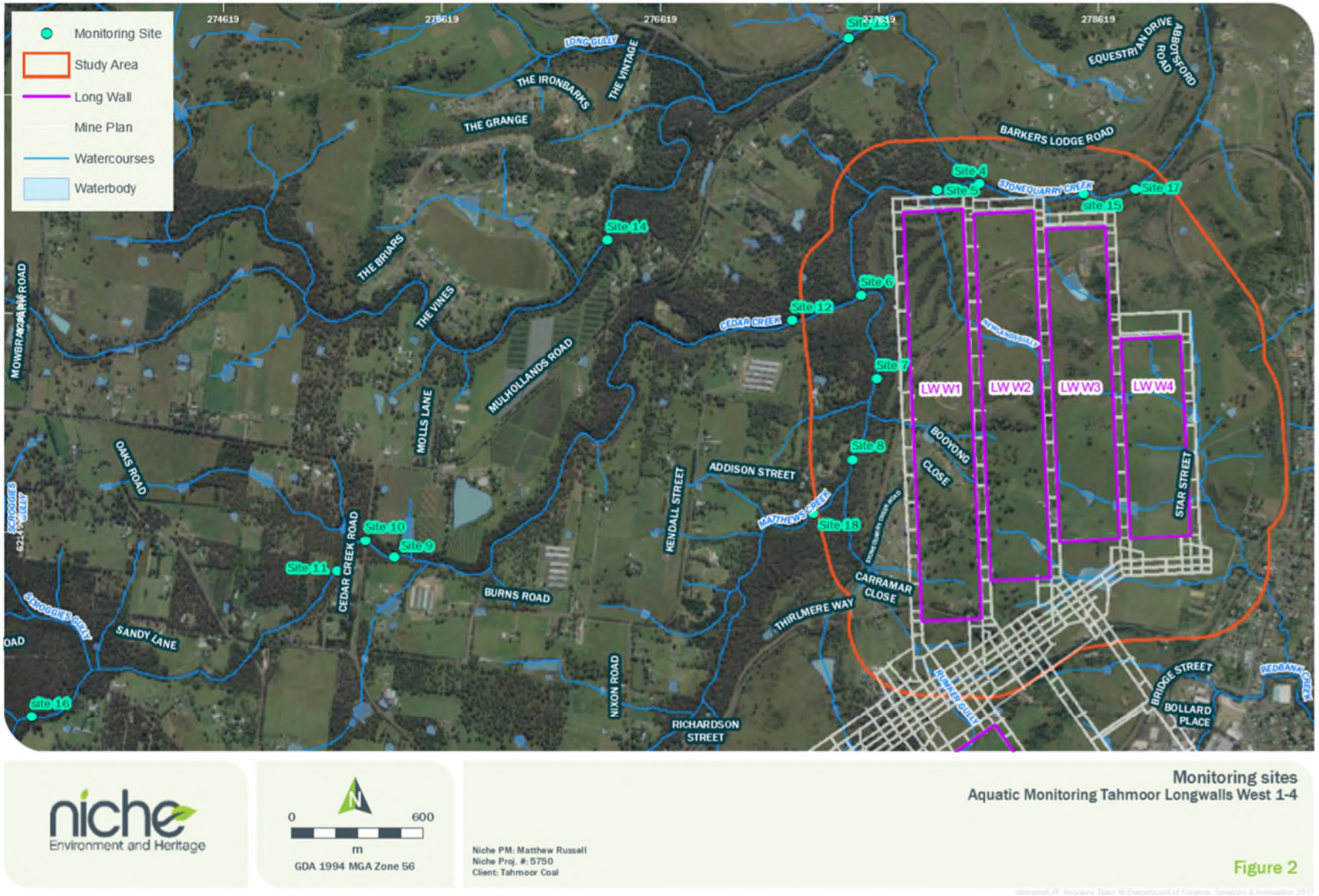

Figure 4-18 LW W1-W2 Aquatic Ecology Monitoring Locations (source: Niche, LW W1-W2 Biodiversity Management Plan)

