SIMEC

MEMBER OF GFG ALLIANCE

Tahmoor Coal Pty Ltd

SIX MONTHLY SUBSIDENCE IMPACT REPORT

Western Domain Longwalls West 1 – West 4

1 October 2021 – 15 May 2022

Report 5 – June 2022

simecgfg.com

Document Control

PUBLICATION DATE:	17 June 2022
REVIEW DATE:	17 June 2022
AUTHORS:	April Hudson – Approvals Specialist *Tahmoor Coal – SIMEC Mining*
REVIEW:	Zina Ainsworth – Environment and Community Manager *Tahmoor Coal – SIMEC Mining*
VERSION NUMBER:	Rev 1
COMMENTS:	Final

simecgfg.com

Executive Summary

This report is the fifth 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 3 and West 4 (LW W3-W4) Extraction Plan. The reporting period of this report is from 1 October 2021 to 15 May 2022.

LW W1 extraction was completed on 6 November 2020, and Longwall West 2 (LW W2) extraction was completed on 17 June 2021. Longwall West 3 (LW W3) commenced extraction on 13 September 2021 and was completed on 21 March 2022. Longwall West 4 (LW W4) extraction commenced on 16 May 2022 and subsidence impacts from this longwall are not included in this report.

During the reporting period, observed subsidence along the centreline of LW W3 was less than predicted subsidence, and the maximum observed vertical subsidence relating to the extraction of LW W3 was 857 mm recorded along the LW W1-W3 crossline survey.

There were eleven (11) environmental aspects that were associated with Trigger Action Response Plans (TARPs) triggers, as well as a number of impacts to roads and built structures that required remediation. All triggers have been reviewed by the Environmental Response Group / Structural Response Group / specialists to determine if any further action is required. These TARP triggers included:

- Pool Water Level TARP – Level 3 triggered due to pool water level reduction in Cedar Creek (pool CR14) during October and November 2021. During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically. This TARP resolved after November 2021 and no further actions other than ongoing monitoring are required. Tahmoor Coal is reporting on pool water level on a 3-monthly basis to DPE;

- Surface Water Quality TARP – Level 2 triggered due to elevated dissolved aluminium at various pools during January to March 2022. These elevated concentrations were attributed to prevailing climatic conditions, and no further actions other than ongoing monitoring are required;

- Natural Drainage Behaviour TARP – Level 3 triggered due to laminar fracturing at SR17 Rockbar from November 2021 to February 2022. This fracturing has not affected the water level at Pool SR17 and no further actions other than ongoing monitoring are required;

- Groundwater Quality TARP – Level 2 and potential Level 4 triggered due to water quality results exceeding trigger levels. Potential Level 4 triggers were identified for pH at P12B, strontium at P15A, Electrical Conductivity at GW115860, and barium at GW115860. Investigations into the cause of these triggers is ongoing, along with continued monitoring ;

- Groundwater Bore Level TARP – Levels 2 and 3 triggered during the reporting period, however a trend in groundwater recovery was evident. Groundwater bore level will continue to be monitored in accordance with the LW W3-W4 Water Management Plan, and Tahmoor Coal will continue to provide 3-monthly reports to DPE for surface water and groundwater;
- Shallow Groundwater Pressures TARP – Levels 2 and 4 triggered during the reporting period, however a trend in groundwater recovery was evident. This Level 4 TARP trigger is a continuation of the TARP notification to DPE on 30 December 2020. Groundwater bore level will continue to be monitored in accordance with the LW W3-W4 Water Management Plan, and Tahmoor Coal will continue to provide 3-monthly reports to DPE for surface water and groundwater;

- Deep Groundwater Pressures TARP – Level 2 triggered during the reporting period. Groundwater monitoring will continue under the existing monitoring program;
- Historical Heritage TARP – Level 3 Trigger for impacts to sandstone culvert at 88.400 km and 88.980 km. These impacts included cracking and minor spalling. This Level 3 TARP trigger is a continuation of the TARP notification to DPE on 21 September 2021. Tahmoor Coal will undertake remediation after the full effects of LW W3-W4 have been completed;
- Stonequarry Creek Rockbar TARP – Blue Triggers for extension of High Resolution Closure Lines and measured strains across the SR17 Rockbar, and a Yellow Trigger for fractures on the SR17 Rockbar. These triggers have been investigated, and no impacts were noted at the Aboriginal heritage items located on the SR17 Rockbar. Ongoing monitoring is required; and
- Main Southern Railway TARP – Blue Triggers at Ballast Top Subways (88.133 km and 86.838 km) and Picton Tunnel, which were attributed to impacts from rainfall rather than mining impacts. As these triggers have been resolved, ongoing monitoring is required.

During the reporting period, there was one exceedance of environmental performance measures or indicators, as adopted from DA 67/98 Modification 5 or the LW W1-W2 Extraction Plan Approval conditions. Cracking on sandstone culverts at 88.400 km and 88.980 km resulted in exceedance of subsidence performance indicators for 'other Aboriginal and heritage sites'.

Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit with DPE was completed on 12 April 2022. A warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979.* Tahmoor Coal will complete remediation after the full effects of LW W4 have been completed.

1 Table of Contents

2 List of Figures

3 List of Tables

1 Introduction

This Six-Monthly Subsidence Impact Report fulfils the reporting requirement of the Extraction Plan approved for Longwall West 3 and West 4 (LW W3-W4) and covers the period of 1 October 2021 to 15 May 2022.

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

In addition, this report forms part of the three-monthly reporting for surface water and groundwater following an investigation of Level 4 TARP triggers relating to depressurisation of groundwater aquifers and water level at surface water monitoring site CB (Pool CR14). This reporting requirement was requested by NSW Department of Planning, Industry and Environment (DPIE, now DPE) following the notification of these TARP triggers. This report includes a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and any recommendations in relation to ongoing monitoring or corrective actions (refer to **Section 4.2, Appendix B,** and **Appendix C**).

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 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 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 is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal has mined 35 longwalls to the north and west of Tahmoor Mine's current pit top location. The current mining area, the 'Western Domain', is located north-west of the Main Southern Rail between the townships of Thirlmere and Picton (**Figure 1-1**). The Western Domain is within the Tahmoor North mining area and is within Mining Lease (ML) 1376 and ML 1539.

Extraction Plan approval for the third and fourth longwalls in the Western Domain (LW W3-W4) was granted by DPIE (now DPE) on 13 September 2021. A copy of this Project Approval is available on the Tahmoor Coal website (http://www.simec.com/mining/tahmoor-coking-coal-operations/). The Study Area for this extraction plan are provided in **Figure 1-2**.

Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 21 March 2022. Longwall West 4 (LW W4) extraction commenced on 16 May 2022 and subsidence impacts from this longwall are not included in this report.

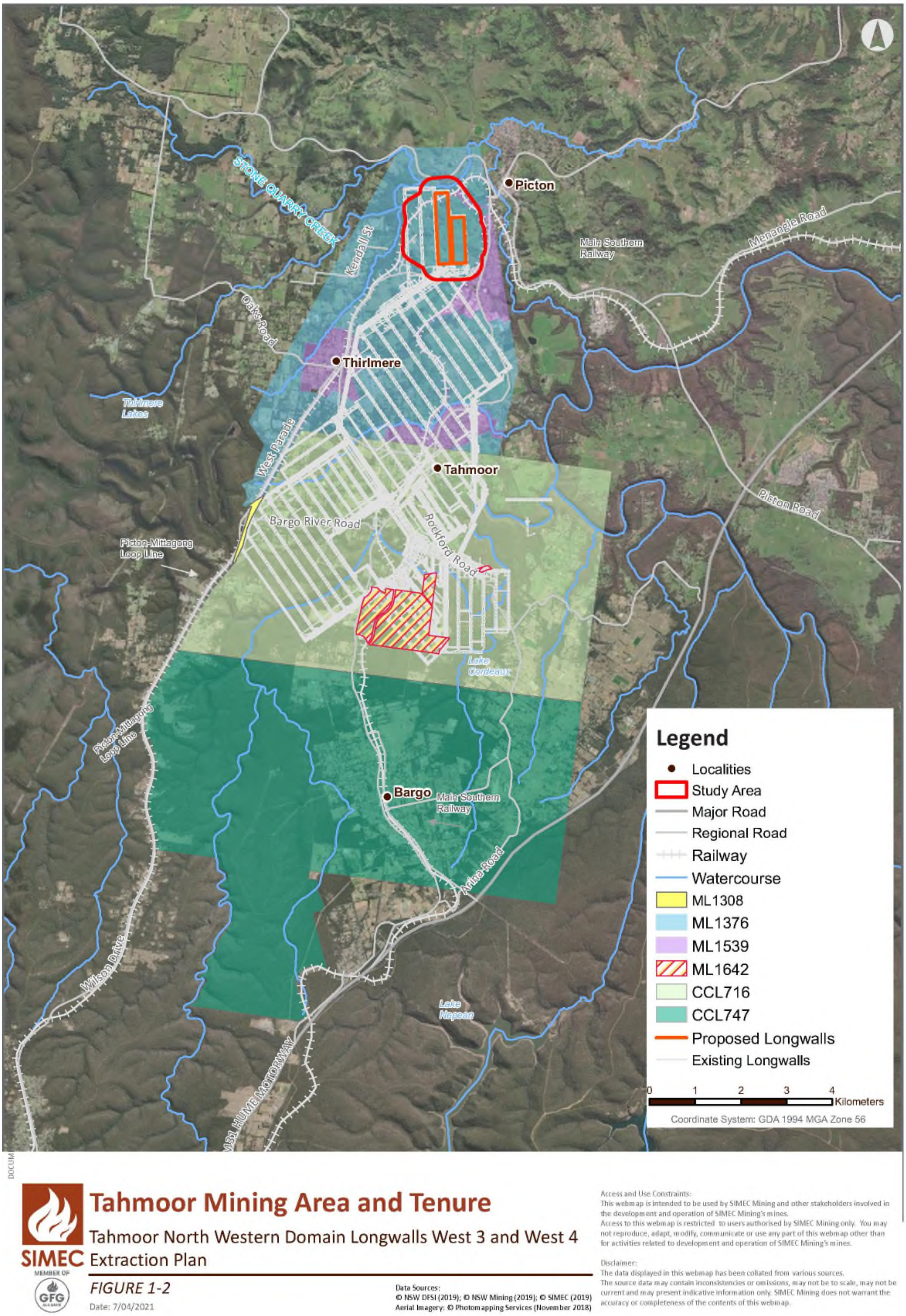


Figure 1-1 Tahmoor Mine Area and Tenure (source: LW W3-W4 Extraction Plan)

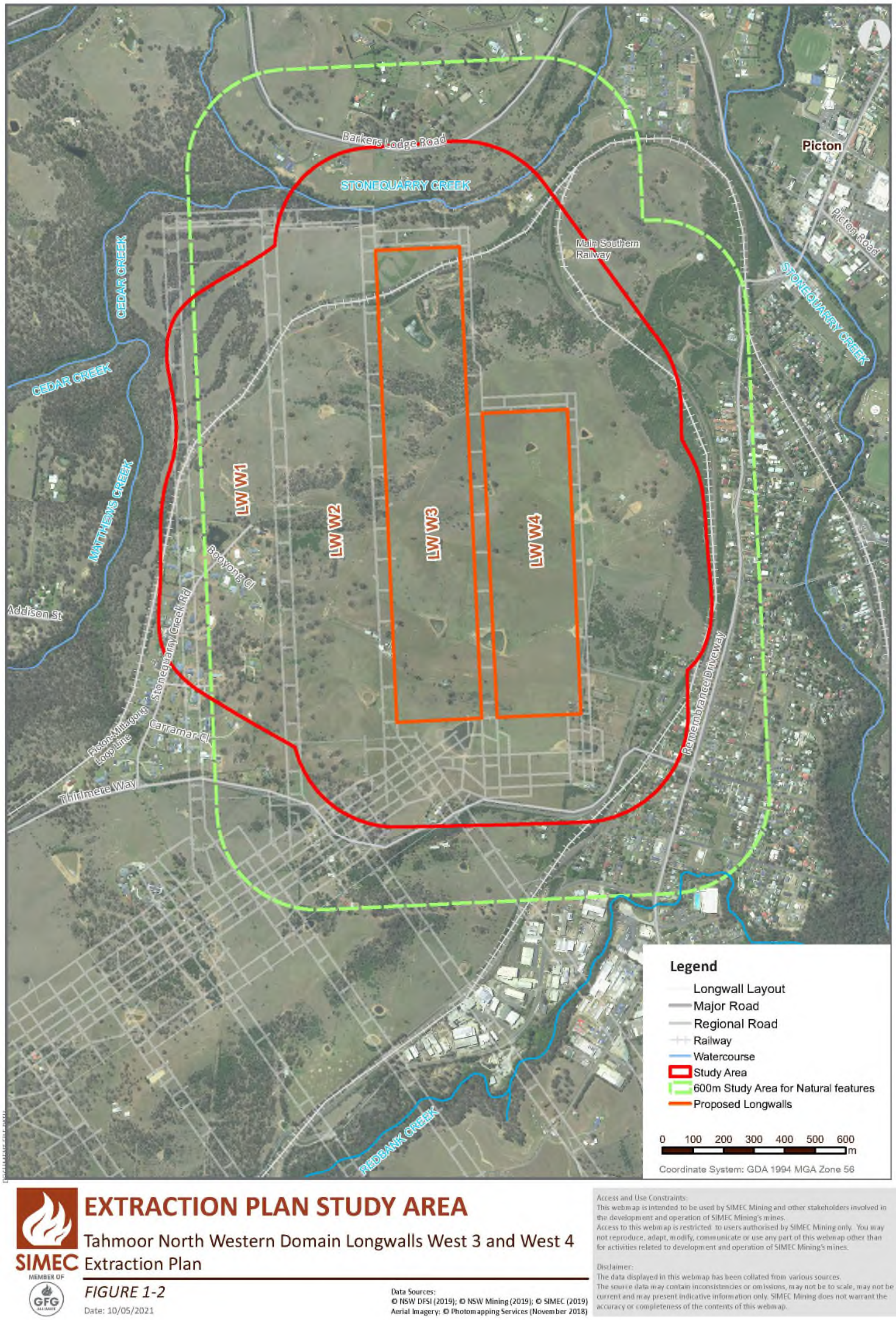


Figure 1-2 LW W3-W4 Extraction Plan Study Area (source: LW W3-W4 Extraction Plan)

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 W3-W4. These requirements are outlined in Section 6.1.4 of the LW W3-W4 Extraction Plan, which are derived from the Section 6 of the 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 W3-W4 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, according to the LW W3-W4 Extraction Plan, is shown in **Figure 1-3**.

The Extraction Plan Study Area for LW W3-W4 is defined as the surface area that is likely to be affected by the extraction of LW W3-W4 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 W3-W4; and
- A 35° angle of draw line from the limit of proposed extraction for LW W3-W4.

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

As part of the LW W3-W4 Extraction Plan, a set of management plans was prepared to manage particular environment or built features with the LW W3-W4 Study Area, which consisted of the following:

- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Stonequarry Creek Rockbar 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 W3-W4 Extraction Plan is provided in the relevant Subsidence Monitoring Programs.

Monitoring of features from the LW W1-W2 Extraction Plan as part of post-mining monitoring has been either completed or incorporated into the LW W3-W4 Subsidence Monitoring Programs, with the exception of post-mining monitoring of cliffs and rock outcrops in the LW W1-W2 Study Area.

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 in accordance with management plans listed above.

This report is the fifth six-monthly report to be submitted since the commencement of extraction of LW W1, in accordance with the requirements of the LW W3-W4 Extraction Plan. The reporting period of this report is from 1 October 2021 to 15 May 2022.

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.

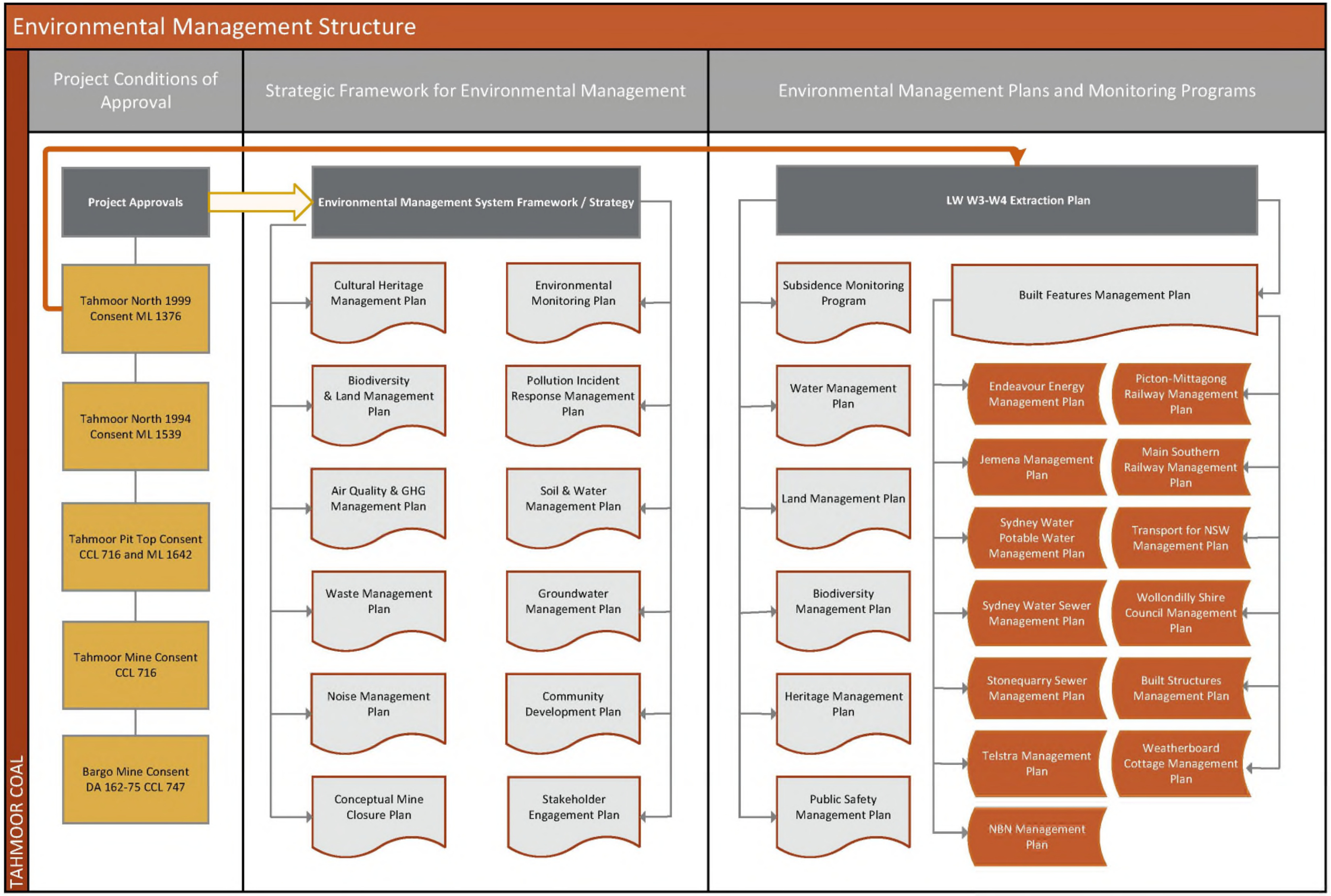


Figure 1-3 Overview of Environmental Management Structure for Tahmoor Coal (source: LW W3-W4 Extraction Plan)

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 for LW W3 reviewing data collected from 21 October 2021 to 15 May 2022 (Reports #4-27).	Weekly	Appendix A (referenced reports only)
Water Management Plan	Surface Water	Stonequarry Creek flow	• WaterNSW	• Hydro Engineering and Consulting (HEC) – now ATC Williams	Surface Water Monitoring Report reviewing data collected from 1 October 2021 to 24 March 2022.	Monthly, summarised in a 6-monthly report	Appendix B
		Pool water level	• ALS				
		Stream water quality					
		Natural drainage behaviour	• Brienan Environment and Safety	• Brienan Environment and Safety	Creek Monitoring Reports reviewing data collected from 17 November 2021 to 17 March 2022.	Monthly	Appendix D (referenced reports only)
	Groundwater	Groundwater quality	• GeoTerra	• SLR	Groundwater Monitoring Report reviewing data collected from 1 November 2021 to 31 March 2022.	Monthly, summarised in a 6-monthly report	Appendix C
		Groundwater bore level	• GeoTerra				
		Shallow groundwater pressures					
		Deep groundwater pressures	• Groundwater Exploration Services				
		Groundwater Inflow	• GeoTerra		Included in 6-monthly Groundwater Monitoring Report reviewing data collected from 1 November 2021 to 31 March 2022.	6-Monthly	

Land Management Plan	Landscape	Cliff lines Steep Slopes Surface cracking (excluding railway corridor) Dams	• Douglas Partners	• Douglas Partners	Geotechnical Monitoring Reports reviewing data collected from 1 November 2021 to 2 May 2022.	Monthly	(Available on request)
		Dams	• Bloor Rail • Newcastle Geotechnical	• MSEC • Bloor Rail • Newcastle Geotechnical	Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports for LW W3 reviewing data collected from 20 October 2021 to 26 April 2022 (Report #7-33).	Weekly	(Available on request)
		Dams	• Building Inspection Service (BIS)	• BIS	Dam inspection reports reviewing data collected from 21 October 2021 to 22 April 2022.	Weekly	(Available on request)
	Agricultural Land	Agricultural Land	• BIS	• BIS	Agricultural Subsidence Monitoring Reports reviewing data collected from 29 October 2021 to 25 April 2022.	Monthly	(Available on request)
Biodiversity Management Plan	Aquatic Ecology	Macroinvertebrates	• Niche	• Niche	Aquatic Ecology Monitoring Reports for Autumn 2022 (March 2022).	Six Monthly	(Available on request)
	Terrestrial Ecology	Amphibians Riparian Vegetation	• Niche	• Niche	Terrestrial Ecology Monitoring Report for Spring 2021 (November 2021) and Autumn 2022 (April 2022).	Six Monthly	(Available on request)
Heritage Management Plan and Stonequarry Creek Rockbar Management Plan	Aboriginal heritage	Grinding Grooves	• SMEC	• MSEC	Subsidence Monitoring Reports for LW W3 reviewing data collected from 21 October 2021 to 15 May 2022 (Reports #4-27).	Weekly	Appendix A (referenced reports only)
			• EMM Consulting	• EMM Consulting	LW W3 End of Panel Report for Aboriginal Heritage.	Once after LW W3 Extraction completed.	(Available on request)

		SR17 Rockbar	• SMEC • Michael Nicholson Consulting • PSM	• MSEC	Stonequarry Creek Rockbar reports for LW W3 reviewing data collected from 1 October 2021 to 29 April 2022 (Reports #7-48)	Weekly	Appendix F (referenced reports only)
	Historical heritage	Railway culverts	• Newcastle Geotechnical	• Newcastle Geotechnical	Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports for LW W3 reviewing data collected from 20 October 2021 to 26 April 2022 (Reports #7-33).	Weekly	(Available on request)
			• EMM Consulting	• EMM Consulting	LW W3 End of Panel Report for Historical Heritage.	Once after LW W3 Extraction completed.	Appendix E
Built Features Management Plan	Built Features	Electricity Infrastructure Gas Infrastructure Potable Water Sewerage Infrastructure Telecommunications Local roads, bridges and culverts Built Structures	• SMEC • BIS • Comms Network Solutions	• MSEC	Subsidence Monitoring Reports for LW W3 reviewing data collected from 21 October 2021 to 15 May 2022 (Reports #4-27).	Weekly	Appendix A (referenced reports only)
		Picton-Mittagong Loop Line	• Southern rail Services • Bloor Rail	• MSEC	PMLL Weekly Status Reports for LW W3 reviewing data collected from 20 October 2021 to 19 April 2022 (Reports #7-32).	Weekly	(Available on request)
		Transport for NSW (TfNSW) Infrastructure	• SMEC • Southern Rail Services • BIS	• MSEC	Victoria Street Status Reports for LW W3 reviewing data collected from 6 October 2021 to 10 May 2022 (Reports #5-34).	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 for LW W3 reviewing data collected from 20 October 2021 to 10 May 2022 (Reports #7-35).	Weekly	Appendix G (referenced reports only)

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 TARPs (if required).

A summary of monitoring results for relevant TARPs 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 W3-W4 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 4 is only used in the Water Management Plan TARPs.

Table 2-2 Trigger Levels for Railway Features (applicable to Picton-Mittagong Loop Line, Main Southern Railway, Transport for NSW, and Stonequarry Creek Rockbar 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	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022
Surface Water	Stonequarry Creek flow	Water Management Plan – Downstream reduction in catchment flow rate in Stonequarry Creek at Picton Gauging Station (GS212053)	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Assessment unable to be completed due to invalidation of current model calibration.[1]	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.
	Pool water level	Water Management Plan – Impact to pool water level	LEVEL 3 TRIGGERED[2] Surface water level triggers occurred at monitoring site CB (pool CR14) between 5 – 11 October 2021, 19 – 23 October 2021, and 28 October to 5 November 2021.	LEVEL 3 TRIGGERED[2] Surface water level triggers occurred at monitoring site CB (pool CR14) between 28 October to 5 November 2021.	No pool water level triggers occurred.	No pool water level triggers occurred.	No pool water level triggers occurred.	No pool water level triggers occurred.	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 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.	No surface water quality triggers occurred.	LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred in CB (Al), SC2 (Al), SC (Al) and SD (Al).	LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred in CG (Al).	LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred in CA (Al), CG (Al), SC2 (Al), SC (Al) and SD (Al).	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.
	Natural drainage behaviour	Water Management Plan – Impact to pool level, natural drainage behaviour or overland connected flow	No impacts to natural drainage behaviour observed.	LEVEL 3 TRIGGERED[4] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek.	LEVEL 3 TRIGGERED[4] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek.	LEVEL 3 TRIGGERED[4] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek.	LEVEL 3 TRIGGERED[4] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek.	LEVEL 3 TRIGGERED[4] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek.	Monitoring during March 2022 was unable to be obtained at monitoring site SB (Pool SR17) in Stonequarry Creek due to high water flow over the rockbar. All other sites did not note any impacts to natural drainage behaviour.	NA – Monitoring data for May 2022 to be summarised in next report.
	Flood levels	Water Management Plan – Impact to flood levels	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.	NR – Flood modelling required after completion of LW W4.
Groundwater	Groundwater quality	Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores	NA – Monitoring data for October 2021 discussed in previous six-monthly report.	LEVEL 2 TRIGGERED[5] Groundwater quality triggers occurred in P12C (Al), P14A (Cu, Sr, Li), P14C (Al), P15A (Sr), P15B (Sr), P15C (Sr), P16A (Fe), P16B (Sr).	LEVEL 2 TRIGGERED[5] Groundwater quality triggers occurred in P12B (pH upper, Al), P14B (Al), P15A (Sr), P15B (EC), P16B (Sr, Fe), P16C (pH upper).	POTENTIAL LEVEL 4 TRIGGERED[7] Groundwater quality triggers occurred in P15A (Sr), GW115860 (EC and Ba). LEVEL 2 TRIGGERED[5] Groundwater quality triggers occurred in P12B (pH upper), P14B (Al), GW104090 (Ba, Sr), GW105228 (Ba), GW072402 (Ba).	POTENTIAL LEVEL 4 TRIGGERED[7] Groundwater quality triggers occurred in P15A (Sr). LEVEL 2 TRIGGERED[5] Groundwater quality triggers occurred in P12A (Cu, Pb), P12B (pH upper), P14A (Li), P14C (Al), P15B (Sr), P15A (EC), P15C (Sr, Al), P15D (Fe, Ba), P16B (Sr).	POTENTIAL LEVEL 4 TRIGGERED[7] Groundwater quality triggers occurred in P12B (pH upper), P15A (Sr). LEVEL 2 TRIGGERED[5] Groundwater quality triggers occurred in P12B (Li), P15A (EC), P15B (EC), P15C (Sr, Mn), P16B (Fe).	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.
	Groundwater bore level	Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	LEVEL 3 TRIGGERED[9] Water level trigger occurred at piezometers P12C and P16C.	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.

Aspect	Feature	Corresponding Management Plan and TARP	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022
			LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.	LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.	LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.	LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.	LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.	LEVEL 2 TRIGGERED[8] Water level trigger occurred at piezometers P16B.		
	Shallow groundwater pressures	Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034	LEVEL 4 TRIGGERED[12] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	LEVEL 4 TRIGGERED[12] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	LEVEL 4 TRIGGERED[12] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	LEVEL 4 TRIGGERED[12] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	LEVEL 4 TRIGGERED[12] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	LEVEL 3 TRIGGERED[11] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl).	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.
			LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).	LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).	LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).	LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).	LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).	LEVEL 2 TRIGGERED[10] Depressurisation trigger occurred at TNC36 (intake 169 mbgl).		
	Deep groundwater pressures	Water Management Plan – Deep groundwater pressures at VMPs TNC036, TNC040, and TNC043	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	LEVEL 2 TRIGGERED[13] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl).	NA – Monitoring data for April 2022 to be summarised in next report.	NA – Monitoring data for May 2022 to be summarised in next report.
Landscape	Cliff lines	Land Management Plan – Cliff line damage or instability	NR – Next 3-monthly inspection of cliffs due in November 2021.	No signs of cliff line damage or instability	NR – Next 3-monthly inspection of cliffs due in April 2022.	NR – Next 3-monthly inspection of cliffs due in April 4022.	NR – Next 3-monthly inspection of cliffs due in April 2022.	NA – No inspection completed in March 2022 due to heavy rainfall.	No signs of cliff line damage or instability	NR – Next 3-monthly inspection of cliffs due in July 2022.
	Steep Slopes	Land Management Plan – Steep slope damage or instability	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 – No inspection completed in December 2021 due to Covid-19 Isolation and Christmas Period Shutdown.	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 – No inspection completed in March 2022 due to heavy rainfall.	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.
	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.	NA – No inspection completed in December 2021 due to Covid-19 Isolation and Christmas Period Shutdown.	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 – No inspection completed in March 2022 due to heavy rainfall.	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.
	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.	NA – No inspection completed in December 2021 due to Covid-19 Isolation and Christmas Period Shutdown.	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 – No inspection completed in March 2022 due to heavy rainfall.	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.
	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.	NA – No inspection completed in December 2021 due to Covid-19 Isolation and Christmas Period Shutdown.	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 – No inspection completed in March 2022 due to heavy rainfall.	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 May 2022 to be summarised in next report.
Aquatic Ecology	Macroinvertebrates	Biodiversity Management Plan – Decline or significant negative change in macroinvertebrate indicators.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	Monitoring macroinvertebrate indicators are within range of baseline data as supported by statistical analysis.	NR – Monitoring next required till Spring 2022.	NR – Monitoring next required till Spring 2022.

Aspect	Feature	Corresponding Management Plan and TARP	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022
		Biodiversity Management Plan – Reduction in aquatic habitat through loss of pools or associated reduction in water quality (AURIVAS habitat assessment)	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	No signs of mining impact resulting in a reduction in aquatic habitat.	NR – Monitoring next required till Spring 2022.	NR – Monitoring next required till Spring 2022.
Terrestrial Ecology	Amphibians	Biodiversity Management Plan – Decline in amphibian populations within watercourses of the Study Area	NR – Monitoring next required till Spring 2021.	No signs of subsidence impacts to amphibian populations.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	No signs of subsidence impacts to amphibian populations.	NR – Monitoring next required till Spring 2022.
	Riparian Vegetation	Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area	NR – Monitoring next required till Spring 2021.	No signs of subsidence impacts to riparian vegetation.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	NR – Monitoring next required till Autumn 2022.	No signs of subsidence impacts to riparian vegetation.	NR – Monitoring next required till Spring 2022.
Aboriginal Heritage	Grinding grooves and scarred tree	Heritage Management Plan – Aboriginal heritage	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	No signs of change at SR17 (grinding groove site) or scarred tree.	NR – No monitoring required till LW W4 is finished.
	SR17 Rockbar	Stonequarry Creek Rockbar Management Plan	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar.	NA – Monitoring data for May 2022 to be summarised in next report.
			BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended. Relative 3D surveys noted measured strains.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	BLUE TRIGGER High resolution closure lines across the rockbar were noted to have extended.	
Historical Heritage	Railway Culverts	Heritage Management Plan – Historical heritage (culverts only)	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	NR – No monitoring required till LW W3 is finished.	LEVEL 3 TRIGGERED[14] LW W2 End of Panel Monitoring confirmed cracking and spalling at sandstone culverts at 88.980 km and 88.400 km exceeds prediction. LW W3 End of Panel Monitoring did not note any additional impacts.	NR – No monitoring required till LW W4 is finished.
Built Features	Picton-Mittagong Loop Line	Picton-Mittagong Railway Management Plan	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	Results are within survey tolerance. Visual inspections did not identify any issues.	NA – Monitoring data for May 2022 to be summarised in next report.
	Main Southern Railway	Main Southern Railway Management Plan	No impacts observed in areas monitored this month.	BLUE TRIGGER Ballast Top Subway (88.133 km) – Small increase in closure at the base of the arch on the Down side.	BLUE TRIGGER Ballast Top Subway (88.133 km) – Small increase in closure at the base of the arch on the Down side.	BLUE TRIGGER Ballast Top Subway (86.838 km) – Small increase in closure near the top of the arch on the Up side.	BLUE TRIGGER Ballast Top Subway (86.838 km) – Small increase in closure near the top of the arch on the Up side.	BLUE TRIGGER Picton Tunnel (87.85 km) – Increasing change in Cant observed at southern end of Tunnel.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.

Aspect	Feature	Corresponding Management Plan and TARP	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022
	Electricity Infrastructure	Endeavour Energy 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.
	Gas Infrastructure	Jemena 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.
	Potable Water	Sydney Water Potable Water 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.
	Sewerage Infrastructure	Stonequarry Creek Sewer Management Plan	No impacts observed in areas monitored this month.	**Minor erosion near the stormwater pit after rainfall (not mining related).**	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.	**Minor settlement of backfill material following rainfall and minor erosion hole (not mining related).**	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Telecommunications	Telstra 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.
		NBN Co 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.
	Local roads, bridges and culverts	Wollondilly Shire Council 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.	**Impact to concrete kerb drain on Stonequarry Creek Road (Report 17).**	No impacts observed in areas monitored this month.	**Impacts to pavement at Connellan Crescent, as well as deterioration of Thirlmere Way road surface (Report 22).** **Impacts to Carramar Close, Thirlmere Way and other streets due to heavy rainfall (Report 23).**	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Built Structures	Built Structures 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.	**Impacts to properties on Stonequarry Creek Road and Booyong Close (Report 23)**	No impacts observed in areas monitored this month.	No impacts observed in areas monitored this month.
	Transport for NSW Infrastructure	Transport for NSW 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.

Notes:

NR – Monitoring not required this month.

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

[1] Stonequarry Creek flow assessment unable to be completed due to invalidation of current model calibration as a result of revision of the rating curve for Stonequarry Creek at Picton (GS 212053) in July 2020 and change of streamflow records from December 2015.

[2] Level 3 TARP for pool water level (LW W3-W4 Water Management Plan): The recorded water level has declined, although not atypical, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND The above has not occurred at one of the upstream pools (beyond mining effects).

[3] level 2 TARP for stream water quality (LW W3-W4 Water Management Plan): 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 precipitation that was not observed in the baseline period.

[4] Level 3 TARP for natural drainage behaviour (LW W3-W4 Water Management Plan): Rock bar and/or stream base cracking, gas release, or iron precipitation noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking in account climatic conditions and observations during baseline monitoring period.

[5] Level 2 TARP for groundwater quality (LW W3-W4 Water Management Plan): Short term increase (<3 months) in salinity and/or metals, or change in pH outside of baseline variability. The effect does not persist after a significant rainfall recharge event. AND/OR a similar trend or response has been noted at other monitored bores or private groundwater bores.

[6] Level 3 TARP for groundwater quality (LW W3-W4 Water Management Plan): Short term increase (<3 months) in salinity and/or metals or change in pH outside of baseline variability. The effect persists after a significant rainfall recharge event AND/OR the change in water quality is determined not to be controlled by climatic or anthropogenic factors.

[7] Level 4 TARP for groundwater quality (LW W3-W4 Water Management Plan): Medium to long term increase in salinity and/or metals or a change in pH outside of baseline variability with the effect persisting for greater than 3 months or after a significant rainfall recharge event AND the reduction in water quality is determined not to be controlled by climatic or anthropogenic factors.

[8] Level 2 TARP for groundwater bore level (LW W3-W4 Water Management Plan): Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

[9] Level 3 TARP for groundwater bore level (LW W3-W4 Water Management Plan): Water level declines below the water level of TARP Significance Level 3 (calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

[10] Level 2 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Greater than 5 m water level reduction in VWP intakes located at or above (i.e. shallower than 200 m depth) following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

[11] Level 3 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Water level declines below the water level of TARP Significance Level 3 following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

[12] Level 4 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Water level reduction greater than the maximum modelled drawdown following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or anthropogenic factors.

[13] Level 2 TARP for deep groundwater pressures (LW W3-W4 Water Management Plan): Calculated or observed drawdown (based on 2009 – 2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown.

[14] Level 3 TARP for historical heritage (LW W3-W4 Heritage Management Plan): Historical heritage site monitoring indicates environmental consequences to heritage site(s).

2.2 Summary of Actions

During the reporting period, there were eleven (11) environmental aspects that were associated with TARP triggers, 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. All triggers have been reviewed by the Environmental Response Group / Structural Response Group / specialists to determine any further actions (if required).

2.2.1 Pool Water Level TARP – Level 3 Triggers for Pool Water Level Reduction

Background

The following TARP triggers occurred during the current reporting period for water level (refer **Appendix B**):

- Monitoring Site CB – Level 3 TARP triggers occurred at pool CR14 (Cedar Creek) between 5-11 October 2021, 19 – 23 October 2021, and 28 October to 5 November 2021.

Further discussion of these triggers is provided in the Surface Water Review (refer **Appendix B**).

The water level records for monitoring site CB (pool CR14) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 16 mm between 5 and 11 October 2021, 20 mm between 19 and 23 October 2021, and 35 mm between 28 October and 5 November 2021 (refer **Appendix B**). During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically.

In accordance with the LW W3-W4 Water Management Plan, a Level 3 TARP significance in relation to pool water level decline at monitoring site CB has been derived for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021. The recorded water level declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period) during these periods and the same did not occur at an upstream pool (beyond mining effects).

Actions Completed

The following actions have been completed in light of the Level 3 TARP trigger during this reporting period:

- *Continue monitoring as per monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data* –monthly result analysis and reporting is ongoing;
- *Review relevant surface water level, groundwater level and streamflow data to assess comparative trends* – completed as part of Groundwater Six-month Review (SLR; refer to **Appendix C**), which suggested that gaining conditions (groundwater contribution to the surface water system) were occurring from mid-October to Late March 2022 in the vicinity of monitoring site CB (pool CR14). Review of water level measurements for monitoring sites in Cedar Creek downstream of monitoring site CB indicate that the water level at these sites generally remained above the baseline minimum during the periods of the Level 3 TARP trigger;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed following the reporting of this data, which included the discussion of this TARP trigger;
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger; and
- *Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached* – considered as part of the Surface Water Review (**Appendix B**). An increase in the frequency of data download and review is not considered to be required at this stage. Monthly download and review of surface monitoring data will continue to be conducted. Should a Level 4

TARP trigger exceedance occur in the future, further action will be taken in accordance with the LW W3-W4 Water Management Plan.

Tahmoor Coal have been providing quarterly (3-monthly) monitoring reports for surface water and groundwater as per the request by DPE on 25 June 2021. This report will form the fourth 3-monthly monitoring report. These reports include a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and any recommendations in relation to ongoing monitoring or corrective actions.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan, and the next 3-monthly Monitoring Report will be provided to DPE in August 2022.

2.2.2 Surface Water Quality TARP – Level 2 Trigger for Surface Water Quality

Background

The following TARP triggers occurred during the current reporting period for surface water quality (refer **Appendix B**):

- Monitoring Site CB – Level 2 TARP trigger for Aluminium in January 2022 and March 2022;
- Monitoring Site CG – Level 2 TARP trigger for Aluminium in February and March 2022;
- Monitoring Site SC2 – Level 2 TARP trigger for Aluminium in January 2022 and March 2022;
- Monitoring Site SC – Level 2 TARP trigger for Aluminium in January 2022 and March 2022; and
- Monitoring Site SD – Level 2 TARP trigger for Aluminium in January 2022 and March 2022.

Further discussion of these triggers is provided in the Surface Water Review (refer **Appendix B**).

The elevated concentrations of dissolved aluminium recorded in January to March 2022 occurred during and following above average rainfall. Additionally, a historically high concentration of dissolved aluminium was recorded at reference sites in January to March 2022. These results at the reference sites indicate that the elevated dissolved aluminium concentrations were likely catchment wide and related to the prevailing climatic conditions.

Actions Completed

The following actions have been completed in light of the Level 2 TARP triggers during this reporting period:

- *Continue monitoring as per monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes* – ongoing monthly result analysis and reporting is ongoing;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed following the reporting of this data, which included the discussion of this TARP trigger; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan.

2.2.3 Natural Drainage Behaviour TARP - Level 3 Trigger for Laminar Fracturing

Background

The following TARP triggers occurred during the current reporting period for natural drainage behaviour (refer **Appendix B**):

- Monitoring Site SB – Level 3 TARP trigger for laminar fracturing on the SR17 rockbar from November 2021 to February 2022. It is noted that due to high flow, observation at the rockbar was unable to be made during the March 2022 monitoring event.

Further discussion of these triggers is provided in the Surface Water Review (refer **Appendix B** and **Appendix D**).

Pool SR17 was initially reported at a Level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienen Environment & Safety reported this as laminar fracturing and extension of a natural crack in the rockbar following their inspection on 17 November 2021. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for the period including and following 17 November 2021.

Actions Completed

In accordance with the Stonequarry Creek Rockbar Management Plan, mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency and initial progress of the longwall capped to a maximum of 50 metres per week.

It is noted that this fracturing has not affected the water level at Pool SR17.

Geotechnical reviews of the rockbar identified that:

- The fractures occurred in thinly bedded, laminated sandstone and were considered a response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes;
- There was no evidence of new cracking outside the existing fractured area;
- The extension of the fractured area was associated with a veneer of sandstone sitting on top of competent sandstone;
- The fracturing was considered consistent with subsidence monitoring results and was effectively an extension of the original fracture site; and
- The fracturing provided a release for mining induced stress and was confined to the sheeted sandstone above the competent sandstone.

The following actions have been completed in light of the Level 3 TARP trigger during this reporting period:

- *Continue monitoring as per monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data* – monthly result analysis and reporting is ongoing;
- *Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess if the change in behaviour is related to LW W3-W4 mining effects, other catchment changes or the prevailing climate* – in response to the Level 3 trigger exceedances in relation to physical features at monitoring site SB (pool SR17), the Environmental Response Group convened and the surface

water level data was reviewed. The water level records for monitoring site SB (pool SR17) indicate that the surficial fracturing of the rockbar has not resulted in an impact to the pool water holding capacity. The water levels recorded at monitoring site SB (pool SR17) have not declined below the baseline minimum water level and no atypical water level behaviour was recorded at this site between 1 October 2021 and 5 February 2022 (extent of available monitoring data);

- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger; and
- *Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached* - an increase in the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level is not considered to be required at this stage. Monthly download and review of surface monitoring data will continue to be conducted.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan.

2.2.4 Groundwater Quality TARP – Level 2 and 4 Triggers for Groundwater Quality

Background

The following potential Level 4 TARP triggers occurred during the current reporting period for groundwater quality:

- P12B – 'Potential' Level 4 TARP trigger for pH in March 2022;
- P15A – 'Potential' Level 4 TARP trigger for Strontium in January to March 2022; and
- GW115860 – 'Potential' Level 4 TARP trigger for Electrical Conductivity and Barium in January 2022.

A number of Level 2 TARP triggers occurred for groundwater quality (refer to **Table 2-3**) however these triggers do not require further discussion.

A summary of the water quality trends is provided below. Further discussion of these triggers is provided in the Groundwater Six-Month Report (refer **Appendix C**).

pH at P12B

P12B triggered the upper trigger level for pH between December 2021 and March 2022 with a pH of 10.65 in March 2022. A potential TARP Level 4 was identified in March 2022 as four consecutive recordings (greater than three months) were recorded during a period of above average rainfalls.

Strontium at P15A

Strontium levels at P15A have continually exceeded the trigger of 2.31 mg/L from October 2021 to March 2022 monitoring rounds resulting in a potential TARP Level 4 exceedance. Strontium concentrations have decreased from 3.7 mg/L in January 2022 to 3.1 mg/L in March 2022. Despite the decrease in concentration in March 2022, Sr concentrations observed at nearby bores suggested that the exceedance in Sr concentrations in March 2022 at P15A remains a potential TARP Level 4.

Barium at GW115860

Barium concentrations at GW115860 exceeded the trigger of 0.33 mg/L for the third consecutive time in the January 2022 (i.e. a period of more than six months), resulting in a potential TARP Level 4 exceedance. Concentrations increased from 0.36 mg/L in October 2021 to 0.39 mg/L in January 2022.

EC at GW115860

The salinity at GW115860 has been steadily increasing from 621 µS/cm in January 2021 to 1,246 µS/cm in March 2022. Final EC in January 2022 at this bore exceeds the trigger level of 948.2 µS/cm for three consecutive recordings (greater than 6 months), resulting in a potential TARP Level 4.

Actions Completed

As discussed in **Appendix C**, the following actions were completed in response to the potential Level 4 TARP triggers for this reporting period:

- *Continue monitoring as per monitoring program* - monthly groundwater monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data and consideration of mining and external stresses (in groundwater monthly report)* – monthly result analysis and reporting is ongoing. The below sections provide an overview of investigations into the potential Level 4 TARP triggers that have been completed during the reporting period; and
- *Convene Tahmoor Coal Environmental Response Group to review response* - completed following the reporting of this data, which included the discussion of this TARP trigger.

As investigations into these potential Level 4 TARP triggers are still ongoing and the cause for these triggers is to be determined (i.e. has or has not been attributed to mining-related impacts), the responses as listed in the LW W3-W4 Groundwater Quality TARP have not been completed. These responses for a confirmed Level 4 TARP Trigger caused by mining impacts include:

- Reporting to DPE and relevant government agencies within 7 days of investigation completion;
- For monitoring bores: if it is concluded that there has been a mining-related impact, then implement an investigation report; and
- For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions in consultation with the affected landholder.

pH at P12B

SLR investigated the recent rise in pH at P12B in January 2022. The following summarises the findings:

- A rising trend in pH was previously observed at P12A, P12B and P12C around December 2020 to April 2021. It has been previously reported that this could be due to compromised integrity of the monitoring bores combined with high rainfall causing cement to become mobilised into the groundwater;
- No anomalous variations in groundwater level were identified in P12A, P12B and P12C, that could be indication of a compromised bore integrity; and
- The reason for the increase in pH at P12B causing the trigger exceedance is unclear and could potentially be related to compromised bore integrity, however an increasing trend was also observed at GW072402.

At this time, a mining-related effect is plausible, however the consequences of this effect (if it is mining-related) are considered minor.

Strontium at P15A

SLR investigated the recent Sr exceedances at P15A in January 2022 with no clear mining-impact identified. Further details regarding the strontium investigation are presented in **Appendix C**. The following presents a summary of the findings:

- Since the start of monitoring at site P15A-D, the Sr concentrations are above the ranges reported at unaffected sites and above the pre-mining Sr concentrations at P14A-P14D except for P15D within pre-mining Sr concentrations at P14;
- No exceedances in Sr concentrations were identified at surface water monitoring sites along Stonequarry Creek, with all surface water monitoring sites across the Western Domain within TARP Level 1 for water quality during the reporting period;
- From the U.S Environmental Protection Agency, Sr concentrations in drinking water are assessed relative to the health-based screening level benchmark of 4 mg/L. Values greater than 4 mg/L are considered high, between 2 mg/L and less than 4 mg/L are considerate moderate and less than 2.0 mg/L are considered low. At P15A, Sr concentrations are considered moderate (less than 4.0 mg/L);
- Since monitoring started at P15A, the higher Sr concentrations observed at P15A compared to other sites (i.e. P14, GW105228 and GW115860) and compared to the deeper piezometers (i.e. P15B-D) suggest a localised Sr source in groundwater at piezometer P15A;
- The range of strontium in natural soils is highly variable, from 50 mg/kg to 1000 mg/kg. P15A is located within the mapped alluvium and may be screened within alluvial soil with a higher Sr concentration compared to the deeper lithology of weathered and fresh Hawkesbury Sandstone. No bore logs are available to review and verify the lithology at this location; and
- The Sr concentrations at nearby registered bores GW105228 and GW115860 are considered low (less than 2 mg/L) suggesting no risk of human-health concerns and that the increase in Sr concentrations at P15A is possibly localised.

Barium at GW115860

SLR investigated the potential TARP Level 4 for Ba at GW115860 (refer to **Appendix C**). The following summarises the findings:

- Ba concentration at GW105228 (110 m from GW115860) are stable within 0.20-0.25 mg/L since monitoring started;
- The short record of Ba concentrations at site P15A-D shows fluctuation within the range of 0.08 to 0.21 mg/L, generally lower than at GW105228; and
- No exceedances or increasing trends in Ba concentrations were identified at sites P14A-D and P15A-C (only 180 m and 65 m from LW W3) between October 2021 and January 2022 (SLR, 2021a, 2022a) except at P15D (TARP Level 2) in February 2022 slightly increasing at the trigger level.

A mining-related effect on Ba at GW115860 was assessed to be unlikely but could not be excluded at the time of the investigation. A revision to the Ba trigger level was undertaken (refer **Appendix C**) as it appeared that the trigger level was conservative and could not be based on pre-mining data. The revised trigger level for Ba at bore GW115860 is 0.51 mg/L and remains conservative (i.e. lower than) with respect to the relevant guideline values considered.

Electrical Conductivity at GW115860

SLR investigated the trigger exceedances at GW115860 for EC (refer to **Appendix C**). The following summarises the findings:

- The reason for the increased EC at GW115860 is unclear, although it is consistent with the trend observed at nearby bore GW105228. Therefore, this trigger is a 'potential' Level 4 TARP trigger, and it has not been confirmed that the cause is mining;
- No drawdown was observed during the extraction of LW LW3 at GW115860, and hence drawdown does seem to be the cause of the change in EC; and
- The increase in EC at GW115860 (to 1,246 µS/cm) does not change the beneficial use classification of the groundwater extracted at this site, and therefore the currently observed effects are considered to be immaterial. Indeed, salinity (TDS) at GW115860 remains within the desirable palatability of less than 600 mg/L (class A1 category). Groundwater quality at GW115860 remains suitable for all beneficial uses, including the current purpose.
- Given the low salinity of groundwater at GW115860, and the small incremental change in that salinity in relation to the beneficial use classifications it is recommended to continue observing this bore over the next monitoring period (April 2022) to see if EC decreases, otherwise to revise the trigger. The most reliable method to revise the trigger would be to adopt the EC trigger from GW105228 for use at GW115860 as it has been derived from a longer record period.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan. In addition, the following actions are proposed for the Level 2 and potential Level 4 TARP triggers:

- At all sites with Level 2 trigger for groundwater quality, to continue monitoring program and a review of water quality data in the next groundwater monthly report;
- For pH at P12B, continue monitoring to confirm trends;
- For Sr at P15A in the short term, continue monitoring Sr concentration at site P15A-D, P14A-D and at the two nearby registered bores (GW105228 and GW115860);
- For Sr at P15A in the medium term, if Sr concentrations at P15A remain within a potential TARP Level 4, (i.e. show fluctuations between 2 mg/L and 4 mg/L) and no significant increase in Sr concentration is observed at other monitoring piezometers P15B, P15C and P15D and the nearby registered bores (i.e. not resulting in a TARP Level 4) over the period January-June 2022 (i.e. six months), it is suggested to revise the Sr concentration trigger level at P15A to 4 mg/L (i.e. based on US health-based screening level benchmark, and in the absence of an ANZECC guideline);
- For Br at GW115860, continue monitoring to confirm trends, particularly in light of the amended trigger value; and
- For EC at GW115860, continue monitoring to confirm trends and consider revision of the trigger.

2.2.5 Groundwater Bore Level TARP – Level 2 and 3 Triggers for Open Standpipe Piezometer Groundwater Levels

Background

During this reporting period, a number of groundwater intakes in open standpipe piezometers (OSPs) have recorded reduced water level elevation below the baseline range. This was noted in the following OSP intakes (refer to **Appendix C**):

- P12C – Level 3 TARP trigger from October 2021 to March 2022;
- P16B – Level 2 TARP trigger from October 2021 to March 2022; and
- P16C – Level 3 TARP trigger from October 2021 to March 2022.

P12C

During the reporting period, groundwater levels at P12C have increased to a maximum of 174.2 mAHD in March 2022 and are 2.1 m below baseline levels. Groundwater levels at P12C have increased by 2.8 m in March 2022 and are approximately 3.1 m above groundwater level observed in the upper piezometer P12A and P12B. A TARP Level 3 still applies at P12C as the recovered groundwater levels as of March 2022 are below the trigger level 3.

P16B and P16C

Both P16B and P16C have shown a TARP Level 4 exceedance from December 2020 to August 2021 and reduced respectively to Level 2 and Level 3 from September 2021. During the reporting period a TARP Level 2 and Level 3 still apply at P16B and P16C respectively.

At P16B, groundwater levels were observed at 202.8 mAHD in mid-January 2022, below the trigger TARP Level 2 (205.9 mAHD) following a decline of approximately 1.8m. During the second half of January 2022, water levels at P16B declined by 1.4 m, dropping below the TARP Level 3 for a short-period of time between 25-31 January 2022 before rising back to approximately 203.4 mAHD from March 2022. As of March 2022, groundwater levels at P16B are within a TARP Level 2.

SLR investigated the nature of the sharp decline (**Appendix C**). The recent decline in groundwater levels could be due to a delayed mining effect from LW W2 and active mining at LW W3. The sudden decline in groundwater levels at P16B could potentially be due to the sudden movement of strata from mining. Similar sudden declines were observed at P15 located adjacent to the northern end of LW W3 after the commencement of that panel.

Groundwater levels at P16C gradually declined by approximately 0.4 m throughout the reporting period to 190.2 mAHD and are observed at 191.3 mAHD in March 2022. As of March 2022, groundwater levels remain below the trigger TARP Level 3 (193.9 mAHD), hence a TARP Level 3 still applies.

Actions Completed

On 30 December 2020, Level 4 TARP triggers for the reduced water level elevations at P13C, P16B, P16C and TNC036 were notified to DPE and NRAR. This reduction was attributed to mining induced depressurisation of deeper groundwater aquifer, however this also correlated to a reduction in rainfall recharge events.

In light of the Level 4 TARP triggers, Tahmoor Coal have been providing quarterly (3-monthly) monitoring reports for surface water and groundwater as per the request by DPE on 25 June 2021. This report will form the fourth 3-monthly monitoring report. These reports include a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and any recommendations in relation to ongoing monitoring or corrective actions.

The following actions have been completed in light of the Level 2 and Level 3 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Ongoing review of water level data and consideration of mining and external stresses* –monthly result analysis and reporting is ongoing;
- *Review relevant surface water level, groundwater level and streamflow data to assess comparative trends* – completed as part of 3-monthly Monitoring Reporting for surface water and groundwater. The next monitoring report will be provided to DPE in August 2022;

- *Compare against base case and deterministic model scenarios* – completed as part of the Groundwater Report (**Appendix C**);
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program, and the next 3-monthly Monitoring Report will be provided to DPE in August 2022.

2.2.6 Shallow Groundwater Pressures TARP – Level 2, 3 and 4 Triggers 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 (refer to **Appendix C**):

- TNC036 intake 97 mbgl – Level 4 TARP trigger from October 2021 to February 2022, and a Level 3 TARP trigger in March 2022; and
- TNC036 intake 169 mbgl – Level 2 TARP trigger from October 2021 to March 2022.

At HBSS-97m groundwater levels are observed between 180.7 and 179.6 mAHD between November 2021 and February 2022. Over this period groundwater levels seem to have stabilised with fluctuations up to 1 m. This follows a period of recovery since June 2021. In February 2022, groundwater levels declined marginally below the trigger TARP Level 4 (180 mAHD) for short periods of time (five days in February 2022). As of March 2022, groundwater levels increased above the trigger TARP Level 4, hence a TARP Level 3 applies.

In HBSS-169m, the reduction to a TARP Level 2 occurred in September 2021 while groundwater levels continued to recover within the revised TARP Level 2. Groundwater levels are observed between 161.5 and 163.5 mAHD and increase by approximately 2 m during the reporting period. As of March 2022, groundwater levels remain below the trigger for TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies.

Actions Completed

On 30 December 2020, Level 4 TARP triggers for the reduced water level elevations at P13C, P16B, P16C and TNC036 were notified to DPE and NRAR. This reduction was attributed to mining induced depressurisation of deeper groundwater aquifer, however this also correlated to a reduction in rainfall recharge events. The Level 4 TARP triggers observed during this reporting period are a continuation of the trend as previously notified.

In light of the Level 4 TARP triggers, Tahmoor Coal have been providing quarterly (3-monthly) monitoring reports for surface water and groundwater as per the request by DPE on 25 June 2021. This report will form the second 3-monthly monitoring report. These reports include a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and any recommendations in relation to ongoing monitoring or corrective actions.

The following actions have been completed in light of the Level 2 and Level 3 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Ongoing review of water level data and consideration of mining and external stresses* –monthly result analysis and reporting is ongoing;
- *Compare against base case and deterministic model scenarios* – completed as part of the Groundwater Report (**Appendix C**);
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program, and the next 3-monthly Monitoring Report will be provided to DPE in August 2022.

2.2.7 Deep Groundwater Pressures TARP – Level 2 Trigger for Deep Vibrating Wire Piezometer Groundwater Pressure

Background

During this reporting period, groundwater intakes in deep (>200 mbgl) VWPs have recorded a trend of depressurisation below the baseline range. These trends have been noted in the following VWP intakes (refer to **Appendix C**):

- TNC036 intake 214 mbgl – Level 2 TARP triggered from October 2021 to March 2022; and
- TNC036 intake 412.5 mbgl – Level 2 TARP trigger from October 2021 to March 2022.

Actions Completed

The following actions have been completed in light of the Level 2 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Ongoing review of water level data* – monthly result analysis and reporting is ongoing;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program.

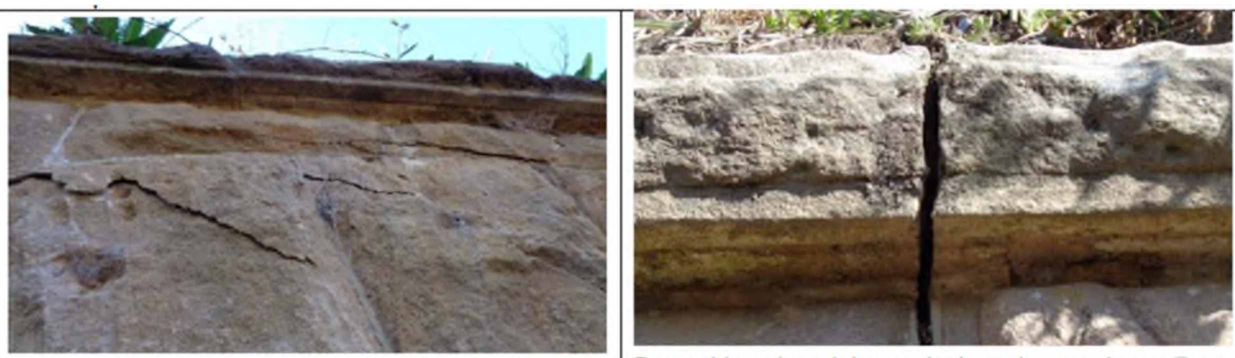
2.2.8 Historical Heritage TARP – Level 3 Trigger for Sandstone Culvert Impacts

Background

Visual inspections during the previous reporting period noted the development of a number of cracks and spalling of sandstone blocks on sandstone culverts at 88.400 km and 88.980 km along the Picton-Mittagong Loop Line. The end of panel inspection confirmed that impacts to the two culverts had triggered a Level 3 TARP trigger for historical heritage in accordance with the LW W1-W2 Heritage Management Plan.

During the current reporting period, it was confirmed that no new impacts to the culverts have been observed during the monitoring throughout the extraction of LW W3, and the end of panel heritage inspection confirmed that no additional cracking, worsening of existing cracks or spalling had occurred (**Appendix E**). A Level 3 TARP trigger remains relevant.

Cracking and spalling of the sandstone blocks on these culverts are illustrated in **Figure 2-1** and **Figure 2-2**.



Upside outlet sandstone block obvert cracking and outward movement of crest up to 8mm 5/10/2021

Downside culvert inlet vertical crack – maximum 7mm - 8mm at crest 5/10/2021

Figure 2-1 Cracking at culvert 88.44 km

Upside culvert outlet - headwall outward rotation up to 5mm along circumferential crack 21/6/21

Upside culvert headwall - outward rotation up to 5mm along developing crack – 21/6/21

Figure 2-2 Cracking at culvert 88.980 km

Actions Completed

As per the Historical Heritage TARP, the following actions have been completed:

- *Continue monitoring program as per monitoring program* - monitoring is ongoing according to the monitoring program;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis. This TARP trigger was discussed shortly after the identification of the trigger on 14 September 2021;
- *Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect* – completed as part of the LW W2 End of Panel inspection, as well as during the LW W3 End of Panel inspection;
- *Investigate exceedance of subsidence prediction* – completed as part of the LW W2 End of Panel Historical Heritage Report;
- *Review mine design / predictions against mine criteria* - completed as part of the LW W2 End of Panel Historical Heritage Report;

- *Review monitoring program and modify if necessary* - completed as part of the LW W2 End of Panel Historical Heritage Report, with no modifications were deemed required;
- *Notify DPE and Heritage NSW within one week of awareness of the event* – Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit was undertaken with DPE representatives on 12 April 2022 and a warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979;* and
- *Investigate and implement any additional management measures as required in consultation with Heritage NSW and DPE* – rehabilitation of the two culverts will be completed following the full effects of LW W4 in accordance with the Transport for NSW (TfNSW) Structures Repair Standard TMC302. A works program for the rehabilitation of the two culverts was submitted to DPE on 10 May 2022, as well as a report on the proposed rehabilitation methodology. Tahmoor Coal also provided the rehabilitation methodology to the Heritage Division of TfNSW on 19 May 2022.

Proposed Actions

Monitoring and management of sites will continue in accordance with the LW W3-W4 Heritage Management Plan. The Picton Mittagong Loop Line Management Plan for LW W3-W4 was prepared in consultation with Transport Heritage NSW and the Tahmoor Coal Rail Management Group. Monitoring of the two culverts in accordance with this management plan have been adopted in the LW W3-W4 Heritage Management Plan.

Tahmoor Coal has approached a number of heritage stonemasons to seek input into the repair methodology for the sandstone culverts. However, to date, no contributions have been received.

Rehabilitation of the two culverts will be undertaken after the full effects of LW W4 have been completed. All repair work on the impacted heritage structures will be completed in accordance with the Transport for NSW (TfNSW) Structures Repair Standard TMC302.

2.2.9 Stonequarry Creek Rockbar TARP – Yellow Trigger for visual inspection and Blue Trigger for High Resolution Closure Lines and Relative 3D Surveys

Background

During this reporting period, a number of triggers were recorded in accordance with the Stonequarry Creek Rockbar Management Plan TARPs. These TARP triggers included:

- Blue Trigger for extension of High Resolution Closure Lines across the SR17 Rockbar, first observed in October 2021 with the extension of HRC-D and BRC-E lines by 2.4 mm and 2.5 mm respectively (Stonequarry Creek Rockbar Status Report 8, **Appendix F**);
- Yellow Trigger for fractures on the SR17 Rockbar during detailed visual inspection first observed on 28 October 2021 with fractures observed between Marks RBF04 and RBF05 (Stonequarry Creek Rockbar Status Report 13, **Appendix F**); and
- Blue Trigger for measured strains in Relative 3D Surveys, noted on 14 February 2022 for measured strain between RBF04 and RBF05 (Stonequarry Creek Rockbar Status Report 41, **Appendix F**).

A copy of the referenced reports is provided in **Appendix F**.

Actions Completed

Following the Blue Trigger for the extension of High Resolution Closure Lines across the SR17 Rockbar on 11 October 2021, the Stonequarry Creek Rockbar Technical Committee met and reviewed the results, considered the Key Assessment Criteria and determined that the current survey, visual inspections, monitoring and management measures remained suitable. The results were then reviewed on a twice weekly basis. Regular updates were also provided to DPE on the status of the rockbar throughout mining, including the outcomes of the Technical Committee meetings.

In accordance with the Stonequarry Creek Rockbar Management Plan, mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40m downstream of the nearest grinding grove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency.

Geotechnical reviews of the rockbar identified that:

- The fractures occurred in thinly bedded, laminated sandstone and were considered a response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes;
- There was no evidence of new cracking outside the existing fractured area;
- The extension of the fractured area was associated with a veneer of sandstone sitting on top of competent sandstone;
- The fracturing was considered consistent with subsidence monitoring results and was effectively an extension of the original fracture site; and
- The fracturing provided a release for mining induced stress and was confined to the sheeted sandstone above the competent sandstone.

Following the Blue Trigger for the measured strain across the SR17 Rockbar on 14 February 2022, the Stonequarry Creek Rockbar Technical Committee noted that this site has been managed in accordance with the yellow trigger level since fractures were first observed on 28 October 2021.

Proposed Actions

Monitoring of the SR17 Rockbar will continue in accordance with the Stonequarry Creek Rockbar Management Plan.

2.2.10 Main Southern Railway TARP – Blue Trigger at Ballast Top Subway (88.133 km), Ballast Top Subway (86.838 km) and Picton Tunnel (87.85 km)

Background

During the reporting period, the following TARP triggers occurred related to Main Southern Railway features:

- Ballast Top Subway (88.133 km) – Blue Level Trigger for small increase in closure at the base of the arch on the Down side, first observed in November 2021 (MSR Status Report 10);

- Ballast Top Subway (86.838 km) - Blue Level Trigger for small increase in closure near the top of the arch on the Up side, first noted in January 2022 (MSR Status Report 19); and
- Picton Tunnel (87.85 km) – Blue Level Trigger for increasing change in Cant observed at southern end of the Tunnel, observed in March 2022 (MSR Status Report 28).

These triggers are documented in the reports referenced, which are included in **Appendix G**.

Actions Completed

Following the Blue Level Trigger for the Ballast Top Subway (88.133 km), a structural inspection was completed on 30 November 2021 and noted no immediate concern. Cause of the trigger was noted to be most likely due to build up of moisture behind the wingwall. A geotechnical inspection of the abutment foundations was also completed, which confirmed that fill material at the base of the wall was softened due to rainfall. The Rail Management Group reviewed the results and the structural report and agreed to increase the Blue Trigger Level from 5 mm to 10 mm, which resolved this Blue Level Trigger (refer to MSR Status Report 14, **Appendix G**).

Following the Blue Level Trigger for the Ballast Top Subway (86.838 km), a structural inspection was completed on 7 January 2022 and noted no immediate concern. Trains on the PMLL track were suspended until 5 February 2022. A geotechnical investigation confirmed that substantial footing was located in competent clay soils, and advised that the changes are not due to mine subsidence. The Rail Management Group reviewed the results and the structural report and agreed to increase the Blue Trigger Level from 20 mm to 25 mm, which resolved this Blue Level Trigger (refer to MSR Status Report 23, **Appendix G**).

Following the Blue Level Trigger for the Picton Tunnel (87.85 km), it was determined that the changes in track centres at 87.780 km was likely due to effects of weather as there was no measurable change across the width of the tunnel. This Blue Level Trigger was resolved (refer to MSR Status Report 29, **Appendix G**).

Proposed Actions

Visual inspection of MSR infrastructure will continue under the existing monitoring program.

2.2.11 Impacts to Built Structures and Local Roads

Background

A number of impacts to local roads and built structures occurred during the reporting period as a result of subsidence from LW W3 extraction. These impacts are focused within the Stonequarry Estate and along Thirlmere Way and can be summarised as:

- Stonequarry Creek Road - impacts to kerb drain (January 2022) and a property (March 2022);
- Connellan Crescent - impacts to road surface (March 2022);
- Carramar Close - impacts to road surface (March 2022);
- Booyong Close - impacts to a property (March 2022); and
- Thirlmere Way - impacts to road surface (March 2022).

The impacts to the road surfaces was noted to be largely attributed to the large rain event from the end of February to early March 2022.

These triggers are documented in the MSEC report included in **Appendix A**.

Actions Completed

Where appropriate, Tahmoor Coal has completed temporary repairs to roads and built structures within the Stonequarry Estate and Thirlmere Way. 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 W3-W4:

- DA 67/98 Modification 5:
  - Condition 13A – Performance Measures for Natural and Heritage Features;
  - Condition 13E – Performance Measures for Built Features;
- LW W3-W4 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 W3-W4 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 W3-W4 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: 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 W3-W4 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**	Section 4.4.1 and 4.4.2
Heritage Management				
Heritage sites (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences**. Negligible loss of heritage value**.	Isolated finds/artefact scatters (AHIMS items) No performance indicators are currently established as impacts are predicted to be negligible.	**No** *Note: The LW W3-W4 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
		Scarred tree (AHIMS item) This performance indicator will be considered to be triggered if:	**No** *Note: The LW W3-W4 Heritage Management Plan assessed the probability of impacts to the scarred tree*	Not applicable

		• subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or • subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage	*from the proposed longwall mining as very unlikely.* *Impacts to open sites, such as the scarred 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>Main Southern Railway Heritage Items (Mushroom Tunnel, Picton Tunnel, Antill Street Underbridge, Picton Viaduct, Argyle Street Underbridge)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies cracking of external brick work or physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking , exfoliation, brick movement or brick fall.	**No**	Section 4.5.2
		<u>Main Southern Railway Heritage Items (Pedestain overbridge 86.1 km, MSR culverts, Subway 88.133 km, high retaining wall 84.687 km, bridge on Matthews Lane, Prince Street overbridge, Connellan Crescent Overbridge)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.	**No**	Section 4.5.2

		Cottage (Weatherboard) 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
		Redbank Uniting Church This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall.	**No**	Section 4.5.2
		Rural Landscape – Thirlmere Way This performance indicator will be considered to be triggered if subsidence monitoring identifies visual subsidence, surface cracks.	**No**	Not applicable
		Rural landscape – Thirlmere Way (local heritage significance) No performance indicators are currently established as impacts are predicted to be negligible.	**No**	Not applicable
Other Aboriginal and heritage sites (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences**.	Loop line 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.	**Yes** Cracking on sandstone culverts at 88.400 km and 88.980 km resulted in exceedance of subsidence performance indicators. DPE and Heritage NSW were notified of this exceedance on 21 September 2021. Tahmoor Coal will complete remediation after the full effects of LW W3-W4 have been completed.	Sections 2.2.8, 4.5.2 and 4.6
		Loop line 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**	Sections 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,	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		

swimming pools, tennis courts, roads, tracks and fences (DA 67/98 Condition 13E)	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
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 DPE.

** 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

During the reporting period, the LW W3-W4 Subsidence Monitoring Program have 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 eighteen (18) Global Navigation Satellite System (GNSS) units measuring absolute horizontal and vertical positions in real time installed directly above and adjacent to LW W3-W4.

A summary of all surveys and inspections completed during the reporting period is provided in Figure A and Table 1 of the MSEC1204 LW W3 Subsidence Monitoring Report 27 (refer **Appendix A**). A weekly review of the subsidence survey results during the reporting period has been completed by Tahmoor Coal and MSEC.

Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 21 March 2022. Longwall West 4 (LW W4) extraction commenced on 16 May 2022 and subsidence impacts from this longwall are not included in this report.

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 857 mm of vertical subsidence relating to the extraction of LW W3 has been recorded along the LW W1-W3 crossline survey.

Table 4-1 Subsidence Monitoring Observations for the start and end of this Reporting Period (source: MSEC, Subsidence Monitoring Report 27, Appendix A)

	Report 27 (MSEC1204)	
Monitoring Period	30/03/2022 – 15/05/2022	
Length of extraction	LW W3 completed	
Distance travelled by longwall since previous report	NA, longwall completed	
Observed Ground Movement Parameters	**Maximum Observed Total**	**Location**
Subsidence (mm)	857	LW W1-W3 Crossline
Tilt (mm/m)	3.8	Stonequarry Creek Road
Hogging Curvature (km^{-1})	0.22	PMLL
Sagging Curvature (km^{-1})	-0.29	LW W1-W3 Crossline
Tensile Strain (mm/m)	1.4	PMLL
Compressive Strain (mm/m)	-5.0	PMLL

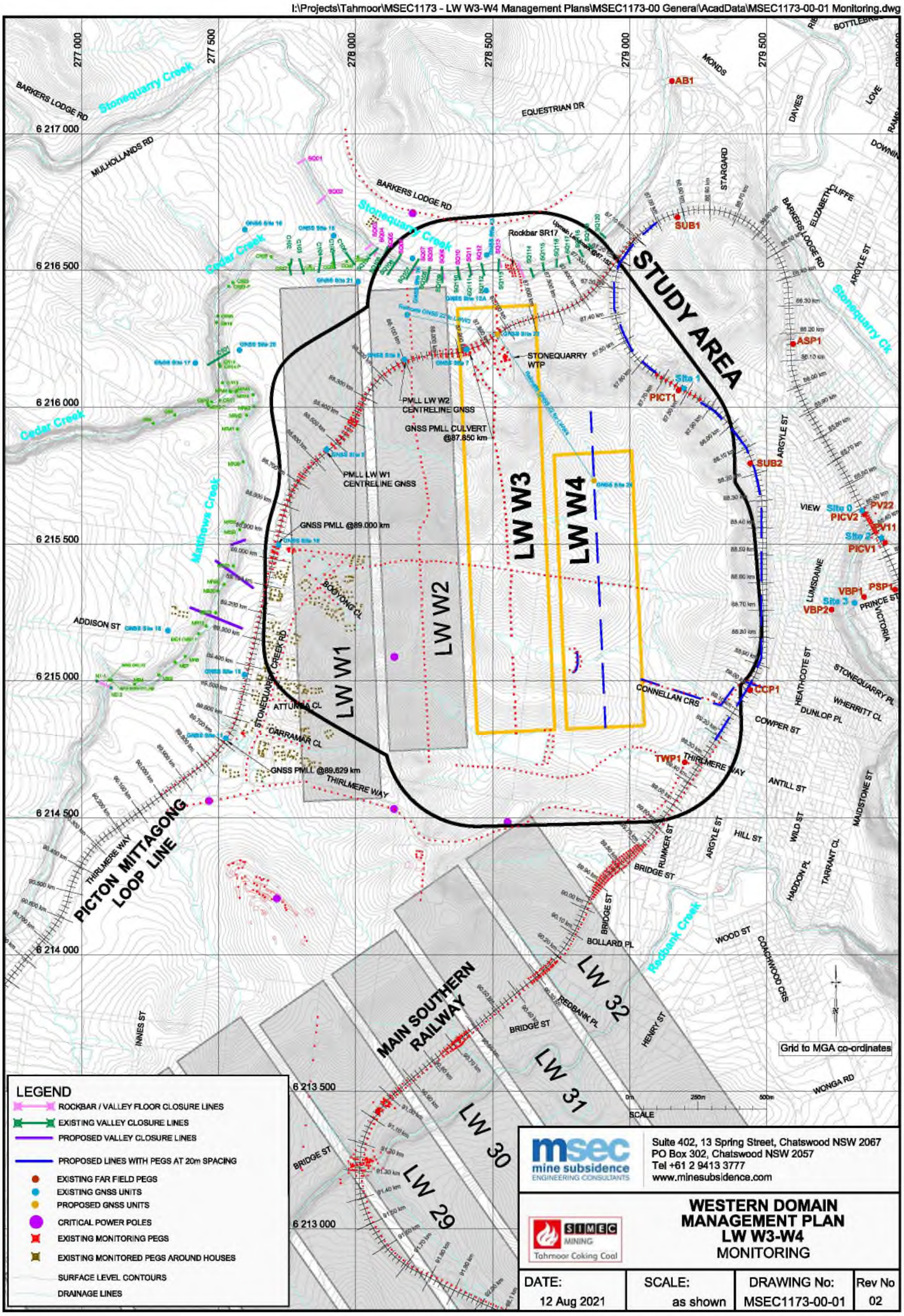


Figure 4-1 LW W3-W4 Subsidence Monitoring Program (source: LW W3-W4 Subsidence Monitoring Program)

4.1.1 Ground Survey Results

The development of subsidence at pegs and GNSS units located on the LW W3 centreline that have been mined directly beneath by LW W3 are illustrated in **Figure 4-2**. This figure shows that subsidence currently observed along the centreline of LW W3, as well as that observed at GNSS Site 23 and 87.760 km on the Picton Mittagong Loop Line, was less than predicted.

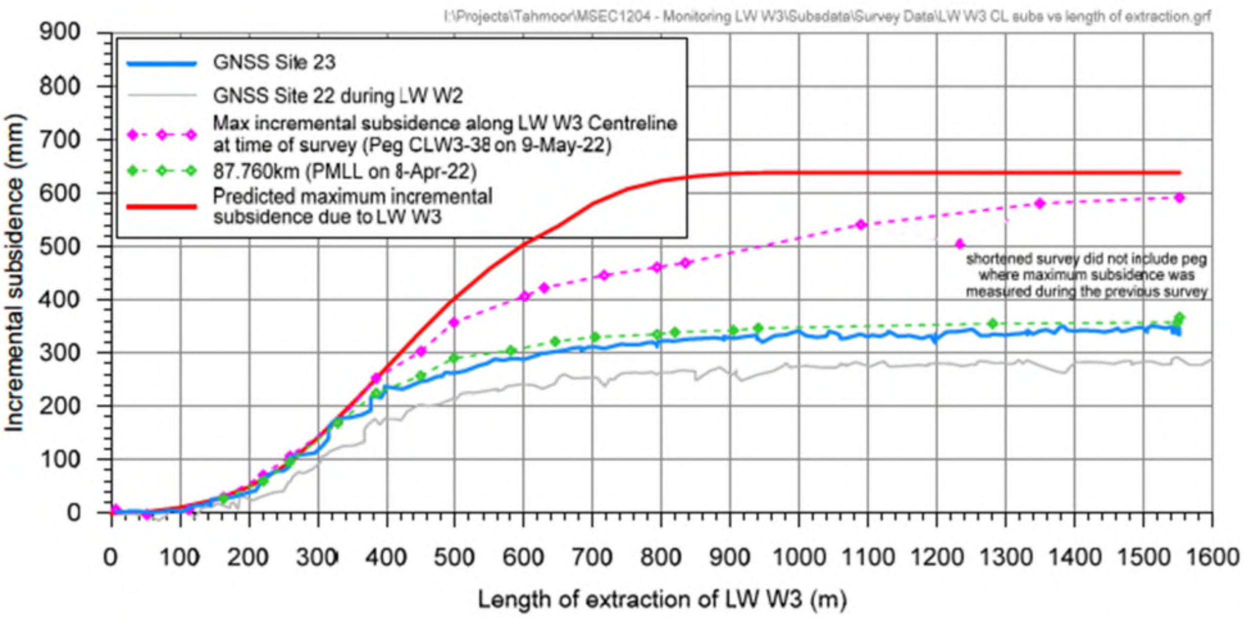


Figure 4-2 Development of subsidence along centreline of LW W3 (source: MSEC, Subsidence Monitoring Report 27, Appendix A)

Regular surveys were conducted along the Picton Mittagong Loop Line during the mining of LW W3. Compressive strains were noted above the centreline of LW W3 and across the creek crossing, however visual inspections did not identify any issues associated with mine subsidence.

Regular surveys were conducted along the Main Southern Railway during the mining of LW W3. All results were within survey tolerance during mining, and visual inspections did not identify any issues associated with mine subsidence.

Regular surveys were conducted at the Victoria Bridge over Stonequarry Creek during the mining of LW W3. Very small and gradual closure was observed across Stonequarry Creek. Visual inspections did not identify any impacts associated with mine subsidence but the gap between the deck and the eastern abutment was observed to almost close. Transport for NSW is currently in the process of reinstating a gap prior to the influence of LW W4.

A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC Subsidence Monitoring Report 27 (refer to **Appendix A**).

4.1.2 GNSS Monitoring Observations

Some trends can be seen in the results of the observed GNSS movements with the closest GNSS units generally moving towards the extracted panel as expected. Results from all GNSS units, including incremental horizontal movements, are presented in the MSEC Subsidence Monitoring Reports (refer **Appendix A**).

Changes in horizontal distances between GNSS units stationed near each other and on opposite sides of a waterway as a result of the extraction of LW W1-W3 are shown in **Figure 4-3**. During LW W3 extraction, only minor changes have been observed between the GNSS units.

The GNSS unit at Site 14 has been removed at the request of the landowner. The last reading was on 4 November 2021. The GNSS unit at Site 13 has been confirmed as disturbed in January, likely during removal of the surrounding fencing. Minor changes have been observed since this time. The unit was relocated on 28 March and results normalised.

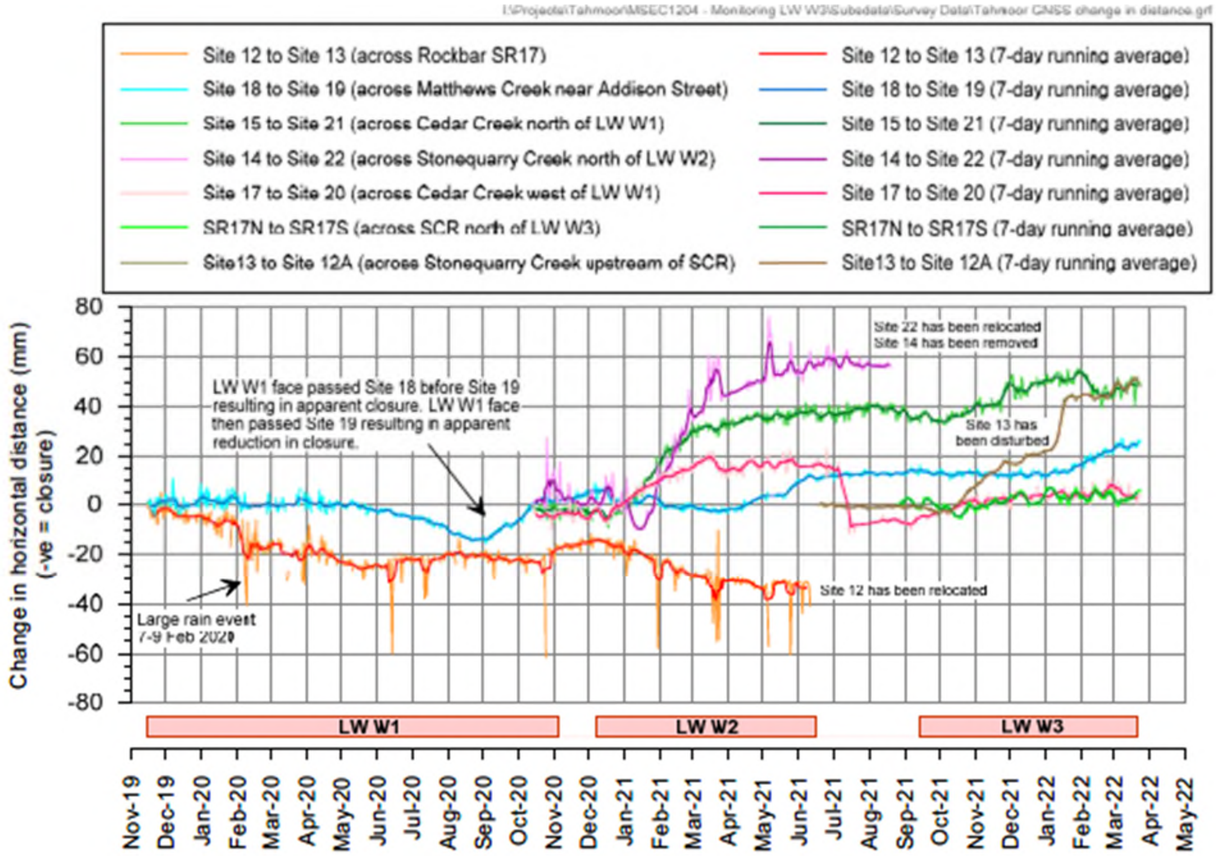


Figure 4-3 Observed changes in horizontal distances between GNSS units during LW W1-W3 extraction (source: MSEC, Subsidence Monitoring Report 27, Appendix A).

4.1.3 Valley Closure in Creeks

Survey marks installed across rockbars in Stonequarry Creek, Cedar Creek and Matthews Creek are illustrated in **Figure 4-1**.

Along Stonequarry Creek, Valley closure has been measured to develop across Stonequarry Creek at SQ104 and SQ105, which are located near the confluence of Stonequarry Creek and Cedar Creek. Minor closure was developing across SQ104, SQ105, SQ106 and SQ107 up to 3 November 2021. The survey pegs for SQ101 to SQ109 were removed following the survey on 3 November, as requested by the landowner.

The most recent monthly survey for Rockbar SR17 was on 22 February. Small changes in horizontal distances were observed both along and across the rockbar. Minor ground shortening is observed in the southeast corner of the rockbar, which is captured by measurements at Marks RBE11, RBF05 and RBF06.

Very little change in closure along Cedar Creek and Matthews Creek was observed during the mining of LW W3. The most recent survey was on 24 January for Cedar Creek and 8 December 2021 for Matthews Creek, with minor changes observed.

4.2 Water Monitoring

The LW W3-W4 Water Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 extraction on surface water and groundwater systems in accordance with Condition 13H(vii)(c) of DA 67/98.

During this reporting period, the LW W3-W4 Water Management Plan have been implemented to monitor the following surface water and groundwater systems:

- Surface Water:
  - Flow, pool water level and surface water quality monitored for Stonequarry Creek, Cedar Creek and Matthews Creek – monitoring data reviewed and reported by Hydro Engineering & Consulting (refer to **Appendix B**);
  - Creek monitoring for natural drainage behaviour – visual inspections and reporting by Brienan Environment and Safety (refer to **Appendix D** for references report);
- Groundwater:
  - Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monitoring data reviewed and reported by SLR (refer to **Appendix C** for Six Monthly Report); and
  - Mine water intake – data for this reporting period reviewed and reported by SLR (refer to **Appendix C** for Six Monthly Report).

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

The assessment of downstream reduction in catchment flow rate recorded at the WaterNSW gauging station Stonequarry Creek at Picton (GS212053) relies on a calibrated streamflow model which enabled comparison of modelled and monitored streamflow rates. The locations of GS212053 is illustrated in **Figure 4-4**.

The rating curve for Stonequarry Creek at Picton (GS212053) was revised by WaterNSW in July and November 2020 and, as such, the streamflow records for the site have changed thereby invalidating the previous model calibration. Despite attempts to recalibrate the streamflow model, challenges were encountered due to the limitations of the gauging station at Stonequarry Creek at Picton (GS212053), the limitations of catchment rainfall records, water extraction from Stonequarry Creek catchment and the inability to adequately match the monitored and modelled flows. As such, the assessment method, and subsequently assessment of trigger exceedances in relation to catchment flow rate in Stonequarry Creek at Picton, have been discontinued.

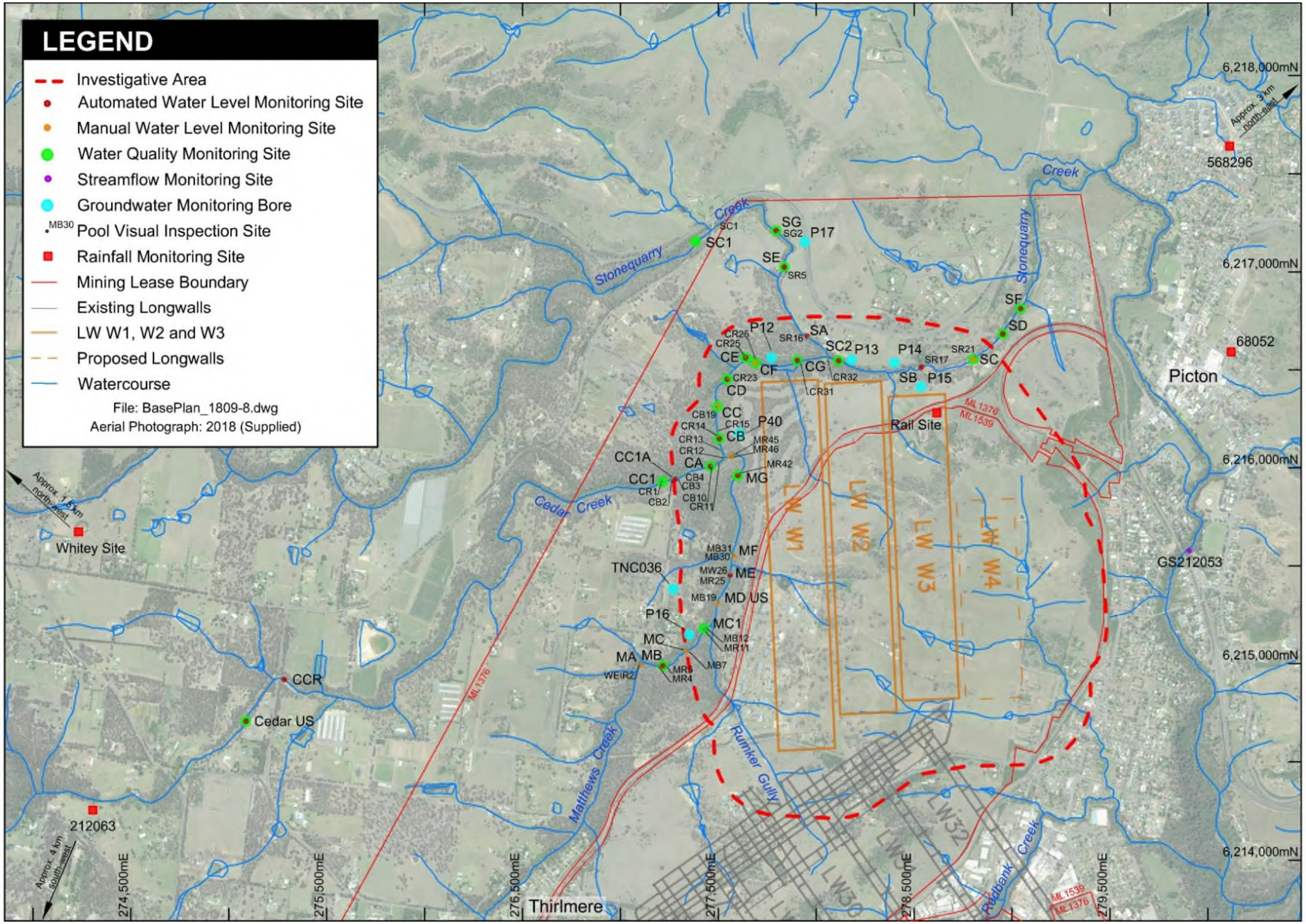


Figure 4-4 *LW W3-W4 Surface Water Monitoring Locations (source: ATC Williams, Surface Water Review, Appendix B)*

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 4-4**. Continuous surface water level data has been recorded at three pool monitoring sites on Matthews Creek, eight 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 4-4**.

During the reporting period, monitoring sites on Matthews Creek, Stonequarry Creek, and Cedar Creek water levels remained above minimum baseline levels and/or consistent with baseline conditions, with the exception of the monitoring sites CB (Pool CR14), CD (Pool CR23), CE (Pool CR31) and SG (Pool SG2) as discussed below.

Charts illustrating monitored pool water level hydrographs for pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts A1-25 in Attachment A of the Surface Water Monitoring Report (refer to **Appendix B**).

Monitoring site CB

The water level records for monitoring site CB (Pool CR14) indicate that water level declined below the baseline minimum for parts of October and November 2021, with a maximum decline of 35 mm below the baseline minimum recorded on 3 November 2021. The water level rose in response to subsequent rainfall events and was recorded above the cease to flow (CTF) level and baseline minimum for the remainder of the reporting period. During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically.

In accordance with the LW W3-W4 Water Management Plan, a Level 3 TARP significance in relation to pool water level decline at monitoring site CB has been derived for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021. The recorded water level declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period) during these periods and the same did not occur at an upstream pool (beyond mining effects).

Monitoring site CD

The water level records for monitoring site CD (Pool CR23) indicate that water level declined below the baseline minimum for parts in October and November 2021. A maximum decline of 35 mm below the baseline minimum was recorded on 3 November 2021. The water level rose in response to subsequent rainfall events and was recorded above the CTF level and baseline minimum for the remainder of the reporting period.

As the water level behaviour at this monitoring site has been consistent with baseline conditions and/or consistent with reference site conditions throughout the reporting period, a Level 1 TARP significance in applicable during this reporting period.

Monitoring site CE

The monitoring records indicate that the water level declined very slightly below the baseline minimum for brief periods in February 2022, however, remained above the CTF level. The water level rose in response to a major rainfall event in early March 2022 and remained above the baseline minimum for the remainder of the reporting period.

As the water level behaviour at this monitoring site has been consistent with baseline conditions and/or consistent with reference site conditions throughout the reporting period, a Level 1 TARP significance in applicable during this reporting period.

Monitoring site SG

The monitoring records for reference site SG indicate that the water level declined to a historically low level for brief periods on 3 November 2021 (noting that there is no baseline data available for this site – i.e. monitoring did not commence until after the start of LW W1). The water level then rose in response to rainfall events and remained above the previously recorded minimum for the remainder of the reporting period.

As the water level behaviour at this monitoring site has been consistent with baseline conditions and/or consistent with reference site conditions throughout the reporting period, a Level 1 TARP significance in applicable during this reporting period.

4.2.3 Natural Drainage Behaviour

Visual and photographic surveys for subsidence impacts on creeks have been completed monthly for all monitoring pools on Stonequarry Creek, Cedar Creek and Matthews Creek within the active subsidence zone of LW W3. 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 4-5**, and a summary of creek observations for the reporting period is provided below:

- Pool water level and overland connective flow was influenced by a major rainfall event that occurred from late February to early March 2022, resulting in catchment base-flow recharge;
- Surficial fracturing of the controlling rockbar at Pool SR17 was noted following the inspection on 17 November 2021 (refer to **Appendix D**). The fractures occurred in thinly bedded, laminated sandstone and were likely in response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes. The formation of fractures resulted in a Level 3 TARP trigger for physical features and natural behaviour of pool SR17. Further information on this TARP trigger and the actions completed and proposed are provided in **Section 2.2.3**;
- There were no other surface fracturing or cracking noted in the waterways during the reporting period;
- No reduction in pool flow or connective overland flow was observed in the waterways during the reporting period;
- Some minor iron hydroxide precipitation was observed in Stonequarry Creek, Cedar Creek and Matthews Creek during the reporting period, however these levels did not exceed pre-Longwall West 1 baseline levels; and
- No gas release was noted in the waterways during the reporting period.

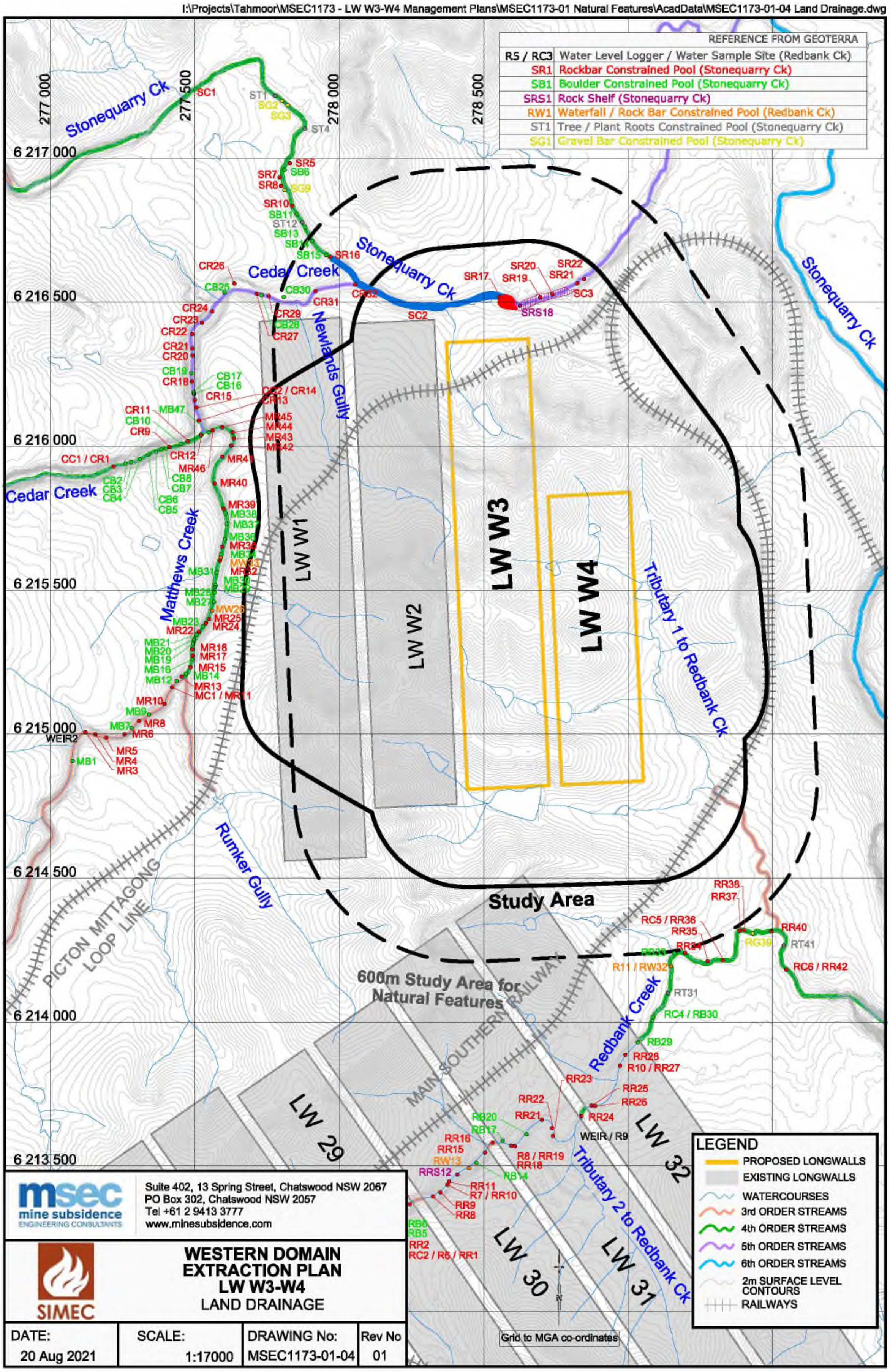


Figure 4-5 LW W3-W4 Creek Monitoring Locations (source: MSEC, 2021; LW W3-W4 Subsidence Predictions and Impact Assessment Report)

4.2.4 Surface Water Quality

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

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

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen, temperature and oxidation reduction potential. Laboratory analyses are undertaken for pH, EC, TDS, alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, fluoride, nitrate+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.

A summary of observations for the reporting period is provided in **Table 4-2**. Charts illustrating water quality results for monitored pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts B1-11 in Appendix B of the Surface Water Review (refer to **Appendix B**).

To date, there has been negligible evidence of an influence of mining LW W1, LW W2 or LW W3 on surface water quality in Matthews Creek, Cedar Creek or Stonequarry Creek. The water quality characteristics of monitoring sites following commencement of mining LW W1, LW W2, and LW W3 have been largely consistent with baseline conditions and / or consistent with reference site conditions.

Although isolated occurrences of elevated dissolved aluminium were recorded at some monitoring sites on Cedar Creek and Stonequarry Creek during January to March 2022, these levels occurred during and following above average rainfall. Additionally, a historically high concentration of dissolved aluminium was recorded at reference sites during this period, indicating that the elevated dissolved aluminium concentrations were likely catchment wide and related to the prevailing climatic conditions.

Further discussion of the elevated water quality occurrences and related TARP triggers is provided in **Section 2.2.2**.

Table 4-2 Summary of Notable Results for Key Water Quality Parameters for the Reporting Period

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
pH	The field pH values indicate near neutral pH conditions for the duration of the reporting period, consistent with baseline values.	The field pH values indicate slightly acidic to near neutral conditions for the duration of the reporting period. Generally higher pH values were recorded during the reporting period in comparison to the baseline period.	The field pH values indicate near neutral to slightly alkaline pH conditions for the duration of the reporting period. Historically high pH values were recorded at monitoring sites SD and SF and at reference site SG in March 2022. The pH values recorded at all other monitoring sites were generally consistent with baseline values.
Electrical Conductivity	Field EC values were consistent with baseline values for the duration of the reporting period (less than 337 µS/cm at all sites).	Field EC values were generally less than baseline values for the duration of the reporting period (less than 568 µS/cm at all sites).	Field EC values were consistent with or less than baseline values for the duration of the reporting period (less than 862 µS/cm at all sites).

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
Dissolved Aluminium	Dissolved aluminium concentrations were elevated in January and March 2022 in comparison to the remainder of the reporting period. The elevated concentrations occurred following a period of above average rainfall. However, the concentrations were consistent with baseline values (equal to or less than 0.13 mg/L at all sites).	Dissolved aluminium concentrations were elevated in January, February and March 2022 in comparison with the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded in January and February at reference site CCR and in March 2022 at all monitoring sites with the exception of CC1 and CB.	Dissolved aluminium concentrations were elevated in January and March 2022 in comparison with the remainder of the reporting period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded at all monitoring sites, except SC1, in March 2022 including at reference sites SE and SG.
Dissolved Barium	Dissolved barium concentrations recorded over the duration of the reporting period were equal to or less than 0.027 mg/L at all sites and generally consistent with baseline values.	Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.2 mg/L at all sites and generally less than baseline values.	Dissolved barium concentrations recorded over the duration of the reporting period were equal to or less than 0.1 mg/L at all sites and consistent with or less than baseline values.
Dissolved Iron	Dissolved iron concentrations were slightly elevated from December 2021 to March 2022 in comparison to the remainder of the reporting period, including at reference site MB, however were generally consistent with baseline values.	An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at all sites were equal to or less than 2.55 mg/L and generally consistent with baseline values.	An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at each monitoring site were equal to or less than 1.88 mg/L and generally consistent with baseline values.
Dissolved Manganese	Dissolved manganese concentrations recorded over the duration of the reporting period were less than 0.157 mg/L at all sites and consistent with or less than baseline values.	Dissolved manganese concentrations recorded at all sites for the duration of the reporting period were less than 0.613 mg/L and less than baseline values.	Dissolved manganese concentrations recorded at all sites for the duration of the reporting period were less than or equal to 0.461 mg/L and consistent with baseline values.
Dissolved Nickel	Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the reporting period and consistent with baseline values.	Dissolved nickel concentrations were less than 0.004 mg/L at all sites during the reporting period and generally less than baseline values.	Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the reporting period and consistent with or less than baseline values.

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
Dissolved Zinc	Dissolved zinc concentrations were equal to or less than 0.009 mg/L at all sites during the reporting period and consistent with baseline values.	Dissolved zinc concentrations were equal to or less than 0.035 mg/L at all sites during the reporting period and consistent with baseline values.	Dissolved zinc concentrations were less than 0.017 mg/L at all sites during the reporting period and consistent with baseline values.
Sulphate	Sulphate concentrations recorded at all sites during the reporting period were equal to or less than 8 mg/L and consistent with baseline values.	Sulphate concentrations recorded at all sites during the reporting period were equal to or less than 8 mg/L and consistent with baseline values.	A decreasing trend in sulphate concentrations was recorded at all sites over the duration of the reporting period. The sulphate concentrations recorded at all sites were equal to or less than 15 mg/L and consistent with or less than baseline values.

4.2.5 Groundwater Quality

A total of 17 open standpipe piezometers (OSPs) have been installed at six locations in the Western Domain – P12 to P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W3-W4. The locations of these groundwater bores are illustrated in **Figure 4-6**.

Further detail on the above groundwater quality triggers, including graphs showing progressive groundwater quality results for pH, EC and selected metals, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater quality are also discussed in **Section 2.2.4**.

Electrical conductivity and pH

Prior to this reporting period, there had been no trigger exceedances for EC at any of the standpipes (P12-P14, P16, and P17). Private bores GW104090 and GW115860 showed a TARP Level 2 EC trigger exceedance in the July monitoring round, with GW115860 also showing an exceedance in October 2021.

The recovery in groundwater levels at the open standpipes is accompanied with a stable pH and EC across the Western Domain. An increasing trend in EC was noted at site P15A, P15B and GW115860. The cause of the rise in salinity, although minor, remains difficult to assess as baseline data is not available. The beneficial use classifications remain unchanged at the private bore GW115860 and no significant increase in EC was identified along Stonequarry Creek.

An issue with the integrity of the bore is likely at P12B following the rise in pH since October 2021, and previously observed in April 2021 following rainfall. As of March 2022, nearby monitoring bores are within TARP Level 1, it is suggested to keep the exceedances in pH at P12B as potential 4 TARP Level noting that the consequences of this effect (if it is mining-related) are considered minor.

During this reporting period, three monitoring sites have triggered EC trigger levels within this six-monthly monitoring period:

- P15A;
- P15B; and
- GW115860.

All others EC measurements from the Tahmoor standpipes and private bores are within the Level 1 TARP.

Two monitoring sites have triggered pH trigger levels within this six-monthly monitoring period:

- P12B - triggered the upper pH threshold; and
- P16C - triggered the upper pH threshold.

Metal concentrations

Most of the exceedances in metal concentrations reported during the reporting period are short-term increase (less than three months) likely due to above average rainfall conditions during late 2021 and intense rainfall in early 2022.

A consistent rise in the concentration of strontium was observed during the reporting period at site P15A piezometer and requires further monitoring. SLR investigated the rise as being localised and further information on stratigraphy in this area may assist assessing reasons for the increasing concentrations.

Metal concentration exceedances (TARP Level 2) remain active as of March 2022 for Fe (P16B), Mn (P15C), Li (P12B), Ba (GW104090, GW105228, GW072402) Sr (P15A, P15C, GW104090).

Exceedances in Fe at P16B are likely due to iron staining in the bore (previously observed during bore census conducted by GeoTerra in 2019).

Single exceedances in metal concentrations (i.e. Sr and Ba) have been recorded in some private bores during the reporting period (i.e. only one sampling event in January 2022). There are no clear trends in metal concentrations that may be linked to mining operations. Metal concentration exceedances (TARP Level 2) remain active as of January 2022 (i.e. last sampling event) for Ba (GW104090, GW105228, GW072402) and Sr (GW104090).

A potential TARP Level 4 was reported for Ba at GW115860 and investigated in SLR (2022a). This was assessed to be unlikely a mining impact. A revised trigger level was calculated as it appeared that the trigger level was conservative and could not be based on pre-mining data. Further monitoring at GW115860 will be undertaken in April 2022 to confirm trends.

The following metal triggers were exceeded over the five-monthly monitoring period from November 2021 to March 2022 in the respective bores:

- Iron (Fe) - P15D (February), and P16B (December and March)
- Manganese (Mn) – P15C (March)
- Copper (Cu) – P12A (February), P14A (November)
- Lead (Pb) – P12A (February)
- Aluminium (Al) – P12B (December), P12C (November), P14B (December and January), P14C (November and February), P15C (February)
- Lithium (Li) – P12B (March), P14A (November and February)
- Barium (Ba) – P15D (February), P16A (November), GW104090, GW105228, GW072402, GW115860 (all in January); and
- Strontium – P14A (November), P15A (all months), P15B (November and March), P15C (November, February and March), P16B (November, December and February), GW104090 (January).

Over the reporting period, there were no exceedances in the lower pH and in dissolved zinc (Zn), nickel (Ni), arsenic (As) and selenium (Se).

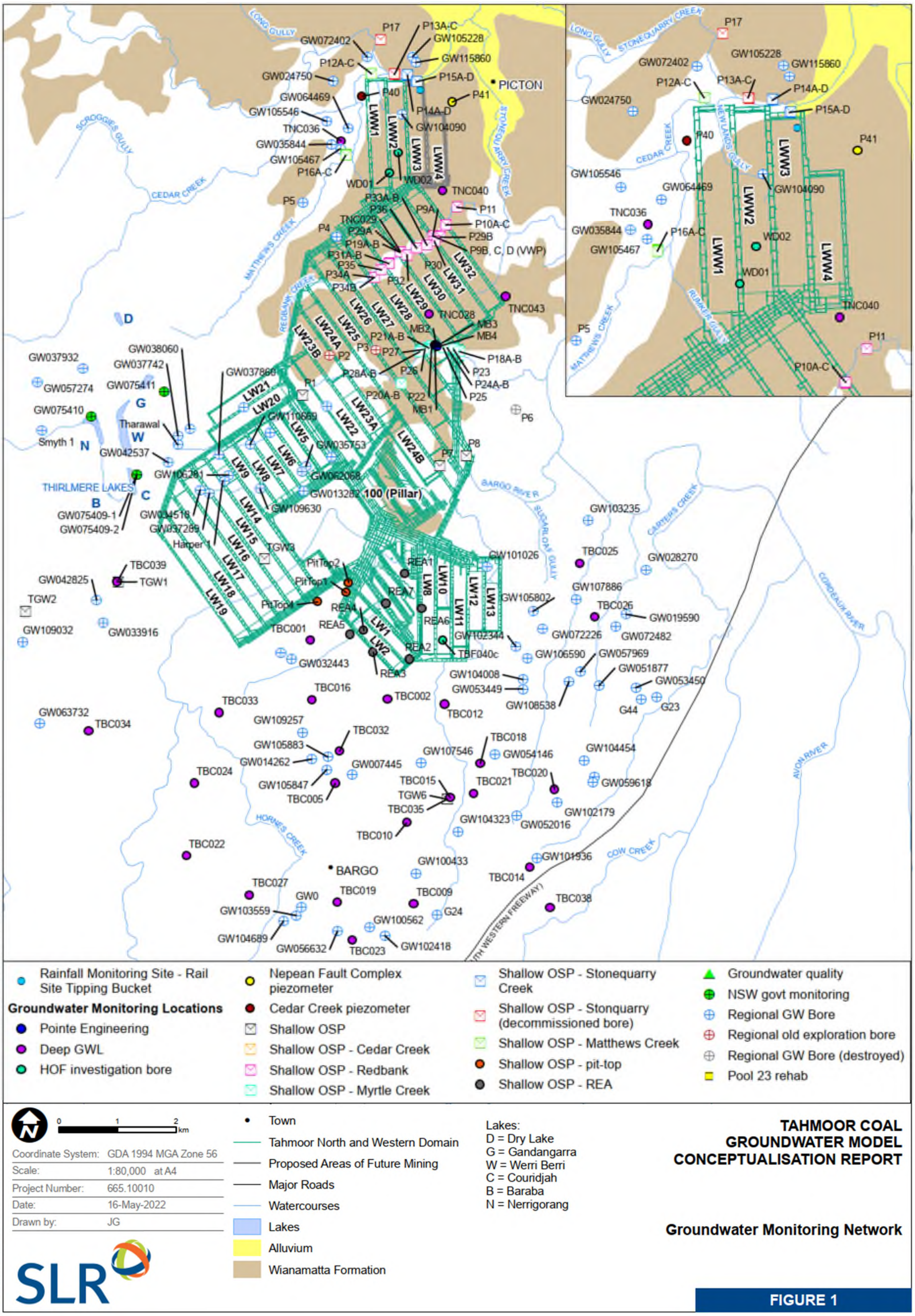


Figure 4-6 LW W3-W4 Groundwater Monitoring Bores (source: Groundwater Six-Month Review, SLR; Appendix C)

4.2.6 Groundwater Bore Levels

A total of 17 OSPs have been installed at six locations in the Western Domain – P12 to P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W3-W4. The locations of these groundwater bores are illustrated in **Figure 4-6**.

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 2.2.5**.

Monitoring bores

The following groundwater bore level exceedances occurred during the six-monthly monitoring period in the respective bores (**Appendix C**):

- TARP Level 4 at the shallow VWP sensors at TNC036 (HBSS-97m) from October 2021 to February 2022, with a reduction in TARP to Level 3 in March 2022;
- TARP Level 3 at the shallow open standpipes P12C and P16C during the reporting period;
- TARP Level 2 at the shallow open standpipe P16B during the reporting period;
- TARP Level 2 at the shallow VWP sensors at TNC036 (BGSS-169m) during the reporting period; and
- TARP Level 2 at the two deep VWP sensors at TNC036 (BGSS-214m and BGSS-412.5m) during the reporting period.

All other groundwater monitoring sites remained within TARP Level 1 across the reporting period.

At most of the monitoring sites, groundwater levels have clearly responded to the above average rainfall condition observed throughout December 2021 to March 2022 (i.e. marked by floods events in late February – early March 2022), while groundwater levels seemed to have been less responsive to wet conditions in November 2021 although it was the second wettest month in 2021 with 177.8 mm of rainfall. This is likely attributed to a delayed mining effect of LW W2 and the progression of LW W3 during the reporting period.

A period of stable groundwater level was identified between October and February 2021 in the upper Hawkesbury Sandstone aquifer at the open standpipes P12A and P12B.

The LW W3 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain. However, a series of consistent and minor declines were observed at site P14 and P15 during November 2021 (LW W3 approximately 50% complete) and ranging from 0.3m to 0.5m; similar to observations made in September and October 2021. These series of decline are likely associated with the progression of LW W3 although short-term responses to rainfall recharge were observed over the same period. No effects on surface water were observed at the rock bar SR17 due to LW W3 over the reporting period.

To the east of the Western Domain, a minor depressurisation was observed in the lower fault zone at P41D and could potentially be due to LW W3 extraction while other VWPs at P41 show stable groundwater levels.

To the west of the Western Domain, a delayed mining effect from LW W2 and active mining at LW W3 had a short-term effect on groundwater levels at P16B and P16C (i.e. combination of sharp and gradual decline) associated with a subsequent slower groundwater recovery. This could be related to fracturing of the strata due to valley closure along the western side of LW W1 (i.e. increase in porosity hence storage leading to longer recovery time).

From December 2021, groundwater recovery in the Hawkesbury Sandstone aquifer improved at the open standpipes P12C, P14B-D, P15A-D and P40A-D and from February 2022 at sites P12A, P12B, P16A-B, P41C-D. The rate of recovery accelerated in late February 2022 at all monitoring sites. The groundwater recovery is associated with the completion of LW W3, and the exceptional wetter condition in February-March 2022.

At monitoring site P40, located in between LW W1 and Cedar creek, groundwater levels in the upper Hawkesbury Sandstone (P40A) continued to recover over the reporting period while groundwater recovery in the mid Hawkesbury Sandstone started later in December 2021 (P40B-P40D). The difference in timing may be due to the upper Hawkesbury Sandstone aquifer being recharged first by rainfall and stream flow losses, gradually infiltrating the mid-Hawkesbury Sandstone aquifer.

Groundwater recovery identified in the upper and mid Hawkesbury Sandstone aquifers confirms a potential for recovery at monitoring site CB. This is following the triggering of TARP Level 3 at monitoring site CB during October 2021 and early November 2021, suggested to be a delayed mining effect due to subsidence over LW W2. It is difficult to assess if drawdown alone was causing the reduction at monitoring site CB, however, if fracturing in the subsurface has occurred it seems that flood events in early 2022 have contributed to fill the increased storage (i.e. pore space) in the Hawkesbury Sandstone aquifer and could have improved baseflow conditions at monitoring site CB.

The medium-term impact previously identified on shallow groundwater levels at site P16A is difficult to assess at the end of the reporting period to potential surface run-off ingress, showing a rise in water levels of 1.2m and not representative of groundwater condition. Further monitoring at P16A and P40 is required to confirm groundwater trends, and whether recovery is complete and sustained, especially during periods of below average rainfall condition. This will then confirm whether hydrogeological conditions near CB have returned to pre-mining conditions and whether baseflow has improved.

Private bores

From available information, there is no depressurisation identified at private bores with available groundwater levels and therefore no groundwater level exceedances are recorded at these locations. Further monitoring at private bores will be undertaken in April 2022 to confirm trends and identify whether the early part of LW W4 extraction has any effect on groundwater levels.

In terms of yield and groundwater level at the private bores, the following observations are noted over the reporting period (to January 2022):

- GW105228: There was no significant change in groundwater yield at GW105228 that could impede groundwater use in January 2022. In January 2022, groundwater yield was recorded between 2.0-2.1 L/sec compared to 1.82 L/sec during the baseline period (GeoTerra, 2019). As of January 2022, groundwater levels are observed within baseline level. TARP Level 1 applies;
- GW115860: There was no significant change in groundwater yield at GW115860 that could impede groundwater use in January 2022. In January 2022, groundwater yield at this location is recorded between 2.0-2.05 L/sec compared to 2.3 L/sec during the baseline period. As of January 2022, groundwater levels are observed within baseline level. TARP Level 1 applies;
- GW105467: In January 2021 the bore yield at GW105467 has declined from 0.67 L/s to 0.38 L/s in July 2021. A TARP Level 2 was applied at GW105467 as the lowest groundwater yield during the baseline period was 0.47 L/s in March 2019 and during the severe NSW drought. This bore is not actively used for groundwater extraction and no site access was possible in October 2021 and January 2022. Further monitoring is planned at this location; and
- There was no site access at GW105546 throughout the reporting period, hence the assessment of trigger assessment exceedances at this location was not possible.

4.2.7 Groundwater Pressures

Four VWP arrays have been installed at locations TNC36, TNC40, TNC43 and WD01 (refer to **Figure 4-6**).

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 2.2.6** and **Section 2.2.7**.

Shallow VWPs

The LW W3 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain.

A period of stable groundwater level was identified between October and February 2021 in the upper Hawkesbury Sandstone aquifer at TNC36 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m.

From February 2022, groundwater recovery in the Hawkesbury Sandstone aquifer improved at TNC036 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m. The rate of recovery accelerated in late February 2022 at all monitoring sites. The groundwater recovery is associated with the completion of LW W3, and the exceptional wetter condition in February-March 2022.

Deep VWPs

The LW W3 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain.

Deeper strata at TNC036 (BGSS-214m) shows depressurisation as of March 2022 with an ongoing clear depressurisation in BUSM-412m (i.e. due to Tahmoor mine and regional mining), as expected for deep strata near to a longwall, within a magnitude that exceed the predicted modelled drawdown (+ 15-20 m of observed).

4.2.8 Mine Water Intake

Tahmoor Coal has 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 vented in and out of the mine (water in vented air), and moisture in coal extracted from the mine.

SLR completed an analysis of water make for Tahmoor Mine recorded between 1 January 2009 to 31 March 2022 (**Appendix C**). 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.

The period between mid-2020 shows an increase in inflows to greater than 5 ML/day at the end of July 2020 likely due to the extraction of LW W1. Inflows declined in late 2020, before rising in February 2021 (early in LW W2), with the recent peak at marginally over 6 ML/d in March and April 2021 (**Figure 4-7**). Inflows to the Western Domain are not metered in isolation from other parts of Tahmoor North but were estimated to be greater than 2.5 ML/d in early 2021 (based on advice from Tahmoor Coal staff in early 2021).

The increase in mine inflow in the Western Domain between the months of April-May 2021 has been discussed with Tahmoor Coal staff and consultants. Other than the minor fault observed in the southern section of LW W1 and LW2, no other obvious geological structures have been noted as intersecting current longwalls. The faults on the north-eastern edge of LW W4 were mapped with major splays 1000 m from LW W4. Following this, investigations of the hydraulic properties within the lower fault zone were conducted within P41. The measured hydraulic properties within this zone were not abnormal and within those measured elsewhere at Tahmoor Mine.

During LW W3 and as of March 2022, the average inflows to the mine have been 4.3 ML/d, remaining below the average entitlement of 4.5 ML/d. A consistent increase in inflow is observed between November 2021 and February 2022 from 3 ML/d to 5.5 ML/d likely attributed to LW W3 extraction. Mine inflow reduced to 3.5 ML/d in early March 2022 before rising back to 5.3 ML/d at the completion of LW W3.

The latest observations confirm that during extraction of LW W3 groundwater inflow to the mine stayed within ranges previously observed which suggest that no additional inflow to the mine was driven from the faults mapped in the Nepean Fault Complex. During extraction of LW W4, it is expected that groundwater inflow to the mine will remain within similar ranges previously observed. This is if subsidence above and adjacent to LW W3-W4 remain within predictions and mobilisation of fault structures do not occur due to longwall subsidence.

Groundwater entitlement was not exceeded for the 2021-22 water year and as of March 2022 remain just below the limit for the 2021-22 water year (based on a pro-rata calculation).

Tahmoor Coal is currently in the process of obtaining additional groundwater entitlement to meet the likely requirements of the remaining Western Domain and early Tahmoor South mining operations.

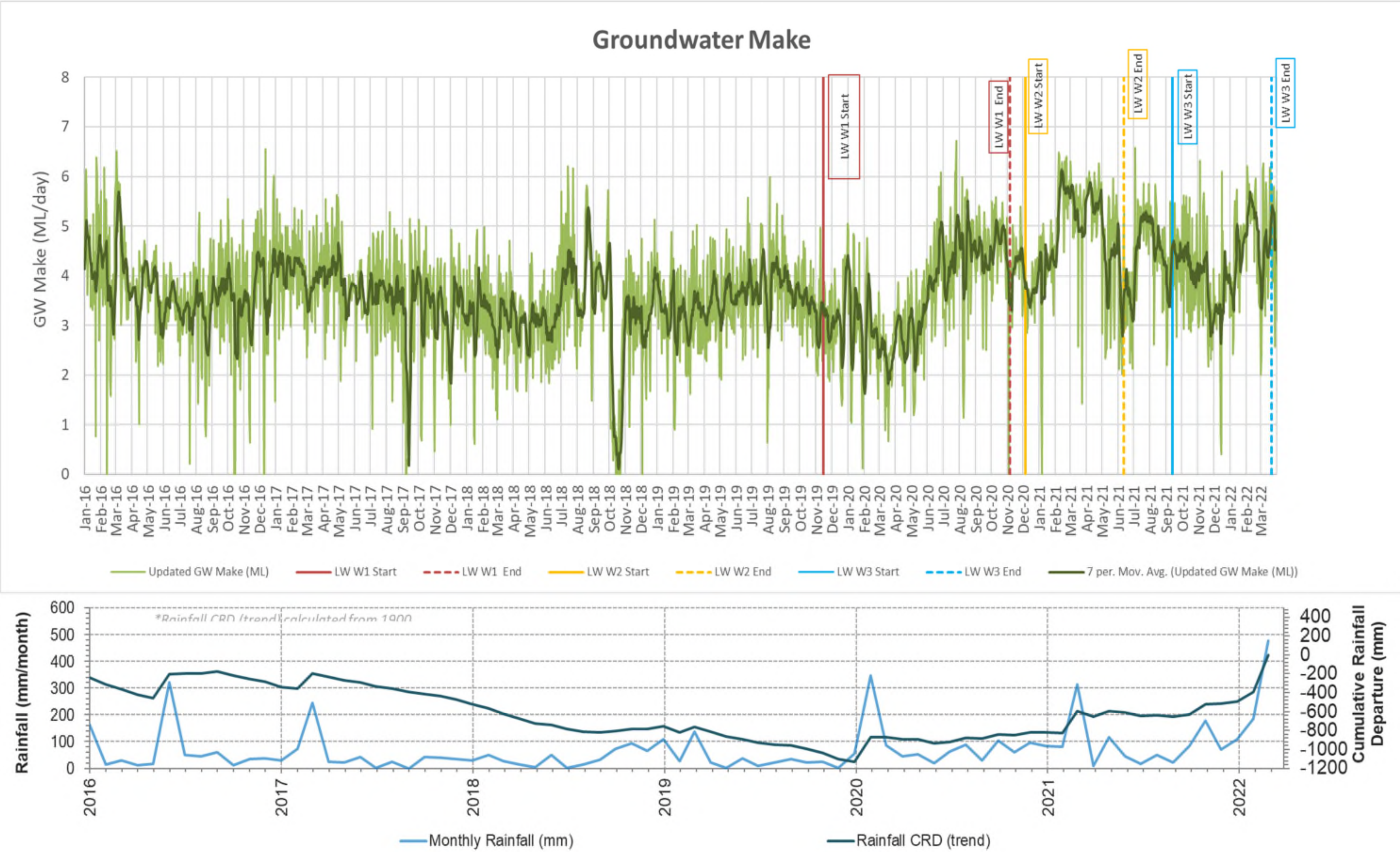


Figure 4-7 *Historical record of inflows at Tahmoor Mine (source SLR, Groundwater Monitoring Report, Appendix C)*

4.3 Land Monitoring

The LW W3-W4 Land Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 extraction on steep slopes, dams, agricultural land, and land in general in accordance with Condition 13H(vii)(e) of DA 67/98. In addition, monitoring of cliffs and rock outcrops in the LW W1-W2 Study Area in accordance with the LW W1-W2 Land Management Plan

During this reporting period, the LW W1-W2 Land Management Plan and LW W3-W4 Land Management Plan have been implemented to monitor the following landscape features:

- Cliffs and rock outcrops – 3-monthly visual inspections and reporting by geotechnical engineers from Douglas Partners;
- Steep slopes, and dams – monthly visual inspections and reporting by geotechnical engineers from Douglas Partners;
- Stonequarry Sewage Treatment Plan retention basin (Dam FD7) – weekly visual inspections and reporting by Newcastle Geotechnical;
- Dams in active subsidence zone – weekly visual inspections and reporting by Building Inspection Services; and
- Agricultural land – monthly visual inspections and reporting by 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 every three months in accordance with the LW W1-W2 Land Management Plan. The purpose of the surveys is to note any new instabilities in the cliff structures that have occurred since the commencement of LW W1-W2 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 LW W1-W2 Study Area are illustrated in **Figure 4-8**.

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.

As there are no cliffs or rock outcrops within the LW W3-W4 Study Area (refer to **Figure 4-9**), no monitoring of these features has been completed during the extraction of LW W3.

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 W3-W4 active subsidence zone. The locations of steep slopes within the LW W3-W4 Study Area are illustrated in **Figure 4-9**.

During the reporting period, structures located on Stonequarry Creek Road, Booyong Close, Attunga Close and Waste Water Treatment Plant (WWTP) 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 W3-W4 active subsidence zone. The location of dams within the LW W3-W4 Study Area are illustrated in **Figure 4-10**.

During the reporting period, the dams monitored were considered to be within the normal ranges as defined in the TARP for dams.

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 W3-W4 active subsidence zone. Inspections points were set up prior to the commencement of LW W3 mining to provide vantage of agricultural land within the LW W3-W4 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 LW W3-W4 Study Area are illustrated on **Figure 4-11**.

During the reporting period, it was noted that seasonal changes had affected vegetation growth, however there were no observable changes to agricultural land in comparison to pre-mining baseline data.

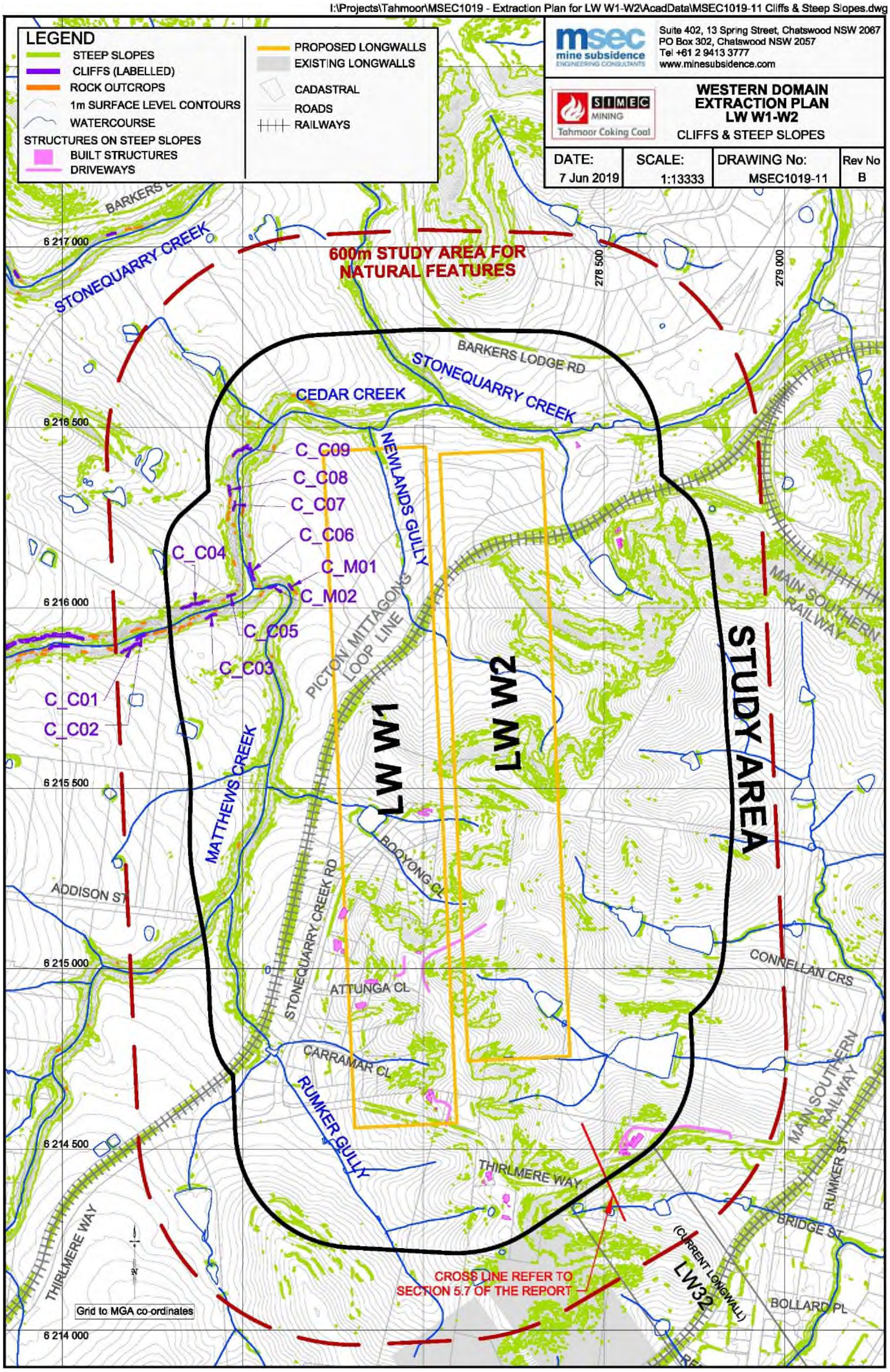


Figure 4-8 Cliffs, rock outcrops and steep slopes within the LW W1-W2 Study Area (source: MSEC, 2019 - LW W1-W2 Subsidence Predictions and Impact Assessment Report)

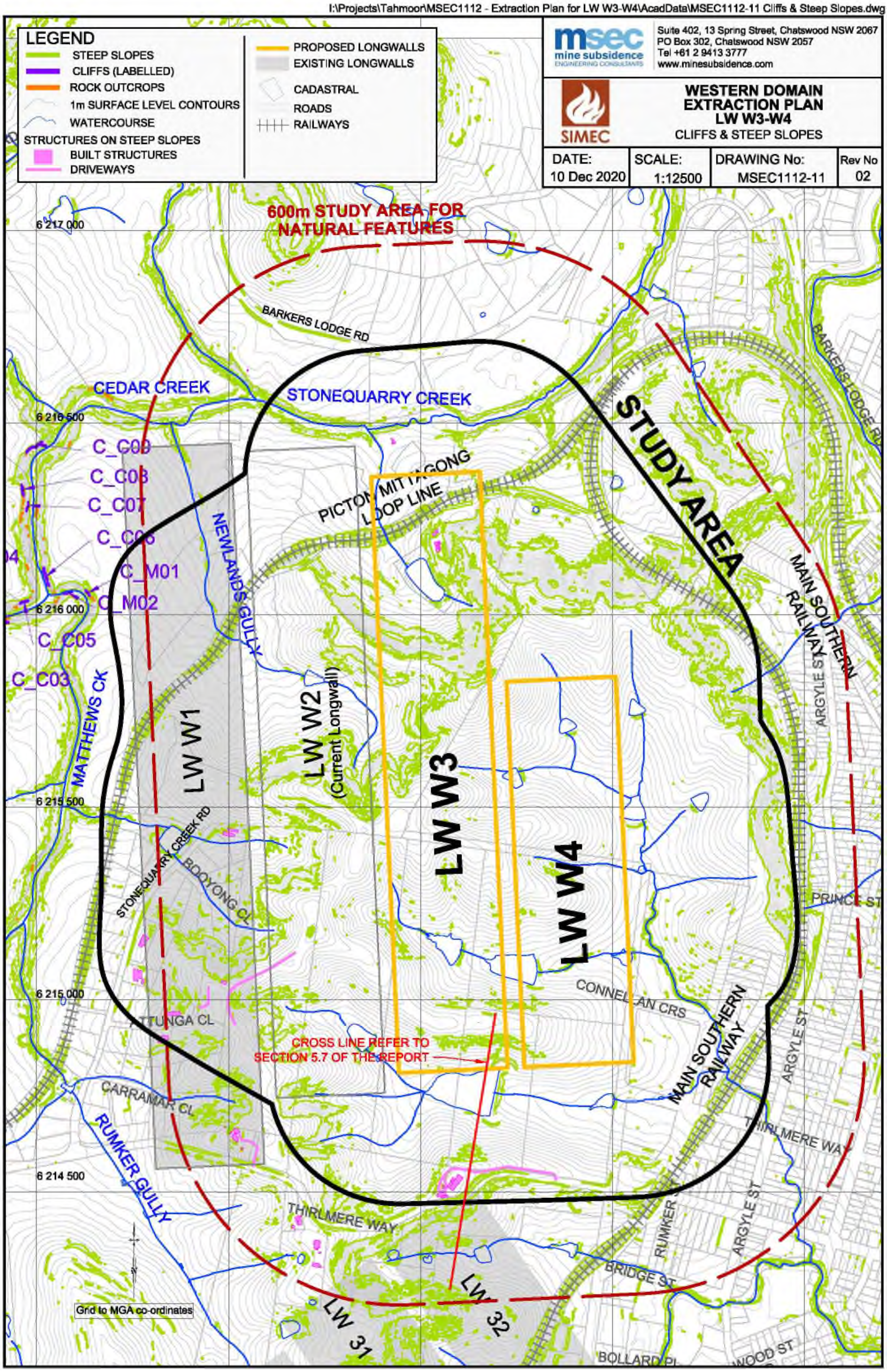


Figure 4-9 Steep slopes within the LW W3-W4 Study Area (source: MSEC, 2021 - LW W3-W4 Subsidence Predictions and Impact Assessment Report)

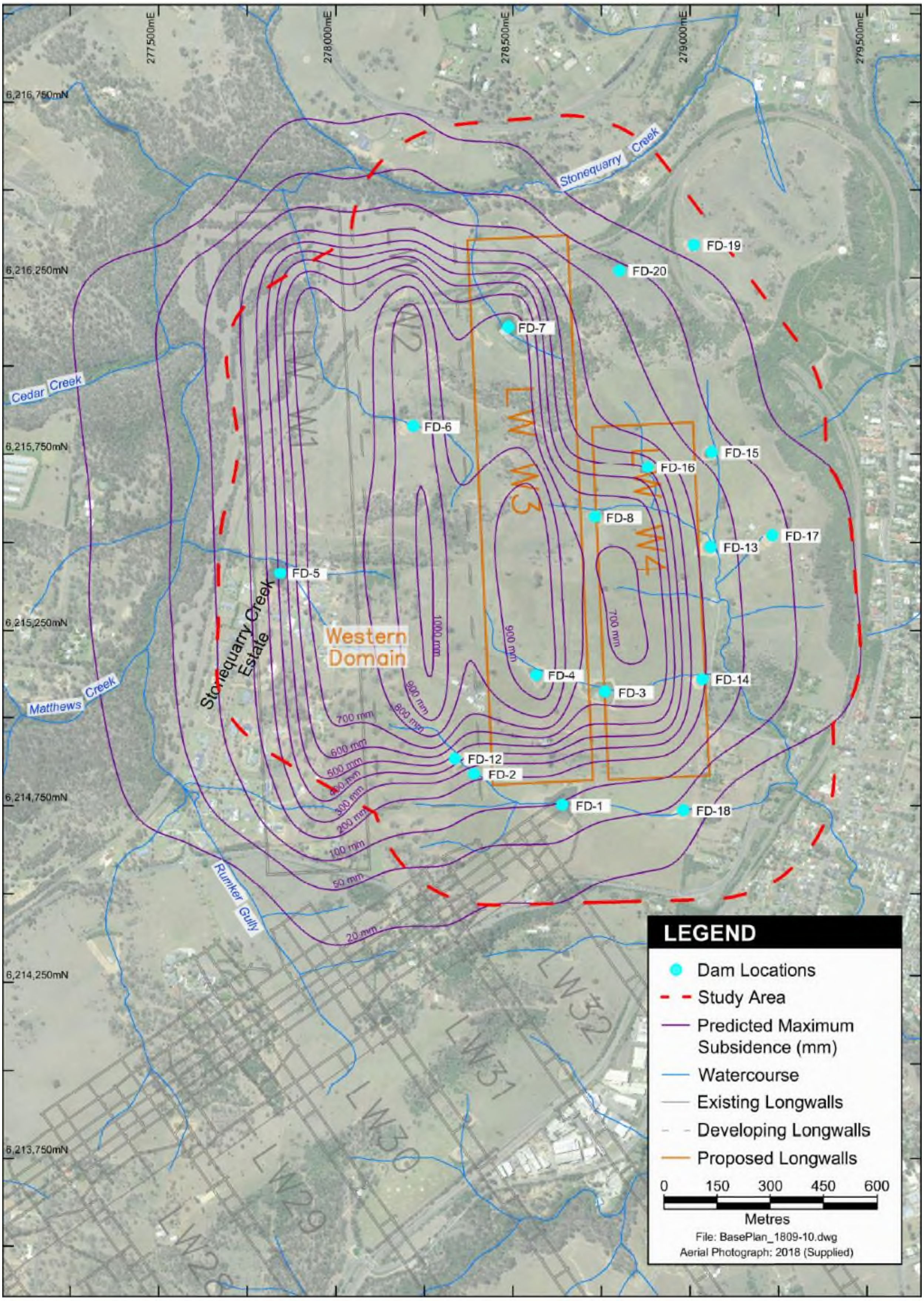


Figure 4-10 Dams within the LW W3-W4 Study Area (source: LW W3-W4 Water Management Plan)

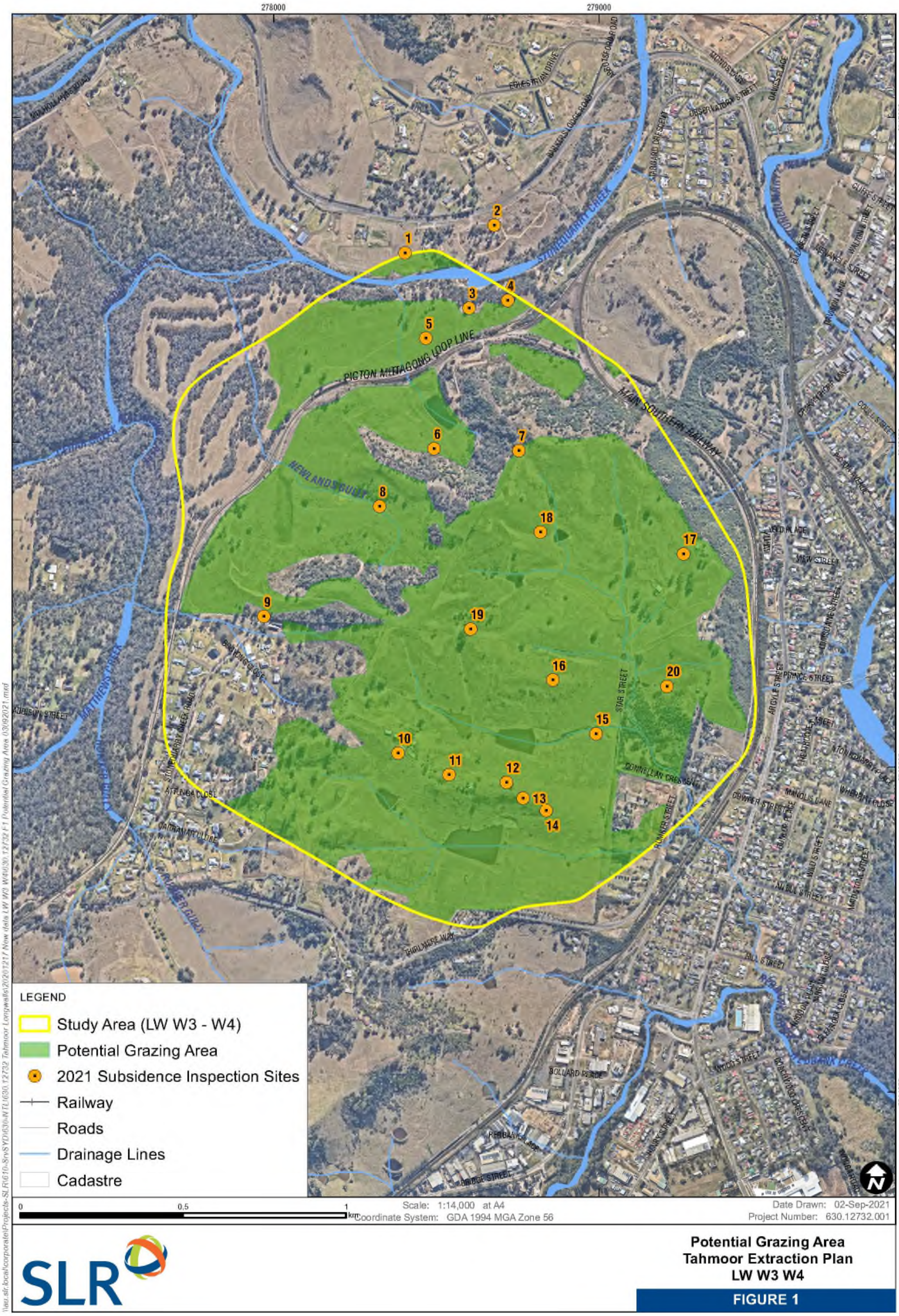


Figure 4-11 Agricultural land and inspection points within the LW W3-W4 Study Area (source: SLR Agricultural Subsidence Monitoring LW W3-W4 Report (SLR, 2021))

4.4 Biodiversity Monitoring

The LW W3-W4 Biodiversity Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 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 and LW W3-W4 Biodiversity Management Plan have been implemented to monitor ecology in the Study Area, as outlined below:

- Aquatic ecology – macroinvertebrate monitoring during Autumn 2021 by Niche Environment and Heritage; and
- Terrestrial ecology – amphibian and riparian vegetation monitoring during Autumn 2021 by Niche Environment and Heritage.

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 W3-W4 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;
- 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 sixteen 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 4-12**.

Autumn 2022 Monitoring Results

Aquatic monitoring for autumn 2022 was conducted by Niche Environment and Heritage in March 2022. The following results were observed for Autumn 2022 monitoring:

- There was aquatic habitat present at all sites in autumn 2022;
- All sites had similar riparian and channel condition prior to pre-mining sampling, except for SQC4 which has been subject to habitat modifications a result of causeway construction by a landowner;
- AUSRIVAS OE50 scores were generally comparable to pre-mining stream surveys, despite fluctuations in scores and associated Bands in autumn 2022 when compared to spring 2021;
- SIGNAL2 scores were low but were comparable to pre-mining scores and indicated more moderate levels of pollution or environmental stress in autumn 2022 than in recent surveys;
- Ephemeroptera Plecoptera Trichoptera (EPT) scores at all sites were similar or slightly increased when compared to pre-mining surveys;
- Number of taxa were within the range of pre-mining results but were generally slightly reduced when compared to recent surveys, which is anticipated in seasons of elevated flows;

- The macroinvertebrate assemblages showed variability spatially (site level) and temporally (between surveys); and
- The assemblage results in autumn 2022 were different to those of previous surveys, reflecting the prevailing elevated flows and associated changes in habitats present.

No thresholds within the Aquatic Ecology TARPs in the LW W3-W4 Biodiversity Management Plan were triggered for Spring 2021 monitoring, and therefore, no remedial management actions are required.

4.4.2 Terrestrial Ecology

The terrestrial ecology monitoring program for LW W3-W4 has been designed to monitor subsidence-induced impacts on terrestrial ecology including riparian vegetation and amphibian monitoring. 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:
  - Spotlighting;
  - Call provocation;
  - Listening for diagnostic frog calls; and
  - Tadpole identification.

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

A total of eight locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of four impact sites and five control sites. The locations of monitoring sites are illustrated in **Figure 4-13**.

Spring 2021 Monitoring Results

Riparian vegetation monitoring for Spring 2021 was conducted by Niche Environment and Heritage between 24-26 November 2021, and amphibian monitoring for Spring 2021 was conducted between 15-22 November 2021.

The following results were observed for Spring 2021 monitoring:

Riparian monitoring:

- River-flat Eucalypt Forest, which is listed as an EEC under the BC Act, was recorded at control Site 9 and impact Site 11, along Stonequarry Creek;
- Spring 2021 impact Sites had a slightly higher mean flora species richness than control Sites. However, control Sites had higher percentage vegetation cover than Impact Sites. This is likely due to persistent rainfall patterns, human disturbance and altered flow regimes increasing weed dominance at control Sites; and
- Sites 3, 7, 8 and 9 tended to have higher soil fertility and organic matter loads, which lead to higher species diversity and generally more exotic species. These Sites appeared to be more influenced by seasonal changes and flooding events (e.g. witnessed in 2020 and 2021) than Sites further up the catchment (Sites 4, 5, 6 and 10) which tended to be protected in deep gullies and canyons.

Amphibian monitoring:

- Amphibian detection rates were variable between Before and After monitoring for most Sites. In Spring 2021, the most widespread and abundant amphibian species was the Common Eastern

- Froglet (*Crinia signifera*), which was detected at all but one of the Sites. Striped Marsh Frog (*Limnodynastes peronii*) and Stony Creek Frog (*Litoria lesueuri*) were both detected at five of the nine Sites, three of which are impact Sites (Sites 3, 4 and 5). The greatest number of amphibians detected was at Site 7 with 43 Common Eastern Froglet individuals recorded;
- There was no significant difference in species diversity between control Sites and impact Sites;
- The six amphibian species detected represent an otherwise normal assemblage of common species that may be expected to be present in the Study Area under the current climatic conditions;
- The targeted threatened amphibian species were not detected during the survey and appear not to be present in the Study Area, at least not in numbers that can be detected by the current monitoring program. While the Study Area contains superficially suitable habitat, it is possible that the species would no longer be able to survive in the area due to predation pressures from two introduced predators: the Plague Minnow and the Yabby, both of which were detected at all Sites;
- The amphibian community present contains at least six species which are likely still viable indicators of impending or current environmental change; and
- Amphibian detection rates fluctuated between monitoring events for most Sites, likely due to the highly variable weather and climatic conditions experienced across all monitoring events.

No thresholds within the Terrestrial Ecology TARPs in the LW W3-W4 Biodiversity Management Plan were triggered for Spring 2021 monitoring, and therefore, no remedial management actions are required.

Autumn 2022 Monitoring Results

Riparian vegetation monitoring for Autumn 2022 was conducted by Niche Environment and Heritage between 21-26 April 2022, and amphibian monitoring for Autumn 2022 was conducted between 11-19 April 2022.

The following results were observed for Autumn 2022 monitoring:

Riparian monitoring:

- River-flat Eucalypt Forest, which is listed as an EEC under the BC Act, was recorded at control Site 9 and impact Site 11, along Stonequarry Creek;
- Autumn 2022 impact Sites had a slightly higher mean flora species richness than control Sites. However, control Sites had higher percentage vegetation cover than impact Sites. This is likely due to persistent rainfall patterns, stream morphology, human disturbance and altered flow regimes (e.g., flood events) increasing weed dominance at control Sites;
- Sites 3, 5, 6, 7, 8 and 9 appeared to be more influenced by seasonal changes and flooding events (e.g. witnessed in 2020, 2021 and 2022) than Sites further up the catchment (Sites 4, 10 and 11) which tended to be protected in deep gullies and canyons; and
- Statistical analyses identified a significant difference between vegetation cover for 'After' data between control and impact Sites, specifically, Autumn 2021 and Autumn 2022. Given that there were noticeable reductions in vegetation cover across control Sites 6, 7, 8 and 9, as well as impact Site 5, impacts cannot be attributed to mining. Based on stream morphology, persistent rainfall during the La Niña climatic period, and other associated factors, these Sites appeared to be heavily affected by the recent (March 2022) flooding event (e.g., destabilisation of the embankments, loss of riparian vegetation and large accumulation of flood debris). Continuation of monitoring is recommended to observe the recovery of vegetation cover with time, at impact and control Sites post-natural disaster event.

Amphibian monitoring:

- Amphibian detection rates were variable between Before and After monitoring for most Sites. In Autumn 2022, the most widespread and abundant amphibian species was the Common Eastern Froglet (*Crinia signifera*), which was detected at all but two of the Sites. Stony Creek Frog (*Litoria lesueuri*) was detected at two of the nine Sites, one of which is an impact Site (Sites 3). The greatest number of amphibians detected were at Site 11 (impact) with 35 Common Eastern Froglet individuals recorded;
- For all Autumn data, there was a significant difference in amphibian assemblages at the control Sites and impact Sites, and a significant difference in amphibian assemblages Before and After. There was also a significant BACI interaction for amphibian assemblages. This means the 'Impact' had a significantly different effect on control Sites, when compared with impact Sites. However, amphibian numbers appear to have increased at impact Sites (After), while control Sites appear to have a similar number of individuals for before and after. Given amphibian numbers are increasing at impact Sites, the BACI interaction for this round of monitoring appears not to be a viable indicator of mining impacts;
- The two amphibian species detected represent an otherwise normal assemblage of common species that may be expected to be present in the Study Area under the current climatic conditions;
- The targeted threatened amphibian species were not detected during the survey and appear not to be present in the Study Area, at least not in numbers that can be detected by the current monitoring program. While the Study Area contains superficially suitable habitat, it is possible that the species would no longer be able to survive in the area due to the impact of the multiple flooding events that have occurred over the past three years, including a major flooding event that preceded the Autumn 2022 surveys. Predation pressures from two introduced predators: the Plague Minnow and the Freshwater Crayfish (*Cherax destructor*), both of which were detected at all Sites, may also be impacting on the suitability of the habitat for these threatened frogs; and
- Amphibian detection rates fluctuated between monitoring events for most Sites, likely due to the highly variable weather and climatic conditions experienced across all monitoring events.

No thresholds within the Terrestrial Ecology TARPs in the LW W3-W4 Biodiversity Management Plan were triggered for Autumn 2022 monitoring, and therefore, no remedial management actions are required.

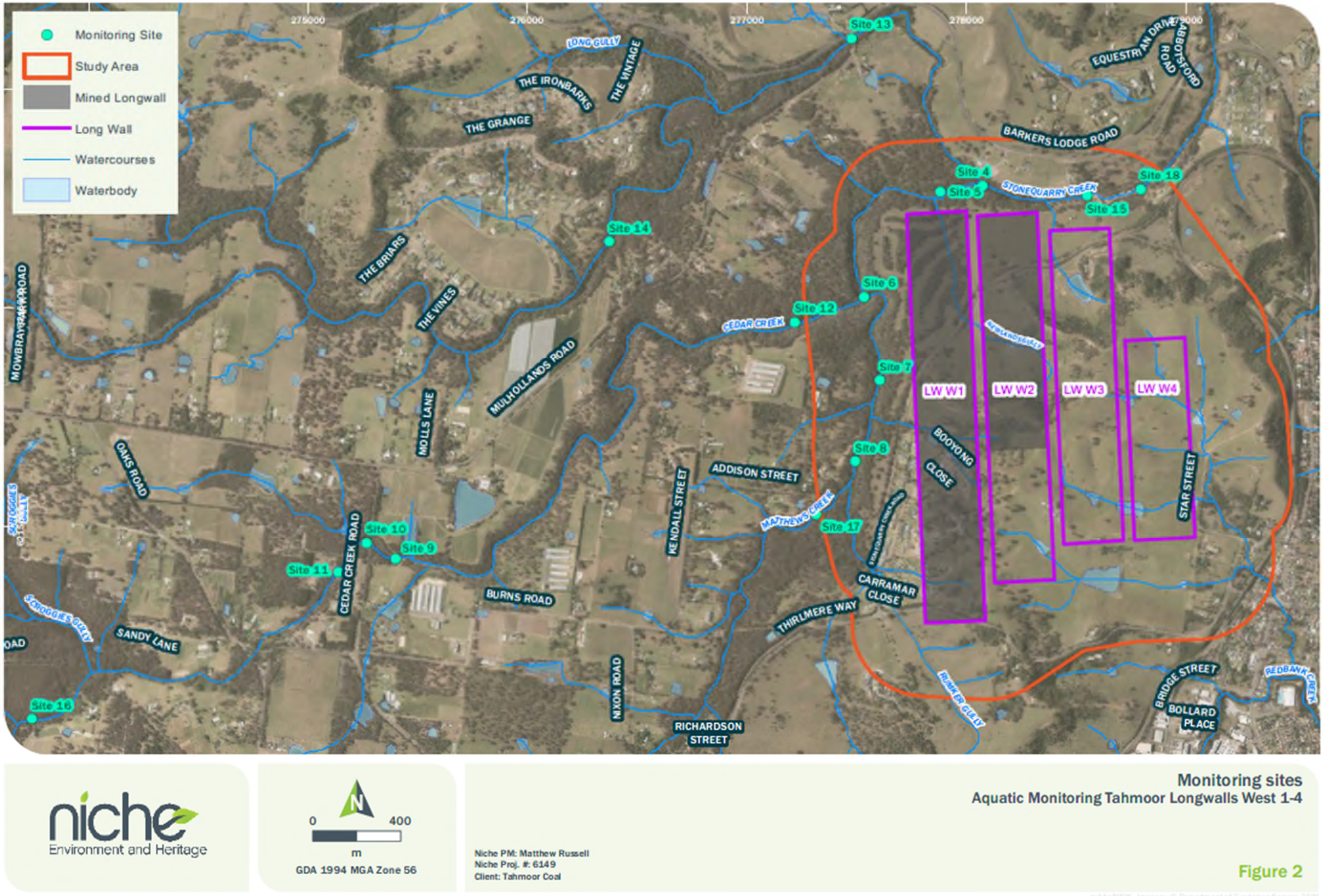


Figure 4-12 LW W1-W4 Aquatic Ecology Monitoring Locations (source: Niche, 2022a)

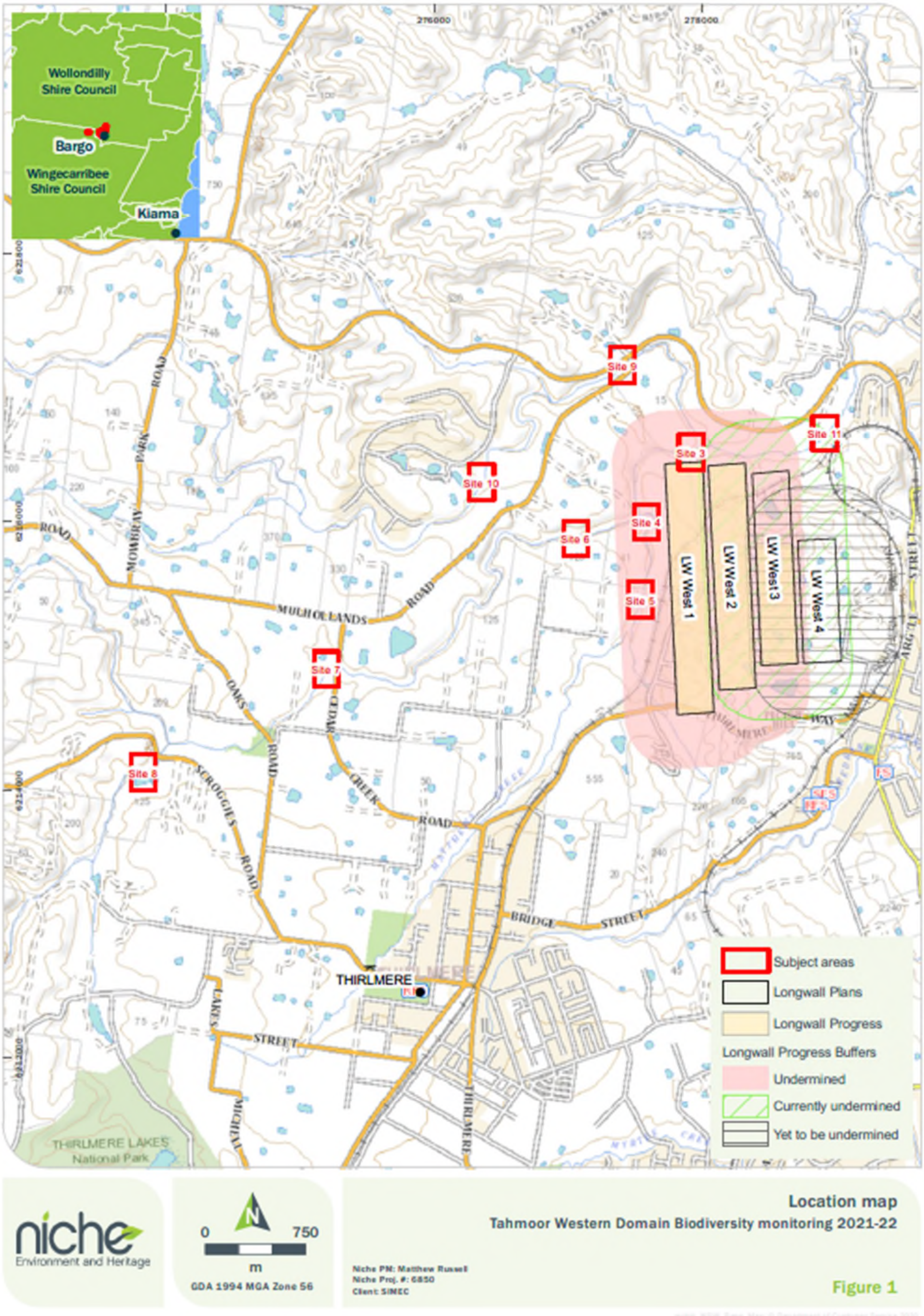


Figure 4-13 LW W1-W4 Terrestrial Ecology Monitoring Locations (source: Niche, 2022b)

4.5 Heritage Monitoring

The LW W3-W4 Heritage Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 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 W3-W4 Heritage Management Plan and the LW W3-W4 Stonequarry Creek Rockbar Management Plan has been implemented to monitor subsidence impacts for the following heritage items:

- Aboriginal heritage:
  - Grinding grooves:
    - Monthly review of GNSS unit movements by MSEC (refer to **Appendix A** for referenced reports);
    - Weekly or more frequent monitoring of the SR17 Rockbar in accordance with the Stonequarry Creek Rockbar Management Plan (refer to **Appendix F** for referenced reports);
    - End of panel review of items by an EMM Archaeologist and a RAP representative (EMM, 2022a);
  - Scarred Tree – end of panel review of items by an EMM Archaeologist and a RAP representative (EMM, 2022a);
- Historical heritage:
  - Sandstone and brick culverts along the PMLL:
    - Weekly visual inspection by Newcastle Geotechnical; and
    - End of panel review of items by an EMM Archaeologist (refer to **Appendix E**; EMM, 2022b).

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

Archaeological Item Review

An end of panel monitoring inspection following LW W3 extraction was carried out by an EMM archaeologist and a RAP representative on 26 April 2022, and the findings of this inspection reported in an end of panel report (EMM, 2022a). The focus of the fieldwork was to conduct archaeological monitoring of Aboriginal sites associated with the underground coal mining of LW W3 after completion of its panel extraction in the Tahmoor Mine Western Domain. The locations of Aboriginal heritage items within the Study Area of LW W3-W4 are illustrated in **Figure 4-14**.

In accordance with the subsidence monitoring program, the inspection related to one grinding groove site and one modified tree. The six open artefact sites do not require monitoring.

The grinding groove site (AHIMS #52-2-2068) has been monitored during LW W3 extraction through the GNSS units and various other monitoring strategies as outlined in the Stonequarry Creek Rockbar Management Plan. Three triggers to the Stonequarry Creek Rockbar TARPs were noted during the reporting period, as discussed in **Section 2.2.9**. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40 m downstream of the nearest grinding grove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

During the end of panel inspection, no subsidence related impacts were observed to any of the Aboriginal sites inspected, and as such no additional management strategies are required.

4.5.2 Historical Heritage

EMM consultants completed an end of panel monitoring inspection on 5 April 2022 focused on the eight historical brick and sandstone culverts within the Study Area of LW W3-W4 (**Appendix E**). The locations of historical heritage items are illustrated in **Figure 4-15** and **Figure 4-16**.

During the extraction of LW W3, the culverts have been continuously monitored at weekly intervals by Mark Delaney, principal engineering geologist at Newcastle Geotech, as part of the subsidence monitoring program.

As discussed in **Section 2.2.8** of this report, visual inspections during the previous reporting period noted the development of a number of cracks and spalling of sandstone blocks on sandstone culverts at 88.400 km and 88.980 km along the Picton-Mittagong Loop Line. The end of panel inspection confirmed that impacts to the two culverts had triggered a Level 3 TARP trigger for historical heritage in accordance with the LW W1-W2 Heritage Management Plan.

Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit with DPE was completed on 12 April 2022. A warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979.*

Rehabilitation of the two culverts will be undertaken after the full effects of LW W4 have been completed. A works program for the rehabilitation of the two culverts was submitted to DPE on 10 May 2022, as well as a report on the proposed rehabilitation methodology. All repair work on the impacted heritage structures will be completed as prescribed in the TfNSW Structures Repair Standard TMC302.

Tahmoor Coal has approached a number of heritage stonemasons to seek input into the repair methodology for the sandstone culverts. However, to date, no contributions have been received. Tahmoor Coal provided the rehabilitation methodology to the Heritage Division of TfNSW on 19 May 2022.

During the current reporting period, it was confirmed that no new impacts to the culverts have been observed during the monitoring throughout the extraction of LW W3, and the end of panel heritage inspection confirmed that no additional cracking, worsening of existing cracks or spalling had occurred (**Appendix E**).

No other impacts to historical heritage were observed during this reporting period.

SIMEC

This information has been retracted

- For more information contact Tahmoor Coal

Figure 4-15 Historical Heritage Sites (registered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)

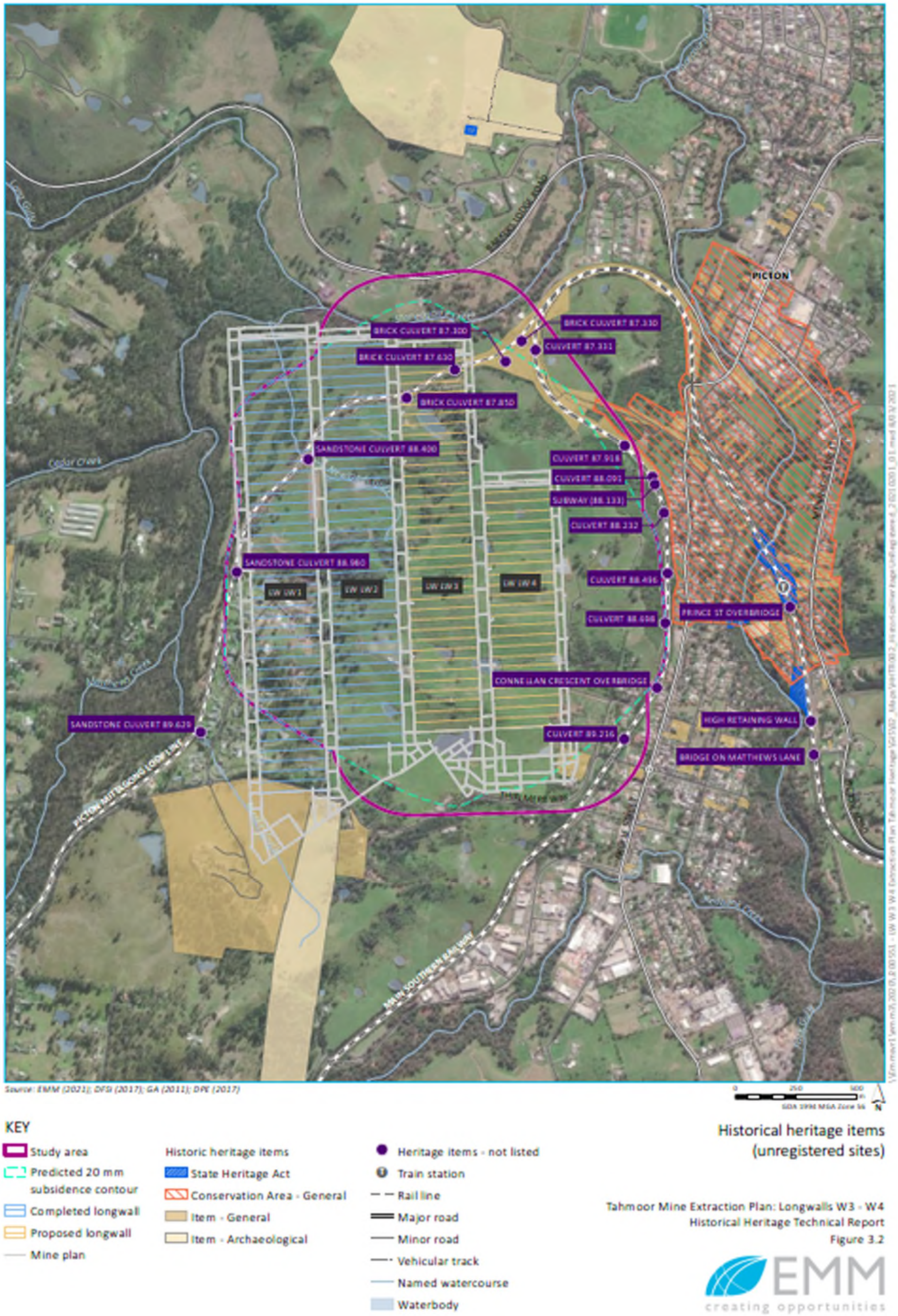


Figure 4-16 Historical Heritage Sites (unregistered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)

4.6 Built Features Monitoring

The LW W3-W4 Built Features Management Plan and associated sub-plans were prepared to manage the potential environmental consequences of LW W3-W4 extraction on built features in accordance with Condition 13H(vii)(b) of DA 67/98.

During this reporting period, the LW W3-W4 Subsidence Monitoring Program have been implemented to monitor subsidence impacts on infrastructure owned by Endeavour Energy (electrical infrastructure), Sydney Water (potable water infrastructure and sewer 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), Weatherboard House (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 3 of the MSEC LW W3 Subsidence Monitoring Report 27 (refer to **Appendix A**).

A number of impacts to local roads and built structures occurred during the reporting period as a result of subsidence from LW W3 extraction (as discussed in **Section 2.2.11**). These impacts are focused within the Stonequarry Estate and along Thirlmere Way and can be summarised as:

- Stonequarry Creek Road - impacts to kerb drain (January 2022) and a property (March 2022);
- Connellan Crescent - impacts to road surface (March 2022);
- Carramar Close - impacts to road surface (March 2022);
- Booyong Close - impacts to a property (March 2022); and
- Thirlmere Way - impacts to road surface (March 2022).

The impacts to the road surfaces was noted to be largely attributed to the large rain event from the end of February to early March 2022.

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

Three Blue Level Triggers were noted on the Main Southern Railway during the reporting period (as discussed in **Section 2.2.10**), however these changes were also attributed to rainfall events rather than mine subsidence.

The two sandstone culverts that have been impacted by subsidence will continue to be monitored in accordance with the rail subsidence management plan. Following the full effects of LW W4, the sandstone culverts will be remediated.

Very gradual and minor closure was observed to develop across Stonequarry Creek at Victoria Bridge, which is located approximately 1000 metres from LW W3. The timing of the closure coincided with the final stages of mining LW W3, a period of heavy rainfall and completion of abutment strengthening works by TfNSW. Inspections were conducted by a structural engineer and bridge maintenance engineers from TfNSW. While no immediate concerns were observed, the gap between the bridge deck and the eastern abutment was observed to almost close. TfNSW is currently arranging to reinstate the gap prior to the influence of LW W4.

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

4.7 Public Safety Monitoring

The LW W3-W4 Public Safety Management Plan were prepared to manage the potential consequences as a result of LW W3-W4 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 and LW W3-W4 Land Management Plan (refer to **Section 4.3** 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 W3-W4 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), Draft Guidelines for the Preparation of Extraction Plans V5.

EMM Consulting (2022a), Aboriginal heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End Of Panel Monitoring Inspection.

EMM Consulting (2022b), Historical heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End of Panel Monitoring Inspection.

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.

Mine Subsidence Engineering Consultants (MSEC) (2021), Tahmoor Coal – Longwalls W3 and W4, Subsidence Predictions and Impact Assessments for Natural and Built Features due to the Extraction of the Proposed Longwalls W3 and W4 in Support of the Extraction Plan Application. Prepared for Tahmoor Coal, March 2021, document MSEC1112.

Niche (2022a), Aquatic Ecology Monitoring Report 2017-2022, report to Tahmoor Coal, 17 June 2022.

Niche (2022b), Terrestrial Ecology Monitoring Report, Riparian vegetation and amphibian monitoring Spring 2022, report to Tahmoor Coal, 7 June 2022.

SLR (2021), Agricultural Subsidence Monitoring LW W3-W4, letter report to Tahmoor Coal, 26th August 2021, document 630.12953.001

<u>Tahmoor Coal Documents:</u>

- Extraction Plan LW W3-W4 Extraction Plan Main Document, TAH-HSEC-326
- Extraction Plan LW W3-W4 Water Management Plan, TAH-HSEC-328
- Extraction Plan LW W3-W4 Land Management Plan, TAH-HSEC-330
- Extraction Plan LW W3-W4 Biodiversity Management Plan, TAH-HSEC-325
- Extraction Plan LW W3-W4 Heritage Management Plan, TAH-HSEC-331
- Extraction Plan LW W3-W4 Stonequarry Creek Rockbar Management Plan, TAH-HSEC-352
- Extraction Plan LW W3-W4 Built Features Management Plan, TAH-HSEC-332
- Extraction Plan LW W3-W4 Public Safety Management Plan, TAH-HSEC-333
- Extraction Plan LW W3-W4 Subsidence Monitoring Program, TAH-HSEC-329

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. 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.

Term	Definition
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
BGSS	Bargo Sandstone
BIS	Building Inspection Service
CTF	Cease to flow
DA	Development Approval
DRNSW	Department of Regional NSW
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
EC	Electrical conductivity
EPA	NSW Environment Protection Authority
EPT	Ephemeroptera Plecoptera Trichoptera scores
GFG	GFG Alliance
GNSS	Global Navigation Satellite System units
HBSS	Hawkesbury Sandstone
HEC	Hydro Engineering and Consulting, now ATC Williams
Km	Kilometres
LW W1	Longwall West 1
LW W1-W2	Longwall West 1 to West 2
LW W2	Longwalls West 2
LW W3	Longwall West 3
LW W3-W4	Longwalls West 3 to West 4
LW W4	Longwall West 4
m	metres
mbgl	Metres below ground level

Abbreviation	Definition
mg/L	Milligrams per litre
ML	Mining Lease
mm	millimetre
MSEC	Mine Subsidence Engineering Consultants
MSR	Main Southern Railway
NRAR	NSW Industry – Land & Water – Natural Resources Access Regulator – East
NSW	New South Wales
OE	Observed expected score
OSP	Open Standpipe Piezometers
pH	pH units
PMLL	Picton-Mittagong Loop Line railway
RCE	Riparian Channel and Environment Inventory
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TDS	Total dissolved solids
TfNSW	Transport for NSW
VMP	Vibrating Wire Piezometer
WWTP	Waste water treatment plant

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
DPE - Planning	(Planning Portal)	(Planning Portal)	(https://www.planningportal.nsw.gov.au/major-projects)
	Jessie Evans	Director – Resource Assessments	Jessie.evans@planning.nsw.gov.au
	Gabrielle Allan	Team Leader	Gabrielle.Allan@planning.nsw.gov.au
DPE - Resources Regulator (Subsidence)	(General email)	(General email)	subsidence.monitoring@planning.nsw.gov.au nswresourcesregulator@service-now.com
	Dr. Gang Li	Principal Subsidence Engineer	subsidence.monitoring@planning.nsw.gov.au
DRNSW – Mining Exploration and Geoscience	(General email)	(General email)	resource.operations@planning.nsw.gov.au

Agency	Contact Person	Position	Electronic Copy
DRNSW – Resources Regulator – Mining Act Inspectorate	(General email)	(General email)	nswresourcesregulator@service-now.com
	Greg Kininmonth	Manager Environmental Operations (Southern)	greg.kininmonth@planning.nsw.gov.au
Wollondilly Shire Council	(General email)	(General email)	council@wollondilly.nsw.gov.au
	Bianca Klein	Acting Manager Waste and Environmental Services	alexandra.stengl@wollondilly.nsw.gov.au
	David Henry	Acting Team Leader Environmental Services	david.henry@wollondilly.nsw.gov.au
Subsidence Advisory NSW	(General email)	(General email)	subsidencetechnical@customerservice.nsw.gov.au
	John Johnston	Technical Manager	John.Johnston@customerservice.nsw.gov.au
NRAR	(General email)	(General email)	nrar.servicedesk@dpie.nsw.gov.au
	Guy Ohandja	Manager Compliance Monitoring & Audit	guy.ohandja@nrar.nsw.gov.au
EPA	(General email)	(General email)	epa.illawarra@epa.nsw.gov.au
	Andrew Couldridge	Senior Operations Officer - Metropolitan Illawarra	andrew.couldridge@epa.nsw.gov.au
TCCCC Committee Members	Documents sent to TCCCC Committee Members at private email addresses.		

A – Subsidence Monitoring Reports

SIMEC

End of Panel Subsidence Monitoring Report for Tahmoor Longwall W3

Summary	
Monitoring period	30 March to 15 May 2022
Length of extraction of LW W3	LW W3 completed extraction on 21 March 2022 LW W4 commenced extraction on 16 May2022
Distance travelled by longwall since previous report	
Distance to completion of LW W3	

Summary of observed ground movements

Subsidence Parameter		Maximum observed at completion of LW W3	Location
Subsidence (mm)	*Inc* *Total*	592 857	LW W3 Centreline LW W1-W3 Crossline
Tilt (mm/m)	*Inc* *Total*	3.5 3.8	LW W3 Centreline & LW W1-W3 Crossline Stonequarry Creek Rd
Hogging Curvature (km^{-1})	*Inc* *Total*	0.22 0.22	LW W3 Centreline PMLL
Sagging Curvature (km^{-1})	*Inc* *Total*	-0.29 -0.28	LW W1-W3 Crossline LW W3 Centreline
Tensile Strain (mm/m)	*Inc* *Total*	1.4 1.4	LW W3 Centreline & PMLL PMLL
Compressive Strain (mm/m)	*Inc* *Total*	-2.7 -5.0	LW W3 Centreline PMLL

Actions

HAVE ANY DEFINED TRIGGERS BEEN REACHED SINCE PREVIOUS REPORT?	NO.
IS ANY URGENT ACTION REQUIRED?	NO.

This monitoring report provides the results of the latest ground surveys during the mining of LW W3, in accordance with the requirements of subsidence management plans.

Longwall face position

LW W3 commenced on 13 September 2021 and completed extraction on 21 March 2022. A map showing the mine layout and the monitoring peg positions is shown in Drawing No. MSEC1204-01.

Summary of surveys and inspections completed

Surveys and inspections are being conducted to meet the requirements of the LW W1-W2 Extraction Plan. A timeline showing when each type of survey and inspection was conducted is shown Figure A.

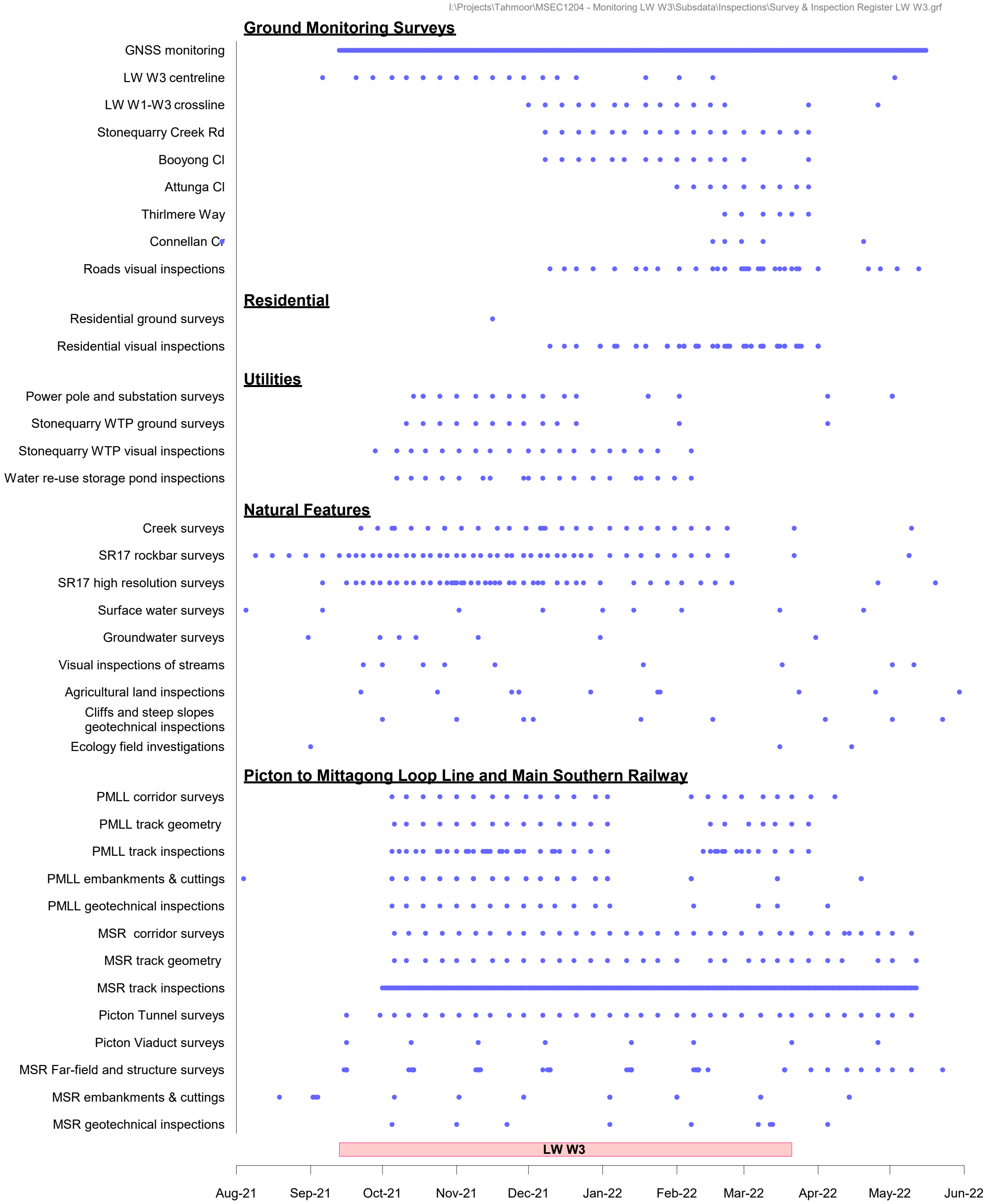


Figure A Surveys and inspections during LW W3

A summary of surveys and inspections is provided in Table 1.

Table 1 Surveys and inspections conducted during LW W3

Inspection / Survey	Responsibility	Number of Inspections / Surveys
Ground Monitoring Surveys		
LW centreline and crossline surveys	SMEC	34
Local road surveys	SMEC	52
Local road inspections	BIS	33
Sub-Total		**119**
Natural Features		
Rockbar SR17 surveys	SMEC	52
Rockbar SR17 high resolution & 3D surveys	MNC	45
Stonequarry, Cedar and Matthews Creek Survey Lines	SMEC	35
Stonequarry, Cedar and Matthews Creek Visual inspections	Brienen Environment & Safety	9
Surface water manual monitoring	ATC Williams	9
Groundwater manual monitoring	SLR	7
Agricultural land inspections	BIS	10
Cliffs and steep slopes geotechnical inspections	Douglas Partners	9
Terrestrial ecology field investigations	Niche	2
Aquatic ecology field investigations	Niche	2
Sub-Total		**180**
Picton-Mittagong Loop Line		
Ground Surveys	Southern Rail Surveys	23
Track Geometry Surveys	BloorRail	21
Track Inspections	BloorRail	42
Embankments and cutting surveys	Southern Rail Surveys	78
Embankments and cuttings geotechnical inspections	Newcastle Geotech	18
Sub-Total		**182**
Main Southern Railway		
Ground Surveys	Southern Rail Surveys	33
Track Geometry Surveys	BloorRail	30
Track Inspections	BloorRail	224
Picton Tunnel surveys	Southern Rail Surveys	34
Picton Viaduct surveys	Southern Rail Surveys	8
Main Southern Railway structure surveys	Southern Rail Surveys	87
Far-field Surveys	Southern Rail Surveys	7
Embankments and cutting surveys	Southern Rail Surveys	28
Embankments and cuttings geotechnical inspections	Newcastle Geotech	9
Sub-Total		**460**
Utilities		
Endeavour Energy Power Pole and substation Surveys	SMEC	22
Water Re-use Storage Pond and sewer rising main visual inspections	Newcastle Geotech	18
Stonequarry wastewater treatment plant ground surveys	SMEC	13
Stonequarry wastewater treatment plant visual inspections	BIS	19
Sub-Total		**72**
Residential		
Pre-mining Front of House inspections	JMA Solutions	78
Pre-mining Structural Hazard Identification inspection and PMI	JMA Solutions	114
Pre-mining Geotechnical Hazard Identification inspections	Douglas Partners	127
Private property ground surveys	SMEC	1
Private property visual inspections	BIS	119
Sub-Total		**439**
Total		**1452**

Monitoring Results

Ground monitoring has been undertaken within the active subsidence zone during LW W3. Monitoring results are shown graphically at the back of this report. Maximum incremental subsidence parameters from the most recent surveys are summarised in Table 2.

Table 2 Summary of maximum observed subsidence parameters

Monitoring Line		Maximum observed subs (mm)	Maximum observed tilt (mm/m)	Maximum observed hogging curvature (km^{-1})	Maximum observed sagging curvature (km^{-1})	Maximum observed tensile strain (mm/m)	Maximum observed comp. strain (mm/m)
LW W3 Centreline	*Inc* *Total*	592 629	3.5 3.3	0.22 0.19	-0.26 -0.28	1.4 2.3	-2.7 -2.8
LW W1-W3 Crossline	*Inc* *Total*	586 857	3.5 3.4	0.14 0.07	-0.29 -0.08	0.7 0.9	-1.0 -1.6
Stonequarry Creek Rd	*Inc* *Total*	94 619	0.6 3.8	0.03 0.07	-0.02 -0.11	0.2 0.2	-0.2 -0.9
Attunga Cl	*Inc* *Total*	44 195	0.6 1.8	0.02 0.06	-0.01 -0.01	0.4 0.4	-0.2 -0.7
Connellan Cr	*Inc*	12	0.4	0.03	-0.03	0.2	-0.3
Thirlmere Way	*Inc* *Total*	42 188	0.5 2.4	0.03 0.12	-0.03 -0.08	0.3 0.5	-0.4 -1.0
Optic Fibre West	*Inc*	72	0.7	0.04	-0.03	0.2	-0.4
PMLL railway	*Inc* *Total*	387 697	2.5 3.7	0.09 0.22	-0.07 -0.17	1.4 1.4	-1.7 -5.0
Main Southern Railway	*Inc*	4	0.9	0.08	-0.05	0.4	-0.6

Ground survey results

A map showing the locations of survey marks is provided in Drawing No. MSEC1204-01. A map showing the spatial distribution of incremental subsidence is shown in Drawing No. MSEC1204-02.

Subsidence along centreline of LW W3

GNSS Site 23 was located directly above the centreline of LW W3, approximately 100 metres from the commencing end. The unit recorded approximately 345 mm subsidence. With the mining of LW W3 finished, the GNSS unit has been relocated to its planned position above the commencing end of LW W4.

Survey marks were installed along the centreline of LW W3. The purpose of the centreline was to provide early subsidence information to confirm the magnitude of subsidence above LW W3. The development of subsidence along the centreline of LW W3 is shown in Fig. 1, where a maximum of 581 mm has been measured on 16 February at Peg CLW3-24, which is located on the ridge to the south of the Stonequarry Estate Wastewater Treatment Plant. Observed subsidence remains less than prediction.

The development of subsidence relative to the length of longwall extraction at sites of interest along the centreline is shown in Figure B.

A plot showing the development of subsidence relative to the position of the longwall face at the time of each survey is shown in Figure C.

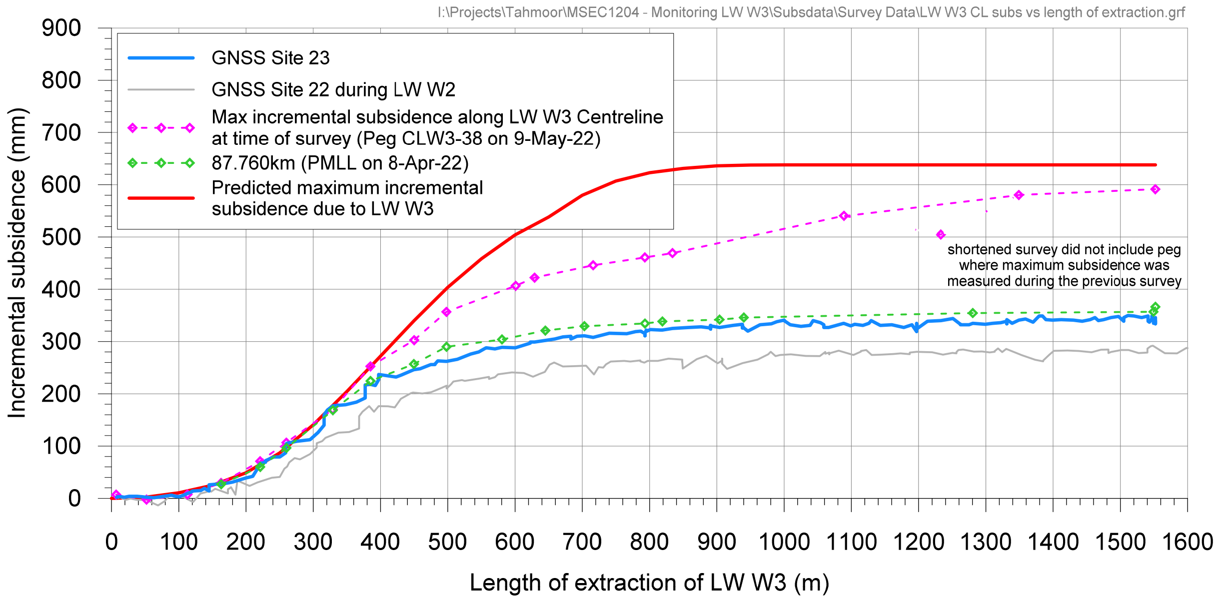


Figure B **Development of subsidence along centreline of LW W3**

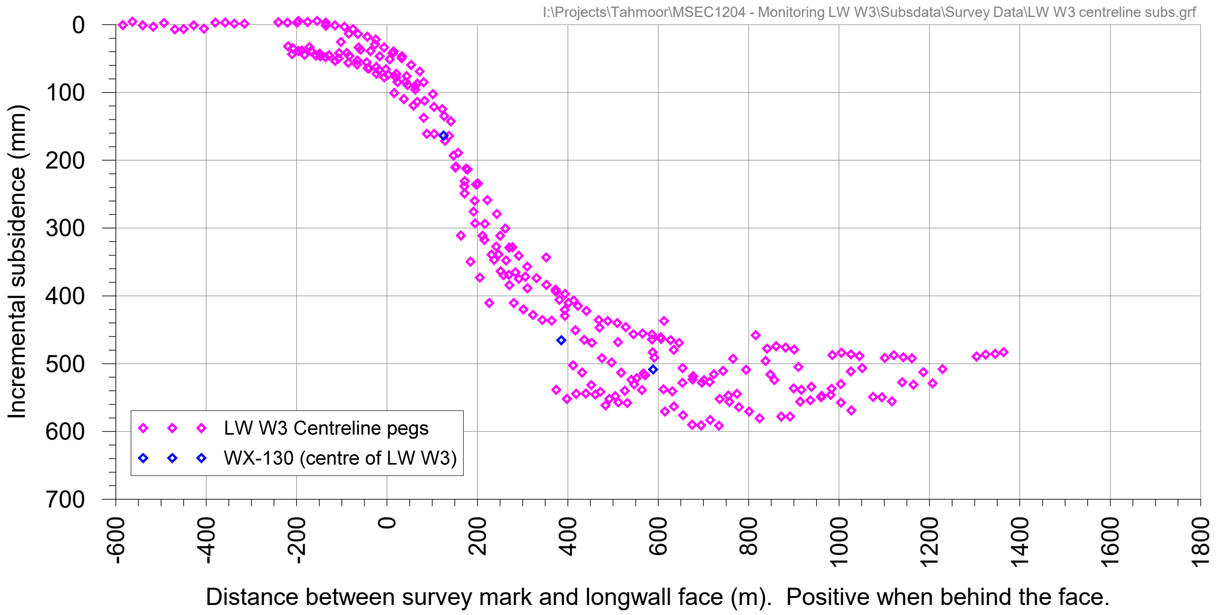


Figure C **Development of subsidence along centreline of LW W3 relative to position of LW face at times of the surveys**

Picton – Mittagong Loop Line

Regular surveys were conducted along the Picton to Mittagong Loop Line during the mining of LW W3. Compressive strains were observed above the centreline of LW W3 and across the creek crossing. Visual inspections did not identify any issues associated with mine subsidence.

Main Southern Railway

Regular surveys were conducted along the Main Southern Railway during the mining of LW W3. Results were within survey tolerances during mining. Visual inspections did not identify any issues associated with mine subsidence.

Victoria Bridge

Regular surveys were conducted at the Victoria Bridge over Stonequarry Creek during the mining of LW W3. Very small and gradual closure was observed across Stonequarry Creek. Visual inspections did not identify any impacts associated with mine subsidence but the gap between the deck and the eastern abutment was observed to almost close. Transport for NSW is currently in the process of reinstating a gap prior to the influence of LW W4.

GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time. There are 18 units located directly above and adjacent to LW W3-W4. These include two units above the commencing end, and along the centreline of, LW W2, being Sites 23 and 7.

The measured positions of each GNSS unit varies depending on atmospheric conditions and the array of satellites that are present in the sky at each time, and the vegetation cover surrounding each unit. Measured variations in height are typically greater than the variations for eastings and northings.

The results from the GNSS units are shown in Fig. G07 to Fig. G23. The 7-day running average readings are the most appropriate reflection of measured changes to date. Some trends can be seen from the results, with the closest GNSS units generally moving towards the extracted panel.

Changes in horizontal distances can be calculated between GNSS units that are stationed close together and results are shown in Figure D. Minor changes are currently observed between the GNSS units.

The GNSS unit at Site 14 has been removed at the request of the landowner. The last reading was on 4 November 2021.

The GNSS unit at Site 13 has been confirmed as disturbed in January, likely during removal of the surrounding fencing. Minor changes have been observed since this time. The unit was relocated on 28 March and results normalised.

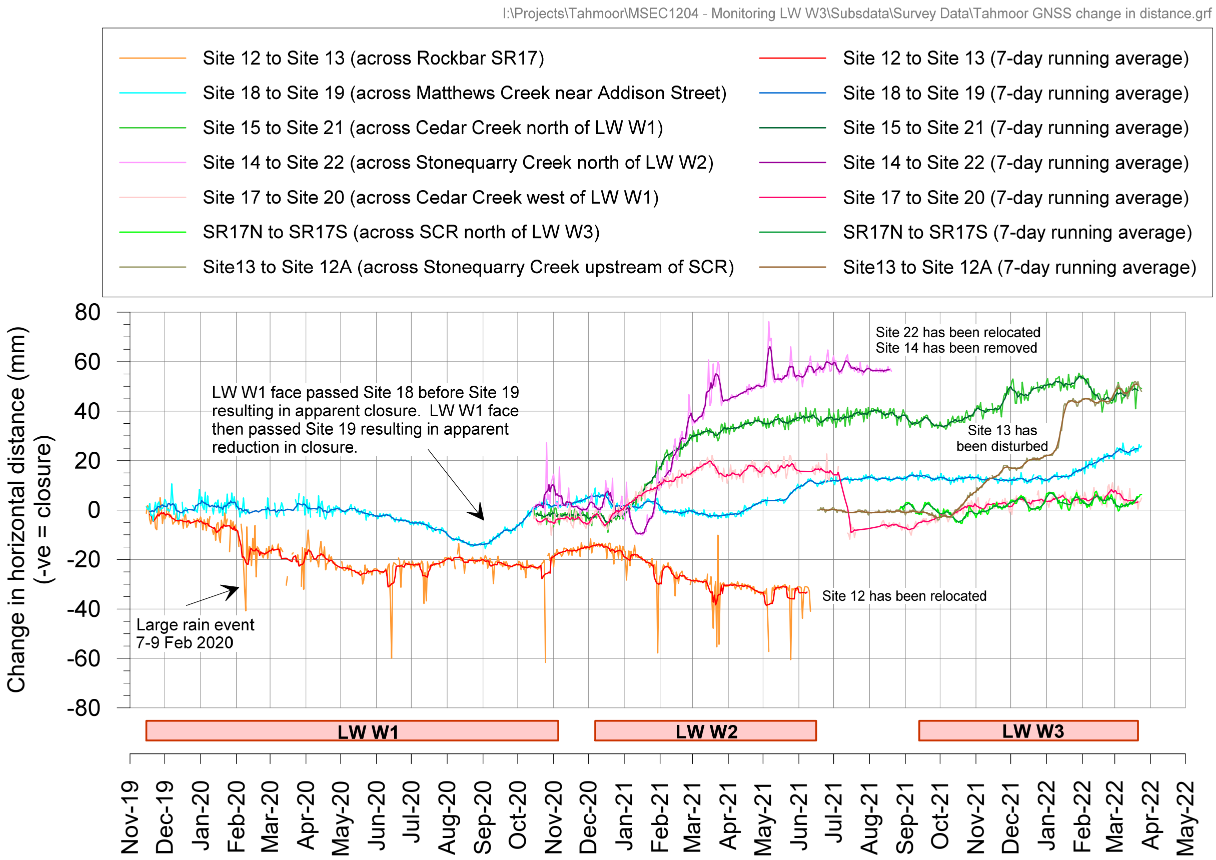


Figure D Observed changes in horizontal distances between GNSS units

Summary of impacts to surface features

A comparison between assessed and observed impacts to surface features is summarised in Table 3. The assessed and observed impacts to surface features compare reasonably well with predictions.

Table 3 Summary of predicted and observed impacts during LW W3

Surface Feature	Predicted Impacts	Observed Impacts
Natural Features		
Stonequarry, Cedar and Matthews Creek	Potential cracking in creek bed. Potential surface flow diversion (less than 10% of pools in Study Area) Potential reduction in water quality during times of low flow. Potential gas emissions.	Minor fracturing observed in south-east corner of Rockbar SR17. No reduction in pool levels below baseline levels. Pools currently full following multiple rainfall events, particularly in March 2022. No reduction in water quality observed. Refer to report below for further details and report by Brienen and HEC.
Aquifers or known groundwater resources	Temporary lowering of piezometric surface by up to 15m which may stay at that level until maximum subsidence develops. Groundwater levels should recover with no permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops Potential impacts to privately owned groundwater bores. Please refer report by SLR.	Groundwater levels gradually recovered during mining of LW W3 in response to above average rainfall. Please refer report summarising 6 months of results by SLR.
Steep slopes and cliffs	Potential soil slippage and cracking to slopes. Large scale slope failures or cliff instabilities unlikely.	No impacts observed during LW W3.
Natural vegetation	No impacts anticipated.	No impacts observed during LW W3.
Public Utilities		
Picton to Mittagong Loop Line (PMLL)	Railway will remain safe and serviceable with management plans in place.	Railway maintained in safe and serviceable condition during mining. No issues were observed. Refer to report below for further details.
Main Southern Railway	Unlikely to experience adverse impacts. Monitoring program in place to measure far field movements.	No adverse impacts observed. Minor far field movements observed.
Roads and Bridges (all types)	Minor cracking and buckling may occur in isolated locations.	Kerb damage and cracking of concrete drain on Stonequarry Creek Road. No impacts observed to Victoria Bridge but gap between bridge deck and eastern abutment almost closed. The gap is in the process of being reinstated prior to the influence of LW W4. Refer to report below for further details.
Water pipelines	Minor impacts possible to pipelines, particularly at creek crossings.	No impacts observed during LW W3.
Sewer pipelines	Minor impacts possible to pipelines, particularly at creek crossings.	No impacts observed to rising main and gravity sewers during LW3.
Wastewater Treatment Plant (WTP)	WTP unlikely to experience impacts and will remain safe and serviceable with management plans in place.	Minor settlement of backfill material following rainfall and minor erosion hole (not mining related). No impacts observed to Water Re-use Storage Dam wall from visual inspections from rail corridor. No impacts observed to pumping stations.
Gas pipelines	Unlikely to experience adverse impacts with management plan in place.	No impacts observed during LW W3.

Surface Feature	Predicted Impacts	Observed Impacts
Electricity infrastructure	Some adjustments of power poles, catenaries or aerial powerline connections may be required.	No impacts observed during LW W3
Telecommunication infrastructure	Unlikely to experience adverse impacts with management plan in place.	No impacts observed during LW W3
Public Amenities	No public amenities within influence of LW W3.	No impacts observed during LW W3.
Farmland and Facilities		
Farm buildings, sheds, tanks	Negligible to slight impacts predicted for all farm buildings and sheds with management plan in place.	No impacts observed during LW W3.
Fences	Potential for impacts to fences and gates.	No impacts reported to fences on farm properties during LW W3.
Farm dams	Potential adverse effects on dam walls and storage capacity.	No impacts observed during LW W3.
Wells or bores	Potential impact on one NOW registered bore directly above LW W2.	No impacts reported.
Areas of Archaeological Significance	Open camp sites, the modified tree and rock shelter sites are unlikely to experience impacts. Grinding groove site 52-2-2068 on Rockbar SR17 may experience fracturing but unlikely to occur.	End of Panel report by EMM confirmed no impacts to archaeological sites. Negligible impact at grinding groove site 52-2-2068. Minor fracturing observed in south-east corner of rockbar away from the grooves.
Areas of Heritage Significance	Potential low-level impacts at weatherboard cottage at 796 Thirlmere Way but will remain safe, serviceable and repairable with management plan in place. Impacts may occur to culverts along the PMLL but will remain safe, serviceable and repairable with management plans in place.	No impacts reported during mining of LW W3.
Permanent Survey Control Marks	Ground movement predicted at identified survey marks.	Ground movement occurred.
Residential Establishments		
Houses	All houses expected to remain safe, serviceable and repairable provided that they are in sound condition prior to mining. Impacts predicted to some houses.	Minor impacts have occurred to some houses, including impacts to plasterboard walls, door and window frames and floor tiles. Houses have remained safe, serviceable and repairable. Refer to report below for further details.
Swimming pools	While predicted tilts are not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strain impacts are low, many of the pools are inground, which are more susceptible.	Minor impacts reported. No pool gates have required adjustment.
Associated structures such as workshops, garages, on-site wastewater systems, water or gas tanks or tennis courts	Potential impact to pipes connected to inground septic tanks. Negligible impacts predicted for non-residential domestic structures, including sheds and tanks.	No impacts reported during LW W3.
External residential pavements	Cracking and buckling likely to occur, though majority of impacts are expected to be minor.	Minor impacts to some external pavements.
Fences in urban areas	Some fences and gates could be slightly damaged. Most vulnerable are Colorbond fences.	No impacts to fences reported.

Natural Features

Survey marks have been installed across rockbars in Cedar, Matthews and Stonequarry Creeks prior to the commencement of LW W1, at locations shown in Drawing No. MSEC1204-01.

Valley closure has been measured to develop across Stonequarry Creek at SQ104 and SQ105, which are located near the confluence of Stonequarry Creek and Cedar Creek. Minor closure was developing across SQ104, SQ105, SQ106 and SQ107 up to 3 November. The survey pegs for SQ101 to SQ109 were removed following the survey on 3 November, as requested by the landowner. Results are shown in Figure E.

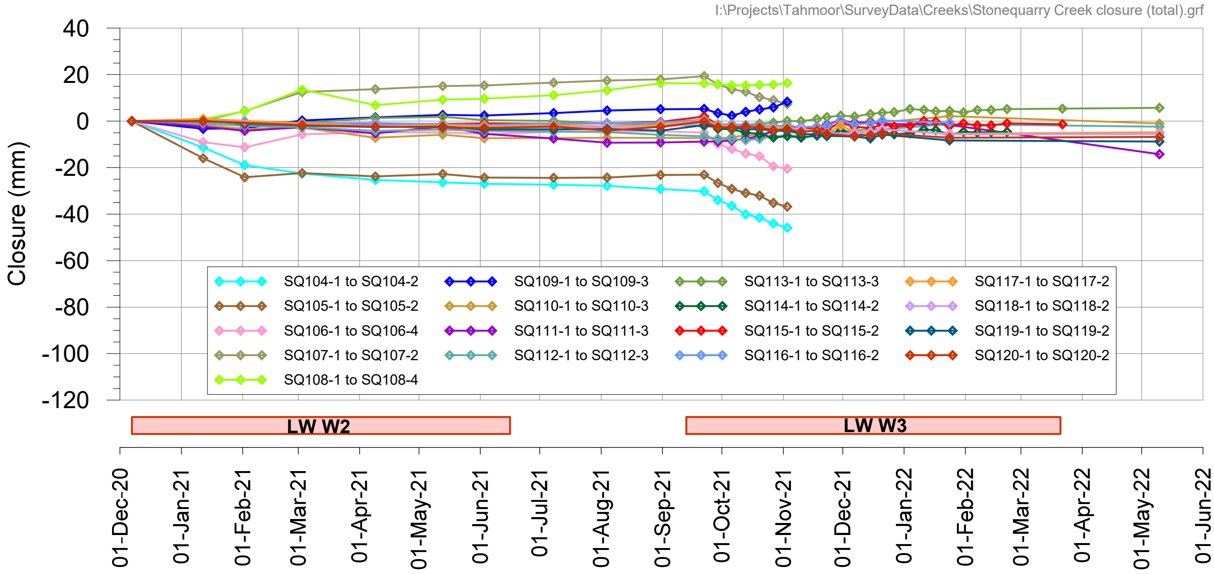


Figure E Development of observed valley closure along Stonequarry Creek (new closure marks)

The most recent monthly survey for Rockbar SR17 was on 22 February. Small changes in horizontal distances were observed both along and across the rockbar, as shown in Figure F. Minor ground shortening is observed in the southeast corner of the rockbar, which is captured by measurements at Marks RBE11, RBF05 and RBF06.

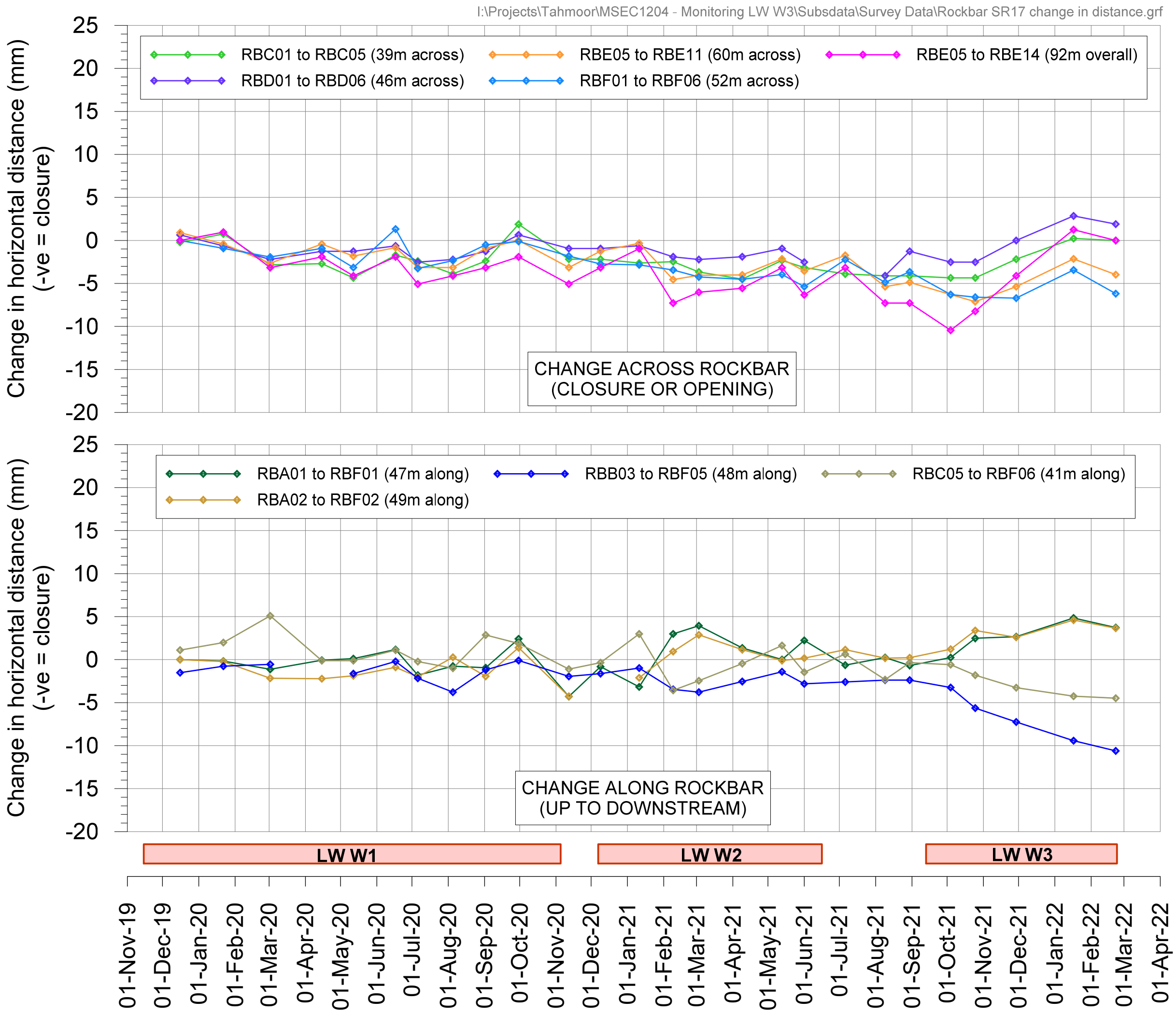


Figure F Changes in distance across and along Rockbar SR17 during LW W1-W3

A comparison between observed and predicted valley closure along Cedar Creek is shown in Figure G. Very little change in closure was observed during the mining of LW W3. The most recent survey was on 24 January, with minor changes observed.

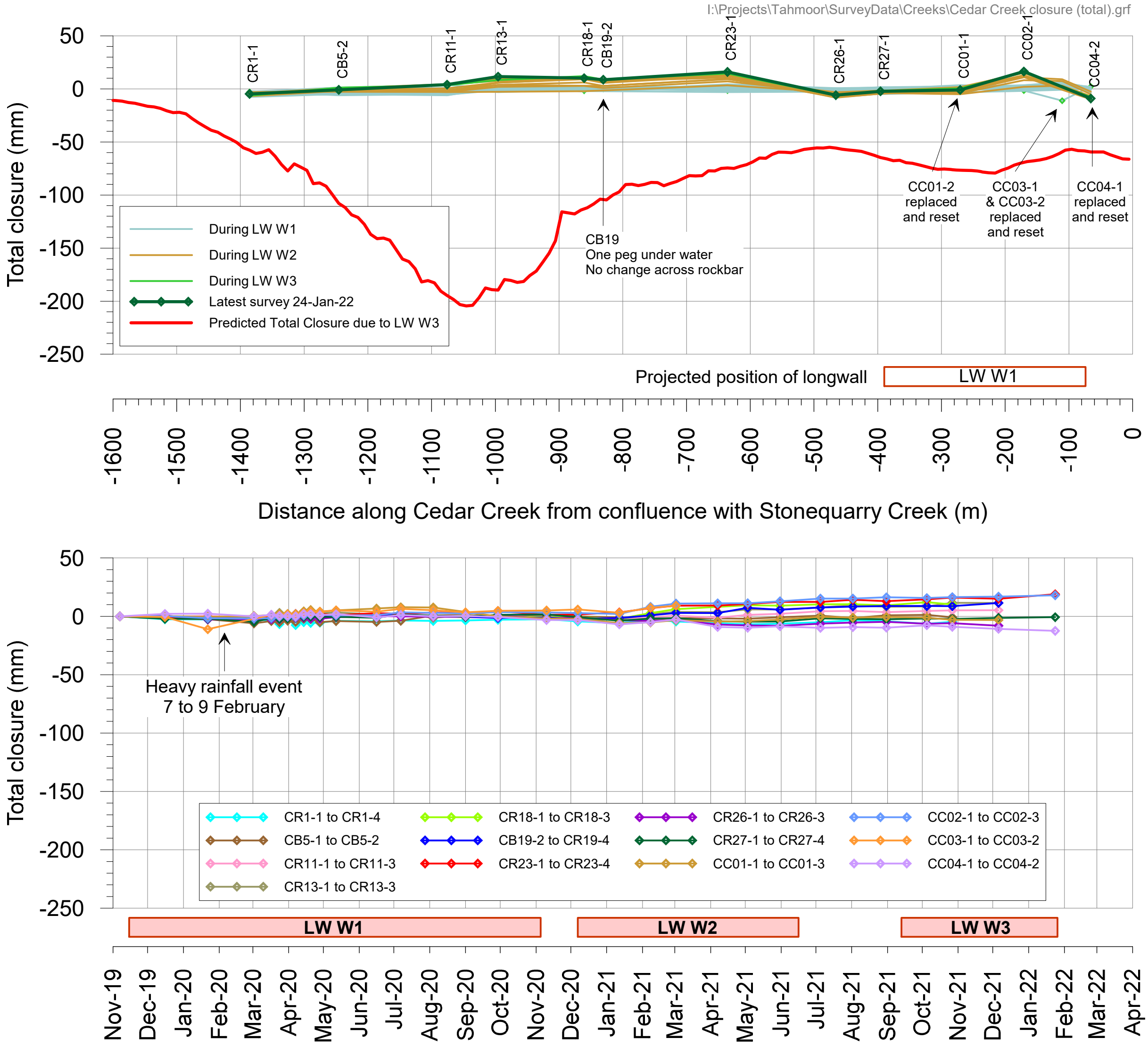


Figure G Comparison between observed and predicted valley closure along Cedar Creek

Surveys across the newly installed closure marks are shown in Figure H. The most recent survey was on 10 May with minor changes observed.

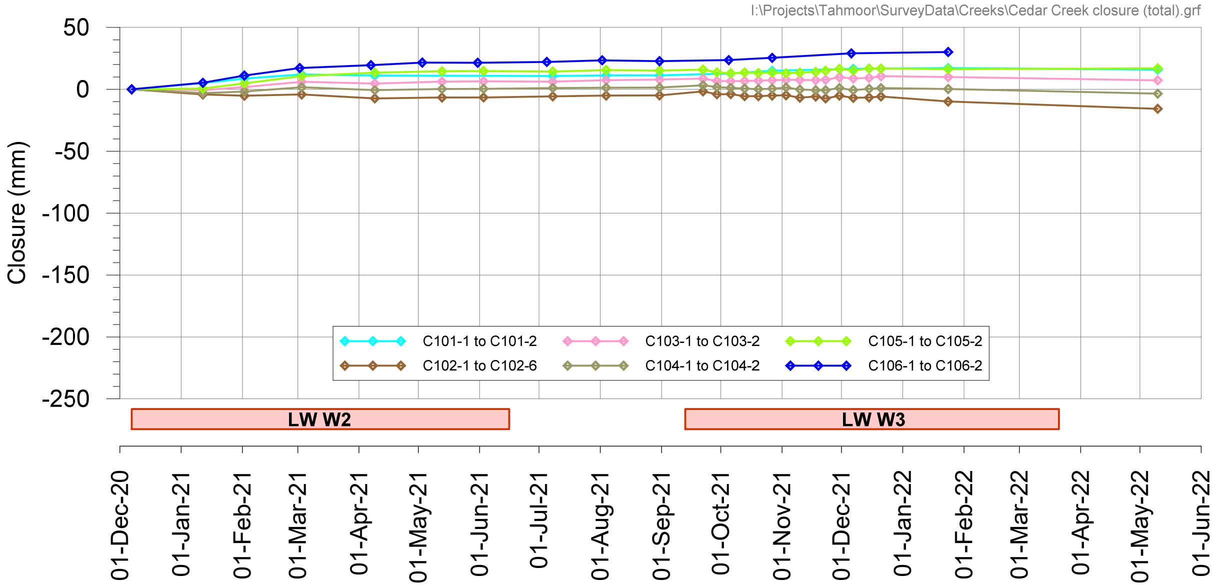


Figure H Development of observed valley closure along Cedar Creek (new closure marks)

Survey pegs C101-1 and C101-2 are aligned with GNSS sites 17 and 20. A reasonable comparison in measured changes in distance between the two survey sites is shown in Figure I, though one of the GNSS units appears to have been disturbed in July 2021 between the completion of LW W2 and commencement of LW W3.

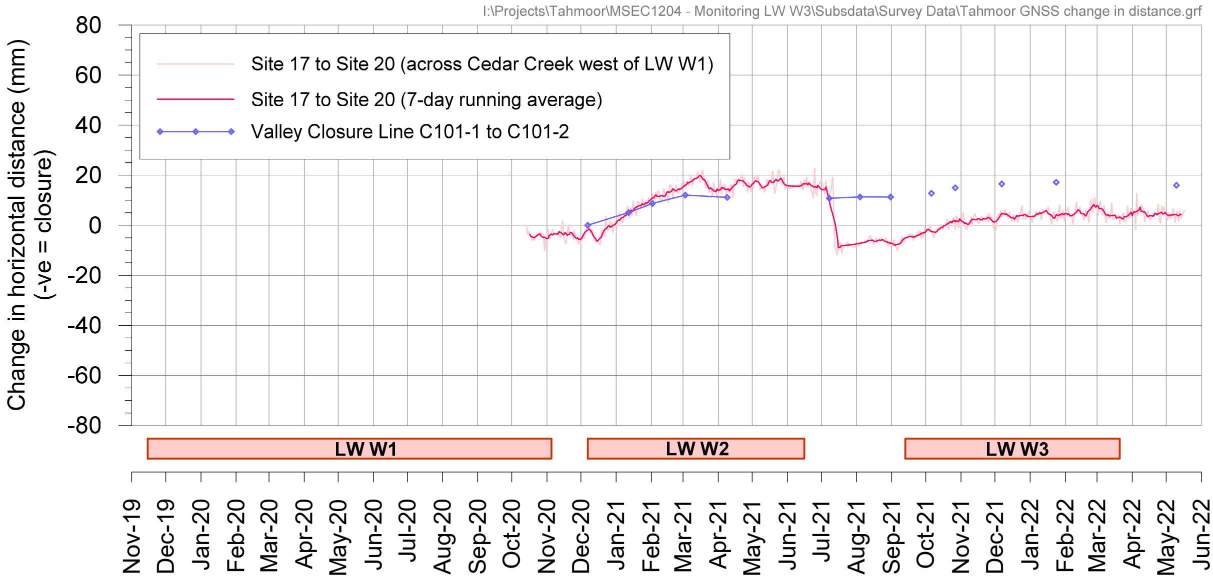


Figure I Development of observed valley closure along and across Cedar Creek

A comparison between observed and predicted valley closure along Matthews Creek is shown in Figure J. The most recent survey was on 8 December, with minor changes observed.

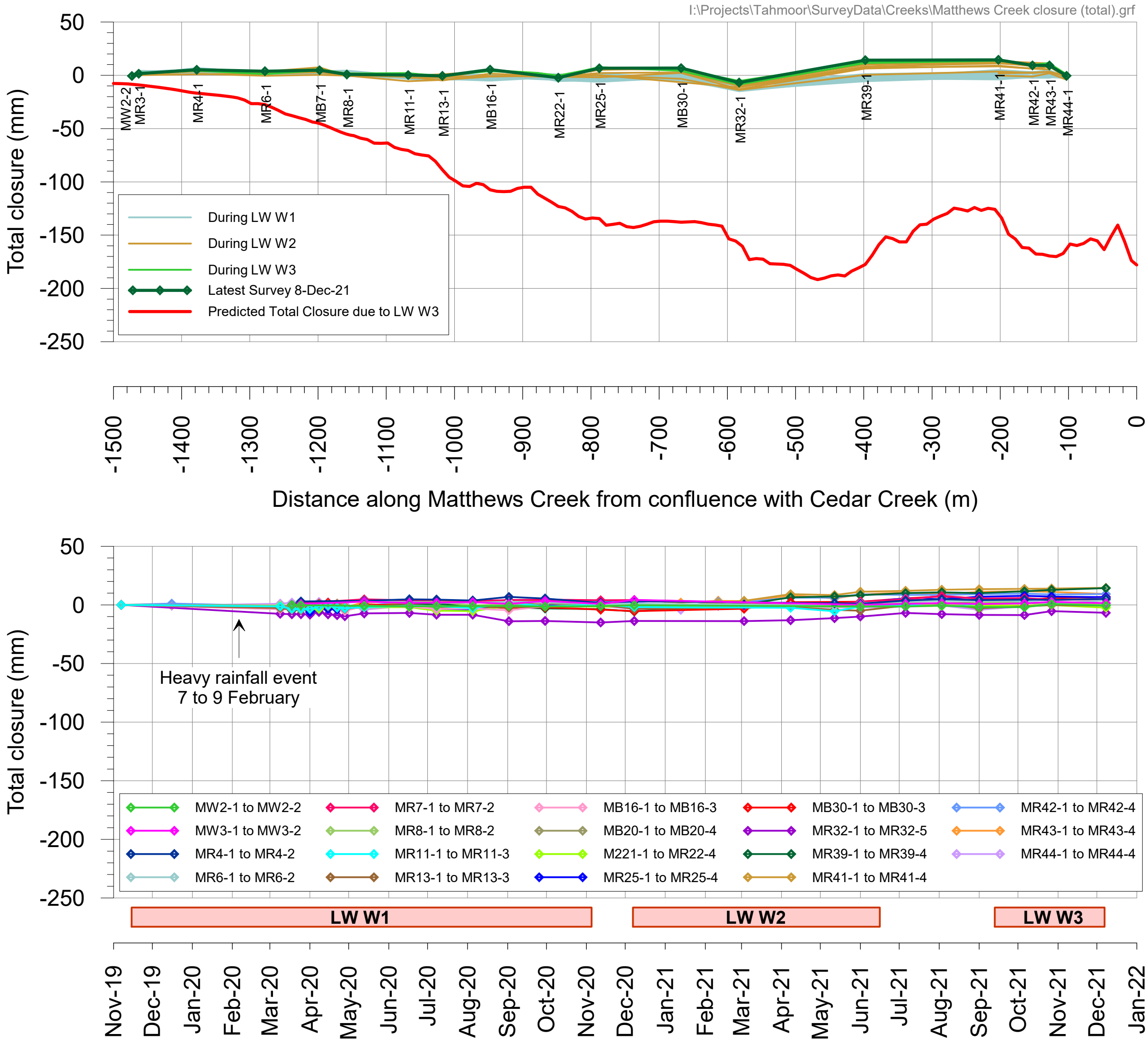


Figure J Comparison between observed and predicted valley closure along Matthews Creek

Visual inspections prior to the commencement of LW W1 and in December 2019 found that there was no connective overland water flows in Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. No connective overland water flows were observed in Cedar Creek upstream of the confluence with Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. Downstream of Matthews Creek, pools in Cedar Creek were full with a trickle flow observed out of the majority of the pools. There was no flow over the sand substrate at the lower reaches of Cedar Creek. The water level in the long pool in Stonequarry Creek fell below the Cease to Flow level in late October prior to the start of LW W1.

An inspection was conducted on 22 January 2020 following a series of rain events between 8 and 21 January. Pools that were previously dry were observed to contain water and the overland flow was observed over the previously dry lower reaches of Cedar Creek. An inspection was conducted on 27 February 2020 following a large rain event on 7 to 9 February 2020. Higher volumes of connective flow and flood levels were observed in Matthews, Cedar and Stonequarry Creeks.

Monthly monitoring and inspections during the mining of LW W1 observed rising and falling of water levels consistent with rainfall events. No mining-induced impacts were identified in the visual inspections.

No mining-induced impacts were observed to Stonequarry and Matthews Creeks during the mining of LW W2, including the pool at Rockbar SR17 in Stonequarry Creek.

A focussed visual inspection was conducted on 19 January 2021, which confirmed low water levels in 7 pools, which were Pools CB10, CR12, CR13, CR14 and CR15 in Cedar Creek and Pools MR45 and MR46 in Matthews Creek. Rainfall events occurred intermittently during January 2021 and follow up inspections in February 2021 found a return to normal water levels and overland flows. A substantial rainfall event occurred in mid to late March 2021 and inspections in March and April found pool water levels to be full.