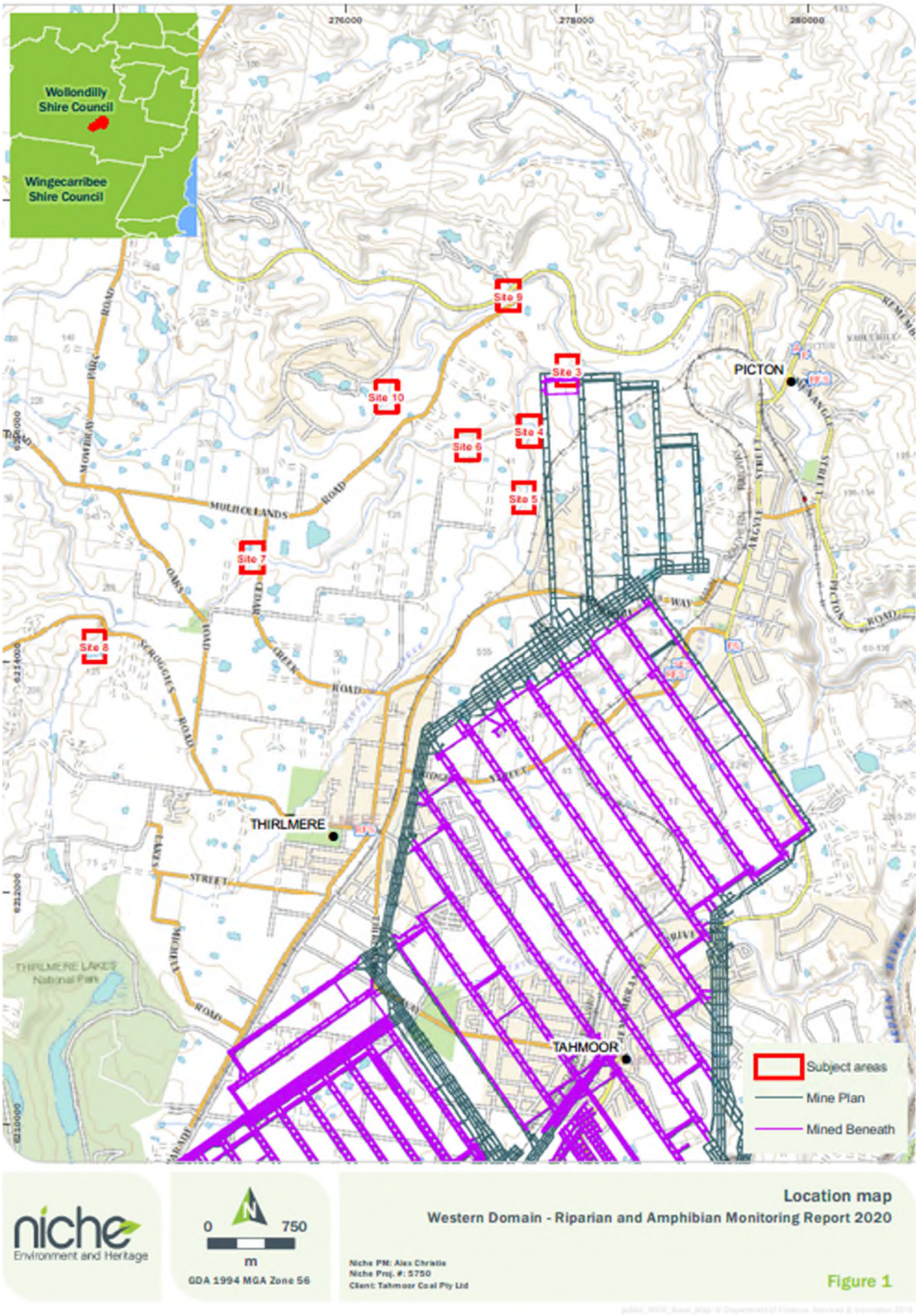

Figure 4-19 LW W1-W2 Terrestrial Ecology Monitoring Locations (source: Niche Environment and Heritage, LW W1-W2 Biodiversity Management Plan)

4.5 Heritage Monitoring

The Tahmoor Coal LW W1-W2 Heritage Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on Aboriginal heritage and historical heritage sites and values in accordance with Condition 13H(vii)(f) of DA 67/98.

During this reporting period, the LW W1-W2 Heritage Management Plan has been implemented to monitor subsidence impacts for the following heritage items:

- Aboriginal heritage:
  - Rockshelters – monthly external visual inspections of rockshelters by GeoTerra (refer to **Appendix C**);
  - Grinding grooves – monthly review of GNSS unit movements by MSEC (refer to **Appendix A**);
  - Rockshelters and grinding grooves – one review of items by an EMM Archaeologist and a RAP representative; and
- Historical heritage:
  - Sandstone and brick culverts along the PMLL – weekly visual inspection by Newcastle Geotechnical (refer to **Appendix E**).

Performance against all Heritage Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarised the observations made during the reporting period.

4.5.1 Aboriginal Heritage

The locations of Aboriginal heritage items within the Study Area of LW W1-W2 are illustrated in **Figure 4-20**.

No subsidence related rock face cracking or spalling in the vicinity of the rockshelters. In addition, there were no signs of change to the grinding groove site or culverts during this reporting period.

A visual inspection of Aboriginal heritage items in the Study Area (where accessible due to ongoing longwall extraction) was completed by an EMM archaeologist and a RAP representative on 19 August 2020. The focus of the fieldwork was to inspect grinding groove site AHIMS #52-2-2068 on Stonequarry Creek and to generally inspect the cliff lines of Cedar Creek and Matthews Creek to observe if any subsidence impact has occurred. It was not possible to systematically inspect each rock shelter within the LW W1 Study Area because LW W1 extraction was still in progress and accessing all terrain during this period was considered hazardous and unsafe (refer **Appendix G**).

Within the limits of the permitted inspection, no impacts to Aboriginal sites or objects were identified.

As part of the monitoring, an additional small cluster of five grinding grooves were identified at the grinding groove site approximately 13 m west of the main clusters. These additional grooves may have previously been obscured from view by vegetation during the original inspection and subsequently denuded by recent flooding.

In addition, the RAP representative noted a hairline fracture (about 30 cm in length) in the sandstone bedrock approximately 15 m south of the grinding grooves site. However, this area was not previously subject to detailed archival recording, and it is unknown whether this crack existed prior to LW W1 extraction (refer to **Appendix G**).

A detailed visual inspection of all heritage items will be completed shortly now that LW W1 extraction has been completed.

4.5.2 Historical Heritage

The locations of historical heritage items within the Study Area of LW W1-W2 are illustrated in **Figure 4-21**.

In the Picton-Mittagong Loop Line Monitoring Report 46 (refer to Appendix F), it was noted that visual inspections of the sandstone culvert at 89.629 km in late August to early September 2020 had noted that a small transverse crack up to 1 mm in width had become evident across the downside culvert overt about 0.4 – 0.5 m inside the headwall. This minor crack was pre-existing and had been observed due to minor opening of the aperture in response to slight subsidence.

It was highlighted in the report that the crack was minor and was not adversely affecting the structural integrity of the culvert. No further developments of this crack had been noted in subsequent weekly reports during this reporting period. However, this observation triggered a Level 2 TARP trigger for historical heritage in September 2020 to October 2020.

A detailed visual inspection of all heritage items will be completed shortly now that LW W1 extraction has been completed.