Following observations of atypical water level behaviour at Pools CB3, CB10 and CR14 in Cedar Creek in late 2020 and early 2021, water levels returned to normal levels during February in response to a series of rainfall events.

Water level monitoring in March did, however, detect a reduction in water levels in only Pool CR14 until a large storm event refilled the pool in late March 2021. Water levels in Pools CB3 and CB10 remained consistent with baseline conditions during this time.

Visual inspections and water level monitoring have found that water levels have returned to normal since March 2021 at Pool CR14. They have not declined atypically during periods of dry weather. Water levels have remained above minimum levels in response to above average rainfall during the mining of LW W3. No changes were observed during the most recent inspection in May 2022.

Previously observed gas bubbling at Pool MR45 have not been found during the mining of LW W3, including the end of panel inspection in May 2022. Iron-oxy hydroxide precipitation was observed during the October 2021 inspections that was similar to previously observed precipitations during pre-mining baseline inspections and at sites in Stonequarry Creek located well upstream from the longwalls, beyond the influence of mine subsidence. No changes were observed during the most recent inspection on 17 March 2022.

Minor surface fracturing has been observed on Rockbar SR17 in the south-east corner of the rockbar, downstream of the access road. The fractures are in a localised area and limited to the laminar surface rocks only.

Local Roads

Ground surveys and visual inspections were conducted along Stonequarry Creek Road, Booyong Close and Attunga Close. No issues were observed along Booyong Close and Attunga Close. Minor deterioration was observed on 19 January 2022 to a concrete kerb drain at the northern end of Stonequarry Creek Road, which was previously damaged during the mining of LW W2. No significant change was observed as mining continued.

Surveys and visual inspections along Connellan Crescent found pavement damage at the intersection of Rumker Street and Thirlmere Way on 3 March. Running and ponding water has resulted in erosion of the unsealed surface of Star Street. The changes are not mining related.

Surveys and inspections along Thirlmere Way was conducted, with approximately 30 mm residual subsidence measured since the completion of LW W2. Minor changes in horizontal distances were measured across the pavement since the completion of LW W2. Deterioration of the road surface was observed on 1 March, accelerated by heavy rainfall. On 7 March several small landslips due to heavy rainfall were observed. The debris was cleared by Council and was not mining related. No significant change was observed after this time.

Victoria Bridge across Stonequarry Creek

Very gradual and minor closure was observed to develop across Stonequarry Creek at Victoria Bridge, which is located approximately 1000 metres from LW W3. The timing of the closure coincided with the final stages of mining LW W3, a period of heavy rainfall and completion of abutment strengthening works by Transport for NSW (TfNSW). Inspections were conducted by a structural engineer and bridge maintenance engineers from TfNSW. While no immediate concerns were observed, the gap between the bridge deck and the eastern abutment was observed to almost close. TfNSW is currently arranging to reinstate the gap prior to the influence of LW W4.

Structures

There are no structures located above LW W3. No claims have been received for structures located above or near LW W3 since mining commenced.

Weekly inspections were conducted for properties along Booyong Close, Stonequarry Creek Road and Attunga Close.

A property on Booyong Close experienced a wet sub floor area and minor collapse of shale material in the same location as previously reported during LW W2. The owner reported water running through the garage.

Stormwater Detention Basin

Ground surveys and visual inspections were conducted during the mining of LW W3. Minor changes were measured since the completion of LW W2 with no issues observed from visual inspections.

Gas Infrastructure

No gas infrastructure is located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

Electrical Infrastructure

Monthly surveys were conducted for power pole 762531 located on Rockbar SR17 with very minor subsidence measured during the mining of LW W3.

Surveys were also conducted around the substation during the mining of LW W3, with measured changes in horizontal distances around the substation within survey tolerance. Visual inspections were conducted with no significant changes observed.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

Telecommunications Infrastructure

No telecommunications infrastructure was located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

Surveys and visual inspections were conducted along the optical fibre cable beyond the finishing end of LW W3. The pegs were installed and initially surveyed when LW W2 was approximately 450 metres from the finishing end. The results, therefore, included a measure of total subsidence due to the mining of LW W2 and LW W3. A reasonable correlation was found between predicted and observed subsidence. Observed tilts and strains were close to survey tolerance.

Potable Water Infrastructure

No potable water infrastructure was located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

Sewer Infrastructure

Subsidence was observed to develop gradually at the Wastewater Treatment Plant (WTP) and Re-use Water Storage Pond during the mining of LW W3, as expected.

Visual inspections of the WTP were conducted on a weekly basis during the period of active subsidence. An inspection on 15 November found further erosion near the stormwater pit after rainfall (not mining related). Backfill material around the stormwater pit was relevelled. No mining-induced impacts were observed.

Visual inspections of the Re-Use Water Storage Dam wall were conducted regularly during the mining of LW W3. No impacts were observed.

A sewer rising main associated with the Stonequarry Estate follows the alignment of the Picton-Mittagong Loop Line, and is partly located directly above LW W3. No impacts have been observed from visual inspections.

Ground surveys and visual inspections were conducted during the mining of LW W3 around the detention basin and Pumping Station 2. No impacts have been observed.

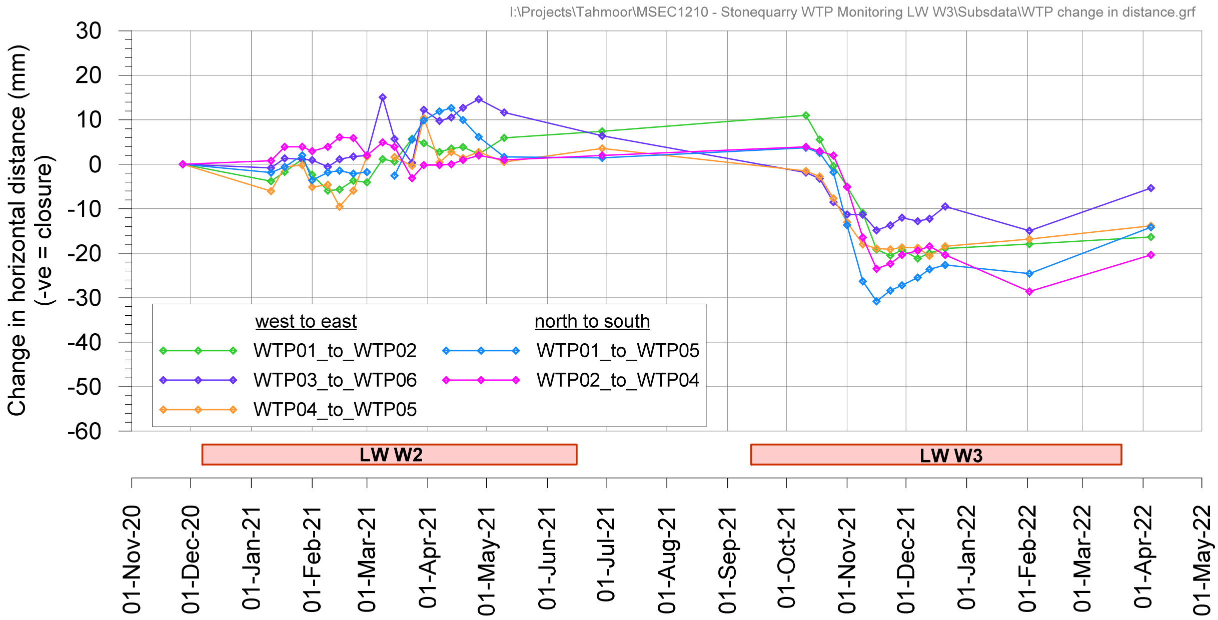


Figure K Total changes in distance over time

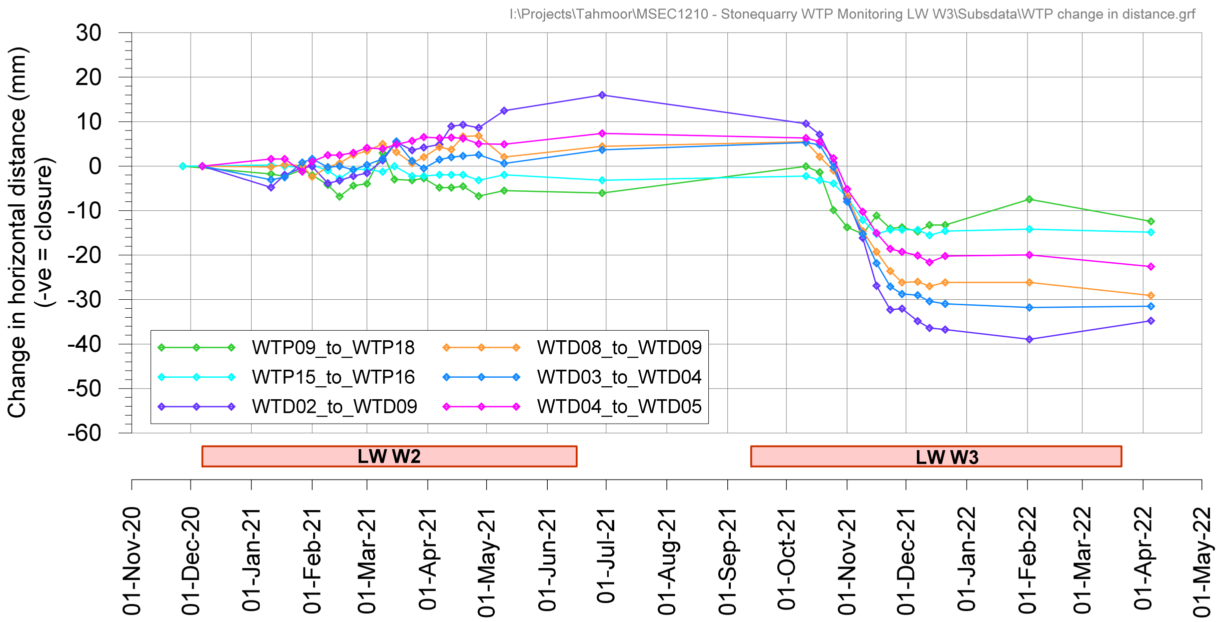


Figure L Total changes in distance over time

Dams

Regular surveys and inspections were conducted at Farm Dam FD-1 and Farm Dam FD-3.

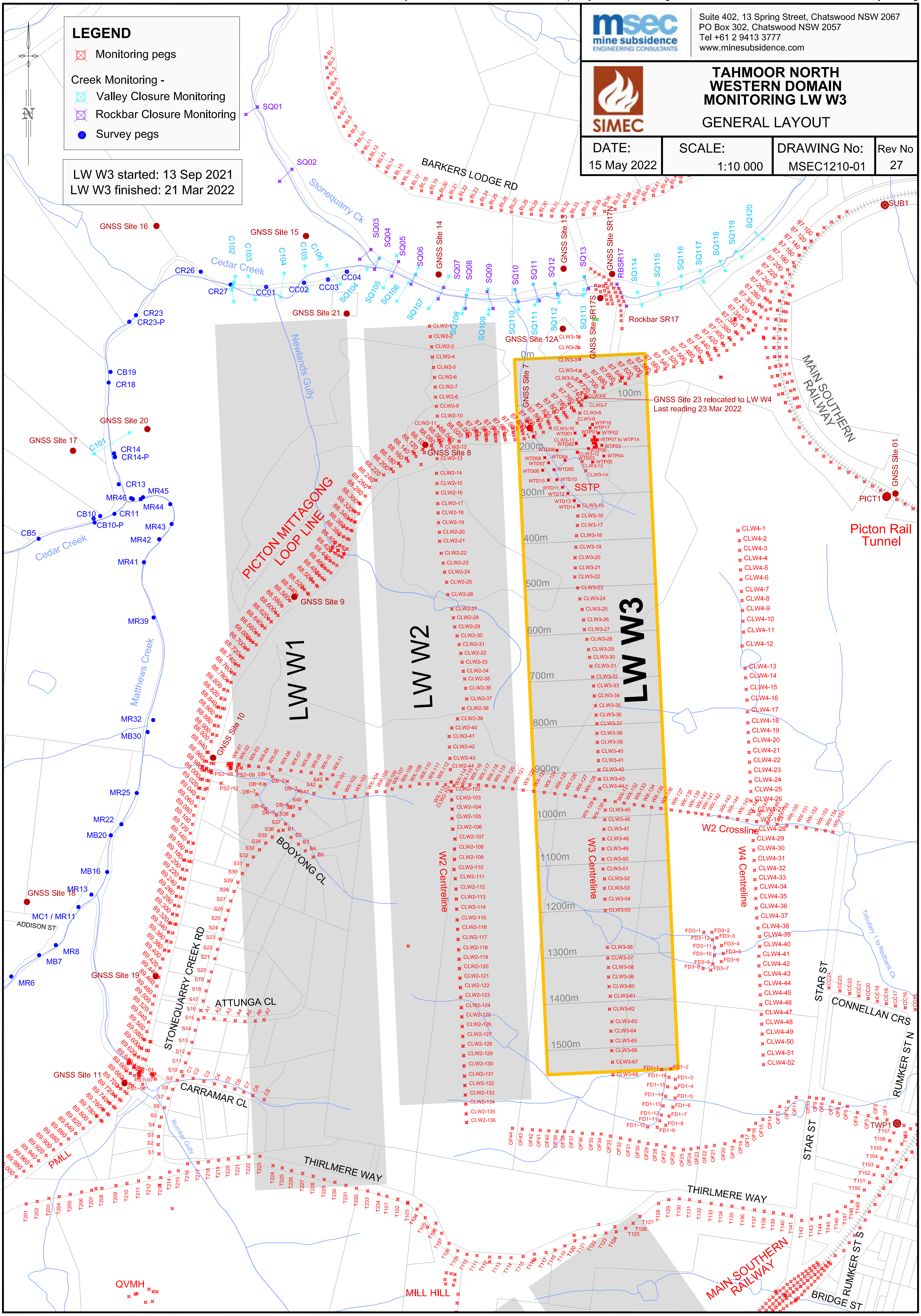
Minor subsidence movements were observed, with compressive strains developing across the bases of the valleys. The dams are currently full following above rainfall during the mining of LW W3. No mining-induced impacts were observed.

Archaeological Sites

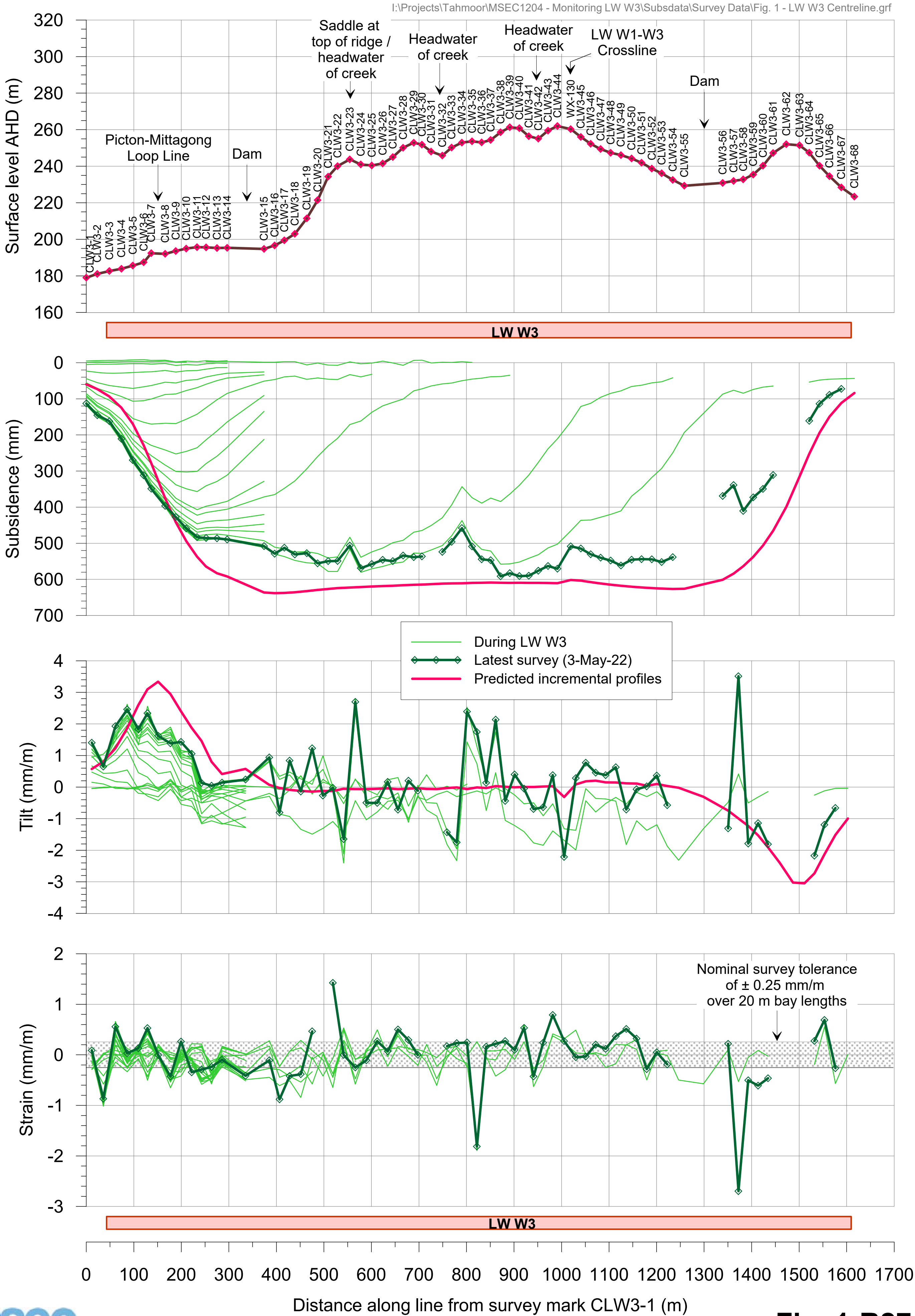
Very minor ground movements have been measured across Rockbar SR17, with no impacts observed at the grinding groove sites. Surface fractures were observed on the rockbar approximately 40 metres downstream of the grinding grooves since late October 2021. The fractures have been assessed to have negligible impact on the heritage value of the site.

Aboriginal rock shelters show no subsidence related rock face cracking or spalling.

I:\Projects\Tahmoor\MSEC1210 - Stonequarry WTP Monitoring LW W3\AcadData\MSEC1210-01 General Layout.dwg



Tahmoor LW W3
Incremental subsidence profiles along LW W3 Centreline



msec

Fig. 1-R27

Tahmoor LW W3
Incremental subsidence profiles along Rockbar SR17

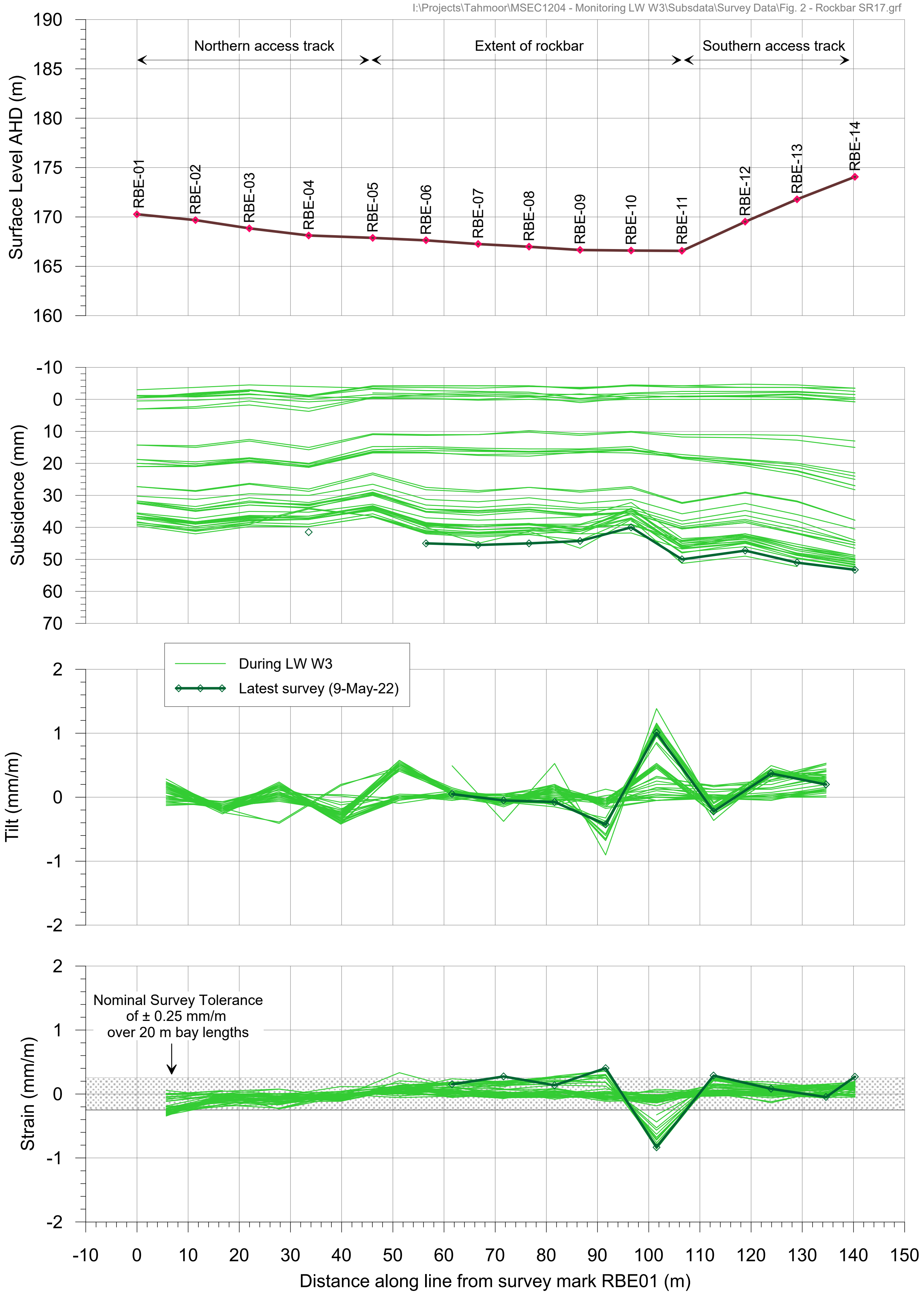


Fig. 2-R27

Tahmoor LW W3 - Picton-Mittagong Loop Line
Incremental subsidence profiles
Survey date: 8 April 2022

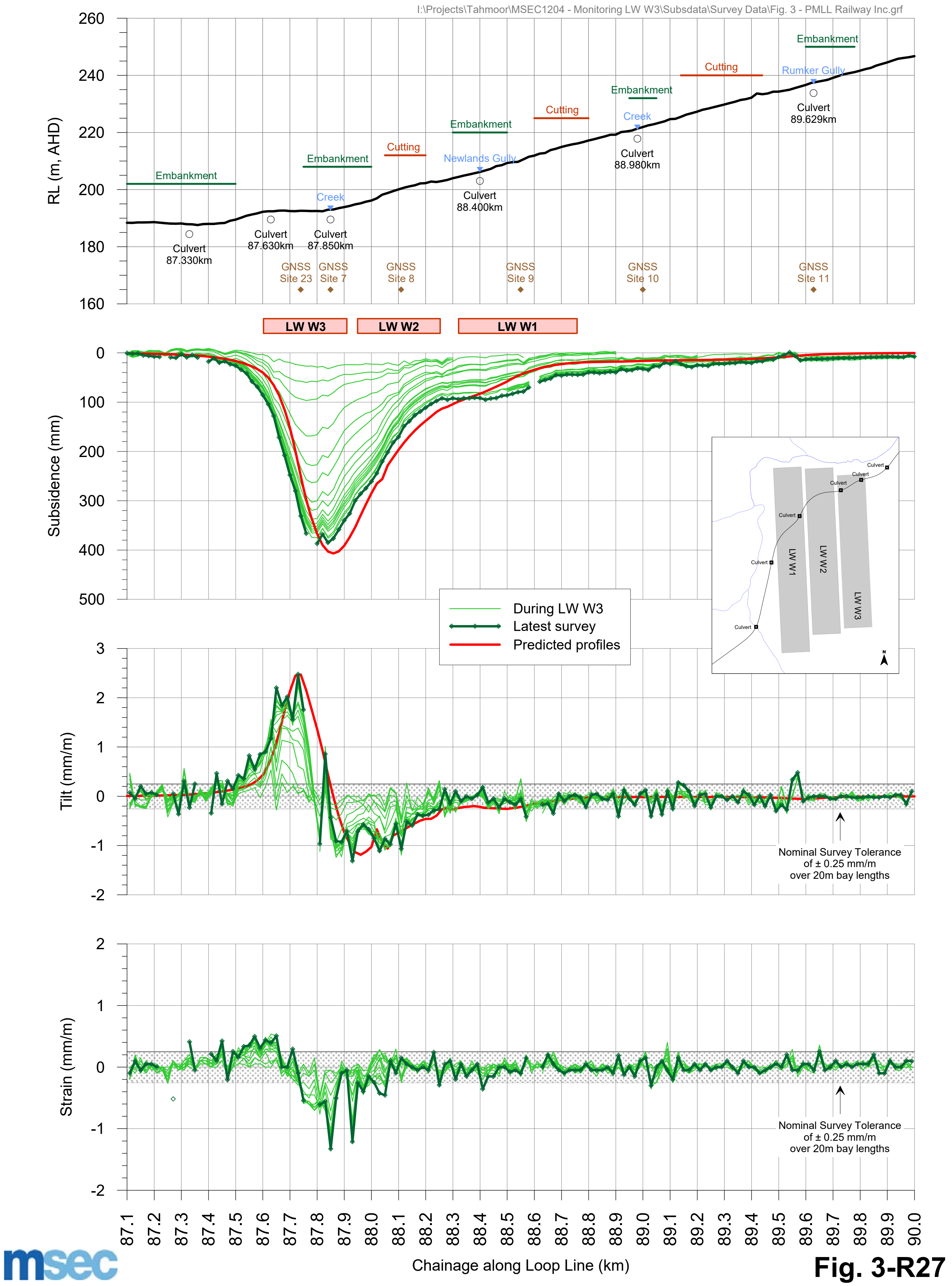
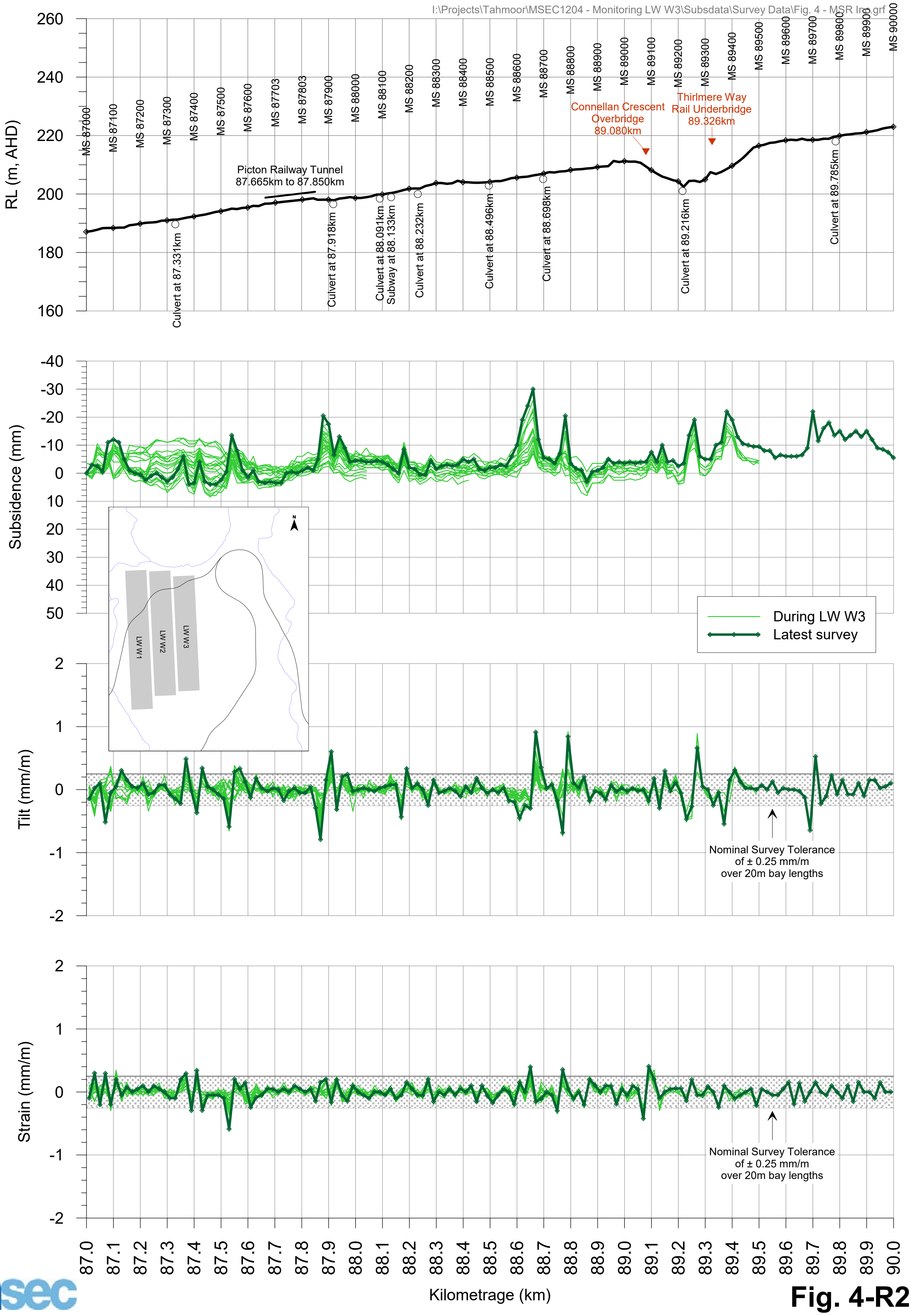


Fig. 3-R27

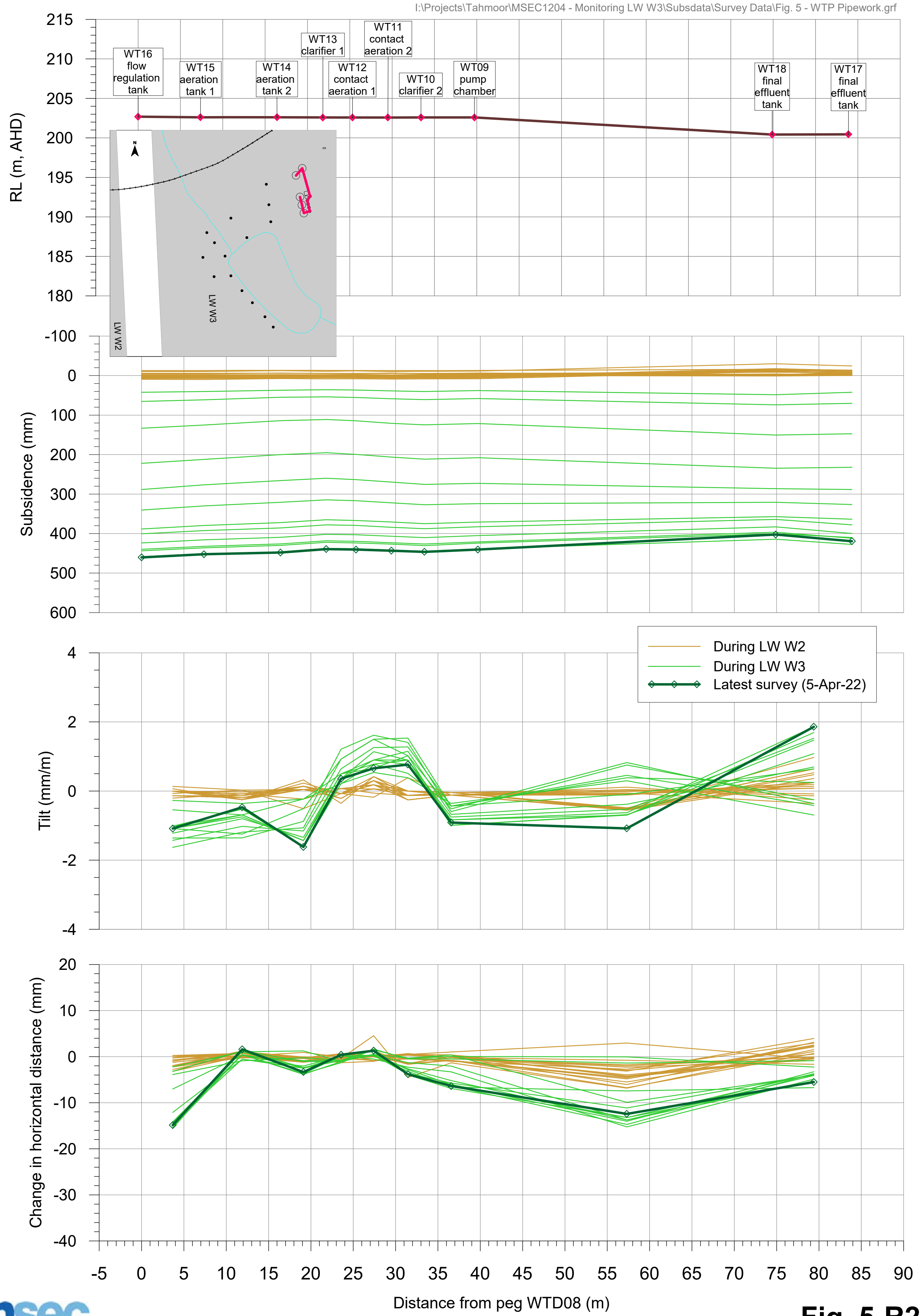
Tahmoor LW W3 - Main Southern Railway
Incremental subsidence profiles
Survey date: 14 April 2022



msec

Fig. 4-R27

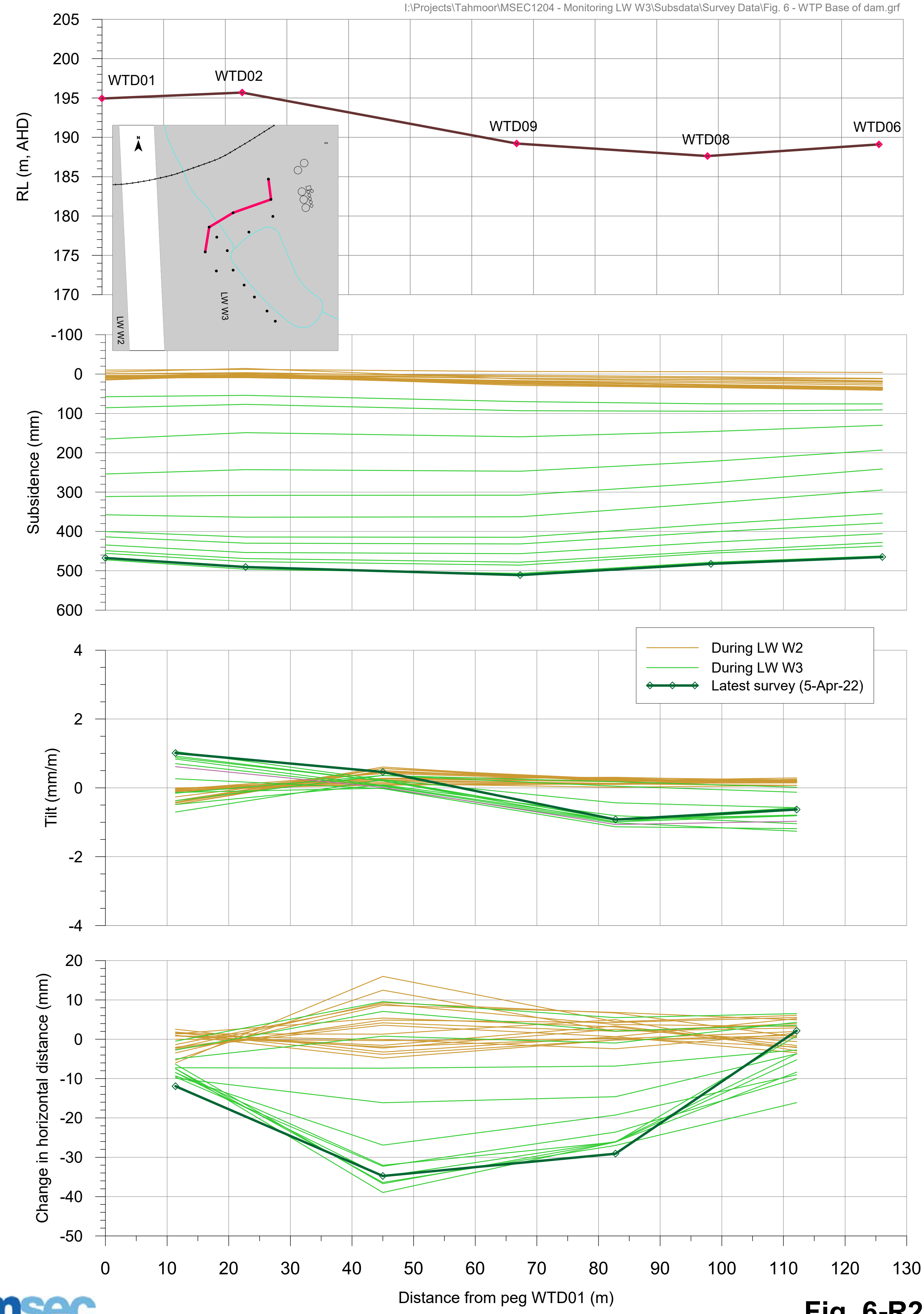
Tahmoor LW W3 - Stonequarry WTP
Total subsidence profiles along path of treated effluent



msec

Fig. 5-R27

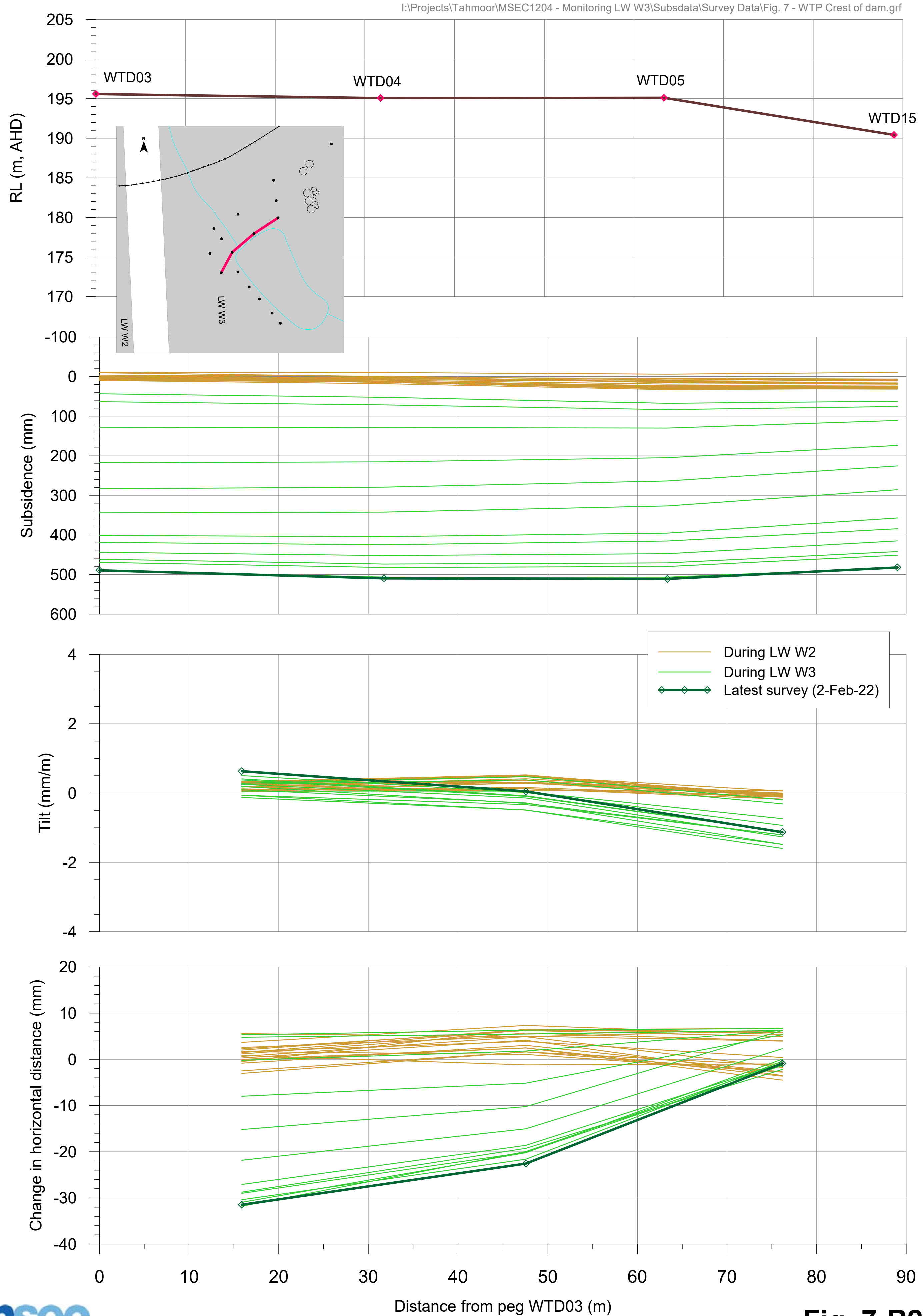
Tahmoor LW W3 - Stonequarry WTP
Total subsidence profiles along base of dam



msec

Fig. 6-R27

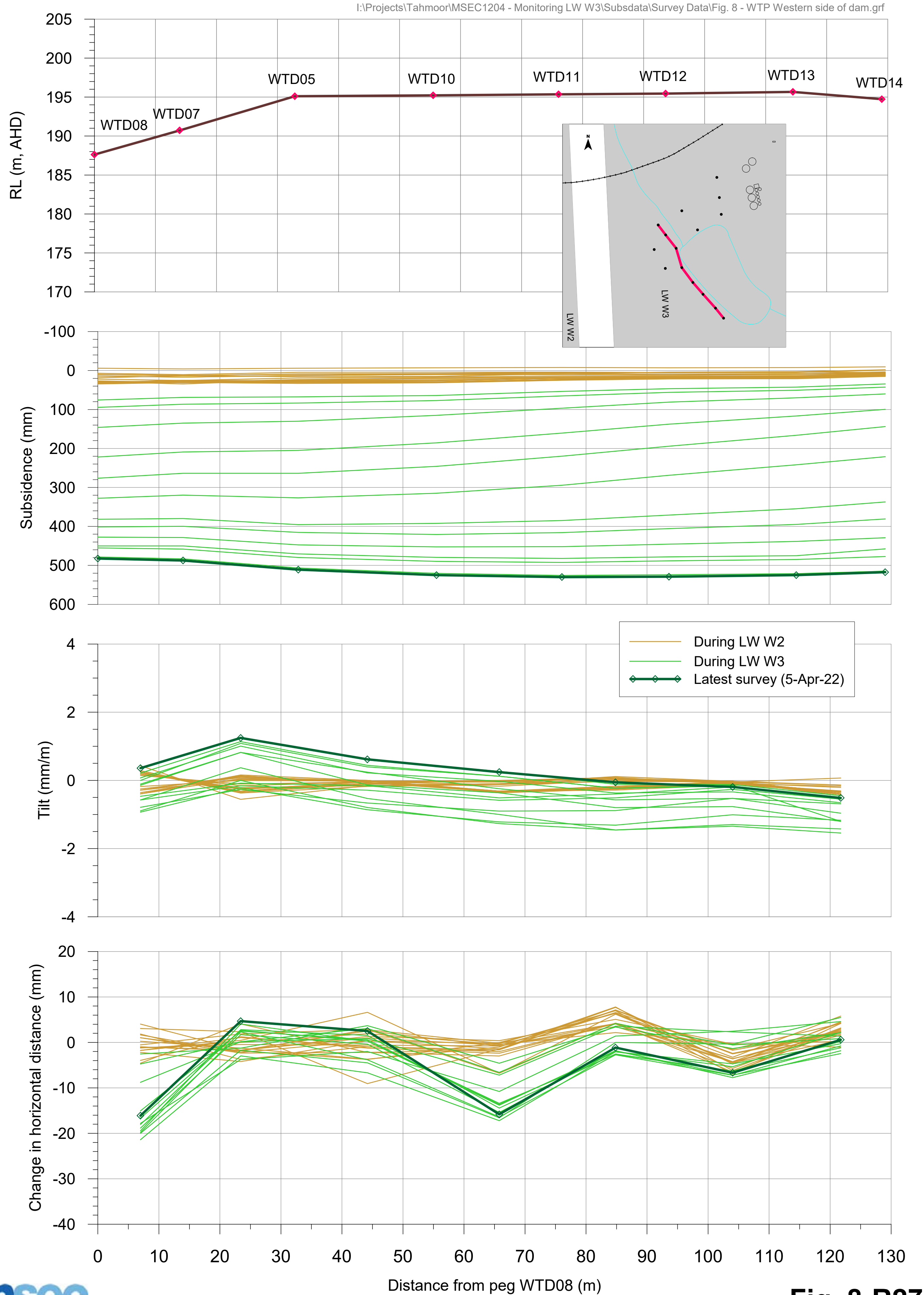
Tahmoor LW W3 - Stonequarry WTP
Total subsidence profiles along crest of dam



msec

Fig. 7-R27

Tahmoor LW W3 - Stonequarry WTP
Total subsidence profiles along western side of dam



msec

Fig. 8-R27

Tahmoor LW W3
Total subsidence profiles along LW W1-W3 Crossline

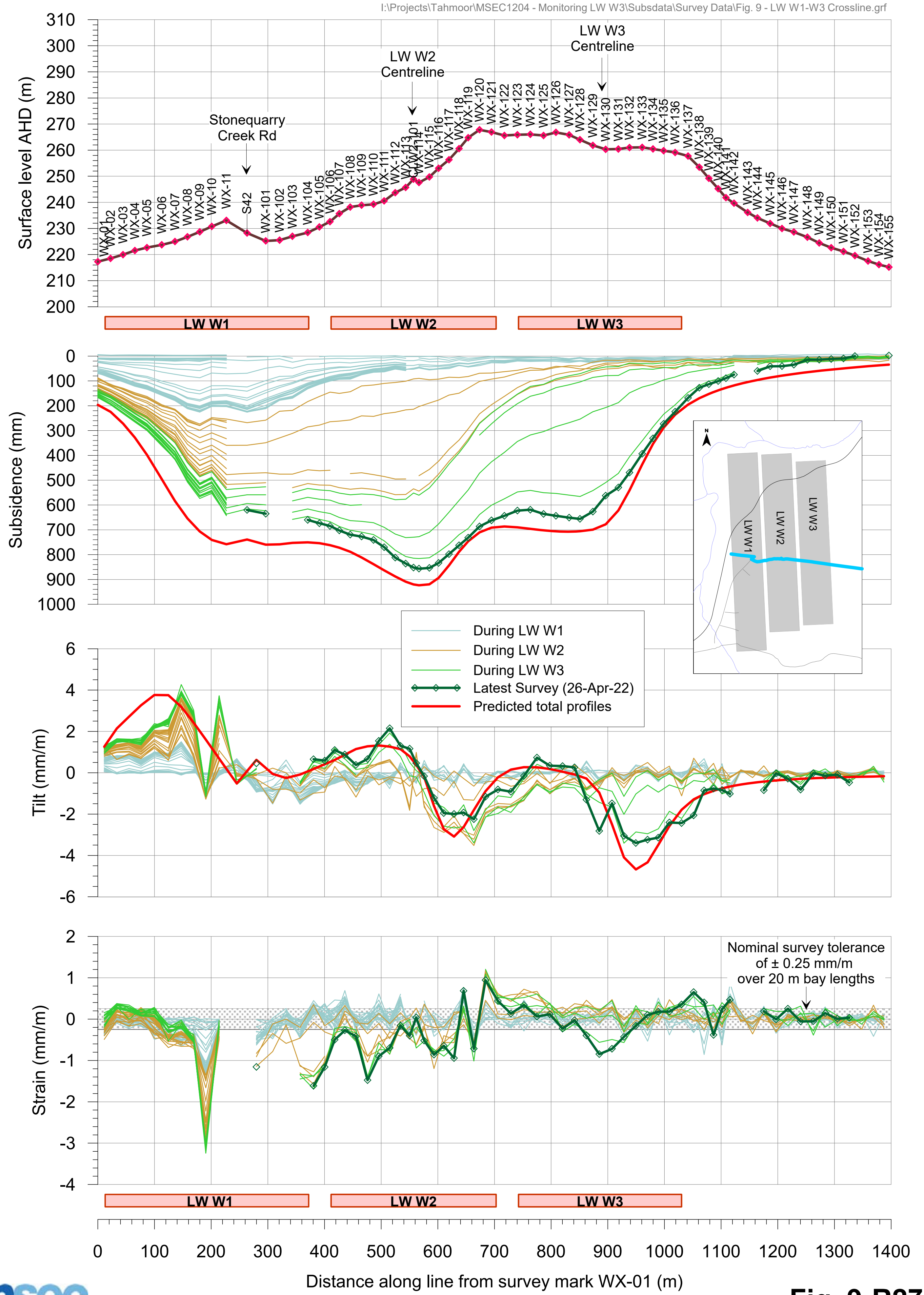
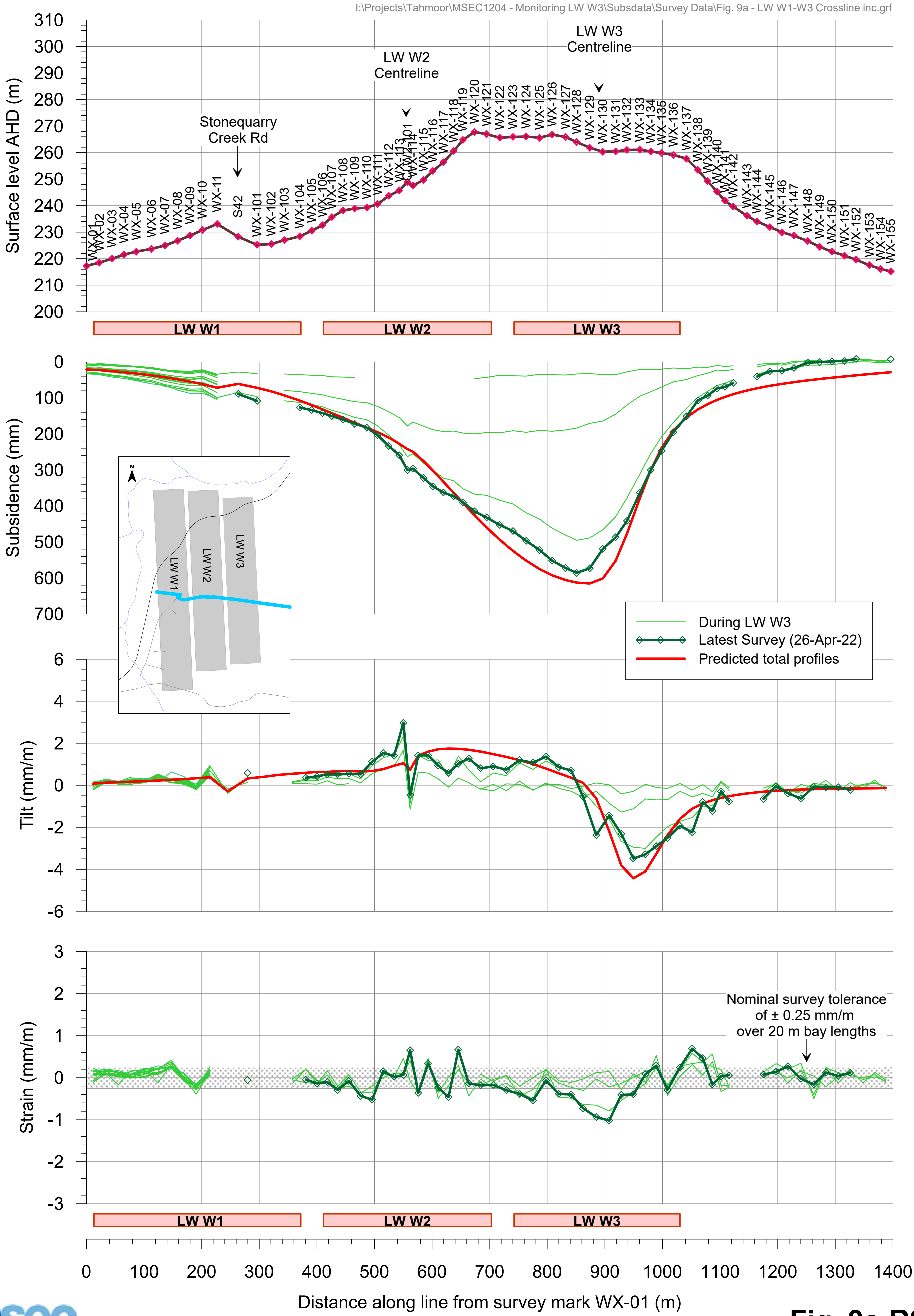


Fig. 9-R27

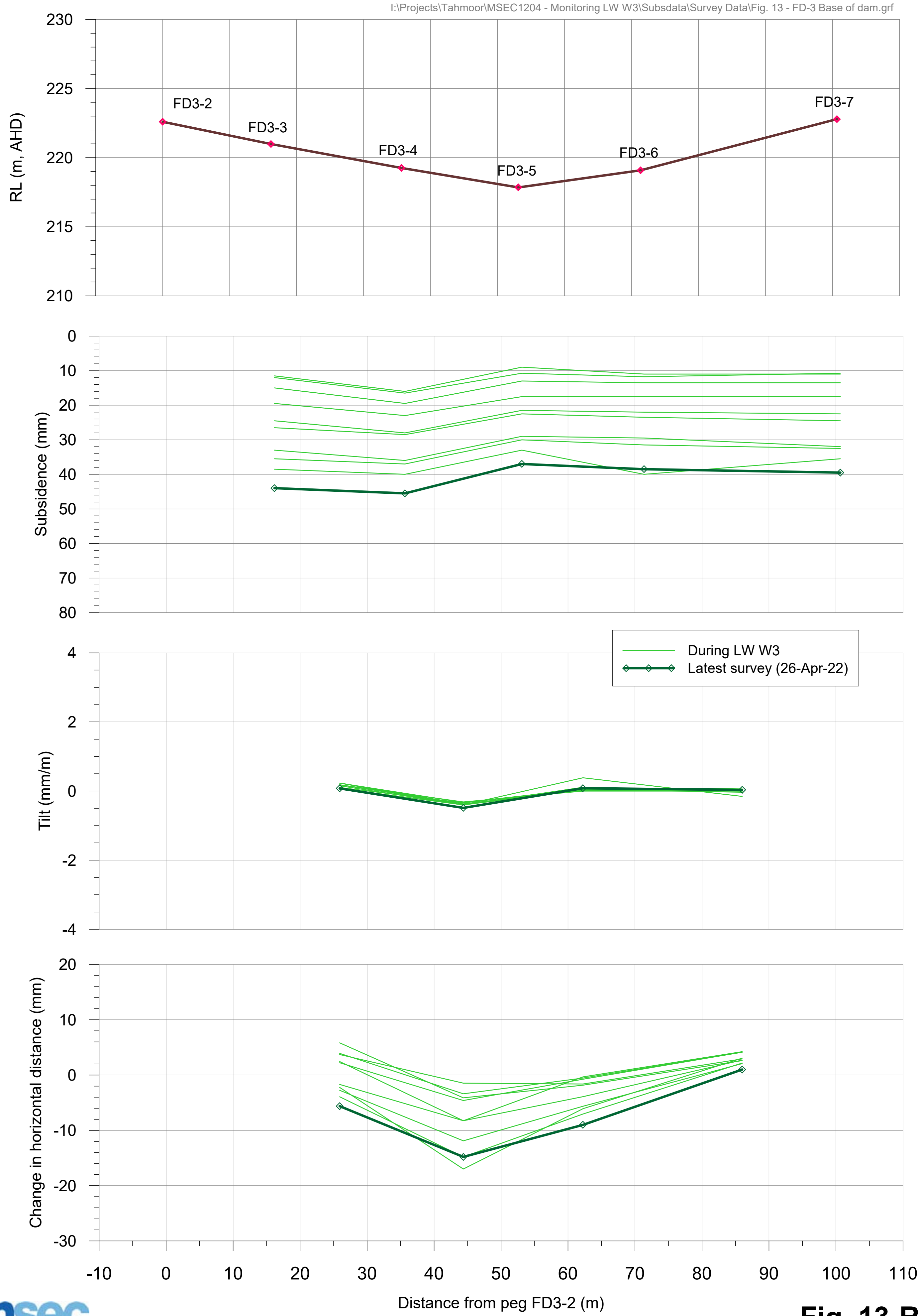
Tahmoor LW W3
Incremental subsidence profiles along LW W1-W3 Crossline



msec

Fig. 9a-R27

Tahmoor LW W3
Incremental subsidence profiles along base of dam FD-3



msec

Fig. 13-R27

Tahmoor LW W3
Incremental subsidence profiles along crest of dam FD-3

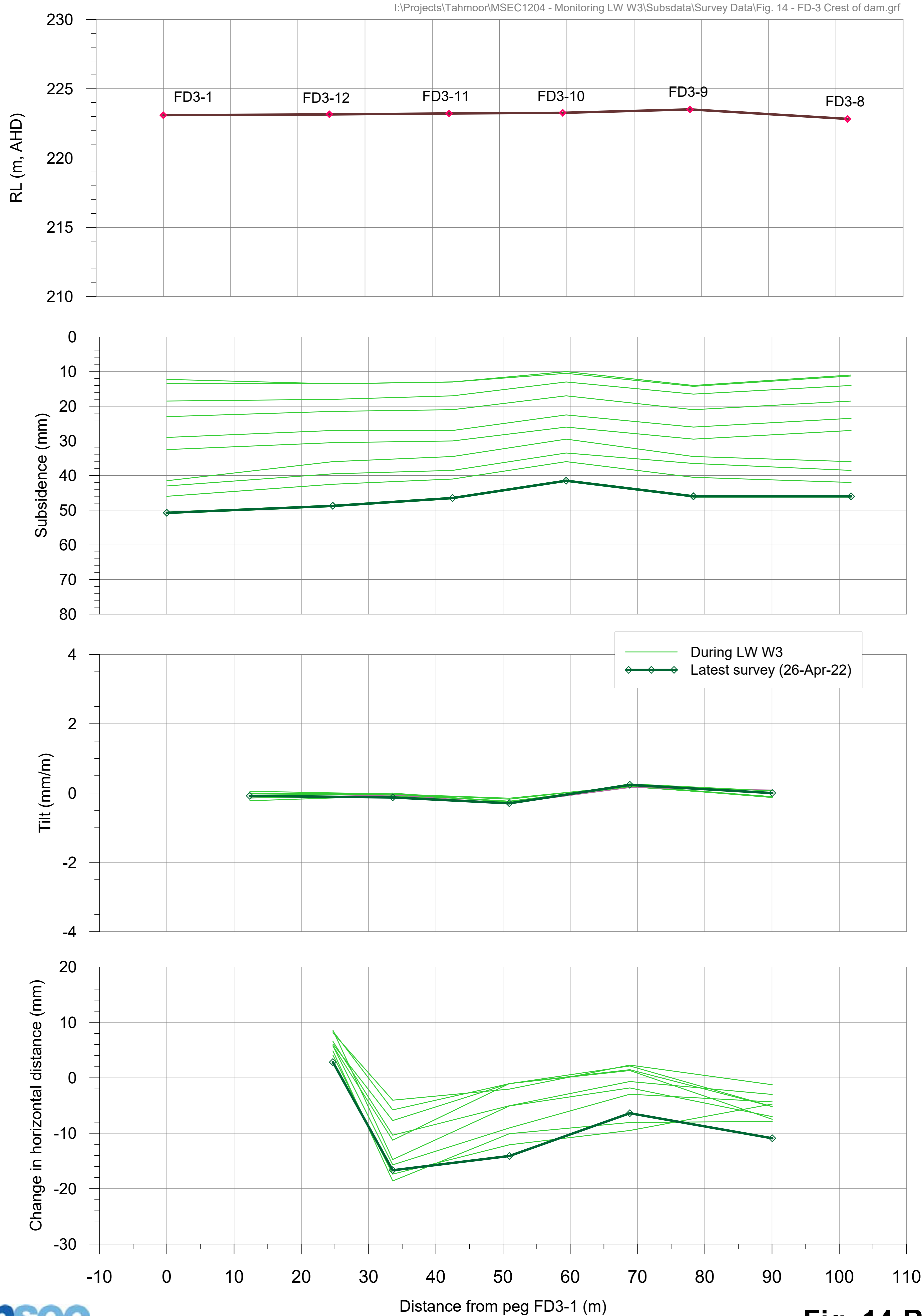
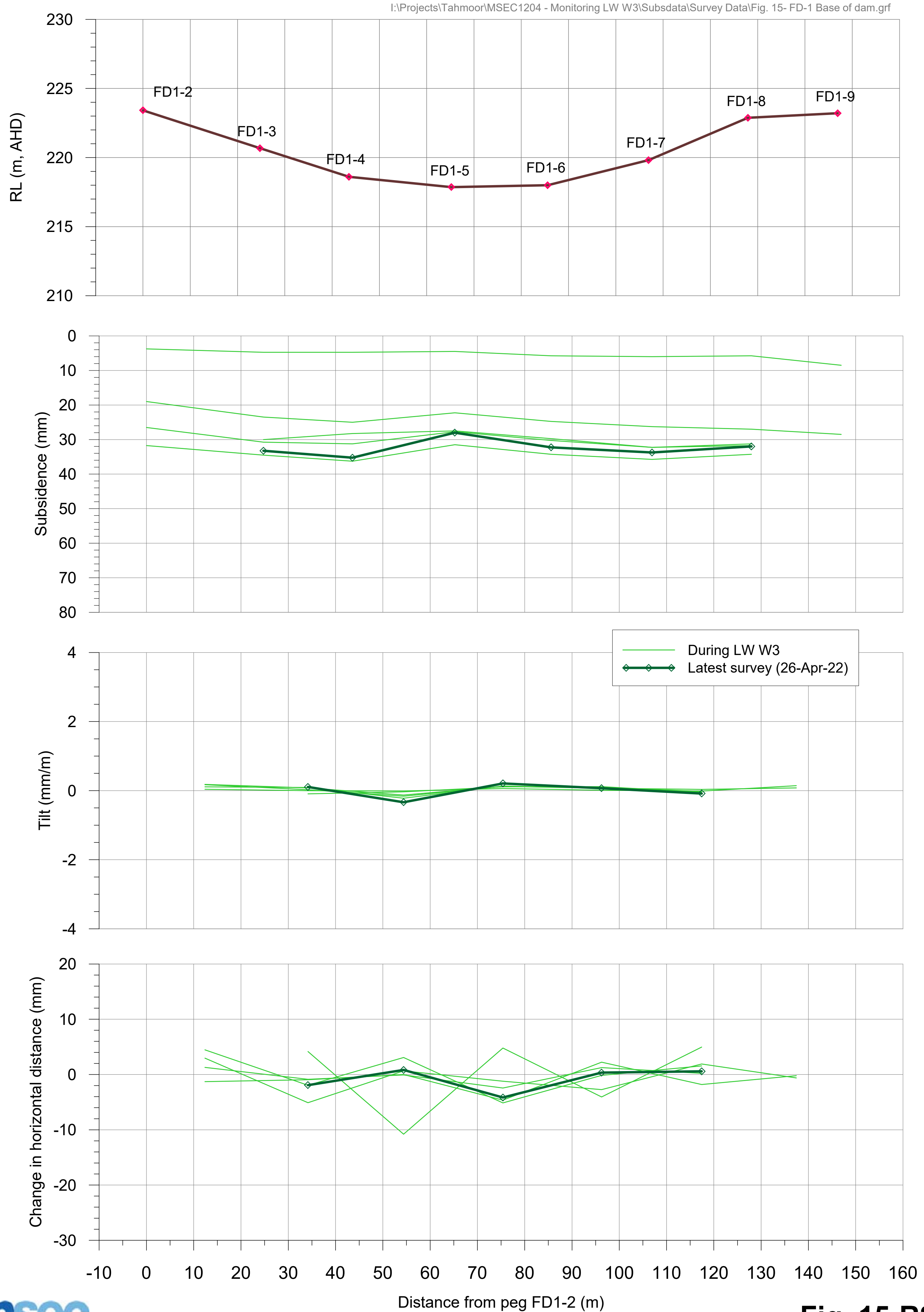


Fig. 14-R27

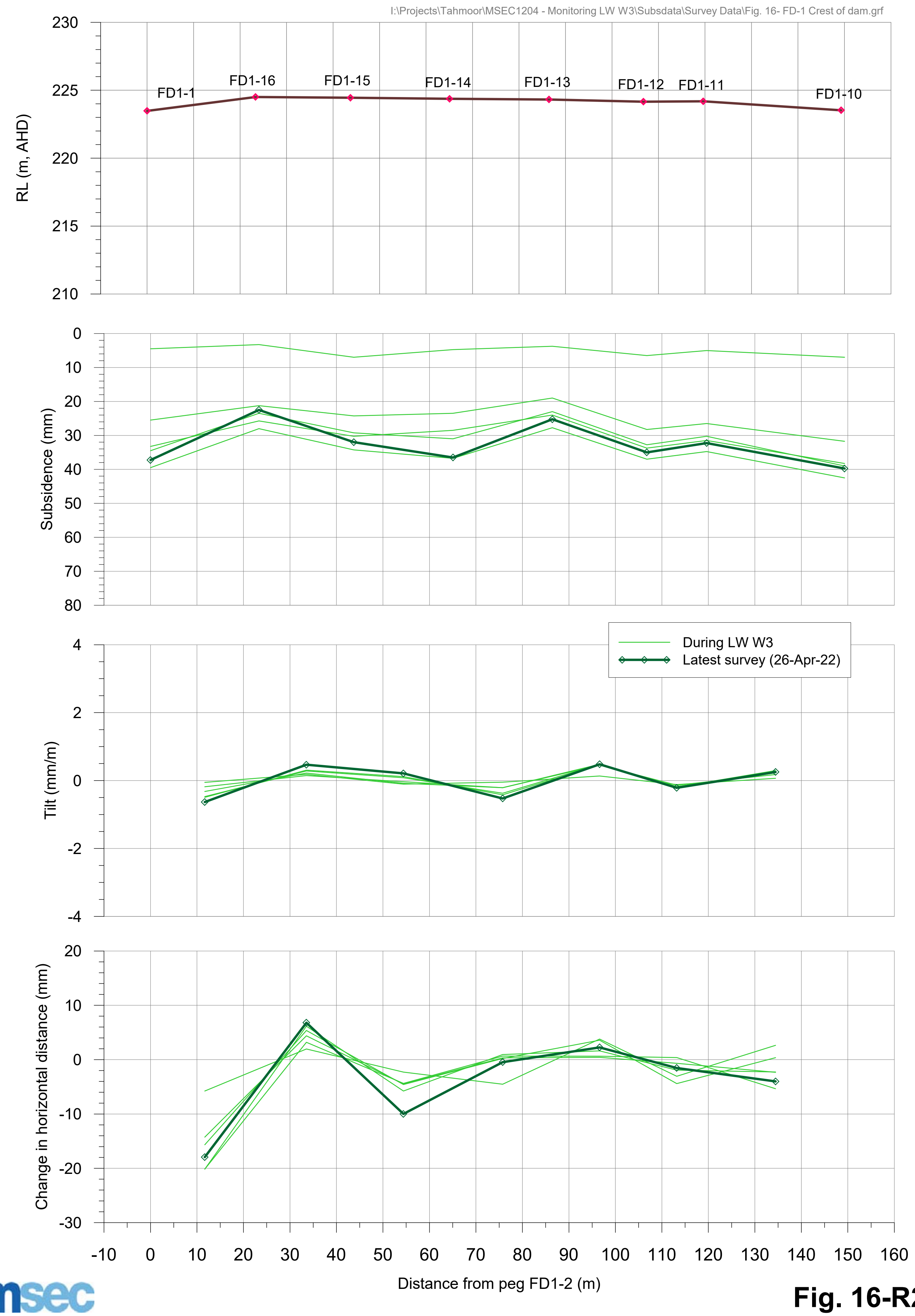
Tahmoor LW W3
Incremental subsidence profiles along base of dam FD-1



msec

Fig. 15-R27

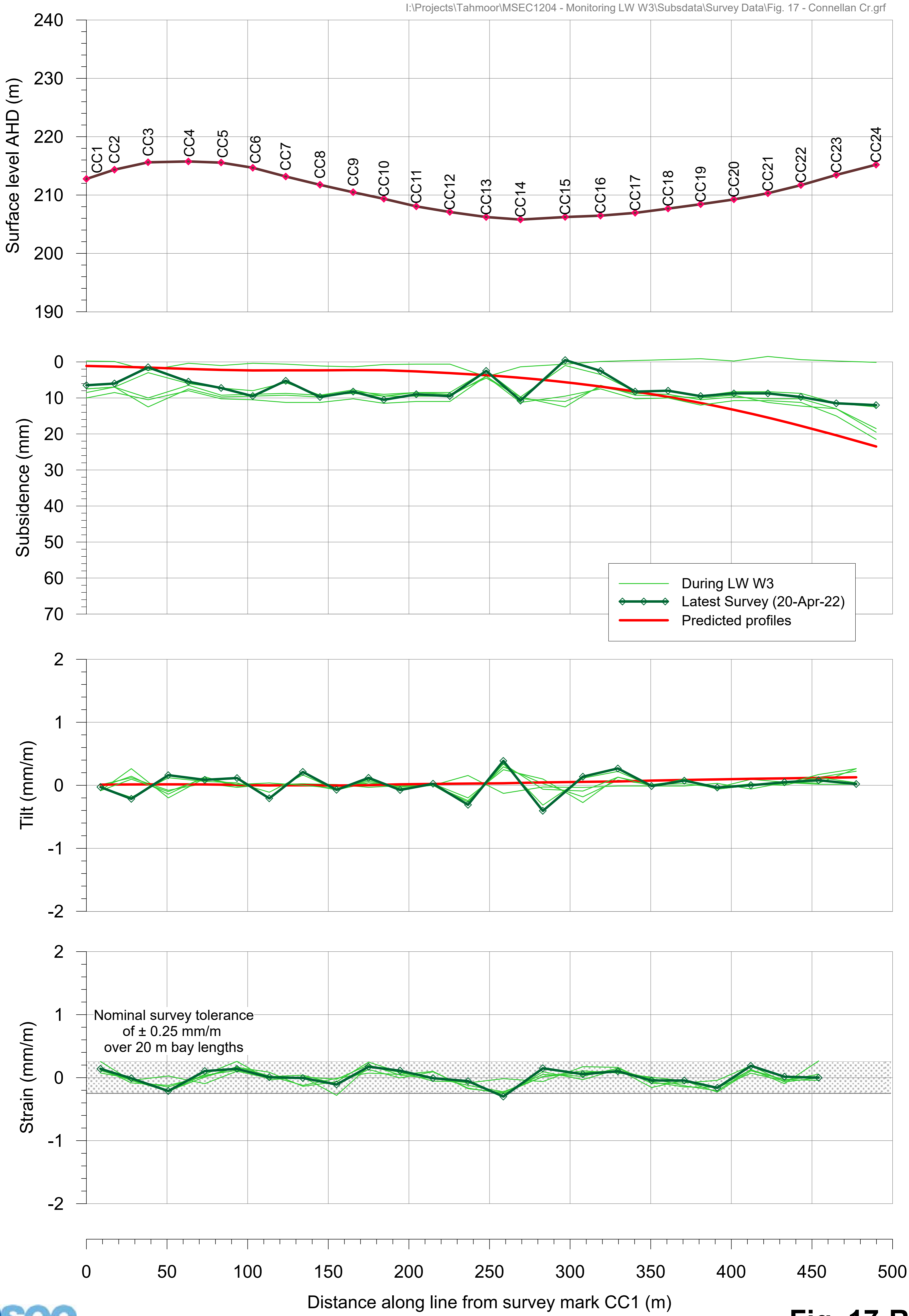
Tahmoor LW W3
Incremental subsidence profiles along crest of dam FD-1



msec

Fig. 16-R27

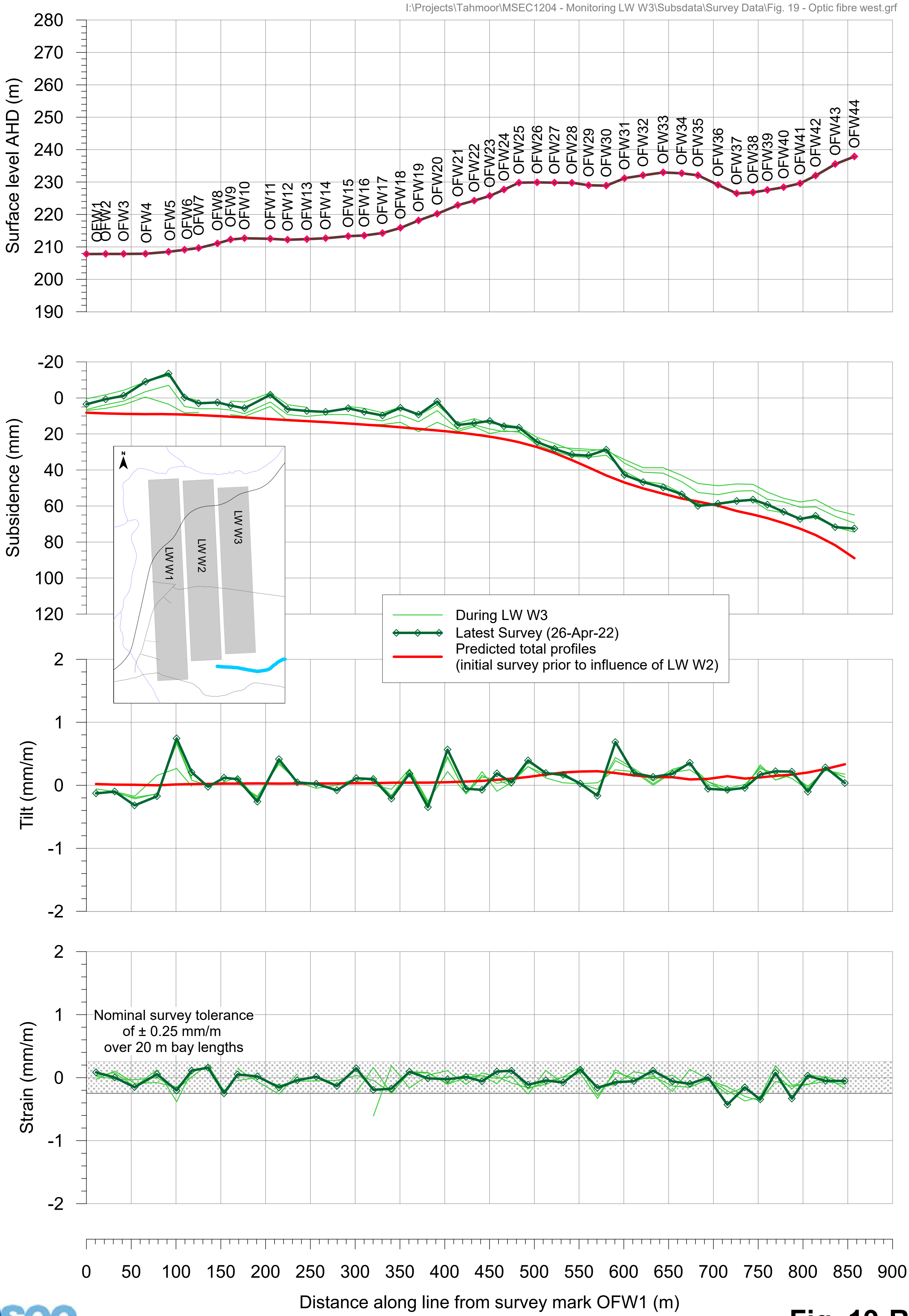
Tahmoor LW W3
Incremental subsidence profiles along Connellan Crescent



msec

Fig. 17-R27

Tahmoor LW W3
Total subsidence profiles along Optic Fibre West line



msec

Fig. 19-R27

Tahmoor LW W3
Incremental subsidence profiles along LW W4 Centreline

Fig. 20-R27

Appendix B – Surface Water Monitoring Report

ATC WILLIAMS

DRAFT REPORT

TAHMOOR COAL PTY LTD
ABN: 97076663968

Tahmoor North Western Domain

Surface Water Review
1 October 2021 to 16 / 24 March 2022

121171.8, R01, Rev E
June 2022

TAILINGS.WATER.WASTE.

Document Control

Project Name:	Tahmoor North Western Domain Surface Water Review
Document Title:	Six Monthly Review 1 October 2021 to 16 / 24 March 2022
File Location:	N:\Synergy\Projects\121\121171 1809 Tahmoor (SIMEC) Surface Water Assistance\8 LW W1 Monthly SW TARP Review\Documents\6 Monthly Reports\R01\121171.8-R01e.docx
Document Number:	121171.8-R01e.docx

Revision History

Revision	Issue	Issue Date	Prepared by	Reviewed by
e	Final	16/6/2022	Camilla West	Client

ATC Williams Company Details

Prepared By:	Camilla West
Approved By:	Tony Marszalek
Address:	Ground Floor, 16-20 Edmondstone St, Newmarket QLD 4051
Email:	camillaw@atcwilliams.com.au

CONTENTS

TABLES

MAPS

TAILINGS.WATER.WASTE.

1 INTRODUCTION

1.1 Background

In accordance with the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (Tahmoor Coal, 2021), Tahmoor Coal Pty Ltd (Tahmoor Coal) have committed to monthly review and analysis of surface water monitoring data recorded at sites within and adjacent to the Tahmoor North Western Domain (the Western Domain). The outcomes of the analysis are assessed against the performance measures, performance indicators and Trigger Action Response Plan (TARP) documented in the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (WMP).

Tahmoor Coal have developed a comprehensive rainfall, surface water and groundwater monitoring network within and adjacent to the Western Domain. The monitoring network comprises rainfall stations, water level monitoring sites, water quality monitoring sites and visual inspection sites. The locations of the relevant rainfall stations, surface water and groundwater monitoring sites and visual inspection sites are shown in Map 1.

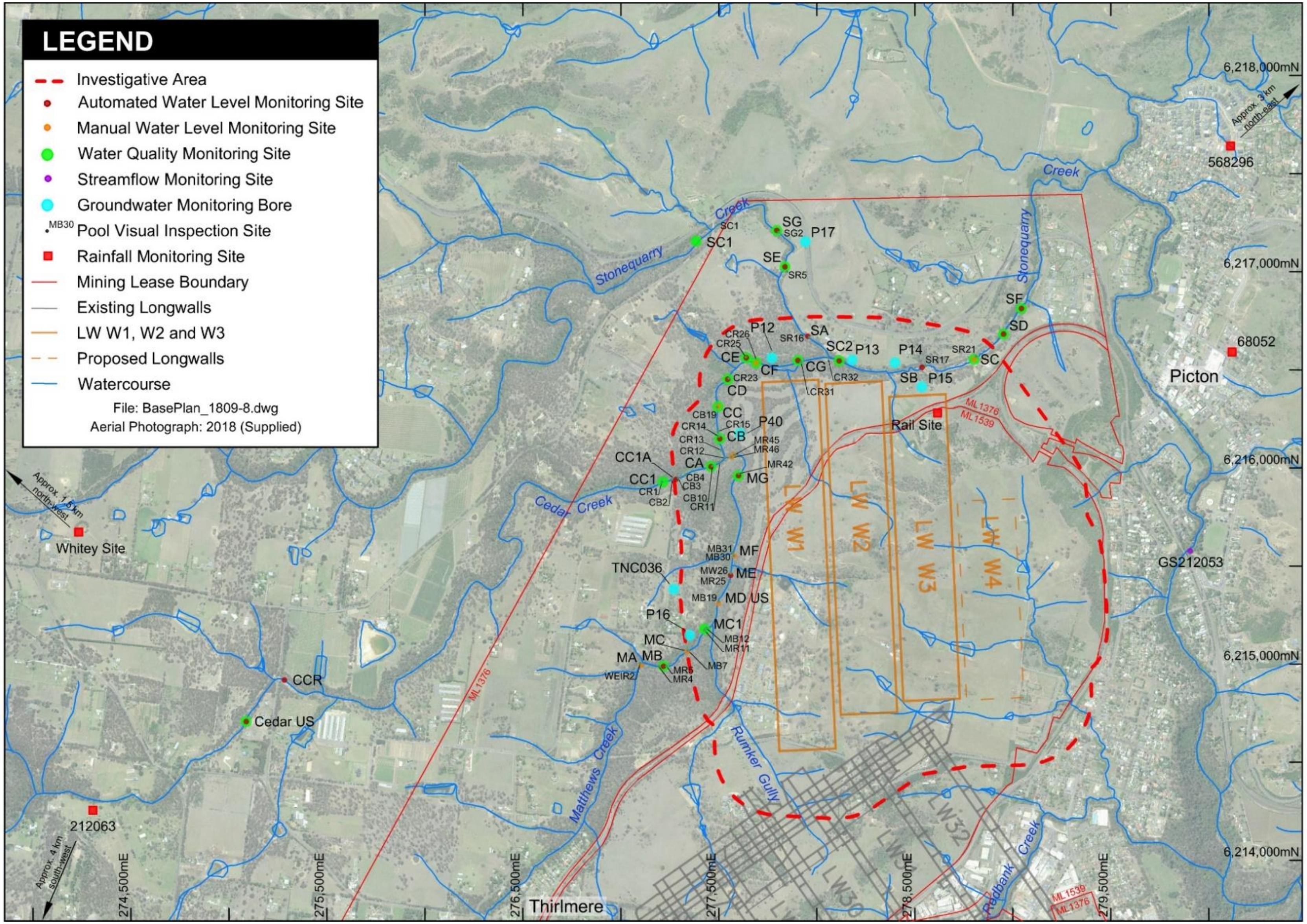
Mining of Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 12 March 2022. Mining of Longwall West 4 (LW W4) commenced on 16 May 2022.

1.2 Scope of Work

This report documents a review undertaken by ATC Williams Pty Ltd (ATCW) of the environmental performance of the LW W3 mining activities in relation to surface water (water resources and watercourses) within and adjacent to the Western Domain Investigative Area for the review period 1 October 2021 to 16 / 24 March 2022[1]. The Western Domain Investigative Area is shown in Map 1. The report forms a component of the *Subsidence Impact Report* for the Tahmoor North Western Domain and comprises:

- review and interpretation of monitoring data;
- assessment against the performance measures and performance indicators for surface water; and
- recommendations in relation to ongoing monitoring or corrective actions.

[1] Data was collected for a portion of the monitoring sites on 16 March and the remainder on 24 March 2022.



MAP 1: RELEVANT RAINFALL, SURFACE WATER AND GROUNDWATER MONITORING SITES

2 SURFACE WATER MONITORING DATA REVIEW

The following sections present a summary of the surface water monitoring data recorded for the review period at monitoring sites in Matthews Creek, Cedar Creek and Stonequarry Creek (refer Map 1 for site locations). Further review and interpretation of monitoring data in relation to the relevant TARP is presented in Section 3.2.

2.1 Surface Water Level Data

Surface water level data has been collected by Tahmoor Coal at monitoring sites located on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in Map 1. Continuous surface water level data has been recorded at three pool monitoring sites on Matthews Creek, eight monitoring sites on Cedar Creek and seven monitoring sites on Stonequarry Creek. The surface water level data has been recorded hourly using water level sensors. Manual water level measurements have also been collected monthly by Tahmoor Coal at the sites shown in Map 1.

Appendix A provides charts of the automated and manual water level data for the full period of record. Note that the cease to flow (CTF) level shown on the automated water level plots refers to the point at which surface water ceases to flow over the streamflow control i.e. the lowest point on a controlling rockbar or boulder field. In the event that streamflow over the rockbar or boulder field ceases, there may still be streamflow around, through or under the rockbar / boulder field control which reports downstream of the control.

The following is noted in relation to the monitoring data recorded during the current review period:

- Monitoring site CCR - the reference bolt at monitoring site CCR has not been located and as such the raw data recorded from 8 December 2021 was unable to be converted to a water level measurement.
- Monitoring site SA – data for the period between 15 January and 5 February 2022 was lost.
- Monitoring site SC2 - the logger has not been located since 7 December 2021 and therefore no data is available since this date.
- Monitoring site SB - the logger was washed away during a major rainfall event that occurred from late February to early March 2022 and as such no data is available since 5 February 2022.
- Monitoring site SD - the reference bolt at monitoring site SD has not been located and as such the raw data recorded from 7 December 2021 was unable to be converted to a water level measurement.
- The manual water level measurements have not been recorded for some sites due to access restrictions (i.e. high flow conditions) or at sites where the reference bolt has not been located.

The logger at monitoring site SB is to be replaced once the water level has sufficiently receded to enable installation. Additionally, the logger at monitoring site SC2 is to be located once the water level has sufficiently receded.

Table 1 presents a summary of the water level monitoring data for the review period, 1 October 2021 to 16 / 24 March 2022. The summary is presented for each pool in which an automated water level sensor is installed, while Appendix A provides charts of the water level data for all monitoring sites (including manual water level monitoring sites) and daily rainfall. Daily rainfall data is from the 'Rail Site' rainfall gauge (refer Map 1) and, prior to the commissioning of this station, the Lake Nerrigorang rainfall station (WaterNSW Station 212063). The 'baseline minimum' refers to the period of monitoring from commencement to the end of the extended low rainfall period in late 2019 to mid-January 2020.

TABLE 1: SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD

Monitoring Site	Natural Control Characteristics	Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022
Matthews Creek		
MB (Pool MR5) Reference Site	Rockbar constrained	The monitoring records indicate that the water level remained above the baseline minimum for the duration of the review period. In late February 2022, the water level declined slightly below the CTF level and then rose in response to a rainfall event and was recorded above the CTF level at the end of the review period (Figure A2, Appendix A).
ME (Pool MR25) Potential Impact Site	Boulder/rockbar constrained	The water level records indicate that the water level remained above the baseline minimum for the duration of the review period. Consistent with historical behaviour, the water level declined very slightly below the CTF level in mid-October 2021 and late February 2022. For the remainder of the review period, the water level was recorded above the CTF level (Figure A5, Appendix A).
MG (Pool MR42) Potential Impact Site	Boulder constrained	The water level records indicate that the water level remained above the baseline minimum and CTF level for the duration of the review period (Figure A7, Appendix A).
Cedar Creek		
CCR Reference Site	Weir	The water level at reference site CCR is influenced by backwater effects from a large weir downstream during and following high rainfall periods. As such, the water level records are not necessarily reflective of natural water level conditions during these periods. Notwithstanding, the recorded water level at CCR remained above the CTF level for the duration of the available data for monitoring period – i.e. to 8 December 2021 (Figure A8, Appendix A).
Cedar US Reference Site	Rockbar constrained	The water level records indicate that the water level remained above the CTF level and the previously recorded minimum for the duration of the review period (Figure A9, Appendix A).
CC1A (Pool CB3) Reference Site	Boulder/rockbar constrained	The water level records indicate that the water level remained above the baseline minimum and the CTF level for the duration of the review period (Figure A10, Appendix A).

TABLE 1 (CONT.): SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD

Monitoring Site	Natural Control Characteristics	Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022
Cedar Creek		
CA (Pool CB10) Potential Impact Site	Boulder constrained	The monitoring records indicate that the water level remained above the baseline minimum for the duration of the review period. Consistent with historical behaviour, the water level declined very slightly below the CTF level for brief periods on 9 October 2021 and from 1 to 4 November 2021 (Figure A11, Appendix A).
CB (Pool CR14) Potential Impact Site	Rockbar constrained	The monitoring records indicate that the water level declined below the baseline minimum for parts of October and November 2021, with a maximum decline of 35 mm below the baseline minimum recorded on 3 November 2021. The water level rose in response to subsequent rainfall events and was recorded above the CTF level and baseline minimum for the remainder of the review period (Figure A12, Appendix A).
CD (Pool CR23) Potential Impact Site	Rockbar/boulder constrained	The monitoring records indicate that the water level declined very slightly below the baseline minimum for brief periods in October and November 2021. The water level rose in response to subsequent rainfall events and remained above the CTF level and baseline minimum for the remainder of the review period (Figure A14, Appendix A).
CE (Pool CR25) Potential Impact Site	Rockbar/boulder constrained	The monitoring records indicate that the water level declined very slightly below the baseline minimum for brief periods in February 2022, however, remained above the CTF level. The water level rose in response to a major rainfall event in early March 2022 and remained above the baseline minimum for the remainder of the review period (Figure A15, Appendix A).
CG (Pool CR31) Potential Impact Site	Rock shelf constrained	The water level records indicate that the water level remained above the baseline minimum and the CTF level for the duration of the review period (Figure A17, Appendix A).

TABLE 1 (CONT.): SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD

Monitoring Site	Natural Control Characteristics	Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022
Stonequarry Creek		
SG (Pool SG2) Reference Site	Rock shelf constrained	The monitoring records for reference site SG indicate that the water level declined to a historically low level for brief periods on 3 November 2021 (noting that there is no baseline data available for this site – i.e. monitoring did not commence until after the start of LW W1). The water level then rose in response to rainfall events and remained above the previously recorded minimum for the remainder of the review period (Figure A18, Appendix A).
SE (Pool SR5) Reference Site	Rockbar constrained	The monitoring records indicate that the water level remained above the previously recorded minimum for the duration of the review period (Figure A19, Appendix A).
SA (Pool SR16) Potential Impact Site	Rockbar/boulder constrained	The water level records indicate that the water level remained above the baseline minimum and CTF level for the duration of the available data for the monitoring period (Figure A20, Appendix A).
SC2 (Pool SR17) Potential Impact Site	Rockbar constrained	The water level records indicate that the water level remained above the historical minimum water level for the duration of the available data for the monitoring period – i.e. to 7 December 2021 (Figure A21, Appendix A).
SB (Pool SR17) Potential Impact Site	Rockbar constrained	The monitoring records indicate that the water level remained above the baseline minimum for the duration of the available data for the monitoring period – i.e. to 5 February 2022 (Figure A22, Appendix A).
SD Potential Impact Site	Rockbar constrained	The monitoring records indicate that the water level did not decline below the baseline minimum or the CTF level for the duration of the available data for the monitoring period – i.e. to 7 December 2021 (Figure A24, Appendix A).
SF Potential Impact Site	Rockbar constrained	The monitoring records indicate that the water level remained above the previously recorded minimum and the CTF level for the duration of the monitoring period (Figure A25, Appendix A).

2.2 Surface Water Quality

Surface water quality monitoring has been conducted at the following sites (refer Map 1 for locations):

Baseline / Impact Site

- Cedar Creek (CA, CB, CC, CD, CE, CF, CG)
- Matthews Creek (MC1, MG)
- Stonequarry Creek (SC2, SC, SD, SF)

Reference / Control Site

- Cedar Creek (Cedar US, CC1)
- Matthews Creek (MB)
- Stonequarry Creek (SC1, SE, SG)

Water quality monitoring commenced at monitoring sites CC1, CB, CG, MC1, MG, MB, SC1, SC2, SD and SC in January 2019; monitoring site CA in June 2019; monitoring site SE in April 2020; monitoring site SF in May 2020; monitoring site SG in September 2020; monitoring site Cedar US in October 2020 and monitoring sites CC, CD, CE and CF in January 2021.

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen (DO), temperature and oxidation reduction potential (ORP). Laboratory analyses are undertaken for pH, EC, total dissolved solids (TDS), alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, fluoride, nitrate+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.

Monitoring results for key constituents are shown on a series of plots in Appendix B and summarised in Table 2.

TABLE 2: SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD

Constituent	**Matthews Creek:** MB (reference site), MC1 and MG (potential impact sites)	**Cedar Creek:** Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites)	**Stonequarry Creek:** SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites)
pH (Figure B1, Appendix B)	The field pH values indicate near neutral pH conditions for the duration of the review period, consistent with baseline values.	The field pH values indicate slightly acidic to near neutral conditions for the duration of the review period. Generally higher pH values were recorded during the review period in comparison to the baseline period.	The field pH values indicate near neutral to slightly alkaline pH conditions for the duration of the review period. Historically high pH values were recorded at monitoring sites SD and SF and at reference site SG in March 2022. The pH values recorded at all other monitoring sites were generally consistent with baseline values.
Electrical Conductivity (Figure B3, Appendix B)	Field EC values were consistent with baseline values for the duration of the review period (less than 337 µS/cm at all sites).	Field EC values were generally less than baseline values for the duration of the review period (less than 568 µS/cm at all sites).	Field EC values were consistent with or less than baseline values for the duration of the review period (less than 862 µS/cm at all sites).
Dissolved Aluminium (Figure B5, Appendix B)	Dissolved aluminium concentrations were elevated in January and March 2022 in comparison to the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. However, the concentrations were consistent with baseline values (equal to or less than 0.13 mg/L at all sites).	Dissolved aluminium concentrations were elevated in January, February and March 2022 in comparison with the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded in January and February at reference site CCR and in March 2022 at all monitoring sites with the exception of CC1 and CB.	Dissolved aluminium concentrations were elevated in January and March 2022 in comparison with the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded at all monitoring sites, except SC1, in March 2022 including at reference sites SE and SG.

TAILINGS.WATER.WASTE.

TABLE 2 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD

Constituent	**Matthews Creek:** MB (reference site), MC1 and MG (potential impact sites)	**Cedar Creek:** Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites)	**Stonequarry Creek:** SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites)
Dissolved Barium (Figure B6, Appendix B)	Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.027 mg/L at all sites and generally consistent with baseline values.	Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.2 mg/L at all sites and generally less than baseline values.	Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.1 mg/L at all sites and consistent with or less than baseline values.
Dissolved Iron (Figure B7, Appendix B)	Dissolved iron concentrations were slightly elevated from December 2021 to March 2022 in comparison to the remainder of the review period, including at reference site MB, however were generally consistent with baseline values.	An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at all sites were equal to or less than 2.55 mg/L and generally consistent with baseline values.	An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at each monitoring site were equal to or less than 1.88 mg/L and generally consistent with baseline values.
Dissolved Manganese (Figure B8, Appendix B)	Dissolved manganese concentrations recorded over the duration of the review period were less than 0.157 mg/L at all sites and consistent with or less than baseline values.	Dissolved manganese concentrations recorded at all sites for the duration of the review period were less than 0.613 mg/L and less than baseline values.	Dissolved manganese concentrations recorded at all sites for the duration of the review period were less than or equal to 0.461 mg/L and consistent with baseline values.
Dissolved Nickel (Figure B9, Appendix B)	Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the review period and consistent with baseline values.	Dissolved nickel concentrations were less than 0.004 mg/L at all sites during the review period and generally less than baseline values.	Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the review period and consistent with or less than baseline values.

TABLE 2 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD

Constituent	Matthews Creek: MB (reference site), MC1 and MG (potential impact sites)	Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites)	Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites)
Dissolved Zinc (Figure B10, Appendix B)	Dissolved zinc concentrations were equal to or less than 0.009 mg/L at all sites during the review period and consistent with baseline values.	Dissolved zinc concentrations were equal to or less than 0.035 mg/L at all sites during the review period and consistent with baseline values.	Dissolved zinc concentrations were less than 0.017 mg/L at all sites during the review period and consistent with baseline values.
Sulphate (Figure B11, Appendix B)	Sulphate concentrations recorded at all sites during the review period were equal to or less than 8 mg/L and consistent with baseline values.	Sulphate concentrations recorded at all sites during the review period were equal to or less than 8 mg/L and consistent with baseline values.	A decreasing trend in sulphate concentrations was recorded at all sites over the duration of the review period. The sulphate concentrations recorded at all sites were equal to or less than 15 mg/L and consistent with or less than baseline values.

3 ASSESSMENT AGAINST SURFACE WATER TARPS

3.1 Subsidence Impact Performance Measures – Natural Features

As detailed in the WMP, TARPs have been developed for the Western Domain to set out response measures for unpredicted subsidence impacts to surface water. The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in the Western Domain against the subsidence impact performance measures specified in Table 3. This report addresses the first subsidence impact performance measure listed in Table 3 while the second performance measure is addressed in SLR (2022).

TABLE 3: SUBSIDENCE IMPACT PERFORMANCE MEASURES – NATURAL FEATURES

Surface Water System	Subsidence Impact Performance Measure	Exceedance of Performance Measure
Stonequarry Creek, Cedar Creek and Matthews Creek	No subsidence impact or environmental consequence greater than minor*	The performance measure 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 Investigative Area; and/or • Pool SR17.
	No connective cracking between the surface, or the base of the alluvium, and the underground workings	The performance measure 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.

* Minor is defined as *not very large, important or serious.*

3.2 Impact to Pool Water Level, Physical Features and Natural Behaviour

3.2.1 Significance Triggers for Automated Pool Water Level and Physical Features

The significance levels / triggers, as detailed in the WMP, are summarised in Table 4 for pool water level and in Table 5 for physical features and natural behaviour of pools. In accordance with the WMP, the pool water level data and visual inspection observations have been assessed against the tabulated criteria for each trigger level.

TAILINGS.WATER.WASTE.

TABLE 4: SIGNIFICANCE LEVELS / TRIGGERS FOR POOL WATER LEVEL

	Pool Water Level
Level 1	The recorded water level has not declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) OR the recorded water level has declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) but the decline is due to a monitoring or sensor error or the magnitude of the decline (below the recorded baseline minimum level) is within the range of sensor accuracy.
Level 2	The recorded water level has declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has occurred at one of the upstream pools (beyond mining effects).
Level 3	The recorded water level has declined, although not atypically*, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects).
Level 4	The recorded water level has declined atypically* below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND similar behaviour has not occurred at one of the upstream pools (beyond mining effects).

* 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the CTF level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

TABLE 5: SIGNIFICANCE LEVELS / TRIGGERS FOR PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS

Level	Physical Features and Natural Behaviour of Pools
Level 1	No observed impacts to pool level, drainage or overland connected flow.
Level 2	Visually observed reduction in pool level, drainage or overland connected flow AND the above has occurred at one of the upstream pools (beyond mining effects) OR visual monitoring of pools has not noted any mining related impacts*.
Level 3	Rockbar and / or stream base cracking, gas release or iron precipitation noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period.
Level 4	Visually observed reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period AND the above change has not occurred at one of the upstream pools (beyond mining effects).

* Rockbar and/or stream base cracking, gas release or iron precipitation in excess of baseline conditions.

3.2.2 Assessment of Automated Pool Water Level Data and Visual Inspection Observations

A summary of the pool water level, physical features and natural behaviour TARP significance levels for potential impact sites over the duration of the review period is presented in Table 6 and discussed in the sections which follow.

TABLE 6: SURFACE WATER TARP SIGNIFICANCE LEVELS – 1 OCTOBER 2021 TO 16 / 24 MARCH 2022

Date	Location(s)	Comment	TARP Significance
Surface Water Level			
1 October 2021 – 16 March 2022	All monitoring sites excluding MB, ME, SB, SC2, SD and CB	The recorded water level did not decline below the baseline minimum level (in one 24 hour period)	Level 1
1 October 2021 – 24 March 2022	Monitoring sites MB and ME	The recorded water level did not decline below the baseline minimum level (in one 24 hour period)	Level 1
1 October – 7 December 2021^	Monitoring sites SC2 and SD	The recorded water level did not decline below the baseline minimum level (in one 24 hour period)	Level 1
1 October 2021 – 5 February 2022^	Monitoring site SB	The recorded water level did not decline below the baseline minimum level (in one 24 hour period)	Level 1
1 – 4 October 2021; 12 – 18 October 20211; 24 – 27 October 2021; 6 November 2021 – 16 March 2022	Monitoring site CB (pool CR14) in Cedar Creek	The recorded water level did not decline below the baseline minimum level (in one 24 hour period)	Level 1
5 – 11 October 2021		The water level declined by a maximum of 16 mm below the baseline minimum	Level 3
19 – 23 October 2021		The water level declined by a maximum of 20 mm below the baseline minimum	Level 3
28 October – 5 November 2021		The water level declined by a maximum of 35 mm below the baseline minimum	Level 3
Physical Features and Natural Behaviour of Pools			
1 October 2021 – 17 March 2022	All monitoring sites excluding SB	No observed impacts to pool level, drainage behaviour or overland connected flow	Level 1*
1 – 27 October 2021	Monitoring site SB (pool SR17)	No observed impacts to pool level, drainage behaviour or overland connected flow	Level 1*
28 October 2021 – 24 February 2022+	Monitoring site SB (pool SR17)	Laminar fractures and extension of natural fracture	Level 3*

* Source: BES (2021a, 2021b, 2021c) and BES (2022a, 2022b, 2022c)

\+ Visual inspection was unable to be conducted in March due to high water flow over the rockbar at pool SR17 (BES, 2022c)

^ Data has not been able to be recorded or corrected for the remainder of the review period

Matthews Creek and Stonequarry Creek

To date, there has been negligible evidence of an influence of mining of LW W3 on pool surface water level or surface water behaviour in Matthews Creek or Stonequarry Creek. The water level behaviour of monitoring sites in Matthews Creek and Stonequarry Creek following commencement of mining has been consistent with baseline conditions and/or consistent with reference site conditions throughout the review period. As such, this equates to a Level 1 TARP significance in relation to water level for all monitoring sites in Matthews Creek and Stonequarry Creek.

Pool SR17 was initially reported at a Level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienen Environment & Safety (2021b) reported this as laminar fracturing and extension of a natural crack in the rockbar following the inspection on 17 November 2021. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for the period including and following 17 November 2021.

The water level records for pool SR17 have been assessed with consideration to the surficial fracturing of the controlling rockbar and summarised in Section 3.2.3.

Cedar Creek

The water level behaviour of monitoring sites in Cedar Creek, with the exception of monitoring sites CB was consistent with baseline conditions and / or consistent with reference site conditions for the duration of the review period. As such, this equates to a Level 1 TARP significance in relation to water level for all monitoring sites in Cedar Creek with the exception of monitoring site CB.

The water level records for monitoring site CB (pool CR14) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 16 mm between 5 and 11 October 2021, 20 mm between 19 and 23 October 2021 and 35 mm between 28 October and 5 November 2021 (refer Figure A12, Appendix A). During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically.

In accordance with the LW W3-W4 WMP, a Level 3 TARP significance in relation to pool water level decline at monitoring site CB has been derived for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021. The recorded water level declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period) during these periods and the same did not occur at an upstream pool (beyond mining effects).

The actions and responses undertaken for the Level 3 trigger exceedances for pool water level at monitoring site CB (pool CR14), in accordance with LW W3-W4 WMP (Tahmoor Coal, 2021), are summarised in Section 3.2.3.

The water level records for monitoring site CD (pool CR23) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 6 mm for short periods on 22 and 23 October 2021 and 1 and 2 November 2021 (refer Figure A14, Appendix A). The water level did not decline below the baseline minimum for a consecutive 24 hour period and, as such, a Level 1 TARP significance in relation to pool water level decline at monitoring site CD has been derived for the review period.

The water level records for monitoring site CE (pool CR25) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 2 mm for short periods on 20 and 21 February 2022 (refer Figure A15, Appendix A). The water level did not decline below the baseline minimum for a consecutive 24 hour period and, as such, a Level 1 TARP significance in relation to pool water level decline at monitoring site CE has been derived for the review period.

3.2.3 Trigger Exceedance Action and Response

Table 7 summarises the actions and responses required to be undertaken in relation to the Level 3 exceedances recorded at monitoring sites CB (pool CR14) and SB (pool SR17).

TABLE 7: TRIGGER EXCEEDANCE ACTION AND RESPONSE

Level	Action	Response
Impact to pool water level		
Level 3	• Continue monitoring as per monitoring program. • Continue monthly review of data. • Review relevant surface water level, groundwater level and streamflow data to assess comparative trends. • Convene Tahmoor Coal Environmental Response Group to review response.	• As defined by Environmental Response Group. • Consider increasing download and review of data frequency to fortnightly for sites where Level 3 has been reached. • Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline.
Impact to physical features and natural behaviour of pools		
Level 3	• Continue monitoring as per monitoring program. • Continue monthly review of data. • Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess if the change in behaviour is related to LW W3-W4 mining effects, other catchment changes or the prevailing climate.	• As defined by Environmental Response Group. • Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached.

<u>Monitoring Site CB (Pool CR14)</u>

In response to the Level 3 trigger exceedances at monitoring site CB (pool CR14), the Environmental Response Group convened and the surface water level data was reviewed in relation to rainfall data and relevant groundwater level monitoring data. As stated in SLR (2022), the groundwater level in the vicinity of monitoring site CB (pool CR14) was inferred at 0.1 m below the surface water level as of early October 2021. The groundwater level was inferred to increase above the surface water level as of mid to late October 2021 and continue to increase notably in response to rainfall events from November 2021. The groundwater level was recorded at a level of approximately 4.2 m above the creek bed elevation at the end of the review period (SLR, 2022). This would suggest that gaining conditions (groundwater contribution to the surface water system) were occurring from mid-October to late March 2022 in the vicinity of monitoring site CB (pool CR14).

However, if fractures were present in the base of pool CR14 or in the subsurface, this would prohibit, to some extent dependent on the nature of the fractures, gaining conditions occurring at pool CR14 (pers. comm. SLR, 16 December 2021). It is noted that fractures have not been observed, however, the base of the pool has not been visible as the pool has continued to retain water. The decline in water level below the baseline minimum recorded at monitoring site CB (pool CR14) in late October and early November 2021 suggests that losing conditions (surface water contribution to the groundwater system), rather than gaining conditions, were prevailing during this period and may potentially indicate the presence of fractures in the base of pool CR14 or in the subsurface.

Nonetheless, the water level records for monitoring site CB (pool CR14) recorded over the duration of the review period indicate that water level impacts were transient, minor (maximum of 35 mm decline below the baseline minimum) and not atypical. In addition, water level impacts were not evident at other monitoring sites in Cedar Creek during the review period; notably monitoring sites CC1A and CA which have previously recorded atypical behaviour (HEC, 2021).

Review of the water level measurements for monitoring sites in Cedar Creek downstream of monitoring site CB, namely monitoring sites CD, CE and CG, indicate that the water level at these sites generally remained above the baseline minimum during the periods 5 to 11 October 2021, 19 to 23 October 2021 and 28 October to 5 November 2021 (refer Appendix A). The water level records for monitoring site CD indicate that water level declined slightly below the baseline minimum for very brief periods on 22 and 23 October and 1 and 2 November 2021, however, the water level did not decline for a full 24 hour period (refer Appendix A). As such, there is no indication that there was a wide spread or prolonged effect on surface water levels in the downstream reach of Cedar Creek during this period.

Accordingly, an increase in the frequency of data download and review is not considered to be required at this stage. Monthly download and review of surface monitoring data will continue to be conducted. Should a Level 4 trigger exceedance occur in the future, further action will be taken in accordance with the LW W3-W4 WMP.

<u>Monitoring Site SB (Pool SR17)</u>

In accordance with the Stonequarry Creek Rockbar Management Plan (Tahmoor Coal, 2021), mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40 metres (m) downstream of the nearest grinding grove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency.

Geotechnical reviews by PSM Consulting (2021a, b and c) identified that:

- The fractures occurred in thinly bedded, laminated sandstone and were considered a response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes.
- There was no evidence of new cracking outside the existing fractured area.
- The extension of the fractured area was associated with a veneer of sandstone sitting on top of competent sandstone.
- The fracturing was considered consistent with subsidence monitoring results and was effectively an extension of the original fracture site.
- The fracturing provided a release for mining induced stress and was confined to the sheeted sandstone above the competent sandstone.

In response to the Level 3 trigger exceedances in relation to physical features at monitoring site SB (pool SR17), the Environmental Response Group convened and the surface water level data was reviewed. The water level records for monitoring site SB (pool SR17) shown in Chart A22, Appendix A, indicate that the surficial fracturing of the rockbar has not resulted in an impact to the pool water holding capacity. The water levels recorded at monitoring site SB (pool SR17) have not declined below the baseline minimum water level and no atypical water level behaviour was recorded at this site between 1 October 2021 and 5 February 2022 (extent of available monitoring data). As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

3.3 Surface Water Quality

3.3.1 Significance Triggers for Surface Water Quality

Water quality data has been analysed for key water quality parameters of relevance to surface water systems and the effects of subsidence, namely pH, EC, dissolved (field filtered) aluminium, iron, manganese, nickel and zinc at monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek. The monitoring results have been assessed against the criteria for each significance level/trigger listed in Table 8.

TABLE 8: SIGNIFICANCE LEVELS / TRIGGERS FOR WATER QUALITY

	Surface Water Quality
Level 1	The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period.
Level 2	The trigger for pH, EC or dissolved metals occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period.
Level 3	The trigger for pH, EC or dissolved metals occurs in one month and there is visual evidence of increased iron staining that was not observed in the baseline period.
Level 4	Any of the following: • pH: the value falls below a corresponding control (upstream) site(s) mean*, or at the site itself, minus two standard deviations (i.e. the sample becomes more acidic) for more than two consecutive months OR the value rises above corresponding control (upstream) site(s) mean, or at the site itself, plus two standard deviations (i.e. the sample becomes more alkaline) for more than two consecutive months. • EC: the value rises above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months. • Dissolved metals: a specific metal or metals laboratory value/s rise above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months.

* The value is compared with the corresponding control (upstream) site(s) mean to date plus two standard deviations and with the baseline mean plus two standard deviations for the site itself.

3.3.2 Assessment of Surface Water Quality

A summary of the water quality TARP significance levels for the review period is presented in Table 9 and discussed in the sections which follow.

TABLE 9: WATER QUALITY TARP SIGNIFICANCE LEVELS – 1 OCTOBER 2021 TO 16 / 24 MARCH 2022

Date	Location(s)	Comment	TARP Significance
October 2021 to March 2022	All monitoring sites in Matthews Creek	The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period.	Level 1
October to December 2021 and February 2022	All monitoring sites in Cedar Creek		Level 1
October to December 2021 and February 2022	All monitoring sites in Stonequarry Creek		Level 1
January 2022	Monitoring site CB in Cedar Creek	The trigger for dissolved aluminium occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period.	Level 2
February and March 2022	Monitoring site CG in Cedar Creek		Level 2
March 2022	Monitoring site CA		Level 2
January and March 2022	Monitoring sites SC2, SC and SD in Stonequarry Creek		Level 2

Matthews Creek

A water quality TARP significance above Level 1 was not reported for any sites in Matthews Creek during the period 1 October 2021 to 16 / 24 March 2022.

Cedar Creek

As stated in Table 2 and illustrated in Figure B5 of Appendix B, historically high concentrations of dissolved aluminium were recorded in March 2022 at monitoring sites CA, CC, CD, CE, CF and CG in Cedar Creek. Elevated concentrations of dissolved aluminium were also recorded at monitoring sites CB, CD, CC, CA and CC1 in Cedar Creek in January 2022 and at monitoring site CG in February 2022. Historically high concentrations of dissolved aluminium were recorded at reference site CCR in January, February and March 2022 and at reference site Cedar US in March 2022.