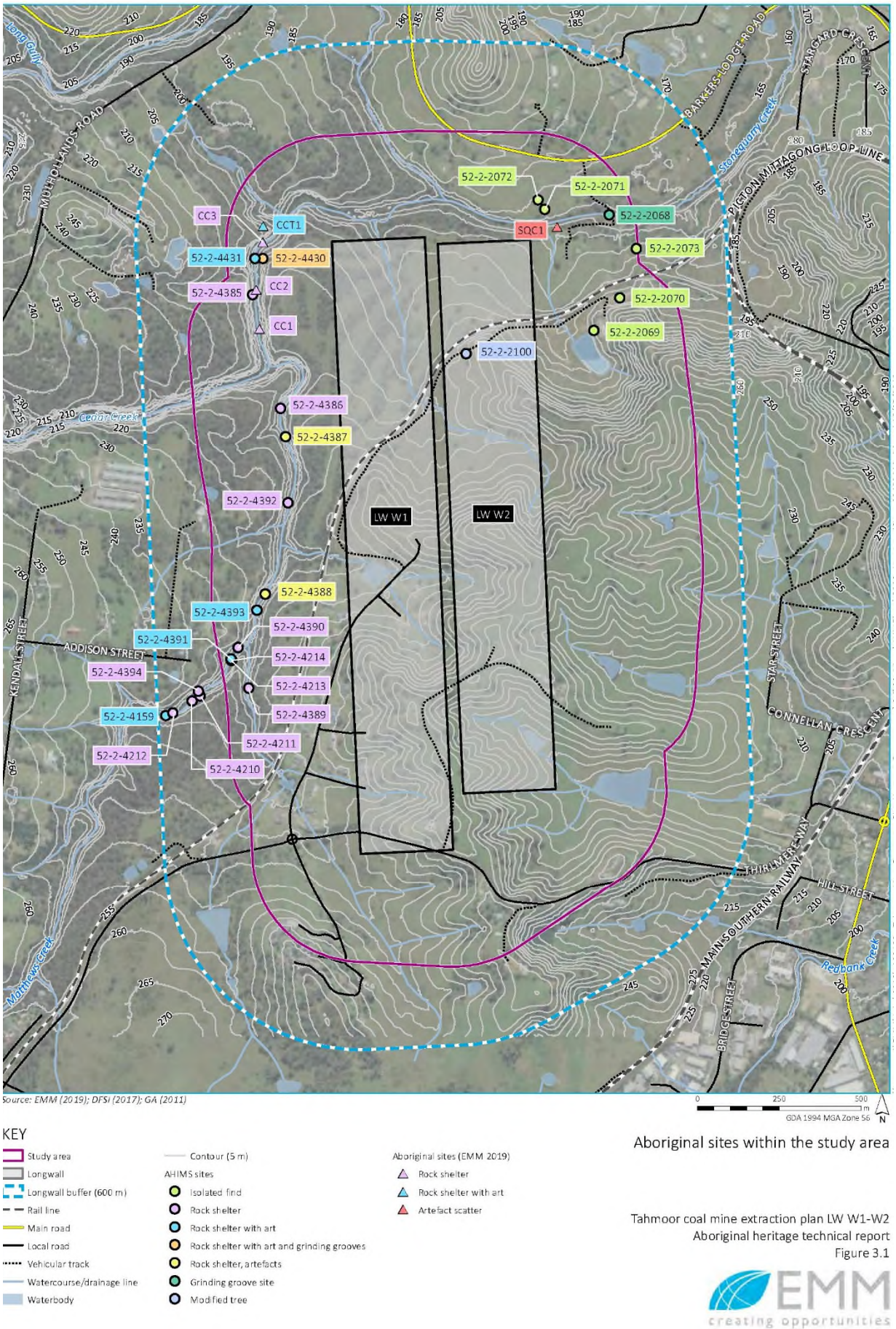

Figure 4-20 Aboriginal heritage and historical heritage items within the LW W1-W2 Study Area (source: EMM, 2019a; LW W1-W2 Aboriginal Heritage Technical Report)

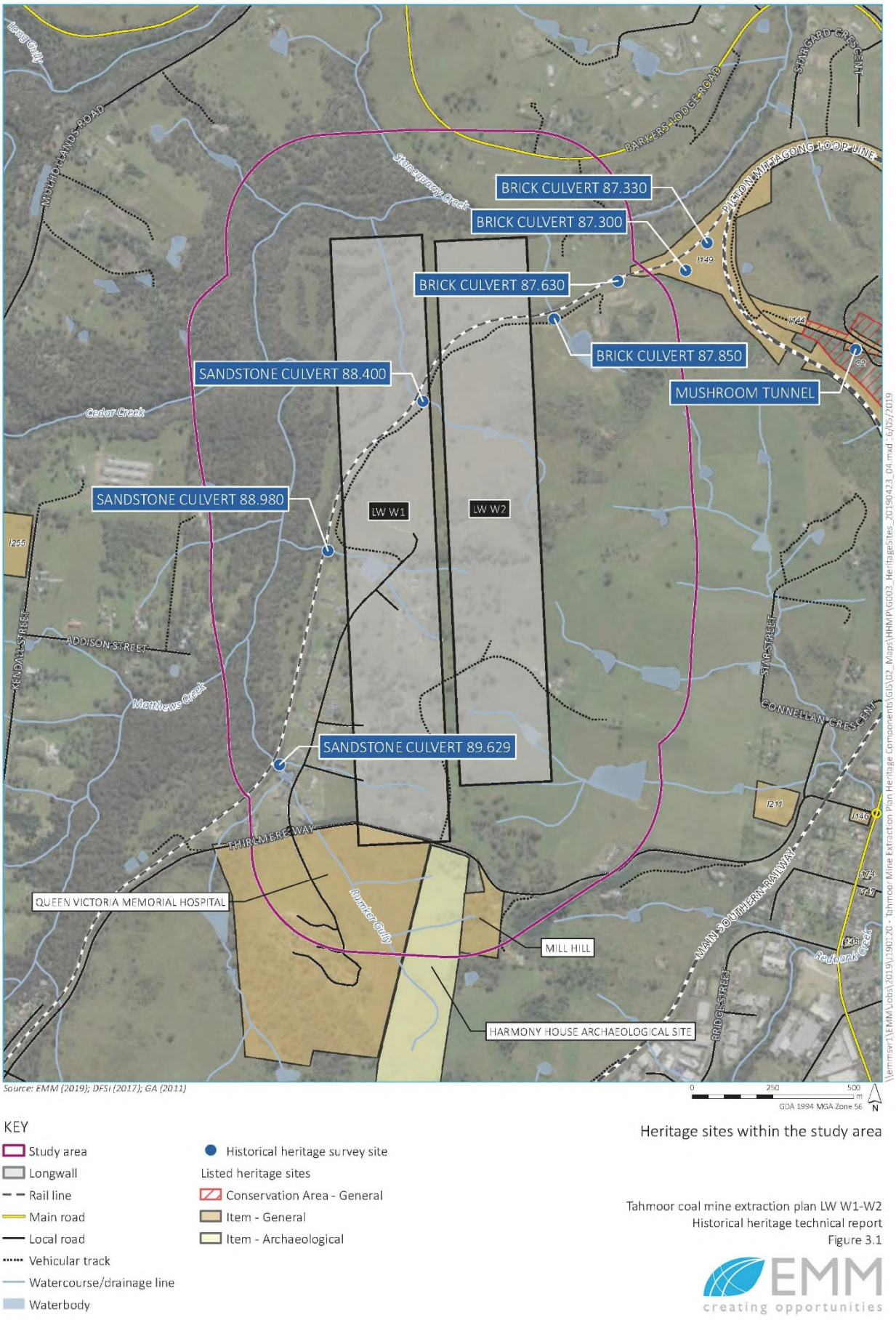

Figure 4-21 Historical Heritage Sites in the Study Area and Surrounds (source: EMM, 2019b; LW W1-W2 Historical Heritage Technical Report)

4.6 Built Features Monitoring

The Tahmoor Coal LW W1-W2 Built Features Management Plan and associated sub-plans were prepared to manage the potential environmental consequences of LW W1-W2 extraction on built features in accordance with Condition 13H(vii)(b) of DA 67/98.

During this reporting period, the LW W1-W2 Subsidence Monitoring Program has been implemented to monitor subsidence impacts on infrastructure owned by Endeavour Energy (electrical infrastructure), Sydney Water (potable water infrastructure), Bradcorp (sewer infrastructure), Jemena (gas infrastructure), Wollondilly Shire Council (roads, bridges and culverts), Telstra (telecommunications infrastructure), NBN (telecommunications infrastructure), ARTC (rail infrastructure), Transport Heritage NSW (rail infrastructure), Queen Victoria Memorial Home (historical building and nursing home), Mill Hill (historical building), and private property owners. The details of the Subsidence Monitoring Program are illustrated in **Figure 4-1**.

A weekly review of the subsidence survey results during the reporting period has been completed by MSEC (refer **Appendix A**). Monitoring observations for built infrastructure from the weekly and monthly reports, as well performance against all Infrastructure Management Plan TARPs for the reporting period have been summarised in **Table 2-3**.

A comparison between assessed and observed impacts to surface features is summarised in Table 2 of the MSEC Subsidence Monitoring Report 29 (refer to **Appendix A**).

A number of impacts to local roads and built structures occurred during August to November 2020 as a result of subsidence from LW W1 extraction. These impacts can be summarised as:

- Impacts to stormwater drains along Stonequarry Creek Road (August to October 2020);
- Impacts to houses on Stonequarry Creek Road (September to October 2020);
- Impacts to houses on Booyong Close (September 2020);
- Impacts to houses on Attunga Close (October 2020 and November 2020);
- Impacts to a house on Carramar Close (November 2020);
- Impacts to Carramar Close road (November 2020);
- Impacts to pool gates on Stonequarry Creek Road (September 2020); and
- Impacts to a pool gate and pool pavers on Carramar Close (October 2020, November 2020).

Where possible, Tahmoor Coal has repaired damages to roads and built structures within the Stonequarry Estate in consultation with SA NSW where appropriate.