The dissolved aluminium concentrations recorded at monitoring sites CB, CA and CC1 in January 2022 did not exceed baseline concentrations. It is noted that monitoring of sites CC, CD and CE only commenced in January 2021 and, as such, baseline data is not available for these sites. Additionally, Cedar US was unable to be accessed for monitoring in January and February 2022.

The elevated concentrations of dissolved aluminium recorded at monitoring site CB in January 2022, at monitoring site CG in February 2022 and at monitoring sites CA and CG in March 2022 resulted in an exceedance of the mean plus two standard deviations, equating to a Level 2 TARP significance at these sites. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods. Additionally, the elevated concentration of dissolved aluminium recorded at monitoring site CB in January 2022 did not exceed the baseline maximum concentration of dissolved aluminium recorded at monitoring site CB.

Stonequarry Creek

As stated in Table 2 and illustrated in Figure B5 of Appendix B, historically high concentrations of dissolved aluminium were recorded in March 2022 at reference sites SE and SG and at monitoring sites SC2, SC, SD and SF in Stonequarry Creek. Elevated concentrations of dissolved aluminium were also recorded at reference site SC1 and at monitoring sites SC and SD in January 2022. The dissolved aluminium concentration recorded at monitoring site SC2 in January 2022 did not exceed the maximum baseline concentration or reference site concentrations and the dissolved aluminium concentrations recorded at SC, SD and SF in March 2022 did not exceed reference site concentrations. It is noted that monitoring at site SF did not commence until May 2020 and, as such, baseline data is not available for this site.

The elevated concentrations of dissolved aluminium recorded at monitoring sites SC2, SC and SD in January 2022 and March 2022 resulted in an exceedance of the mean plus two standard deviations, equating to a Level 2 TARP significance at these sites. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods.

3.3.3 Trigger Exceedance Action and Response

Table 10 summarises the actions and responses required to be undertaken in relation to the Level 2 exceedances recorded at monitoring site CB in January 2022, monitoring site CG in February and March 2022, monitoring site CA in March 2022 and monitoring sites SC2, SC and SD in January 2022 and March 2022.

TABLE 10: TRIGGER EXCEEDANCE ACTION AND RESPONSE

Level	Action	Response
Impact to stream water quality		
Level 2	• Continue monitoring as per monitoring program. • Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes. • Convene Tahmoor Coal Environmental Response Group to review response.	As defined by Environmental Response Group.

In response to the Level 2 trigger exceedances, the Environmental Response Group convened and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends.

The elevated concentrations of dissolved aluminium recorded in January, February and March 2022 occurred during and following above average rainfall. As stated in Section 3.3.2, concentrations were also elevated and, in some cases, historically high at reference sites (upstream of mining influences) in January, February and March 2022. Accordingly, the elevated dissolved aluminium concentrations were considered to be catchment wide and related to the prevailing climatic conditions.

In accordance with the WMP, monthly monitoring and review of water quality data recorded at sites in Cedar Creek, Stonequarry Creek and Matthews Creek will continue to be undertaken and assessed in relation to the water quality TARP.

4 SUMMARY AND CONCLUSIONS

Review and assessment of surface water monitoring data recorded prior to and during the review period of 1 October 2021 to 16 / 24 March 2022 has indicated the following:

- A water quality TARP significance above Level 1 was not reported for any sites in Matthews Creek during the period 1 October 2021 to 16 / 24 March 2022.
- A water quality TARP significance of Level 2 was reported for dissolved aluminium recorded at Cedar Creek monitoring site CB in January 2022 and monitoring sites CA and CG in March 2022.
- A water quality TARP significance of Level 2 was reported for dissolved aluminium recorded at Stonequarry Creek monitoring sites SC2, SC and SD in January and March 2022.
- The TARP Level 2 significance for water quality at these sites appeared to be catchment wide and related to the prevailing (high rainfall) climatic conditions.
- There is no evidence from the monitoring data of an influence of mining LW W3 on surface water quality in Matthews Creek, Cedar Creek or Stonequarry Creek.
- With the exception of monitoring site CB in Cedar Creek, a water level TARP significance above Level 1 was not reported for sites in Matthews Creek, Cedar Creek or Stonequarry Creek during the period 1 October 2021 to 16 / 24 March 2022.
- A Level 3 TARP significance in relation to pool water level decline at monitoring site CB in Cedar Creek was reported for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021.

- The water level at monitoring site CB did not decline atypically or below the previously recorded minimum during these periods.
- The inferences of groundwater-surface water connectivity indicated that the surface water system was gaining from the groundwater system in the vicinity of monitoring site CB (pool CR14) during these periods. However, the presence of fractures in the base of pool CR14 or in the subsurface would prohibit, to some extent dependent on the nature of the fractures, gaining conditions occurring at pool CR14.
- A Level 3 TARP significance was reported for pool SR17 in Stonequarry Creek due to surficial fracturing of the rockbar.
- The fractures occurred in thinly bedded, laminated sandstone and were likely in response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes.
- There has been no evidence of fracturing at the grinding groove sites at rockbar SR17.
- The water level records for monitoring site SB (pool SR17) indicate that the surficial fracturing of the rockbar has not resulted in an apparent impact to the pool water holding capacity. As such, an increase in the frequency of monitoring from monthly to fortnightly is not required at this stage.

Less than 10% of the pools within the Investigative Area have been impacted and the surficial fracturing of the rockbar at pool SR17 in Stonequarry Creek has not resulted in an impact to pool water level. Consequently, there is negligible evidence to date of subsidence impacts with environmental consequences greater than minor[2] associated with mining in the Western Domain.

It is recommended that monthly review of surface monitoring data is continued to be undertaken in accordance with the WMP.

---

[2] Minor is defined as *not very large, important or serious.*

REFERENCES

BES (2021a). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), October.

BES (2021b). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), November.

BES (2021c). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), December.

BES (2022a). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), January, February, March.

BES (2022b). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), February.

BES (2022c). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), March.

PSM (2021a). "PSM3139.12 Stonequarry Creek SR17 Fracture". Email to Tahmoor Coal Pty Ltd, October.

PSM (2021b). "Structural Geology Assessment – Stonequarry Creek, SR17 Rockbar". Prepared for Tahmoor Coal Pty Ltd, November.

PSM (2021c). "Site Inspection of Additional Fracturing at SR17 Rockbar". Prepared for Tahmoor Coal Pty Ltd, December.

Tahmoor Coal (2021a). "Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan". September.

Tahmoor Coal (2021b). "Tahmoor North – Western Domain, LW W3-W4 Stonequarry Creek Rockbar Management Plan". September.

SLR (2022). "Groundwater six-month review". Prepared for Tahmoor Coal Pty. Ltd., May, Report No: 610.30831.00000-R03-v1.0.

CONDITIONS OF REPORT

This report must be read in its entirety.

This report has been prepared by ATCW for the purposes stated herein and ATCW's experience, having regard to assumptions that can reasonably be expected to make in accordance with sound professional principles. ATCW does not accept responsibility for the consequences of extrapolation, extension or transference of the findings and recommendations of this report to different sites, cases, or conditions.

This document has been prepared based in part on information which was provided to ATCW by the client and/or others and which is not under our control. ATCW does not warrant or guarantee the accuracy of this information. The user of the document is cautioned that fundamental input assumptions upon which the document is based may change with time. It is the user's responsibility to ensure that these assumptions are valid.

Unless specifically agreed otherwise in the contract of engagement, ATCW retains Intellectual Property Rights over the contents of the document. The client is granted a licence to use the report for the purposes for which it was commissioned.

APPENDIX A – WATER LEVEL PLOTS

TAILINGS.WATER.WASTE.

MATTHEWS CREEK SURFACE WATER MONITORING SITES

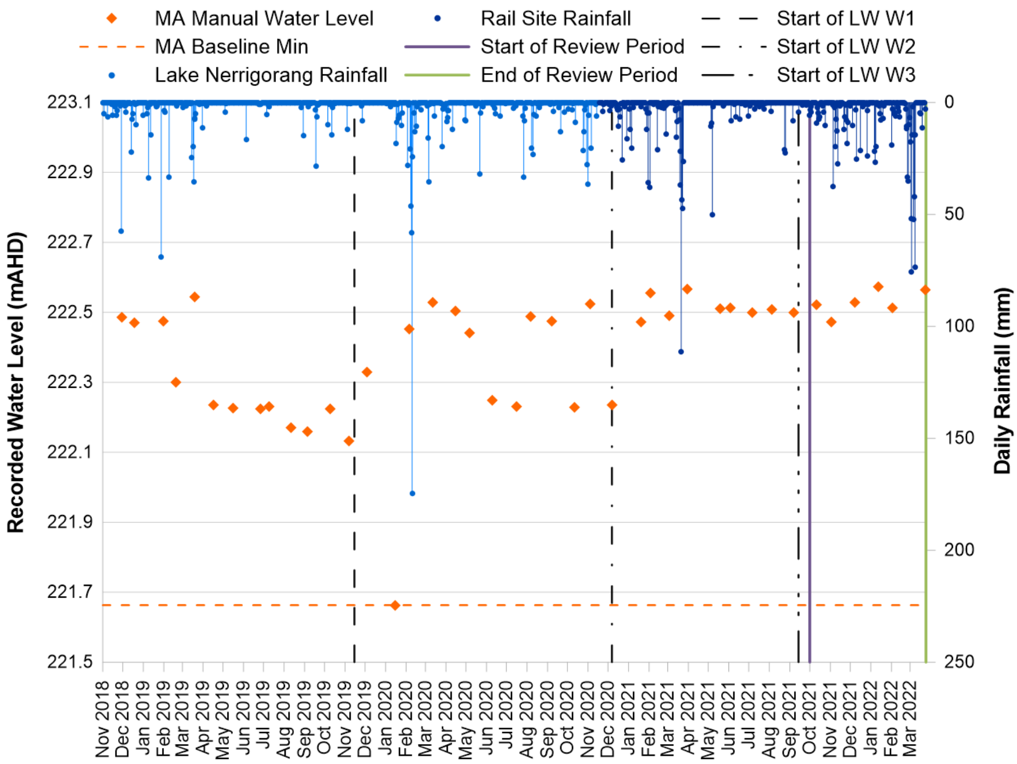


FIGURE A1: MONITORING SITE MA WATER LEVEL RECORDS

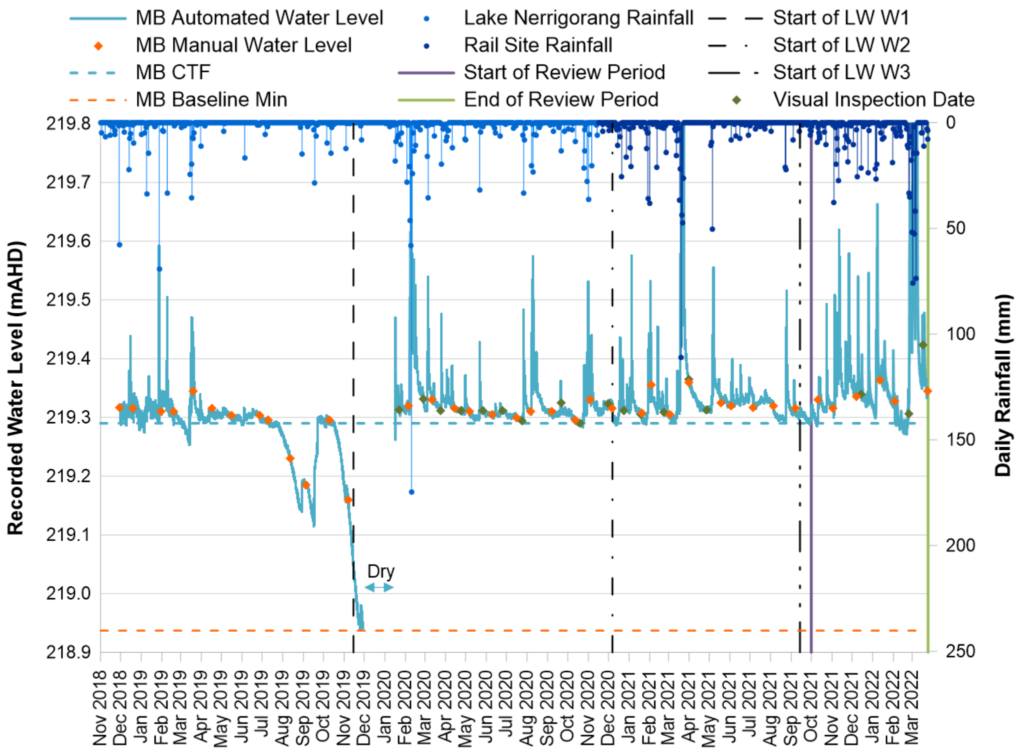


FIGURE A2: MONITORING SITE MB WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

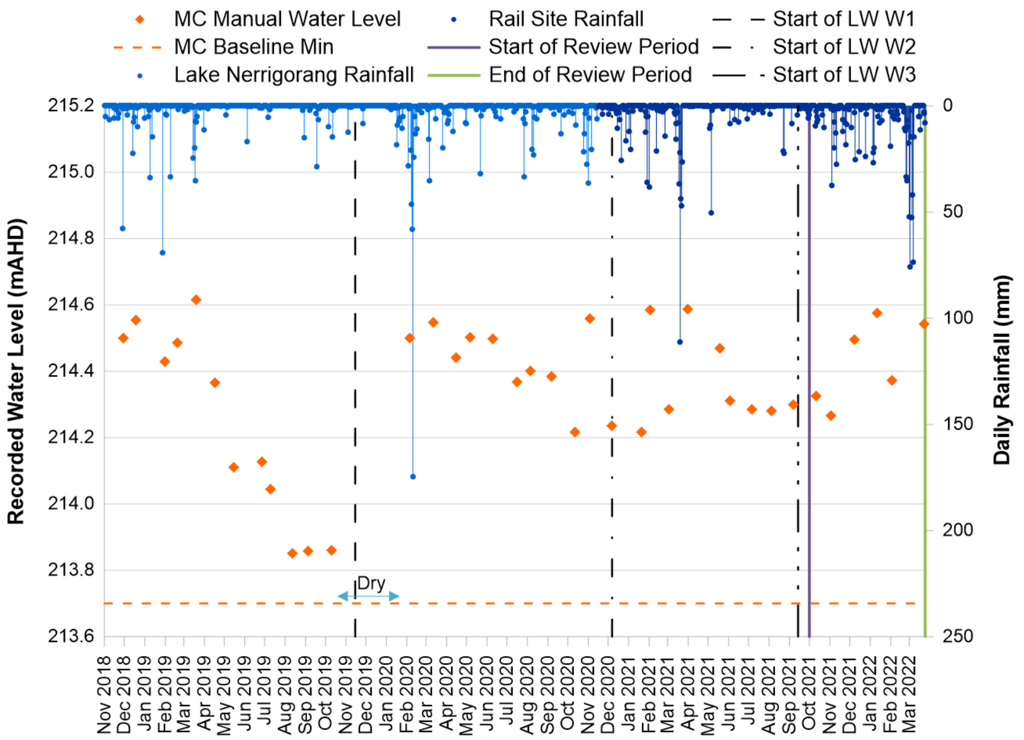


FIGURE A3: MONITORING SITE MC WATER LEVEL RECORDS

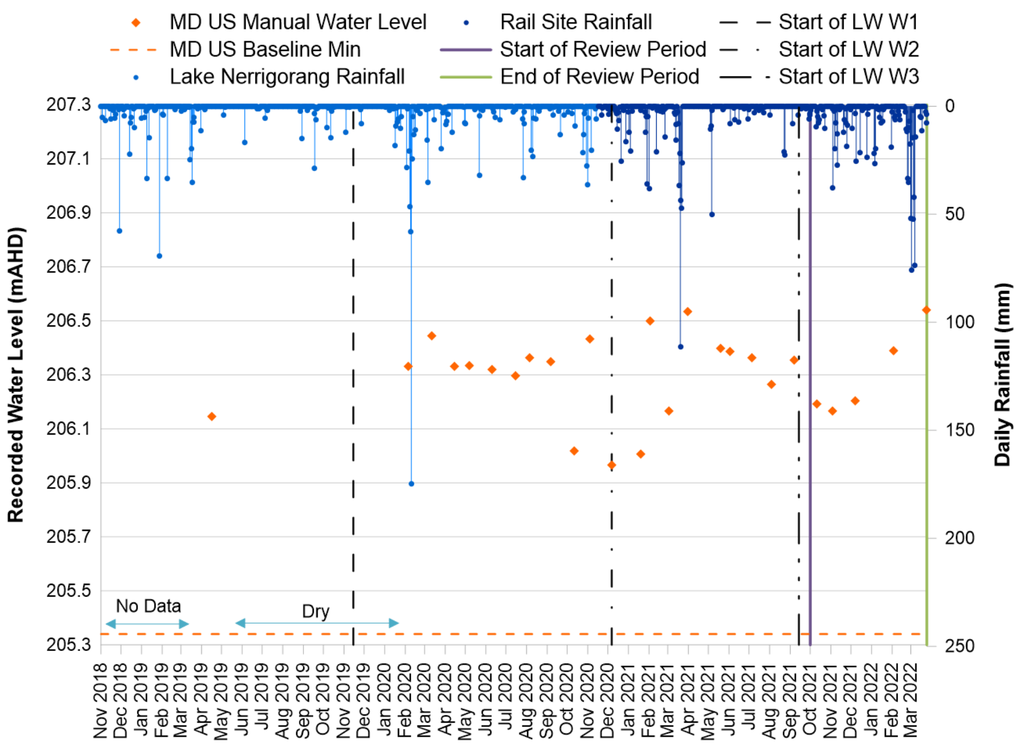


FIGURE A4: MONITORING SITE MD US WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

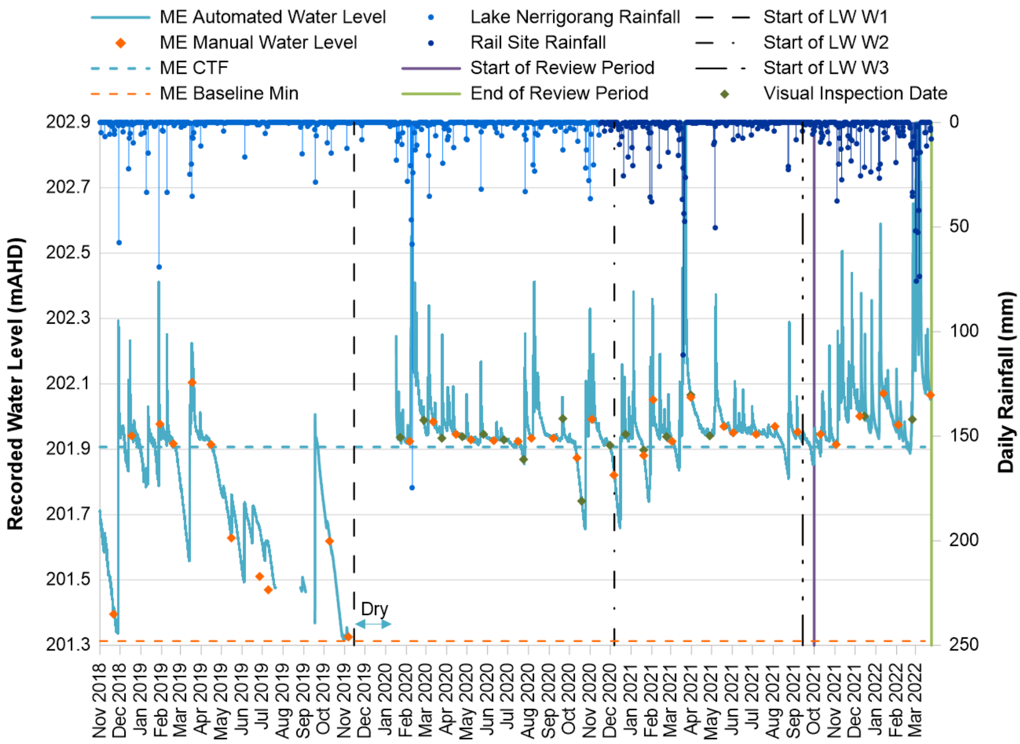


FIGURE A5: MONITORING SITE ME WATER LEVEL RECORDS

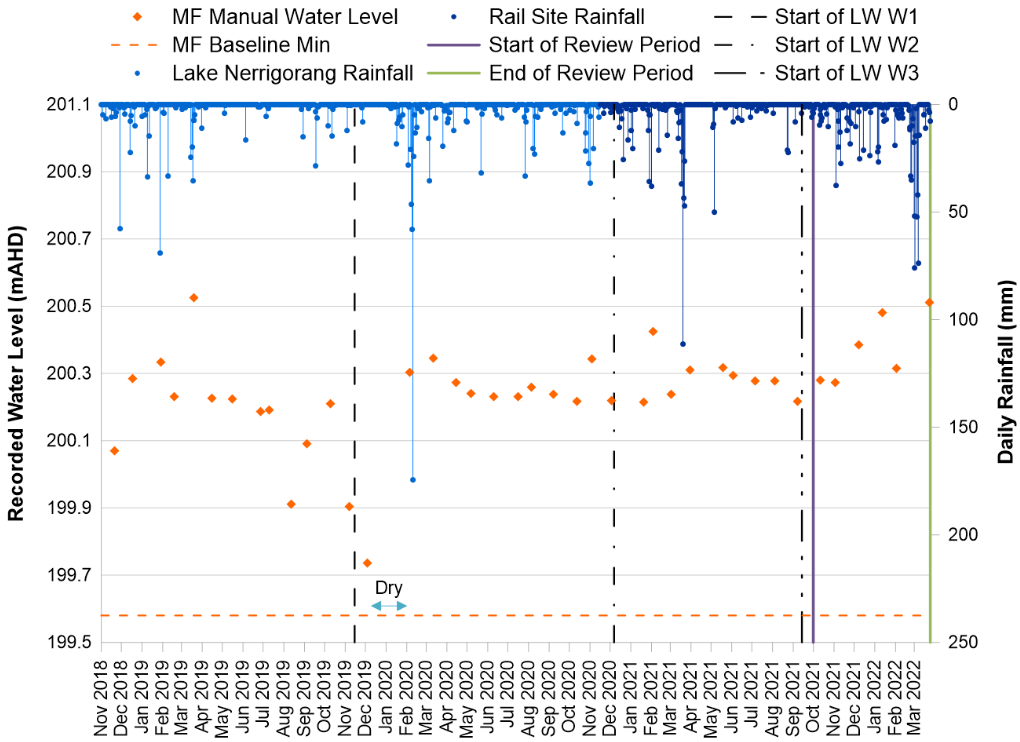


FIGURE A6: MONITORING SITE MF WATER LEVEL RECORDS

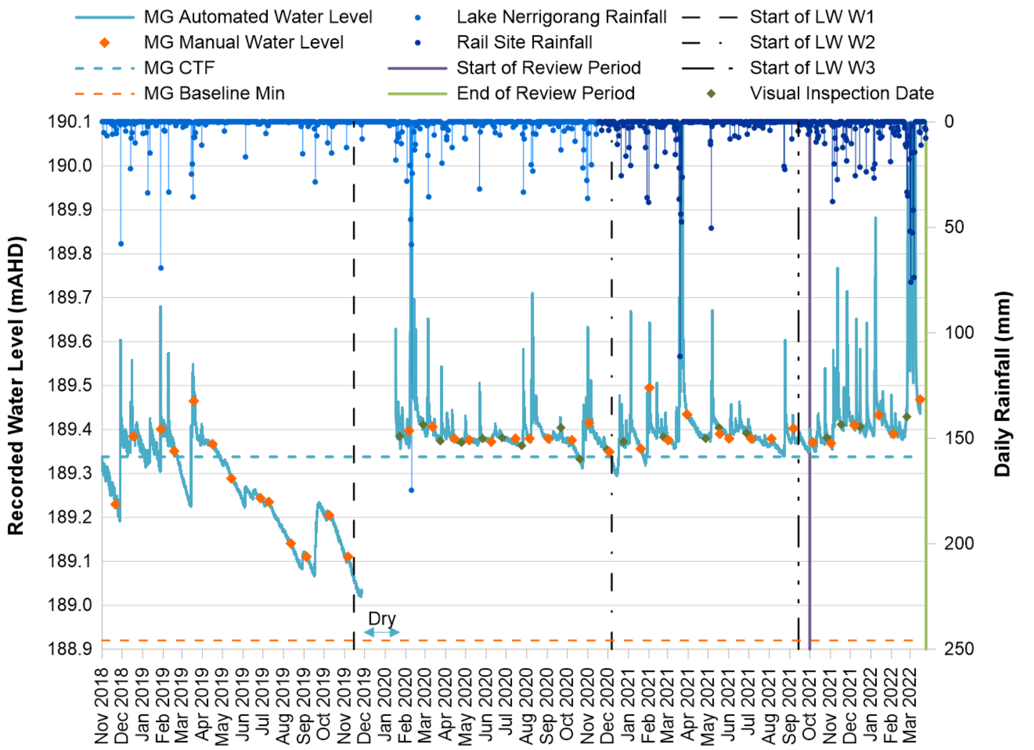


FIGURE A7: MONITORING SITE MG WATER LEVEL RECORDS

CEDAR CREEK SURFACE WATER MONITORING SITES

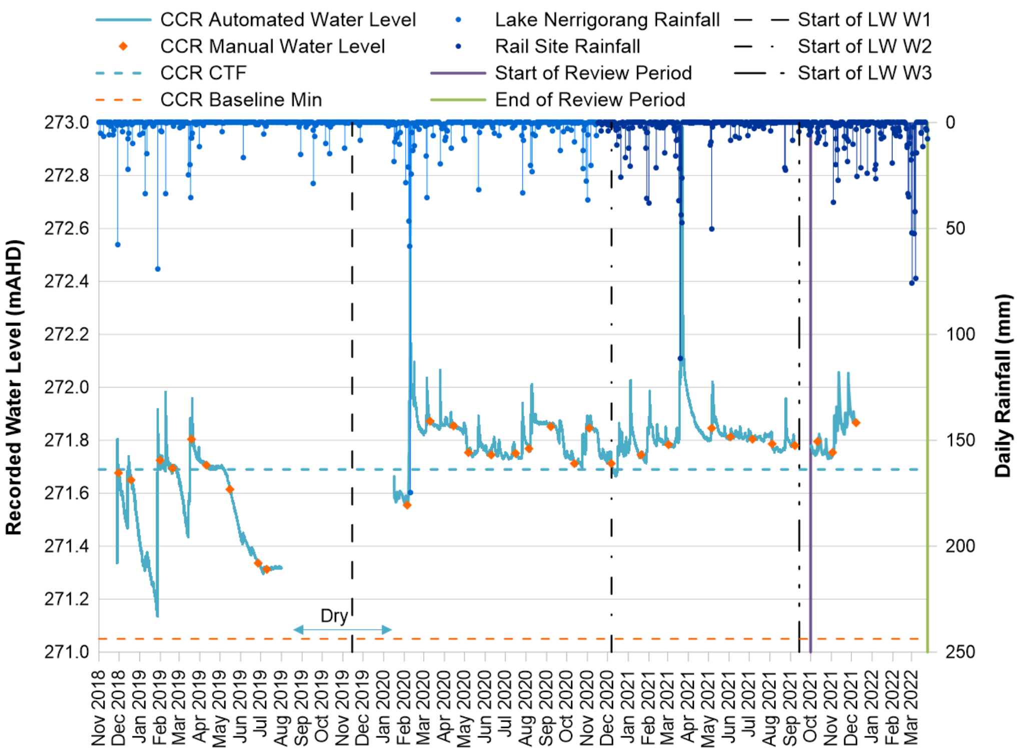


FIGURE A8: MONITORING SITE CCR WATER LEVEL RECORDS[3]

[3] The reference bolts at monitoring sites CCR and SF have not been found and as such the raw data recorded from 7 / 8 December 2021 was unable to be converted to a water level measurement.

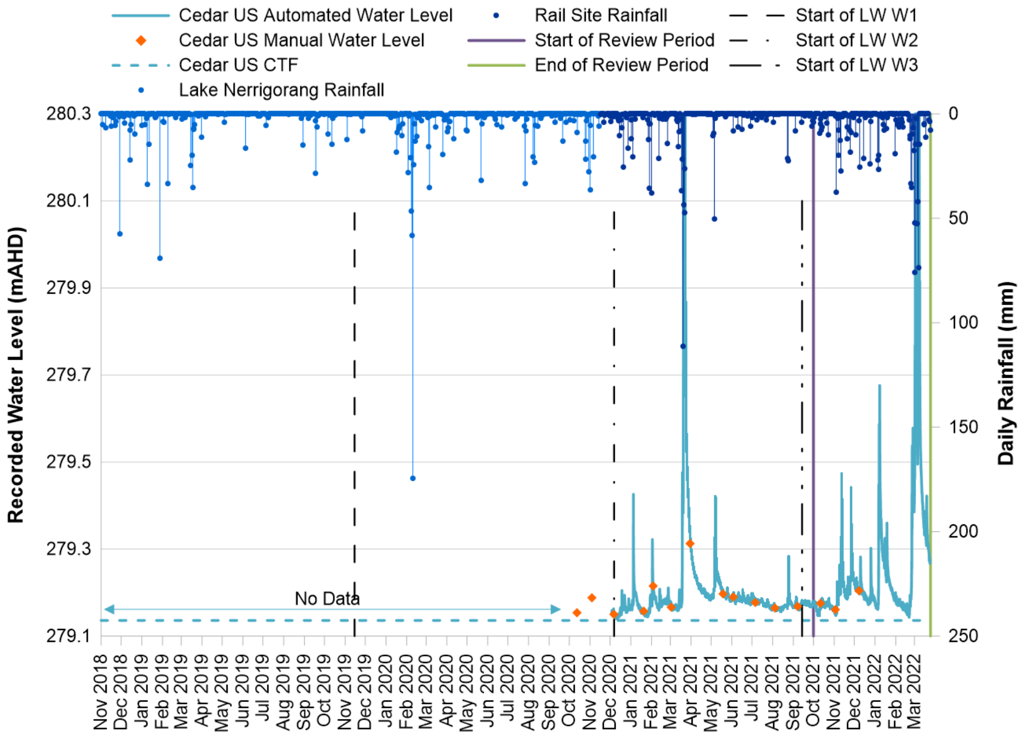


FIGURE A9: MONITORING SITE CEDAR US WATER LEVEL RECORDS

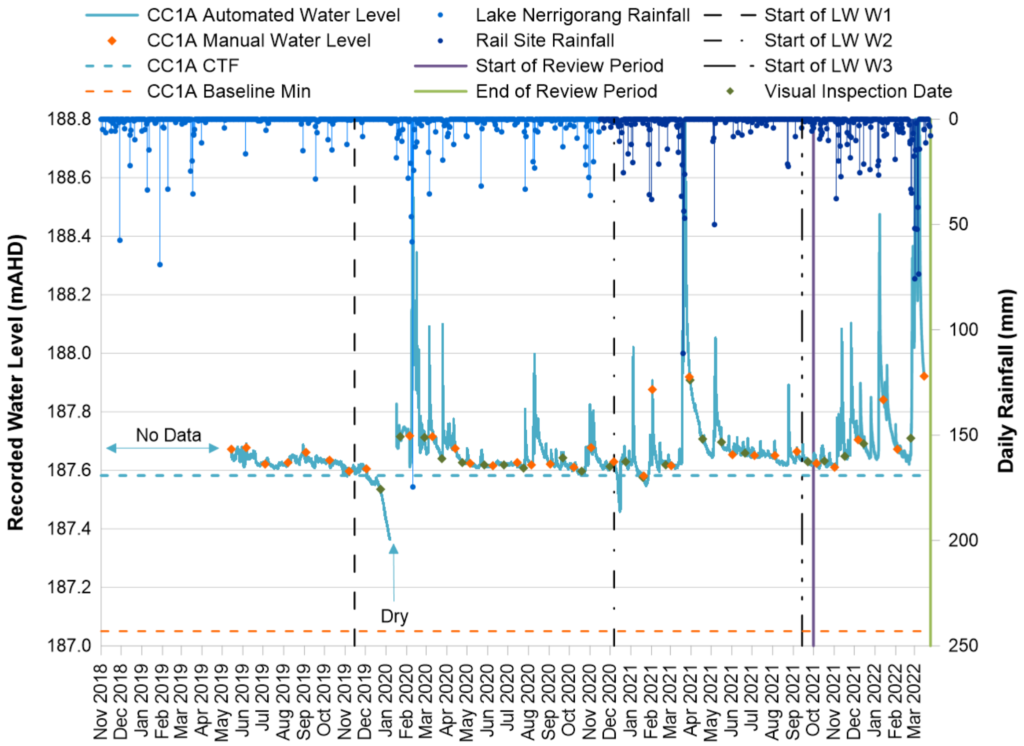


FIGURE A10: MONITORING SITE CC1A WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

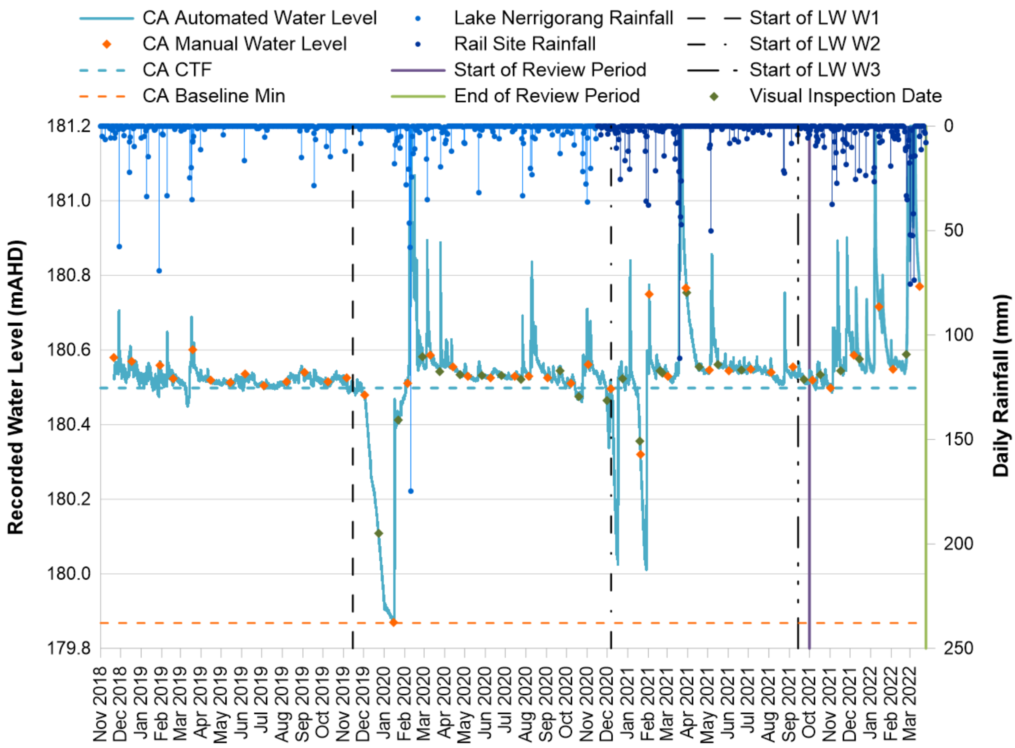


FIGURE A11: MONITORING SITE CA WATER LEVEL RECORDS

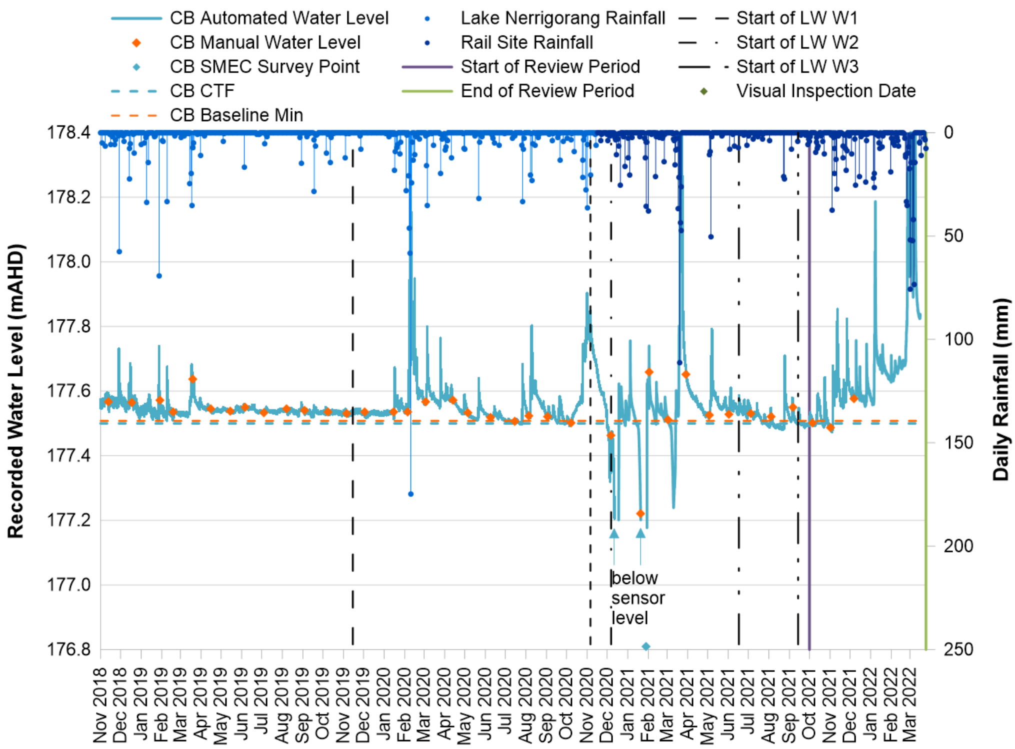


FIGURE A12: MONITORING SITE CB WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

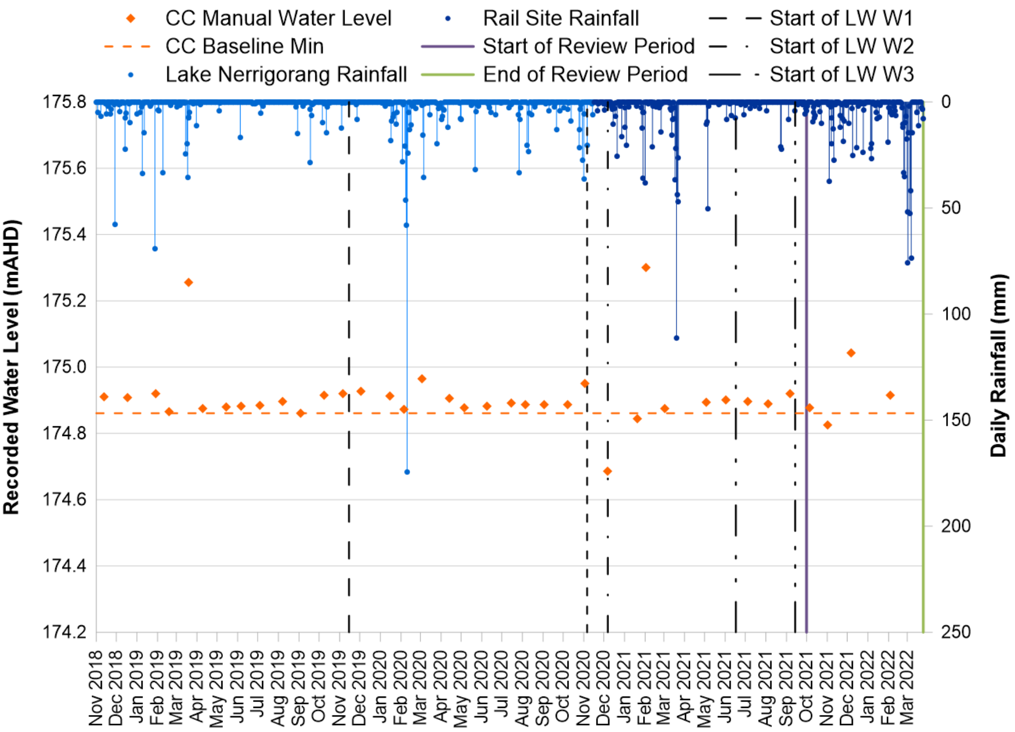


FIGURE A13: MONITORING SITE CC WATER LEVEL RECORDS

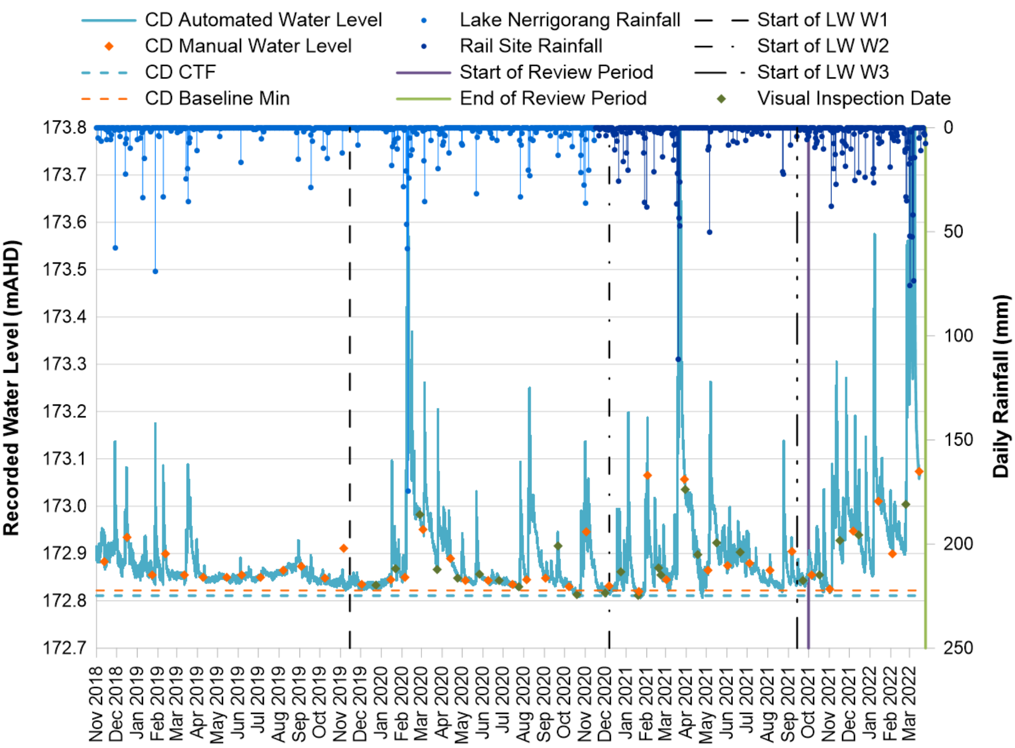


FIGURE A14: MONITORING SITE CD WATER LEVEL RECORDS

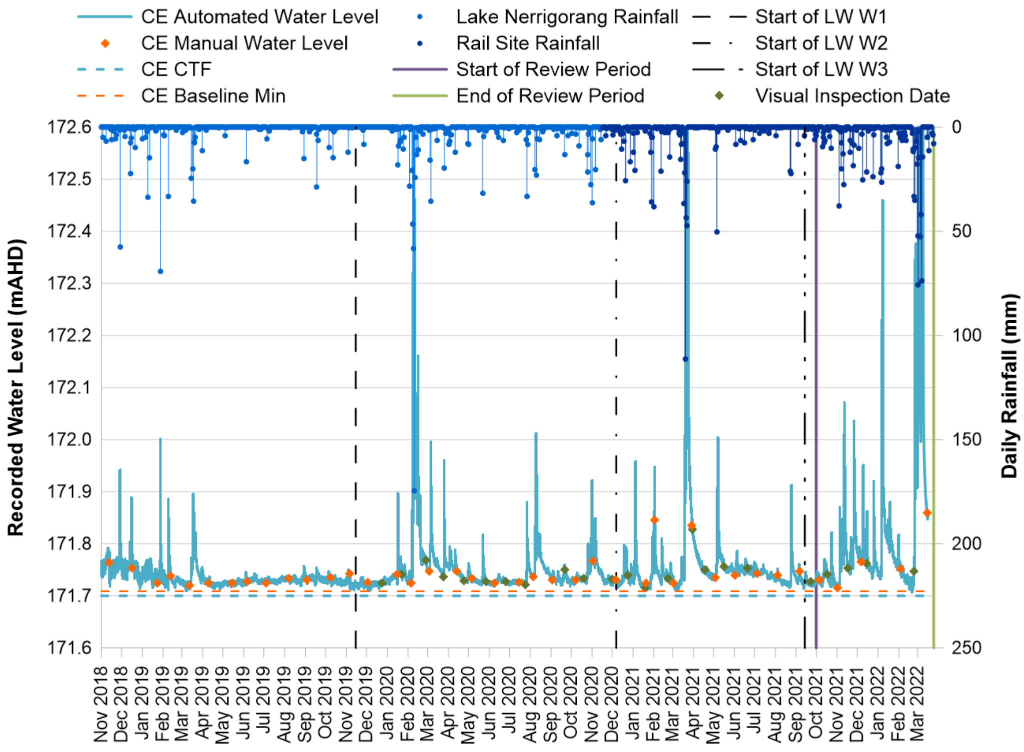


FIGURE A15: MONITORING SITE CE WATER LEVEL RECORDS

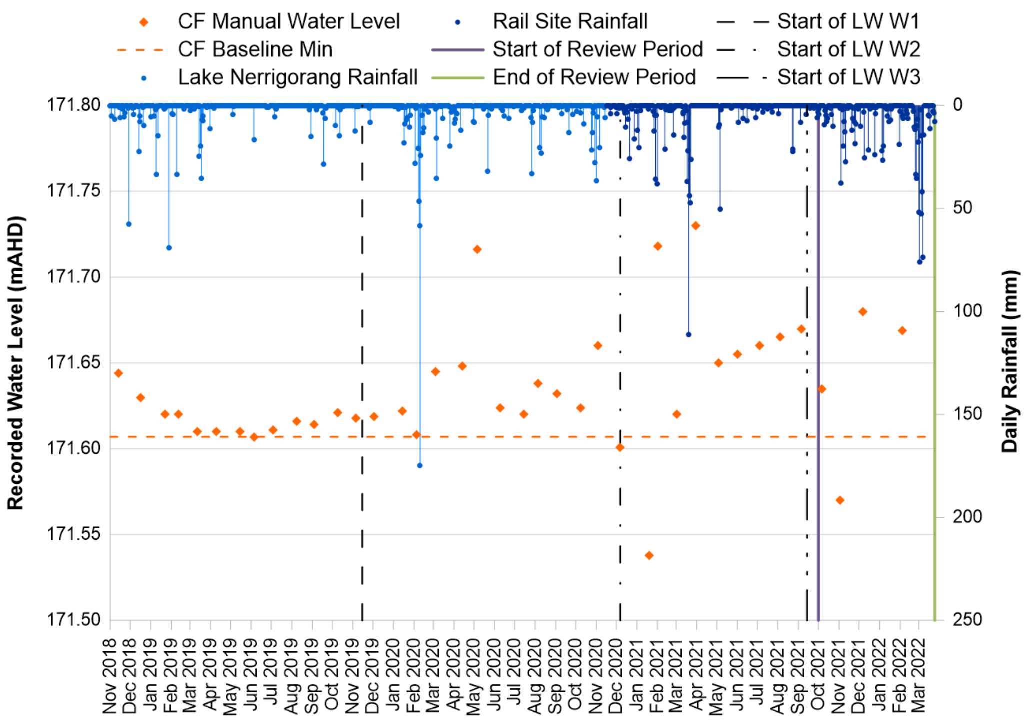


FIGURE A16: MONITORING SITE CF WATER LEVEL RECORDS

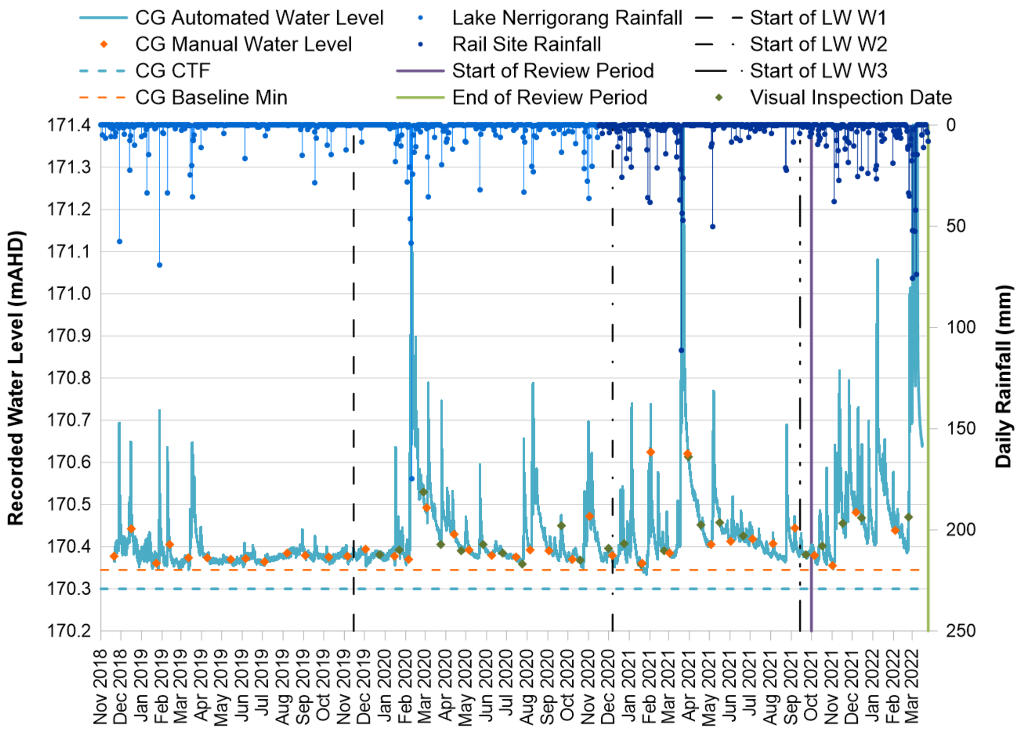


FIGURE A17: MONITORING SITE CG WATER LEVEL RECORDS

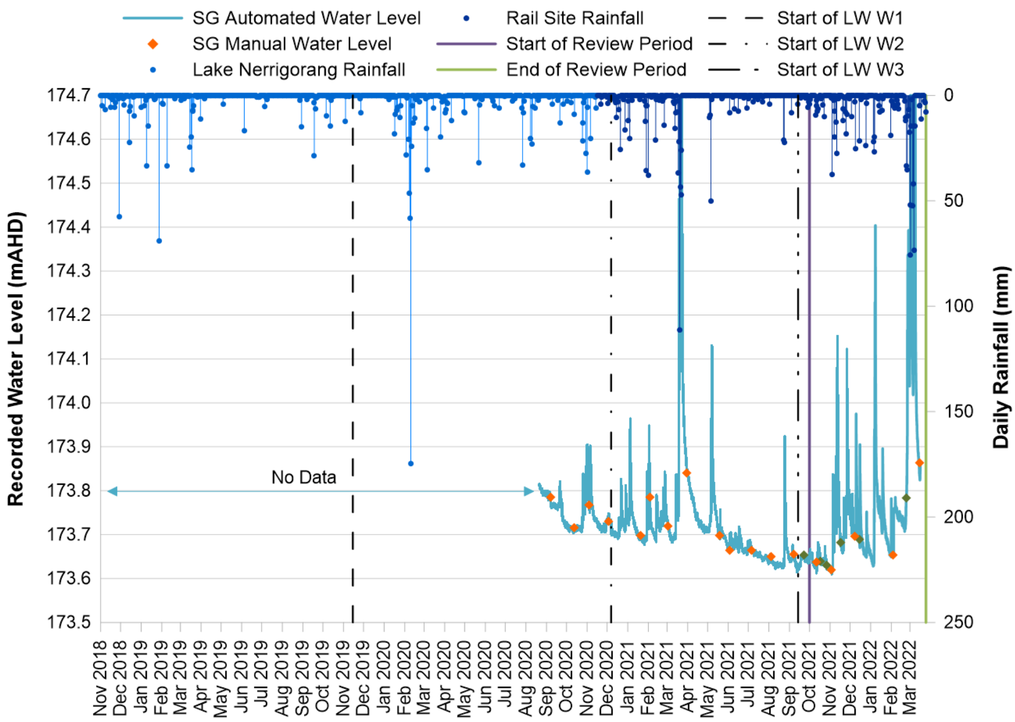


FIGURE A18: MONITORING SITE SG WATER LEVEL RECORDS

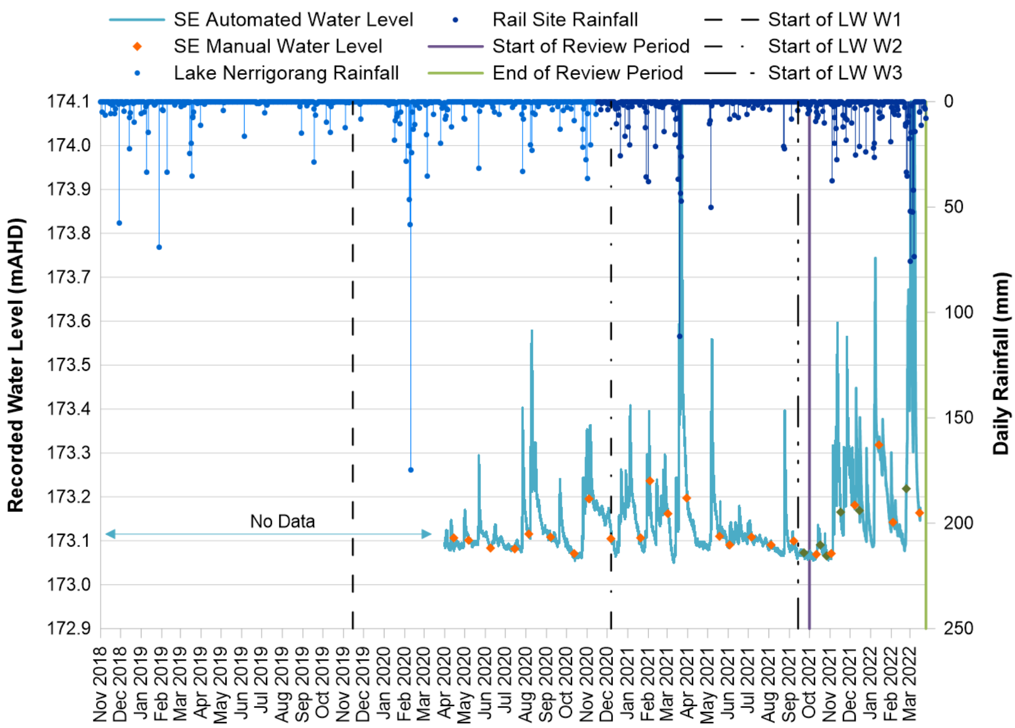


FIGURE A19: MONITORING SITE SE WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

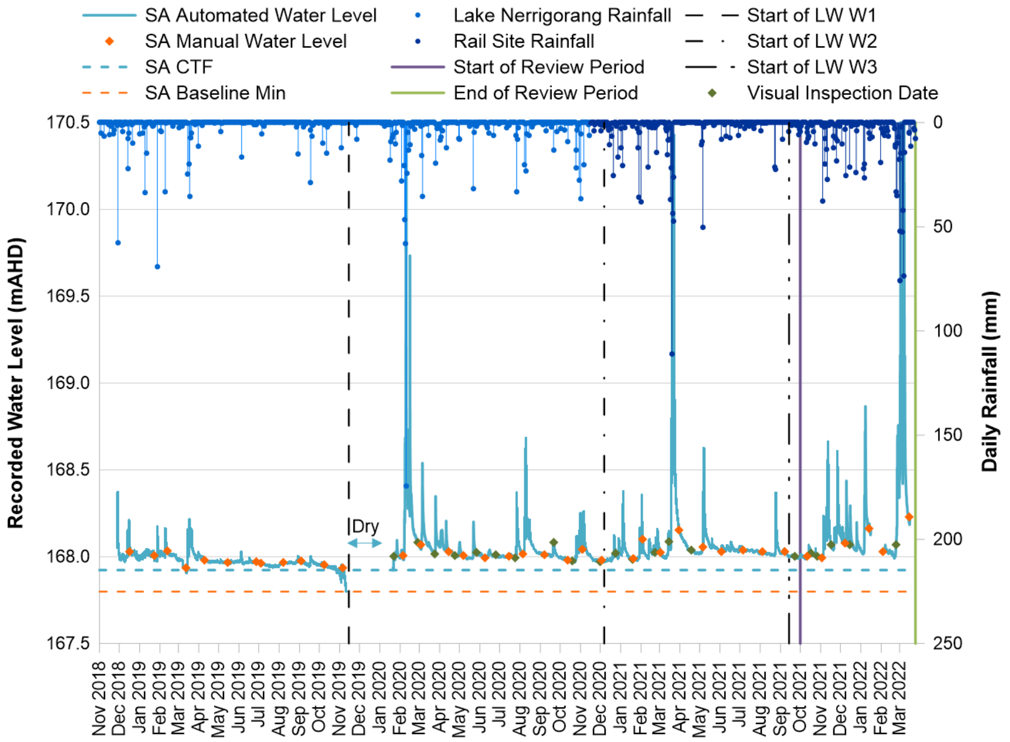


FIGURE A20: MONITORING SITE SA WATER LEVEL RECORDS[4]

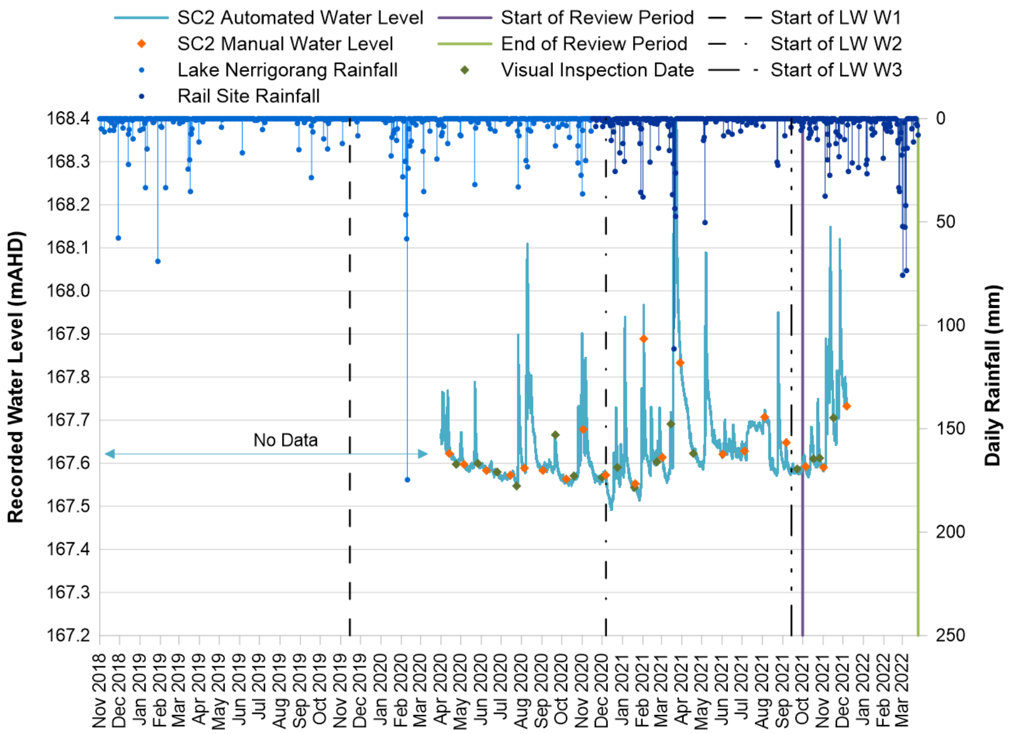


FIGURE A21: MONITORING SITE SC2 WATER LEVEL RECORDS[5]

[4] Between 15 January and 5 February 2022, an incomplete data download occurred at monitoring site SA, or the logger was not correctly restarted, and as such no data is available for this period.

[5] The water level sensor has not been located and therefore records are not available from 7 December 2021.

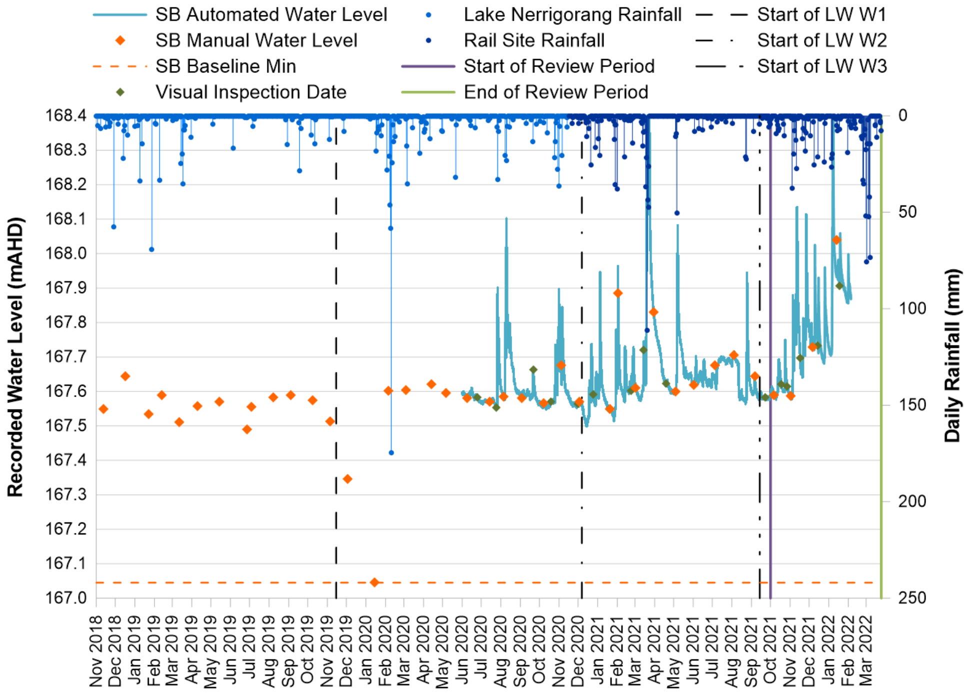


FIGURE A22: MONITORING SITE SB WATER LEVEL RECORDS[6]

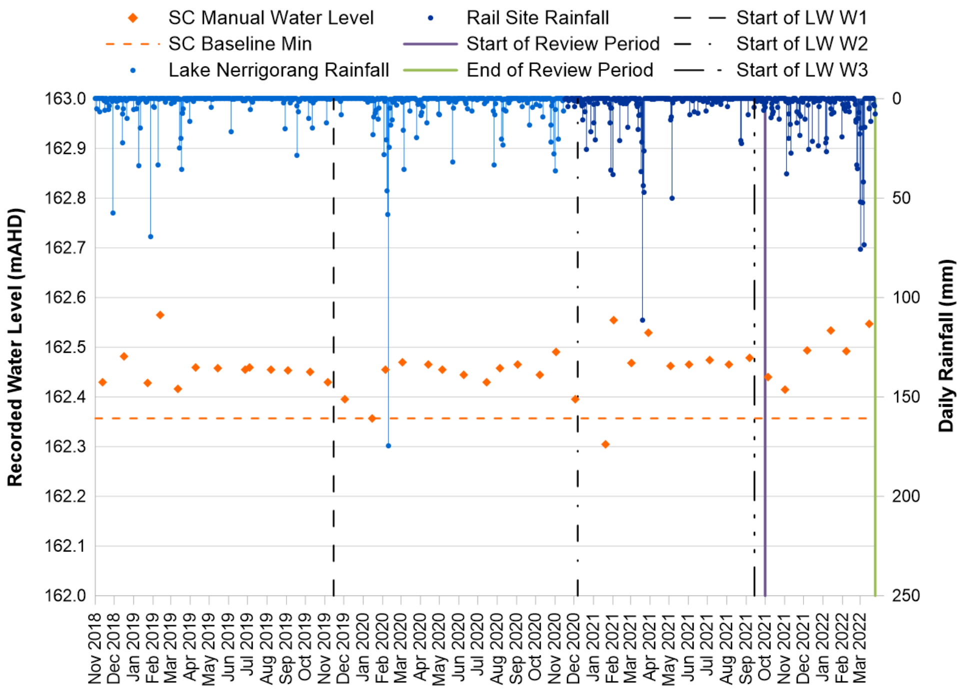


FIGURE A23: MONITORING SITE SC WATER LEVEL RECORDS

[6] The logger at monitoring site SB was washed away during a major rainfall event from late February to early March 2022 and as such data has not been collected since 5 February 2022.

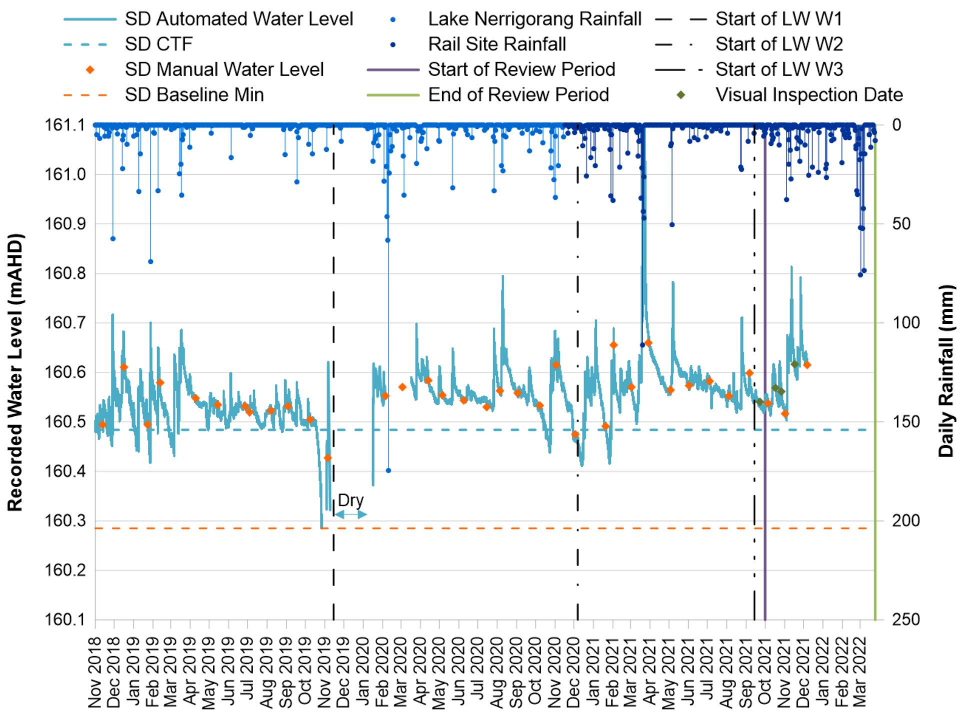


FIGURE A24: MONITORING SITE SD WATER LEVEL RECORDS[7]

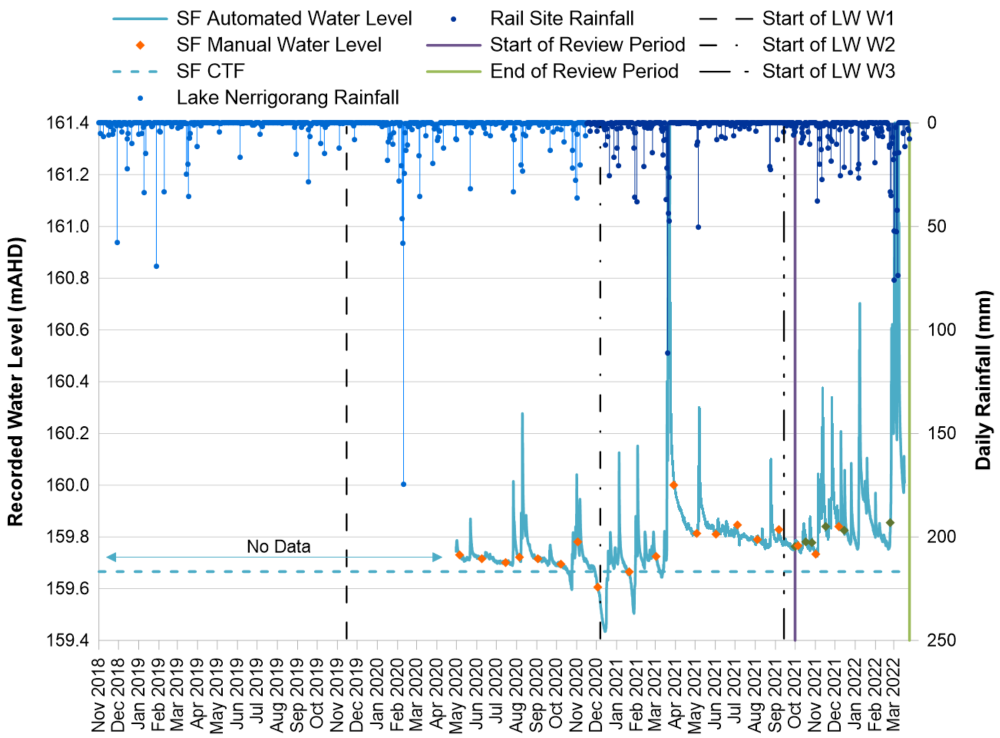


FIGURE A25: MONITORING SITE SF WATER LEVEL RECORDS

[7] The water level sensor has not been located and therefore records are not available from 7 December 2021.

TAILINGS.WATER.WASTE.

APPENDIX B – WATER QUALITY PLOTS[8]

[8] When the recorded value was below the limit of reporting, the value has been plotted at the limit of reporting in the following plots.

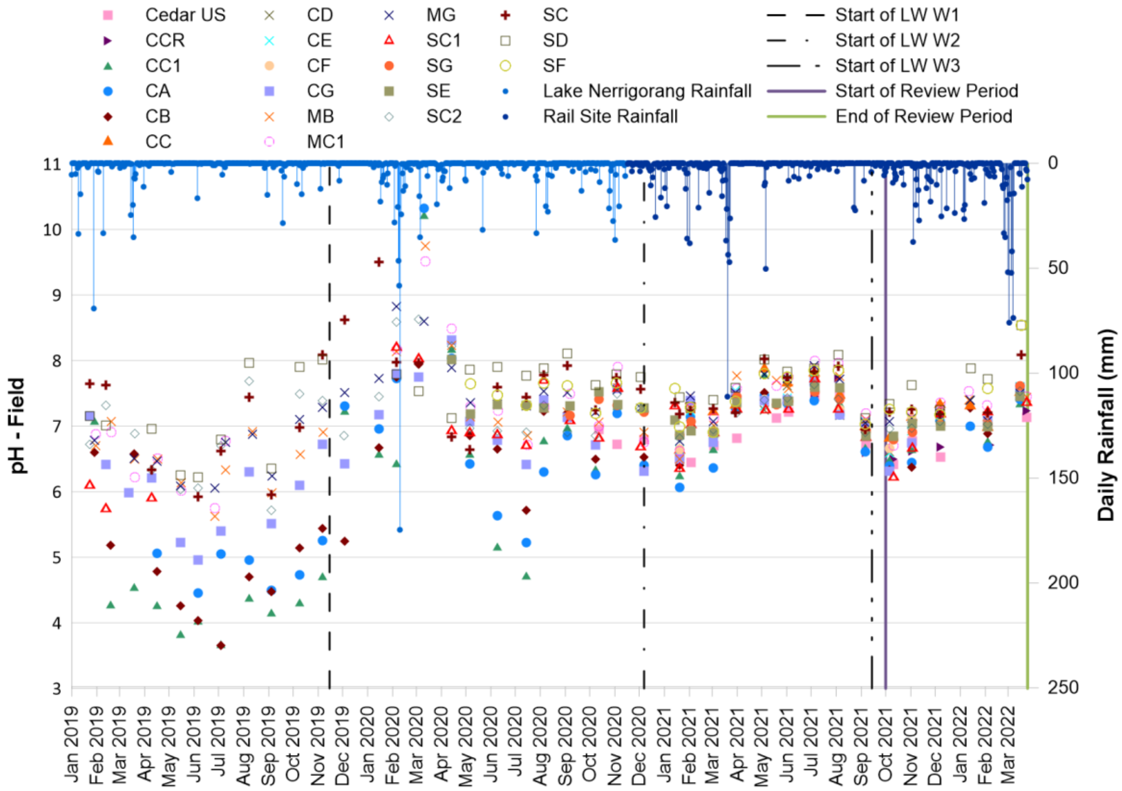


FIGURE B1: FIELD PH RECORDS

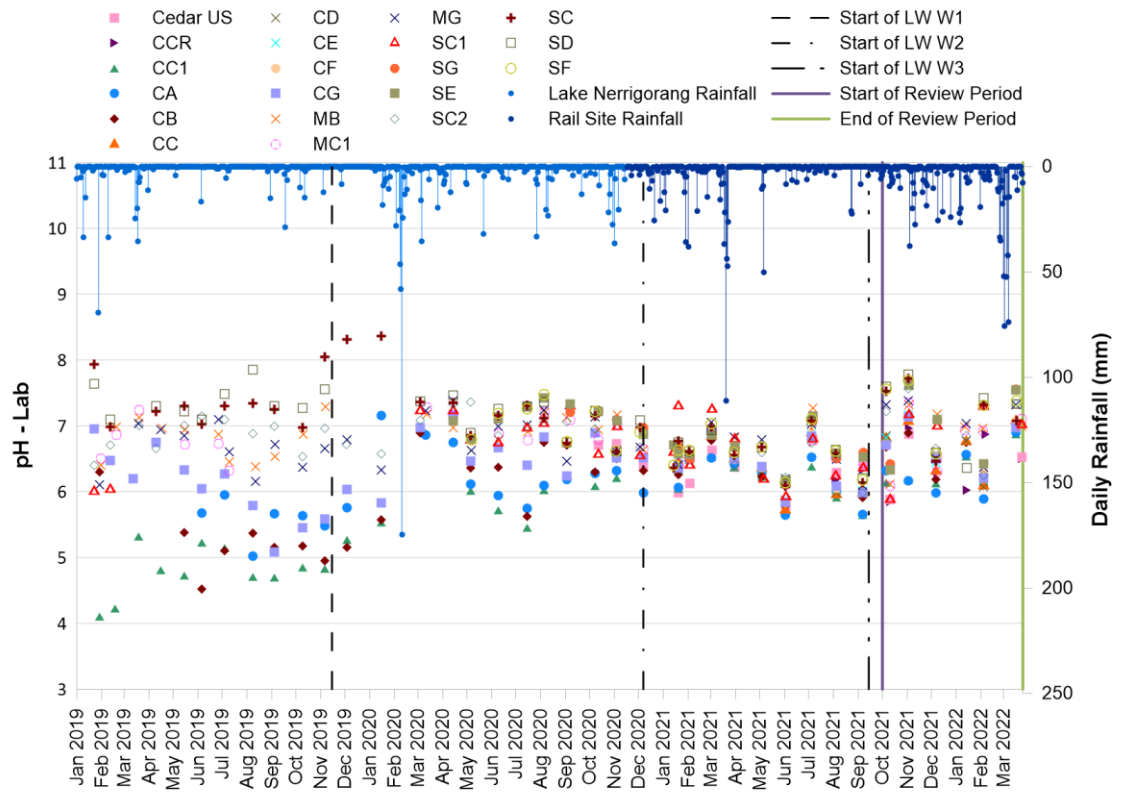


FIGURE B2: LABORATORY PH RECORDS

TAILINGS.WATER.WASTE.

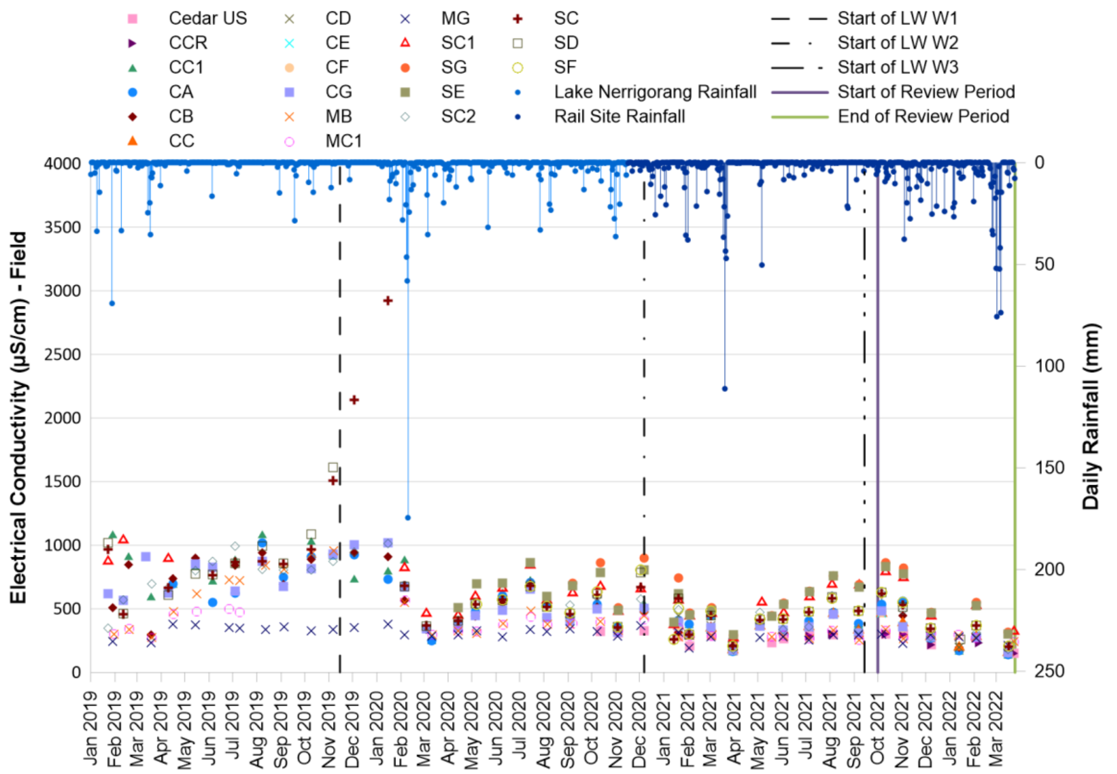


FIGURE B3: FIELD ELECTRICAL CONDUCTIVITY RECORDS

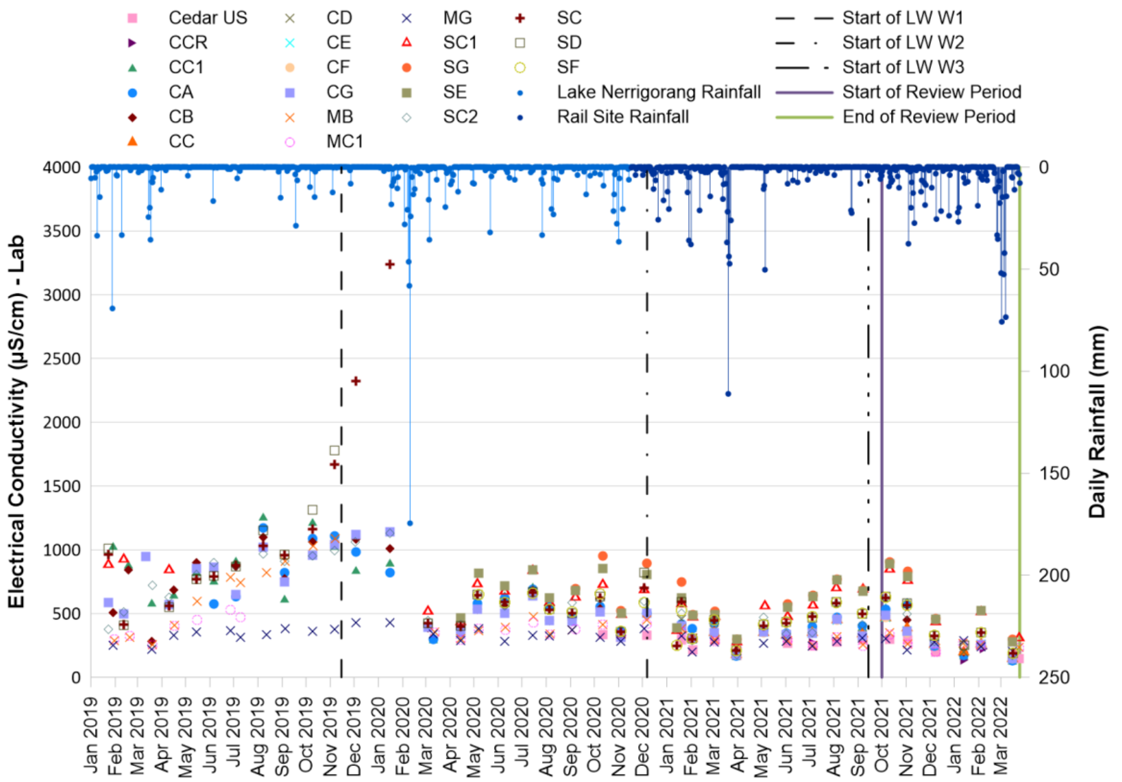


FIGURE B4: LABORATORY ELECTRICAL CONDUCTIVITY RECORDS

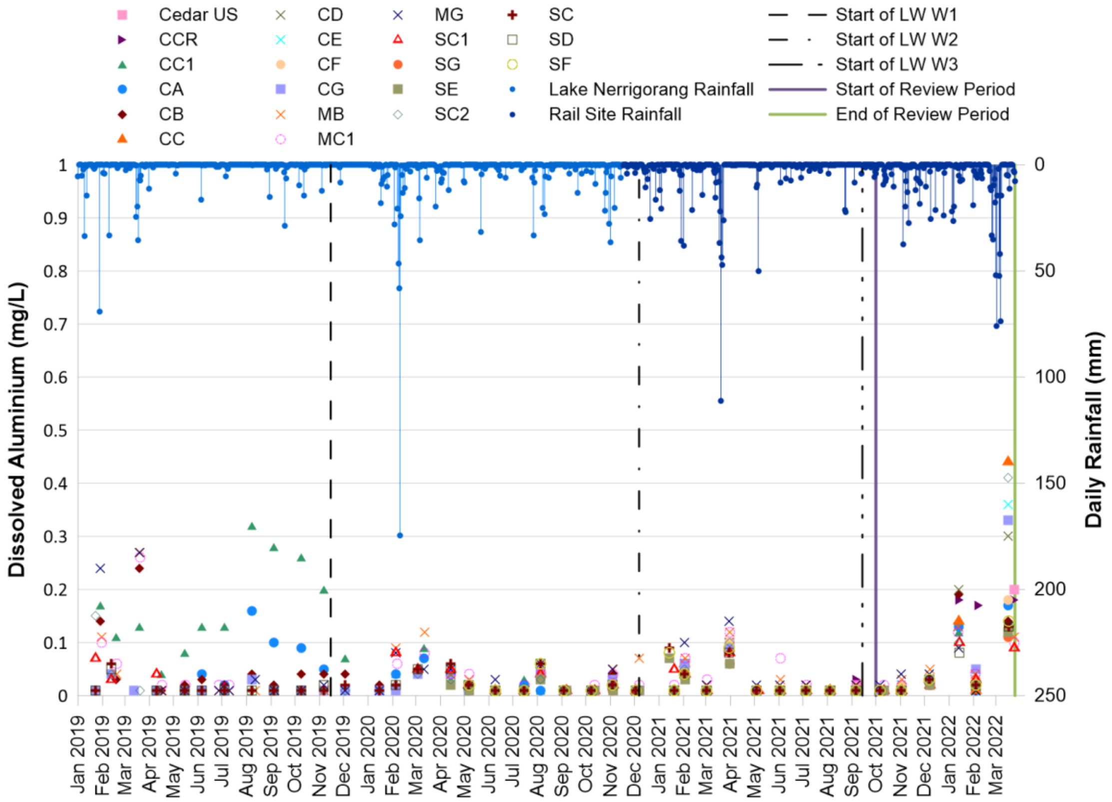


FIGURE B5: DISSOLVED ALUMINIUM RECORDS

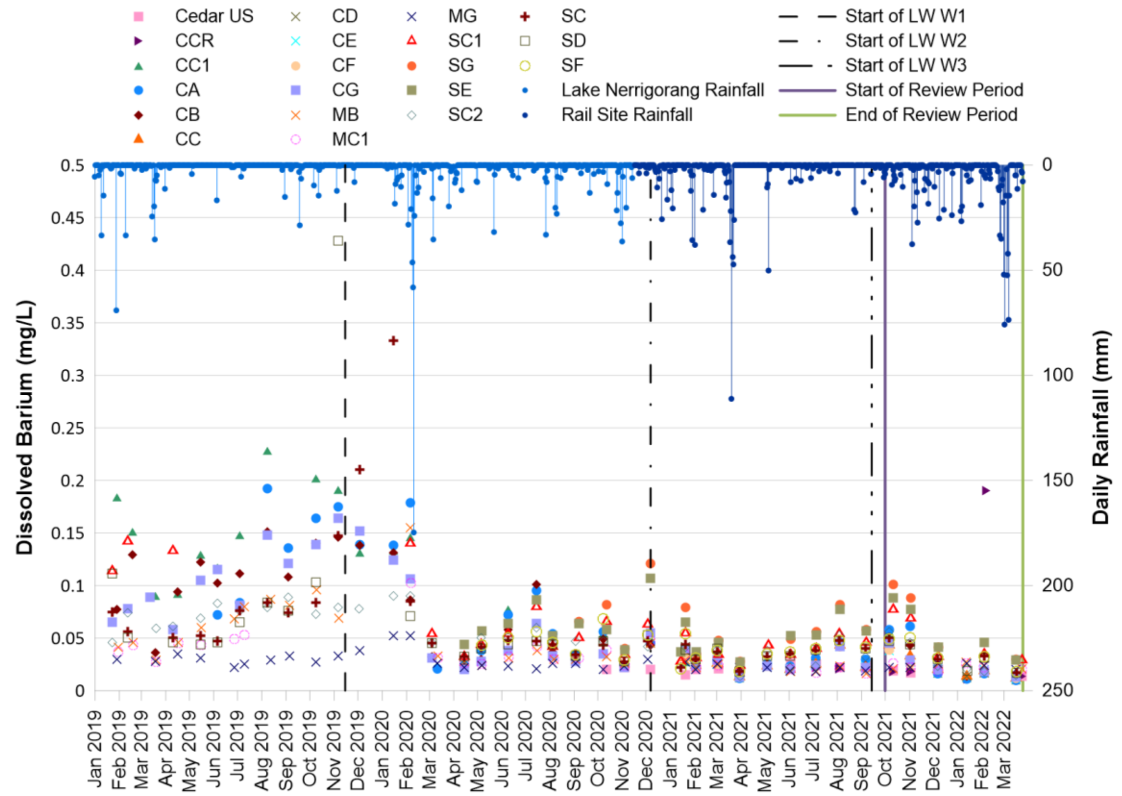


FIGURE B6: DISSOLVED BARIUM RECORDS

TAILINGS.WATER.WASTE.

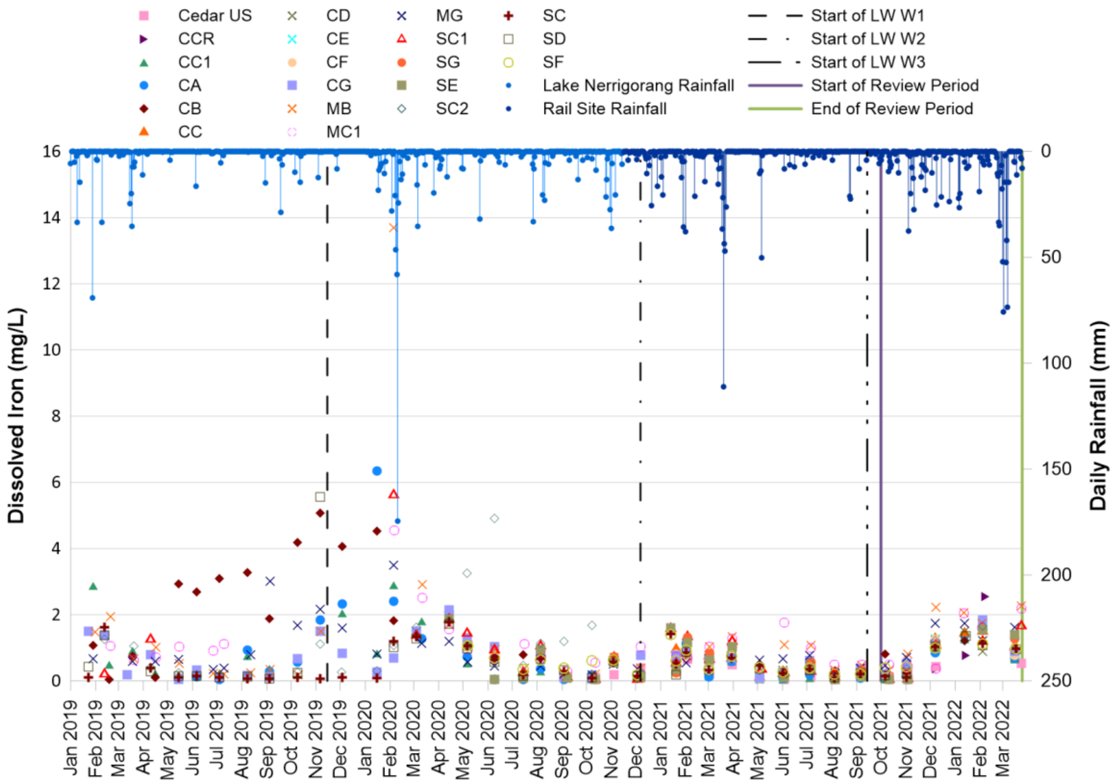


FIGURE B7: DISSOLVED IRON RECORDS

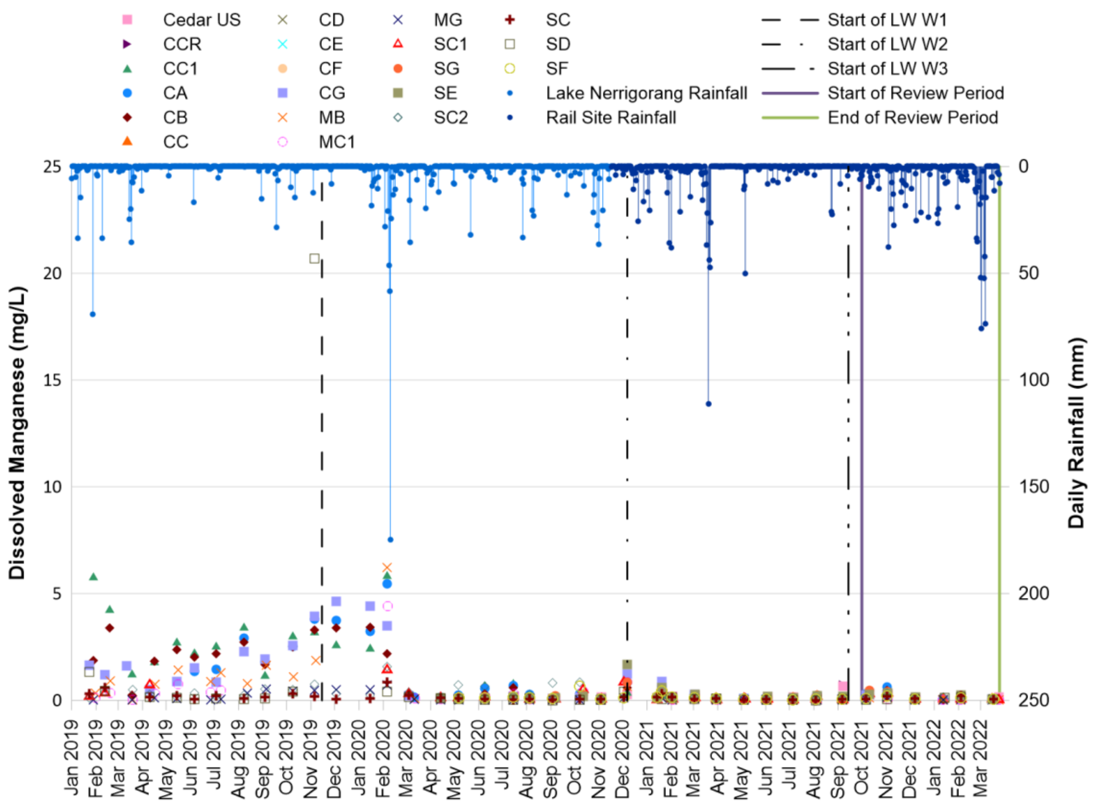


FIGURE B8: DISSOLVED MANGANESE RECORDS

TAILINGS.WATER.WASTE.

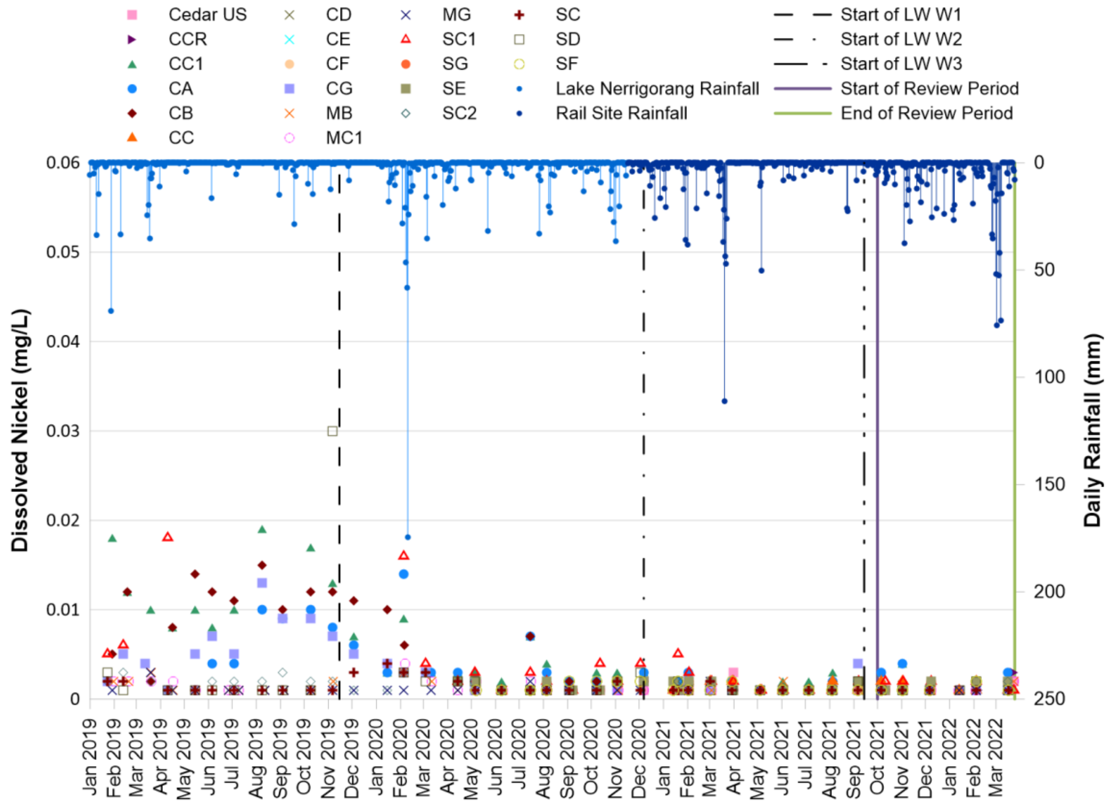


FIGURE B9: DISSOLVED NICKEL RECORDS

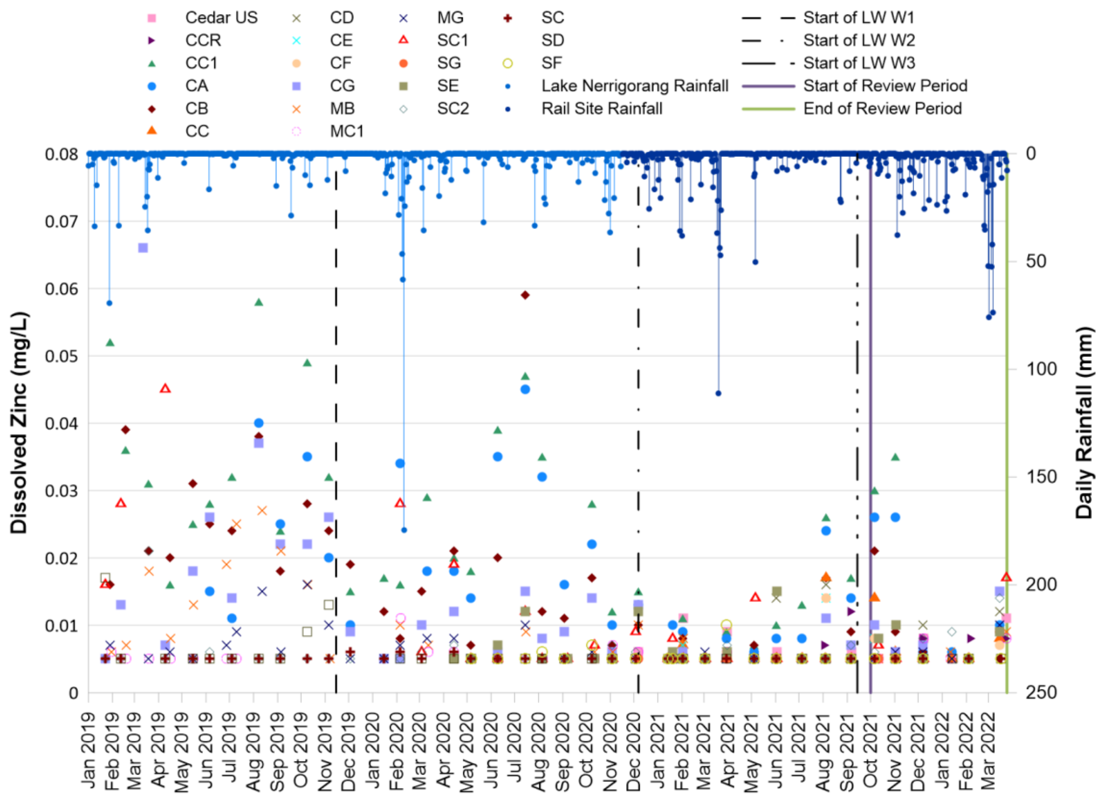


FIGURE B10: DISSOLVED ZINC RECORDS

TAILINGS.WATER.WASTE.

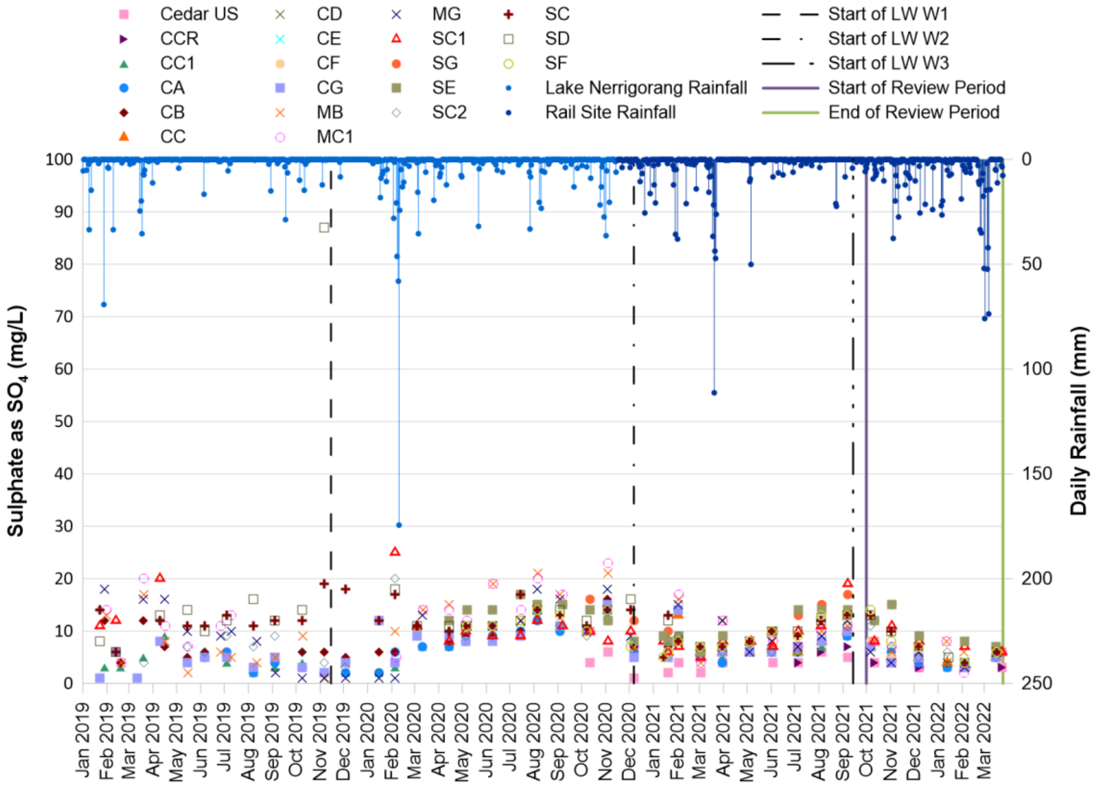


FIGURE B11: DISSOLVED SULPHATE RECORDS

TAILINGS.WATER.WASTE.

Appendix C – Groundwater Monitoring Report

TAHMOOR COAL

Groundwater Six-Month Review
November 2021 - March 2022

Prepared for:

Tahmoor Coal Pty Ltd

SLR Ref: 610.30831.00000-R03
Version No: -v3.0
June 2022

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street
North Sydney NSW 2060 Australia

T: +61 2 9427 8100
E: sydney@slrconsulting.com   www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tahmoor Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30831.00000-R03-v3.0-20220616.docx	16 June 2022	Maxime Philibert	Corinna De Castro	Corinna De Castro
610.30831.00000-R03-v2.0-20220513.docx	30 May 2022	Maxime Philibert	Corinna De Castro	Corinna De Castro
610.30831.00000-R03-v1.0-20220513.docx	27 May 2022	Maxime Philibert	Will Minchin	Corinna De Castro

CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

CONTENTS

FIGURES

CONTENTS

APPENDICES

1 Introduction

1.1 Overview

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a groundwater six-monthly review for the Tahmoor Coal Mine (Tahmoor Mine), located between the towns of Tahmoor and Bargo, New South Wales (NSW). A five-month reporting period was chosen to match with the review period presented in the surface water review completed in ATC Williams (2022a).

This review focuses on the five-month reporting period from 1st November 2021 to 31st March 2022, and includes:

- A review of groundwater levels in monitoring bores in the context of the water level triggers specified in the Longwall W1-W2 Water Management Plan (WMP) and Longwall W3-W4 Water Management Plan (Tahmoor Coal, 2021), with a subsequent evaluation and analysis of any groundwater level trends that exceed this assessment to determine possible causes for these trends;
- A review of water quality triggers and analysis of any bores that exceed these water quality trigger limits as specified in the WMP (i.e. LW W1-W2 and LW W3-W4 WMP); and
- A review of groundwater inflow to the underground mine and compliance with the water access licence held by Tahmoor Coal.

1.2 Site Background

Tahmoor Mine is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney. 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 since Tahmoor Mine commenced in 1979 using board and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal has previously mined 35 longwalls to the north and west of Tahmoor Mine's current pit top mine infrastructure location. The current mining area, the 'Western Domain', is located north-west of the Main Southern Rail between the townships of Thirlmere and Picton. The Western Domain is within Mining Lease (ML) 1376 and ML 1539.

The mine plan for the Western Domain includes four longwalls - Longwalls West 1 to West 4. An Extraction Plan for the first two longwalls in the Western Domain, Longwalls West 1 and West 2 (LW W1-W2), was approved by the NSW Department of Planning, Industry and Environment (DPIE[1]) on 8 November 2019. LW W1 extraction commenced on 15 November 2019 and was completed on 6 November 2020. The extraction of LW W2 commenced on 7 December 2020 and was completed on 17 June 2021. The extraction of LW W3-W4 was approved in September 2021 under the WMP (Tahmoor Coal, 2021). Extraction of LW W3 started on 13 September 2021 and was completed on 21 March 2022. LW W4 started on 16th May 2022.

[1] Currently the Department of Planning and Environment (DPE) since 21 December 2021

1.3 Recent Mining Activity

Over the reporting period from 1 November 2021 to 31 March 2022 the following mining (new and continued mining) activities have taken place at the Tahmoor Mine:

- LW W3 extraction started on 13 September 2021 and was completed on 21 March 2022.

1.4 Methodology

This report details the analysis of groundwater levels and quality to comply with the conditions of the WMP, outlined in Section 2, focusing on groundwater levels and water quality parameters that have exceeded the trigger levels. To fulfil these requirements this report has carried out the following:

- An analysis of groundwater levels in the relevant monitoring bores to determine groundwater level changes over the reporting period in the vicinity of the Western Domain of Tahmoor Mine to demonstrate the correlation between climatic conditions and groundwater levels. Where any unexpected groundwater level changes and exceedances of defined trigger levels are observed, an analysis is carried out to determine the main reasons for this groundwater change (Section 4);
- A review of groundwater quality monitoring, including both field and laboratory data, undertaken during the monitoring period, and identification of any parameters that fall outside those specified in the WMP and the possible causes for these exceedances (Section 5);
- A summary of comparison between the modelled and observed groundwater levels using the latest model results presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (Section 6); and
- An analysis of groundwater mine inflow to determine compliance with groundwater licences and the causes of any significant increases or decreases in groundwater take at Tahmoor Mine (Section 7).

2 Statutory Requirements

The relevant statutory requirements for the Tahmoor Mine six-month groundwater review (presented here as a five-month groundwater review, refer to Section 1.1) are outlined in the following sections. These requirements outline the licensed take from groundwater and highlight trigger levels for the approved impacts to groundwater levels and quality.

2.1 Development Application

The activities at the Tahmoor North Coal Mine were initially approved under the conditions of Development Application (DA 67/98) in 1999. Since this approval five modifications to the DA have been made to maintain the relevance of the approval conditions to changes in legislation and policy, industry practice, as well as environmental and community values.

In September 2018 (Modification 4) additional conditions (13A to 13J) were added to the DA to make provision to report on and measure the impacts of subsidence on natural, built and heritage features in the landscape. Under condition 13H of this modified section, is the request to prepare an Extraction Plan for all longwalls after and including Longwall 33 (now known as LW W1). Condition 13H section (vii) c) required the inclusion of a WMP to accompany the Extraction Plan for LW W3-W4. It is noted that a Modification 5 of DA 67/98 was issued by DPIE in October 2020 and includes only minor alterations to condition 13H. In September 2021, the extraction of LW W3-W4 was approved under the Tahmoor North – Western Domain Longwalls West 3 and West 4 Water Management Plan (Tahmoor Coal, 2021).

2.2 Water Licensing

Water Access Licences (WAL) held by Tahmoor Coal under the authority of the *Water Management Act 2000* are listed in Table 1.

Table 1 Tahmoor Coal Water Access Licences

Work approval	WAL title	Issued	Purpose	Share
10WAI18745	WAL 36442	06/12/2013	Mining dewatering (groundwater) (Nepean Sandstone Groundwater MZ2)	1,642 ML
10AL103025	WAL 25777	27/10/2014	Surface Water Take (Maldon Weir MZ)	5 ML
10MW119329	WAL 43572	13/04/2021	Incidental Surface Water Take (Stonequarry Creek MZ)	16 ML

2.3 Water Management Plan

The approval of LW W1-W2 was conducted under the WMP for LW W1-W2 and the approval of LW W3-W4 is currently conducted under the WMP for LW W3-W4 recently submitted and approved in September 2021.

As part of the Project Approval the WMP outlines the relevant approval conditions and monitoring requirements that the Tahmoor Mine is subject to. As part of the WMP, a Groundwater Technical Report was prepared to determine monitoring and acceptable impacts to groundwater. The Groundwater Technical Report (Appendix D of the WMP, prepared by SLR (2021)) outlines both the groundwater relevant triggers and Trigger Action Response Plan (TARP). Subsequent modifications to the TARP were undertaken to address comments made by DPIE and the Independent Advisory Panel for Underground Mining (IAPUM) prior to the submission of the WMP in September 2021 (Tahmoor Coal, 2021).

A summary of the requirements of the WMP that are relevant to this groundwater assessment and where they are addressed in this document are presented in Table 2.

Table 2 Groundwater Technical Report requirements of the WMP for Water Monitoring

WMP Parameter	Groundwater Requirements Summary
Springs	There are no springs identified in the vicinity of LW W1-W4 or the surrounding watercourses. Therefore, monitoring and management of such features is currently not required.
Groundwater level	Detection of a lowering of groundwater (drawdown) that exceeds beyond the trigger (trigger levels detailed further in Section 4.2), the Trigger Action Response Plan must be implemented (Appendix B).
Groundwater quality Field: pH, EC, temperature Lab: pH, EC, Total dissolved solids, sodium, calcium, potassium, magnesium, chloride, fluor, sulphate, total phosphorous, total nitrogen, organic carbon, total alkalinity as calcium carbonate, bicarbonate and carbonate, arsenic, cadmium, copper, iron, lead, manganese, nickel, selenium, zinc, aluminium	Assessment of whether concentrations are within the minimum and maximum background values (detailed further in Section 5.1). If the trigger values for selected groundwater quality parameters are exceeded, or are found to be out of the acceptable range, the Trigger Action Response Plan must be implemented (Appendix B).
Groundwater interception (mine inflow)	Determination of groundwater interception as part of the Annual Review process to identify that the annual inflow to underground workings is covered by the water licence of 1,642 ML (WAL36442).
Subsidence performance measures	Subsidence performance measures for natural and heritage features are listed under Condition 13A of DA 67/98. There are no performance measures specific to groundwater.

3 Existing Network and Monitoring Program

There are six existing boreholes with vibrating wire piezometers (VWPs) (TNC036, TNC040, TNC043, WD01, P40 and P41) that are routinely monitored by Tahmoor Coal to monitor groundwater levels in the aquifers surrounding Tahmoor Western Domain. In addition, there is a set of standpipe monitoring bores (at sites P12, P13, P14, P15, P16 and P17) as shown on Figure 1. P13 and P17 were decommissioned in September 2021.