On 14 September 2020, detailed measurements were completed between 88.35 km and 88.65 km where predicted ground shortening has occurred. More than 50% of joints have closed between 88.5 km and 88.6 km triggering a blue TARP trigger (refer to PMLL Status Report 44; **Appendix F**). Adjustments of the track between 88.5 km and 88.6 km were completed on 12 October 2020, resolving the TARP trigger.

No other subsidence impacts to built features were observed during this reporting period.

4.7 Public Safety Monitoring

The Tahmoor Coal LW W1-W2 Public Safety Management Plan was prepared to manage the potential consequences as a result of LW W1-W2 extraction on public safety within the Study Area in accordance with Condition 13H(vii)(g) of DA 67/98.

As noted in **Section 1.3** of this report, management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan. Monitoring of cliffs, rock outcrops and steep slopes and other landscape features has been conducted for the reporting period in accordance with the LW W1-W2 Land Management Plan (refer to **Section 4.3.1** for a summary of monitoring results). In addition, monitoring of infrastructure items has also been conducted for the reporting period in accordance with the LW W1-W2 Built Features Management Plan (refer to **Section 4.6** for a summary of monitoring results).

No subsidence impacts were identified during the reporting period that were considered to pose a risk to public safety.

5 Document Information

5.1 References

Department of Planning and Environment (DPE) (2015), Guidelines for the Preparation of Extraction Plans V5.

EMM Consulting (2019a), Tahmoor Mine Extraction Plan: Longwalls West 1 – West 2 – Aboriginal Heritage Technical Report, report for Tahmoor Coal.

EMM Consulting (2019b), Tahmoor Mine Extraction Plan: Longwalls West 1 – West 2 – Historical Heritage Technical Report, report for Tahmoor Coal.

Hydro Engineering & Consulting (HEC) (2019), Tahmoor Mine Extraction Plan LW W1-W2 – Surface Water Technical Report, prepared for Tahmoor Coal, document J1809-2_R1j.

Mine Subsidence Engineering Consultants (MSEC) (2019), Tahmoor Coking Coal Operations – Longwalls W1 and W2, Subsidence Predictions and Impact Assessments for Natural and Built Features due to the Extraction of the Proposed Longwalls W1 and W2 in Support of the Extraction Plan Application. Prepared for Tahmoor Coal, May 2019, document MSEC1019.

SLR (2019), Tahmoor Extraction Plan LW W1-W2 Land and Agricultural Resource Assessment, prepared for Tahmoor Coal, document 630.12732-R01-v0.1.

Tahmoor Coal Documents:

- Extraction Plan LW W1-W2 Extraction Plan Main Document, TAH-HSEC-00248
- Extraction Plan LW W1-W2 Water Management Plan, TAH-HSEC-00244
- Extraction Plan LW W1-W2 Land Management Plan, TAH-HSEC-00247
- Extraction Plan LW W1-W2 Biodiversity Management Plan, TAH-HSEC-00246
- Extraction Plan LW W1-W2 Heritage Management Plan, TAH-HSEC-00242
- Extraction Plan LW W1-W2 Subsidence Monitoring Program, TAH-HSEC-00249

5.2 Glossary of Terms

Terms references to this document are provided below in **Table 5-1**.

Table 5-1 Glossary of Terms

Term	Definition
Active Subsidence Zone	The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 m in front of the active longwall face and 450 m behind the active longwall face or following 500 m of longwall extraction.
Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence)
Cliffs	Continuous rockfaces having minimum heights of 10 m, minimum lengths of 20 m and minimum slopes of 2 to 1, i.e. having minimum angles to the horizontal of 63°.
Closure	The reduction in the horizontal distance between the valley sides. The magnitude of closure, which is typically expressed in the units of mm, is the greatest reduction in distance between any two points on the opposing valley sides.