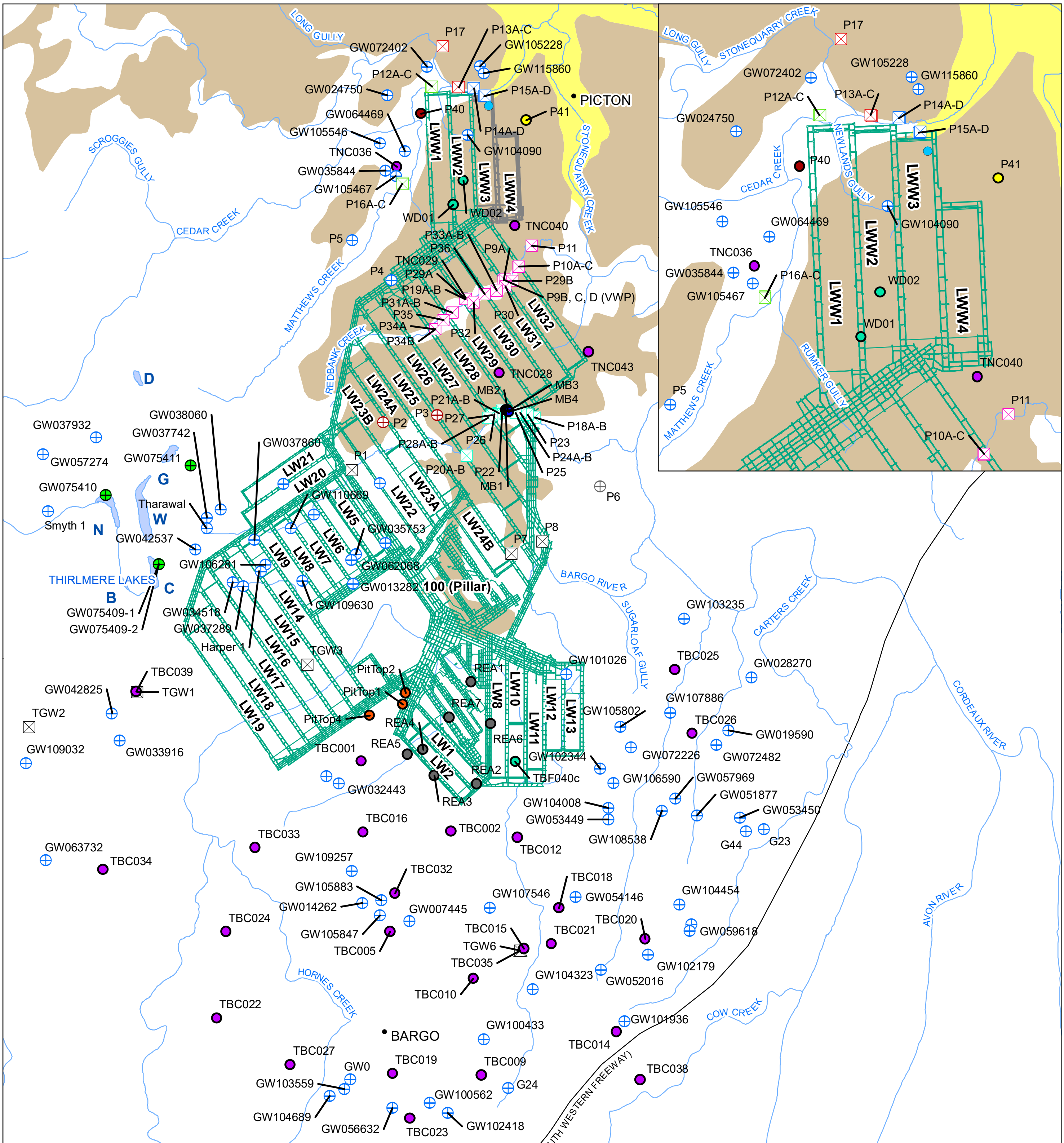
P40, located near the surface water monitoring site CB along Cedar Creek (approximately 115 m east of the creek), was drilled to a depth of 97.8 m (Figure 1). Four VWP instruments (P40A-D) were installed at different depths within the Hawkesbury Sandstone (39, 44, 49 and 85 m below ground level (bgl)) at P40 with groundwater levels recorded since late August 2021.

The Nepean Fault Complex VWPs at P41 were installed in early 2021 approximately 230 m north-east of LW W4 and 600 m south of Stonequarry Creek within the Nepean Fault Complex. P41 is an angled borehole equipped with six VWPs instruments at different depths (P41A-F) within the Wianamatta Formation and Hawkesbury Sandstone recording groundwater levels since late August 2021.

P40 and P41 provide data on groundwater level throughout the current extraction of LW W3 and future extraction of LW W4. Other monitoring locations that may be added to the network in future would be included in an updated monitoring program. In addition, bores WD01 (existing) and WD02 (proposed) are designed to monitor groundwater level response directly above Western Domain workings.

To fulfill the requirements of the WMP, groundwater level monitoring at Tahmoor Mine is carried out in accordance with the WMP conditions. All groundwater level monitoring bores and VWPs in the vicinity of Tahmoor, and their available monitoring details, are listed in Table 3 below. Some piezometers or bores have failed due to ground movement (subsidence effects) or had equipment fail or logger equipment stolen, which affects the ability to collect data or affects the frequency of data measurement. The status of each instrument is listed in Table 3.

In addition to groundwater level monitoring, all shallow standpipe bores are sampled to fulfill the requirements of the WMP groundwater quality monitoring at Tahmoor Mine.



Rainfall Monitoring Site - Rail Site Tipping Bucket

Groundwater Monitoring Locations

- Pointe Engineering
- Deep GWL
- HOF investigation bore
- Nepean Fault Complex piezometer
- Cedar Creek piezometer
- Shallow OSP
- Shallow OSP - Cedar Creek
- Shallow OSP - Redbank
- Shallow OSP - Myrtle Creek
- Shallow OSP - Stonequarry Creek
- Shallow OSP - Stonquarry (decommissioned bore)
- Shallow OSP - Matthews Creek
- Shallow OSP - pit-top
- Shallow OSP - REA
- Groundwater quality
- NSW govt monitoring
- Regional GW Bore
- Regional old exploration bore
- Regional GW Bore (destroyed)
- Pool 23 rehab

0 1 2 km

Coordinate System:	GDA 1994 MGA Zone 56
Scale:	1:80,000 at A4
Project Number:	665.10010
Date:	16-May-2022
Drawn by:	JG

SLR

- Town
- Tahmoor North and Western Domain
- Proposed Areas of Future Mining
- Major Roads
- Watercourses
- Lakes
- Alluvium
- Wianamatta Formation

Lakes:
D = Dry Lake
G = Gandangarra
W = Werri Berri
C = Couridjah
B = Baraba
N = Nerrigorang

TAHMOOR COAL

Groundwater Monitoring Network

FIGURE 1

H:\Projects-SLR\620-BNE\665-WOL\665.TAH05 Tahmoor GWMP\GIS\66510010 Fig1 Groundwater monitoring locations May 2021- October 2021.mxd

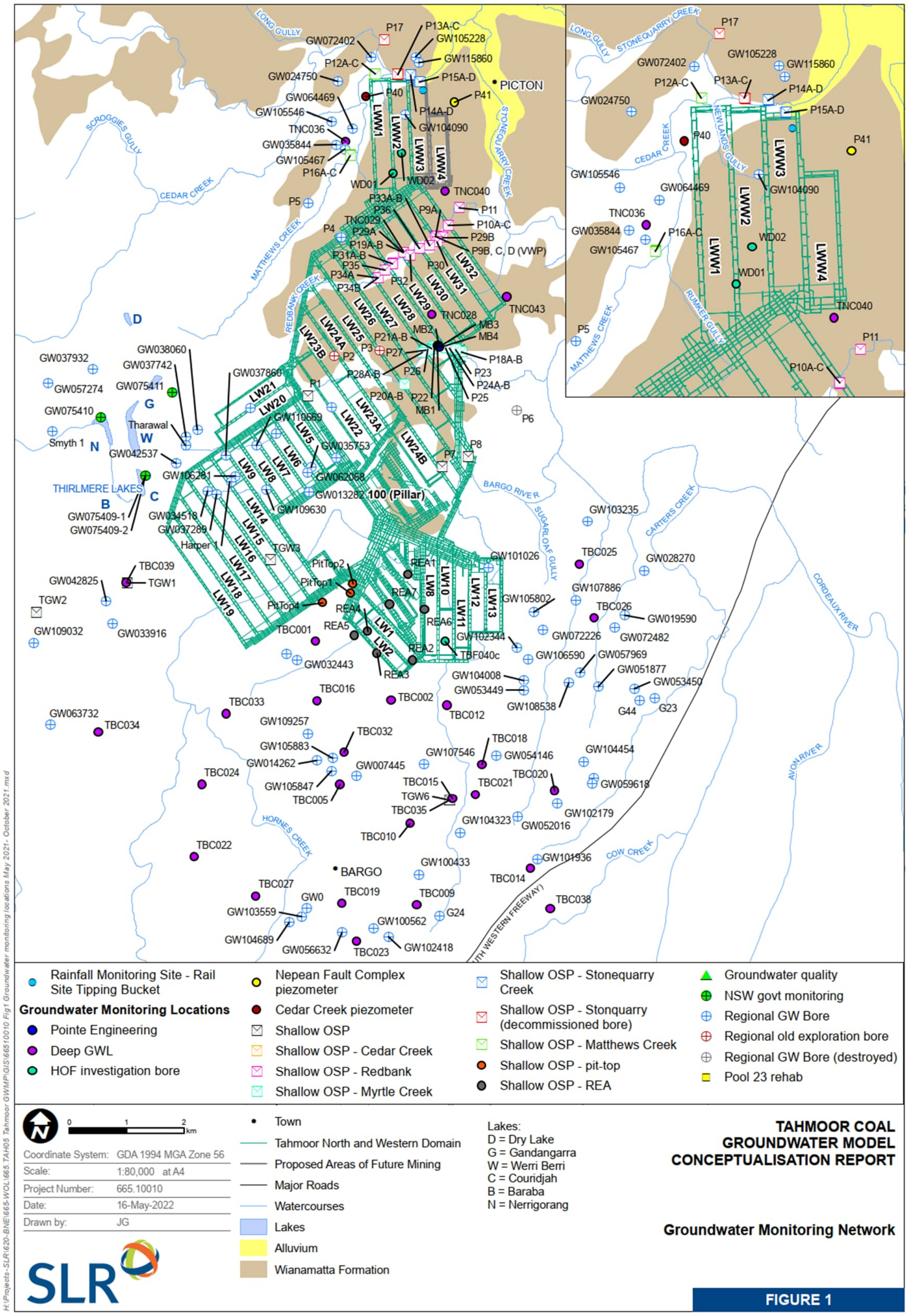


Figure 1 Groundwater Monitoring Network

Table 3 Groundwater Monitoring Network

Monitoring Bore or VWP ID	Owner	Easting[1] (MGA94)	Northing[1] (MGA94)	Bore screen or VWP sensor depth (mBGL)	Status	Groundwater Level Monitoring Frequency	Groundwater Quality Monitoring Frequency	Impact or Control Bore
Shallow Groundwater Levels (Monitoring bores/standpipe piezometers)								
P12A	Tahmoor Coal (TC)	277771	6216561	14.6 - 19.6	EX	PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter. DURING MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter.	PRE-MINING - Field water quality and laboratory analysis monthly. DURING MINING - Field water quality and laboratory analysis monthly. POST MINING - Field water quality and laboratory analysis monthly for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group.	Impact
P12B	TC	277776	6216560	31.6 - 34.6	EX			Impact
P12C	TC	277781	6216559	61.6 - 64.6	EX			Impact
P13A	TC	278180	6216550	19.5 - 22.5	D			Impact
P13B	TC	278175	6216554	33.5 - 37.5	D			Impact
P13C	TC	278170	6216558	64.5 - 67.5	D			Impact
P14A	TC	278398	6216536	4.5 - 6.0	EX			Impact
P14B	TC	278393	6216534	13.6 - 16.6	EX			Impact
P14C	TC	278397	6216542	28.6 - 31.6	EX			Impact
P14D	TC	278391	6216540	58.6 - 61.6	EX			Impact
P15A	TC	278550	6216426	16.1-17.6	EX			Impact
P15B	TC	278545	6216423	18.6-20.1	EX			Impact
P15C	TC	278556	6216427	30.5-32.0	EX			Impact
P15D	TC	278561	6216431	66 (bore depth)	EX			Impact
P16A	TC	277351	6215147	24.5 - 27.5	EX			Impact
P16B	TC	277350	6215140	42.5 - 45.5	EX			Impact
P16C	TC	277347	6215135	72.5 - 75.5	EX			Impact

Monitoring Bore or VWP ID	Owner	Easting[1] (MGA94)	Northing[1] (MGA94)	Bore screen or VWP sensor depth (mBGL)	Status	Groundwater Level Monitoring Frequency	Groundwater Quality Monitoring Frequency	Impact or Control Bore
P17	TC	277941	6217153	19.6 - 22.6	D	POST MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group.		Control
GW072402	Private	277708	6216852	8.2 - 72.0	EX			Impact
GW105228	Private	278490	6216858	23.0 - 63.0	EX			Impact
GW105467	Private	277253	6215247	73.0 - 79.0	EX			Impact
GW105546	Private	277018	6215732	48.0 - 56.0	EX			Impact

GW115860	Private	278543	6216760	20, 48 and 55	EX	PRE-MINING – Standing water level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019, 2021b). DURING MINING - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis. POST MINING - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group.	PRE-MINING - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019, 2021b). DURING MINING - Field water quality and laboratory analysis on a 3-monthly basis. POST MINING - Field water quality and laboratory analysis on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group.	Impact
Shallow Groundwater Pressures (VWPs < 200 mBGL)								

Monitoring Bore or VWP ID	Owner	Easting[1] (MGA94)	Northing[1] (MGA94)	Bore screen or VWP sensor depth (mBGL)	Status	Groundwater Level Monitoring Frequency	Groundwater Quality Monitoring Frequency	Impact or Control Bore
P40(A-D)	TC	277620.6	6216160.1	HBSS-39	EX	PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download. DURING MINING - Minimum continuous 24-hourly readings with monthly logger download. POST MINING - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. The period may be extended as per the decision by the Environmental Response Group.	Not monitored for water quality	Impact
				HBSS-44	EX			Impact
				HBSS-49	EX			Impact
				HBSS-85	EX			Impact
P41(A-F)	TC	279167	6216068	WNFM-53 (vertical)	EX			Impact
				HBSS-71 (vertical)	EX			Impact
				HBSS-88 (vertical)	EX			Impact
				HBSS-106 (vertical)	EX			Impact
				HBSS-123 (vertical)	EX			Impact
				140 (vertical)	EX			Impact
TNC036	TC	277269	6215382	HBSS-65	EX			Impact
				HBSS-97	EX			
				BGSS-169	EX			
TNC040	TC	279004	6214521	WNFM-27	EX			Control
				HBSS-65	EX			
				HBSS-111	F			
TNC043	TC	280077	6212671	HBSS-65	L			Control
				HBSS-111.5	L			
WD01	TC	278099	6214828	HBSS-70	EX			Impact

Monitoring Bore or VWP ID	Owner	Easting[1] (MGA94)	Northing[1] (MGA94)	Bore screen or VWP sensor depth (mBGL)	Status	Groundwater Level Monitoring Frequency	Groundwater Quality Monitoring Frequency	Impact or Control Bore
				HBSS-90	EX			
				HBSS-190	F			
WD02	TC	278246	6215178	Not drilled yet	P			Impact
Deep Groundwater Pressures (VWPs > 200 mBGL)								
TNC036	TC	277269	6215382	BGSS-214	EX	PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download. DURING MINING - Minimum continuous 24-hourly readings with monthly logger download.	Not monitored for water quality	Impact
				BGSS-298.5	F			
				BGSS-412.5	EX			
				BUSM-463.5	F			
TNC040	TC	279004	6214521	HBSS-225	F			Control (for LW W1-W4)
				BHCS-252	F			
				BGSS-352	F			
				SCSS-482	F			
				BUCO-501.9	F			
TNC043	TC	280077	6212671	HBSS-213	F			Impact
				BGSS-240	F			
				BGSS-332.6	F			
				BGSS-405.2	F			
				BUCO-476.3	F			
WD01	TC	278099	6214828	210-HBSS	EX			Impact
				230-Newport Fm	F			

Monitoring Bore or VWP ID	Owner	Easting[1] (MGA94)	Northing[1] (MGA94)	Bore screen or VWP sensor depth (mBGL)	Status	Groundwater Level Monitoring Frequency	Groundwater Quality Monitoring Frequency	Impact or Control Bore
				300-BGSS	F	POST MINING - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group.		
				330-BGSS	F			
				350-BGSS	F			
WD02	TC	278246	6215178	Not yet drilled	P			Impact

1 Coordinates in metres (GDA94 Zone 56).

WNFM – Wianamatta Group *BGSS – Bulgo Sandstone* *VWP – vibrating wire piezometer* *HBSS – Hawkesbury Sandstone*
SCSS – Scarborough Sandstone *mBGL – metres below ground level* *BHCS – Bald Hill Claystone* *BUCO – Bulli Coal Seam*
EX – Existing *F - Failed* *P – Proposed monitoring bore* *L – Loss of logger (stolen), manual readings still taken.*
"-" - Not drilled yet *D – Decommissioned* *vert. = vertical depth below ground in angled hole*

4 Groundwater Level Trigger Review

The following section addresses the compliance of groundwater levels at Tahmoor Coal during the reporting period in relation to both a rainfall cause-and-effect and trigger analysis.

4.1 Cause and Effect Analysis

An analysis of rainfall at Tahmoor Mine has been carried out to provide context for observed changes and trends in groundwater levels and quality. This cause-and-effect analysis has then been used to determine if the observed changes in groundwater levels could be attributed to weather conditions, a mining effect, or a combination of both. Groundwater levels may also be affected by local groundwater pumping (at bores unrelated to Tahmoor Mine), however pumping records are not available, and this cause/effect is difficult to identify with confidence.

In accordance with the current TARP in place, any exceedances in groundwater levels or quality identified across the Western Domain are flagged below. A more detailed summary of performance against the associated response plan for each monitoring location is discussed in Section 4.3.

4.1.1 Rainfall Analysis

Rainfall data in the area is available from several sources. Bureau of Meteorology (BoM) operate two rainfall stations, Picton Council Depot (68052) and Buxton (68166) which are located approximately 1.3 km east and 2.2 km west respectively to Tahmoor Mine. The locations, range of data and comment about quality of the rainfall data are presented in Table 4. Tahmoor Coal operates three rainfall stations (Mine gauge, Rail Site and Whiteys Site), and the SILO climate data source provides interpolated and infilled records for 0.05°x0.05° latitude and longitude tiles. Due to the occasional gaps in the data for the BoM sites, and the relatively short record of data held by Tahmoor (the Mine gauge record has no gaps, but only started in July 2006), the SILO record for the 0.05°x0.05° tile centred on the location 274250E, 6212950N has been adopted for this report to understand long-term trends.

Table 4 Rainfall Data Sources

Data Source	Owner	Location	Range of Data	Comment
Picton Council Depot (68052)	BOM	Picton	1880-2020	Good quality, occasional gaps
Buxton (68166)	BOM	Buxton	1966-2021	Good quality, occasional gaps
Mine gauge	Tahmoor Coal	Western Domain	2006-2021	Data quality can be suspect.
Rail Site	Tahmoor Coal	Western Domain	Nov-2020 to present	Good quality, short record
Whiteys Site	Tahmoor Coal	Upper Stonequarry Creek catchment	Feb-2021 to present	Good quality, short record
SILO 0.05x0.05 tiles	SILO	274250E, 6212950N	Jan-1900 to present	Interpolated infilled record

Monthly average rainfall is presented on Figure 2, alongside potential evaporation and estimated actual evapotranspiration. Rainfall is generally consistent all year with average monthly totals of 41 to 88 mm. The highest monthly rainfall is typically in February and March, (88 and 84 mm respectively), while September is typically the driest month (averaging 41 mm) for the period of record. The average annual rainfall at Tahmoor is approximately 765 mm. Evaporation and evapotranspiration show similar trends with higher rates during the summer months and lower rates in winter. The average monthly potential evaporation is highest in December (200 mm). The average annual potential evaporation is 1463 mm.

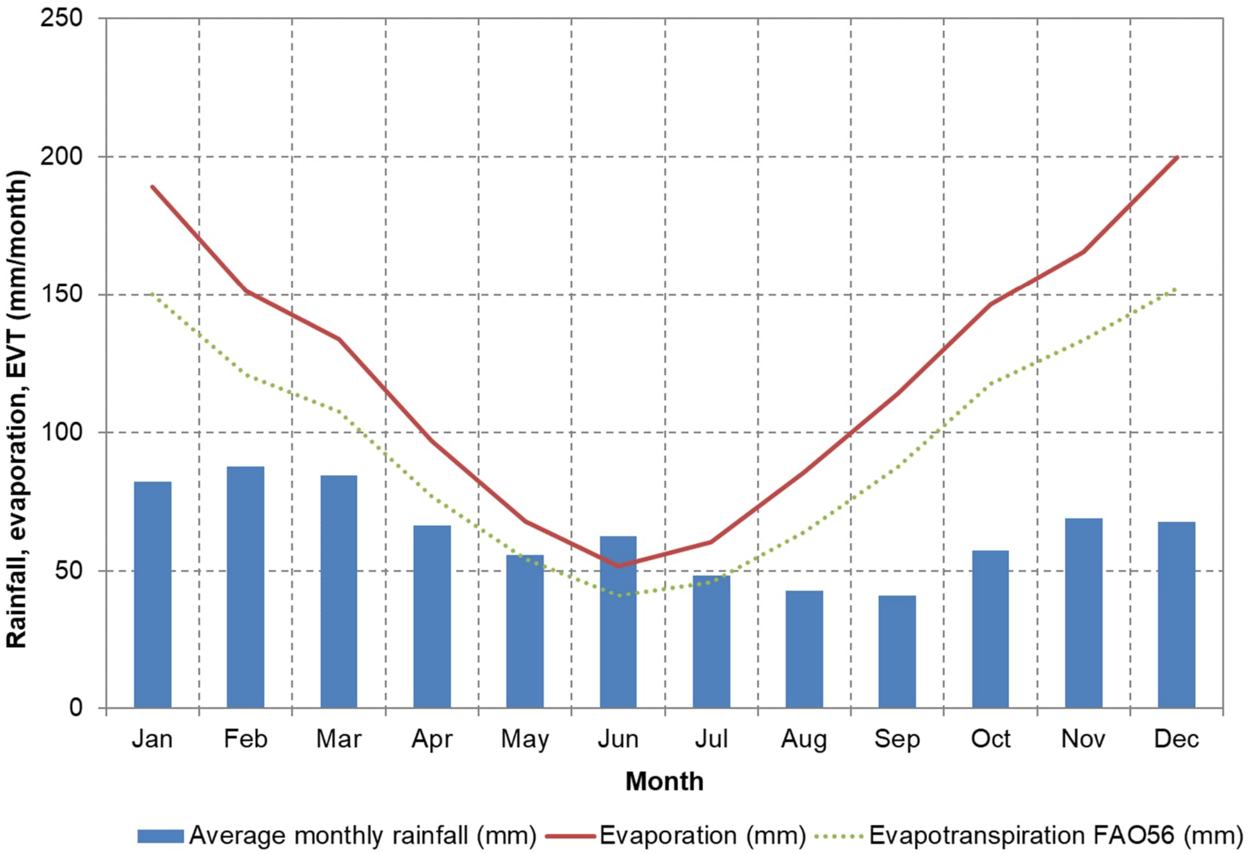


Figure 2 Monthly Average Rainfall and Potential Evaporation and Rainfall Trends

Figure 3 shows the historical record of monthly rainfall and potential evaporation, and the calculated trend in rainfall (using “cumulative residual departure” from mean method). This trend (dark green line) shows wet periods as upward gradients, droughts as downward gradients, and average conditions as horizontal. Of note in recent times, there was a significant drought period from mid-2017 until January 2020, with extreme conditions in November 2019 to January 2020, notable for bushfire conditions around Tahmoor Mine and more widely across eastern NSW. Since then, conditions have been wetter than average, including high rainfall totals in February and August 2020, in March 2021 and again in March 2022. Wetter than average conditions were observed during the entire reporting period. Total rainfall in March 2022 was 476.4 mm resulting in major floods across much of NSW including around Picton and well above the long-term average of 84 mm. The cumulative rainfall departure (CRD) gradient in Figure 3 is based on SILO records dating back to 1900.

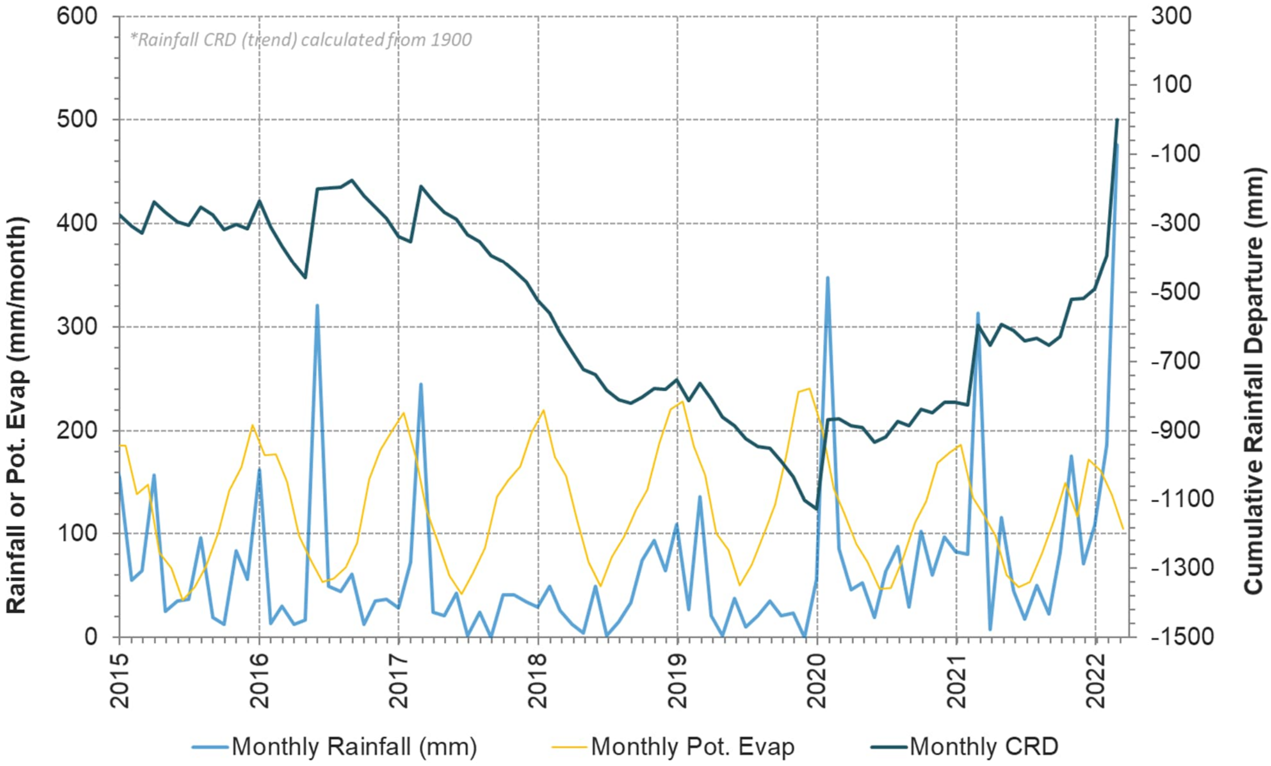


Figure 3 Long-term Rainfall Record and Trends

4.1.2 Western Domain

Hydrographs for the existing shallow standpipe bores (P12-P16) and VWP sites P40 and P41 drilled in 2019 and 2021 around the Western Domain are presented in Appendix A (A1-A6) with the rainfall trend (CRD). Monitoring bores P12-P14, P15 and P17 are located north of the Western Domain longwalls, outside the mine footprint and adjacent to Stonequarry Creek (P13, P14, P15 and P17) and Cedar Creek (P12). P16 is situated along Matthew Creek, 300 m west of LW W1 and upstream from the confluence of Matthews Creek and Rumker Gully. P40 is located 115 m east from the surface water site CB and P41, the Nepean Fault Complex site, is located 230 m north-east of LW W4. A brief analysis of the groundwater trends in relation to weather and mining activity is presented below except for sites P13 and P17 which were decommissioned in September 2021. Previous analysis conducted at P13 and P17 are presented in SLR (2021, 2021a). Locations for the monitoring sites are shown on Figure 1.

4.1.2.1 Site P12

P12 bores are the closest monitoring bores to LW W1 (50 m north) which was completed in November 2020. The lowest groundwater level recorded at P12C was between June and November 2019 (prior to LW W1 commencement) at 176.3 m AHD. There is evidence of groundwater pumping by nearby users, causing drawdown over short periods (less than two months) in the range of 1 m to 3 m (SLR, 2021).

At P12 (Figure A-1), groundwater levels in the upper Hawkesbury Sandstone (P12A and P12B) stabilised in February 2021 following a progressive reduction of approximately 0.5 m during LW W1 and a further 0.5 m drop during the early part of LW W2. In March 2021, groundwater levels at P12A and P12B responded to rainfall recharge, with increases in the range of 1 m. After the March 2021 rainfall event, more consistent rainfall response in the range of 0.5 m to 0.8 m has been observed. A minor decline of approximately 0.4 m was observed in P12B following the commencement of LW W3 but remain stable in P12A. Between November 2021 and early February 2022, groundwater levels in P12A and P12B were stable with minor fluctuation around approximately 170.4 mAHD. The response to rainfall recharge during November 2021 (a period of above average rainfall) was very limited, suggesting that extraction of LW W3 could have affected (flattened) the groundwater level response to rainfall in the shallow Hawkesbury Sandstone or the rainfall amount was insufficient for a groundwater level recharge response. From late February 2022 groundwater levels have responded to rainfall recharge in the range from 0.5 m to 0.8 m and up to 2.5 m in P12A in early March 2022, likely attributed to the exceptional rainfall. At the end of the reporting period, groundwater levels in P12A and P12B are 0.9 m and 0.3 m above baseline levels respectively, at approximately 171 mAHD.

There was a difference in groundwater levels at P12A and P12B during the baseline period of approximately 0.6 m which suggested an upward vertical gradient. This gradient has weakened following mining at LW W1, LW W2 and early part of LW W3, with groundwater levels at P12A and P12B observed at similar elevations. This suggests that there is more drawdown at P12B, and that the connectivity between the upper (P12A) and mid-Hawkesbury Sandstone (P12B) may have locally increased following mining.

Groundwater levels at P12C declined by approximately 14 m during LW W1, and a further 0.5 m during the early stage of LW W2. Groundwater levels started to recover from February 2021, albeit at a slightly slower rate between July and August 2021. From July 2021, groundwater levels at P12C increased to 1 m above the groundwater levels observed at P12A/P12B suggesting the re-establishment of an upward hydraulic gradient from P12C to P12B observed prior to mining.

In November 2021, groundwater levels at P12C appeared stable at approximately 171.2 mAHD, following a decline in groundwater levels in the range of 0.8 m after the commencement of LW W3 in September 2021. The stabilisation in groundwater levels is likely attributed to above average rainfall in November 2021. From mid-December 2021, groundwater started to recover at a similar rate as observed in 2021 with an acceleration in the rate observed in late February 2022 due to intense rainfall. During the reporting period groundwater levels at P12C increased by approximately 2.8 m, currently at an elevation of 174 mAHD, which is approximately 2.2 m below baseline levels.

The groundwater recovery in P12C results in the strengthening of the upward hydraulic gradient from P12C and P12B (which was the pre-mining condition) and could strengthen inferred gaining condition groundwater to Cedar Creek.

4.1.2.2 Site P14

P14 bores are located 350 m east of LW W1. Since the start of monitoring in June 2019 each of the open standpipes except P14A show a continual and relatively linear decline in groundwater levels which correlate with a reduction in rainfall until February 2020 (Figure A-2). Groundwater levels respond to the wetter conditions from early 2020 to present.

From March 2020 onwards, groundwater levels within P14B, C and D exhibited a progressive reduction in groundwater levels (up to 2 m at P14D) due to LW W1 and a further 1 m reduction following the extraction of LW W2. Groundwater levels started to stabilise in February 2021 as LW W2 progressed to the south. From February to July 2021, groundwater levels at P14B, C and D recovered by approximately 1.5 m. Groundwater levels in P14B and P14C stabilised throughout July and August 2021 at similar levels (166.5 mAHD) while groundwater levels in the lower Hawkesbury continued to recover until the end of August 2021. In early September 2021, a minor and rapid decline in groundwater level of 0.7 m is observed in P14D, which is prior to the commencement of LW W3. Groundwater levels in P14D increased back to levels similar to those in August 2021 during the first 250m LW W3 extraction in September 2021. A consistent and sudden decline ranging from 0.25 m to 0.45 m was observed in P14A, B, C and D between the 15th and 16th October 2021, 32 days following the start of LW W3 (after 250 m extraction of LW W3). This groundwater decline has been investigated in SLR (2021b) and assessed as a minor mining-related effect on groundwater levels at site P14. During the reporting period, groundwater levels at P14B, C and D show a consistent trend. Groundwater levels were stable in November 2021 with minor responses to above average rainfall. In December 2021, a consistent and minor decline in groundwater levels of approximately 0.3 m to 0.4 m is observed in P14B, C and D which is possibly a mining effect related to LW W3 extraction. From January 2022, a consistent recovery in groundwater levels is observed at P14B, C and D with the rate in recovery accelerating following the exceptional rainfall in early March 2022. During the reporting period, groundwater levels in P14D increased by 2 m and are approximately 1.7 m above baseline levels. In P14B and P14C, groundwater levels increased by 1.8 m, are 0.4 m above the approximate creek bed elevation and 1.2 m and 1.3 m respectively above baseline levels.

P14A is screened in surficial sediments (colluvium/alluvium) above the HBSS. The groundwater level in this monitoring bore is very responsive to rainfall conditions. Recent groundwater levels are approximately 2.7 m higher than the pre-mining groundwater levels, due to a shift from drought (occurring 2017 to January 2020) to above-average rainfall from February 2020 through to April 2022. Significant peaks in groundwater level are related to rainfall events (including February 2020, March 2021 and March 2022), with recessions related to the following drier periods. The hydrograph for this site does not show any clear sign of mining-related effects.

4.1.2.3 Site P15

P15 bores are located 540 m and 220 m northeast of LW W1 and LW W2 respectively, and 60 m north of LW W3. P15A, B and C have been installed to depths of 17.6, 20 and 32 m bgl and equipped with loggers recording at 12-hourly readings (Figure A-3). Groundwater level records commenced at P15A, B, C (Figure A-3) in March 2021. Groundwater levels increased by approximately 1 m from that time until early June 2021, likely due to heavy rainfall in March 2021. P15D was drilled in early June 2021 to a depth of 66 m bgl and packer tested on 11 June 2021 which locally affected the connectivity of fractures and influenced groundwater levels at P15 (see annotation on Figure A-3). The drilling of P15D resulted in an overall reduction of 1 m in the water column at P15B, and while it is not clear why this bore is affected and not P15A or C, the data from mid-June is consistent with the other two shallower piezometers. Prior to the commencement of LW W3, groundwater levels in P15A, B and C have showed similar groundwater trends, with response to rainfall in the range of 0.1 m to 0.2 m. At P15D, consistent groundwater levels were observed, similar to those at P14D (drilled at a similar depth).

From September 2021, a short-term increase in groundwater levels is observed at P15D, similar as in P14D for the same period. No mining related effects on groundwater levels is observed at monitoring sites P15 during September 2021 following the commencement of LW W3. Little change in groundwater levels was observed in shallow groundwater in this area adjacent to the commencing end of LW W3 extraction until October 2021 (i.e. groundwater decline ranging from 0.2-0.5 m at site P15, up to 0.8 m in mid-October 2021 in P15D) (SLR, 2021a). This resulted in the trigger exceedances in the shallow groundwater levels at P15A and P14B in October 2021 (SLR, 2021c) and as per the Trigger Action Response Plan for Stonequarry Creek (not presented in this study) (Tahmoor North – Western Domain, September 2021).

SLR (2021c) found no impact on baseflow at site SB (at or near rockbar SR17) in October 2021 (i.e. no loss of surface water to the underlying aquifer) despite trigger exceedances for the rate of shallow groundwater level decline at P15A and P14B (SLR, 2021c). The minor groundwater decline at P15A and P14B was investigated in SLR (2021c) and assessed as a minor mining related effect on groundwater levels at site P15A and P14B (i.e. following the early part of LW W3 extraction).

Between November 2021 and December 2021, groundwater levels in P15D

suddenly declined for short periods of time (between 4-6 days) by approximately 0.5 m (on 20th November 2021, 10th December and 25th December 2021) but responded immediately to rainfall within 1-2 days after the groundwater level decline. These short-term declines could be a combination of reduced rainfall in this period and minor mining related effects due to LW W3.

Figure 4 (a) presents water levels at site P15 for the length of the review period, with the daily CRD plotted and daily rainfall shown on Figure 4 (b).

A similar trend in groundwater levels to that at P15D is observed in the upper and mid Hawkesbury Sandstone aquifer (bores P15A, B and C), including similar short-term fluctuations, but these short-term fluctuations are in the range of 0.2 m (i.e. smaller than those in P15D). This suggests that if a mining related effect due to LW W3 occurred at P15 (as seems likely), it would have been to a greater magnitude in the deeper strata (P15D) than the shallow strata (e.g. P15A-C) as previously observed in October 2021 (SLR, 2021b)).

From late December 2022, a gradual increase in groundwater levels is observed in all piezometers at P15. The rate of groundwater recovery accelerates in late February 2022 following intense rainfall and flooding in the area. Over the reporting period, groundwater levels in P15D increased by approximately 3 m while groundwater levels in P15A, B and C increased by 2.2 m. At the end of the reporting period, groundwater levels in all piezometers at site P15 are at approximately 168 mAHD which is 0.4 m above the creek bed elevation at P15, suggesting that baseflow conditions (i.e. gaining conditions) to Stonequarry Creek have strengthened.

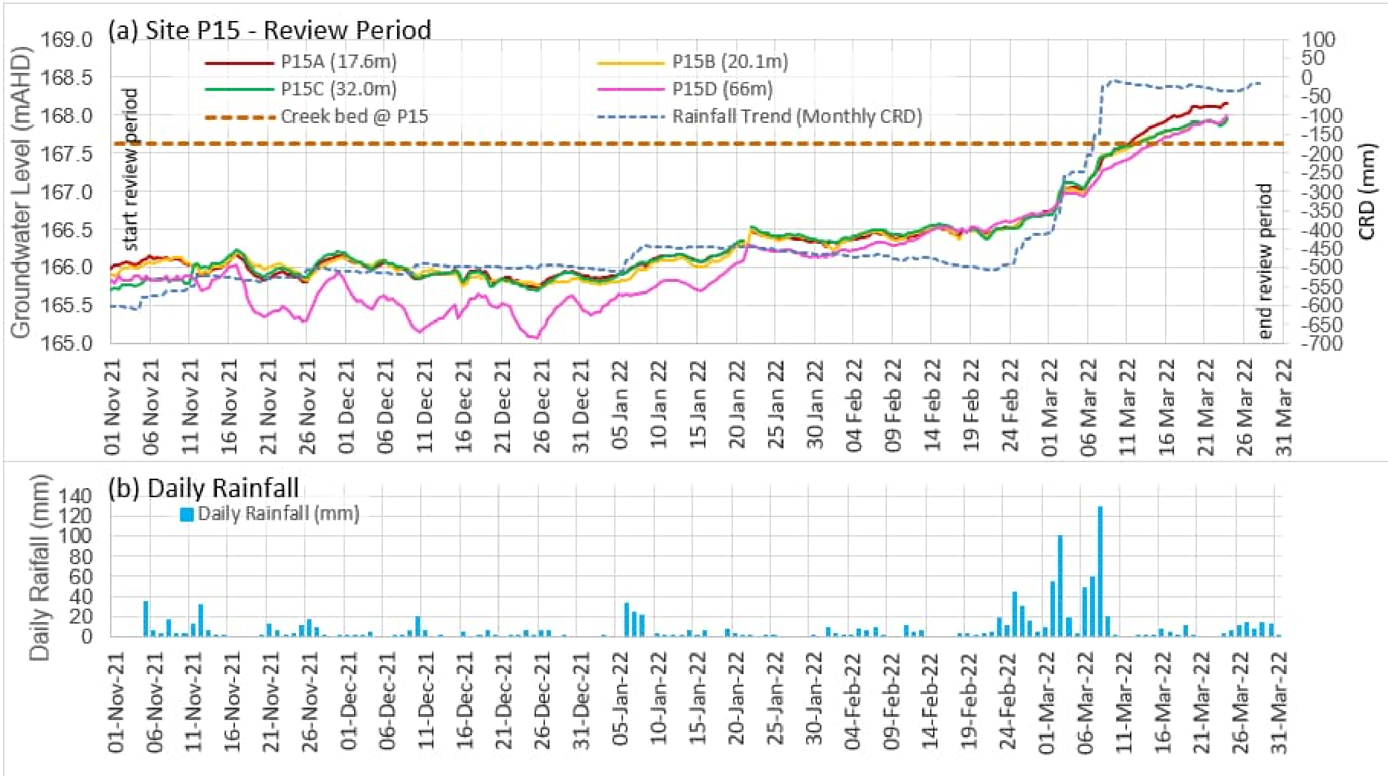


Figure 4 Groundwater levels at P15 during the review period (a); Daily rainfall over the reporting period (b)

4.1.2.4 Site P16

At P16 (Figure A4), situated 430 m west of LW W1, groundwater depressurisation stabilised in late October 2020 (coinciding with the end of LW W1 extraction) which was four months earlier than at P12 and P13. As LW W2 progressed to the south, a slight reduction in groundwater levels of approximately 0.5 m was observed at P16B and P16C five months following the commencement of LW W2. The effects of LW W2 are less here than at the other sites due to the greater distance from the second longwall.

Groundwater levels at P16A declined gradually by approximately 0.8 m during mining at LW W1 and LW W2. Following mining at LW W2 and above average rainfall in June 2021, water levels increased by 0.4 m and stabilised until September 2021. Following the commencement of LW W3, groundwater levels gradually declined by 0.2 m (primarily between November 2021 and early February 2022) despite above average rainfall. From mid to late February 2022, groundwater levels increased by 2 m, rising to 1.2 m above the baseline level as of March 2022. It is possible that this consistent increase is caused by the ingress of surface runoff and not representative of groundwater conditions. Hence, the previously identified long-term impact from LW W1-W2 mining at this site and the progression of LW W3 to the south appears reduced, whereas this might not actually be the case due to potential surface water run-off ingress into the bore. Following this observation, some improvements regarding the diversion of surface water runoff were conducted by GeoTerra to minimise water ingress following rainfall. Further monitoring will confirm groundwater trends and whether P16A is still affected by surface run-off ingress.

From April to June 2021, groundwater levels at P16B and P16C started to recover. At P16B they stabilised in September throughout late December 2021 at 204 mAHD, approximately 4 m above the minima in April 2021, and approximately 2.5-3.5 m below baseline. In January 2022, there was a clear decline of around 1.8 m to 202.8 m AHD at P16B, which followed approximately six months of stable groundwater levels. An additional drop in water levels (approximately 1 m) is observed in late January 2022 before increasing again by 1 m following rainfall in early February 2022. At P16B, GeoTerra noted significant spikes in the raw groundwater level dataset following rainfall which, as with P16A, suggest that surface run-off could likely flow into the piezometer P16B or that P16B is possibly damaged to the surface allowing water ingress. The spikes in groundwater levels observed in the raw datasets have been removed or filtered from Figure A4 (as per the annotation on the graph).

SLR conducted a site visit in March 2022 to identify the potential issue with surface run-off ingress at P16B. The flush head was inspected, with the well cap re-sealed to prevent or minimize any surface water entry into the bore. The presence of iron-staining was observed on the logger and on the rope above the groundwater level suggesting P16 could be damage close to the surface allowing water ingress. While groundwater levels in P16B in March 2022 may not be representative of groundwater condition due to the potential water ingress, groundwater levels are at approximately 204 mAHD, similar level to those at the start of the reporting period or those at the start of LW W2, and 2.4 m below baseline levels.

Groundwater levels at P16C continued to recover until September 2021, having risen 3.6 m since June, but remained 7.8 m below baseline. Water levels in P16C stabilised at 191.7 mAHD in September and October 2021 before gradually declining by 1.3 m throughout November until mid-February 2022. At P16C, a minor response in groundwater levels (i.e. approximately 0.6 m) is observed following the intense rainfall in late February – early March 2022. Groundwater levels have stabilised at 191 mAHD toward the end of the reporting period (8.2 m below baseline levels).

SLR (2022a) investigated the groundwater level decline at P16B and P16C observed during the reporting period.

The recent (January 2022) decline in groundwater levels could be due to a delayed mining effect from LW W2 and active mining at LW W3 (longwall timing displayed as lines on Figure A-4). The sudden decline in groundwater levels at P16B could potentially be due to the sudden movement (subsidence) of strata from mining. As seen in Section 4.1.2.3, similar sudden declines were observed during mining at LW W3 at the P15 bores located adjacent to the northern end of LW W3.

4.1.2.5 Site P40

P40 is situated between LW W1 and the surface water monitoring site CB, approximately 120 m west of the edge of the longwall and 115 m east of CB (Figure A-5). Groundwater levels started to be recorded in late August 2021. P40 is equipped with four VWPs at different depth intervals within the Hawkesbury Sandstone (at 39, 44, 49 and 85 mbgl respectively, reported below as P40A, B, C and D).

Groundwater levels in P40A started to increase from October 2021 and has shown a consistent rise throughout the reporting period with groundwater levels increasing by approximately 4 m to 181.2 mAHD. In P40B, groundwater levels were stable at 176.9 mAHD in November 2021 and started to increase in early December 2021 at a similar rate as observed in P40A. At the end of the reporting period, water levels in P40B increased by 4.4 m and sit approximately at the same elevation as water levels in P40A (181.2 mAHD). The rainfall recharge has reduced the downward vertical gradient identified at the start of monitoring between P40A and P40B. Also, groundwater levels recorded in the two upper sensors at P40 are 3.7 m above the Cedar Creek bed elevation, suggesting a possible strengthening of gaining conditions in the vicinity of the surface water monitoring site CB.

A similar trend in groundwater levels in the two lower sensors P40C and P40D is observed during the reporting period. In November 2021, a minor decline in groundwater levels in the range of 0.1-0.2 m is observed in P40C and P40D before starting to rise at a similar rate in early December 2021. The records in groundwater levels in P40C and P40D indicate a consistent increase of approximately 3 m and 3.4 m respectively throughout the reporting period.

In summary, groundwater levels at P40 indicate that the shallow Hawkesbury Sandstone has been recharged significantly following the exceptional rainfall over the reporting period. A reduction in the downward vertical gradient between P40A and P40B (to near neutral conditions) suggests a potential increase in baseflow along Cedar Creek with both water levels well above the creek bed elevation.

A vertical downward gradient is still recorded between the upper and lower Hawkesbury Sandstone aquifer at P40. This condition is expected at this location, as P40 monitors groundwater levels near LW W1 and although there is no monitoring data to confirm groundwater trends prior to August 2021, it is suggested that the deepest groundwater (P40D) underwent greater depressurisation than the upper strata. The significant rainfall has also recharged the mid and lower Hawkesbury Sandstone aquifer (P40C and P40D) suggesting a potential re-pressurisation of the deeper strata at P40.

4.1.2.6 Site P41

In addition to the hydrogeological investigations near the creeks, SCT conducted an investigation to quantify the hydraulic properties of the Nepean Fault Complex. A borehole (“Nepean Fault Hole C”) was drilled to 202 m at 45 degrees from vertical, angled to intersect the fault splay. This bore intersects two zones of increased jointing inferred to be a secondary splay of the Nepean Fault (SCT, 2021a). The upper zone is within the Wianamatta Formation, and the lower is within the HBSS.

Figure A-6 presents the hydrographs for P41 located 230 m from the north-east corner of LW W4, within the Nepean Fault Complex.

P41 is instrumented with VWPs at multiple depths within the Wianamatta Formation and Hawkesbury Sandstone and has been recording groundwater pressures/heads since August 2021. VWPs are installed respectively at 53 m bgl, 71 m bgl, 88 m bgl, 106 m bgl, 124 m bgl and 140 m bgl and reported as P41A-F. The vertical depth rather than the horizontal depth was used to convert depth-to-water (m bgl) to water level elevation (mAHD), as noted in Table 3. No groundwater records are available in January 2022 due to downloading issues.

The records at P41 indicates a strong downward gradient from P41A to P41C with almost 30 m head difference (Figure A-6). This could be explained by the fact that P41A sits within the Wianamatta Formation and P41B sits just at the interface between the Wianamatta Formation and Hawkesbury Sandstone suggesting the presence of perched groundwater likely to be disconnected from the upper Hawkesbury Sandstone aquifer (P41C).

Groundwater levels in P41A were stable during the reporting period at 190.8 mAHD with no discernible responses to rainfall recharge in February – late March 2022. In P41B, water levels seemed to have stabilised at 172.8 mAHD in early January 2022 following a gradual decline of 2.8 m likely attributed to a period of equilibration following the VWP installation.

At P41C, in November 2021 groundwater levels in the Hawkesbury Sandstone are stable at 160.9 mAHD. From February 2022, water levels in P40C are approximately 0.5 m below water levels observed in December 2021 at 160.4 mAHD, which could suggest a very minor effect due to the progression of LW W3. Since then, water level in P41C slightly responded to the above average rainfall in March 2022 to increase to 161.1 mAHD, which is 0.6 m above the pre-LW W3 water levels. The P41C piezometer is located at a similar elevation to the surveyed elevation of Stonequarry Creek (SC surface water monitoring site) with groundwater levels at approximately 1.3 m below the Stonequarry Creek bed elevation (labelled “creek bed” on Figure A-6).

P41D is located in the lower Fault Zone, as inferred by SCT (2021). Groundwater levels at P41D were stable following the VWP installation in August 2021. In early October 2021, a decline in groundwater level of approximately 1.3 m was observed before rising to pre LWW3 water level late November 2021. The minor depressurisation could be due to an unstable VWP sensor, but more likely suggests a minor effect following the commencement of LW W3.

Following the rainfall in mid-February 2022, groundwater levels in P41D rose by approximately 2.3 m to 162.3 mAHD and 1 m above P41C groundwater levels in March 2022 which suggest some degree of upward vertical gradient between those two sensors. The data from these two piezometers are considered the best means of assessing mining impacts including groundwater depressurisation, if any, in the upper Hawkesbury Sandstone between LW W4 and Stonequarry Creek following the extraction of that longwall and possible activation of the fault zone that could cause an increase in hydraulic conductivity (permeability).

The groundwater levels at P41E and P41F were recently assessed in SLR (2022a). Any correlation between groundwater levels to the daily CRD could not be established (SLR, 2022a). The quality of the data (i.e. rising trend observed from September 2021) is questionable, and it is considered that the VWP sensors at P41E and P41F could be unstable. However, the site will continue to be monitored and reviewed. Further monitoring data is required to confirm groundwater trends.

4.1.2.7 TNC036

TNC036 is located almost 500 m to the west of the middle of LW W1 and west of Matthews Creek. It has a number of sensors placed in the Hawkesbury and Bulgo Sandstones at various depths, as well as one in the Bulli Coal seam (Table 3). The hydrographs for the VWPs are presented in Figure 5. Groundwater pressures at TNC036 have recently been re-assessed and resulted in the removal of the transducer records at 298 m and 463 m (Groundwater Exploration Services [GES], 2020). Data collected from 2010 to 2011 at TNC036 appears erroneous, likely due to influence from construction. Consistent data that appears representative of local groundwater conditions has been collected from 2016. Further details on reliability of TNC036 data is presented in the Groundwater Technical Report LW W3-W4 (SLR, 2021).

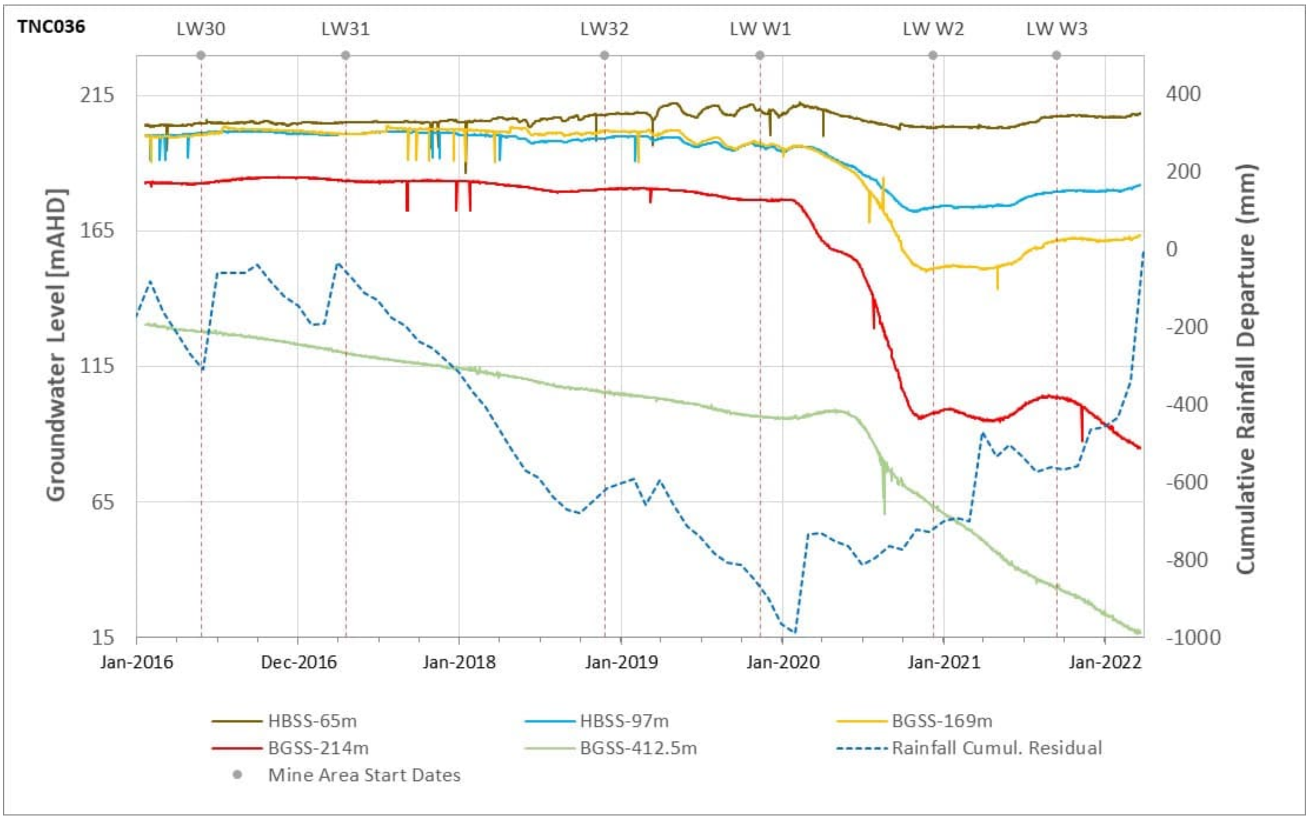


Figure 5 Hydrograph for TNC036

Approximately 60 m of depressurisation is apparent in the lower Bulgo Sandstone (piezometer BGSS-412.5m) for the period from February 2016 to August 2019, with the rate of drawdown increasing in mid-2020 and reducing in late-early 2021. The decline in water levels in the lower Bulgo Sandstone from 2016 (or before) is likely related to regional drawdown of deeper aquifers due to the cumulative effect of Longwalls 29-32 at Tahmoor.

From November 2020, water levels in HBSS-65m, HBSS-97m and BGSS-169m have recovered slightly in all three instruments following depressurisation throughout 2020. In early 2021, groundwater levels in HBSS-97m are stable with minimal responses to the significant rainfall events in March 2021. Water levels in HBSS-65m and BGSS-169m showed slight fluctuations in groundwater levels in the range of 0.5 m to 1 m. Groundwater levels in BGSS-214m stabilised from November 2020 following completion of LW W1, recovered to 99.5 mAHD in mid-January 2021 and declined to 95 mAHD in April 2021 due to the progression of LW W2.

In May 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m are stable and show minor responses to rainfall. From June 2021, as LW W2 is near completion, the rate in groundwater recovery increased rapidly in the three instruments. Between June and August 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m increased by 4 m, 4.4 m and 7 m respectively. Both the timing and rate in groundwater recovery match with that observed at P16 (located 245 m south of TNC036). From mid-August 2021, water levels continued to recover but at a slower rate until October 2021 with water level increasing by 0.8 m, 1 m and 3 m respectively in HBSS-65m, HBSS-97m and BGSS-169m.

In November 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m are stable and show responses to rainfall in the range of 0.5 m. From mid-February 2022, water levels started to increase by approximately 1.5m in the Hawkesbury Sandstone aquifer and by 1m in the upper Bulgo Sandstone aquifer (BGSS-169m) following the intense rainfall in mid-February 2022 to early March 2022.

An additional depressurisation of 13 m in BGSS-412.5m is observed during the reporting period and is likely attributed to mining of LW W2 and LW W3 extraction.

As of November, 2021, the depressurisation (drawdown) observed in the following monitored horizons is primarily a result of LW W1 and LW W2 extraction, with:

- 2.1 m in HBSS-65m.
- 16.5 m in HBSS-97m.
- 35 m in BGSS-169m.
- 75 m in BGSS-214m.
- 67m in BGSS-412m.

As of March 2022, compared against pressures measured in November 2019, the observed depressurisation in the following monitoring horizons are:

- 0.9 m in HBSS-65m.
- 14 m in HBSS-97m.
- 34 m in BGSS-169m.
- 90 m in BGSS-214m.

4.1.2.8 WD01

Figure 6 presents a hydrograph of the pre-mining borehole (WD01) located above a chain pillar between the Western Domain LW W1-W2. The bore is 570 m north of the closest Tahmoor North (not Western Domain) goaf (LW 32) and was completed while LW W1 was 400 m to the north (Section 3). WD01 is instrumented with VWPs at multiple depths and has been recording groundwater pressures/heads since June 2020. The latest available groundwater pressure dataset is dated to January 2022. In late April 2021 the sensors HBSS-190m and NPFM-230m both failed due to ground movement therefore no comment on groundwater elevations can be made past this date. The remaining active sensors HBSS-70m and HBSS-90m continue to show stable groundwater levels with no signs of depressurisation as of January 2022. The HBSS-210m sensor failed in late June 2021 due to ground movements caused by the retreating longwall panels. No groundwater level data past January 2022 is available as yet.

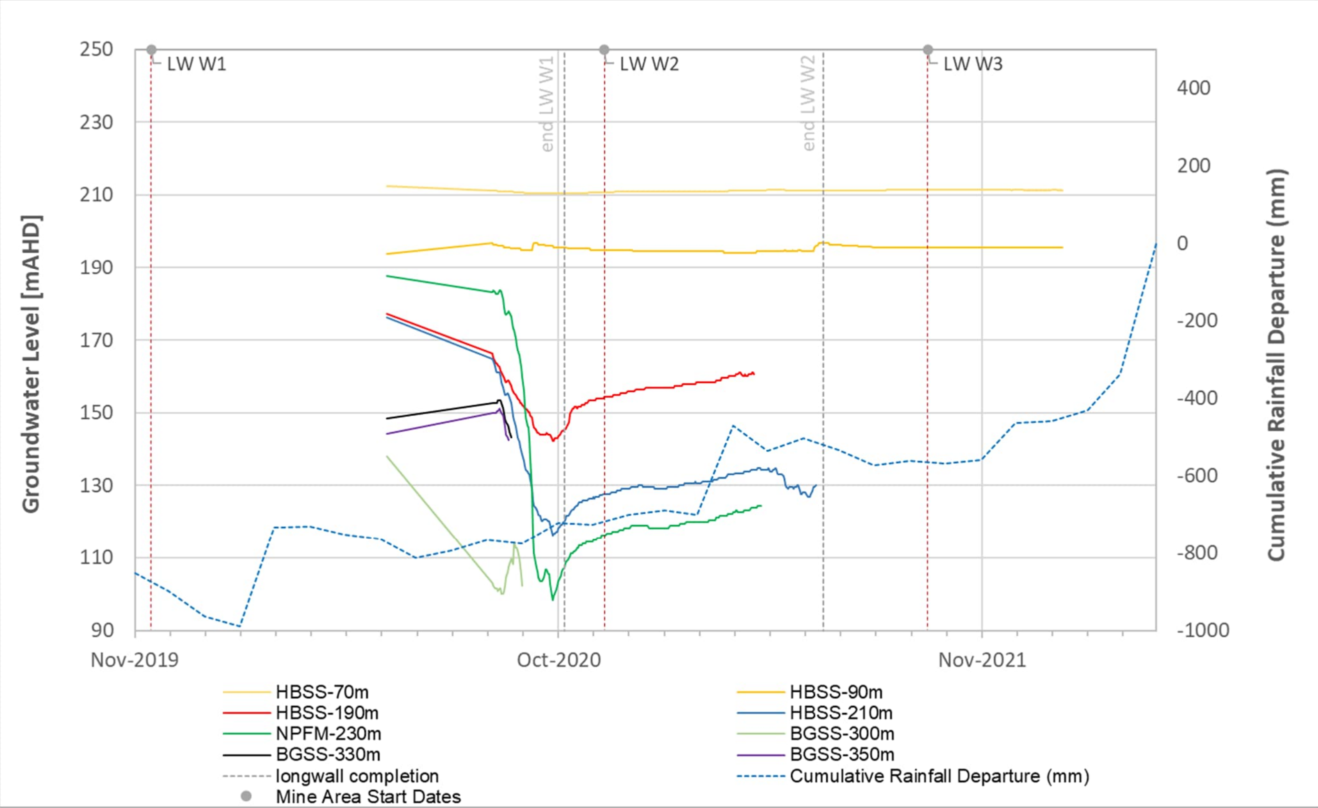


Figure 6 Groundwater Level Trends at WD01

The instrument HBSS-70m shows stable groundwater levels at about 211 mAHD. In HBSS-70m, no mining effect is evident as of January 2022, consistent with previous reporting. A small drawdown (1 m) was observed in HBSS-90m late April 2021 caused by the approach of LW W2. In June 2021, water levels in HBSS-90m recovered by approximately 2 m and has since then been stable at 196 mAHD and does not appear to show any discernible effect from mining.

A sharp decline in groundwater levels was observed in HBSS-190m and HBSS-210m with a respective drawdown of 23 m and 48 m in October 2020 due to the passing of LW W1. Approximately 80 m of depressurisation is apparent in the Newport Formation (piezometer NPFM-230 m) between September 2020 and October 2020 with the rate of drawdown increasing in October 2020.

Groundwater levels in the Newport Formation started to recover at a similar rate to the lower HBSS late October 2020, as or after LW W1 was completed. From October 2020 to April 2021, groundwater levels recovered by 26 m (NPFM-230m) and approximately 18 m (HBSS-190m and HBSS-210m). The rate of recovery slowed in January 2021, possibly due to the commencement of LW W2, but accelerated again from March 2021 following significant rainfall. The instrument HBSS-210m showed a decline in water levels of approximately 6 m in June 2021, probably caused by the progression of LW W2 extraction, and pressures appeared to stabilise before the instrument failed in June 2021.

Prior to November 2020, an apparent downward vertical gradient developed between the instruments HBSS-190m and HBSS-210m due to the passage of LW W1 and has remained stable while recovering with a head separation of 30 m for the remainder of the reporting period. Groundwater levels in the Newport Formation stayed below the groundwater levels of the Hawkesbury Sandstone, with a stable downward vertical head gradient for the remainder of the reporting period.

Groundwater drawdown of shallow groundwater levels in the lower HBSS and NPFM is attributed to strata dilation leading to increased aquifer storage. The pressure recovery since October 2020 points to the filling of this enhanced storage and appears to confirm that this zone is not connected and constantly draining to the goaf/workings. The latest pressure readings from July 2021 confirms this observation.

In the Bulgo Sandstone, the two deeper sensors (BGSS-330 m and BGSS-350 m) show higher groundwater pressures than the upper sensor BGSS-300 m (45 m difference), suggestive of some aquifer confinement. During September 2020, water levels at these two lower sensors declined progressively by 10 m and 7 m respectively before sensor failure in both sensors occurs during mid-September 2020 (significant drawdown after that time is assumed). The BGSS-300 m sensor shows a 3 m decline in early September 2020 with a subsequent increase of 10 m in groundwater level, attributed to strata compression as the longwall approaches, before declining again and then failing due to ground movement in late September 2020. Again, further significant drawdown is assumed after that time, as these Bulgo Sandstone piezometers are very likely to be within the zone of vertically connected fracturing.

4.1.2.9 Private Bores

Several privately-operated and licensed groundwater bores are present to the north and west of LW W3-W4 (Figure 1), as identified in the most recent bore census for the Western Domain and surrounding area (GeoTerra, 2019 and 2021b). The primary usage of these bores is for farming and irrigation. Initial monitoring of licensed groundwater user bores was undertaken in the bore census conducted by GeoTerra (2019) prior to the commencement of LW W1 extraction, and by GeoTerra (2021b) prior to the commencement of LW W3 extraction. Monitoring of water levels and field sampling of water quality parameters is undertaken on a three-monthly basis during the extraction of LW W1-W2 and LW W3-W4, and on an annual basis following mining.

Continuous water level data has been collected at private bores GW072402 and GW104090 since January and March 2021 respectively by automatic dataloggers. LiDAR data has been used to estimate ground elevation at the bores and convert depth-to-water (mbgl) to water level elevation (mAHD). Private bores GW105228 and GW115860 are located 500 m and 400 m north of LW W3 respectively and have been equipped with data loggers recording groundwater level data every 15 minutes, with the latest available data dated to 18 October 2021.

The standing water level at other private bores is not available due to pumps and headworks restricting bore access.

GW072402 is located 430 m north of LW W1. Prior to LW W1, groundwater level at GW072402 was observed at 173.1 mAHD with no significant changes in water levels during mining of LW W1. Following a period of above average rainfall in March-April 2021, water levels slightly increased from 172.5 mAHD to 173.7 mAHD in late August 2021. In mid-September 2021, groundwater records show a decline in water levels of approximately 0.7 m followed by a sharp decline of approximately 0.4 m in late October 2021. The gradual decline of 0.7 m throughout September and early October 2021 is not attributed to groundwater pumping (i.e. private usage) as no pump installed/used in GW72402 (pers. comment Andrew Dawkins, GeoTerra). While the decline start date matches with the commencement of LW W3 (to within 3 days), it is unlikely this reduction in groundwater level could be attributed to mining as there would have been no significant subsidence as the goaf would only have started developing. The sharp water level decline (i.e. 0.4 m) occurring late October 2021 matches with the timing of declines seen at P15 bores and could be attributed to LW W3.

From November 2021, groundwater levels start to rise in response to rainfall recharge. By January 2022, groundwater level increased by 0.7 m to 173.4 mAHD, similar to baseline conditions (Figure 7). No yield information is available at this location due to pump malfunction.

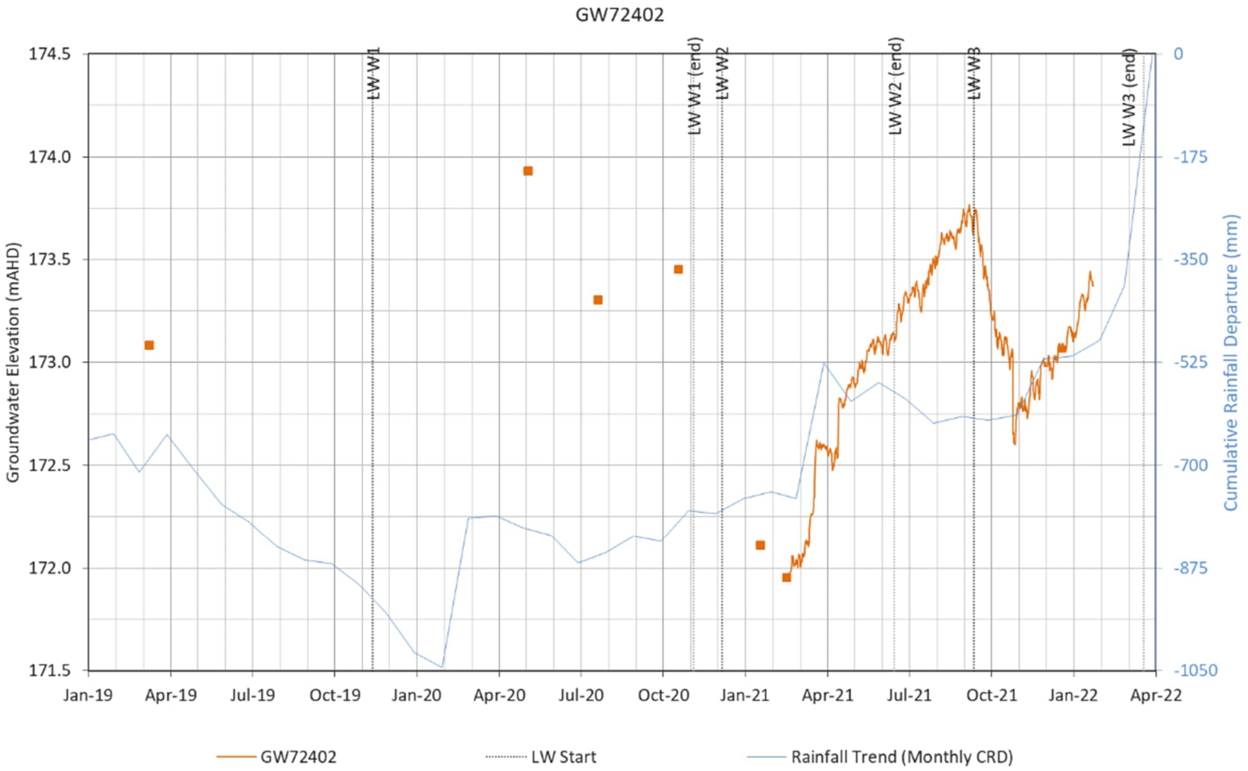
Since October 2021, this bore is used as a control site in place of monitoring site P17 (now inaccessible) due to their distance to LW W3 being similar; 880-900 m.

GW104090 is located above the northern half of LW W2, and north of Newlands Gully. The bore census conducted by GeoTerra (2019) before mining of LW W1 indicated water level in GW104090 at approximately 176.2 mAHD. It is evident from the next available data (March 2021) that the combined effect of mining (LW W1 and W2) and possibly some effect of drought (although that is likely to have been minor in comparison) caused groundwater levels to decline by at least 12 m.

Since March 2021 an improved groundwater level dataset has been available. Following the significant rainfall events in February-March 2021, water levels increased by 4.5 m to 167.5 mAHD in April 2021, which is 8.2 m below baseline level (Figure 7). As noted above, groundwater levels at GW104090 experienced some degree of drawdown (>12 m) due to the passage of LW W1 and W2 but still show good responses to rainfall recharge. No groundwater levels were available between late April 2021 and July 2021 due to loss of the datalogger.

A manual measurement of the groundwater level at 169.2 mAHD was made available while replacing the logger in late July 2021 which suggest that water levels continued to recover during the period of missing data. From August 2021, water levels have responded to rainfall and fluctuates by 0.5 m but appear 2m below the water level taken manually in July 2021 which suggest that either the short periods of drier conditions throughout June-July 2021 and/or the completion of LW W2 influenced water levels during this period (or the manual reading in July 2021 was incorrect). In September 2021, an increasing trend in groundwater levels is observed with no mining effect due to the early part of LW W3 extraction identified. In October 2021, groundwater levels decreased by approximately 1.7 m likely due to the progression of LW W3. From November 2021, groundwater levels appeared stable at 165 mAHD. During the month of January 2022, there was a blockage at the private bore GW104090 at a depth of 48.3 m and thus it should be noted the data from January 2021 to the end of the reporting period at this location is not representative of groundwater conditions. A field inspection is planned in the coming months to identify the cause of the blockage and assess if the bore can be unblocked.

No yield information is available at this location due to pump malfunction at these bore locations.



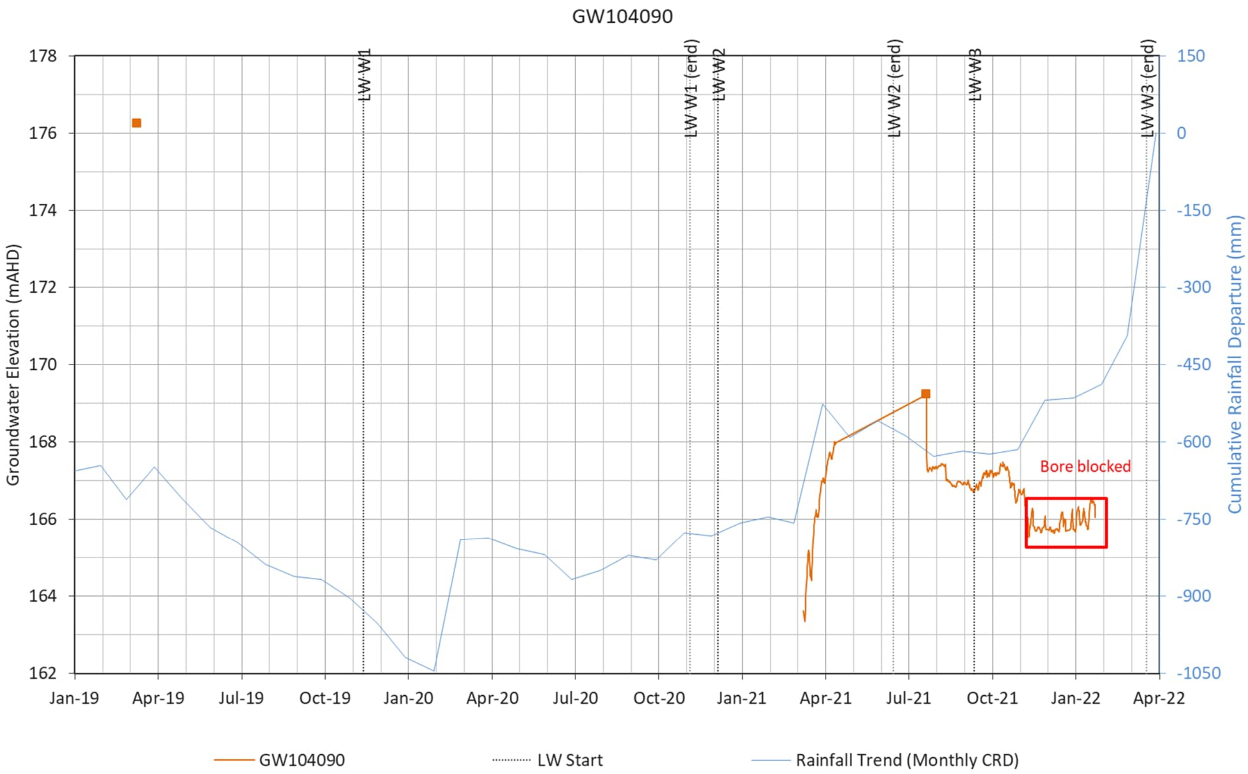


Figure 7 Groundwater level hydrographs for GW72402 and GW10409

Groundwater level data at private bores GW105228 and GW115860 are recorded every 15 minutes and presented on Figure 8, with the latest available data to 24 January 2022. Groundwater levels for the two private bores show no response in water levels following the commencement of LW W3 compared to GW72402 (Figure 7). As discussed in SLR (2021b) any mining effect on groundwater levels due to the early part of LW W3 extraction is difficult to assess due to alternation between pumping and not pumping at one or both bores for private usage. The timing in groundwater level decline and recovery match between GW105228 and GW115860 (only 110 m apart), suggesting that the drawdown in one bore (i.e. due to pumping) influences water levels in the other bore. On Figure 8, the drawdown observed at GW115860 is consistently greater than the drawdown at GW105228, which suggests that GW115860 is more frequently pumping groundwater and influences water levels in GW105228. During mid-October 2021, at GW115860, pumping seems to have reduced as water level increased by 1.8 m, a period also associated with fewer pumping cycles compared to September 2021. This could be explained by the fact that reliability on groundwater has reduced during a period of above average rainfall conditions throughout October and November 2021 and during the exceptional rainfall in early 2022. However, water levels provided before 19th October 2021 seem suspect and any conclusions on pumping effect is difficult to understand prior to this period. No drawdown due to mining of LW W3 is identified during the reporting period at either GW105228 or GW115860.

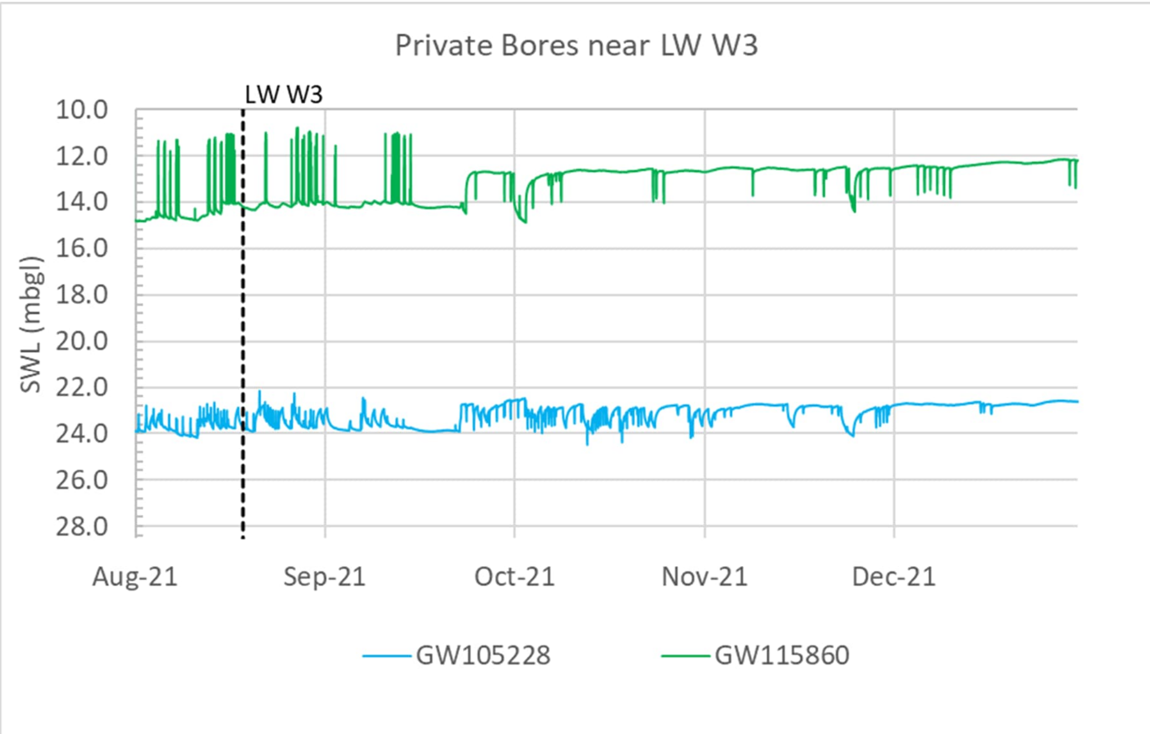


Figure 8 Hydrographs for GW105228 and GW115860

4.1.3 Tahmoor North

4.1.3.1 Site P9

P9 monitoring sites are located on the northern bank of Redbank Creek and overlie the pillar between LW31 and LW32, where extraction commenced in November 2018. These bores are not directly relevant to the Western Domain but show behaviours that would be expected above or near to Western Domain longwalls. Groundwater data has been recorded at P9 since October 2017. The open standpipe bores are screened at 22-24 m (P9A), 37-40 m (P9C) and 65-68 m (P9D), all within the Hawkesbury Sandstone. There were also three VWPs installed in a single P9 bore at 28 m, 40 m and 68 m depths, corresponding to some of the open standpipe intervals (Table 3).

One of the standpipe bores P9D (65-68m) and all three VWP sensors at P9 have failed; failures in P9_V1 in May 2018, P9_V2 in May 2019 and P9_V3 in October 2018. This is not surprising given the position between longwall panels and susceptibility to subsidence effects, however measurements of groundwater level are still recorded at P9A (22-24m) and P9C (37-40m) (Figure 9).

Figure 9 presents hydrographs of groundwater levels at P9 VWPs and open standpipes bores. At the commencement of monitoring the water levels in P9_V1 and P9_V2 were closely related. Greater head separation exists (approximately 5 m) between the water levels in the two shallower VWPs and the deeper instrument (P9_V3), however, groundwater levels at all depths show similar peaks and declines in response to rainfall.

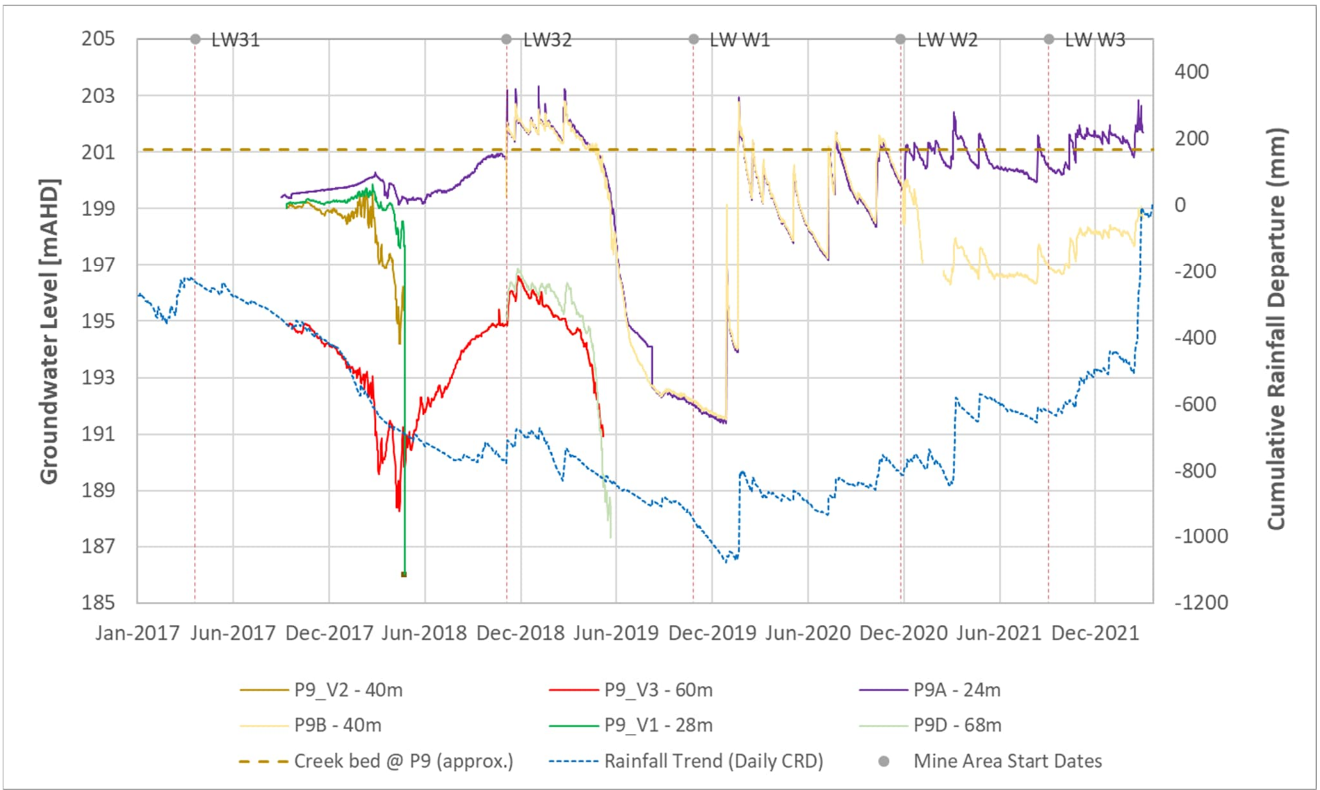


Figure 9 Groundwater Level Hydrographs at P9

Water levels in most of the P9 instruments declined gradually throughout the first half of 2018, following a trend similar to of the rainfall cumulative residual curve. During this period water levels decline by approximately 5 m in each of the VWPs. Following this, groundwater levels decreased to below the groundwater levels at VWPs P9_V1 and P9_V2 and these instruments fail at this point, while pressures at V3 begin to recover. By December 2018, water levels in P9_V3 have fully recovered and are approximately 2 m higher than those first recorded in October 2017. The higher head in P9_V3 at this time may be related to surface fracturing along Redbank Creek. An investigation of shallow groundwater in boreholes (including P9) around Redbank Creek was conducted by SCT in late 2018 (SCT, 2018b). This report identified increases in hydraulic conductivity at bore P9 in the presence of subsidence-induced “surface cracking”. This hydrograph indicates that water drains from shallower horizons and recharges deeper horizons.

From December 2018 to April 2019, as LW32 advanced toward the P9 bores, water levels in P9_V2 and in standpipe bore P9D-68m declined by 2 m, followed by a sharp drawdown of 6 m in May 2019 due to the extraction of LW32, noting that this monitoring site lies above the chain pillar of LW32.

Following significant rainfall in March 2020, water levels in P9A-24m and P9B-40m recovered by approximately 11 m and are observed at similar levels as the pre-LW32 groundwater levels. Throughout 2020, water levels in P9A-24m and P9B-40m responded to rainfall events in the range of 2-3 m, which suggests that fluctuations could have been exacerbated by the progression of LW W1. Between December 2020 and April 2021, water levels in P9A-24m stabilised between 200-201 mAHD and approximately 1.5 m above the first recorded water level in 2017 but declined by 2.5 m in P9B-40m in early January 2021 (i.e. before failing of sensor/logger). The logger was repaired and replaced in March 2021, with water levels recorded at 196 mAHD in P9B-40m and since then have continued to show responses to rainfall but remain 5 m below the first water levels recorded in November 2018. This suggests that extraction of LW W1 (or W2, although that is considered much less likely) has had an effect on recent water levels in P9B-40m, with further drawdown just after LW W1 was completed.

During the early extraction of LW W3, responses to rainfall are observed in both P9A-24m and P9B-40m with water levels in December 2021 being 1.5 m and 1.8 m respectively above pre-LW W3 water levels. In early February 2022, a decline of 0.4 m is observed in P9A-24m and P9B-40m during a period of low rainfall (Figure 9). Following the major rainfall in early March 2022, groundwater levels increase by approximately 1 m. We note that water levels at P9A-24m were observed above the creek bed elevation for most of the reporting period which suggests gaining conditions along Redbank Creek in the vicinity of P9, except during the short period of water level decline in February 2022, which would be associated with groundwater in the shallow Hawkesbury Sandstone (P9A-24m) leaking to the underlying aquifer (P9B-40m). No recent mining effect is discernible over the reporting period in the P9A-24m and P9B-40m piezometers.

4.1.3.2 Site P11

Bore P11, located along Redbank Creek and 300 m east of (downstream of) LW 32 shows a mining induced drawdown of approximately 3 m between July 2019 and January 2020 (Figure 10). The groundwater levels along Redbank Creek are correlated to weather patterns or rainfall events. There is a clear response in groundwater levels to the significant rainfall commencing in January 2020. Since March 2020 water levels have recovered above the baseline level (period prior LW W32) and show small responses to rainfall events. Water levels have gradually declined by approximately 0.4 m between March 2021 and August 2021 and have shown a response to rainfall in late August 2021. During the reporting period, groundwater levels at P11 have increased by 0.7 m in response to the above average rainfall conditions. As of March 2022, water levels at P11 are around 2.7 m above the first recorded level in February 2019. No discernible effects on water levels due to LW W3 are identified during the reporting period.

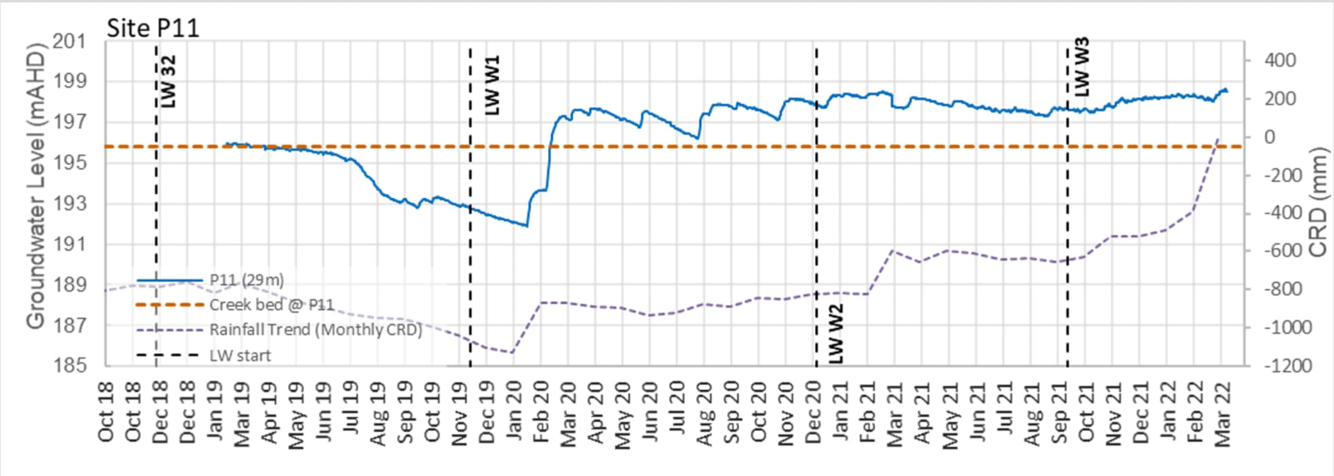


Figure 10 Groundwater Level Hydrograph at P11

4.1.3.3 TNC040

TNC040 is situated 300 m north of LW32, 650 m south-east of LW W2, and will be 430 m south of LW W4. Eight data sensors installed in TNC040 are positioned within the Wianamatta Group, Hawkesbury Sandstone, Bald Hill Claystone, Bulgo Sandstone, Scarborough Sandstone and Bulli Coal seam (Table 3). As of February 2019, the lower four VWP sensors were no longer active due to subsidence effects (GES, 2019). The decline in water level shown in late 2018 in the lowest sensor in the Bulli Coal seam (BUCO-501.9m) is a result of a nearby road advancement that has caused depressurisation of this seam.

As of March 2022, the upper two sensors (WMFM-27m, HBSS-65m) remain active, with monthly manual measurements taken between June 2021 and December 2021 and do not appear to show an influence from mining (Figure 11). In January 2022 the two loggers WMFM-27m and HBSS-65m were repaired, and continuous data was available from that time. In early February 2022, groundwater levels in HBSS-65m gradually declined by 1 m before stabilising at 187.3 mAHD. Minor fluctuations are observed in WMFM-27m (i.e. 0.2 m water level fluctuations). This water level decline in HBSS-65m could be associated with the progression of LW W3 to the south in the direction of TNC040 (i.e. 450 m from LW W3). No mining effect is discernible in the WMFM-27m piezometer.

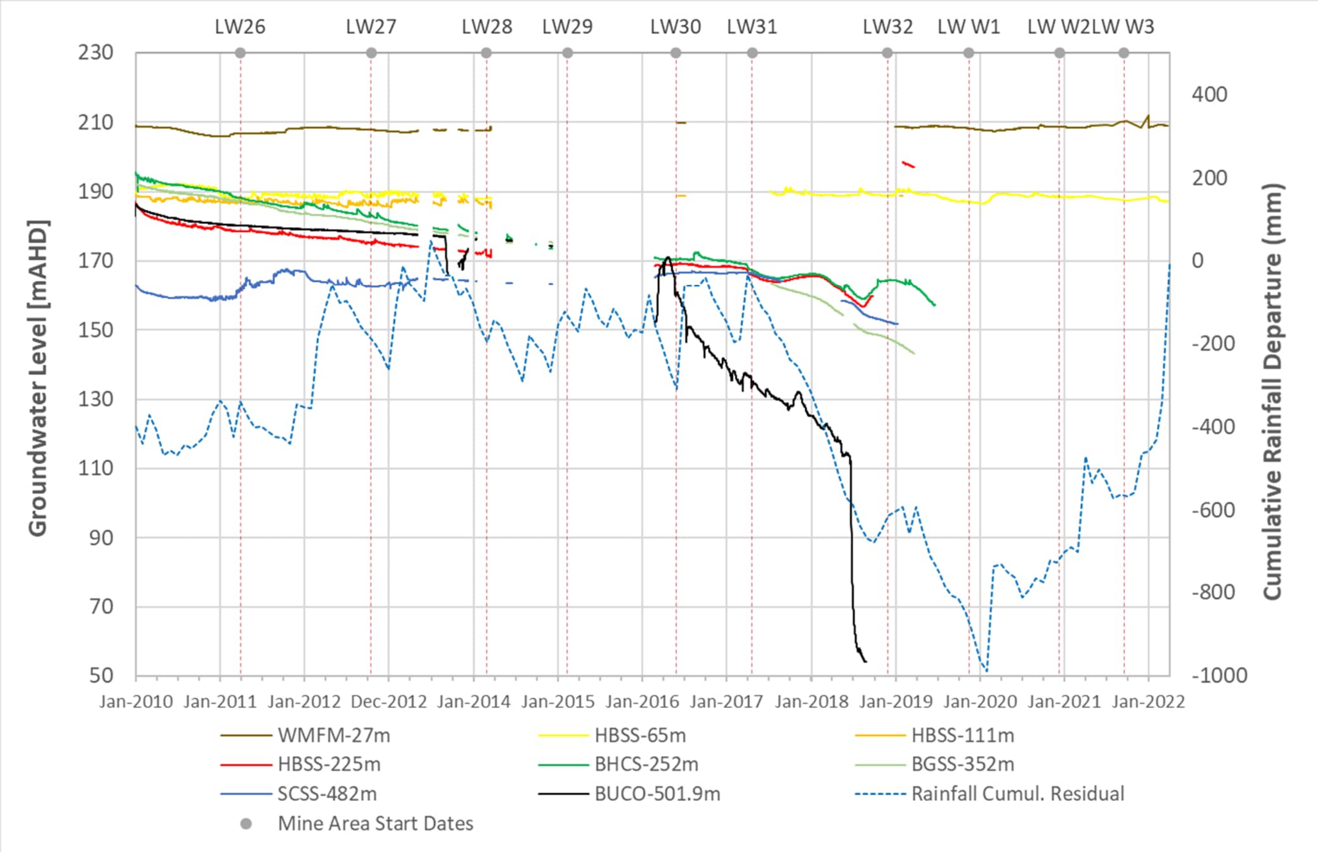


Figure 11 Groundwater Level Trends at TNC040

4.1.3.4 TNC043

TNC043 is also located 140 m east of the southern end of LW32, at the opposite end to TNC040. Monitoring began at this VWP-instrumented borehole in July 2010, and as with TNC036 and TNC040, there are some gaps in the record. However, data has been consistently collected since mid-2015. Until October 2019, the HBSS-65m and HBSS-111.5m piezometers were the only active instruments at this bore, with the remainder failing in 2018 due to subsidence from nearby LW32. The two upper sensors HBSS-65m and HBSS-111.5m at TNC043 remained active until September 2020 before being stolen at the end of 2020 (Table 3). Despite the loss of the loggers, manual readings are taken for the upper two sensors approximately monthly.

The water levels at HBSS-65m and HBSS-111.5m present similar trends to one another and both have responded to rainfall since monitoring started (Figure 12).

A gradual decline in water levels is observed throughout 2020 which is likely attributed to mining at LW W1. Water levels at HBSS-65m and HBSS-111.5m stabilised in November 2020 and started to recover respectively at 158.7 mAHD and 154.2 mAHD in April 2021. Since this period, water levels in HBSS-65m and HBSS-111.5m fluctuated by 0.5m and have responded to the early 2022 rainfall in the range 0.7m to 1m.

As of March 2022, water levels in HBSS-65m and HBSS-111.5m are respectively 2.5 m and 1 m above water levels observed during the baseline period (i.e. prior to LW 32).

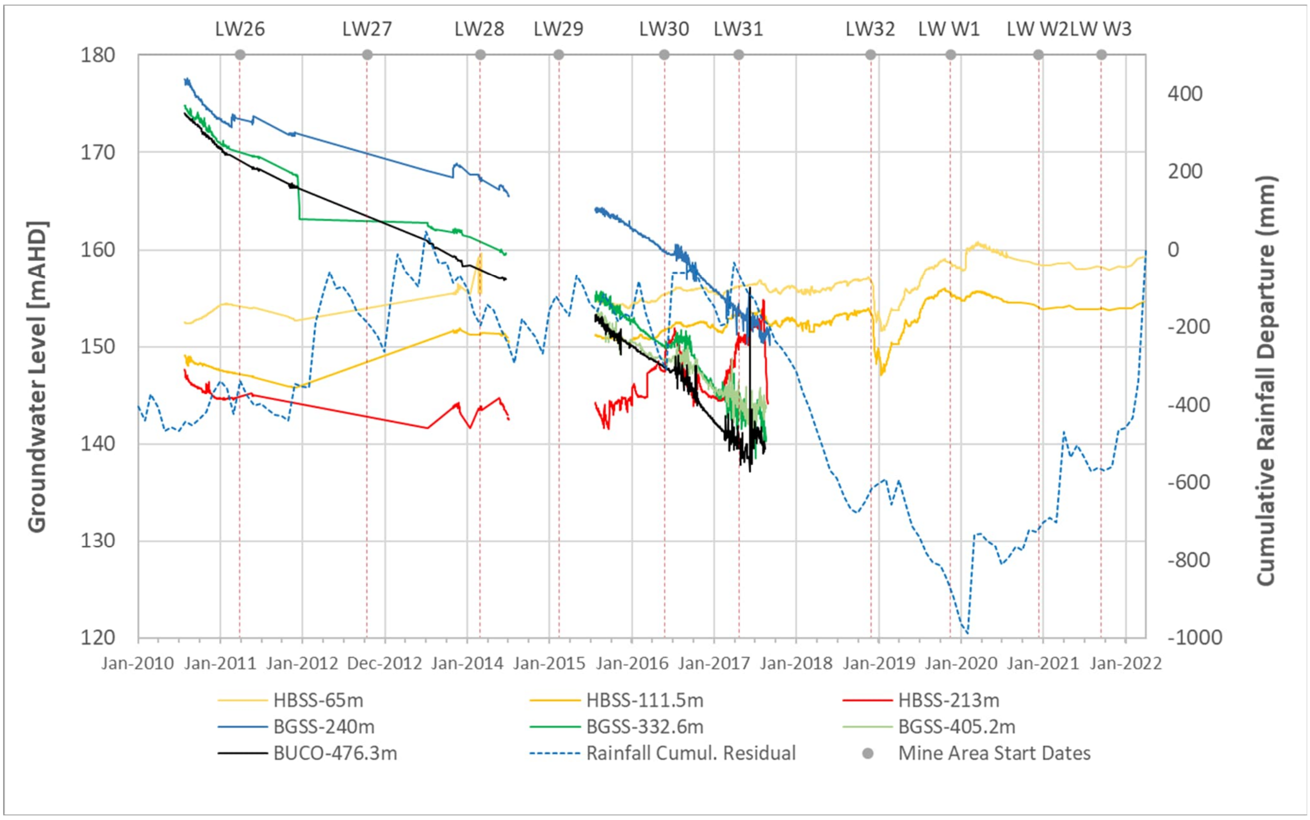


Figure 12 Groundwater Level Hydrographs at TNC043

4.2 Trigger Criteria

TARPs have been developed based on the groundwater management program outlined in the Groundwater Technical Report LW W3-W4 (SLR, 2021) and the WMP (Tahmoor Coal, 2021), and describe necessary responses for exceedances in groundwater quality and groundwater level triggers at open standpipe 'P' bores, as well as exceedance of groundwater pressure triggers developed for VWPs. The approved trigger criteria for shallow and deep groundwater levels are summarised and presented in Table 5. Appendix B1 details the latest approved impact assessment trigger criteria from the LW W3-W4 Extraction Plan presented in the WMP (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance occur during mining of LW W1-W2 and LW W3-W4. Figure 13 to Figure 17 present groundwater hydrographs at each site with the associated groundwater level triggers.

Prior to the approval of LW W3 in September 2021, groundwater levels and quality observations were assessed against the TARPs developed for and outlined in the Groundwater Technical Report LW W1-W2 (HS/SLR, 2019). From September 2021, as stated above, groundwater levels and quality observation across the Western Domain are now assessed against latest approved impact assessment trigger criteria (Tahmoor Coal, 2021). The following sections present the groundwater exceedances identified and highlight the change in TARPs that occurred from September 2021.

Further details regarding the development of the TARPs are provided in SLR (2021).

Table 5 Groundwater TARP Level Criteria for Open Standpipes, Shallow VWPs and Deep VWPs (Tahmoor Coal, 2021).

Significance Level	Criteria		
	Open standpipes	Shallow VWPs (<200m bgl)	Deep VWPS (>200m bgl)
Level 1	Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Appendix C).	No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth.	Observed data does not exceed predicted (modelled) impacts (excluding those monitoring the Bulli Coal Seam).
Level 2	Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Appendix C for TARP Significance Level 2). AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	Greater than 5 m water level reduction in VWP intakes located at or above (i.e. shallower than) 200 m depth following the commencement of extraction at LW W1 (and LW W2, W3 and W4) (refer to Appendix C for TARP Significance Level 2). AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown.
Level 3	Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more.
Level 4	Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND The reduction in water level is determined not to be controlled by climatic or anthropogenic factors.	Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more.

4.3 Trigger Exceedances

Table 6 presents the occurrence of trigger level exceedances in groundwater levels since the start of mining at Western Domain as per the trigger values (HS/SLR, 2019; SLR, 2021) and the TARP trigger criteria presented in Table 5 and Appendix B1.

Table 6 Groundwater Level Trigger Exceedances over January 2021 – March 2022 for the Shallow Open Standpipes, Shallow and Deep VWPs.

Bore	Groundwater Level prior to LW W1 (m AHD)	Trigger Level Exceedances															Maximum drawdown Nov 2020 - Aug 2021	GWL Prior to LW W3 (10-SEP-21) (m AHD)	Drawdown since Nov 21 as of March 2022 (m)
		Jan 21	Feb 21	Mar 21	Apr 21	May 21	Jun 21	Jul 21	Aug 21	Sep 21	Oct 21	Nov 21	Dec 21	Jan 22	Feb 22	Mar 22			
Shallow OSP		TARP (HS/SLR, 2019)								TARP (Tahmoor Coal, 2021)									
P12A	170.1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	0.5	170.5	-
P12B	170.7	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	0.8	170.7	-
P12C	176.3	L4	L4	L4	L4	L4	L4	L4	L4	L3	L3	L3	L3	L3	L3	L3	11.0	172.1	2.1
P13A	167.2	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	#	#	#	#	#	0.7	167.5	#
P13B	166.4	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	#	#	#	#	#	1.5	166.5	#
P13C	169.8	L4	L4	L4	L4	L4	L4	L2	L1	L2	#	#	#	#	#	#	5.0	168.3	#
P14A	168.6	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	-	170.3	-
P14B	166.7	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	1.4	166.4	-
P14C	166.6	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	1.7	166.2	-
P14D	164.8	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	1.8	164.8	-
P15A	164.7^	L1	L1	L1	L1	L1	*	L1	L1	L1	L1	L1	L1	L1	L1	L1	-	165.7	-
P15B	165.2^	L1	L1	L1	L1	L1	*	L1	L1	L1	L1	L1	L1	L1	L1	L1	-	165.6	-
P15C	164.9^	L1	L1	L1	L1	L1	*	L1	L1	L1	L1	L1	L1	L1	L1	L1	-	165.6	-
P15D	165.4^	#	#	#	#	#	#	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	164.4	-
P16A	211.3	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	1.1	210.7	-
P16B	206.4	L4	L4	L4	L4	L4	L4	L4	L4	L2	L2	L2	L2	L2	L2	L2	5.7	203.9	2.4

Bore	Groundwater Level prior to LW W1 (m AHD)	Trigger Level Exceedances															Maximum drawdown Nov 2020 - Aug 2021	GWL Prior to LW W3 (10-SEP-21) (m AHD)	Drawdown since Nov 21 as of March 2022 (m)
		Jan 21	Feb 21	Mar 21	Apr 21	May 21	Jun 21	Jul 21	Aug 21	Sep 21	Oct 21	Nov 21	Dec 21	Jan 22	Feb 22	Mar 22			
P16C	199.6	L4	L4	L4	L4	L4	L4	L4	L4	L3	L3	L3	L3	L3	L3	L3	13.8	191.4	8.3
P17	171.3	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	#	#	#	#	#	0.2	171.5	#
		Shallow VWPs (<200m)																	
TNC036 - HBSS-65	209.5	L4	L4	L4	L4	L4	L4	L2	L1	L1	L1	L1	L1	L1	L1	L1	6.7	207.3	0.9
TNC036 - HBSS-97	196.3	L4	L4	L4	L4	L4	L4	L4	L4	L4	L4	L4	L4	L4	L4	L3	24.0	179.5	14.2
TNC036 - BGSS-169	197.5	L4	L4	L4	L4	L4	L4	L4	L4	L2	L2	L2	L2	L2	L2	L2	47.6	161.5	34
TNC040 - WNFM-27	208.3	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	L1	L1	L1	L1	L1	-	210.3	-
TNC040 - HBSS-65	187.1	L1	L1	L1	L1	L1	L1	L1	L1	L1	#	L1	L1	L1	L1	L1	-	187.5	-
TNC043 - HBSS-65	158.7	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	0.3	158.2	-
TNC043 - HBSS-111.5	155.6	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	1.8	153.9	0.9

Bore	Groundwater Level prior to LW W1 (m AHD)	Trigger Level Exceedances															Maximum drawdown Nov 2020 - Aug 2021	GWL Prior to LW W3 (10-SEP-21) (m AHD)	Drawdown since Nov 21 as of March 2022 (m)
		Jan 21	Feb 21	Mar 21	Apr 21	May 21	Jun 21	Jul 21	Aug 21	Sep 21	Oct 21	Nov 21	Dec 21	Jan 22	Feb 22	Mar 22			
		Deep VWPs (>200m)																	
TNC036 - BGSS-214	176.5	L3	L3	L3	L3	L3	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	81.4	103.4	85.5
TNC036 - BGSS-412.5	96.8	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	L2	49.7	33.5	73.5

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

LX: maximum trigger level exceedances recorded (including P13 and P17 decommissioned in October 2021) *"-": no observed drawdown* *^ baseline groundwater level at P15 (A,B,C,D) is the groundwater level recorded in June 2021.* *#: not applicable*

"" not assessed due to disruption in groundwater levels during drilling and packer testing at P15D (see (SLR, 2021c) section 2.3)*

Table 7 Groundwater Level Trigger Exceedances over the Reporting Period (January 2021 – January 2022) for Private Bores

Bore	Baseline Maximum Ground water Depth (m bgl)	Baseline Groundwater Yield (L/s)	Trigger Level Exceedances													Groundwater Depths as of January 2022 (m bgl)	Ground water Yield as of January 2022 (L/s)
			Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021	July 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021	Jan 2022		
Private Bores																	
GW104090	39.0	#	L1	L1	L1	L1	#	#	#	L1	L1	L1	L1	L1	#	# (49.2^)	#
GW105467	32.0	0.5	L1	L1	L1	L1	L1	L1	L2	#	#	*	*	*	*	#	#
GW105228	23.0	1.8	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	22.4	2.0-2.1
GW072402	11.76	#	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	11.5	#
GW115860	5.0	#	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	12.6	2.0
GW105546	31.9	1.6	L1	L1	L1	L1	#	#	*	#	#	*	*	*	*	#	#

LX: maximum trigger level exceedances recorded *#: not applicable* ** no site access* *"-"standing water level not available (access is not available inside the bore)*

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

4.4 Discussion of Groundwater Level Exceedances

This section discusses any exceedances observed over the reporting period from November 2021 to March 2022. TARP level exceedances were observed in bores as follows:

- TARP Level 4 at the shallow VWP sensors at TNC036 (HBSS-97m) from October 2021 to February 2022, with a reduction in TARP to Level 3 in March 2022;
- TARP Level 3 at the shallow open standpipes P12C and P16C during the reporting period;
- TARP Level 2 at the shallow open standpipe P16B during the reporting period;
- TARP Level 2 at the shallow VWP sensors at TNC036 (BGSS-169m) during the reporting period; and
- TARP Level 2 at the two deep VWP sensors at TNC036 (BGSS-214m and BGSS-412.5m) during the reporting period.

All other groundwater monitoring sites remained within TARP Level 1 across the six-monthly reporting period.

In terms of yield and groundwater level at the private bores, the following observations are noted over the reporting period (to January 2022):

- GW105228: There was no significant change in groundwater yield at GW105228 that could impede groundwater use in January 2022. In January 2022, groundwater yield was recorded between 2.0-2.1 L/sec compared to 1.82 L/sec during the baseline period (GeoTerra, 2019). As of January 2022, groundwater levels are observed within baseline level. TARP Level 1 applies.
- GW115860: There was no significant change in groundwater yield at GW115860 that could impede groundwater use in January 2022. In January 2022, groundwater yield at this location is recorded between 2.0-2.05 L/sec compared to 2.3 L/sec during the baseline period. As of January 2022, groundwater levels are observed within baseline level. TARP Level 1 applies.
- GW105467: In January 2021 the bore yield at GW105467 has declined from 0.67 L/s to 0.38 L/s in July 2021. A TARP Level 2 was applied at GW105467 as the lowest groundwater yield during the baseline period was 0.47 L/s in March 2019 and during the severe NSW drought. This bore is not actively used for groundwater extraction and no site access was possible in October 2021 and January 2022. Further monitoring is planned at this location.
- There was no site access at GW105546 throughout the reporting period, hence the assessment of trigger assessment exceedances at this location was not possible.

4.4.1 Shallow Open Standpipes

4.4.1.1 P12C

During the reporting period, groundwater levels at P12C have increased to a maximum of 174.2 mAHD in March 2022 and are 2.1 m below baseline levels (Table 6). Groundwater levels at P12C have increased by 2.8 m in March 2022 and are approximately 3.1 m above groundwater level observed in the upper piezometer P12A and P12B (Figure A-1). A TARP Level 3 still applies at P12C as the recovered groundwater levels as of March 2022 are below the trigger level 3.

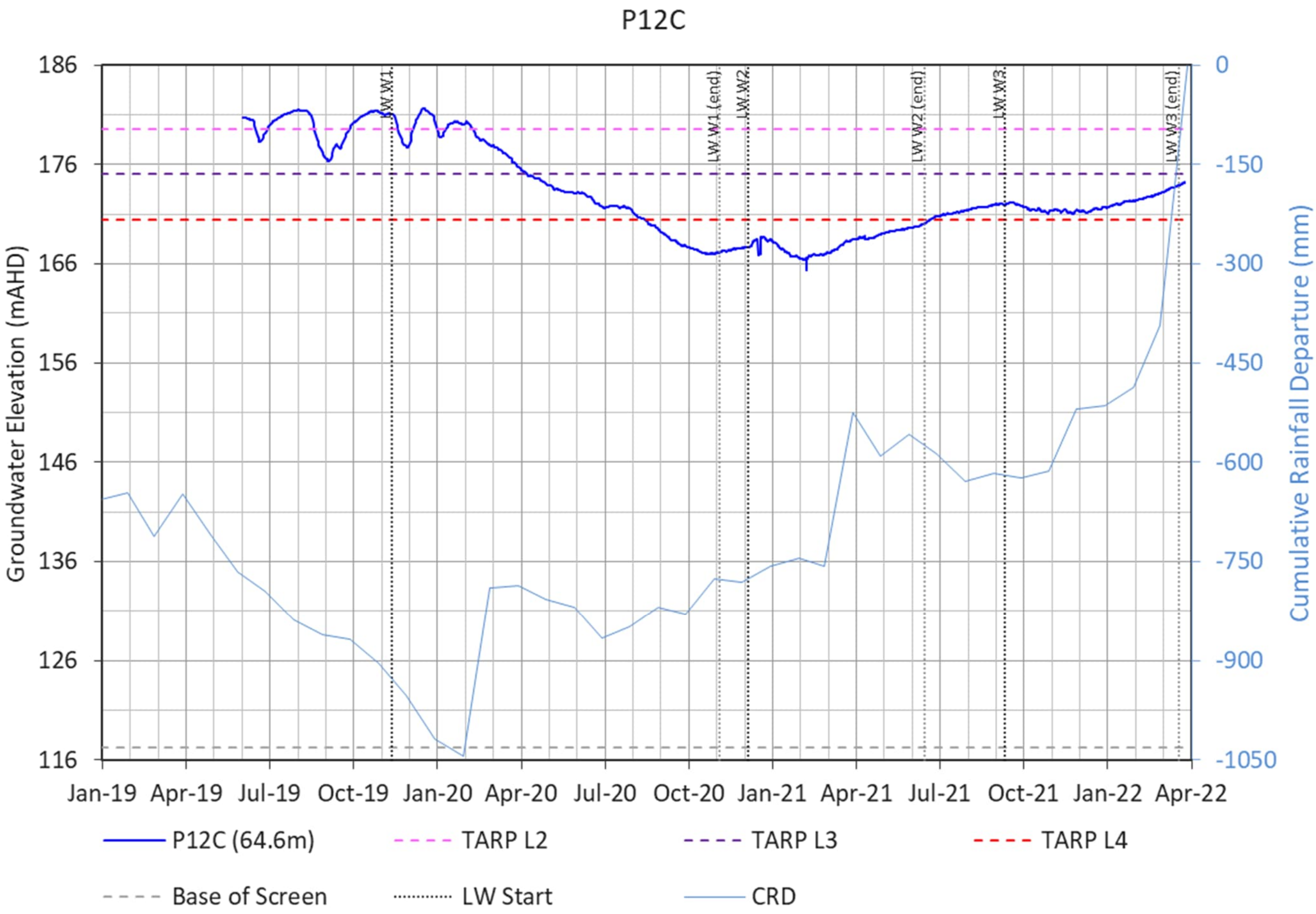


Figure 13 Groundwater Level Exceedance at P12C

4.4.1.2 P16B and P16C

Both P16B and P16C have shown a TARP Level 4 exceedance from December 2020 to August 2021 and reduced respectively to Level 2 and Level 3 from September 2021. During the reporting period a TARP Level 2 and Level 3 still apply at P16B and P16C respectively.

At P16B, groundwater levels were observed at 202.8 mAHD in mid-January 2022, below the trigger TARP Level 2 (205.9 mAHD) following a decline of approximately 1.8m (Figure 14). SLR investigated the nature of the sharp decline (SLR, 2022a). The recent decline in groundwater levels could be due to a delayed mining effect from LW W2 and active mining at LW W3. The sudden decline in groundwater levels at P16B could potentially be due to the sudden movement of strata from mining. Similar sudden declines were observed at P15 located adjacent to the northern end of LW W3 after the commencement of that panel (Appendix A, Figure A-3).

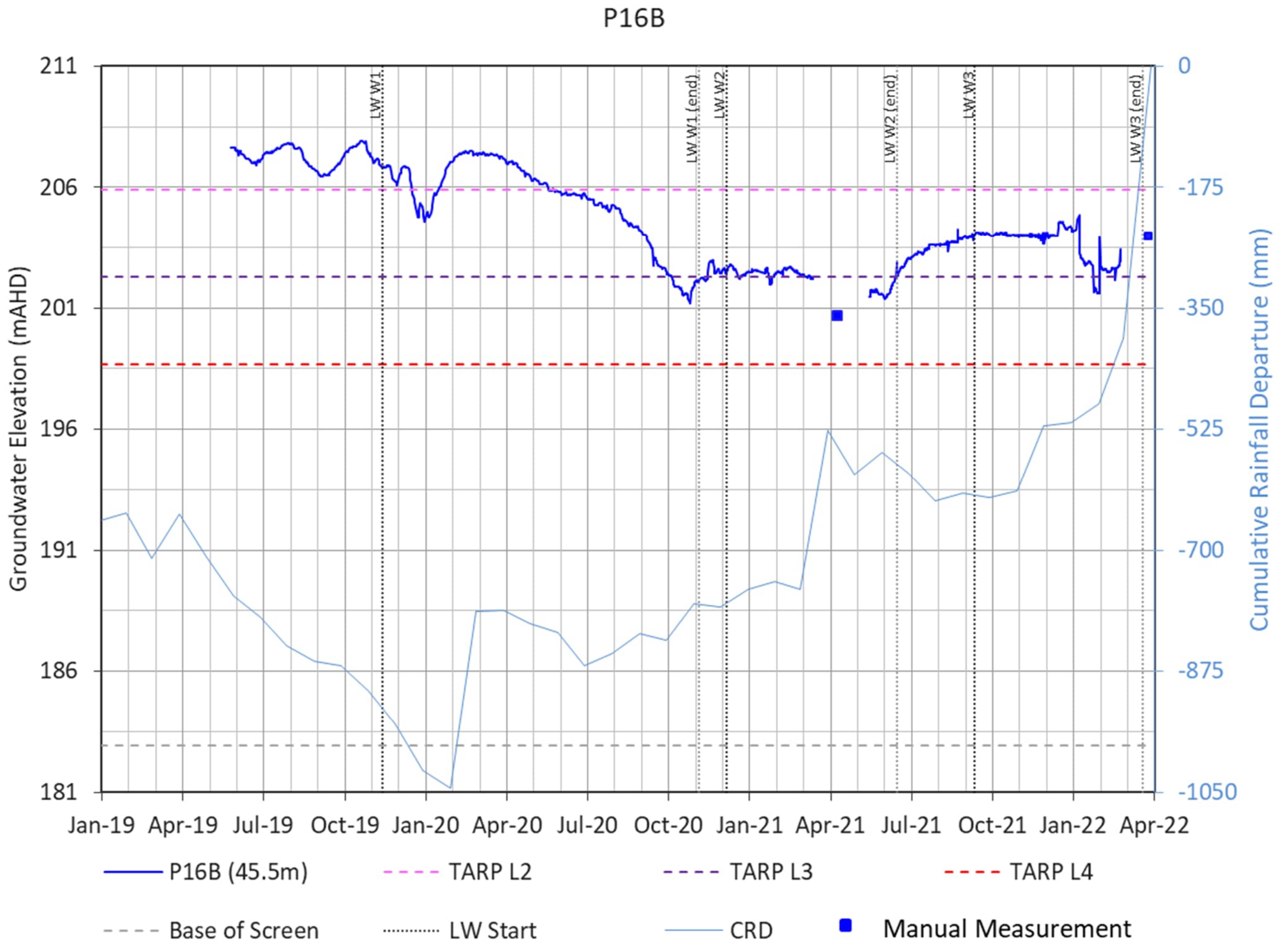


Figure 14 Groundwater Level Exceedance at P16B

During the second half of January 2022, water levels at P16B declined by 1.4 m, dropping below the TARP Level 3 for a short-period of time between 25th- 31st January 2022 before rising back to approximately 203.4 mAHD from March 2022. As of March 2022, groundwater levels at P16B are within a TARP Level 2 (Figure 14).

During the reporting period, recovery in groundwater at P16C has reduced with water levels at 191.7 mAHD and 7.6 m below baseline levels (Table 6 and Figure 15).

Groundwater levels at P16C gradually declined by approximately 0.4 m throughout the reporting period to 190.2 mAHD and are observed at 191.3 mAHD in March 2022. As of March 2022, groundwater levels remain below the trigger TARP Level 3 (193.9 mAHD), hence a TARP Level 3 still applies (Figure 15).

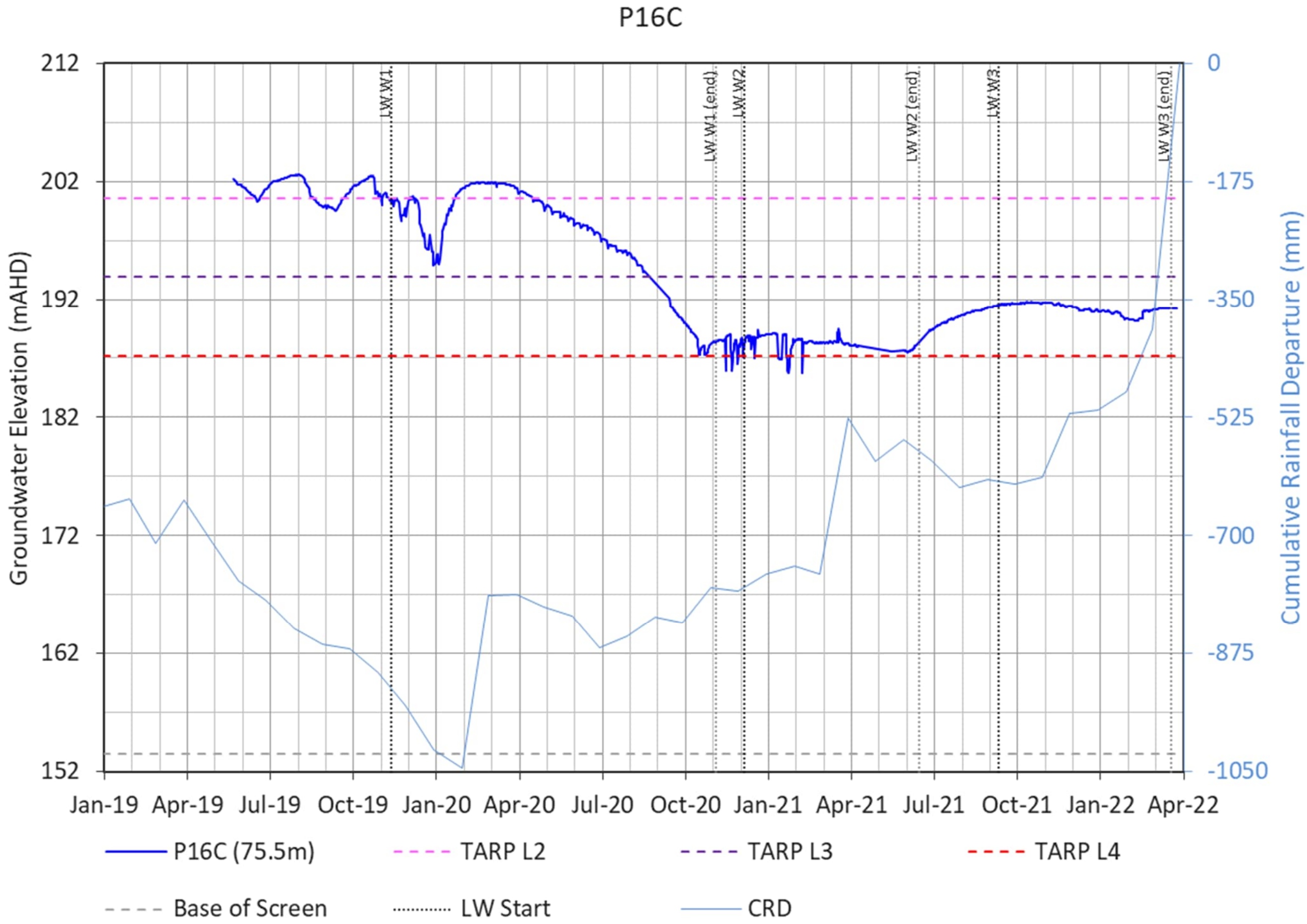


Figure 15 Groundwater Level Exceedance at P16C

4.4.2 Shallow VWPs – TNC036

Groundwater trends at monitoring sites equipped with shallow VWPs (less than 200m depth) were within the TARP Level 1 except at TNC036 (HBSS-65m, HBSS-97m and BGSS-169m) triggering the TARP Level 3 throughout 2020 and TARP Level 4 from December 2020 to April 2021 (Table 6).

The triggering of TARP Level 3 at TNC036 was attributed to mining induced depressurisation of deeper aquifer throughout the passage of LW W1 and exacerbated by a reduction in rainfall recharge events in late 2020.

Following the completion of LW W1 in November 2020, groundwater levels started to stabilise in all shallow TNC036 sensors and in WD01-HBSS-190m. In November 2020, a TARP Level 4 was attributed to TNC036 (HBSS-65m, HBSS-97m and BGSS-169m) due to a greater than 5 m depressurisation over a period of six months. Above LW W1 and following the completion of that longwall, groundwater levels in WD01-190m started to recover.

At TNC036, the progression of mining at LW W2 induced a minor drawdown in HBSS-65m and HBSS-169m while water levels at HBSS-97m are stable. Between December 2020 and June 2021, water levels in HBSS-65m recorded a reduction greater than 5m due to the passage of both LW W1 and LW W2, being within the Level 4 TARP criteria. Groundwater levels started to recover in June 2021 and by the end of July 2021, water levels in HBSS-65m increased above the TARP level 2 (i.e. 4.2 m below baseline level) and since August 2021 a TARP Level 1 applies (Table 6).

At HBSS-97m groundwater levels are observed between 180.7 and 179.6 mAHD between November 2021 and February 2022. Over this period groundwater levels seem to have stabilised with fluctuations up to 1 m. This follows a period of recovery since June 2021 (Figure 16). In February 2022, groundwater levels declined marginally below the trigger TARP Level 4 (180 mAHD) for short periods of time (five days in February 2022). As of March 2022, groundwater levels increased above the trigger TARP Level 4, hence a TARP Level 3 applies.

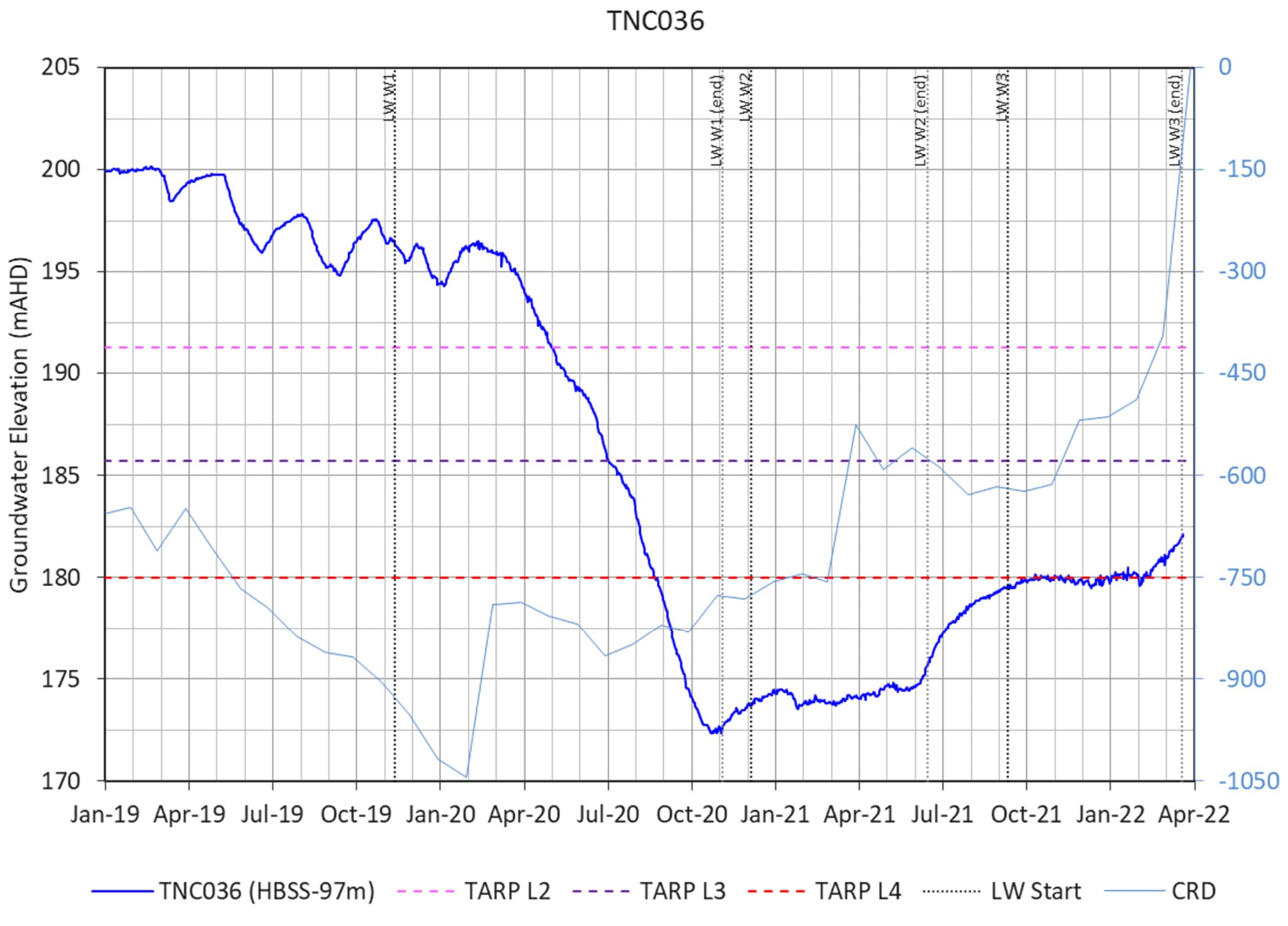


Figure 16 Groundwater Level Exceedance at TNC036-HBSS-97m

In HBSS-169m, the reduction to a TARP Level 2 occurred in September 2021 while groundwater levels continued to recover within the revised TARP Level 2. Groundwater levels are observed between 161.5 and 163.5 mAHD and increase by approximately 2 m during the reporting period (Figure 17). The groundwater trend at TNC36-169m in March 2022 remains consistent with the observations made in the six-monthly review (SLR, 2021a) and previous monthly reporting (SLR, 2022b). As of March 2022, groundwater levels remain below the trigger for TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies.

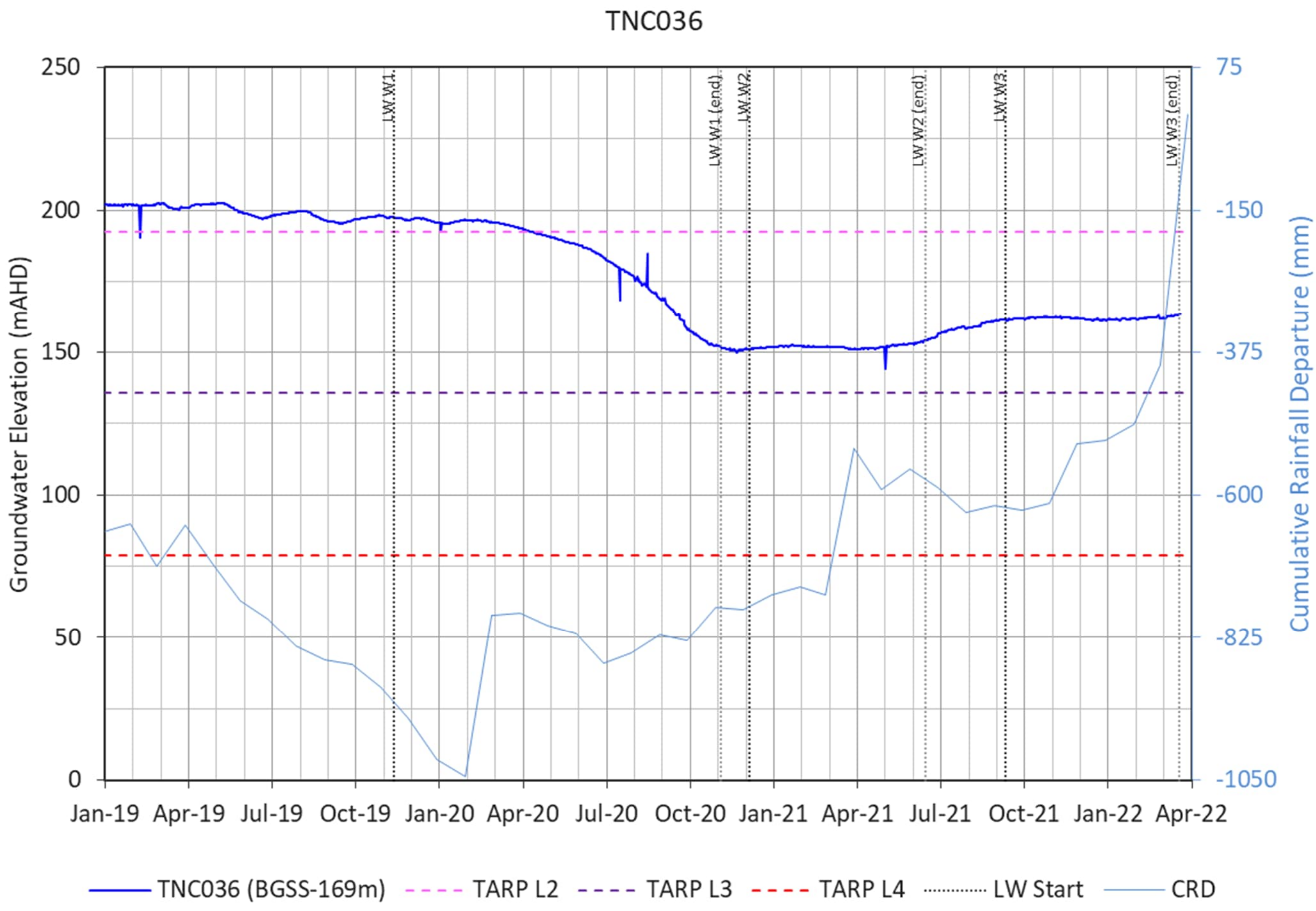


Figure 17 Groundwater Level Exceedance at TNC036-BGSS-169m

4.4.3 Deep VWPs – TNC036

Figure 18 and Figure 19 present the modelled (blueline) and observed (orange marker) drawdown at TNC036 sensors (BGSS-214m, BGSS-412.5m) since the start of LW LW1 extraction. The blue dashed line represents a threshold established as per the TARP for deep VWP sensors which is the modelled drawdown plus 30 m (Table 5).

Figure 18 shows that the observed drawdown at TNC036-BGSS-214m exceeds the modelled drawdown from March 2020 and the 30 m predicted drawdown between September 2020 and April 2021. Since May 2021, a TARP Level 2 applies with observed water levels within the predicted drawdown (+30m) (Table 5).

Figure 19 shows that the observed drawdown at TNC036-BGSS-412.5m exceeds the modelled drawdown from August 2020 but remains within the predicted drawdown (+30m) as of March 2022. A Level 2 TARP criteria applies at TNC036-BGSS-412.5m over the reporting period (Table 5).

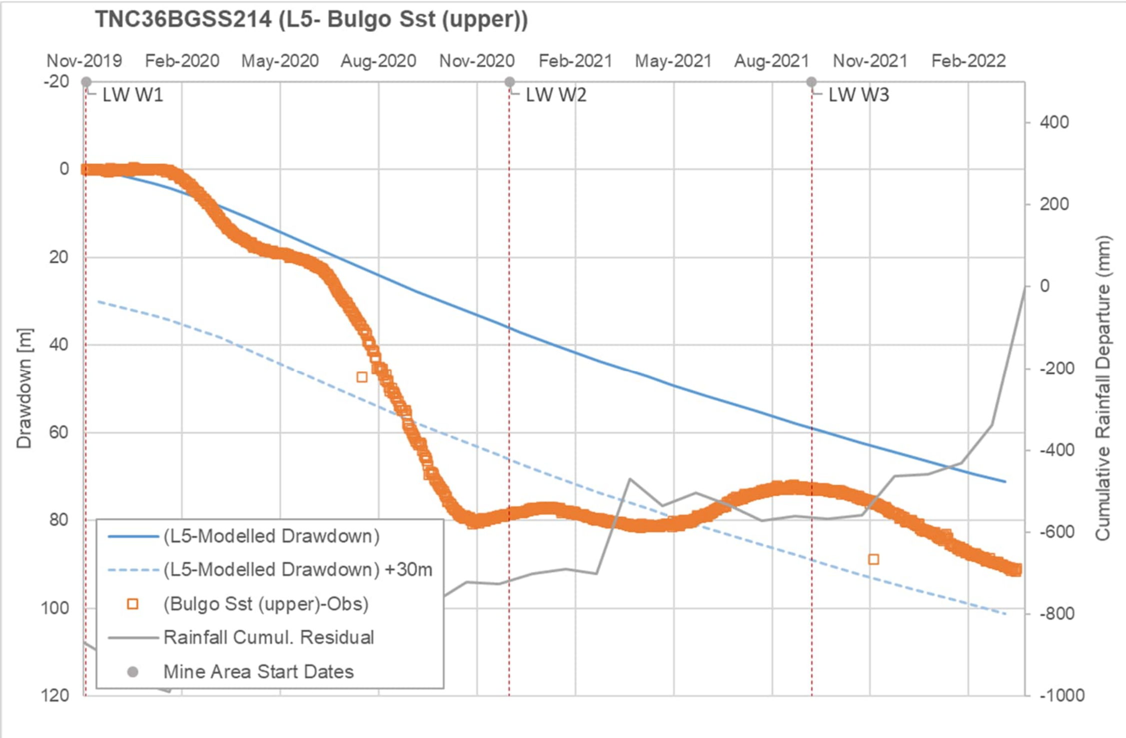


Figure 18 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-214m) with the +30m Threshold Modelled Drawdown

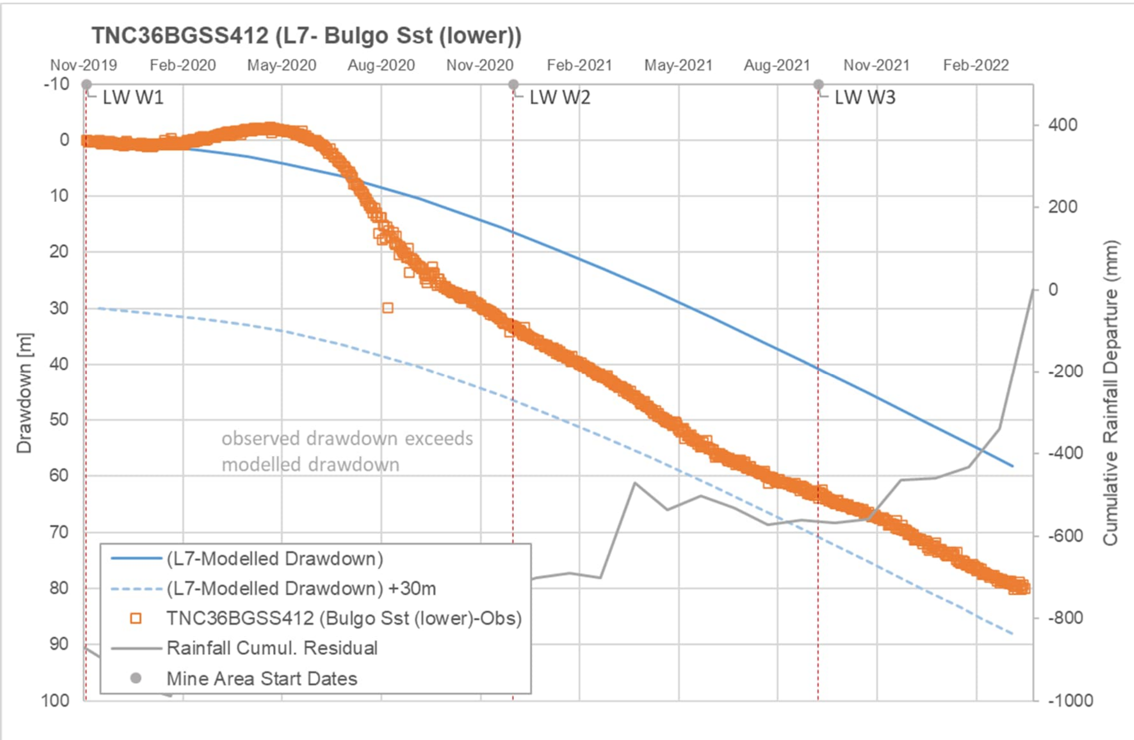


Figure 19 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-412.5m) with the +30m Threshold Modelled Drawdown

5 Groundwater Quality Trigger Review

5.1 Trigger Criteria

The approved trigger criteria for groundwater quality are summarised in Table 8. Appendix B2 details the water quality impact assessment trigger criteria from the LW W3-W4 Extraction Plan (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance in groundwater quality occur during mining of LW W1-W2.

The groundwater triggers for water quality parameters are detailed in the Groundwater Technical Report (SLR, 2021) and reproduced in Table 9 below. These values were set for each bore. The water quality triggers were assigned as follows:

- pH - each bore was assigned a lower and upper pH trigger level based on the minimum and maximum pH value recorded in the available dataset minus/plus a pH unit;
- electrical conductivity (EC) - this trigger was established for each bore as the maximum observed EC during the pre-mining baseline and early mining period, plus ten percent of this maximum value; and
- for metals, either:
    - when the maximum metal concentration was recorded during the mining period, the trigger was set at the 95th percentile of the full historical data record (pre-mining and mining period); or
    - when the maximum metal concentration was recorded during the baseline period, the trigger level was defined as the maximum concentration plus ten percent of that value.

Further details on the methodology to develop the proposed groundwater quality trigger levels are provided in the Section 6.2.2 of the Groundwater Technical Report LWW3-W4 (SLR, 2021).

Table 8 Groundwater Quality TARP Criteria for Open Standpipes and Private Bores (Tahmoor Coal, 2021)

Significance Level	Criteria
	Open Standpipes
Level 1	No observable change in salinity, pH or metals outside of the baseline variability*.
Level 2	Short term increase (< 3 months) in salinity and/or metals, or change in pH outside of baseline variability*. The effect does not persist after a significant rainfall recharge event. AND/OR A similar trend or response has been noted at other monitored bores or private groundwater bores.
Level 3	Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event. AND/OR the change in water quality is determined not to be controlled by climatic or anthropogenic factors.
Level 4	Medium to long term increase in salinity and / or metals or a change in pH outside of baseline variability* with the effect persisting for greater than 3 months or after a significant rainfall recharge event. AND The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors.

*the baseline variability was estimated using available data and refers to the proposed trigger levels (refer the section 6.2.2 and Table 6.2 of Groundwater Technical Report (SLR,2021)

Table 9 Triggers for Groundwater Quality TARPs

Bore	Trigger Level			Trigger Level Concentrations (mg/L) for Metals											
	EC (µS/cm)	pH lower	pH upper	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Li	Ba	Sr	Se
P12A	942	5.4	8.1	26.4	1.7	0.0110	0.0044	75.90	0.011	0.06	0.011	0.06	0.3	0.1	0.011
P12B	729	5.0	8.2	15.2	1.3	0.0044	0.0076	50.6	0.011	0.04	0.011	0.04	0.4	0.2	0.011
P12C	528	5.9	9.2	23.1	0.8	0.0034	0.0011	0.90	0.011	0.04	0.011	0.1	0.2	0.1	0.011
P13A	1232	5.2	9.4	69.3	1.5	0.0036	0.0014	0.91	0.011	0.04	0.011	0.03	0.4	0.3	0.011
P13B	1269	5.4	9.6	16.6	1.2	0.0020	0.0011	0.22	0.011	0.06	0.011	0.04	0.2	0.3	0.011
P13C	376	6.3	10.2	46.2	1.4	0.0011	0.0011	0.1	0.011	0.1	0.011	0.02	0.1	0.3	0.011
P14A	396	4.1	9.1	15.4	2.0	0.0022	0.0011	0.21	0.011	0.05	0.011	0.01	0.1	0.1	0.011
P14B	915	4.6	8.8	46.2	0.9	0.0022	0.0011	0.22	0.011	0.04	0.011	0.07	0.1	0.2	0.011
P14C	1881	5.3	9.4	19.8	1.5	0.0011	0.0011	0.04	0.011	0.1	0.011	0.11	0.2	0.4	0.011
P14D	1198	5.5	9.6	11.0	1.9	0.0011	0.0011	0.04	0.011	0.04	0.011	0.35	0.1	0.2	0.011
P15A	4620	4.63	8.22	5.7	1.0	0.0011	0.0011	0.28	0.0011	0.055	0.011	0.13	2.9	2.3	0.011
P15B	3575	4.11	12.1	4.8	0.9	0.0011	0.0011	0.09	0.0011	0.055	0.011	0.14	1.3	1.2	0.011
P15C	2090	5.04	8.66	6.2	0.5	0.0011	0.0011	0.19	0.0011	0.033	0.011	0.20	0.5	0.5	0.011
P15D	1430	5.48	7.72	3.5	0.9	0.0011	0.0011	0.13	0.0011	0.055	0.011	0.19	0.2	0.4	0.011
P16A	1539	4.9	7.8	116.0	3.9	0.0011	0.0011	0.1	0.011	0.04	0.011	0.06	0.3	0.5	0.011
P16B	1180	5.9	9.6	41.8	1.8	0.0011	0.0011	0.03	0.011	0.05	0.011	0.04	0.2	0.1	0.011
P16C	1212	6.2	9.5	46.6	1.6	0.0011	0.0011	0.02	0.011	0.05	0.011	0.1	0.1	0.1	0.011
P17	2019	4.8	8.3	10.6	0.6	0.0011	0.0011	0.2	0.011	0.04	0.011	0.11	0.2	0.7	0.011
GW105546	448	3.5	7.2	37.4	1.6	0.0011	0.0011	0.1	0.011	0.03	0.011	0.011	0.05	0.04	0.011
GW105467	1041	3.7	6.8	77.0	3.9	0.094	0.0019	0.2	0.039	0.04	0.011	0.072	0.1	0.04	0.011

Bore	Trigger Level			Trigger Level Concentrations (mg/L) for Metals											
	EC (µS/cm)	pH lower	pH upper	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Li	Ba	Sr	Se
GW105228	1793	4.6	7.1	31.4	2.7	0.0011	0.0011	0.2	0.0181	0.04	0.011	0.026	0.23	0.15	0.011
GW072402	8151	4.7	7.5	63.8	0.9	0.0019	0.0011	0.2	0.011	0.03	0.011	0.157	0.3	0.5	0.011
GW115860*	948.2	4.9	7.25	16.5	0.9	0.0011	0.0011	0.02	0.011	0.022	0.011	0.253	0.51	0.3	0.011
GW104090	3861	5.3	7.5	50.6	1.4	0.0011	0.0011	0.05	0.022	0.033	0.011	1.650	0.1	1.2	0.011

'*" Revised trigger level for Ba at bore GW115860 following the groundwater trigger investigation presented in SLR (2022a)

5.2 Discussion of Groundwater Quality Exceedances

The following section details the groundwater quality compliance at Tahmoor Coal in relation to the groundwater quality triggers. Table 10 presents the occurrence of trigger level exceedances in groundwater quality (EC, pH and metals) over the reporting period as per the proposed trigger values (Table 9) and the TARP trigger criteria found respectively in Appendix B.

A brief analysis of the EC, pH and metal concentrations in relation to climate and mining activity during the reporting period is presented in Sections 5.2.1 to 5.2.3 alongside trigger exceedances. Time series plots with the approved trigger values (EC, pH, metals) with exceedances only are shown in Appendix D, Figures D1-D25.

Table 10 Trigger Exceedances for pH, EC and Metal Concentrations over the Reporting Period (November 2021 – March 2022)

Bore	Month	Trigger Level Exceedance														
		EC (µS/cm)	pH lower	pH upper	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Li	Ba	Sr	Se
Shallow OSP																
P12A	Nov															
	Dec															
	Jan															
	Feb						L2	L2								
	Mar															
P12B	Nov															
	Dec			L2							L2					
	Jan			L2												
	Feb			L2												
	Mar			*L4									L2			
P12C	Nov										L2					
	Dec															
	Jan															
	Feb															
	Mar															
P14A	Nov						L2						L2		L2	
	Dec															
	Jan															
	Feb												L2			
	Mar															
P14B	Nov															
	Dec										L2					

Bore	Month	Trigger Level Exceedance														
		EC (µS/cm)	pH lower	pH upper	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Li	Ba	Sr	Se
	Jan										L2					
	Feb															
	Mar															
P14C	Nov										L2					
	Dec															
	Jan															
	Feb										L2					
	Mar															
P14D	Nov															
	Dec															
	Jan															
	Feb															
	Mar															
P15A	Nov														L2	
	Dec														L2	
	Jan														*L4	
	Feb	L2													*L4	
	Mar	L2													*L4	
P15B	Nov														L2	
	Dec	L2														
	Jan															
	Feb														L2	
	Mar	L2														
P15C	Nov					L2									L2	
	Dec															
	Jan															
	Feb										L2				L2	
	Mar					L2									L2	
P15D	Nov															
	Dec															
	Jan															
	Feb				L2									L2		
	Mar															
P16A	Nov													L2		

Bore	Month	Trigger Level Exceedance														
		EC (µS/cm)	pH lower	pH upper	Fe	Mn	Cu	Pb	Zn	Ni	Al	As	Li	Ba	Sr	Se
	Dec															
	Jan															
	Feb															
	Mar															
P16B	Nov														L2	
	Dec				L2										L2	
	Jan															
	Feb														L2	
	Mar				L2											
P16C	Nov															
	Dec			L2												
	Jan															
	Feb															
	Mar															
Private Bores																
GW104090	Jan													L2	L2	
GW105467	Jan															
GW105228	Jan													L2		
GW072402	Jan													L2		
GW115860	Jan	*L4												*L4 ^		
GW105546	Jan															

TARP Level 1 TARP Level 2 TARP Level 3 Potential TARP Level 4 no site access

site decommissioned (P13 and P17)

LX: maximum trigger level exceedances recorded

"*" remains a potential Level 4 TARP trigger

"^" A potential TARP Level 4 was identified at GW115860 for Ba. Following the groundwater trigger investigation (SLR,2022a), a revision of the trigger levels was recommended with a reduction to a TARP Level 1 (see Section 5.2.3.8)

5.2.1 Electrical Conductivity (EC)

Prior to this reporting period, there had been no trigger exceedances for EC at any of the standpipes (P12-P14, P16, and P17). Private bores GW104090 and GW115860 showed a TARP Level 2 EC trigger exceedance in the July monitoring round, with GW115860 also showing an exceedance in October 2021.

During this reporting period, three monitoring sites have triggered EC trigger levels within this six-monthly monitoring period:

- P15A;

- P15B; and
- GW115860.

All others EC measurements from the Tahmoor standpipes and private bores are within the Level 1 TARP.

5.2.1.1 P15A

EC in P15A shows fluctuating behaviour since monitoring started in April 2021. The salinity at P15A has been increasing from 4,010 in December 2021 to 4,860 µS/cm in February 2022 before reducing to 4,760 µS/cm in March 2022. Since February 2022, EC has been marginally above the TARP Level 2 of 4,620 µS/cm (Figure 20).

5.2.1.2 P15B

EC in P15B also shows fluctuating behaviour. At P15B, EC triggered a TARP Level 2 of 3,575 µS/cm in December 2021 before returning within TARP Level 1 in January 2022. In February 2022, EC increased to 4270 µS/cm and reduced slightly to 4,210 µS/cm in March 2022 triggering the TARP Level 2 since February 2022 (Figure 20).

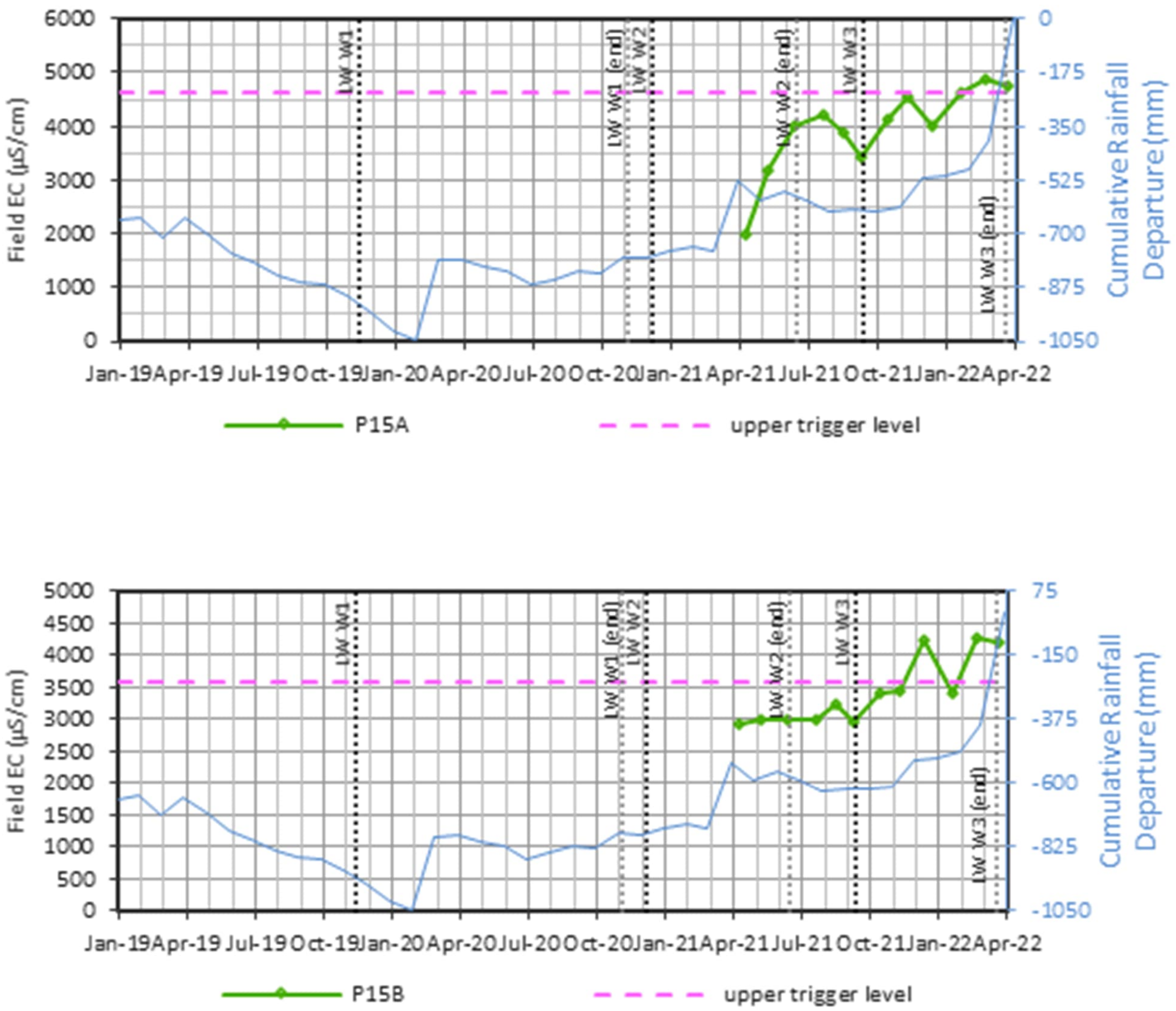


Figure 20 EC Exceedances at P15A and P15B

5.2.1.3 GW115860

The salinity at GW115860 has been steadily increasing from 621 µS/cm in January 2021 to 1,246 µS/cm in March 2022. Final EC in January 2022 at this bore exceeds the trigger level of 948.2 µS/cm for three consecutive recordings (greater than 6 months), resulting in a potential TARP Level 4 (Figure 21). Private bore GW115860 is used for domestic purposes. SLR (2022a) investigated the trigger exceedances at GW115860 for EC. The following summarises the findings presented in SLR (2022a):

- The reason for the increased EC at GW115860 is unclear, although it is consistent with the trend observed at nearby bore GW105228. Therefore, this trigger is only 'potential' Level 4 TARP trigger, and it has not been confirmed that the cause is mining.
- No drawdown was observed during the extraction of LW LW3 at GW115860, and hence drawdown does seem to be the cause of the change in EC;
- The increase in EC at GW115860 (to 1,246 µS/cm) does not change the beneficial use classification of the groundwater extracted at this site, and therefore the currently observed effects are considered to be immaterial. Indeed, salinity (TDS) at GW115860 remains within the desirable palatability of less than 600 mg/L (class A1 category – DPIE, 2012). Groundwater quality at GW115860 remains suitable for all beneficial uses, including the current purpose.
- Given the low salinity of groundwater at GW115860, and the small incremental change in that salinity in relation to the beneficial use classifications it is recommended to continue observing this bore over the next monitoring period (April 2022) to see if EC decreases, otherwise to revise the trigger. The most reliable method to revise the trigger would be to adopt the EC trigger from GW105228 for use at GW115860 as it has been derived from a longer record period.

Further details regarding the investigation of EC exceedances at GW115860 is presented in SLR (2022a).

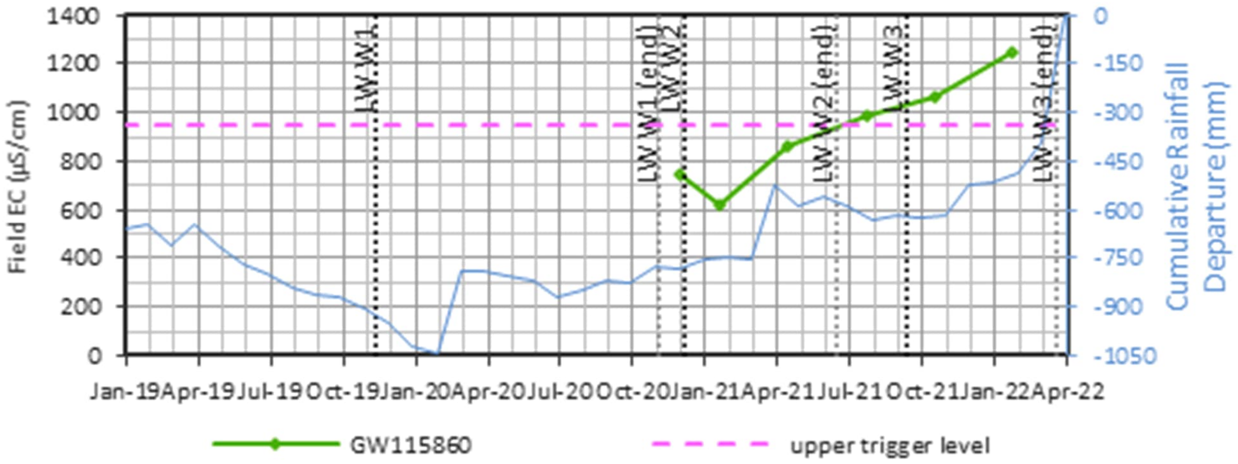


Figure 21 EC Exceedances at GW115860

5.2.2 pH Exceedances

Two monitoring sites have triggered pH trigger levels within this six-monthly monitoring period:

- P12B - triggered the upper pH threshold; and
- P16C - triggered the upper pH threshold.

5.2.2.1 P12B

P12B triggered the upper trigger level for pH between December 2021 and March 2022 with a pH of 10.65 in March 2022 (trigger level = 8.16) (Figure 22). A potential TARP Level 4 was identified in March 2022 as four consecutive recordings (greater than three months) were recorded during a period of above average rainfalls.

SLR (2022a) investigated the recent rise in pH at P12B in January 2022. The following summarises the findings:

- A rising trend in pH was previously observed at P12A, P12B and P12C around December 2020 to April 2021. It has been previously reported by SLR (2021a), that this could be due to compromised integrity of the monitoring bores combined with high rainfall causing cement to become mobilised into the groundwater.
- No anomalous variations in groundwater level were identified in P12A, P12B and P12C, that could be indication of a compromised bore integrity (SLR, 2022a and Figure A-1).
- The reason for the increase in pH at P12B causing the trigger exceedance is unclear and could potentially be related to compromised bore integrity, however an increasing trend was also observed at GW072402.
- GW072402 has experienced a pH increase from 5.9 to 6.8 between January 2021 and January 2022, however the bore had a pH of 6.5 in December 2019 just after mining began. The pH at GW072402 remains at near-neutral values (close to 7), while the pH at P12B is higher, above 10, where a value of 9.5 is often considered the maximum for some beneficial uses (Department of Environment and Heritage Protection, May 2014).

At this time, a mining-related effect is plausible, however the consequences of this effect (if it is mining-related) are considered minor.

In addition, in March 2022, pH at nearby bores P12A and P12C is within a TARP Level 1 at 6.9 and 8.61 respectively, both relatively neutral, and well below the pH seen at P12B (Figure 22). It is recommended that pH at P12B remains a potential TARP Level 4.

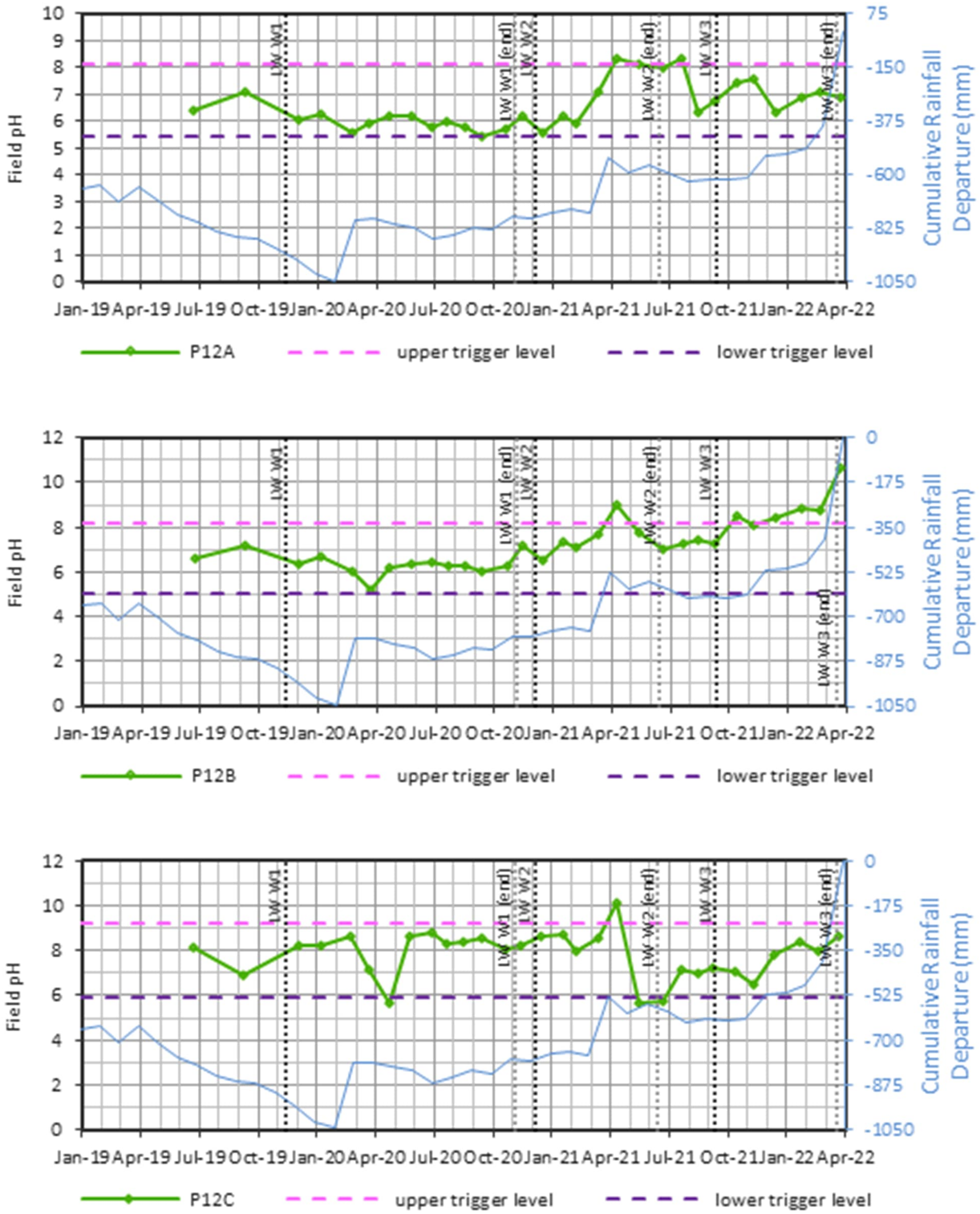


Figure 22 pH at P12A and P12C and pH Exceedances at P12B

5.2.2.2 P16C

pH at P16C exceeded the TARP Level 2 trigger of 9.49 in December 2021. pH increased from 9.36 to 9.5 in December 2021. Between January 2022 and March 2022, pH at P16C shows a fluctuating behaviour ranging from 7.15 to 9.22. As of March 2022, pH at P16C is within a TARP Level 1.

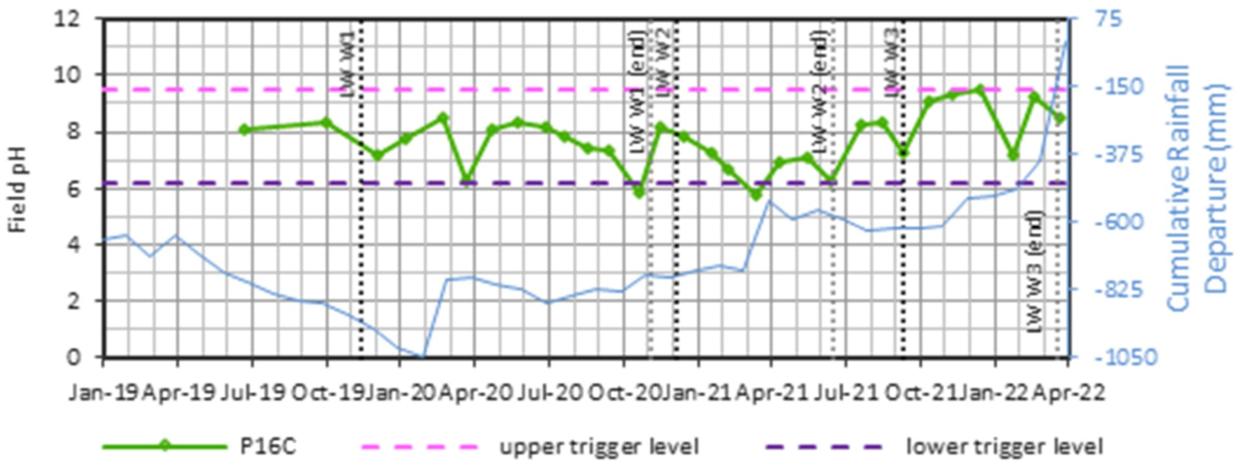


Figure 23 pH Exceedances at P16C

5.2.3 Metals

The following metal triggers were exceeded over the five-monthly monitoring period from November 2021 to March 2022 in the respective bores (Appendix D, Figure D-1 to Figure D-25):

- Iron (Fe) - P15D (February), and P16B (December and March)
- Manganese (Mn) – P15C (March)
- Copper (Cu) – P12A (February), P14A (November)
- Lead (Pb) – P12A (February)
- Aluminium (Al) – P12B (December), P12C (November), P14B (December and January), P14C (November and February), P15C (February)
- Lithium (Li) – P12B (March), P14A (November and February)
- Barium (Ba) – P15D (February), P16A (November), GW104090, GW105228, GW072402, GW115860 (all in January);
- Strontium – P14A (November), P15A (all months), P15B (November and March), P15C (November, February and March), P16B (November, December and February), GW104090 (January).

Over the reporting period, there were no exceedances in the lower pH and in dissolved zinc (Zn), nickel (Ni), arsenic (As) and selenium (Se).

5.2.3.1 P12A, B and C

- A TARP Level 2 for dissolved copper (Cu) and lead (Pb) was triggered at P12A in February Cu concentrations increased from 0.001 mg/Lto 0.011 mg/L in February (i.e. at the trigger level) reducing to 0.005 mg/L in March (Appendix D, Figure D-1). Pb concentrations increased from 0.002 mg/l to 0.005 mg/L in February above the trigger level of 0.0044 mg/L and reducing to 0.003 mg/L in March (Appendix D, Figure D-2).
- A TARP Level 2 for dissolved aluminium (Al) and lithium (Li) was triggered in December and March respectively at P12B. Dissolved (Al) increased from 0.01 mg/L to 0.04 mg/L in December. This aluminium concentration remained close to the trigger level (0.038 mg/L) (Appendix D, Figure D-3). It is noted that aluminium concentrations in all standpipes across the site show fluctuations in the range of 0.01 to 0.06 mg/L, and these are considered representative of the natural groundwater system. Thus, the trigger level for P12B may be too conservative considering the background levels, and therefore occasional exceedances of the trigger limit are expected to occur. Dissolved (Li) increased from 0.027 mg/L to 0.065 mg/L in March marginally above the trigger level of 0.042mg/L (Appendix D, Figure D-4).
- A TARP Level 2 for dissolved aluminium (Al) was triggered in November at P12C. Dissolved (Al) increased from 0.01 mg/L to 0.05 mg/L in November (Appendix D, Figure D-5). Like P12B, this aluminium concentration remained close to the trigger level (0.04 mg/L) and is considered representative of the natural groundwater system.

5.2.3.2 P14A

A TARP Level 2 for dissolved copper (Cu) and strontium (Sr) was triggered in November at P14A. Cu concentration increased to 0.003 mg/L in November, above the trigger level of 0.022 mg/L (Appendix D, Figure D-6). Sr concentration increased to 0.069 mg/L in November, above the trigger level of 0.06 mg/L (Appendix D, Figure D-7).

A TARP Level 2 for dissolved lithium (Li) was triggered in November and February at P14A. Concentrations increased to 0.011 mg/L and 0.09 mg/L marginally above the trigger level of 0.066 mg/L (Appendix D, Figure D-8). As of March, lithium concentration reduced to 0.05 mg/L. As of March 2022, Li concentrations are within TARP Level 1.

5.2.3.3 P14B, C

Short-term increases in dissolved Al triggered the TARP Level 2 throughout the reporting period. A TARP Level 2 was triggered in December and January at P14B for dissolved Al with concentrations rising to 0.05 mg/L (trigger level of 0.044 mg/l) (Appendix D, Figure D-9). A TARP Level 2 was recorded at P14C in November and February with concentration observed rising to the trigger level of 0.05 mg/L (Appendix D, Figure D-10). As mentioned above, aluminium concentrations show natural fluctuations in the range of 0.01 to 0.06 mg/L and these exceedances are not considered a cause for concern.

5.2.3.4 P15A

Strontium levels at P15A have continually exceeded the trigger of 2.31 mg/L from September 2021 to March 2022 monitoring rounds resulting in a potential TARP Level 4 exceedance in January 2022 (Appendix D, Figure D-11). Strontium concentrations have decreased from 3.7 mg/L in January 2022 to 3.1 mg/L in March 2022. SLR (2022a) investigated the recent Sr exceedances at P15A in January 2022 with no clear mining-impact identified.

In March 2022, Sr concentrations at nearby bores P15B and P15C resulted in a minor decrease (-0.2 mg/L at P15B) and was stable at P15C at 0.47 mg/L and observed within a TARP Level 1 at bores P15D, P14A-D. As presented in SLR (2022a), the stable and minor increase in Sr concentrations observed at nearby bores suggest that the exceedance in Sr concentrations in March 2022 at P15A remains a potential TARP Level 4.

Further details regarding the strontium investigation are presented in SLR (2022a). The following presents a summary of the findings:

- Since the start of monitoring at site P15A-D, the Sr concentrations are above the ranges reported at the unaffected sites in Morrison *et al*. (2019) and above the pre-mining Sr concentrations at P14A-P14D except for P15D within pre-mining Sr concentrations at P14.
- No exceedances in Sr concentrations were identified at surface water monitoring sites along Stonequarry Creek, with all surface water monitoring sites across the Western Domain within TARP Level 1 for water quality in January 2022 (HEC, 2022b) and during the reporting period (HEC, 2022a).
- From the U.S Environmental Protection Agency, Sr concentrations in drinking water are assessed relative to the health-based screening level benchmark of 4 mg/L (Musgrove, 2021). Values greater than 4 mg/L are considered high, between 2 mg/L and less than 4 mg/L are considerate moderate and less than 2.0 mg/L are considered low. At P15A, Sr concentrations are considered moderate (less than 4.0 mg/L).
- Since monitoring started at P15A, the higher Sr concentrations observed at P15A compared to other sites (i.e. P14, GW105228 and GW115860) and compared to the deeper piezometers (i.e. P15B-D) suggest a localised Sr source in groundwater at piezometer P15A.
- The range of strontium in natural soils is highly variable, from 50 mg/kg to 1000 mg/kg (USEPA, 1983). P15A is located within the mapped alluvium (Figure 1) and may be screened within alluvial soil with a higher Sr concentration compared to the deeper lithology of weathered and fresh Hawkesbury Sandstone. No bore logs are available to review and verify the lithology at this location.

- The Sr concentrations at nearby registered bores GW105228 and GW115860 are considered low (less than 2 mg/L) (Musgrove, 2021) suggesting no risk of human-health concerns and that the increase in Sr concentrations at P15A is possibly localised.

It is recommended to continue monitoring Sr concentration at site P15A-D, P14A-D and at the two nearby registered bores (GW105228 and GW115860).

5.2.3.5 P15B, C and D

At P15B, strontium levels exceeded the trigger of 1.21 mg/L in November (1.3 mg/L) and February (1.4mg/L) triggering the TARP Level 2. As of March 2022, strontium levels reduced to 1.2 mg/L (Appendix D, Figure D-12).

At P15C, strontium levels exceeded the trigger of 0.45 mg/L in November (concentration rising at the trigger level), in February and March (0.47 mg/L) triggering the TARP Level 2 (Appendix D, Figure D-13). Short-term increases in dissolved Al and Mn were also recorded at P15C triggering a TARP Level 2. Al levels increased from 0.01 mg/l in January to 0.04 mg/L in February, being stable in March above the trigger level of 0.03 mg/L (Appendix D, Figure D-14). As mentioned above, aluminium concentrations show natural fluctuations in the range of 0.01 to 0.06 mg/L and these exceedances are not considered a cause for concern. Mn levels were recorded marginally above the trigger level of 0.54 mg/L in November (0.55 mg/L) and in March (0.58 mg/L) (Appendix D, Figure D-15). As of March 2022, Mn levels at P15C appear lower than in the upper Hawkesbury Sandstone recorded at 0.82 mg/L (P15A) and 0.59 mg/L (P15B) and within a TARP Level 1.

A TARP Level 2 for dissolved iron (Fe) and barium (Ba) was triggered in February at P15D. Fe levels increased from 2.3 mg/L in January to 4.8 mg/L in February and as of March reduced to 2.2 mg/L (TARP Level 1) (Appendix D, Figure D-16). Ba levels increased from 0.15mg/L in December to 0.21 mg/L in February and as of March reduced below the trigger level of 0.21 mg/L to 0.17mg/L (Appendix D, Figure D-17).

5.2.3.6 P16A

A TARP Level 2 for barium (Ba) was triggered in November at P16A. Ba levels increased to 8.5 mg/L in November and reduced to 0.1 mg/L for the rest of the reporting period (Appendix D, Figure D-18). This single trigger is likely an outlier and could be attributed to a lab error measurement. Ba levels at P16A have been observed at 0.1 mg/L since monitoring started.

5.2.3.7 P16B

A TARP Level 2 for Sr was triggered in November and December at P16B and returned to TARP Level 1 in January. In February, Sr levels increased to 0.15 mg/L above the trigger level of 0.13 mg/L triggering the TARP Level 2 (Appendix D, Figure D-9). As of March, Sr reduced to 0.08 mg/L within a TARP Level 1. A TARP Level 2 for Fe was triggered in December at P16B which follows a period of decline in levels observed since July 2021. In January and February, Fe levels reduced within TARP Level 1 (i.e. 9.1mg/L) but as of March Fe levels increased to 86 mg/L (Appendix D, Figure D-20). Iron staining was previously reported at this location likely attributed to the installed steel casing.

5.2.3.8 Private Bores

At GW104090 a short-term increase for Sr and Ba triggered a TARP Level 2 in January. Sr levels have continually been increasing since April 2021 from 0.27 mg/L to 1.7 mg/L in January 2022 (trigger level is at 1.2 mg/L) (Appendix D, Figure D-21). Ba levels increased from 0.08 mg/L in October 2021 to 0.44 mg/L (Appendix D, Figure D-22).

At GW105228, Ba concentrations exceeded the trigger of 0.228 mg/L in January resulting in a TARP Level 2. Concentrations increased marginally from 0.23 mg/L in October 2021 to 0.24 mg/L in January 2022 (Appendix D, Figure D-23).

At GW072402 Ba concentrations in January 2022 were reported at 0.28 mg/L, which is marginally above the trigger value of 0.2785 mg/L, resulting in a TARP Level 2 (Appendix D, Figure D-24).

GW115860 is located 400 m north of LW W3. Barium concentrations at GW115860 exceeded the trigger of 0.33 mg/L for the third consecutive time in the January 2022 (i.e. a period of more than six months), resulting in a potential TARP Level 4 exceedance (Appendix D, Figure D-25). Concentrations increased from 0.36 mg/L in October 2021 to 0.39 mg/L in January 2022. The first reported concentration of Ba in January 2021 at GW115860 was 0.3 mg/L with the lowest concentration reported in April 2021 (0.032 mg/L).

SLR (2022a) investigated the potential TARP Level 4 for Ba at GW115860. The following summarises the findings:

- Ba concentration at GW105228 (110 m from GW115860) are stable within 0.20-0.25 mg/L since monitoring started.
- The short record of Ba concentrations at site P15A-D shows fluctuation within the range of 0.08 to 0.21 mg/L, generally lower than at GW105228.
- No exceedances or increasing trends in Ba concentrations were identified at sites P14A-D and P15A-C (only 180 m and 65 m from LW W3) between October 2021 and January 2022 (SLR, 2021a, 2022a) except at P15D (TARP Level 2) in February 2022 slightly increasing at the trigger level.

A mining-related effect on Ba at GW115860 was assessed to be unlikely but could not be excluded at the time of the investigation. A revision to the Ba trigger level was undertaken (SLR, 2022a) as it appeared that the trigger level was conservative and could not be based on pre-mining data.

The revised trigger level for Ba at bore GW115860 is 0.51 mg/L (SLR, 2022a) (Appendix D, Figure D-27).

The revised trigger level was calculated using the maximum Ba concentration recorded at GW115860 (i.e. 0.39 mg/L in January 2022) plus 30% (i.e. 30% being the percentage increase from 0.3 mg/L in January 2021 to 0.39 mg/L January 2022).

Published guideline values for Barium are:

- 1 mg/L for recreational purposes (ANZECC, 2000 / ANZG, 2018).
- There is no guideline value for Ba for freshwater ecosystems (ANZECC, 2000 / ANZG, 2018).
- 2 mg/L for health (i.e. drinking water) (NHMRC, 2011);

The revised trigger level for Ba at GW115860 remains conservative (i.e. lower than) with respect to the guideline values stated above. Further monitoring at GW115860 will be undertaken in April 2022 to confirm trends.

6 Predicted and Observed Groundwater Depressurisation

The following section provides a summary of comparison between the modelled and observed groundwater levels using the groundwater model SLR (2021) results (i.e. referred in this report as the "groundwater model") presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (up to March 2022).

6.1 Summary

The drawdowns observed during LW W1, LW W2 and LW W3 show a clear relationship with depth below surface (or height above the mined seam), with drawdowns greatest at depth, and being 8-15 m in the lower or mid-Hawkesbury Sandstone, and less in the shallower horizons (typically 0.5-1 m). The same trend is observed for the subsequent recovery post LW W1 and LW2, with greatest recovery in the deep piezometers (6 m) and being 1-3.5 m in the lower or mid-Hawkesbury Sandstone. As of March 2022, groundwater recovery is complete in the shallower horizons except at some site (P16A) where a potential partial recovery is observed (approximately 0.5-0.7 m below baseline).

The hydrographs for P12, P13, P14, P15, P16, and TNC036 monitoring sites were reviewed in light of the TARP exceedances (Section 4.3) at these monitoring sites (Figure 24 to Figure 29). The modelled water level for the piezometer A at each site is shown, however P13 hydrographs are shown below but no observed groundwater level data are available past October 2021, so no comparison between modelled and observed water levels is possible for this review. The key findings are:

- Piezometers at P12 and P16 are spaced, in a vertical sense, at a smaller spacing than model layers, so that it is not possible nor practical for the model to simulate or replicate water levels at all piezometers. Also, temporal discretisation does not allow all short-term variability, especially to rainfall events, to be simulated.
- The groundwater model does not simulate groundwater abstraction at private bores because the extractions are not metered by WaterNSW nor are there estimated extraction rates available.
- The model matches the groundwater level and mining-related drawdown observed in the shallowest horizons (P12A, P16A and P13A) relatively well, and in P12B and P13B. The model also replicates with accuracy the groundwater response to rainfall recharge in February 2020.
- In the deeper piezometers (P12C, P13C and P16C) the overall rate of the modelled drawdown and magnitude matched accurately the observed drawdown during 2020. Further details on the performance of the model (i.e. mining related drawdown) prior to the reporting period is provided in SLR (2021a).
- The historical period of the model ends in November 2020, which means that all predictions after December 2020 are based on average rainfall. Hence, the model does not capture the response to the rainfall recharge observed in March 2021, February and March 2022 (i.e. flood events). From November 2021, the model continues to match the groundwater level observed in the shallowest horizons (P12A) and slightly overestimates the drawdown in P14A by 1 m over the reporting period. In late 2021, the model captures the stabilisation in groundwater level in the shallow aquifer (P16A) although modelled groundwater levels are within +3 m of observed due to overestimation in modelled drawdown in 2021. This is caused by the underestimation of the modelled recharge in March-April 2021 (i.e. using average rainfall) while the observed recovery was accelerated by the flood events at the same period.

- The short records of groundwater level observed at site P15 are well replicated by the model being within 1 m of observed at the end of the reporting period. We note that piezometers P15A, B, C and D all sit within the same model layer 2. With groundwater drawdown expected at this site, the presence of multiple piezometers within a single layer makes it challenging (if not impossible) to replicate or match all observations. The model overestimates the drawdown at P15 in layer 2 by approximately 5 m while observed groundwater levels show short-term water level decline in the range of 0.5-0.8m. This is expected at this location as the modelled recharge in March-April 2021 and March 2022 are underestimated and the observed groundwater levels show responses to rainfall during the same period. At the end of the reporting period, modelled groundwater levels in Layer 1 and Layer 2 are within +/- 2 m to 5 m within observed groundwater level which is acceptable. Similar observations apply to site P14 in terms of model layering and model performance.
- At P12, the recovery in groundwater level (model layer 2) is a good approximation of the recovery in P12C (i.e. same was true for the drawdown in 2020). The timing of recovery is well replicated, while its magnitude is slightly underestimated by the model (within 3 m of observed). From November 2021, the model replicates the magnitude of drawdown due to LW W3 in the range of 1 m, being similar for observed water levels at P12C. At P13, model layer 2 was also a good approximation of drawdown at P13C however the lack of modelled recharge in early 2021 underestimates the magnitude of recovery but modelled levels at P13C remain within 1 m of observed in October 2021. No observed data is available to compare to modelled water levels after October 2021.
- At P16B and P16C, sitting within the model in Layer 1 and Layer 2 respectively, the model replicates the stabilisation of water level throughout May 2021 but underestimates the observed recovery from June 2021 likely caused by the lower modelled recharge in March 2021. At the start of the reporting period, modelled water levels match the stabilisation in the observed groundwater levels but do not capture the short-term water level decline observed early January 2022. Modelled groundwater levels at the end of the reporting are well captured in P16C sitting 1.5 m of observed water levels.

At TNC036 (Figure 29) the simulation of drawdown in model layer 2 is 16 m, which is higher than in the HBSS-65m piezometer (approximately 6 m drawdown), and less than the 24 m recorded against the HBSS-97 m piezometer. The HBSS-65m and HBSS-97 m piezometers are assigned the same model layer, but the model gives a reasonable estimate in the rate and magnitude of drawdown at this location. The model captures the stabilisation in observed water levels between May and June 2021 relatively well. There is a small underestimation in the model to replicate the observed recovery in June 2021 and later in February-March 2022 but modelled groundwater levels are within 10 m observed as of March 2021 (i.e. similar as modelled prior to LW W1).

- The observed stabilisation and recovery in water levels in BGSS-169 m are well replicated by the model, being within 1 m of observed as of March 2022. This suggests that the height and mode of subsidence fracturing in this area is well represented in the model. The issue with comparing the model to these observed drawdowns and recoveries is that the attribution of depths and stratigraphy is not completely reliable (Section 4.1.2.7).

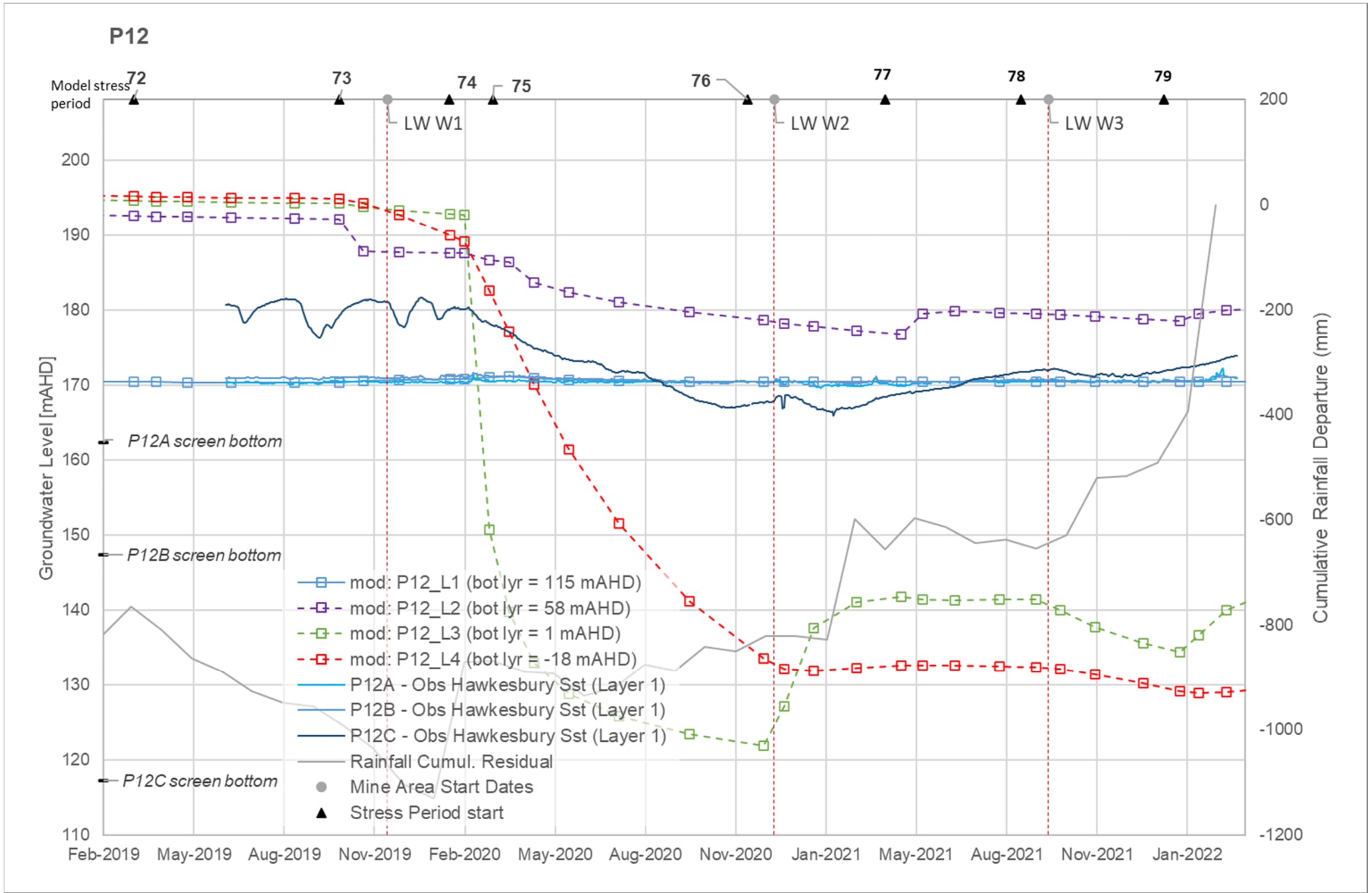


Figure 24 Comparison of Modelled and Observed Groundwater Levels at P12

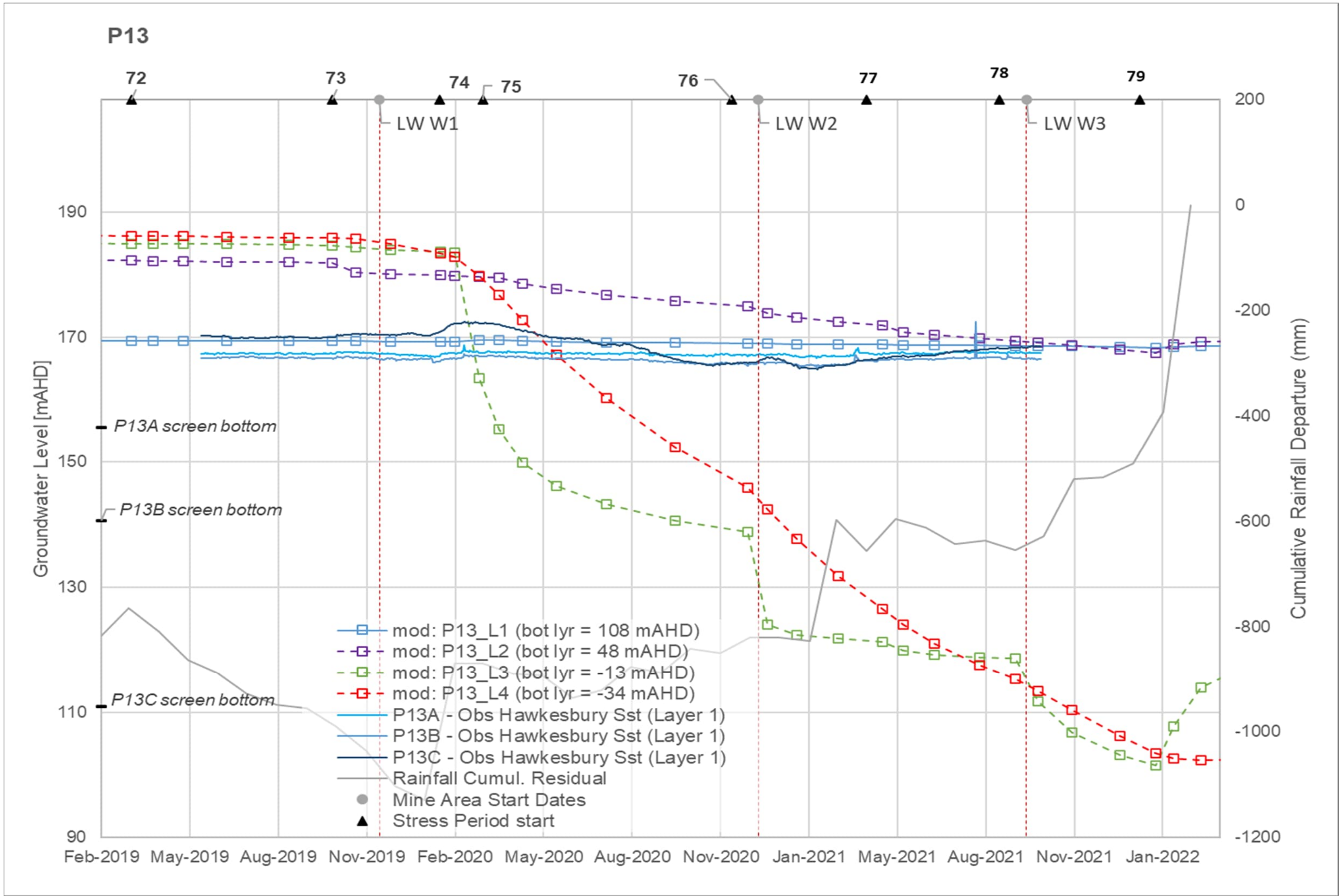


Figure 25 Comparison of Modelled and Observed Groundwater Levels at P13

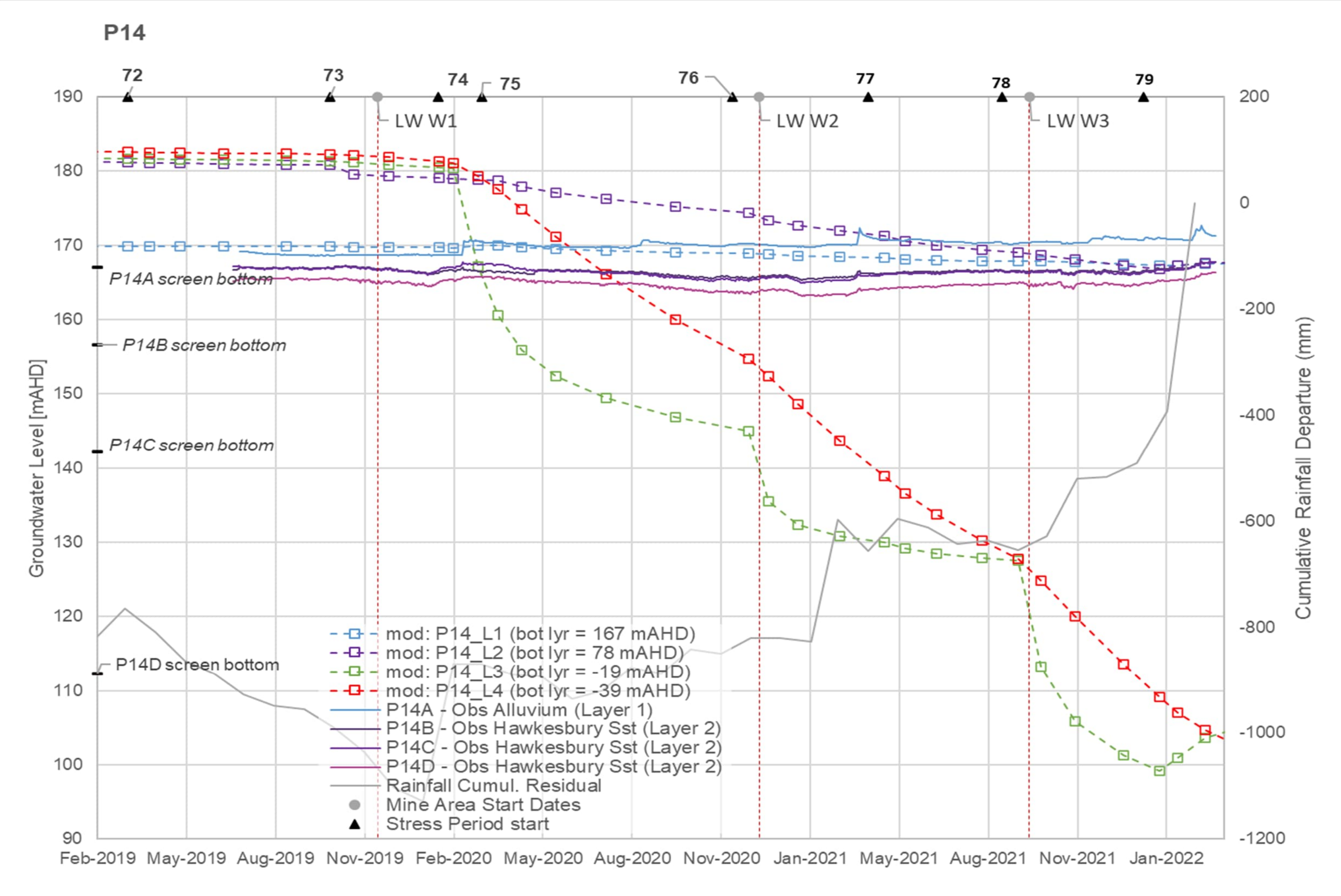


Figure 26 Comparison of Modelled and Observed Groundwater Levels at P14

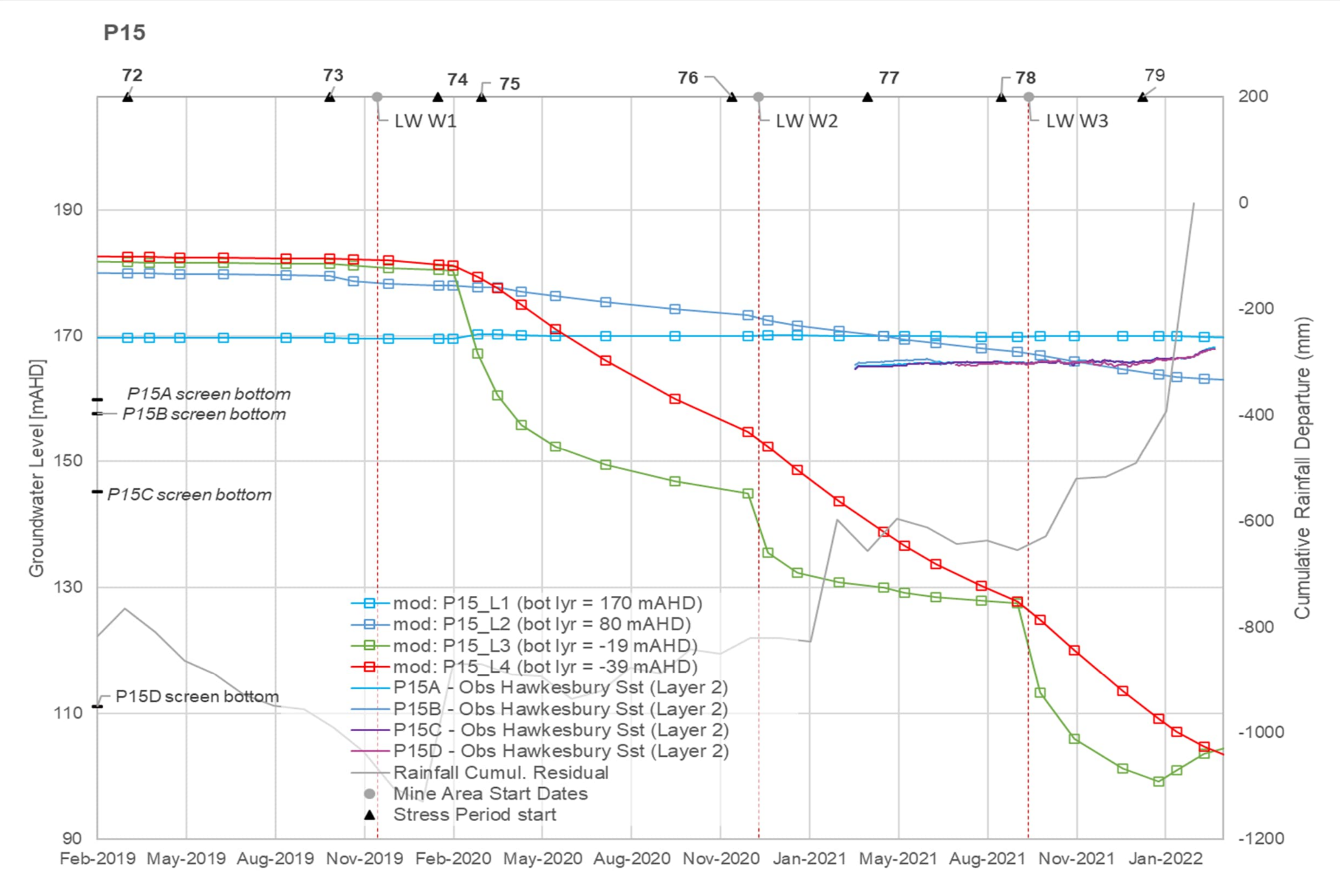


Figure 27 Comparison of Modelled and Observed Groundwater Levels at P15

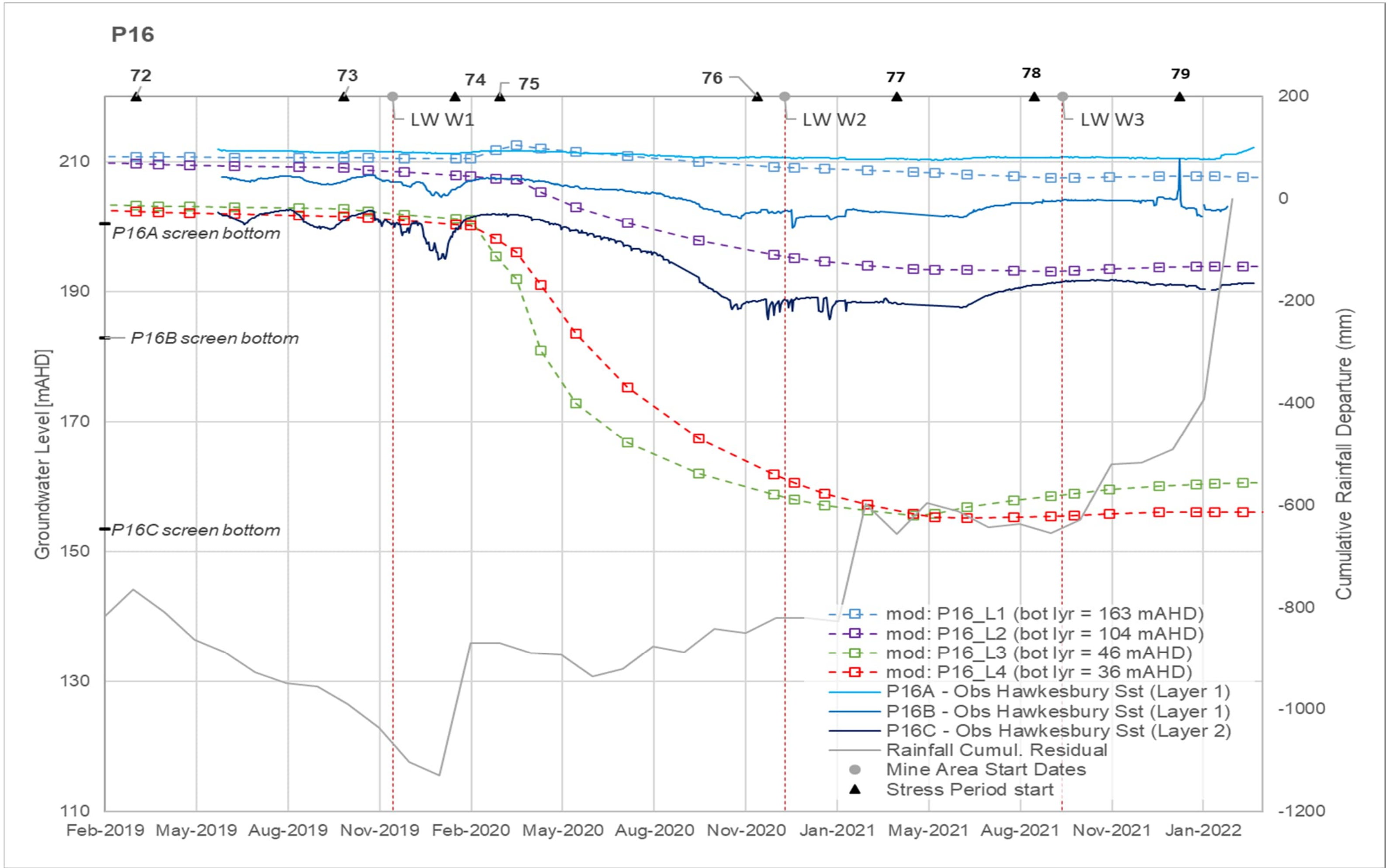


Figure 28 Comparison of Modelled and Observed Groundwater Levels at P16

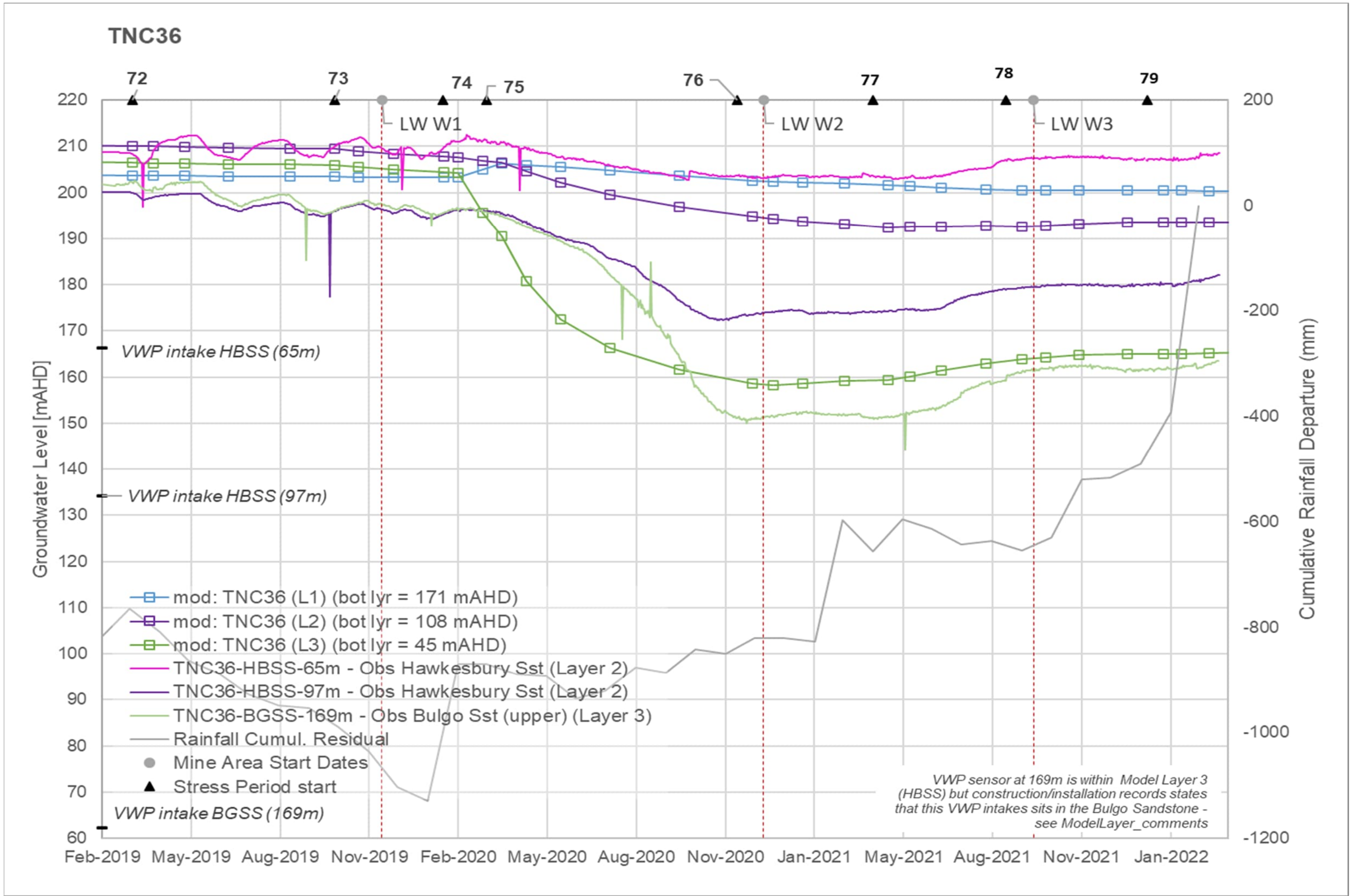


Figure 29 Comparison of Modelled and Observed Groundwater Levels at TNC036

7 Mine Groundwater Inflow

For the period 2009 to March 2022 (latest reported record is on 31st March 2022), inflows to Tahmoor Mine have been within the range of 2 to 6 ML/d. Figure 30 shows net groundwater inflows against daily water pumped from the mine, alongside the historic rainfall (based on records dating back to 1900) and the Western Domain longwall start dates. Inflows to the mine remained relatively steady throughout the extraction of Longwalls 24B to 32 (SLR, 2021a).

A spike in inflows occurred following the cutting of Longwall 27, however, between this time and May 2020 inflow rates have declined (SLR, 2021a). The period between mid-2020 shows an increase in inflows to greater than 5 ML/day at the end of July 2020 likely due to the extraction of LW W1. Inflows declined in late 2020, before rising in February 2021 (early in LW W2), with the recent peak at marginally over 6 ML/d in March and April 2021 (Figure 30). Inflows to the Western Domain are not metered in isolation from other parts of Tahmoor North but were estimated to be greater than 2.5 ML/d in early 2021 (based on advice from Tahmoor Coal staff in early 2021).

The increase in mine inflow in the Western Domain between the months of April-May 2021 has been discussed with Tahmoor Coal staff and consultants. Other than the minor fault observed in the southern section of LW W1 and LW2, no other obvious geological structures have been noted as intersecting current longwalls. The faults on the north-eastern edge of LW W4 were mapped (SCT, 2021b) with major splays 1000 m from LW W4. Following this, investigations of the hydraulic properties within the lower fault zone were conducted within P41. The measured hydraulic properties within this zone were not abnormal and within those measured elsewhere at Tahmoor Mine (SCT, 2021b and SLR, 2021a). The latest observations confirm that during extraction of LW W3 groundwater inflow to the mine stayed within ranges previously observed which suggest that no additional inflow to the mine was driven from the faults mapped in the Nepean Fault Complex. During extraction of LW W4, it is expected that groundwater inflow to the mine will remain within similar ranges previously observed. This is if subsidence above and adjacent to LW W3-W4 remain within predictions and mobilisation of fault structures do not occur due to longwall subsidence (SCT, 2021b, SLR, 2021).

Tahmoor Coal continues to monitor changes in mine inflows and identify where in the workings higher inflows can be observed. Analysis of longwall extraction rate (in metres/day) versus inflow rate (ML/d or m^3/d) indicates that the consistently higher extraction rates that have been achieved in LW W1 and W2 were at least partly responsible for higher inflows. This is confirmed by the fact that once LW W2 was completed in June 2021 inflow reduced to 3-4 ML/d (i.e. inflow similar prior to LW W1) but then increased up to 5 ML/d in July 2021 and throughout early August 2021 (i.e. probably pumping accounted for an earlier short-fall or in preparation of LW W3). During LW W3 and as of March 2022, the average inflows to the mine have been 4.3 ML/d, remaining below the average entitlement of 4.5 ML/d. A consistent increase in inflow is observed between November 2021 and February 2022 from 3 ML/d to 5.5 ML/d likely attributed to LW W3 extraction. Mine inflow reduced to 3.5 ML/d in early March 2022 before rising back to 5.3 ML/d at the completion of LW W3.

The average inflows to the mine for the last four water years have been: 4.4 ML/d for the current water year (July 2021 to date), 4.5 ML/d for last water year (July 2020 to June 2021), 3.3 ML/d for the July 2019 to June 2020 water year, and 3.4 ML/d for the 2018-2019 water year.

Previously, SLR and their subconsultants have advised Tahmoor Coal staff regarding possible options in the event that inflow rates to the workings rise at a similar rate to that of the recent average inflows seen in March-April 2021. Since April 2021, inflow rates to the mine workings have remained below the previous observed peak of 6 ML/d, with a general reduction in the inflow rates. Groundwater entitlement was not exceeded for the 2021-22 water year and as of March 2022 remain just below the limit for the 2021-22 water year (based on a pro-rata calculation).

Tahmoor Coal is currently in the process of obtaining additional groundwater entitlement to meet the likely requirements of the remaining Western Domain and early Tahmoor South mining operations.

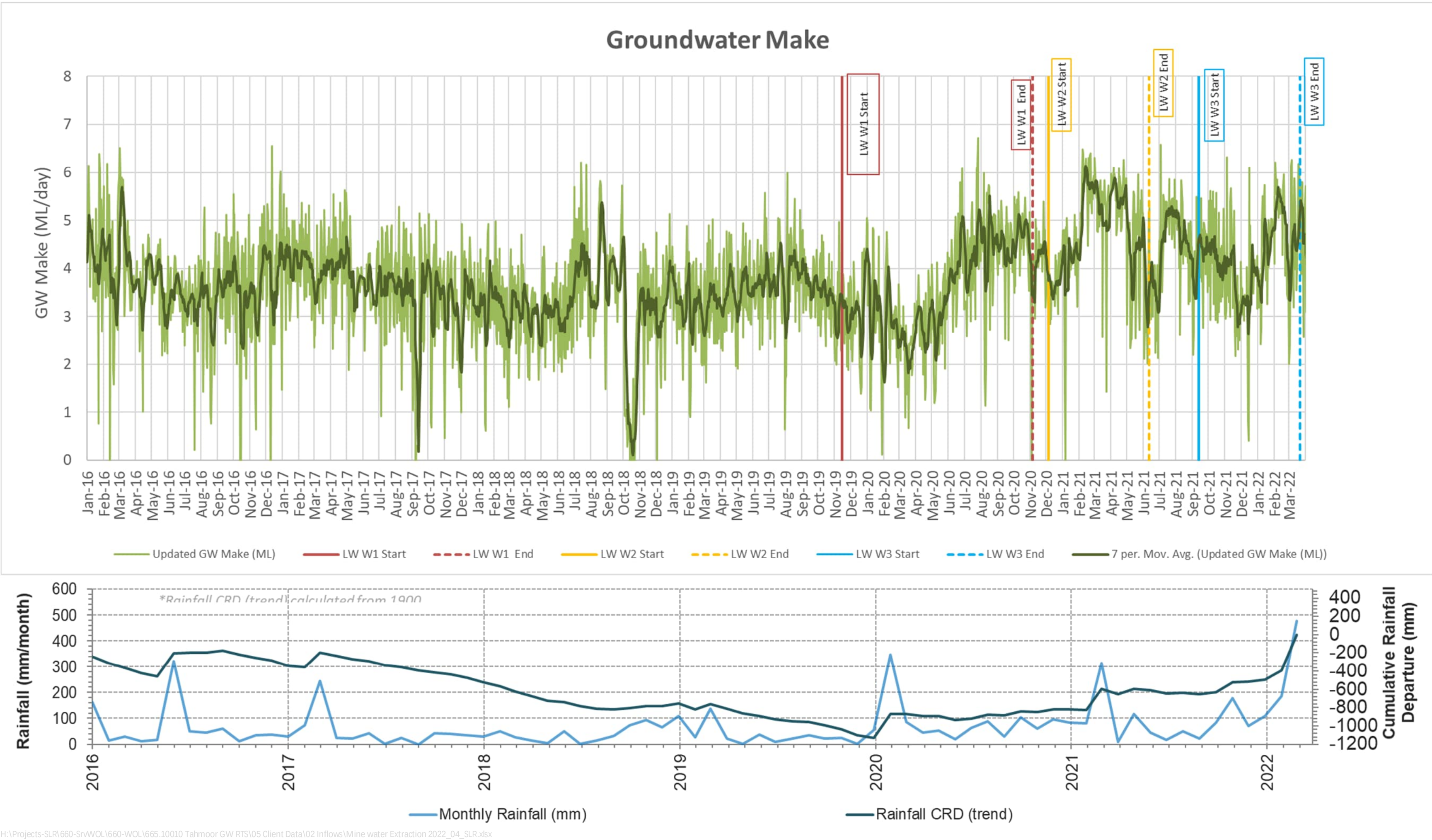


Figure 30 Historical Record of Inflows at Tahmoor North

8 Conclusions

The key conclusions from the six-monthly review are summarised as follows:

- At most of the monitoring sites, groundwater levels have clearly responded to the above average rainfall condition observed throughout December 2021 to March 2022 (i.e. marked by floods events in late February – early March 2022), while groundwater levels seemed to have been less responsive to wet conditions in November 2021 although it was the second wettest month in 2021 with 177.8 mm of rainfall. This is likely attributed to a delayed mining effect of LW W2 and the progression of LW W3 during the reporting period.
- A period of stable groundwater level was identified between October and February 2021 in the upper Hawkesbury Sandstone aquifer at the open standpipes P12A, P12B and at TNC36 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m.
- The LW W3 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain. However, a series of consistent and minor declines were observed at site P14 and P15 during November 2021 (LW W3 approximately 50% complete) and ranging from 0.3m to 0.5m; similar to observations made in September and October 2021 (SLR, 2022a). These series of decline are likely associated with the progression of LW W3 although short-term responses to rainfall recharge were observed over the same period. No effects on surface water were observed at the rock bar SR 17 (HEC, 2022a) due to LW W3 over the reporting period.
- To the east of the Western Domain, a minor depressurisation was observed in the lower fault zone at P41D and could potentially be due to LW W3 extraction while other VWPs at P41 show stable groundwater levels.
- To the west of the Western Domain, a delayed mining effect from LW W2 and active mining at LW W3 had a short-term effect on groundwater levels at P16B and P16C (i.e. combination of sharp and gradual decline) associated with a subsequent slower groundwater recovery. This could be related to fracturing of the strata due to valley closure along the western side of LW W1 (i.e. increase in porosity hence storage leading to longer recovery time).
- From December 2021, groundwater recovery in the Hawkesbury Sandstone aquifer improved at the open standpipes P12C, P14B-D, P15A-D and P40A-D and from February 2022 at sites P12A, P12B, P16A-B, P41C-D and at TNC036 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m. The rate of recovery accelerated in late February 2022 at all monitoring sites. The groundwater recovery is associated with the completion of LW W3, and the exceptional wetter condition in February-March 2022.
- At monitoring site P40, located in between LW W1 and Cedar creek, groundwater levels in the upper Hawkesbury Sandstone (P40A) continued to recover over the reporting period while groundwater recovery in the mid Hawkesbury Sandstone started later in December 2021 (P40B-P40D). The difference in timing may be due to the upper Hawkesbury Sandstone aquifer being recharged first by rainfall and stream flow losses, gradually infiltrating the mid-Hawkesbury Sandstone aquifer.
- Groundwater recovery identified in the upper and mid Hawkesbury Sandstone aquifers confirms a potential for recovery at monitoring site CB. As presented in SLR (2022c), this is following the triggering of TARP Level 3 at monitoring site CB during October 2021 and early November 2021, suggested to be a delayed mining effect due to subsidence over LW W2. It is difficult to assess if drawdown alone was causing the reduction at monitoring site CB, however, if fracturing in the subsurface has occurred it seems that flood events in early 2022 have contributed to fill the increased storage (i.e. pore space) in the Hawkesbury Sandstone aquifer and could have improved baseflow conditions at monitoring site CB.

- The medium-term impact previously identified on shallow groundwater levels at site P16A is difficult to assess at the end of the reporting period to potential surface run-off ingress, showing a rise in water levels of 1.2m and not representative of groundwater condition. Further monitoring at P16A and P40 is required to confirm groundwater trends, and whether recovery is complete and sustained, especially during periods of below average rainfall condition. This will then confirm whether hydrogeological conditions near CB have returned to pre-mining conditions and whether baseflow has improved.
- The recovery in groundwater levels at the open standpipes is accompanied with a stable pH and EC across the Western Domain. An increasing trend in EC was noted at site P15A, P15B and GW115860. The cause of the rise in salinity, although minor, remains difficult to assess as baseline data is not available. The beneficial use classifications remain unchanged at the private bore GW115860 and no significant increase in EC was identified along Stonequarry Creek.
- An issue with the integrity of the bore is likely at P12B following the rise in pH since October 2021, and previously observed in April 2021 following rainfall. As of March 2022, nearby monitoring bores are within TARP Level 1, it is suggested to keep the exceedances in pH at P12B as potential 4 TARP Level noting that the consequences of this effect (if it is mining-related) are considered minor.
- Most of the exceedances in metal concentrations reported during the review period are short-term increase (less than three months) likely due to above average rainfall conditions during late 2021 and intense rainfall in early 2022.
- A consistent rise in the concentration of strontium was observed during the reporting period at site P15A piezometer and requires further monitoring. SLR (2022a) investigated the rise as being localised and further information on stratigraphy in this area may assist assessing reasons for the increasing concentrations.
- Metal concentration exceedances (TARP Level 2) remain active as of March 2022 for Fe (P16B), Mn (P15C), Li (P12B), Ba (GW104090, GW105228, GW072402) Sr (P15A, P15C, GW104090).
- Exceedances in Fe at P16B are likely due to iron staining in the bore (previously observed during bore census conducted by GeoTerra in 2019).
- From available information, there is no depressurisation identified at private bores with available groundwater levels and therefore no groundwater level exceedances are recorded at these locations. Further monitoring at private bores will be undertaken in April 2022 to confirm trends and identify whether the early part of LW W4 extraction has any effect on groundwater levels.
- Single exceedances in metal concentrations (i.e. Sr and Ba) have been recorded in some private bores during the reporting period (i.e. only one sampling event in January 2022). There are no clear trends in metal concentrations that may be linked to mining operations. Metal concentration exceedances (TARP Level 2) remain active as of January 2022 (i.e. last sampling event) for Ba (GW104090, GW105228, GW072402) and Sr (GW104090).
- A potential TARP Level 4 was reported for Ba at GW115860 and investigated in SLR (2022a). This was assessed to be unlikely a mining impact. A revised trigger level was calculated as it appeared that the trigger level was conservative and could not be based on pre-mining data. Further monitoring at GW115860 will be undertaken in April 2022 to confirm trends.
- Deeper strata at TNC036 (BGSS-214m) shows depressurisation as of March 2022 with an ongoing clear depressurisation in BUSM-412m (i.e. due to Tahmoor mine and regional mining), as expected for deep strata near to a longwall, within a magnitude that exceed the predicted modelled drawdown (+ 15-20 m of observed).

9 Recommendations

TARP Exceedance

Based on the trigger exceedances assessment in Section 4.4 and Section 5.2 and based on the TARP presented in Appendix B, the following ongoing actions are recommended:

- At P12C, P16C and TNC036 (HBSS-97m) with a Level 3 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- At P16B with a Level 2 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- At TNC036 (BGSS-169m) with Level 2 trigger for groundwater level, to continue monitoring program and develop a review of groundwater level data in the next groundwater monthly.
- At all sites with Level 2 trigger for groundwater quality, to continue monitoring program and a review of water quality data in the next groundwater monthly report.
- For the medium term, if Sr concentrations at P15A remain within a potential TARP Level 4, (i.e. show fluctuations between 2 mg/L and 4 mg/L) and no significant increase in Sr concentration is observed at other monitoring piezometers P15B, P15C and P15D and the nearby registered bores (i.e. not resulting in a TARP Level 4) over the period January-June 2022 (i.e. six months), it is suggested to revise the Sr concentration trigger level at P15A to 4 mg/L (i.e. based on US health-based screening level benchmark, and in the absence of an ANZECC guideline). To note that Sr concentrations recorded at surface water monitoring sites along Stonequarry Creek are within a TARP Level 1 over the reporting period (HEC, 2022a).
- Convene Tahmoor Coal Environmental Response Group to review response on a monthly basis.