Term	Definition
	It should be noted that the observed closure movement across a valley is the total movement resulting from various mechanisms, including conventional mining induced movements, valley closure movements, far-field effects, downhill movements and other possible strata mechanisms.
Longwall	A system of mining coal in which the seam is extracted on a broad front or long face using a coal shearer and the roof is supported by hydraulic roof supports.
Reporting period	15 November 2019 to 5 May 2020
Run of mine (ROM)	Raw coal production; the unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock.
Study Area	Study Area as defined in the LW W1-W2 Extraction Plan
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel, but, 'subsidence of the ground' in some references can include both a vertical and horizontal movement component. The vertical component of subsidence is measured by determining the change in surface level of a peg that is fixed in the ground before mining commenced and this vertical subsidence is usually expressed in units of mm. Sometimes the horizontal component of a peg's movement is not measured, but in these cases, the horizontal distances between a particular peg and the adjacent pegs are measured.
Subsidence impacts	The physical changes or damage to the fabric or structure of the ground, its surface and environmental features, or built structures that are caused by the subsidence effects. These impacts considerations can include tensile and shear cracking of the rock mass, localised buckling of strata, bed separation, rock falls, collapse of overhangs, failure of pillars, failure of pillar floors, dilation, slumping and also include subsidence depressions or troughs.
Upsidence	Upsidence results from the dilation or buckling of near-surface strata at or near the base of the valley. The term uplift is used for the cases where the ground level is raised above the pre-mining level, i.e. when the upsidence is greater than the subsidence. The magnitude of upsidence, which is typically expressed in the units of mm, is the difference between the observed subsidence profile within the valley and the conventional subsidence profile which would have otherwise been expected in flat terrain.
Western Domain	Area to the north-west of the Main Southern Railway.

5.3 Abbreviations

Abbreviations used in this document are provided below in **Table 5-2**.

Table 5-2 Abbreviations

Abbreviation	Definition
AHIMS	Aboriginal Heritage Information System
ARTC	Australian Rail Track Corporation
AUSRIVAS	The Australian River Assessment System
BACI	Before After Control Impact design
DA	Development Approval
DRNSW	Department of Regional NSW

Abbreviation	Definition
DPE	NSW Department of Planning and Environment (now DPIE)
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical conductivity
ERG	Environmental Response Group
EPA	NSW Environment Protection Authority
GFG	GFG Alliance
GNSS	Global Navigation Satellite System units
HEC	Hydro Engineering and Consulting
Km	Kilometres
LW W1	Longwall West 1
LW W1-W2	Longwalls West 1 to West 2
LW W3-W4	Longwalls West 3 to West 4
m	metres
mbgl	Metres below ground level
mg/L	Milligrams per litre
ML	Mining Lease
mm	millimetre
MSEC	Mine Subsidence Engineering Consultants
NRAR	NSW Industry – Land & Water – Natural Resources Access Regulator – East
NSW	New South Wales
OSP	Open Standpipe Piezometers
pH	pH units
PMLL	Picton-Mittagong Loop Line railway
RCE	Riparian Channel and Environment Inventory
ROM	Run of Mine coal per annum
RMG	Rail Management Group
SIMEC	SIMEC Mining Division
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TCCCC	Tahmoor Colliery Community Consultative Committee
TCCO	Tahmoor Coking Coal Operations
VMP	Vibrating Wire Piezometer

5.4 Document Distribution

This report and associated documents have been distributed according to **Table 5-3**.

Table 5-3 Distribution List for Six Monthly Subsidence Impact Report

Agency	Contact Person	Position	Electronic Copy
DPIE - Planning	Steven O'Donoghue	Director – Resource Assessments	Stephen.ODonoghue@planning.nsw.gov.au
	Glen Lucas	Team Leader	Glen.Lucas@planning.nsw.gov.au
	Andrew Rode	Senior Environmental Assessment Officer	Andrew.Rode@planning.nsw.gov.au
DPIE - Resources Regulator (Subsidence)	Dr. Gang Li	Principal Subsidence Engineer	subsidence.monitoring@planning.nsw.gov.au
DRNSW – Resources and Geosciences	(none assigned)	(none assigned)	resource.operations@planning.nsw.gov.au
DPRNSW – Resources Regulator – Mining Act Inspectorate	Greg Kininmonth	Manager Environmental Operations (Southern)	greg.kininmonth@planning.nsw.gov.au nswresourcesregulator@service-now.com
Wollondilly Shire Council	David Henry	Environmental Assessment Planner	david.henry@wollondilly.nsw.gov.au
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TCCCC Committee Members	Documents sent to TCCCC Committee Members at private email addresses.		

Appendix A – Subsidence Monitoring Reports

Appendix B – Surface Water Monitoring Reports

Appendix C – Creek Monitoring Reports

Appendix D – Groundwater Monitoring Reports

Appendix E – Picton-Mittagong Loop Line Detailed Reports

Appendix F – Picton-Mittagong Loop Line Status Reports

Appendix G – Aboriginal Heritage Monitoring Report