The following actions are recommended for the next 6-month review:

- Ongoing monthly collection and analysis of monitoring data: monthly monitoring and analysis of surface water and groundwater level and water quality data recorded in the vicinity of the Investigative Area and at upstream reference sites should continue to be undertaken and the investigation findings updated to incorporate additional monitoring data and analysis findings (HEC, 2021). The surface water and groundwater monitoring data should continue to be assessed in accordance with the TARP, as documented in the WMP (Tahmoor Coal, 2021).
- Inclusion of the developed groundwater level trigger for P41 (Nepean Fault Complex piezometer) in the next groundwater monthly report. Inclusion of the site P41 in the TARP will help to identify if any exceedances are related to the proposed LW W4 in the lower reach of Stonequarry Creek (P41), within the Nepean Fault Complex (SCT, 2021).
- As recommended in SLR (2022a), if surface water exceedances at site SC (SC3) are identified during and following mining of LW W4, groundwater levels at site P41C-D could be used to infer groundwater levels beneath site SC, or sites SD and SF further downstream, acknowledging that the distance from the piezometers and the creek reduces reliability, but these piezometers provide the best data for this. Observed groundwater levels were used in the past to identify or infer potential change in groundwater-surface water interaction at surface water monitoring sites (SLR, 2021). Extrapolation of groundwater levels from piezometers P41C-D could be used to assess possible groundwater-surface water interactions prior to, during and post-mining of LW W4.

- Analysis and incorporation of post-mining groundwater level data from proposed new VWP borehole WD02 above LW W2 and establish trigger level for groundwater levels for each VWP pressure sensor. Identify any exceedances in groundwater level at this site related to mining and consider implication regarding height of fracturing.
- To assess the implications of lithology on strontium concentrations at P15 or other future exceedances in groundwater quality that may arise in the future, it is recommended that the bore logs are obtained and reviewed for the monitoring bores and VWPs.

10 References

ANZECC, 2000; Agriculture and Resource Management Council of Australia and New Zealand and the New Zealand Environment and Conservation Council (ANZECC and ARMCANZ) 2000. Australian and New Zealand guidelines for fresh and marine water quality. P9.2-89.

ATC Williams, 2022a. *Tahmoor Mine LW W3 and W4 Surface Water Review – November 2021 - March 2022.* Report for Tahmoor Coal, May 2022.

Department of Primary Industries (DPI) Fisheries, 2015. *Tahmoor Longwalls 31-37 SMP – Fisheries comments.* Email submission made to NSW Trade and Investment, Division of Resources and Energy, 15 April 2015.

GeoTerra, 2013. *Tahmoor South - Shallow groundwater baseline monitoring*. Report for Tahmoor Coal, document BAR3 - R1A.

GeoTerra, 2014. *Longwall Panels 31 to 37 Streams, Dams and Groundwater Assessment*. Report for Tahmoor Coal, document TA25-R1A, December 2014.

GeoTerra, 2016. *Tahmoor Colliery Longwall 29 Surface Water, Dams and Groundwater End of Panel Monitoring Report.* Report for Tahmoor Coal, document TA28-R1B.

GeoTerra, 2019. *Longwalls West 1 and West 2 Baseline Private Bore Assessment, Tahmoor, NSW.* Report TA36-R1A prepared for Tahmoor Coal Pty. Ltd., May 2019.

GeoTerra, 2020a. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., January 2020.

GeoTerra, 2020b. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., February 2020.

GeoTerra, 2020c. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., March 2020.

GeoTerra, 2020d. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., April 2020.

GeoTerra, 2020e. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., May 2020.

GeoTerra, 2020f. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., June 2020.

GeoTerra, 2020g. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., July 2020.

GeoTerra, 2020h. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., August 2020.

GeoTerra, 2020i. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., November 2020.

GeoTerra, 2020j. *Longwalls West 3 - West 4 Surface Water Technical Report.* prepared for Tahmoor Coal Pty. Ltd., November 2020

GeoTerra, 2021. *Longwalls West 1 Groundwater Monthly Report, Tahmoor, NSW.* prepared for Tahmoor Coal Pty. Ltd., January 2021.

Geoterra, 2021b. Longwalls W3 and W4 Baseline Private Bore Assessment. Report TA41-R1, 13 Jan 2021.

Groundwater Exploration Services [GES], 2019. *TNC40 – Vibrating Wire Piezometer Partial Failure*, 6th February 2019.

Groundwater Exploration Services [GES], 2020. *TNC36 – Vibrating Wire Piezometer Instrumentation Review* 15th October 2020.

Hydro Engineering & Consulting [HEC], 2021. Tahmoor North Western Domain Surface Water Review 1 April to 30 September 2021. Prepared for Tahmoor Coal Pty Ltd, November.

Hydro Engineering & Consulting [HEC], 2022b *Tahmoor Mine LW W3 and W4 Surface Water Review – January 2022.* Report for Tahmoor Coal, January 2022.

HydroSimulations, 2018. Tahmoor South Project EIS: Groundwater Assessment. Report HS2018/52 for Tahmoor Coal Pty. Ltd., December 2018.

HydroSimulations/SLR, 2019. Tahmoor LW W1-W2 Extraction Plan: Groundwater Technical Report. Report HS2019/14c for Tahmoor Coal Pty. Ltd., July 2019.

HydroSimulations/SLR, 2020. Tahmoor South Project – Amended Project Report: Groundwater Assessment. Report HS2019/42a_v4.0 for Tahmoor Coal Pty. Ltd., August 2020. IEPMC 2018. *Initial report on specific mining activities at the Metropolitan and Dendrobium coal mines.* 12 November 2018. Available via https://www.chiefscientist.nsw.gov.au/independent-reports/mining-in-the-sydney-drinking-water-catchment

Moffitt, R.S., 1999. Southern Coalfield Regional Geology Map, 1:100,000, First Edition. Geological Survey of NSW, Sydney

Musgrove, 2021. The occurrence and distribution of strontium in U.S groundwater. U.S Geological Survey.

NSW Government, 2012. Aquifer Interference Policy. September 2012.

NSW Government Department of Planning, Industry and Environment (DPIE), 2012. Basin Plan 2012 – Darling Alluvium water quality management plan. GW7 Darling Alluvium water resource plan.

NSW Government, 2017. *Coal Mine Subsidence Compensation Act 2017 No37 [NSW] Part 2 Compensation for mine subsidence.* August 2017.

NSW Office of Environment and Heritage (OEH), 2015. *RE: Subsidence Management Plan Application for Tahmoor Colliery Longwalls 31 to 37, Glencore.* Submission made to NSW Trade and Investment, Division of Resources and Energy, April 2015.

NSW Office of Water (NOW), 2011a. *Report Card for the Nepean Sandstone Groundwater Source*.

NSW Office of Water (NOW), 2011b. *Water Sharing Plan – Greater Metropolitan Regional Groundwater Sources: Background Document*.
http://www.water.nsw.gov.au/__data/assets/pdf_file/0005/548105/wsp_metro_groundwater_background.pdf

NSW Office of Water (NOW), 2011c. *Water Sharing Plan – Greater Metropolitan Regional Unregulated River Water Sources: Background Document*.
http://www.water.nsw.gov.au/__data/assets/pdf_file/0003/548058/wsp_metro_surface_water_background.pdf

NSW Office of Water (NOW), 2015. *Subsidence Management Plan Application for Extraction of Longwalls 31 to 37 at Tahmoor Colliery*. Submission made to NSW Trade and Investment, Division of Resources and Energy, April 2015.

SCT, 2014. *Longwall 10A Height of Fracture Borehole for Tahmoor South Project – Observations, Measurements, and Interpretation*. Report for Tahmoor Mine, doc TAH4125, March 2014.

SCT, 2018a, *Structure Determinations of the Nepean Fault Adjacent to Tahmoor Mine*. doc TAH4817. May 2018.

SCT, 2018b. *Redbank Creek Shallow Groundwater Investigation*. Report for Tahmoor Coal, doc TAH4909, December 2018.

SCT, 2019a. *Myrtle Creek Characterisation Boreholes* for Tahmoor Coal, doc TAH5004a, December 2019.

SCT, 2020a. *Myrtle Creek CMAP Trial Project: Site 23 Trial Outcomes Report* for Tahmoor Coal, doc TAH5123, January 2020.

SCT, 2020b. *Redbank Creek Characterisation Boreholes* for Tahmoor Coal, doc TAH5004b, March 2020.

SCT, 2020c. *Tahmoor Western Domain, Height of Fracturing Boreholes – Pre and Post Mining Borehole Locations* for Tahmoor Coal, doc TAH5156, March 2020.

SCT, 2020d. *Structure Determinations of the Nepean Fault Adjacent to Picton Rail Tunnel*. Doc TAH5262, December 2020.

SCT, 2021. *Assessment of Rockbar SR17 and Nepean Fault Complex to Support Longwall W3 and W4 Extraction Plan*. Report for Tahmoor Coal, doc TAH5229, February 2021.

SLR, 2021. Tahmoor Coal LW W3-W4 Extraction Plan: Groundwater Technical Report. Prepared for Tahmoor Coal Pty Ltd, Report No: 665.10010.00006-R01-v3.0

SLR, 2021a. Groundwater six-month review. Prepared for Tahmoor Coal Pty. Ltd., November 2021, Report No: 665.10010.00107-R02-v2.0.

SLR, 2021b. Groundwater Investigation fortnightly review (15 Oct - 27 Oct). Prepared for Tahmoor Coal Pty. Ltd., November 2021, Report No: 665.10010.00907-M03-v1.0.

SLR, 2021c. Groundwater fortnightly review (15 Oct - 27 Oct). Prepared for Tahmoor Coal Pty. Ltd., November 2021, Report No: 665.10010.00907-M03-v1.0.

SLR, 2022a. Tahmoor Western Domain - Groundwater Trigger Investigation – January 2022. Prepared for Tahmoor Coal Pty. Ltd., April 2022, Report No:665.10010.00207-M01-v2.0.

SLR, 2022b. Groundwater monthly review (February 2022). Prepared for Tahmoor Coal Pty. Ltd., May 2022, Report No: 665.10010.00207-M0-v2.0.

SLR, 2022c. Groundwater quarterly monthly review (October-December 2021). Prepared for Tahmoor Coal Pty. Ltd., February 2022, Report No: 640.30362.0000-M02-v3.0.

Tammetta, P., 2013. Estimation of the height of complete groundwater drainage above mined longwall panels. Groundwater, Volume 51, No. 5, p. 723–734. Paper accepted 2012, published 2013.

Tahmoor Coal Pty. Ltd, 2021. Tahmoor North - Western Domain, LW W3-W4 Water Management Plan. TAH-HSEC-326. September 2021, Ver4.

USEPA Office of Solid Waste and Emergency Response, 1983. Hazardous Waste Land Treatment, SW-874 (April 1983), page 273.

APPENDIX A

Hydrographs for P12-P17 and P40-P41

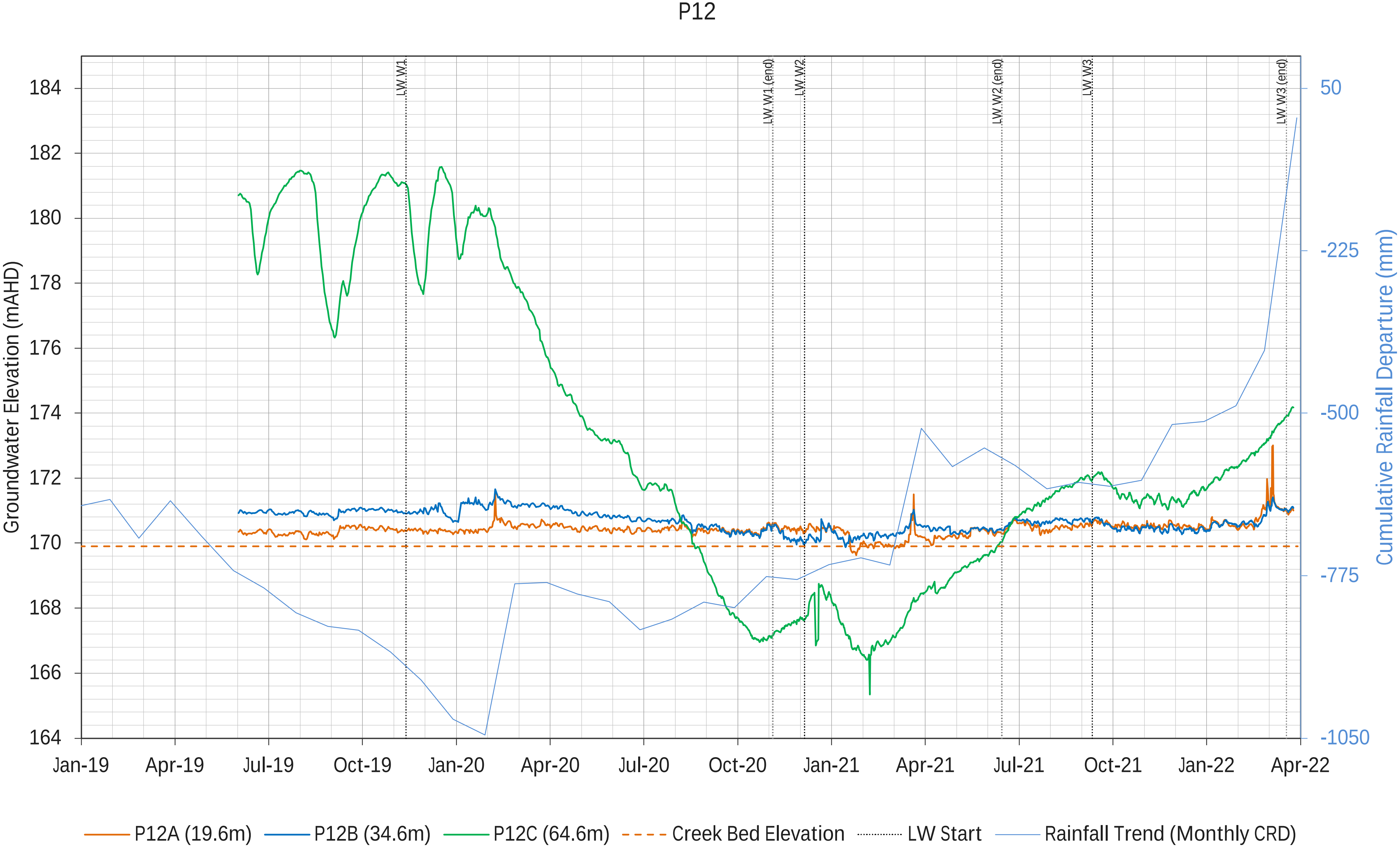

P12
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
182
180
178
176
174
172
170
168
166
164
50
-225
-500
-775
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
P12A (19.6m)
P12B (34.6m)
P12C (64.6m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-1

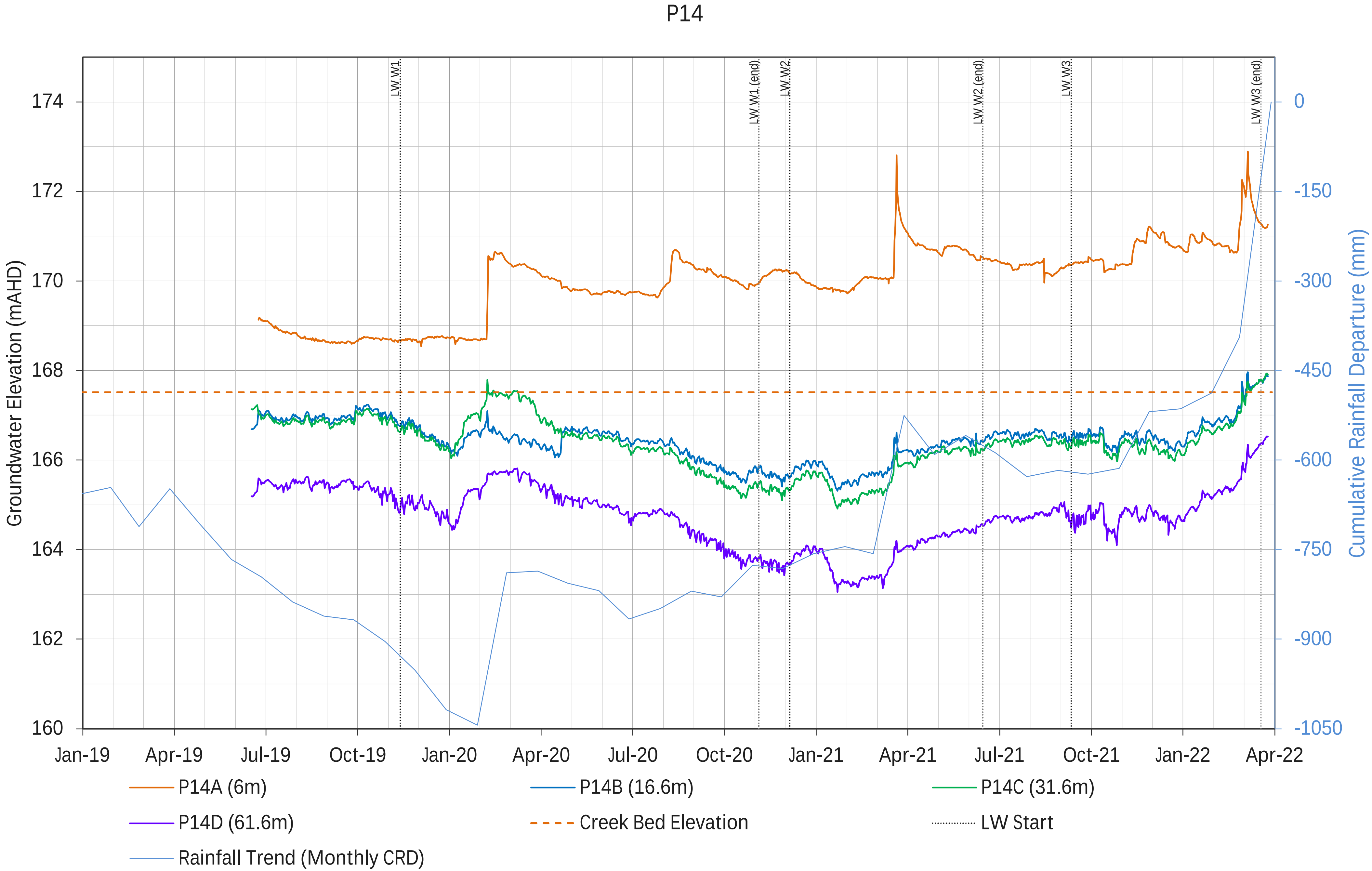

P14
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
0
-150
-300
-450
-600
-750
-900
-1050
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
P14A (6m)
P14B (16.6m)
P14C (31.6m)
P14D (61.6m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-2

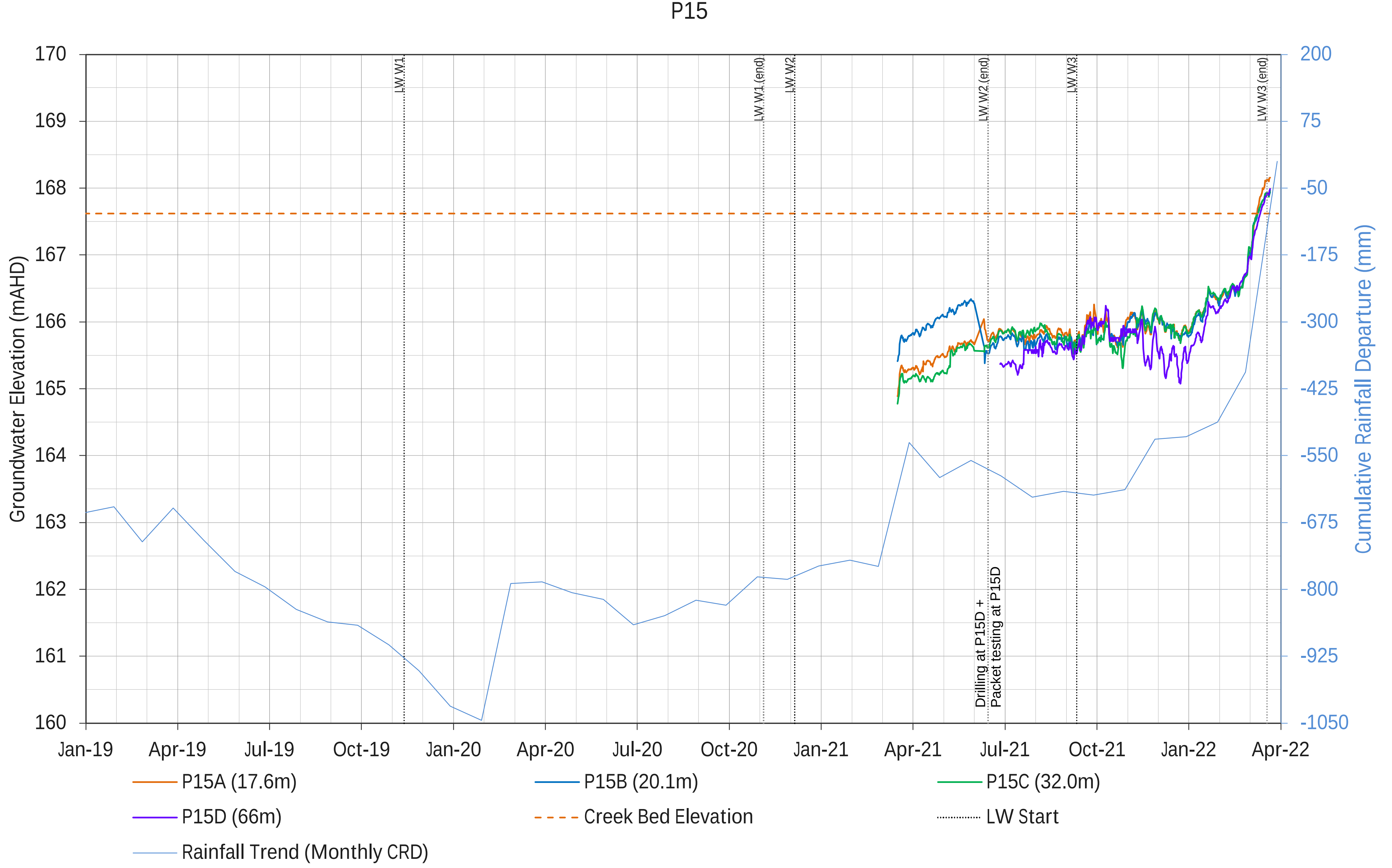

P15
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
170
169
168
167
166
165
164
163
162
161
160
200
75
-50
-175
-300
-425
-550
-675
-800
-925
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
Drilling at P15D +
Packet testing at P15D
P15A (17.6m)
P15B (20.1m)
P15C (32.0m)
P15D (66m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-3

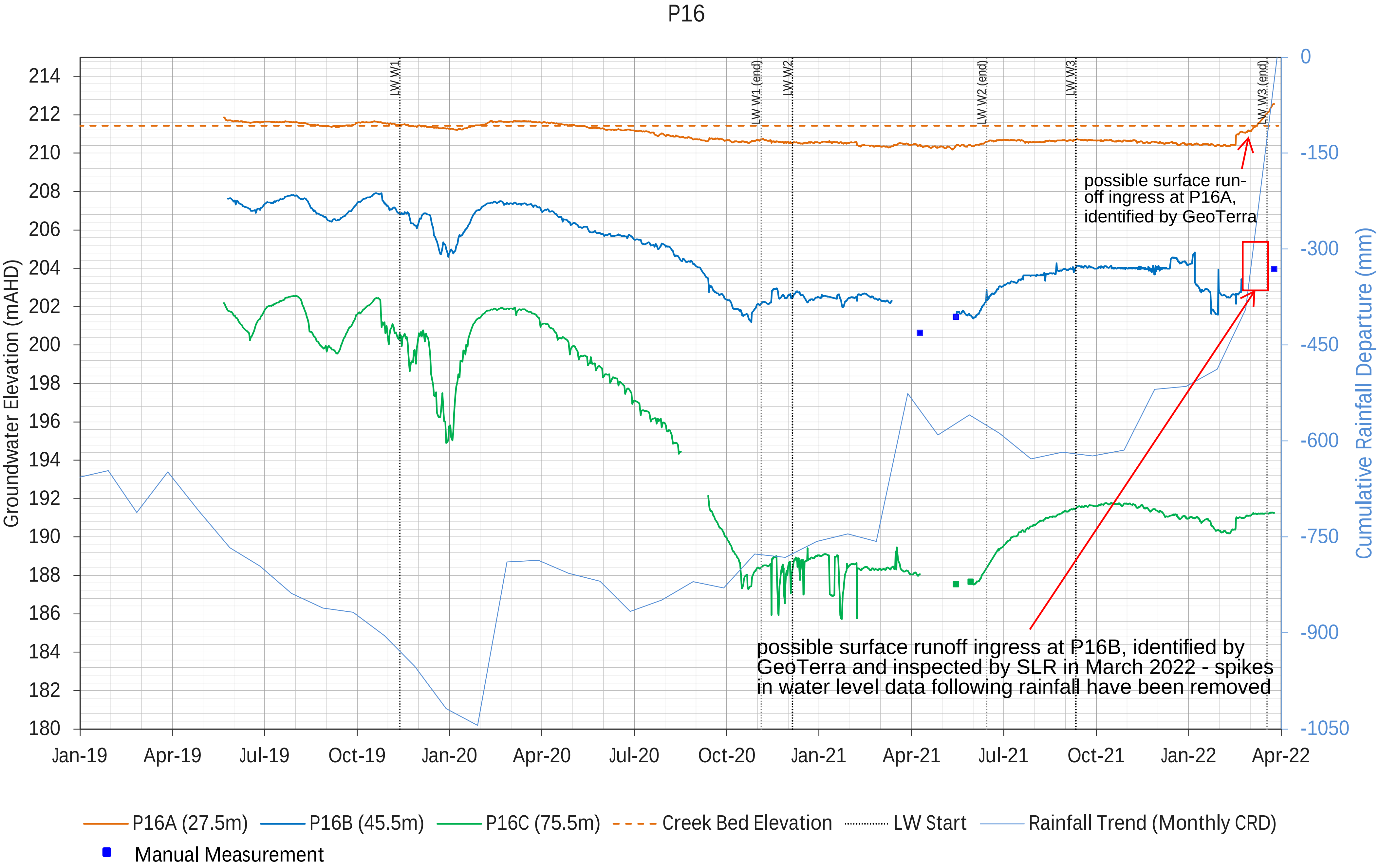

P16
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
214
212
210
208
206
204
202
200
198
196
194
192
190
188
186
184
182
180
0
-150
-300
-450
-600
-750
-900
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
possible surface run-off ingress at P16A, identified by GeoTerra
possible surface runoff ingress at P16B, identified by GeoTerra and inspected by SLR in March 2022 - spikes in water level data following rainfall have been removed
P16A (27.5m)
P16B (45.5m)
P16C (75.5m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)
Manual Measurement

Figure A-4

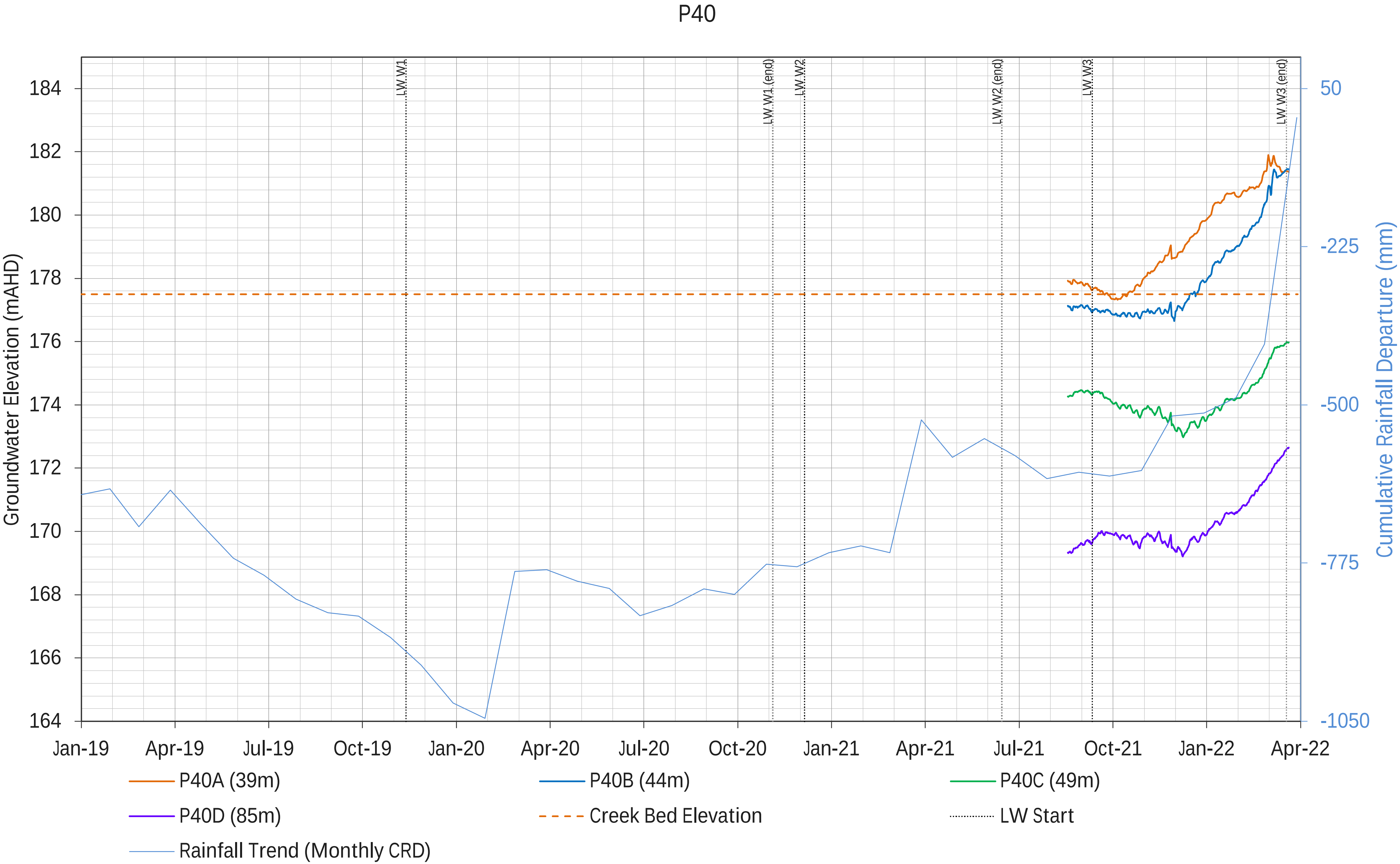
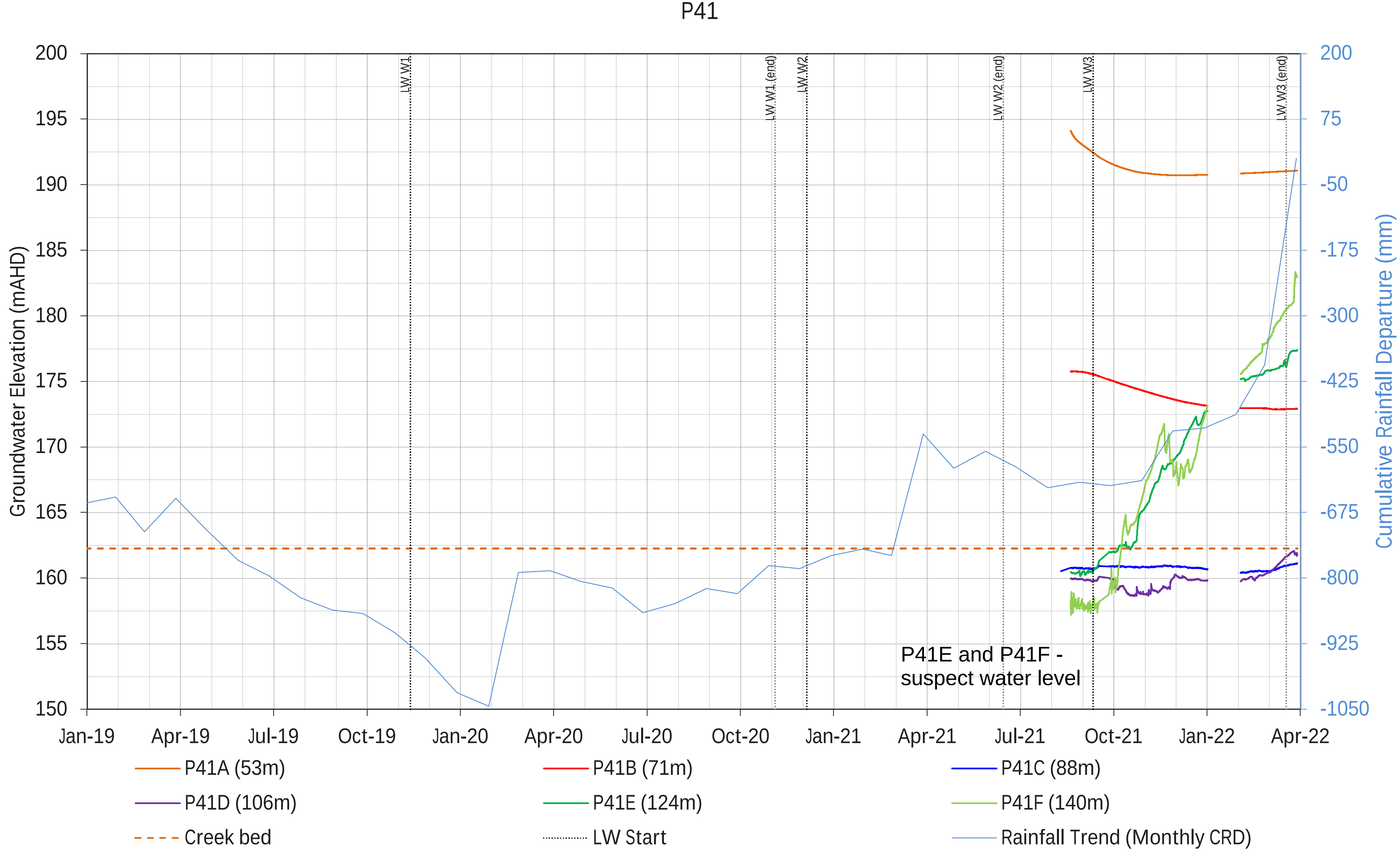

P40
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
182
180
178
176
174
172
170
168
166
164
50
-225
-500
-775
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
P40A (39m)
P40B (44m)
P40C (49m)
P40D (85m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-5



no groundwater level data available in January 2022 due to downloading issues.

Figure A-6

APPENDIX B

Trigger Action Response Plans

- Approved Trigger Criteria and Actions from LW W3-W4 (Tahmoor North - Western Domain, LW W3-W4 Water Management Plan TAH-HSEC-326 (September 2021, Ver4))

<table>
<tr><th rowspan="2">Feature</th><th rowspan="2">Methodology and relevant monitoring</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8">Groundwater Levels at monitoring bores and private groundwater bores.</td><td rowspan="8">GROUNDWATER LEVEL – Monitoring bores
Locations (refer to Figure 3-5)
<u>Impact sites</u> – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)
<u>Control sites</u> – P17, and possibly P11
Frequency
<u>Pre-mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter. Baseline data available since May 2019.
<u>During mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter.
<u>Post mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).

GROUNDWATER LEVEL – Private groundwater bores
Locations (refer to Figure 3-5)
<u>Control sites</u> - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.
Frequency
<u>Pre-mining</u> - Standing Water Level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019).
<u>During mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis.
<u>Post mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).</td><td colspan="3">Level 1</td></tr>
<tr><td>• Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Table 6-2).</td><td>• Continue monitoring program.
• Ongoing review of water level data.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Table 6-2 for TARP Significance Level 2).
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.
• Ongoing review of water level data.
• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.
• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.
• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).
• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.
• Compare against base case and deterministic model scenarios.
• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 4</td></tr>
<tr><td>• Water level reduction greater than the maximum modelled drawdown (refer to Table 6-1 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).
AND
• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring and review as per monitoring program.
• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).
• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.
• Convene Tahmoor Coal Environmental Response Group to review response.
• Compare against base case and deterministic model scenarios.</td><td>• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).
• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation including review and assessment of streamflow records for downstream monitoring sites in comparison with suitable reference sites.
• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with DPIE and the affected landholder.</td></tr>
</table>

Feature	Methodology and relevant monitoring	Management		
		Trigger	Action	Response
Shallow Groundwater Pressures at VWPs TNC036, TNC040, WD01 and WD02 (once installed).	GROUNDWATER PRESSURE **Locations** Impact sites – TNC36, WD01 and WD02 (once installed) (refer to Section 5.2.2). Control sites - Groundwater bores/VWPs TNC40 (refer to Figure 3-5). **Frequency** Pre-mining - Minimum continuous 24-hourly readings with monthly logger download. During mining - Minimum continuous 24-hourly readings with monthly logger download. Post mining - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).	Level 1		
		• No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth.	• Continue monitoring program. • Ongoing review of water level data.	• No response required.
		Level 2		
		• Greater than 5 m water level reduction in VWP intakes located at or above (i.e. shallower than) 200 m depth following the commencement of extraction at LW W1 (and LW W2, W3 and W4) (refer to Table 6-2 for TARP Significance Level 2). AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• Continue monitoring program. • Ongoing review of water level data. • Convene with Tahmoor Coal Environmental Response Group to review response.	• As defined by the Environmental Response Group.
		Level 3		
		• Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND • The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.	• Continue monitoring program • Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report). • Compare against base case and deterministic model scenarios. • Convene Tahmoor Coal Environmental Response Group to review response.	• As defined by the Environmental Response Group.
		Level 4		
		• Water level reduction greater than the maximum modelled drawdown (refer to Table 6-2 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND • The reduction in water level is determined not to be controlled by climatic or anthropogenic factors.	• Continue monitoring and review as per monitoring program. • Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report). • Convene Tahmoor Coal Environmental Response Group to review response. • Compare against base case and deterministic model scenarios.	• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document). • If it is concluded that there has been a mining-related impact, implement an investigation report.

Feature	Methodology and relevant monitoring	Management		
		Trigger	Action	Response
Deep Groundwater Pressures at VWPs TNC036.	GROUNDWATER PRESSURE **Locations** Impact site – TNC36 (refer to Figure 3-5). Control site - Groundwater bores/VWPs TNC40 (refer to Figure 3-5). **Frequency** Pre-mining - Minimum continuous 24-hourly readings with monthly logger download. During mining - Minimum continuous 24-hourly readings with monthly logger download. Post mining - Minimum continuous 24-hourly readings for 12 months after LW W4 completed. Monthly logger downloaded for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).	Level 1		
		• Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than) 200 m depth (excluding those monitoring the Bulli Coal Seam).	• Continue monitoring program. • Ongoing review of water level data.	• No response required.
		Level 2		
		• Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown.	• Continue monitoring program. • Ongoing review of water level data. • Convene Tahmoor Coal Environmental Response Group to review response.	• As defined by the Environmental Response Group.
		Level 3		
		• Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more.	• Continue monitoring program. • Ongoing review of water level data. • Convene Tahmoor Coal Environmental Response Group to review response.	• As defined by the Environmental Response Group. • Consider increasing download frequency at groundwater bores where Level 3 has been reached to a fortnightly basis. Consider increasing review frequency to fortnightly.
		Level 4		
		• Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more.	• Continue monitoring and review as per monitoring program. • Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess whether change in behaviour is related to LW W1-W2 mining effects.	• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document). • If it is concluded that there has been a mining-related impact, implement an investigation report.

Table B2 Trigger Action Response Plan – Groundwater Quality

<table>
<tr><th rowspan="2">Feature</th><th rowspan="2">Methodology and relevant monitoring</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8">Groundwater Quality at monitoring bores and private groundwater bores.</td><td rowspan="8">GROUNDWATER QUALITY – Monitoring bores
Locations (refer to Figure 3-5)
<u>Impact sites</u> – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)
<u>Control sites</u> – P17
Frequency
<u>Pre-mining</u> - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).
<u>During mining</u> - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).
<u>Post mining</u> - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).

GROUNDWATER QUALITY – Private groundwater bores
Locations (refer to Figure 3-5)
<u>Control sites</u> - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.
Frequency
<u>Pre-mining</u> - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019).
<u>During mining</u> - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters).
<u>Post mining</u> - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).</td><td colspan="3">Level 1</td></tr>
<tr><td>• No observable change in salinity, pH or metals outside of the baseline variability.</td><td>• Continue monitoring program.
• Ongoing review of water quality data.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Short term increase (< 3 months) in salinity and/or metals, or change in pH outside of baseline variability*. The effect does not persist after a significant rainfall recharge event.
AND/OR
• A similar trend or response has been noted at other monitored bores or private groundwater bores.</td><td>• Continue monitoring program.
• Ongoing review of water quality data.
• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.
AND/OR
• The change in water quality is determined not to be controlled by climatic or anthropogenic factors.</td><td>• Continue monitoring program.
• Ongoing review of water quality data and consideration of mining and external stresses (in groundwater monthly report).
• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 4</td></tr>
<tr><td>• Medium to long term increase in salinity and / or metals or a change in pH outside of baseline variability* with the effect persisting for greater than 3 months or after a significant rainfall recharge event.
AND
• The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors.</td><td>• Continue monitoring and review as per monitoring program.
• Continue review of water quality data and consideration of mining and external stresses (in groundwater monthly report).
• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).
• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation report.
• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with the affected landholder.</td></tr>
</table>

Footnote:
* The baseline variability was estimated using available data and refers to the proposed trigger levels (refer to Section 6.2.2 and Table 6.2 of the Groundwater Technical Report.

APPENDIX C

Summary of Trigger Levels for Groundwater Level TARPs (revised from Groundwater Technical Report – Table 6-1 SLR, 2021)

Bore	Groundwater Trigger Level (mAHD)		
	TARP Level 2	TARP Level 3	TARP Level 4
Shallow OSP			
P12A	168.6	-	-
P12B	169.1	-	-
P12C	179.5	175.0	170.4
P13A	165.7	163.7	161.6
P13B	165.0	163.0	161.1
P13C	168.5	163.1	157.7
P14A	167.2	165.0	162.9
P14B	165.2	159.8	154.3
P14C	165.2	159.9	154.6
P14D	163.6	158.3	152.9
P15A	163.4	156.4	149.4
P15B	163.9	156.9	149.9
P15C	163.3	156.3	149.4
P15D*	163.7	156.7	149.7
P16A	209.9	209.3	208.8
P16B	205.9	202.3	198.7
P16C	200.6	193.9	187.2
P17	169.7	170.6	171.6
Shallow VWPs (<200m)			
TNC036 - HBSS-65	204.5*	-	-
TNC036 - HBSS-97	191.3*	185.7*	180*
TNC036 - BGSS-169	192.5*	135.7*	79.0*
TNC040 - WNFM-27	203.3	198.2	193.1
TNC040 - HBSS-65	182.1	175.8	169.5
TNC040 - HBSS-111	#	#	#
TNC043 - HBSS-65	153.7	152.5	151.3
TNC043 - HBSS-111.5	150.6	148.5	146.5
WD01- HBSS - 70	206.2	202.4	198.6
WD01- HBSS - 90	191.4	186.7	182.0
WD01- HBSS - 190	F	F	F
Deep VWPs (>200m)			
TNC036 - BGSS-214	Refer to table A1	Refer to table A1	Refer to table A1
TNC036 - BGSS-298.5	^	^	^
TNC036 - BGSS-412.5	Refer to table A1	Refer to table A1	Refer to table A1
TNC036 - BUSM-463.5	^	^	^
TNC040 - HBSS-225	#	#	#
TNC040 - BHCS-252	#	#	#
TNC040 - BGSS-352	#	#	#

Bore	Groundwater Trigger Level (mAHD)		
	TARP Level 2	TARP Level 3	TARP Level 4
TNC040 - SCSS-482	#	#	#
TNC040 - BUCO-501.9	#	#	#
TNC043 - HBSS-213	#	#	#
TNC043 - BGSS-240	#	#	#
TNC043 - BGSS-332.6	#	#	#
TNC043 - BGSS-405.2	#	#	#
TNC043 - BUCO-476.3	#	#	#
WD01- HBSS - 210	Refer to table A1	Refer to table A1	Refer to table A1
WD01- HBSS - 230	F	F	F
WD01- BGSS - 300	F	F	F
WD01- BGSS - 330	F	F	F
WD01- BGSS - 350	F	F	F
Notes: "#" no data after LW W1.			
*Trigger levels first developed in September 2021 review, based on maximum water level prior to start of LW W3 as was commissioned after commencement of LW W1.			
"^" groundwater data not reliable but will still be reported on.			
"F" Sensors failed during mining of LW W1 and LW W2.			
"-" Some VWP sensor or piezometer are assigned Layer 1. No drawdown is simulated in Layer 1 at those sites hence no TARP Level 3 and 4 can be derived here.			

APPENDIX D

Groundwater Quality and Trigger Levels (metal exceedances only)

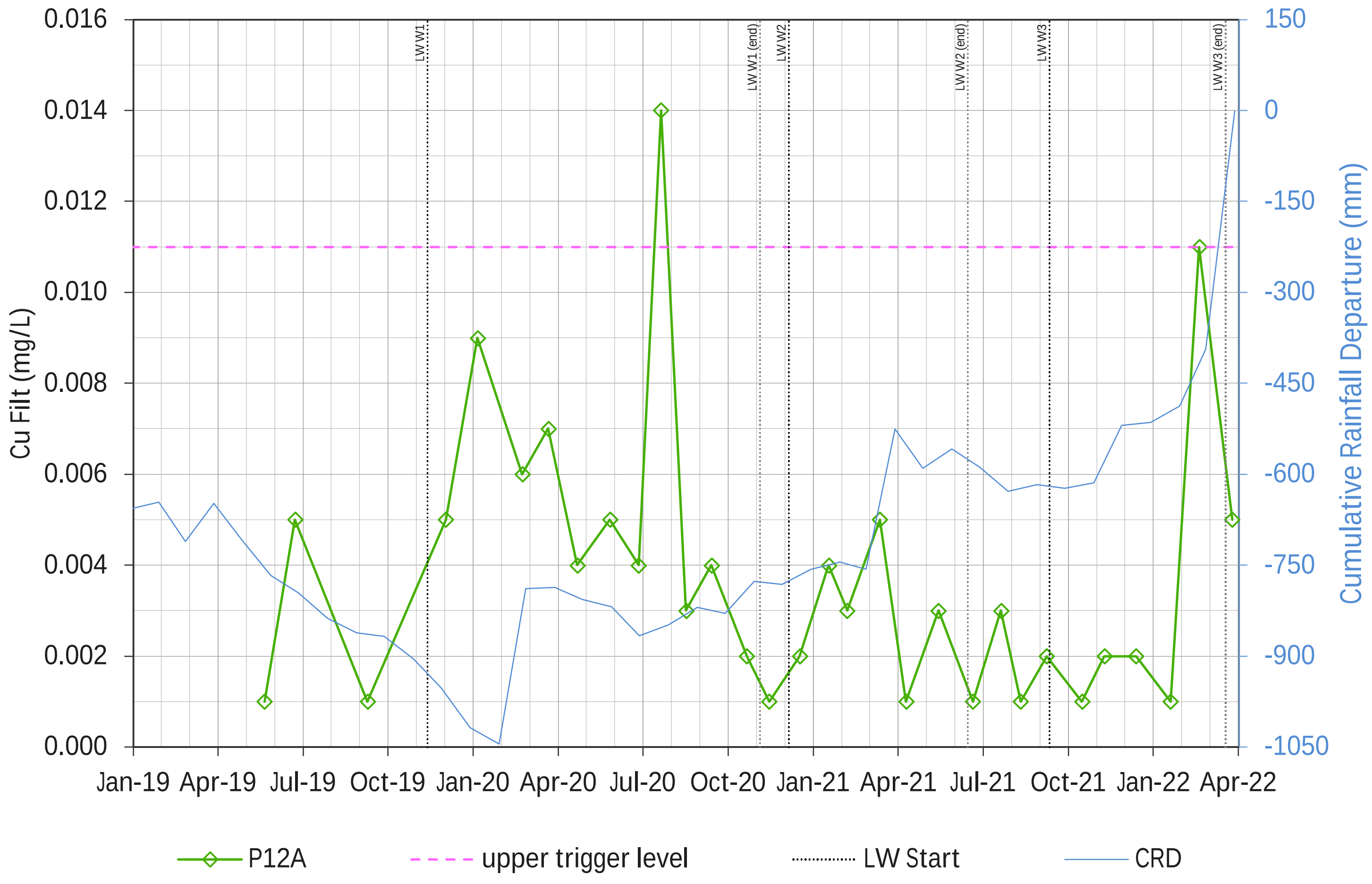


Figure D-1

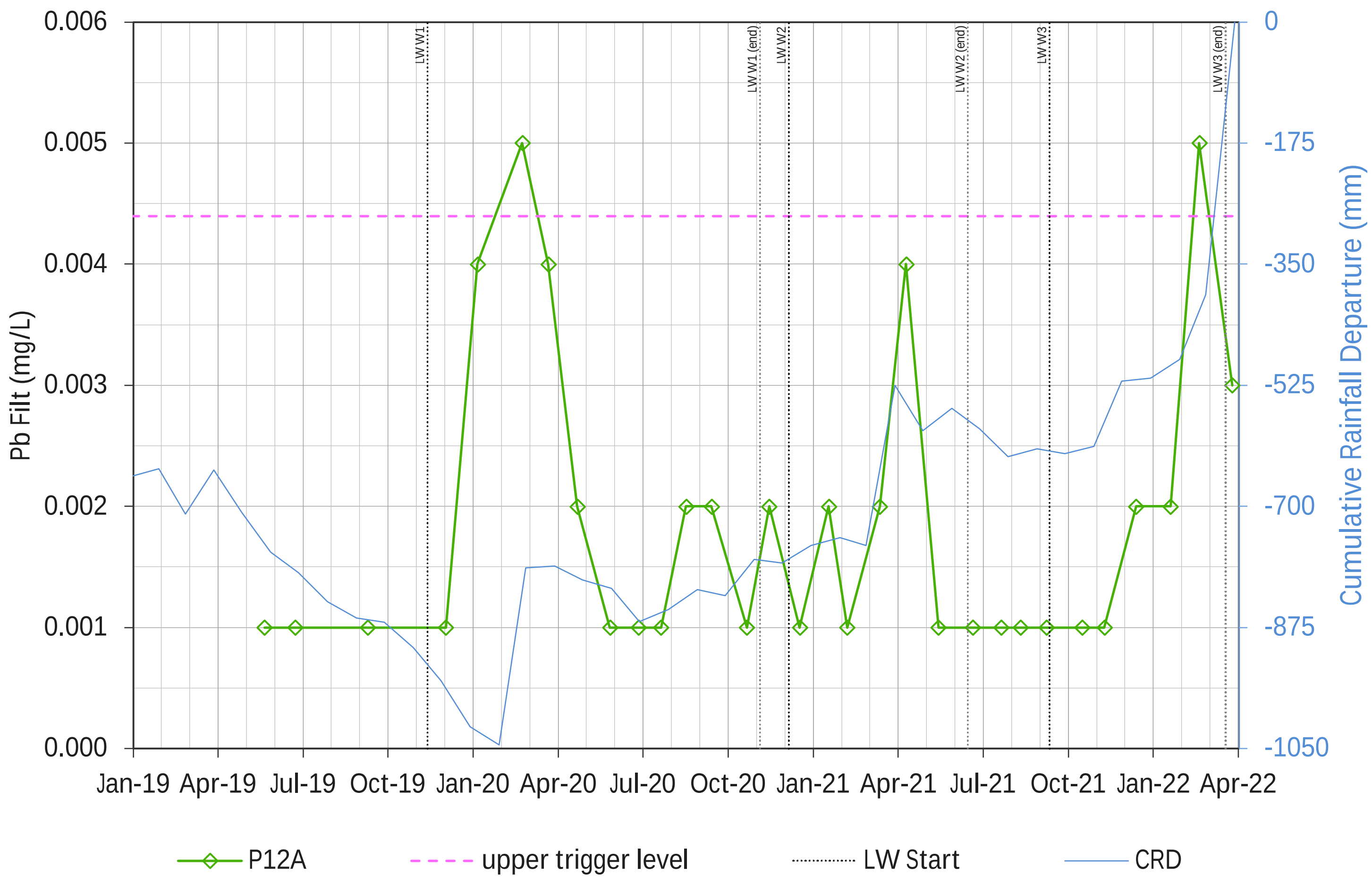


Figure D-2

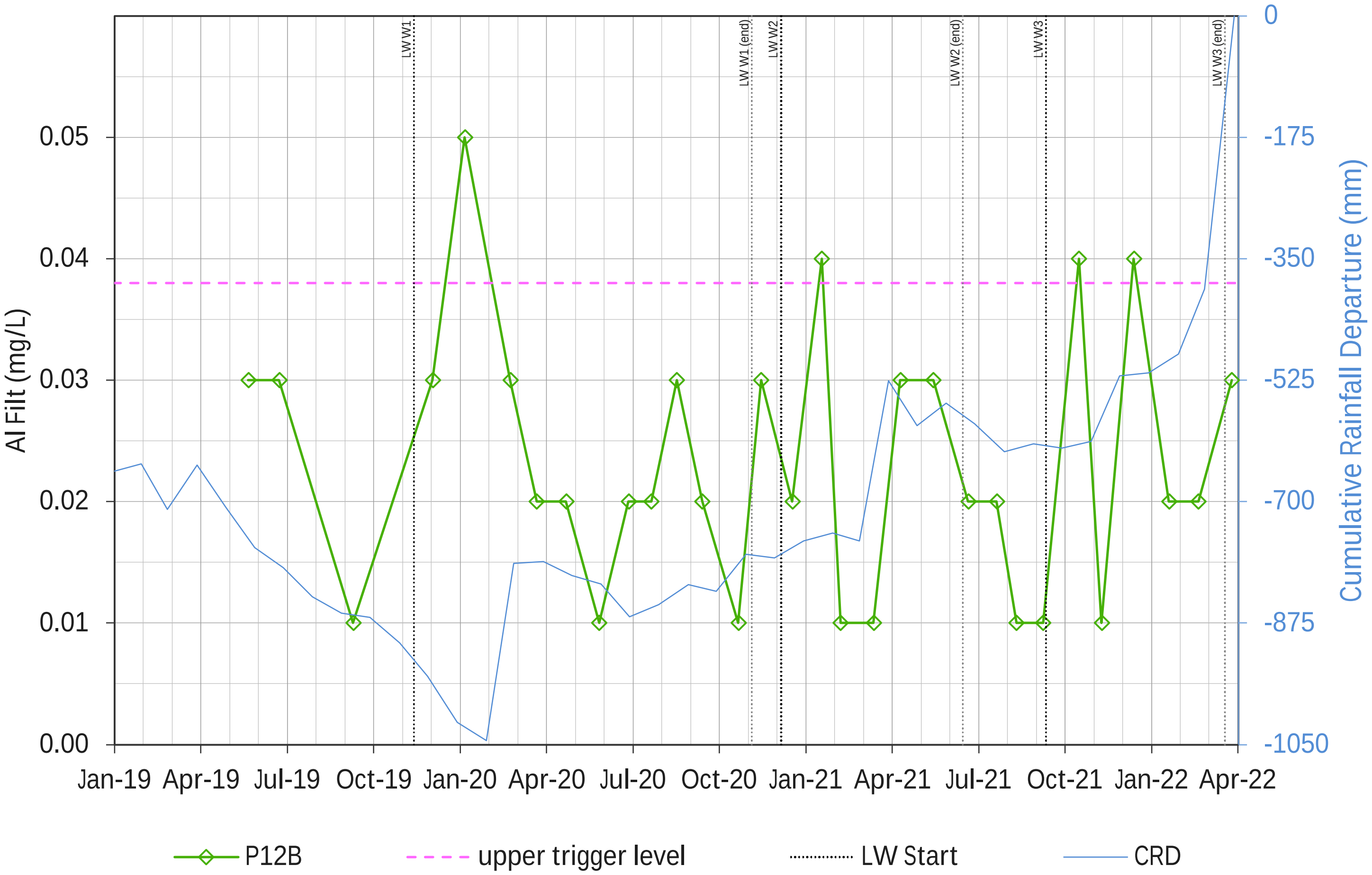


Figure D-3

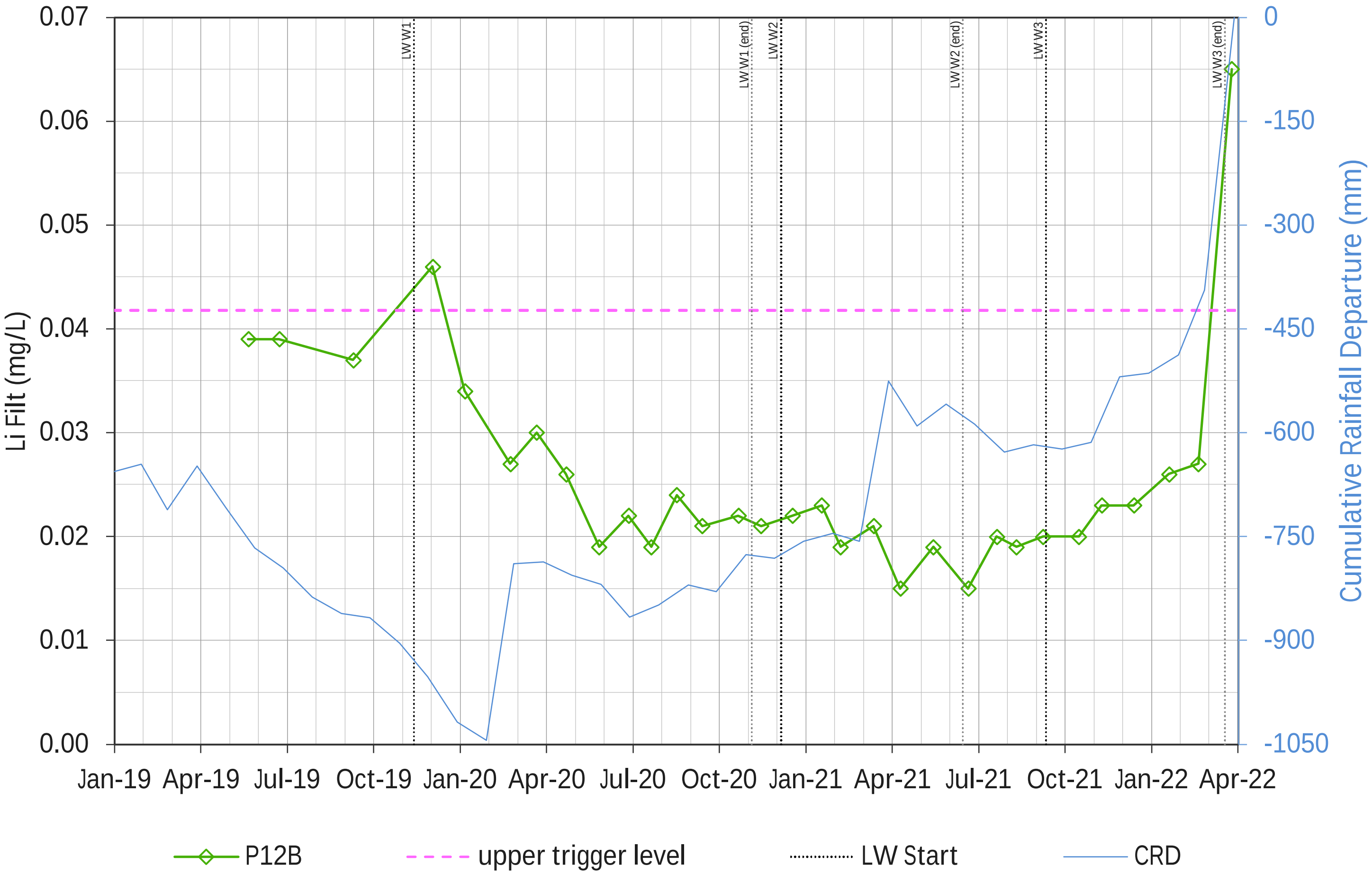


Figure D-4

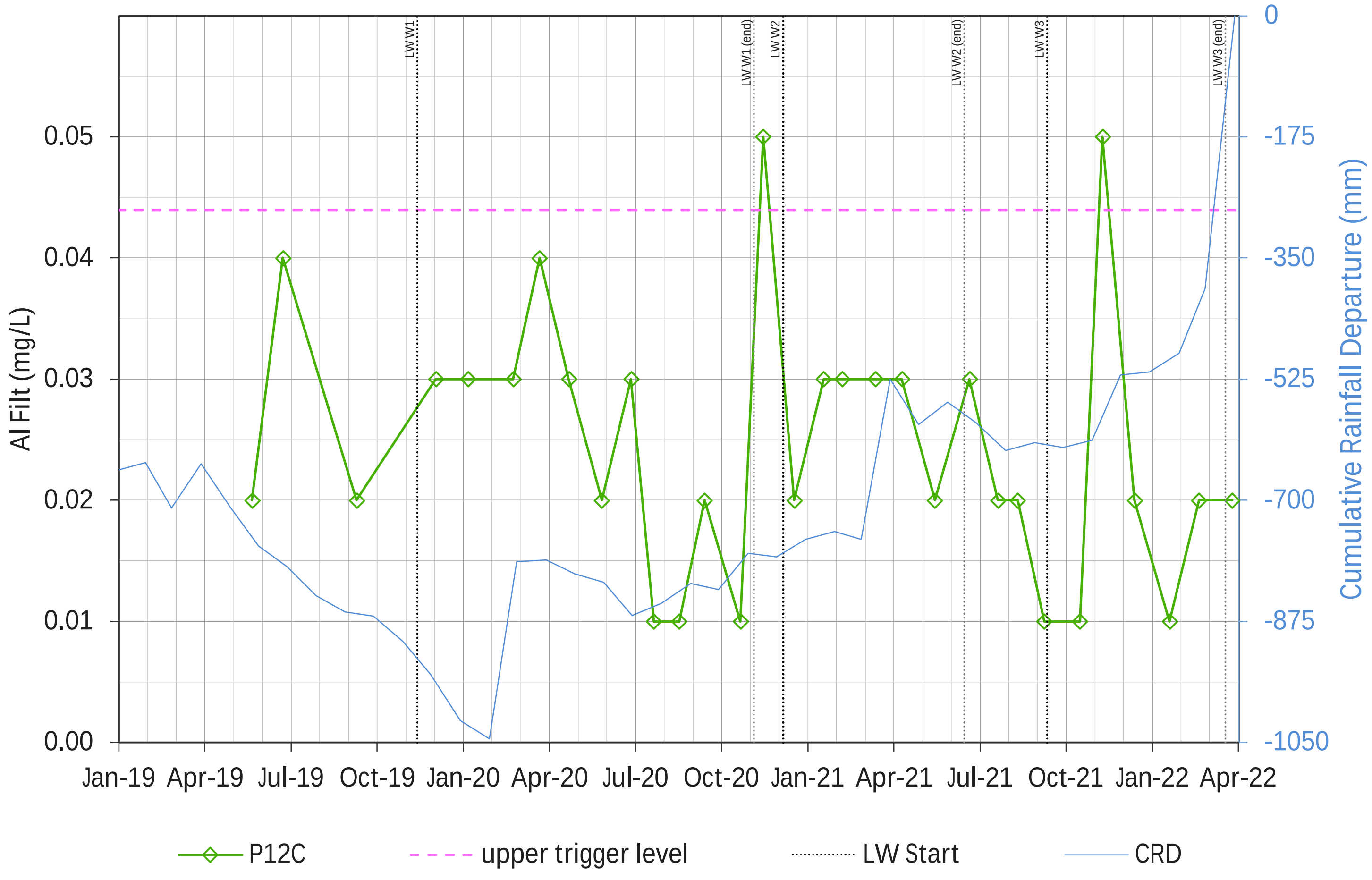


Figure D-5

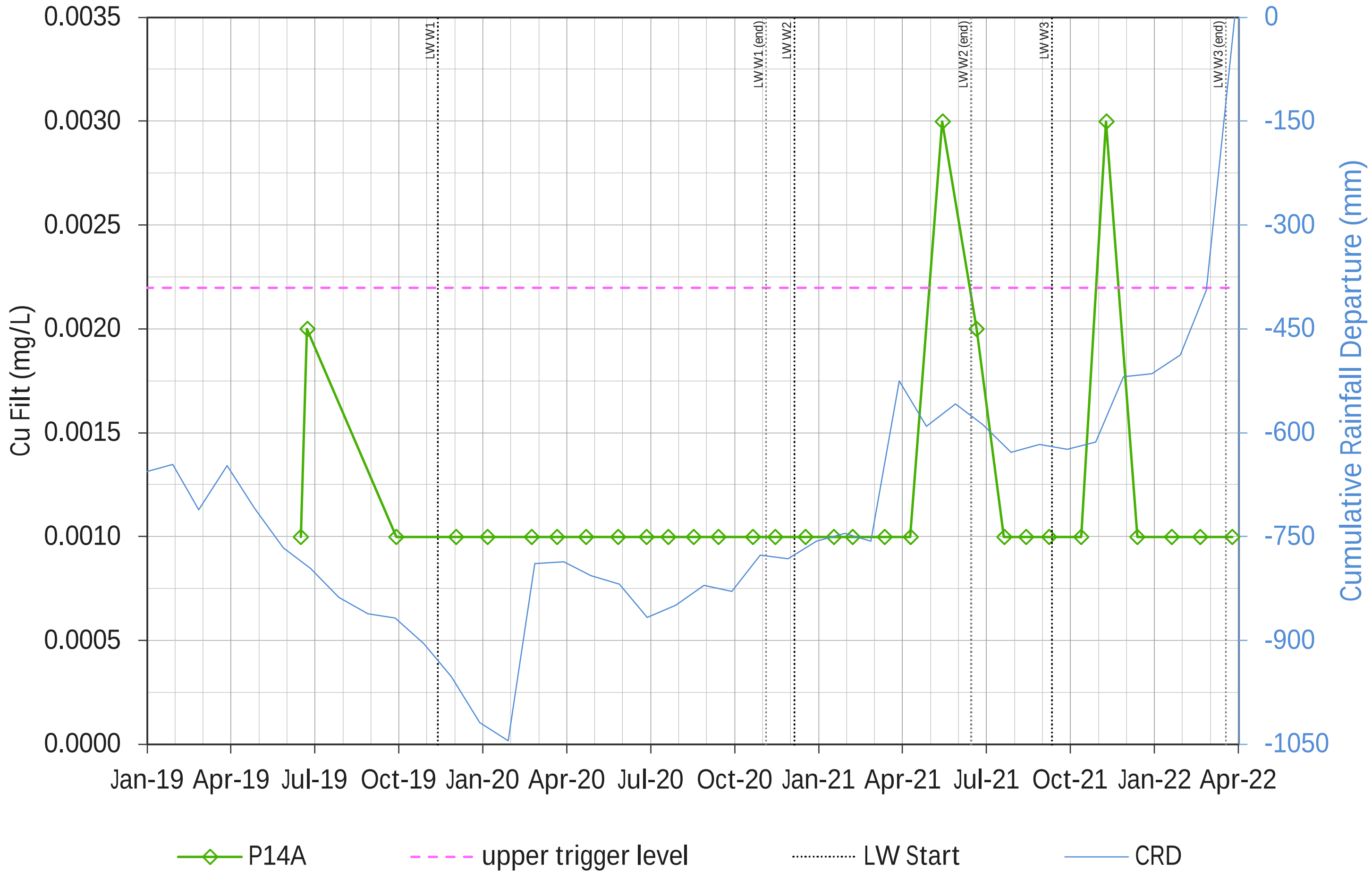


Figure D-6

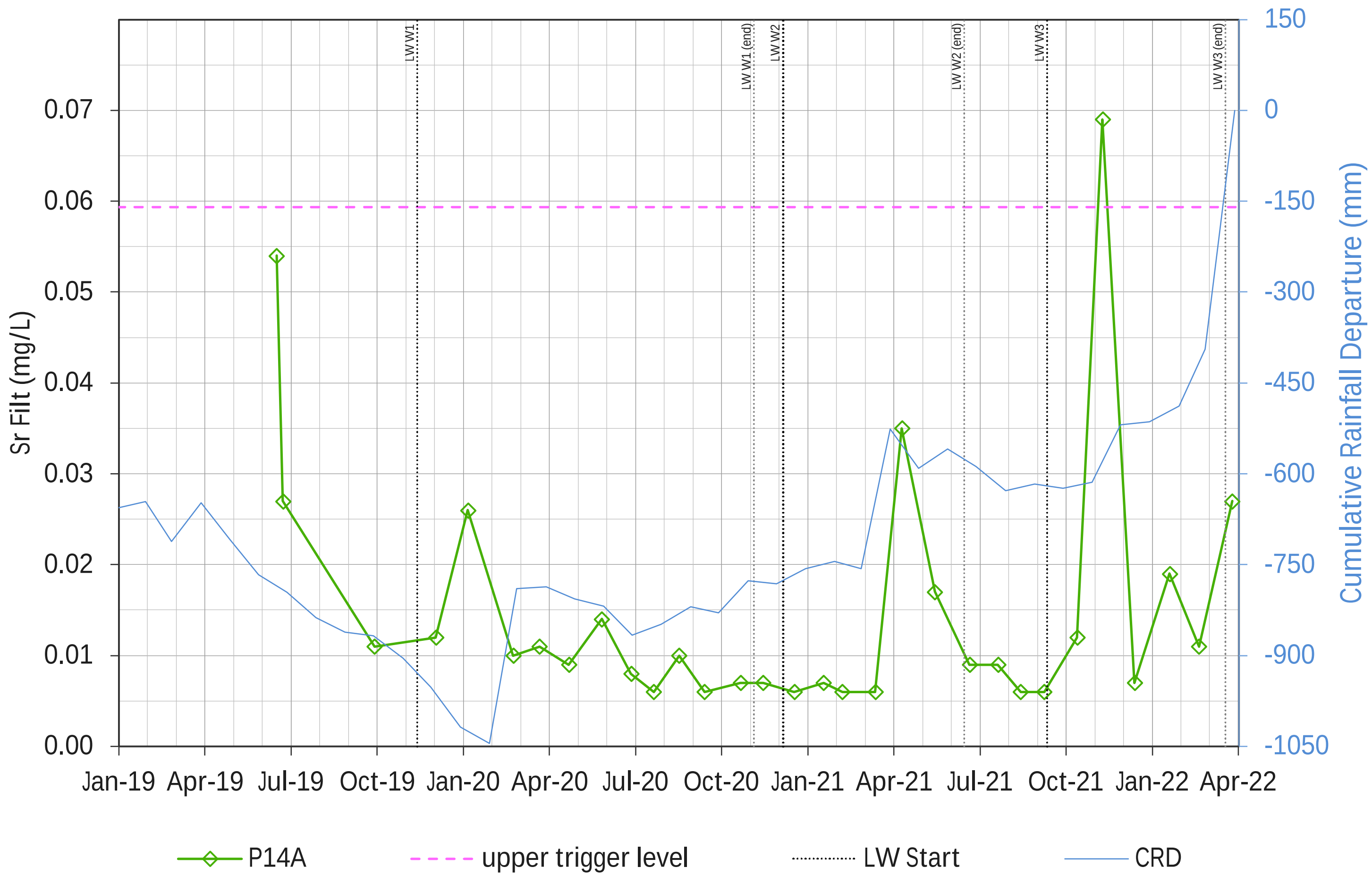


Figure D-7

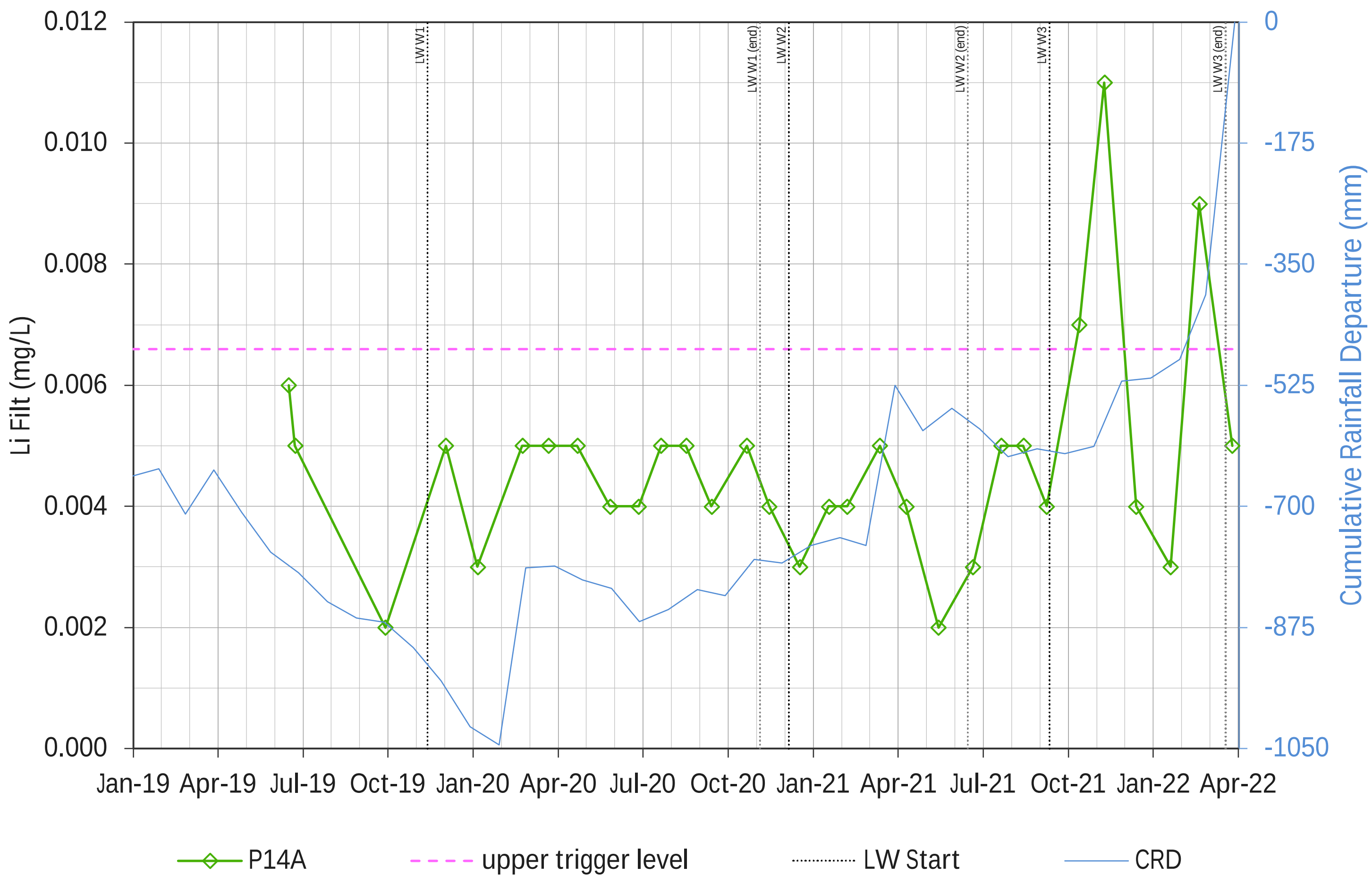


Figure D-8

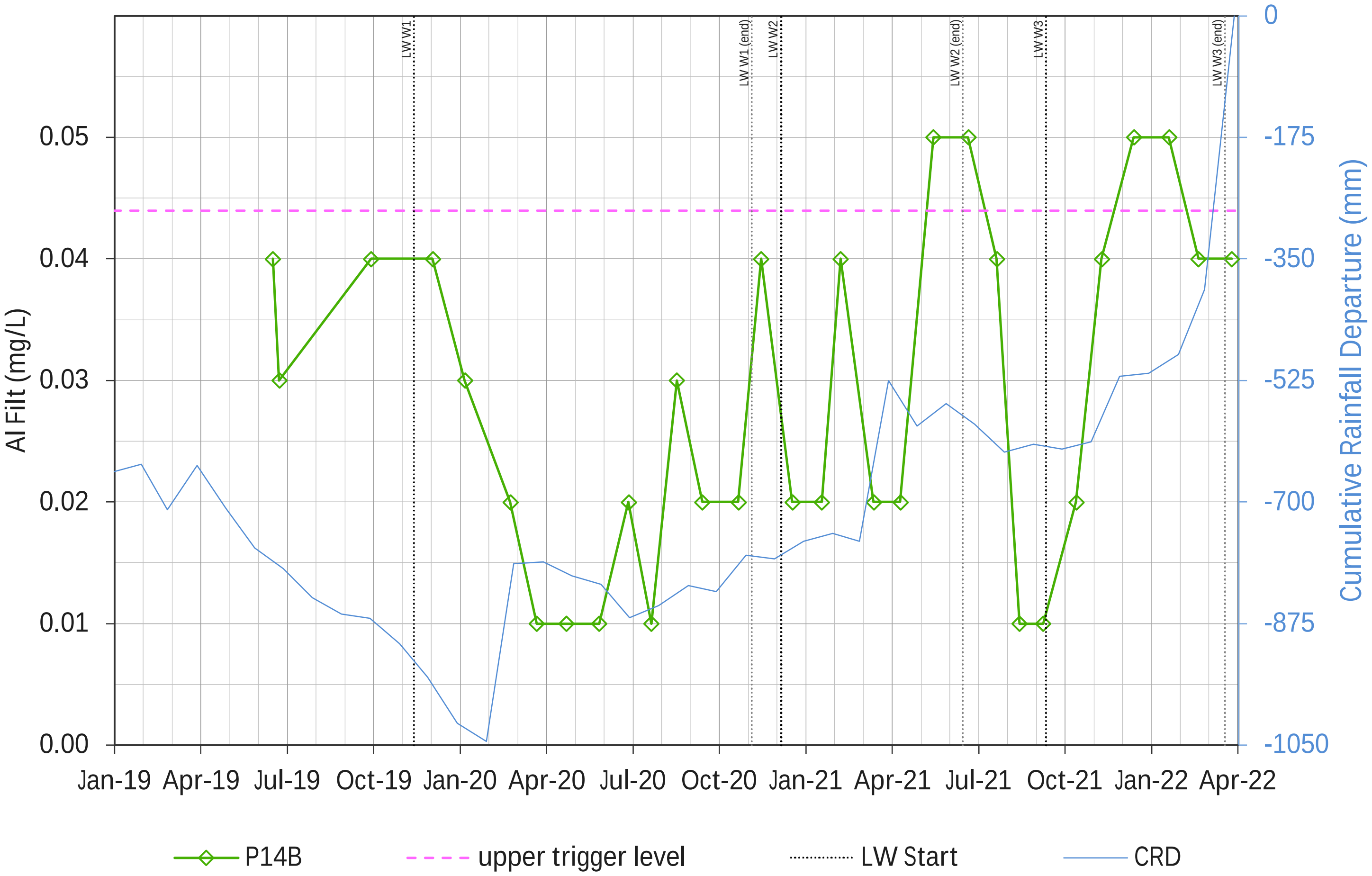


Figure D-9

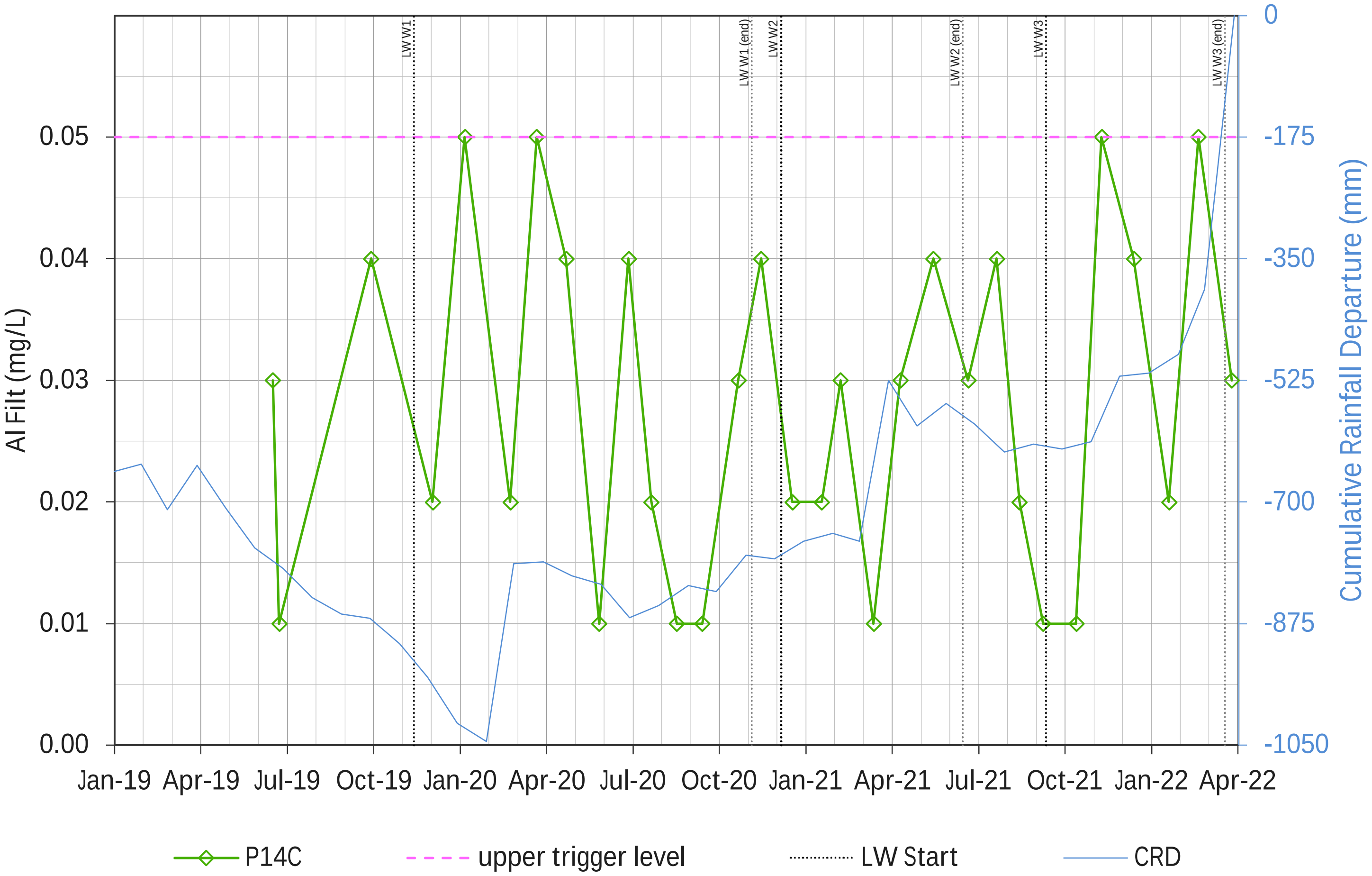


Figure D-10

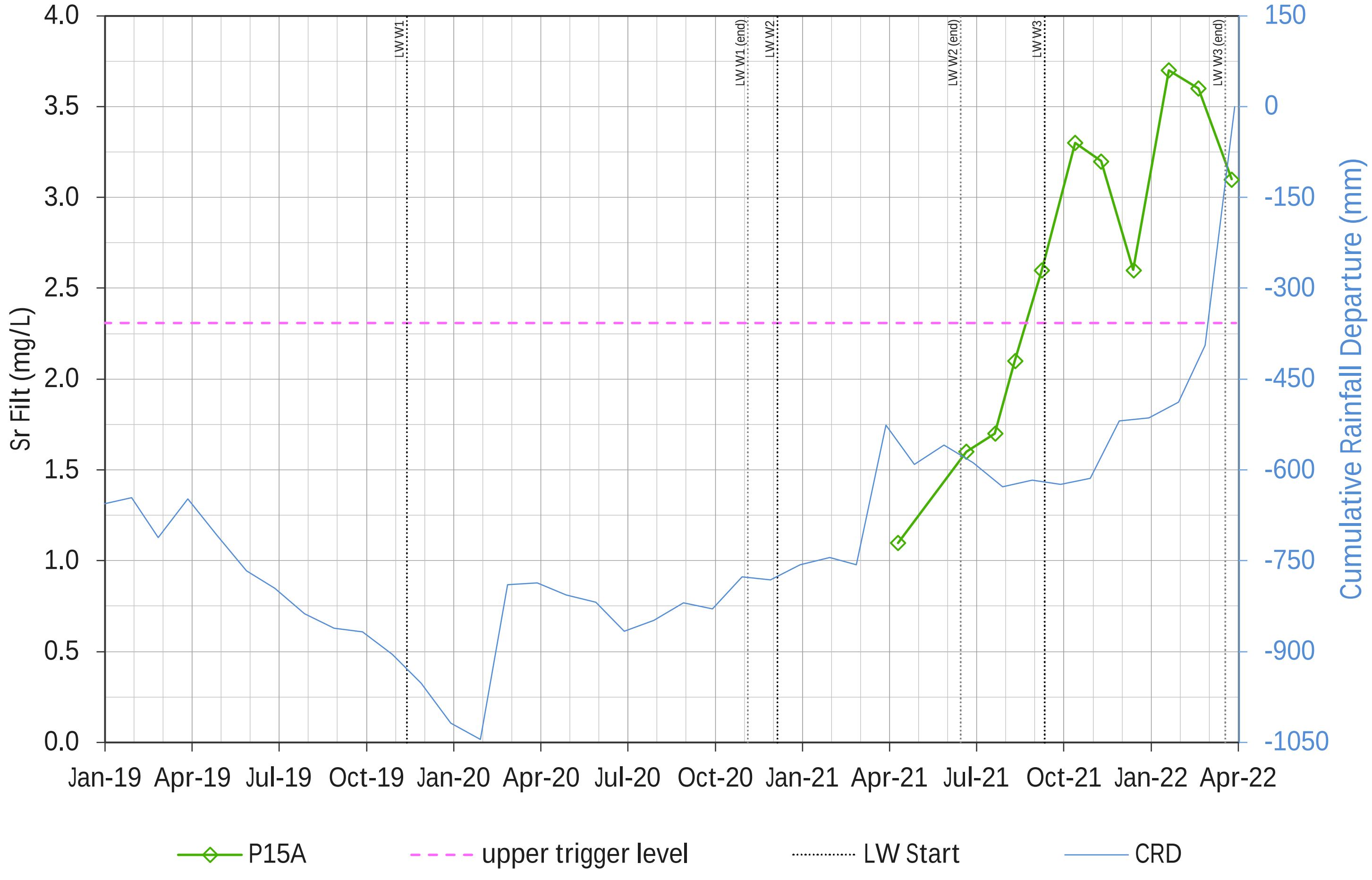


Figure D-11

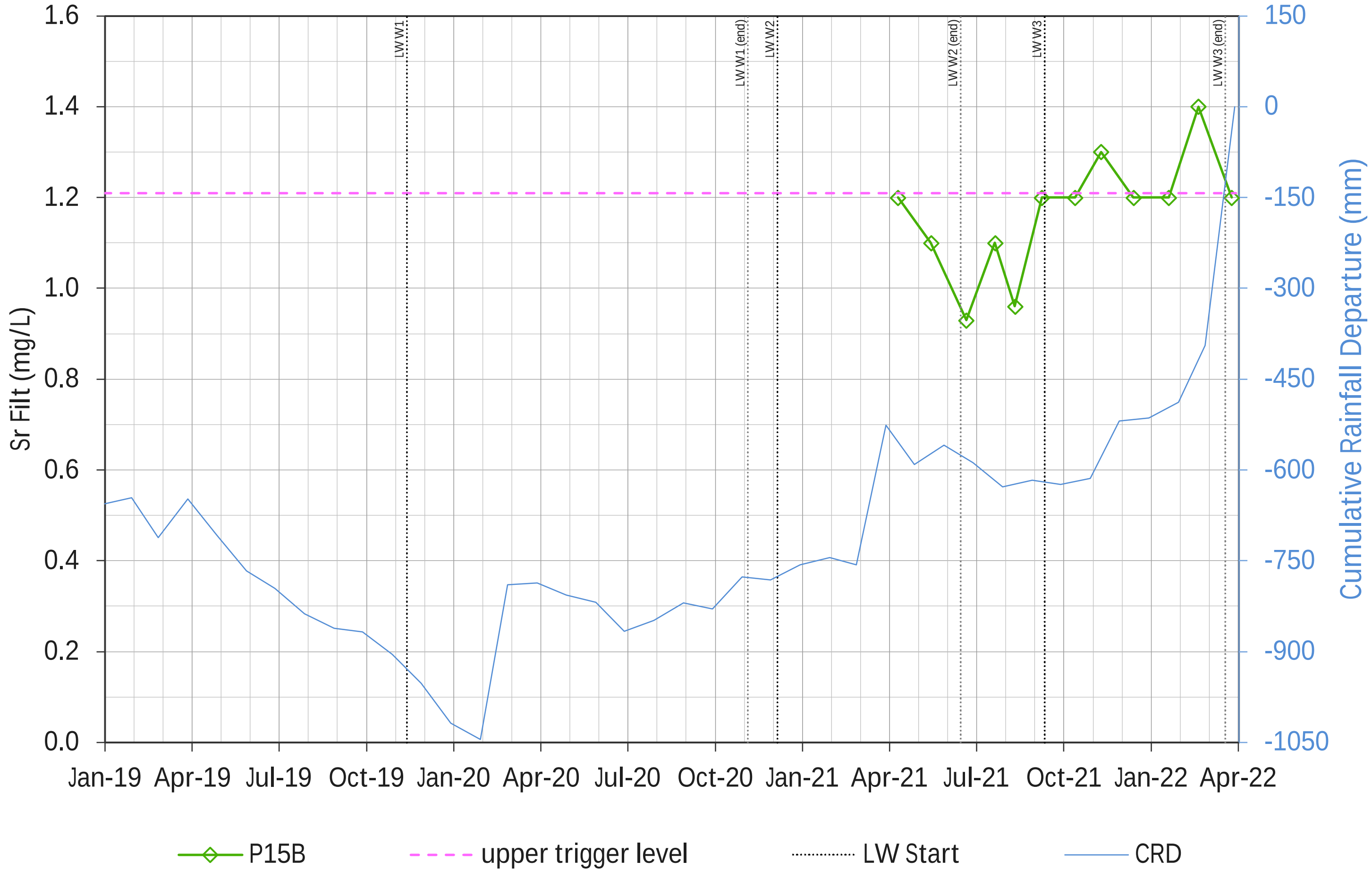


Figure D-12

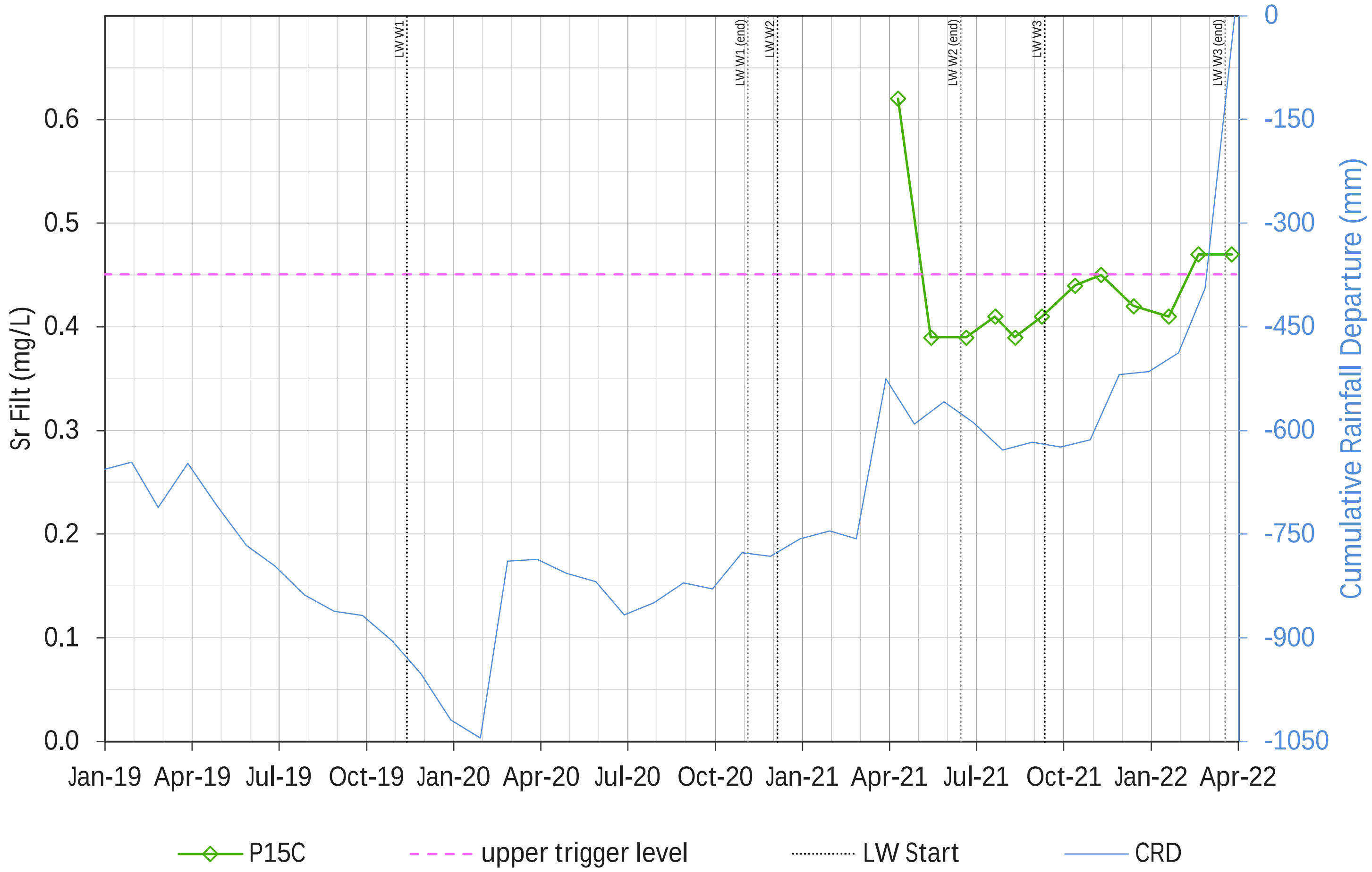


Figure D-13

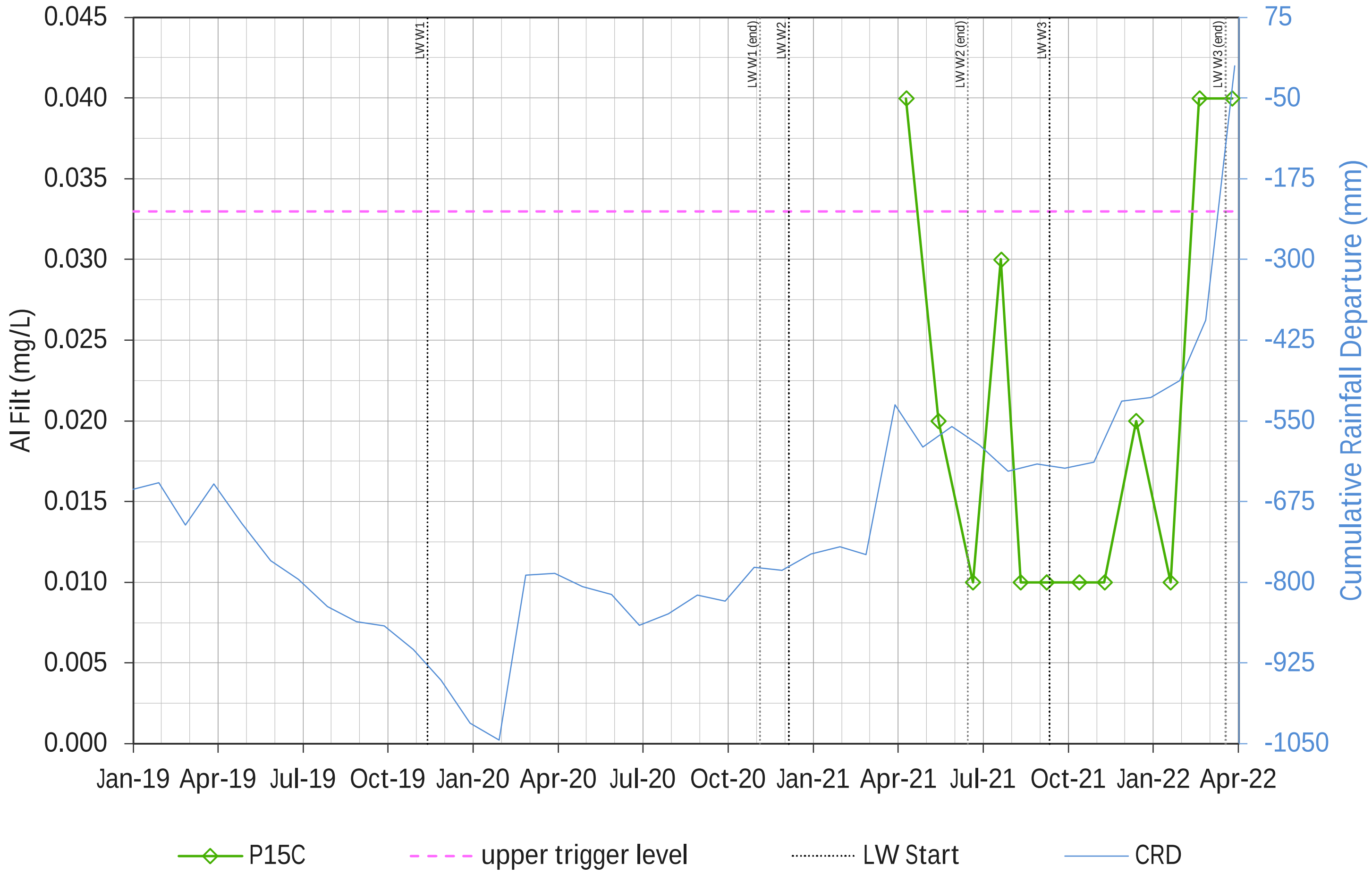


Figure D-14

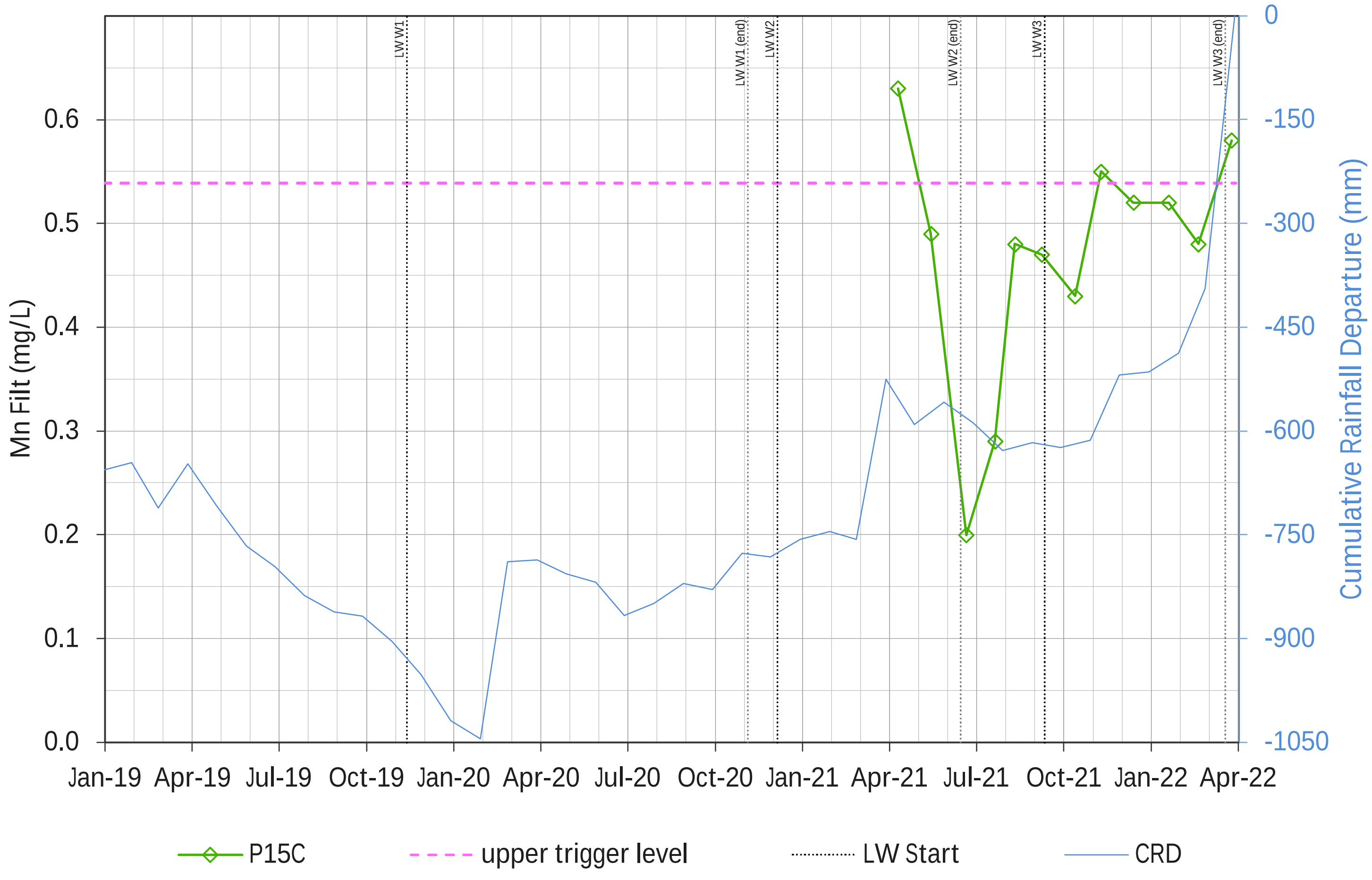


Figure D-15

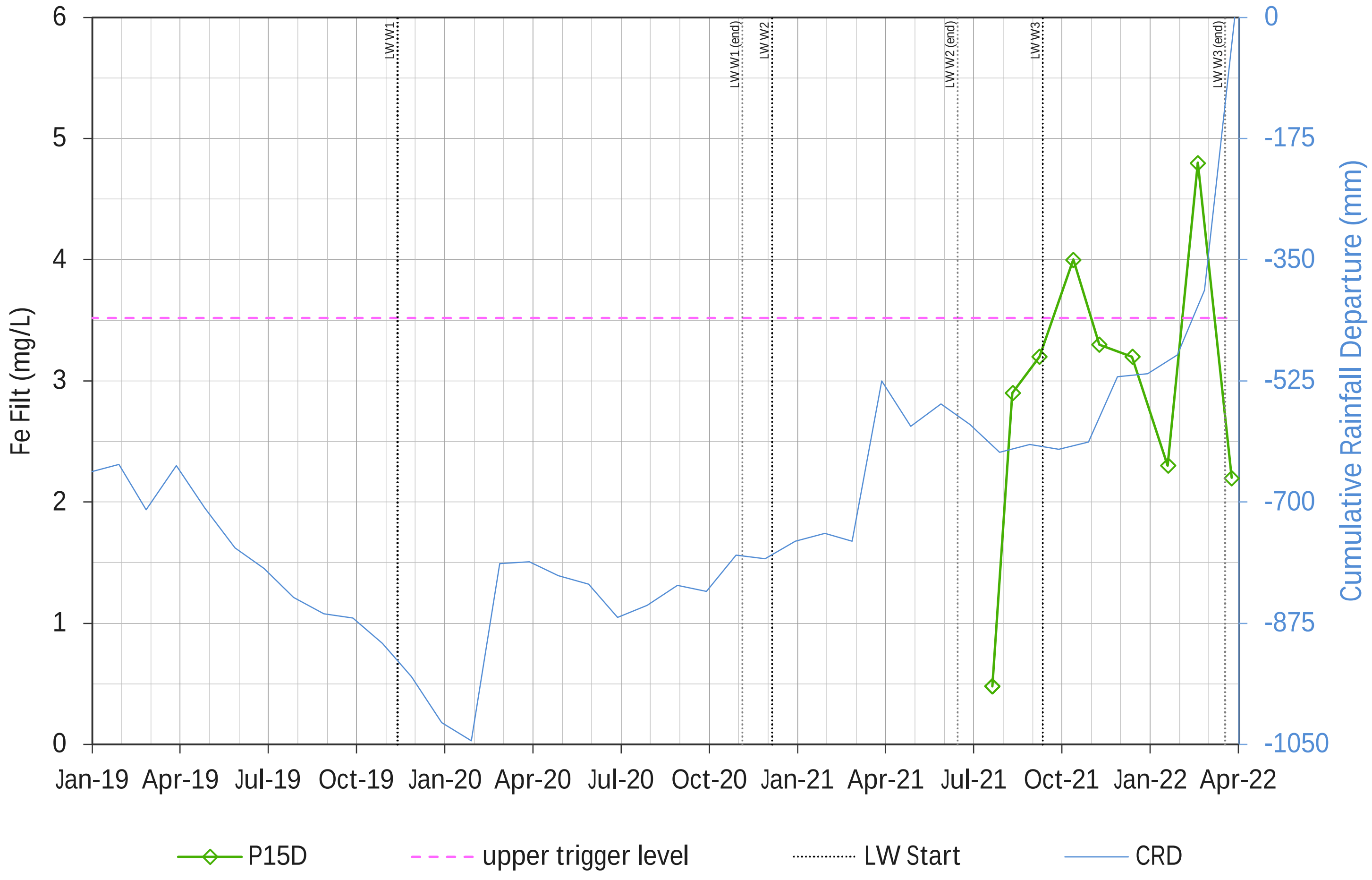


Figure D-16

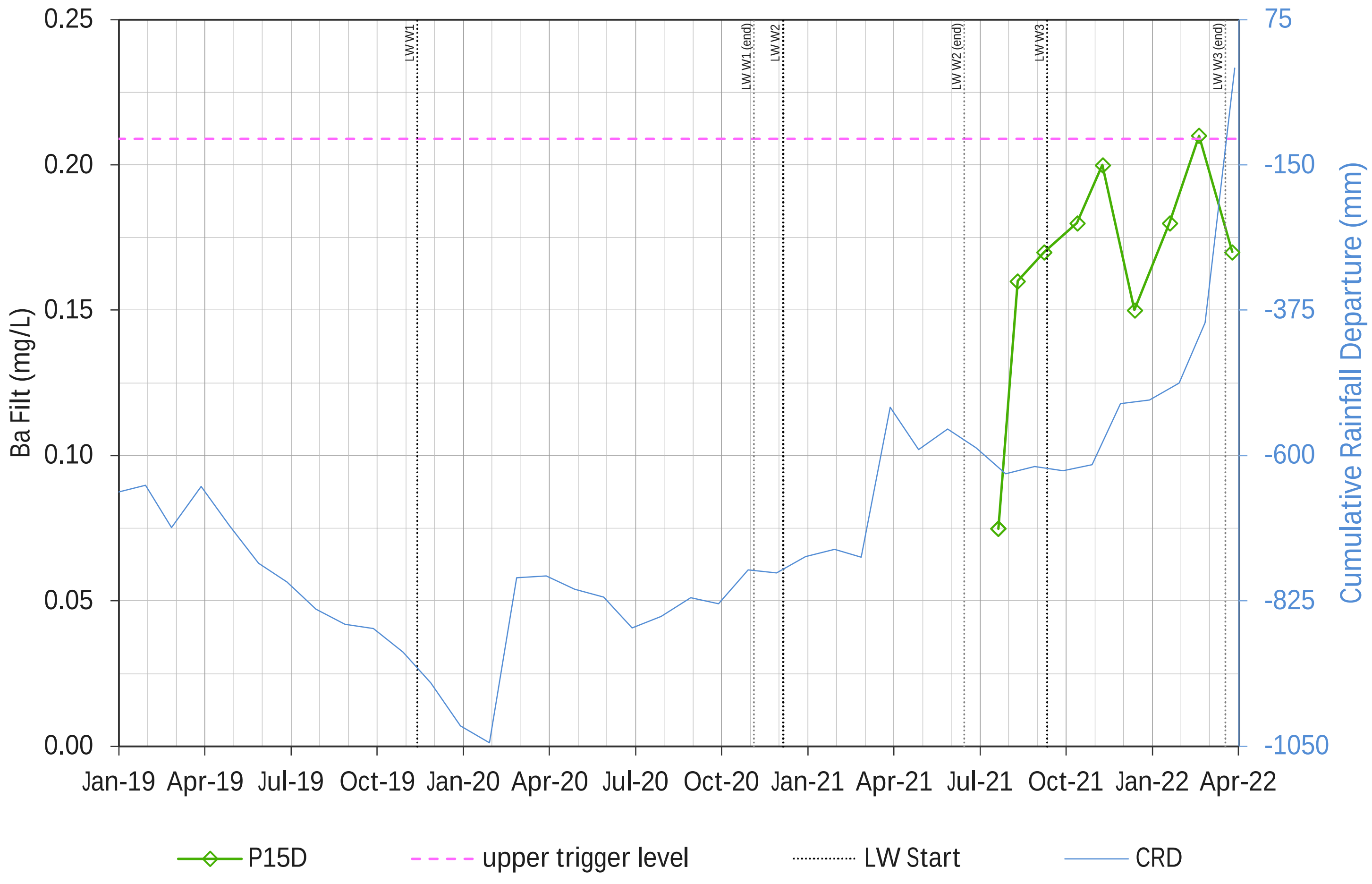


Figure D-17

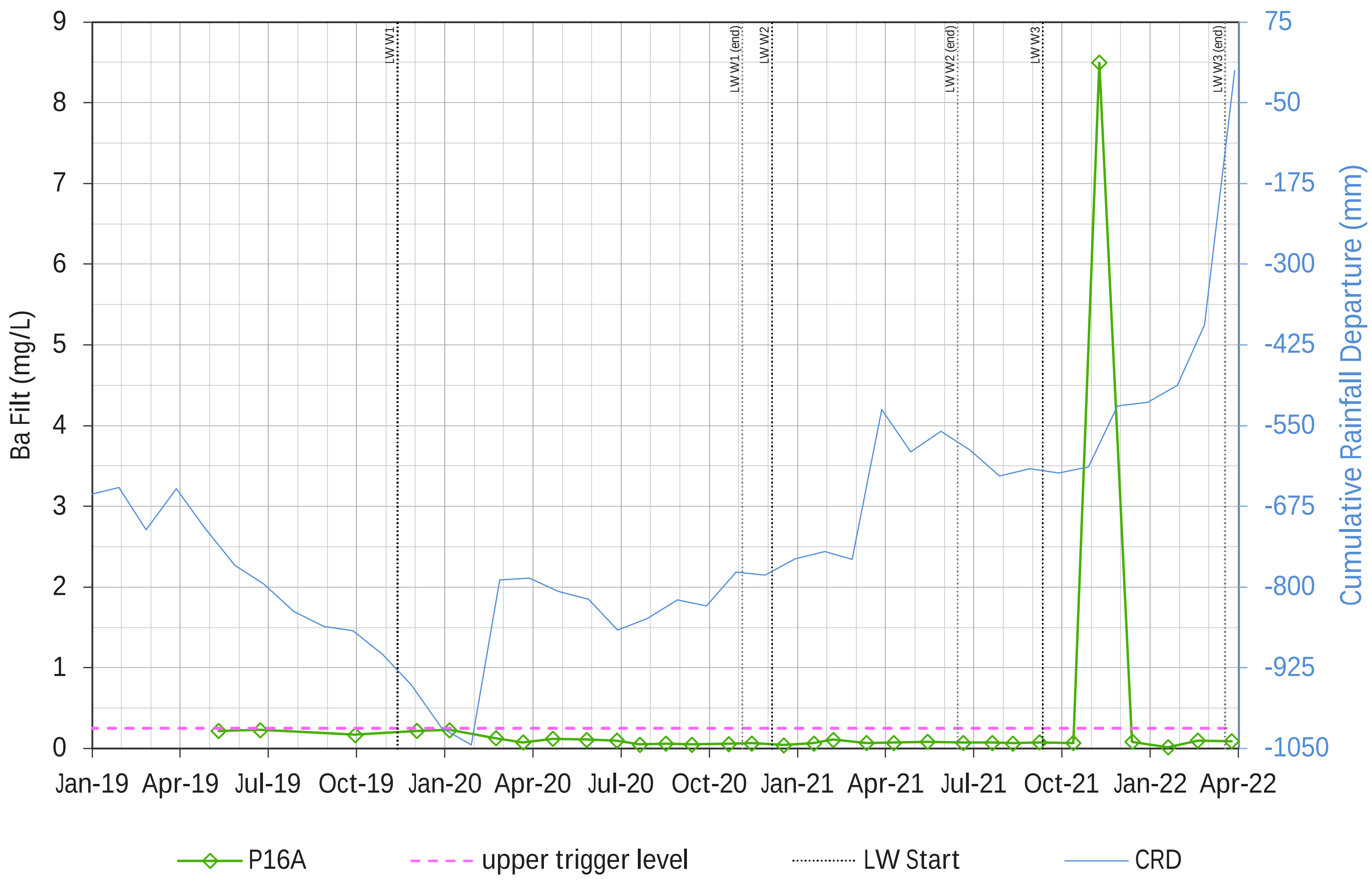


Figure D-18

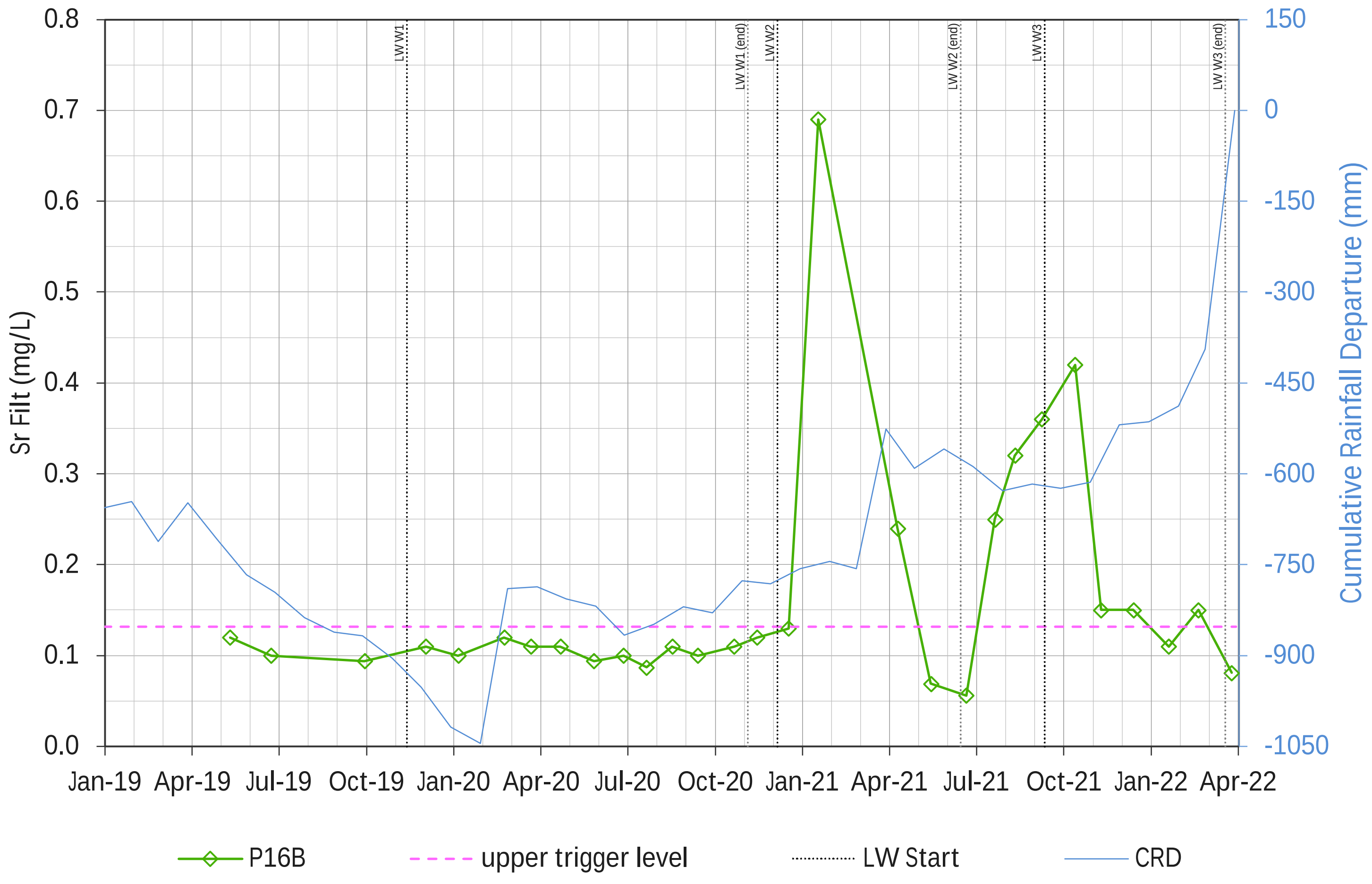


Figure D-19

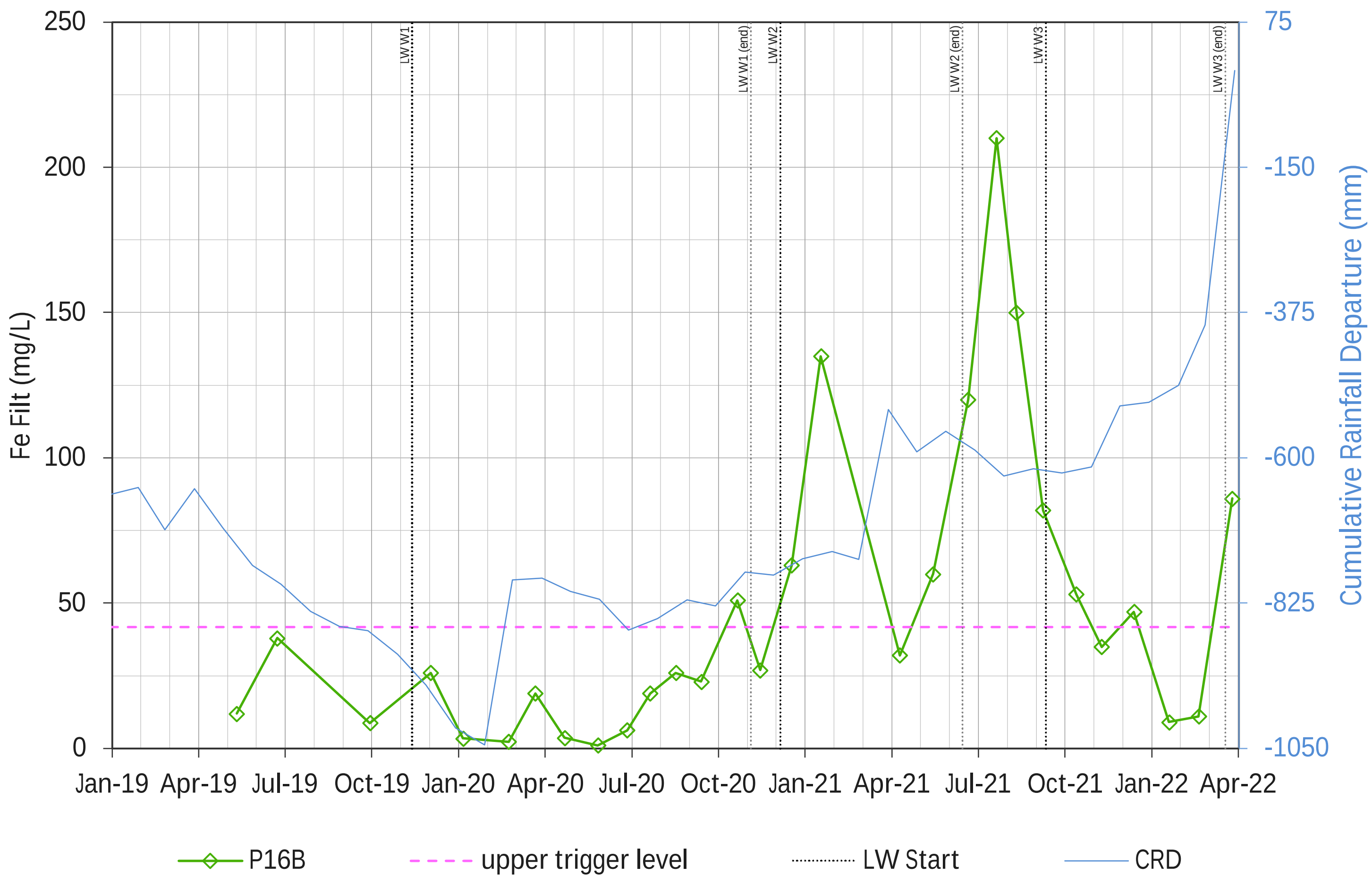


Figure D-20

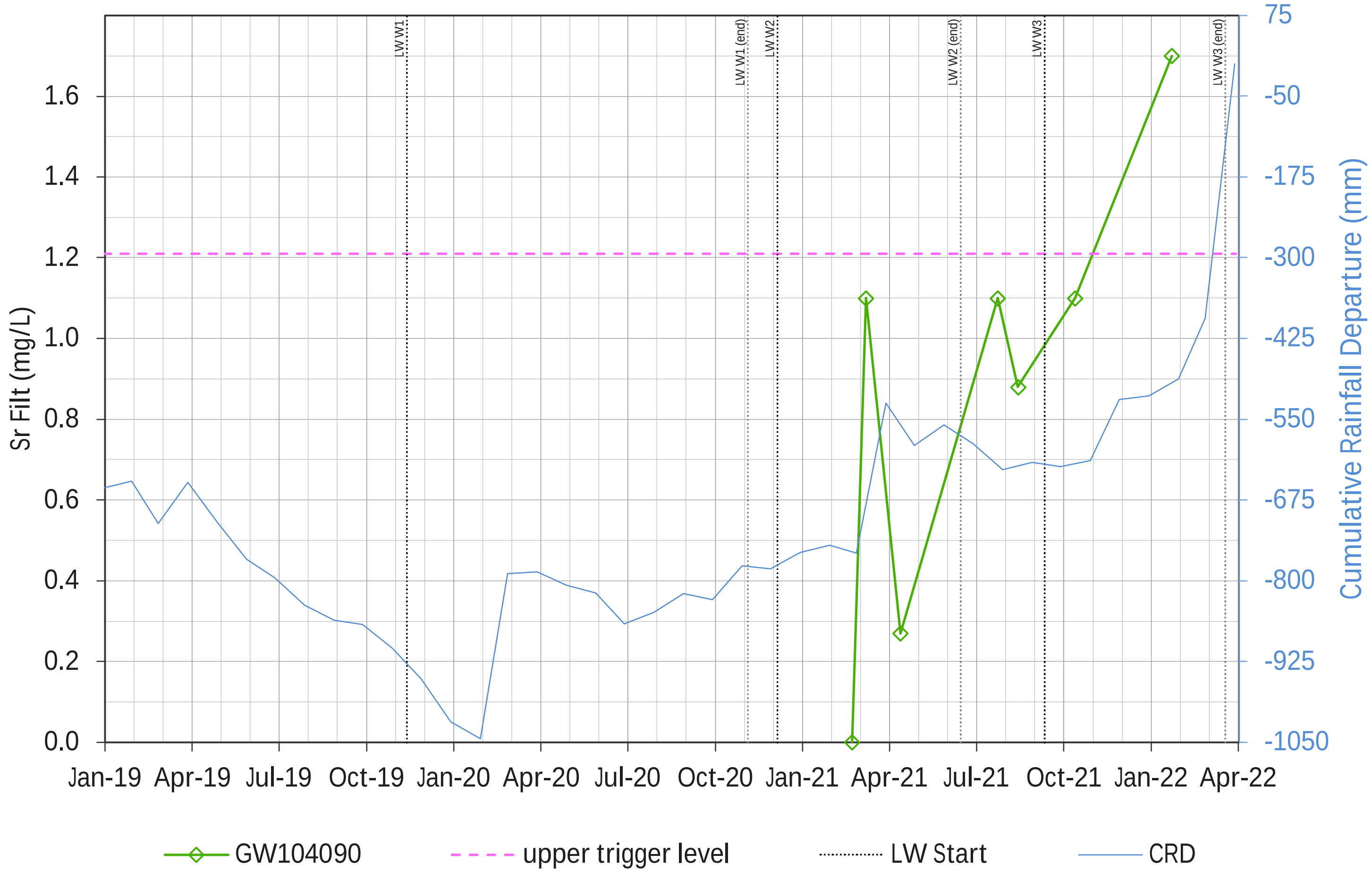


Figure D-21

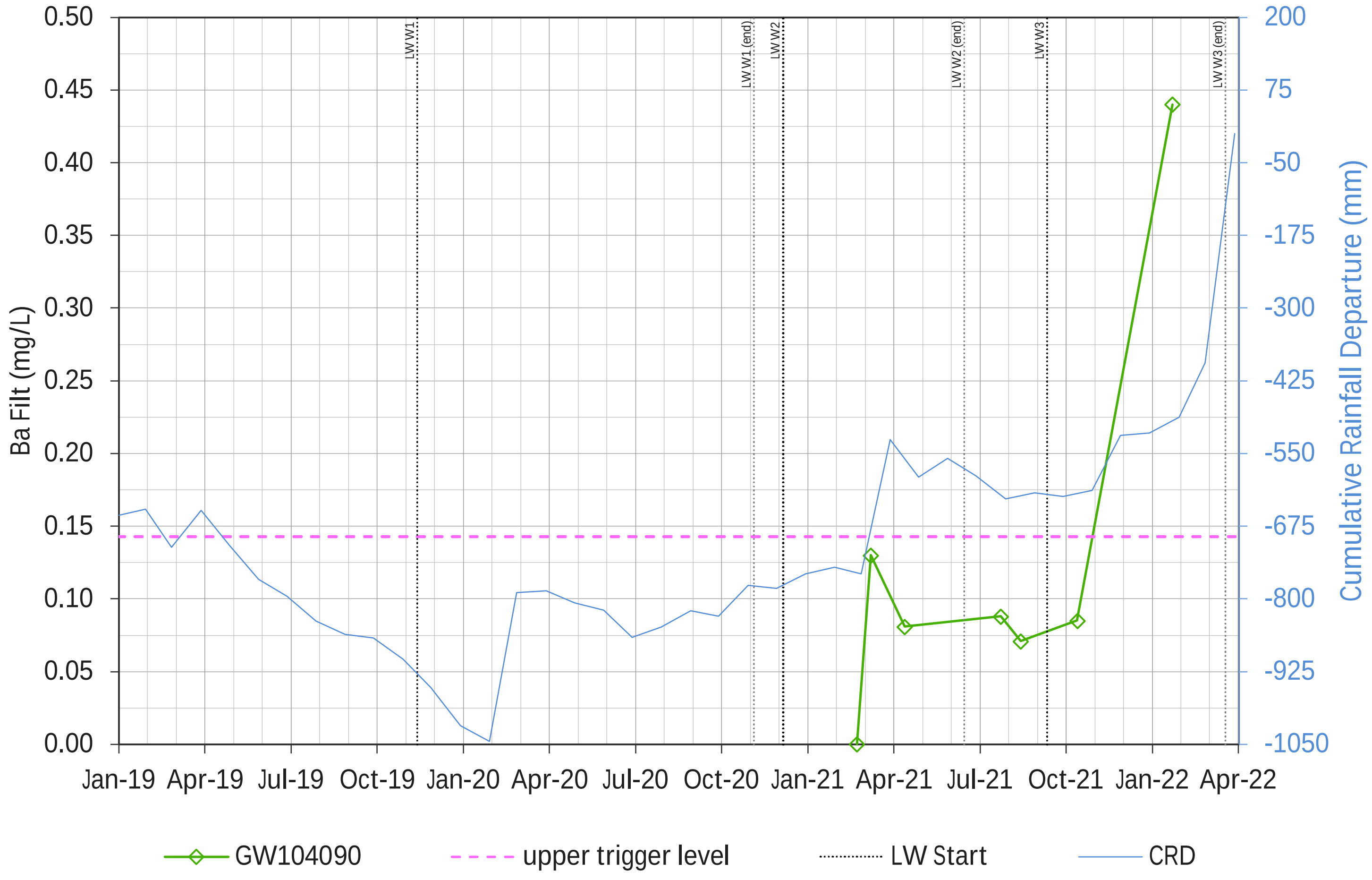


Figure D-22

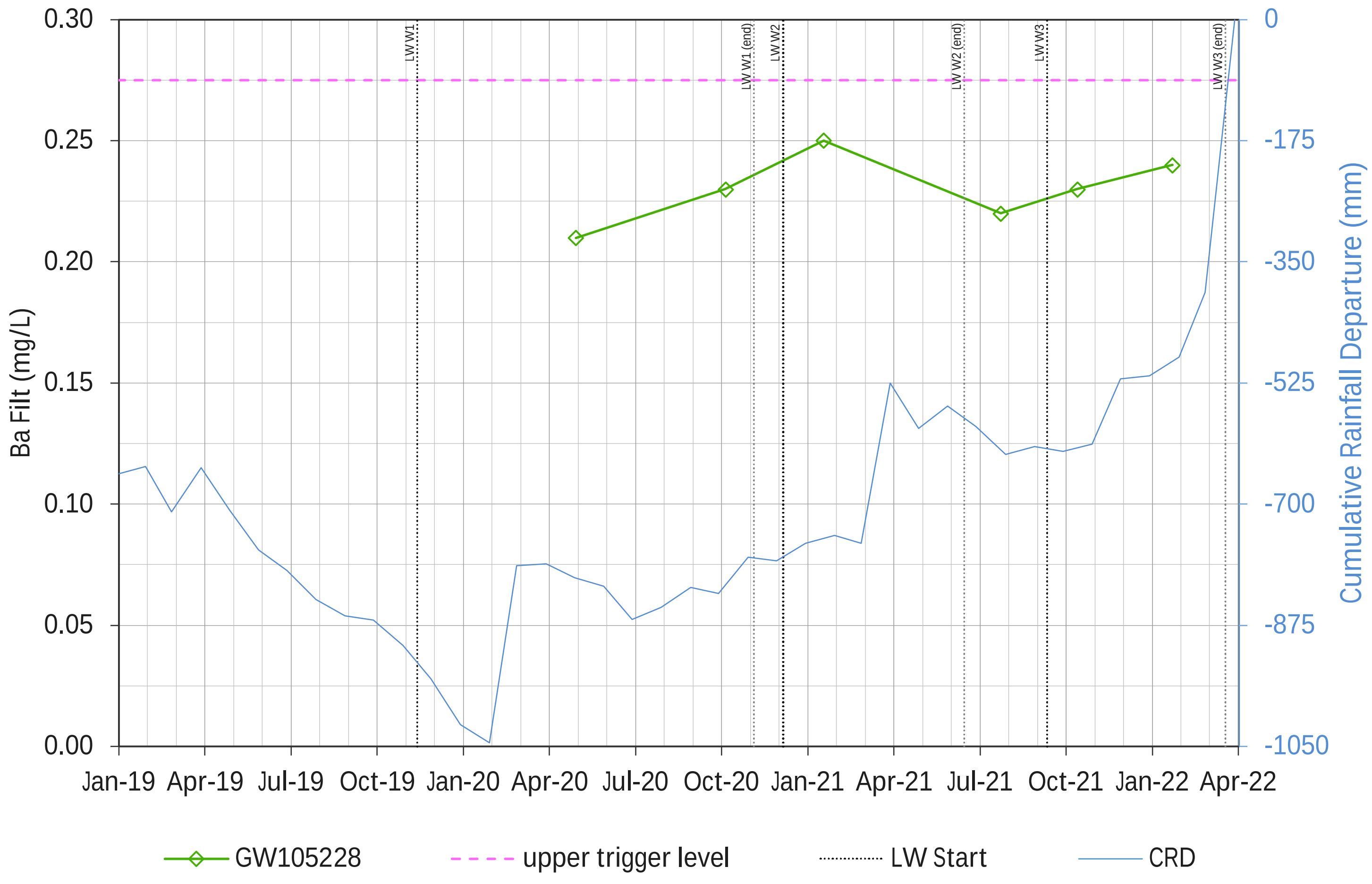


Figure D-23

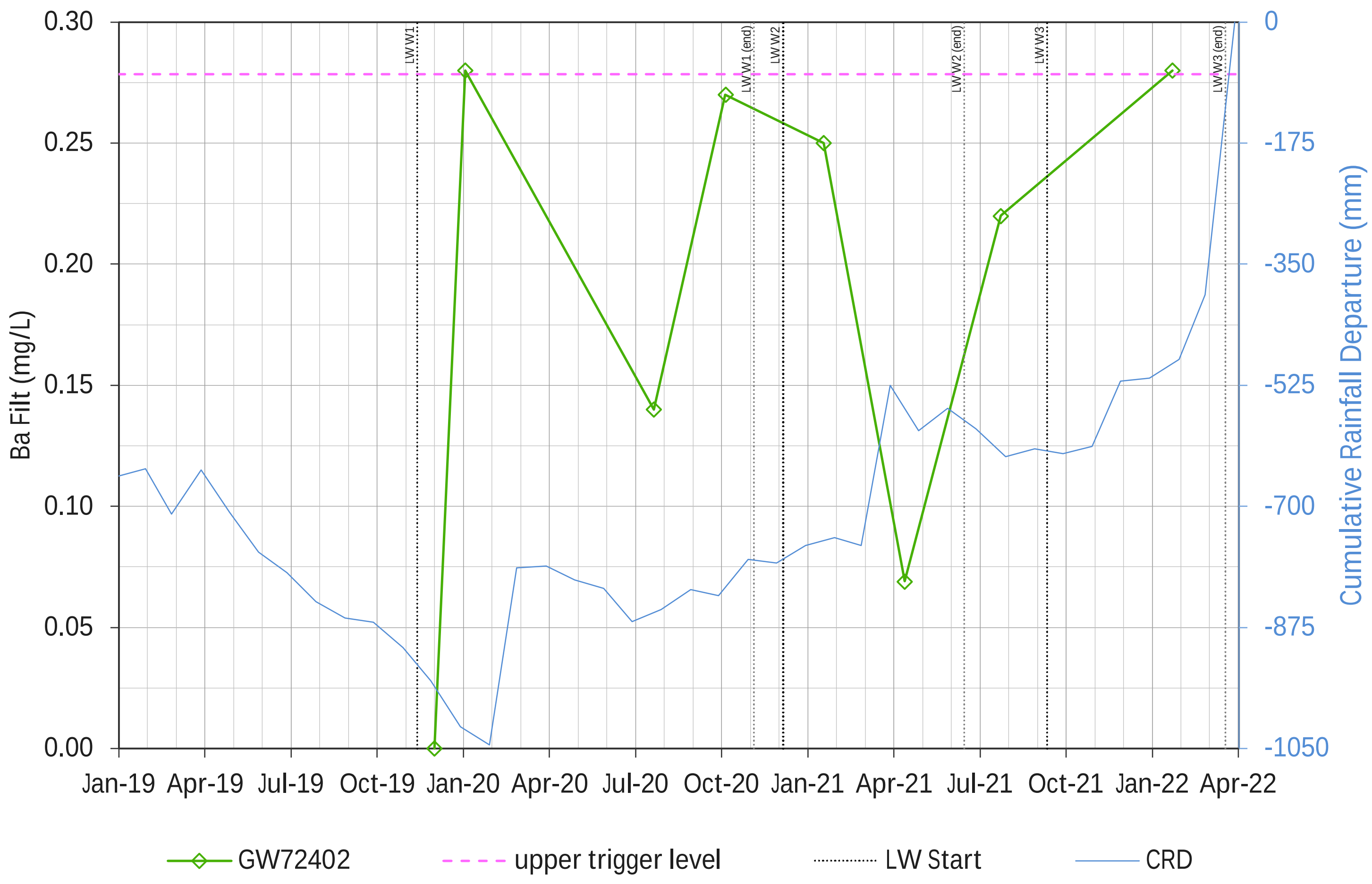
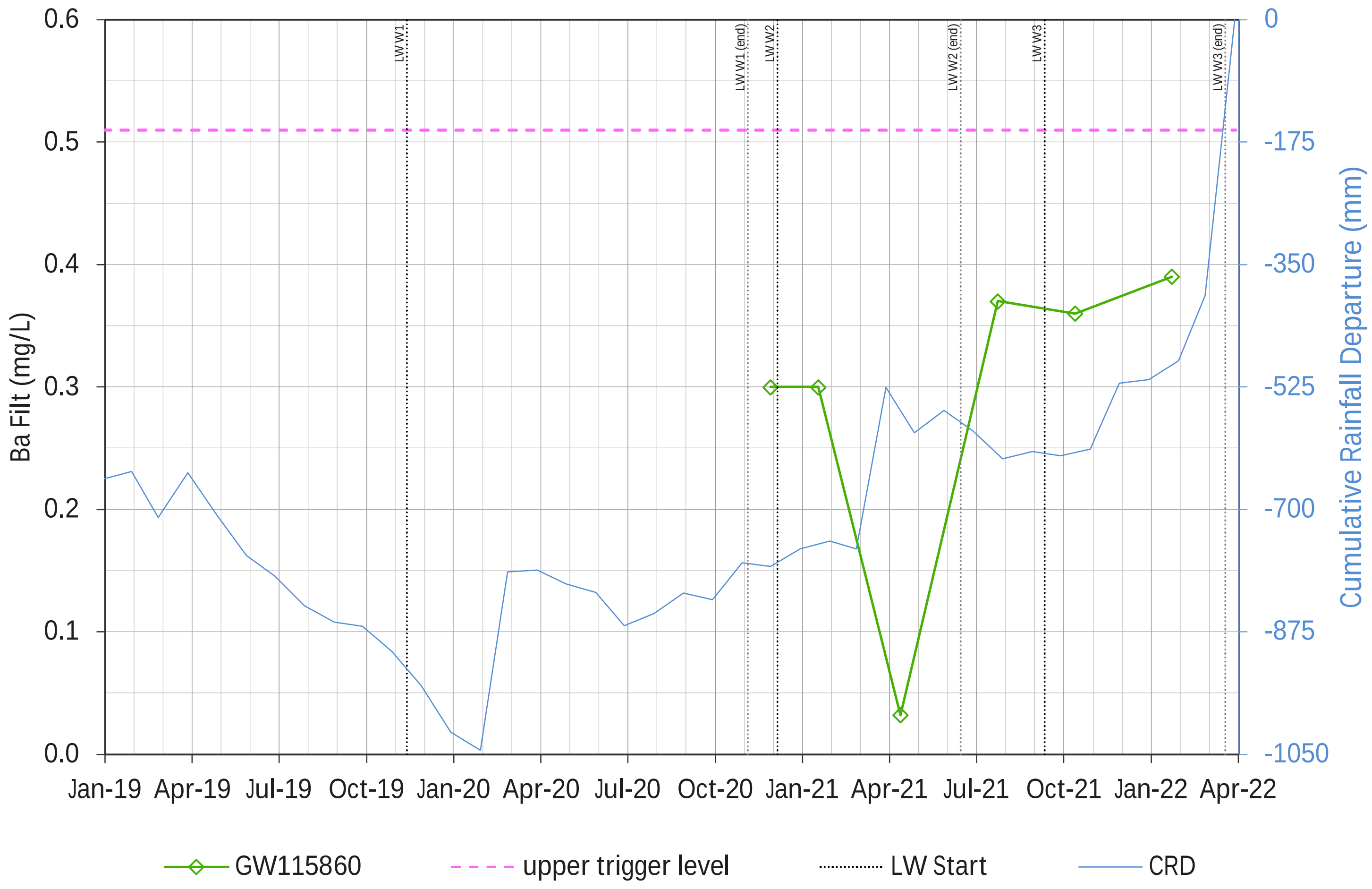


Figure D-24



Ba Filt (mg/L)
Cumulative Rainfall Departure (mm)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
-175
-350
-525
-700
-875
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
GW115860
upper trigger level
LW Start
CRD

Figure D-25

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

NEWCASTLE CBD
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

Appendix D – Creek Monitoring Report

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

SIMEC Mining – Tahmoor Coking Coal
Remembrance Driveway
TAHMOOR NSW 2573

Attention: April Hudson

RE: Longwall West 3 Creek Monitoring:

17 November 2021 (Matthews, Cedar and Stonequarry Creeks)

April,

Please find discussed below observations in Cedar, Mathews and Stonequarry Creeks from surveys conducted on the 17 November 2021.

Stonequarry Creek

Visual inspections of Stonequarry Creek's pools and associated rock bars within the Longwall West 3 active subsidence reach were conducted on 17 November 2021. The inspections at the sites shown in **Figure 1,** indicated that potential mine-induced surface cracking was observed at SR17 Rockbar. The cracking was observed in an area that vehicles use to access the property on the south side of Stonequarry Creek. No surface cracking, gas release, reduction in pool flow or connective overland flow was observed at any other observed site along Stonequarry Creek. Iron-oxy hydroxide precipitation at site SF was observed however, this had been identified in previous surveys.

Due to the development of laminar cracking and an extension of a natural crack, site SR17 would be at TARP Level 3. All other observed Stonequarry Creek sites were within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

Cedar Creek

Visual inspections of Cedar Creek's pools and associated rock bars within the Longwall West 3 active subsidence reach were conducted on 17 November 2021. The inspections at the sites shown in **Figure 2,** indicated that no mine-induced surface cracking, gas release, reduction in pool flow or connective overland flow was observed. Iron-oxy hydroxide precipitation at sites CB7, CR11/12, CR14, CR29 and CB30 was observed however, the precipitation was within the degree observed in the pre–Longwall West 1 baseline period.

All observed Cedar Creek sites were therefore within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Matthews Creek

Inspections within the Longwall West 3 reach of Matthews Creek between sites MR35 and MR46 on 27 Oct 2021 as shown in **Figure 3**, identified the presence of minor iron oxy-hydroxide precipitates at site MR35. It should be noted that the iron-oxy hydroxide precipitation was within the degree of precipitates observed in the pre–Longwall West 1 baseline period.

All observed Matthew Creek sites were therefore within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

Brienen Environment & Safety

15/17 Cemetery Rd
Helensburgh NSW 2508

Brienen Environment & Safety

15/17 Cemetery Rd
Helensburgh NSW 2508

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

Appendix E – Heritage Monitoring Report

Ground floor, 20 Chandos Street
St Leonards NSW 2065
PO Box 21
St Leonards NSW 1590
T 02 9493 9500
E info@emmconsulting.com.au
www.emmconsulting.com.au

7 April 2022

April Hudson
Approvals Specialist
Tahmoor Coal Pty Ltd
2975 Remembrance Driveway
Tahmoor NSW 2574

Re: Historical heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End of Panel inspection

Dear April,

1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Tahmoor Coal Pty Ltd (Tahmoor Coal) to conduct monitoring of historical heritage sites associated with the underground coal mining of Longwall West 3 (LW W3) after completion of its panel extraction in the Tahmoor Mine Western Domain (Figure 1).

This letter report provides the results of the heritage monitoring fieldwork which took place on 5 April 2022.

2 Background and methods

Historical heritage sites associated with LW W3 – W4 are managed through the provisions of the *Tahmoor Mine Extraction Plan Longwall West 3 – West 4 Historical Heritage Technical Report* (HHTR) (EMM 2019), which informs the LW W3 – W4 Heritage Management Plan. The HHTR requires that historical brick and sandstone culverts within the Study Area (Figure 1) be subject to monitoring at the completion of each longwall.

The HHTR provides a subsidence monitoring program for historical heritage sites within the LW W3 – W4 project area (Figure 1). The project area is defined by calculating a 35-degree angle of draw from the extents of LW W3 – W4, and the predicted limit of vertical subsidence (20 mm subsidence contour) that may result from their extraction. The HHTR includes a Trigger Action Response Plan (TARP) which provides a description of performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to sites of historical heritage. It sets out appropriate triggers (levels 1 – 3) to warn of increased risk of exceedance of any performance measures; specific actions to respond in the event of exceedance; and responses including remediation measures and/or adaptive management.

There are six culverts on the Picton Mittagong Loop Line (Loop Line) and two culverts on the Main Southern Railway (MSR) within the project area which require subsidence monitoring. The monitoring program for the eight culverts within the Study Area is provided in Table 1.

Source: EMM (2021); DFSI (2017); GA (2011); DPE (2017)

0 250 500 m

GDA 1994 MGA Zone 56

N

\\Emmsvr1\emm3\2020\J200551 - LW W3 W4 Extraction Plan Tahmoor Heritage\GIS\02_Maps\HHTR002_HistoricalHeritageUnRegistered_20210201_01.mxd 8/03/2021

KEY

- Study area
- Predicted 20 mm subsidence contour
- Completed longwall
- Proposed longwall
- Mine plan

Historic heritage items

- State Heritage Act
- Conservation Area - General
- Item - General
- Item - Archaeological

- Heritage items - not listed
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

Historical heritage items (unregistered sites)

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 3.2

EMM
creating opportunities

Table 2.1 Monitoring program for historical heritage LW W1

Item	Monitoring component	Monitoring		
		Prior to extraction	During extraction	Post mining
Loop Line sandstone culverts	Visual inspection. Baseline recording: • photographs. Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a system, which will monitor ground movements on and around the culverts (completed). Reinforcement (in place).	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Loop Line brick culverts	Visual inspection. Baseline recording: • photographs; and Survey control points. • Structural assessment of culverts, with particular attention given to 87.850 and 87.630.	Baseline recording of the site before mining, noting any existing cracks or damage (completed). Install a monitoring system, which will monitor ground movements on and around the culverts (completed). Reinforcement of culvert 87.630.	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.
Main Southern Railway culverts	Visual inspection. Baseline recording: • photographs; and Survey control points. Structural assessment of culverts.	Baseline recording of the site before mining, noting any existing cracks or damage. Install a monitoring system, which will monitor ground movements on and around the culverts.	Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall.	Visual inspection conducted by a heritage specialist at the completion of each longwall.

LW W3 commenced 13 September 2021 and finished on 21 March 2022. As indicated by Table 1.1, the culverts are continuously monitored, and monthly monitoring reports compiled by MSEC. Since LW W2 commenced extraction in December 2020, subsidence has gradually developed above the longwall panel and impacts have been observed at some of the culverts. This was documented in the Historical Heritage End of Panel Report for LW W2 (EMM 2021).

3 End of panel inspection, LW W3

On 5 April 2022, EMM archaeologist Pamela Chauvel together with Kevin Golledge (Tahmoor Mine) and Mark Ralph (Bloor Rail) completed an archaeological monitoring inspection for the required Loop Line and MSR culverts following the completion of extraction of LW LW3.

Monitoring results and photographs are included in Appendix A.

4 Conclusion and recommendations

The HHTR employs a Trigger Action Response Plan (TARP) to manage heritage impacts for the Extraction Plan project area for LW W1–W2. The TARP outlines the assigned level of risk for each performance indicator:

- Level 1: Normal;
- Level 2: Within Prediction; and

- Level 3: Exceeds Prediction.

The Heritage Management Plan specifies that the subsidence performance indicators for the culverts will be considered triggered if "subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, block movement or block fall."

Where performance indicators indicate that a level of risk has been triggered (Levels 1 to 3 with escalating corresponding risk), a response, or a contingency plan that outlines the adaptive management measures for each level of risk, is required as outlined in the TARP provided in this section below.

Table A.1 Trigger Action Response Plan

Feature	Management		
	Trigger	Action	Response
Historical heritage	Level 1		
	• Historical heritage site monitoring indicates no detectable environmental consequences	• Continue monitoring as per monitoring program.	• No response required.
	Level 2		
	• Historical heritage site monitoring indicates potential detectable environmental consequences but with negligible impacts to heritage sites.	• Continue monitoring as per monitoring program.	• No response required
	Level 3		
	• Historical heritage site monitoring indicates environmental consequences to heritage site(s).	• Continue monitoring program as per monitoring program. • Convene Tahmoor Coal Environmental Response Group to review response. • Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect. • Investigate exceedance of subsidence prediction. • Review mine design/predictions against mine criteria. • Review monitoring program and modify if necessary.	• Notify DPIE and Heritage NSW within one week of awareness of the event. • Investigate and implement any additional management measures as required in consultation with Heritage NSW and DPIE.

Impacts from subsidence during extraction of the Western Domain to date have varied across the culverts. Subsidence monitoring first identified subsidence induced cracking and spalling to culverts 88.980 and 88.400 during extraction of LW W2. Throughout extraction of LW W3, monitoring has identified only minor changes and the culverts remain stable and serviceable. The following sections provide details of the end of panel heritage assessment of the culverts within the Study Area and a summary and photographs are included in Appendix A.

4.1 Loop Line Culvert 88.980

Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain. Additional cracks through the mortar and sandstone capping as well as some minor spalling of the arch stones of the western portal developed during extraction of LW W2.

Structural engineer Mark Delaney (Newcastle GeoTech) inspected the culverts on 21 June 2021 and his report was reviewed by structural engineer John Matheson (JMA Solutions). JMA Solutions are satisfied that the impacts have not adversely affected the safety and serviceability of the culvert. The impacts developed gradually as mining occurred during LW W2 and have remained stable after the period of active subsidence.

Culvert 88.980 km was predicted to experience approximately 25 mm of additional vertical subsidence and 20 mm of valley closure due to the extraction of LW W3. No new impacts to culvert 88.980 have been observed during monitoring throughout the extraction of LW W3. The end of panel heritage inspection identified that the eastern (downside) portal is generally in good condition. The western portal, apart from minor flaking, has not developed additional cracking, or worsening of existing cracks or spalling.

Level 3 of the TARP was triggered during the extraction of LW W2 and remains at Level 3. While the culvert is currently stable, remediation will be required following the conclusion of subsidence. At this time the RCP sleeve will be removed from the culvert, the barrel will be inspected in detail and Tahmoor will seek further expert advice from a heritage stonemason regarding remediation of the sandstone. Repairs will be undertaken after the full effects of LW W3 – W4 have been completed. To do so earlier may cause greater damage at the new filled joint and then be even harder to repair. The culvert will continue to be monitored and managed in accordance with the HHTR.

The culvert is predicted to experience negligible additional subsidence due to the extraction of LW W4.

4.2 Loop Line Culvert 88.400

To date, culvert 88.400 has experienced the greatest impacts of the Loop Line culverts within the Study Area. An 8 mm wide crack in the vertical mortar joint and cracked sandstone capping on the downside abutment (eastern side of culvert), as well as a 7 mm wide crack in a mortar joint around the arch stones at the upside (western side of culvert) as well as minor spalling of sandstone on the arch stones were observed during extraction of LW W2. These impacts are a result of the lime grout becoming so strong over time that the weaker sandstone blocks sheer just below the grout bedding plain when under strain.

Structural engineer Mark Delaney (Newcastle GeoTech) inspected the culverts on 21 June 2021 and his report was reviewed by structural engineer John Matheson (JMA Solutions). JMA Solutions are satisfied that the impacts have not adversely affected the safety and serviceability of the culvert. The impacts developed gradually as mining occurred during LW W2 and have remained stable after the period of active subsidence

Culvert 88.400 was predicted to experience approximately 75 mm of additional vertical subsidence and 25 mm of valley closure due to the extraction of LW W3. No new impacts to culvert 88.980 were observed during monitoring throughout the extraction of LW W3. The end of panel heritage inspection did not identify any additional cracking or worsening of existing cracks or spalling, apart from cracking mostly along the mortar as a result of a screw on the left side of the eastern portal installed to attach the concrete sleeve to the culvert.

Level 3 of the TARP was triggered during the extraction of LW W2 and remains at Level 3. While the culvert is currently stable, remediation will be required following the conclusion of subsidence. At this time the RCP sleeve will be removed from the culvert, the barrel will be inspected in detail and Tahmoor will seek further expert advice from a heritage stonemason regarding remediation of the sandstone. Repairs will be undertaken after the full effects of LW W3 – W4 have been completed. To do so earlier may cause greater damage at the new filled joint and then be even harder to repair. The culvert will continue to be monitored and managed in accordance with the HHTR.

The culvert is predicted to experience negligible additional subsidence due to the extraction of LW W4.

4.3 Loop Line Culvert 87.850

Brick culvert 87.850 has significant cracking across and between the bricks that was identified during pre-extraction inspections. Cracking around the arch is causing the course of bricks to displace. These existing cracks on both sides of the culvert have not increased during extraction of LW W3.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

4.4 Loop Line Culvert 87.630

No subsidence impacts were observed at this small brick culvert.

Inspection of the culvert was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

4.5 Loop Line Culvert 87.330

Only the east side of this culvert was accessible and inspected during the heritage assessment. No subsidence impacts were observed.

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that the western (upside) portal is also in good condition with no evidence of cracking or deformation.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

4.6 Loop Line Culvert 87.300

Only the north side of this brick culvert beneath the old rail alignment embankment was able to be accessed. However, it was inaccessible due to the water level and extent to which it was overgrown with invasive weeds. It is recommended that the weeds and are cleared from around the culvert.

The northern portal has extensive cracking on the headwall. However, baseline photographs taken prior to the commencement of longwall mining in the Western Domain confirmed that the cracking was pre-existing and has nor worsened during LW W3.

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that the southern (downside) portal also contains pre-existing cracking and outward rotation of the headwall which has not worsened during extraction of LW W3.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

4.7 MSR Culvert 87.331

Only the west side of this culvert was inspected due to works on the Picton Tunnel preventing access to the east side of the culvert. The west side of the culvert is very overgrown and the high water level meant that it could not be inspected closely. It appears to be in sound condition.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

4.8 MSR Culvert 89.216

This culvert has minor cracking and weathering throughout but is in sound condition. Cracking is generally confined to the mortar between the bricks and continues along the centre of the culvert's roof.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

5 Closing

The results of the heritage monitoring inspection following the completion of LW W3 has identified only minor changes to pre-existing cracks in the culverts. The culverts remain stable and serviceable. Loop Line culverts 88.980 and 88.400 remain at level 3 in the TARP and will be remediated once underground mining in the Western Domain is concluded. The four other Loop Line culverts and two MSR culverts in the LW W3 – W4 Study Area are considered to be level 1 in the TARP, and as such no additional management strategies are required.

Should you have any questions or concerns please do not hesitate to contact me.

Yours sincerely

Pamela Chauvel
Senior Archaeologist

pchauvel@emmconsulting.com.au

Appendix A

Inspection summary and photographs

A.1 Monitoring results summary

Site Name	**Loop Line Culvert 88.980**
Heritage listing	Not listed
Site type	Built structure
Location	700 m west of LW W3
Predicted probability of impact during LW W3 – 4	Unlikely
Item summary	Dressed sandstone block arch culvert. Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain due to previous attempts at restoration including the application of paint which has resulted in increased exfoliation and erosion of the sandstone. In addition, JMA Solutions (2019) noted the severe loss of wall thickness in some blocks along the roof of the culvert, most likely caused by salt-laden groundwater permeating through the barrel of the barrel of the culvert. This has resulted in expansive salt crystallisation on the surface stone and subsequent exfoliation.
Monitoring comments	On 25 February 2021, minor change in the cracking was first noted around the western (upside) portal headwall. Monitoring by Mark Delaney (Engineering Geologist) in May 2021 concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert, while very minor hairline mortar cracks had developed on the downside inlet headwall (MSEC monitoring report 1150-25). Inspection confirmed the presence of a vertical crack through the mortar that continued as a crack through the sandstone capping on the north side of the eastern (downside) portal. Cracking on the western (upside) side of the culvert follows the top of the arch stones (voussoirs), primarily through the mortar, with some associated spalling of the stones. This does not appear to have worsened during extraction of LW W3. The inside of the culvert could not be inspected due to the RCP sleeve.
Representative photographs	 Western portal. Cracking around arch stones that was first noted during extraction of LW W2 has not worsened during LW W3.

Western portal. Cracking along the mortar and spalling of the arch stones has not worsened significantly during extraction of LW W3.

Eastern portal, generally in good condition.

Site Name	Loop Line Culvert 88.400
Heritage listing	Not listed
Site type	Built structure
Location	380 m west of LW W3
Predicted probability of impact during LW W3 – 4	Possible
Item summary	Dressed sandstone block arch culvert. This culvert was predicted by MSEC to be at possible risk of subsidence impacts. Integrity of the structure and condition of the sandstone is good. Weeds that impeded initial inspection have subsequently been removed. To alleviate downward pressure on the culvert, a vehicle track no longer runs over the top of the culvert but alongside it.
Monitoring comments	This culvert has experienced the severest impacts from subsidence. A vertical crack along a mortar joint on the eastern (downside) wall was first observed on 1 February 2021 (during extraction of LW W2), and the following month a crack on the western (upside) wall was noted along with minor spalling of the sandstone blocks in the arch above the portal. The monitoring report concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert (MSEC monitoring report 1150-25). Inspection confirmed that the cracking and spalling that developed during LW W2 has not worsened significantly during LW W3. The inside of the culvert could not be inspected due to the RCP sleeve.
Representative photographs	 Western portal. Spalling above the arch that developed during extraction of LW W2 has not worsened significantly during LW W3.

Eastern portal. No worsening of cracking during extraction of LW W3.

Eastern portal. Screw securing concrete sleeve to the arch of the culvert has resulted in some cracking along the mortar and through the sandstone.

Site Name	Loop Line culvert 87.850
Heritage listing	Not listed
Site type	Built structure
Location	Above LW W3
Predicted probability of impact during LW W3 – 4	Possible
Item summary	Brick arch culvert When it was initially inspected, this culvert was overgrown with brambles and difficult to assess. Multiple existing cracks were observed during subsequent inspections and supported by photographs.
Monitoring comments	Cracking across and between the bricks is consistent with previous photographs taken during monitoring of the culvert. An inspection by Mark Delaney (engineering geologist) on 3 February 2022 confirmed that the pre-existing cracks on both sides of the culvert have not increased during extraction of LW W3. No changes were noted during the heritage inspection. The inside of the culvert could not be inspected due to the RCP sleeve.
Representative photographs	 Eastern portal

Detail, pre-existing cracking and displacement of bricks around the eastern portal arch that does not appear to have worsened significantly during longwall mining in the Western Domain.

Cracking and displacement of bricks around the western portal arch. Does not appear to have worsened during longwall mining in the Western Domain.

Site Name	Loop Line culvert 87.630
Heritage listing	Not listed
Site type	Built structure
Location	Above LW W3
Predicted probability of impact during LW W3 – 4	Possible
Item summary	Brick arch culvert Concrete skin on base and rubble at the mouth. Mortar is tuck pointed. Headwall and abutment are in good condition. Recent embankment to the south-east means water is largely diverted away from the culvert.
Monitoring comments	There are no existing cracks, and no subsidence impacts were observed. Inspection of the eastern portal was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that no change or cracking has occurred during LW W3 in the headwalls or within the barrel.
Representative photographs	 Western portal. In sound condition

Eastern portal. Overgrown but appears to be in sound condition.

Site Name	Loop Line culvert 87.330
Heritage listing	Not listed
Site type	Built structure
Location	240 m east of LW W3
Predicted probability of impact during LW W3 – 4	Unlikely
Item summary	Brick arch culvert with drainage channels of rendered brick on either side of the embankments to funnel water into the culvert. Cracking is along the mortar only and the condition of the bricks is good.
Monitoring comments	Only the eastern portal was accessible and inspected. It is in sound condition with only minor, pre-existing cracking. Bricks at the base of the chute to the south of the culvert inlet have been displaced and the area has been subject to some erosion. A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation.
Representative photographs	 Eastern (downside) portal. In sound condition

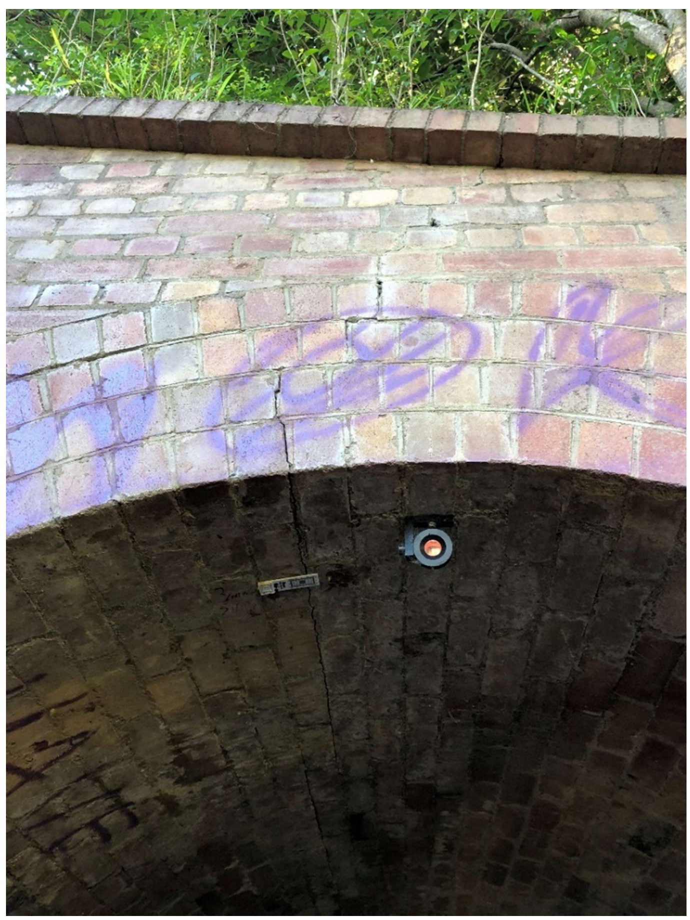
Displaced bricks at the base of the brick chute to the south of the eastern portal.

Site Name	Old formation, culvert 87.300
Heritage listing	Not listed
Site type	Built structure
Location	160 m east of LW W3.
Predicted probability of impact during LW W3 – 4	Unlikely
Item summary	Brick arch culvert located beneath the disused embankment for the original railway alignment. Bricks cracked at northern headwall.
Monitoring comments	Only the northern (upside) portal was accessible and inspected. Results of the monitoring inspection were cross referenced with baseline photographs taken prior to the commencement of longwall mining in the Western Domain which confirmed that the cracking around the northern portal was pre-existing and has nor worsened during LW W3. A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that there have been no changes to the pre-existing cracking and outward rotation of the headwall to the southern (downside) portal.
Representative photographs	 Northern portal. Difficult to access due to water and weeds. Pre-existing cracking around the arch, mostly through mortar.

Site Name	MSR culvert 87.331
Heritage listing	Not listed
Site type	Built structure
Location	280 m east of LW W3.
Predicted probability of impact during LW W3 – 4	Unlikely
Item summary	Brick arch culvert The brick and concrete culvert is in good condition. There is a minor amount of vegetation growth; however, this does not appear to have impacted the feature.
Monitoring comments	Only the western portal was inspected and only from a distance due to water and vegetation. The culvert appears to be in sound condition.
Representative photographs	 Western portal. In sound condition.

Site Name	MSR culvert 89.216
Heritage listing	Not listed
Site type	Built structure
Location	590 m east of LW W3.
Predicted probability of impact during LW W3 – 4	Very unlikely
Item summary	Brick arch culvert. The brick culvert is in good condition despite a moderate amount of graffiti.
Monitoring comments	The culvert is in good condition and the cracks observed above the western portal arch were checked against the baseline photographs taken prior to longwall mining in the Western Domain and identified as pre-existing. The crack along the centre of the culvert roof may have worsened slightly.
Representative photographs	 Eastern portal. Culvert is in good condition.

Roof of culvert. View west



Western portal. Cracking through the mortar above the arch continues along the roof of the culvert.

Appendix F – Stonequarry Creek Rockbar Status Reports

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 8
During the mining of LW W3 for Stonequarry Creek Rockbar

Reporting Period	8 October 2021 to 11 October 2021	
Length of extraction	221 m	as at 11 October 2021
Closest distance of LW W3 face to Rockbar	360 m	to Mark C02 (LW moving away)
Distance travelled by LW since previous report	21 m	Since 7 October. LW commenced 13 September 2021
Maximum incremental subsidence at Rockbar Mark C02 due to LW W3	18 mm	on 7 October 2021.
Maximum increase in subsidence at Rockbar Mark C02 since previous survey	2 mm	from 7 October to 11 October.
Weather and flow conditions	Light rainfall at time of survey. Trickle flow over rockbar along main channel.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
GNSS				
GNSS unit above commencing end of LW W3 (Site 23)	Continuous		N/A	Subsidence developing and minor horizontal movements developing towards the north and west.
GNSS unit (Site 12A)	Continuous		N/A	Minor subsidence developing. Minor horizontal movements developing towards the south.
GNSS unit (Site 13)	Continuous		N/A	Minor subsidence developing. Minor horizontal movements developing towards the south and east.
GNSS unit (Site SR17N)	Continuous		N/A	No measurable subsidence observed. Very minor horizontal movements developing towards the south.
GNSS unit (Site SR17S)	Continuous		N/A	No measurable subsidence observed. Very minor horizontal movements developing towards the south.
High resolution surveys across Rockbar				
High resolution closure lines	11 Oct	Twice weekly		HRC-D line HRC-E lines have extended by 2.4 mm and 2.5 mm, respectively, exceeding the 2 mm Blue trigger level. HRC-G line is gradually extending to 1.7 mm, approaching Blue trigger level. All lines have recorded ground extension since previous survey, with exception of the HRC-A Line, which is closing. Technical Committee has met and reviewed the latest results with consideration of the Key Assessment Criteria and determined that the current survey, visual inspections, monitoring and management measures remain suitable. The results will continue to be reviewed on a twice weekly basis.
3D surveys across grinding groove sites (3D array)	11 Oct	Twice weekly		Results within survey tolerances.
Ground surveys across Rockbar				
Absolute 3D surveys	-	Monthly		Last survey 4 October. Minor changes observed.
Relative 3D surveys	11 Oct	Twice weekly		Minor changes observed.
Ground surveys				
Valley closure lines across Stonequarry Creek and Cedar Creek	-	Weekly	N/A	Last survey 6 October. Minor subsidence developing.
Rockbar / valley closure lines across Stonequarry Creek	-	Weekly	N/A	Last survey 6 October. Minor subsidence developing.
LW W3 Centreline	11 Oct	Weekly	N/A	Subsidence developing above LW W3.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Visual inspections				
Detailed visual inspection	11 Oct	Twice weekly		No changes observed.
Geotechnical monitoring				
Inclinometer surveys	11 Oct	Weekly	N/A	Baseline readings recorded.
In situ stress monitoring	7 Oct	Weekly	N/A	Very small changes in compression in NW-SE direction that is consistent with survey results.
Surface and groundwater monitoring				
Surface water monitoring	-	Download monthly	N/A	Changes consistent with periods of rainfall and dry weather.
Groundwater monitoring	-	Download monthly	N/A	Groundwater recharge observed along Stonequarry and Cedar Creeks.

Other management actions since previous report:
- Nil.

Any additional and/or outstanding management actions:
- Laboratory testing of core samples.

Consultation with stakeholders since previous report:
- Technical Committee meetings held 8 and 12 October.
- Steering Committee meeting held 30 September.
- Landowner on No. 225 Barkers Lodge Road has requested cessation of land access on 5 November. GNSS Unit 14 and Stonequarry Creek closure surveys SQ01 to SQ09 will be removed at this time. The Technical Committee confirmed that due to the location of the survey site and expected longwall progress by 5 November, the loss of survey is not considered significant to the management of the rockbar. No triggers are affected by the loss of these surveys.

Forecast whether continued longwall mining is likely to cause greater than negligible subsidence impacts, environmental consequences or loss of heritage value:

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to Stonequarry Creek Rockbar, the HRC-D and HRC-E lines have exceeded the Blue trigger level this week. HRC-G line may exceed the Blue trigger level in the next week. No other triggers under this Management Plan are expected to be exceeded in the next week.

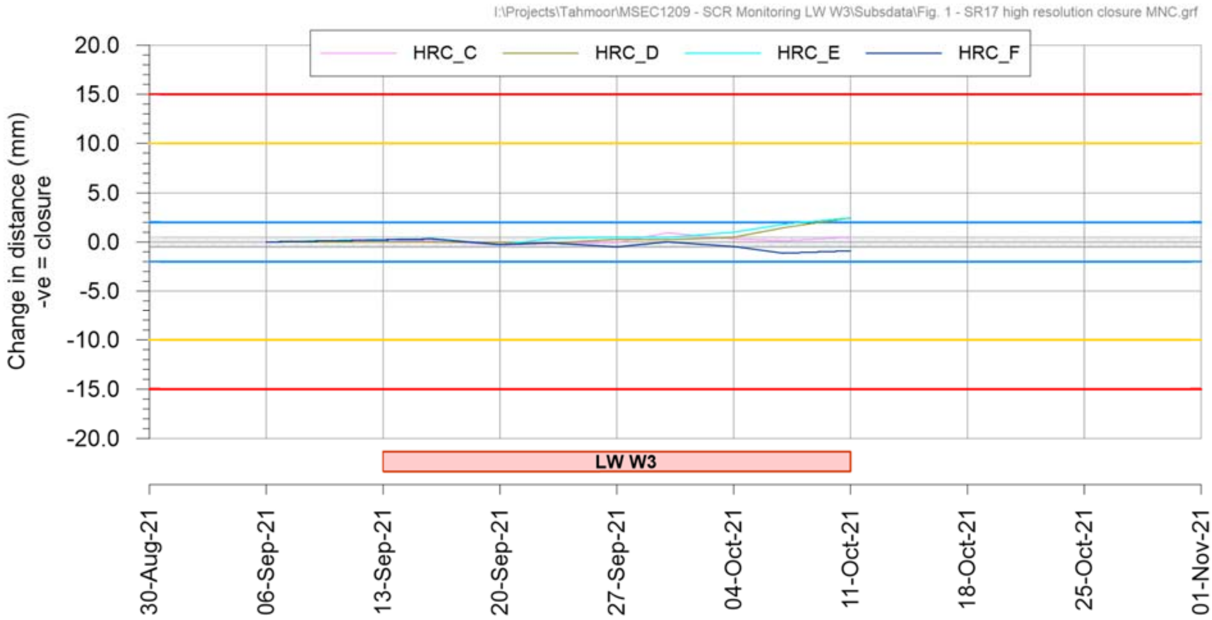
Accordingly continued longwall mining is not likely to result in the occurrence of greater than negligible subsidence impacts, environmental consequences or loss of heritage value.

Copy of Report to:

Peter Vale, Executive General Manager Coal Operations
Clint Mason, Head of Tahmoor Coal Operations
David Corbett, Tahmoor Coal Technical Services Manager
Malcolm Waterfall, Tahmoor Coal, Mining Engineering Manager
Zina Ainsworth, Tahmoor Coal Environment and Community Manager

Stephen O'Donoghue, Director Resource Assessments – DPIE
Gabrielle Allan, Principal Planning Officer - DPIE

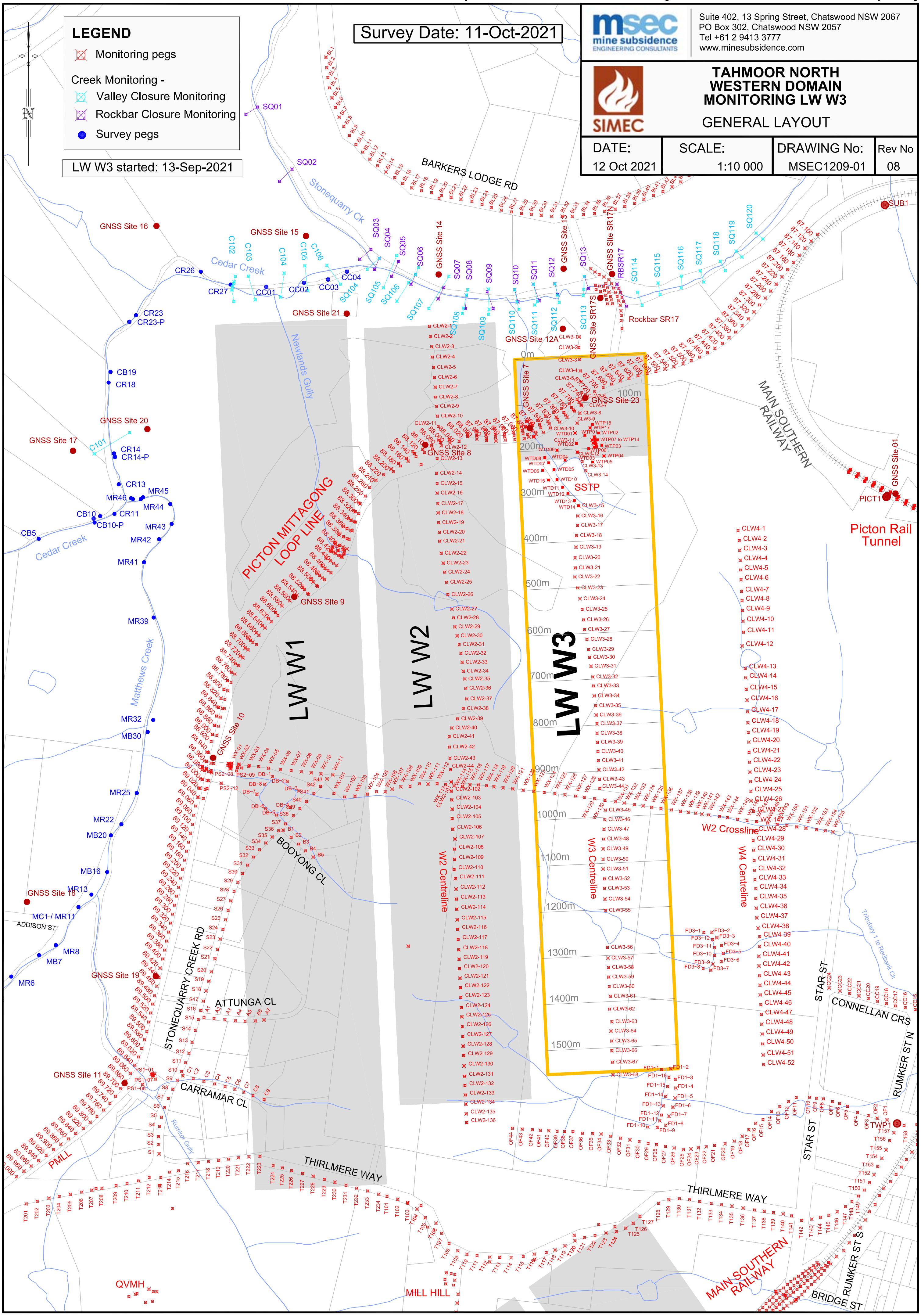
All Technical Committee Members



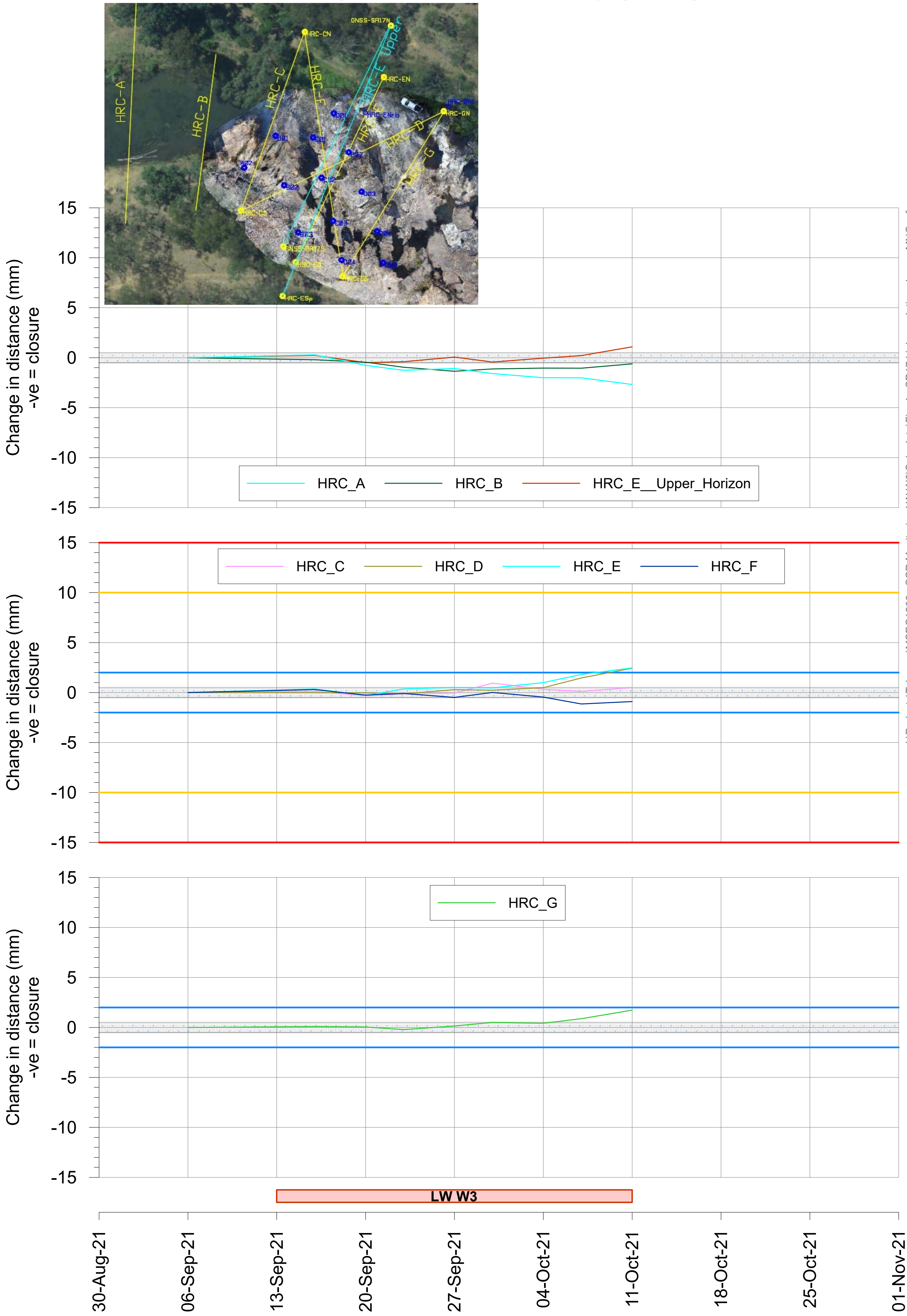
Photograph courtesy MNC Consulting

Rockbar SR17 on 11 October 2021

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-01 General Layout.dwg



Tahmoor LW W3 - SCR Monitoring
High resolution survey (MNC)

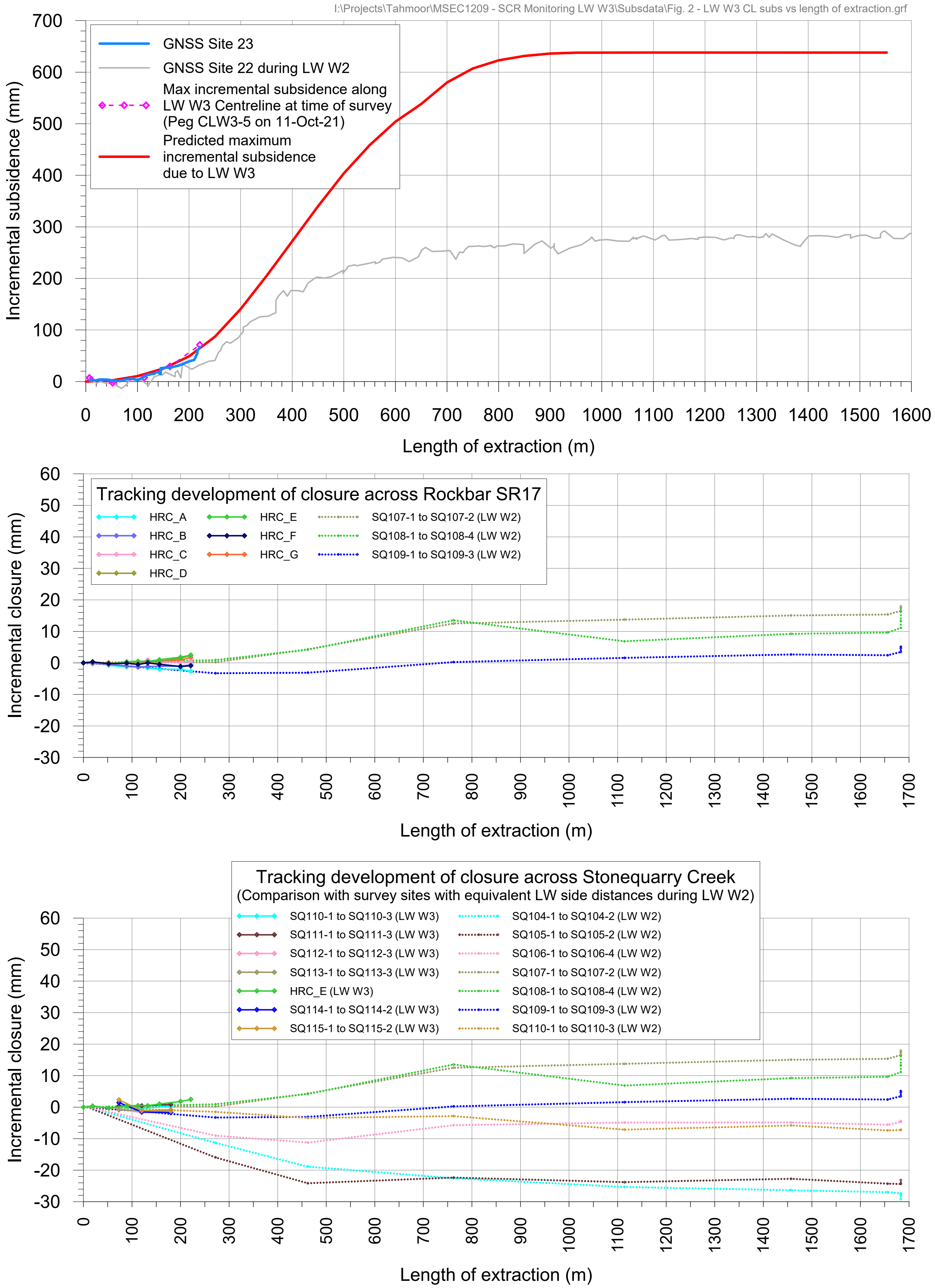


I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. 1 - SR17 high resolution closure MNC.grf

msec

Fig. 1-R08

Tahmoor LW W3
Incremental subsidence and closure relative to length of extraction

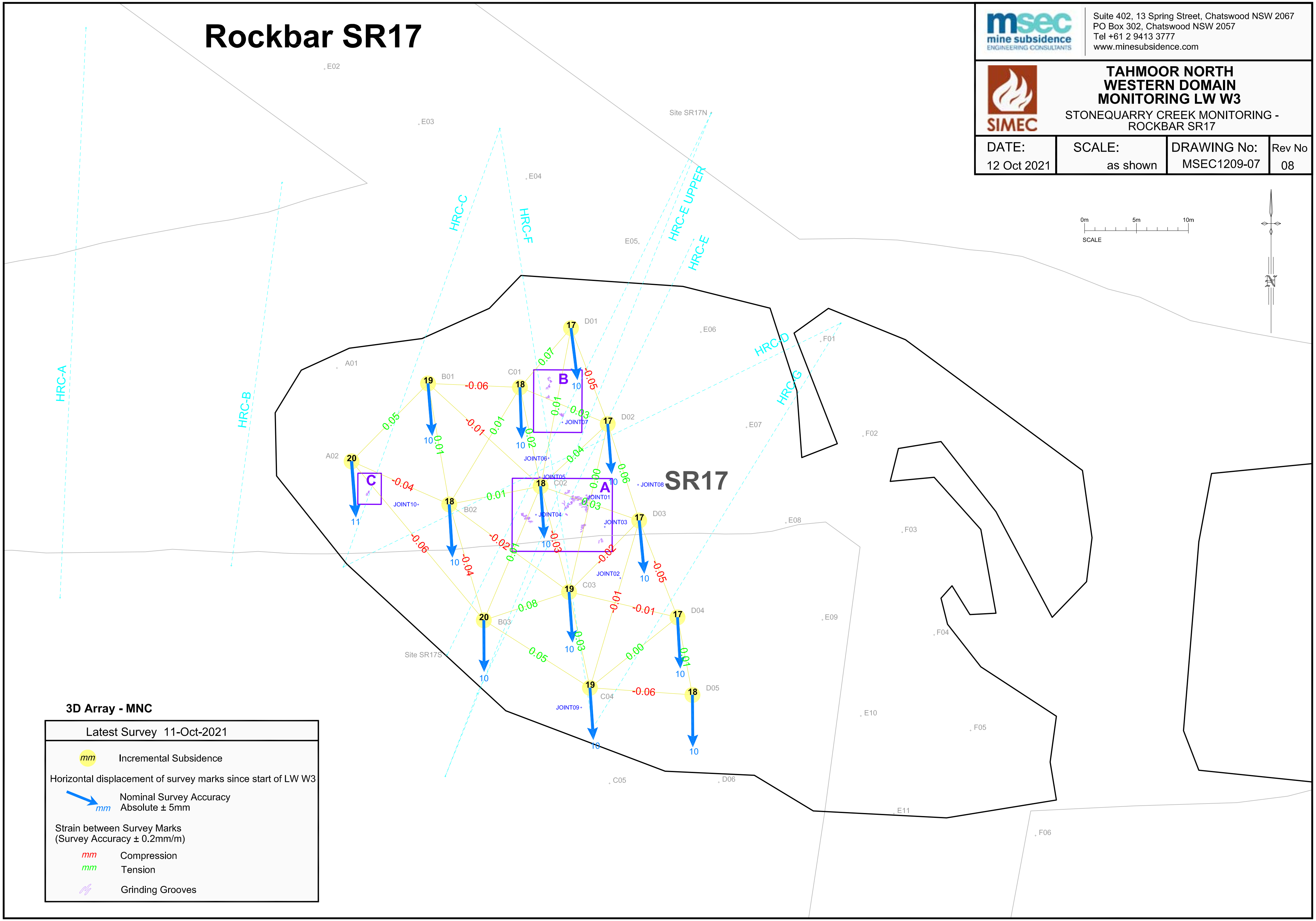


msec

Fig. 2-R08

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-07 Rockbar SR17 MNC survey.dwg

Rockbar SR17



msec
mine subsidence
ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR NORTH
WESTERN DOMAIN
MONITORING LW W3

STONEQUARRY CREEK MONITORING - ROCKBAR SR17

DATE:	SCALE:	DRAWING No:	Rev No
12 Oct 2021	as shown	MSEC1209-07	08

3D Array - MNC

Latest Survey 11-Oct-2021

mm Incremental Subsidence

Horizontal displacement of survey marks since start of LW W3

mm Nominal Survey Accuracy Absolute ± 5mm

Strain between Survey Marks
(Survey Accuracy ± 0.2mm/m)

mm Compression

mm Tension

Grinding Grooves

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-06 Rockbar SR17 SMEC survey.dwg

msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

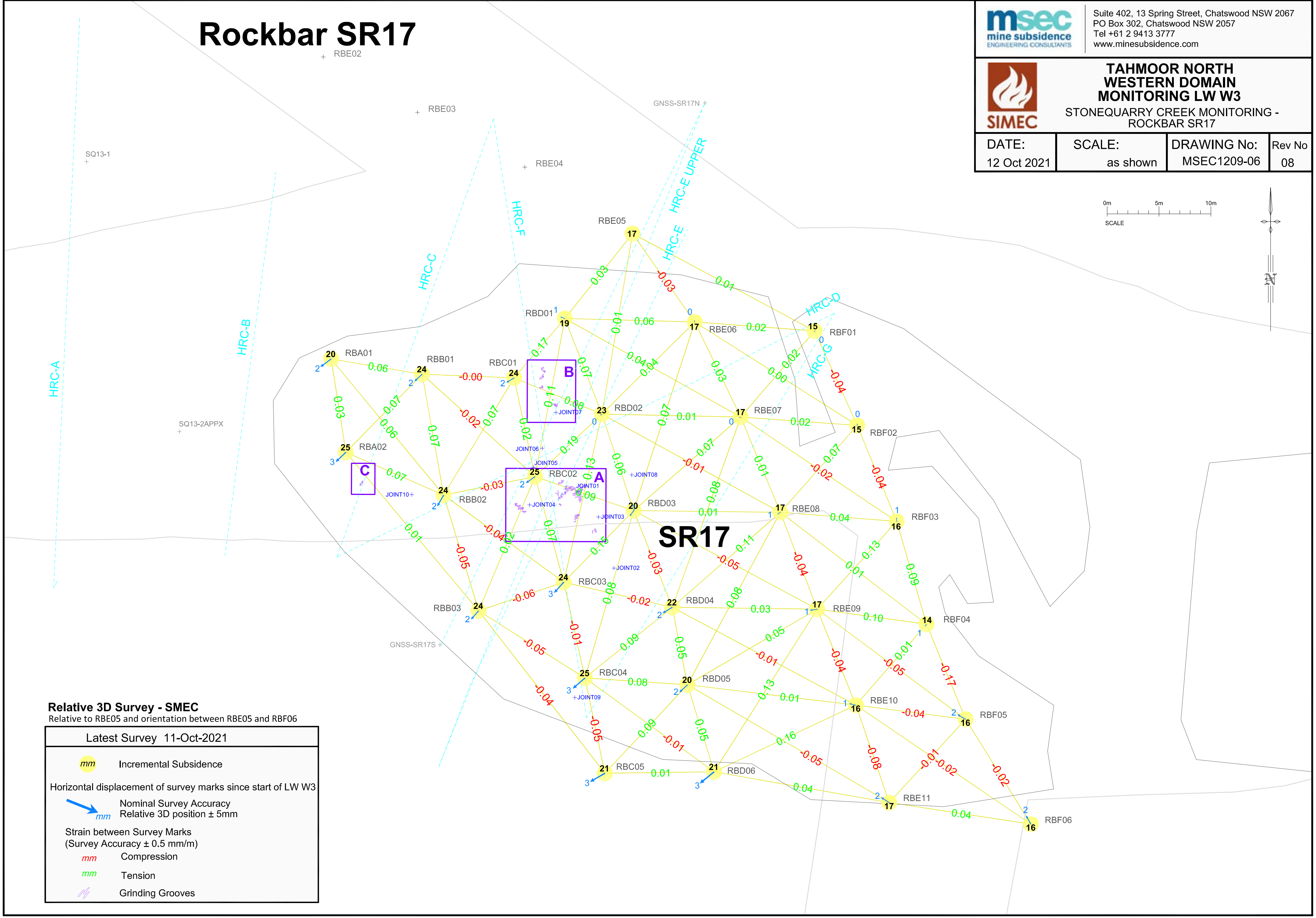
SIMEC

TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W3

STONEQUARRY CREEK MONITORING - ROCKBAR SR17

DATE:	SCALE:	DRAWING No:	Rev No
12 Oct 2021	as shown	MSEC1209-06	08

Rockbar SR17



Relative 3D Survey - SMEC

Relative to RBE05 and orientation between RBE05 and RBF06

Latest Survey 11-Oct-2021

mm Incremental Subsidence

Horizontal displacement of survey marks since start of LW W3

mm Nominal Survey Accuracy Relative 3D position ± 5mm

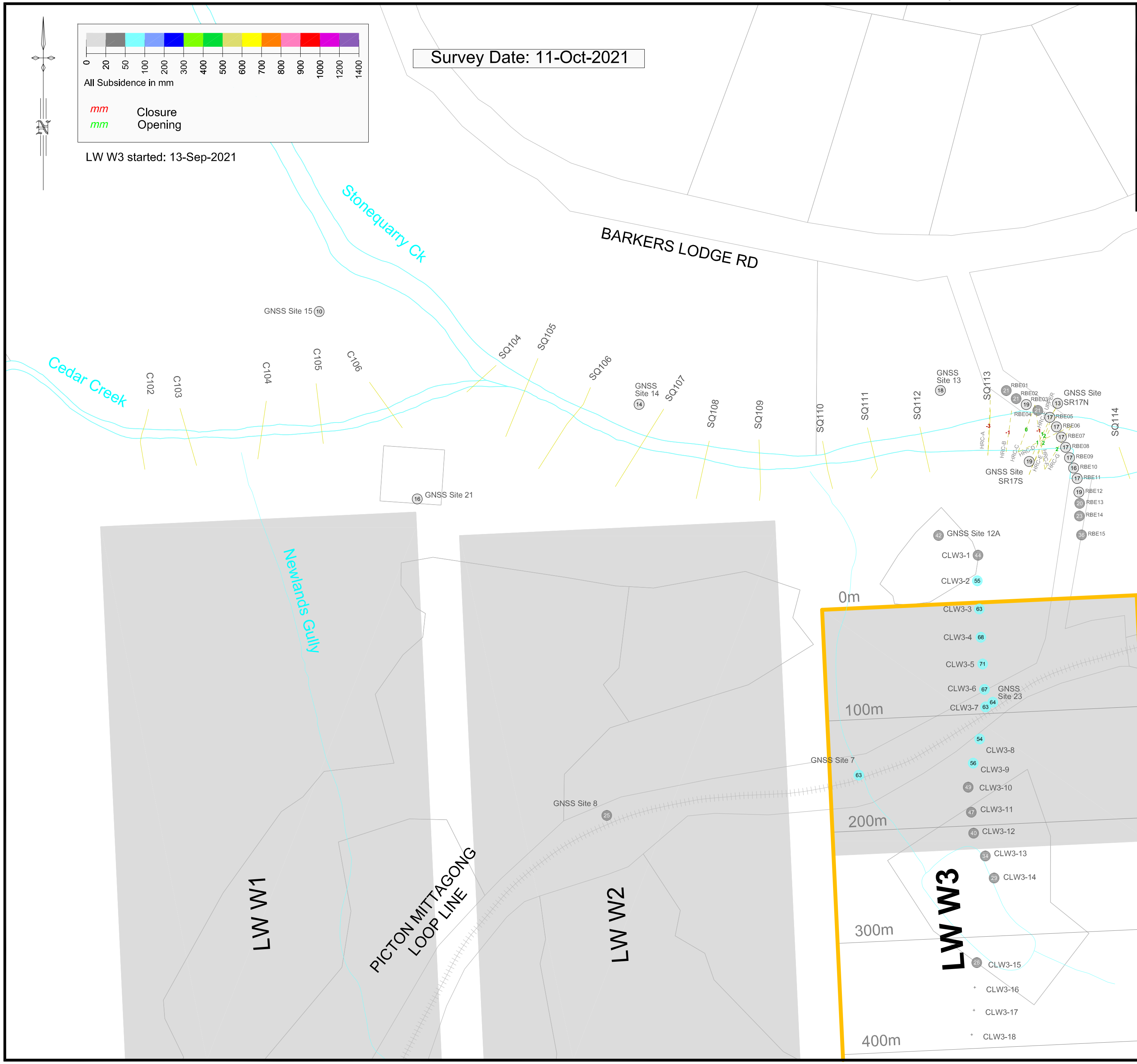
Strain between Survey Marks (Survey Accuracy ± 0.5 mm/m)

mm Compression

mm Tension

Grinding Grooves

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-02 Incremental Subsidence.dwg



msec mine subsidence ENGINEERING CONSULTANTS

Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W3

OBSERVED INCREMENTAL SUBSIDENCE DUE TO LW W3

DATE:	SCALE:	DRAWING No:	Rev No
12 Oct 2021	1:10 000	MSEC1209-02	08

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-04 Inc Hzl Movt.dwg

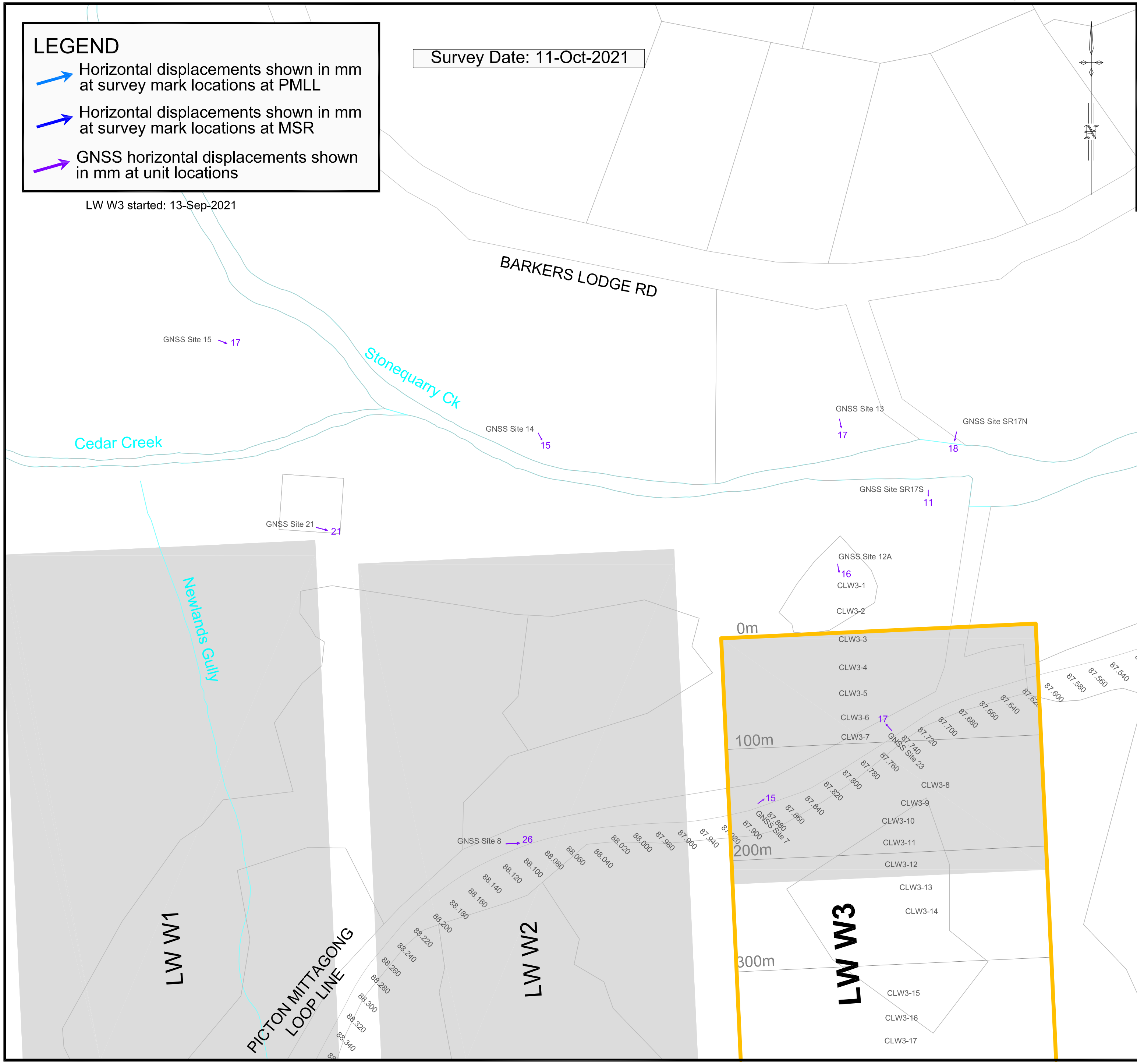
msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

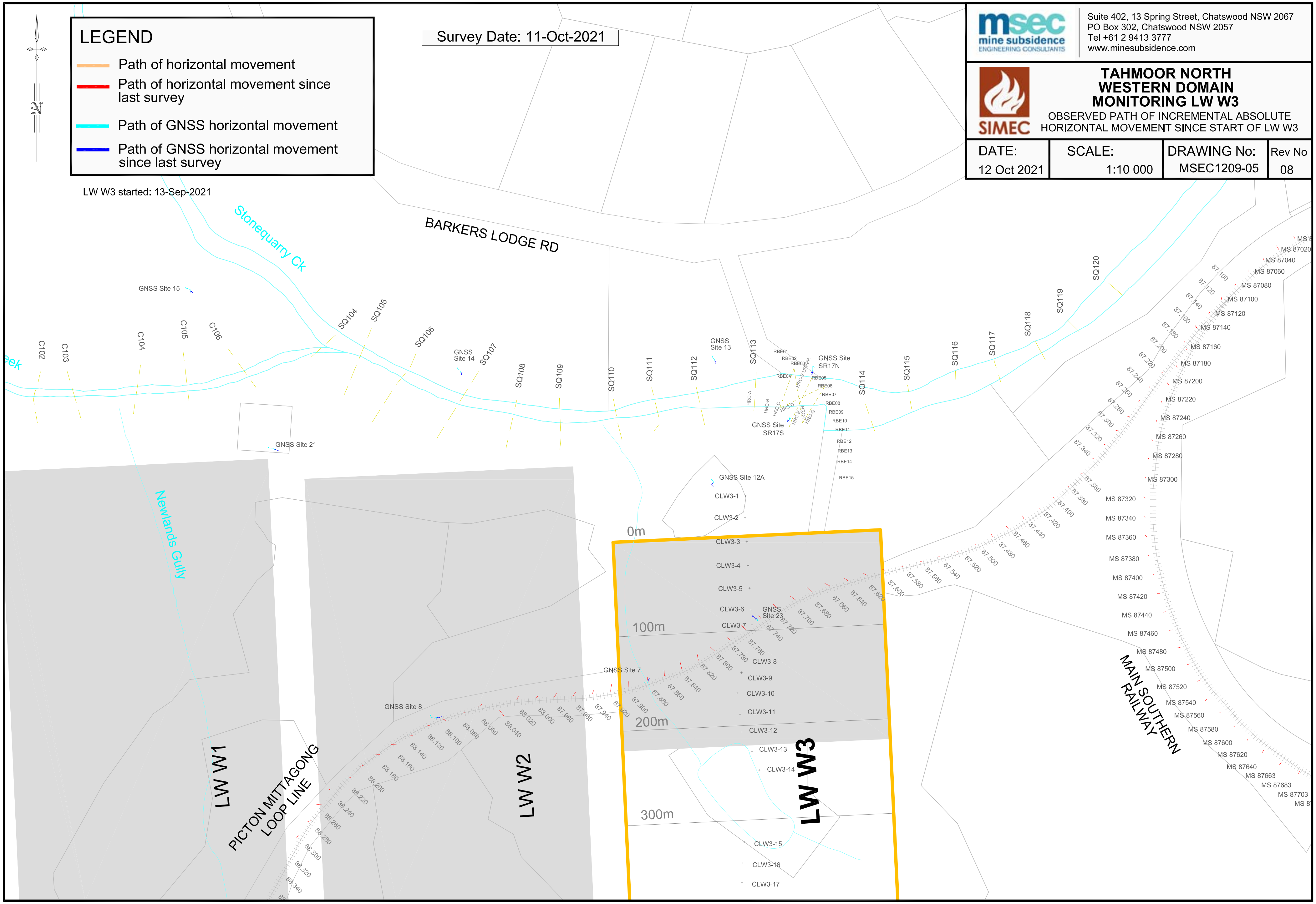
TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W1-W2

OBSERVED INCREMENTAL ABSOLUTE HORIZONTAL MOVEMENT SINCE START OF LW W3

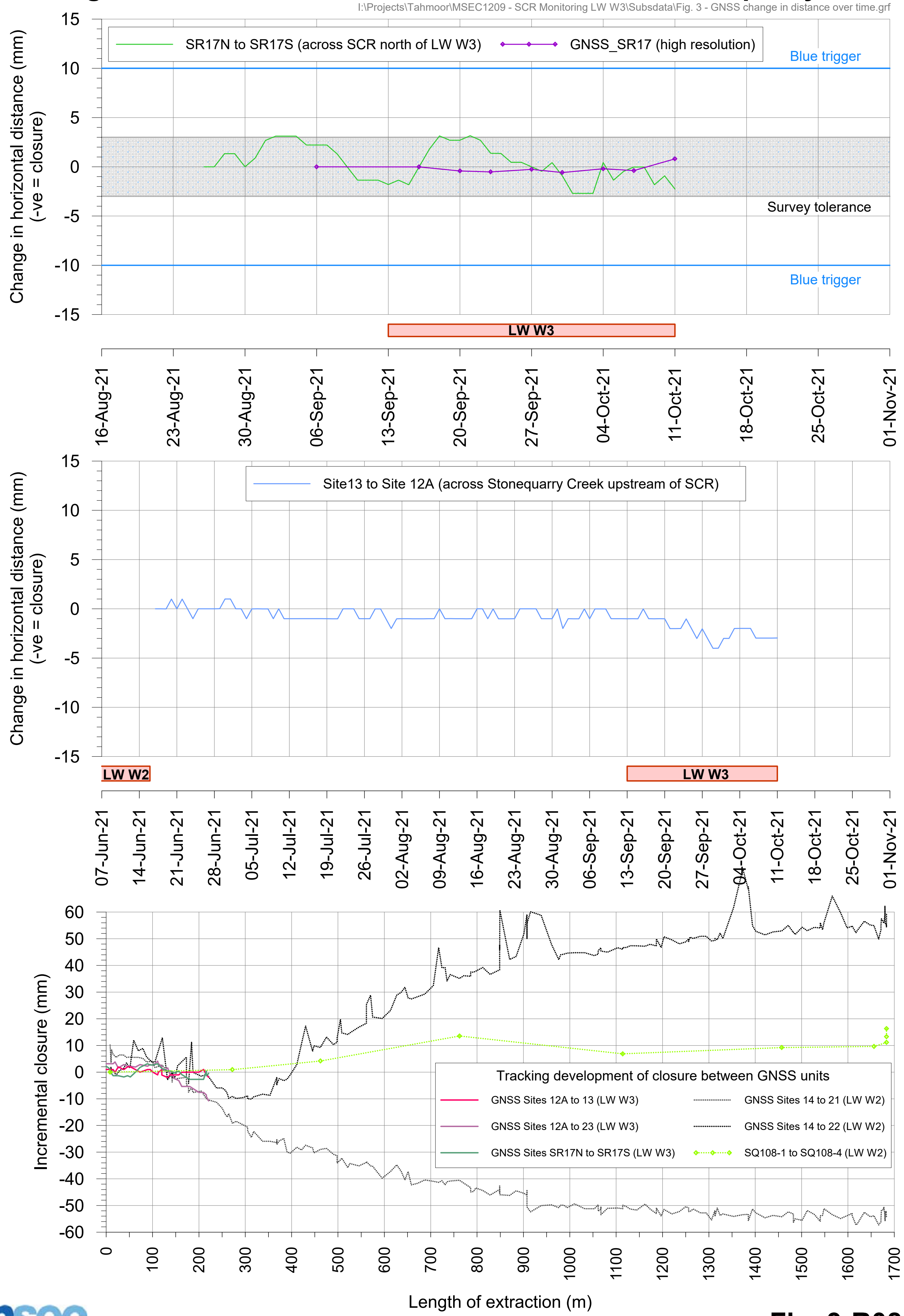
DATE:	SCALE:	DRAWING No:	Rev No
12 Oct 2021	1:10 000	MSEC1209-04	08



I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-05 Inc Loci.dwg



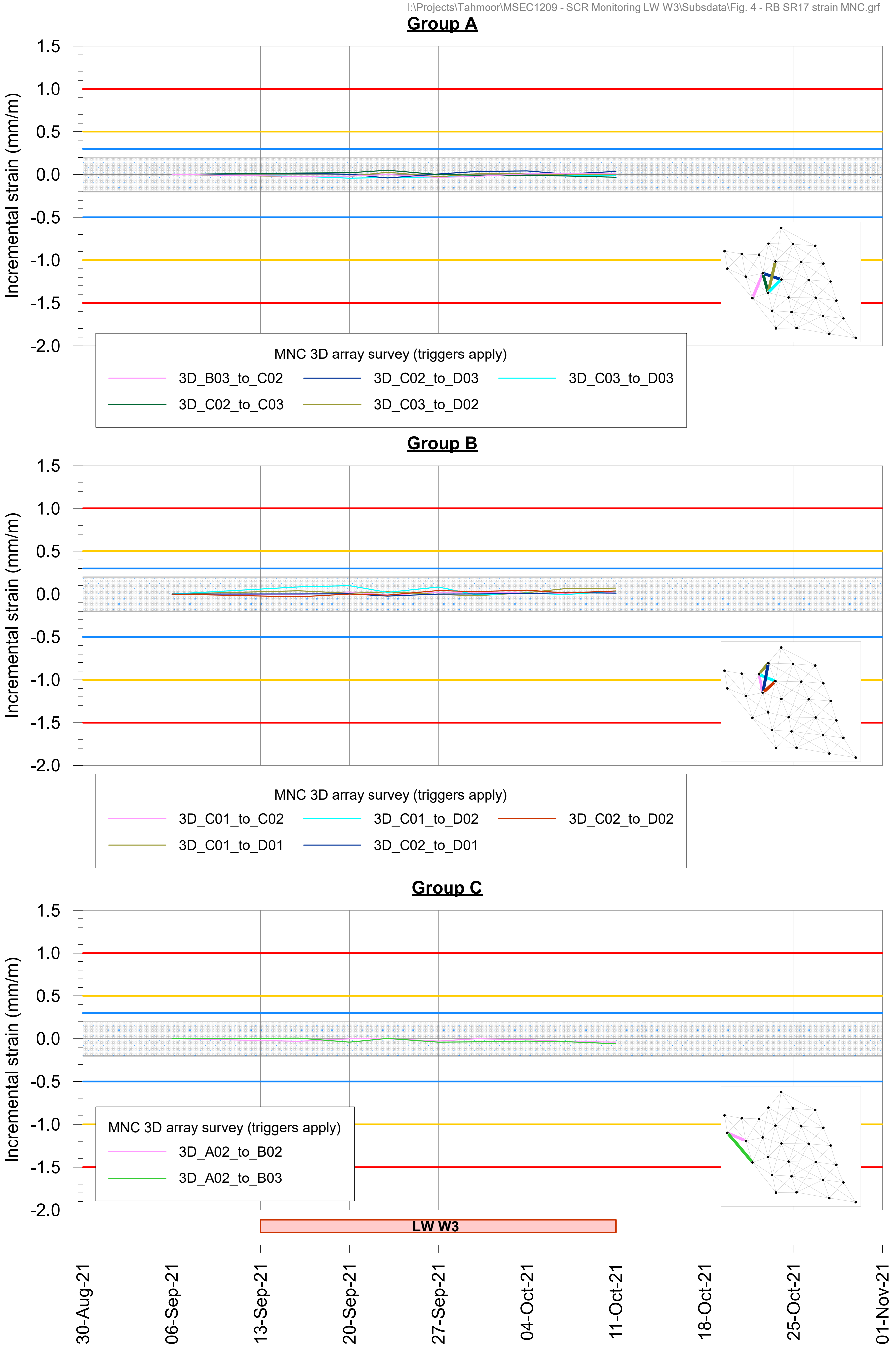
Tahmoor LW W3 - GNSS Monitoring
Change in distance between GNSS units across Stonequarry Creek



msec

Fig. 3-R08

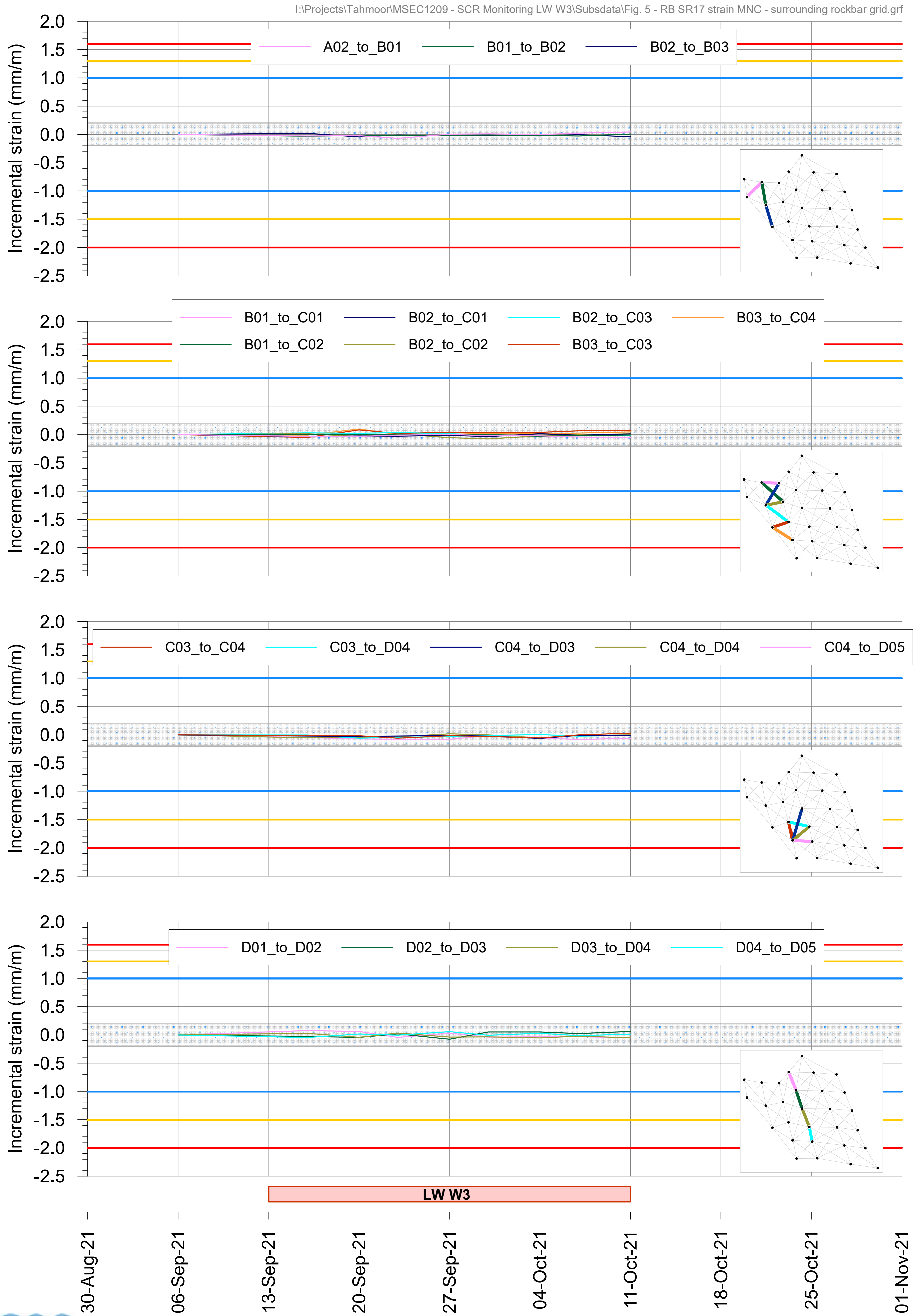
Tahmoor LW W3 - SCR Monitoring (MNC)



msec

Fig. 4-R08

Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (MNC)



msec

Fig. 5-R08

Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (SMEC - triggers apply)

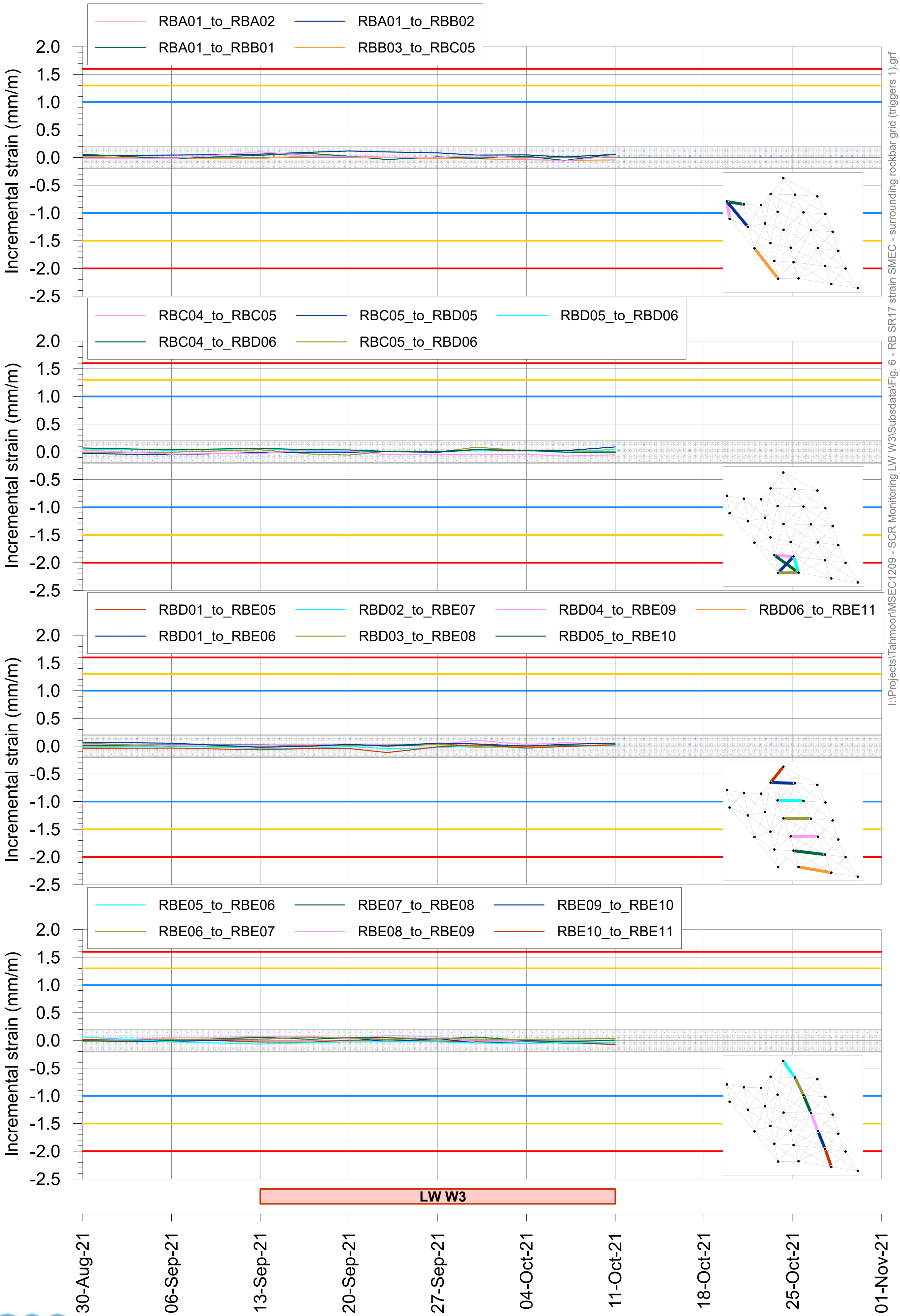
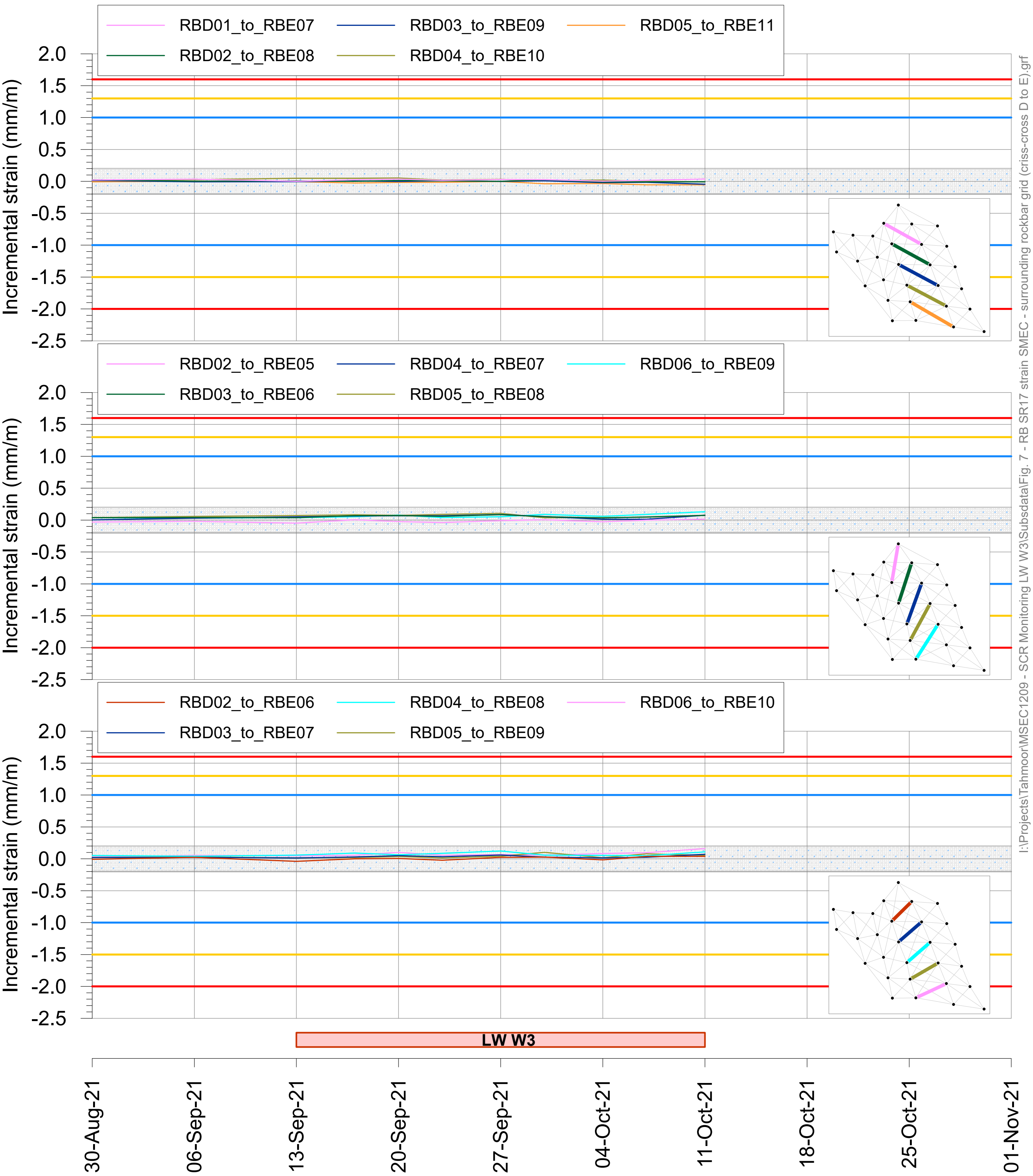
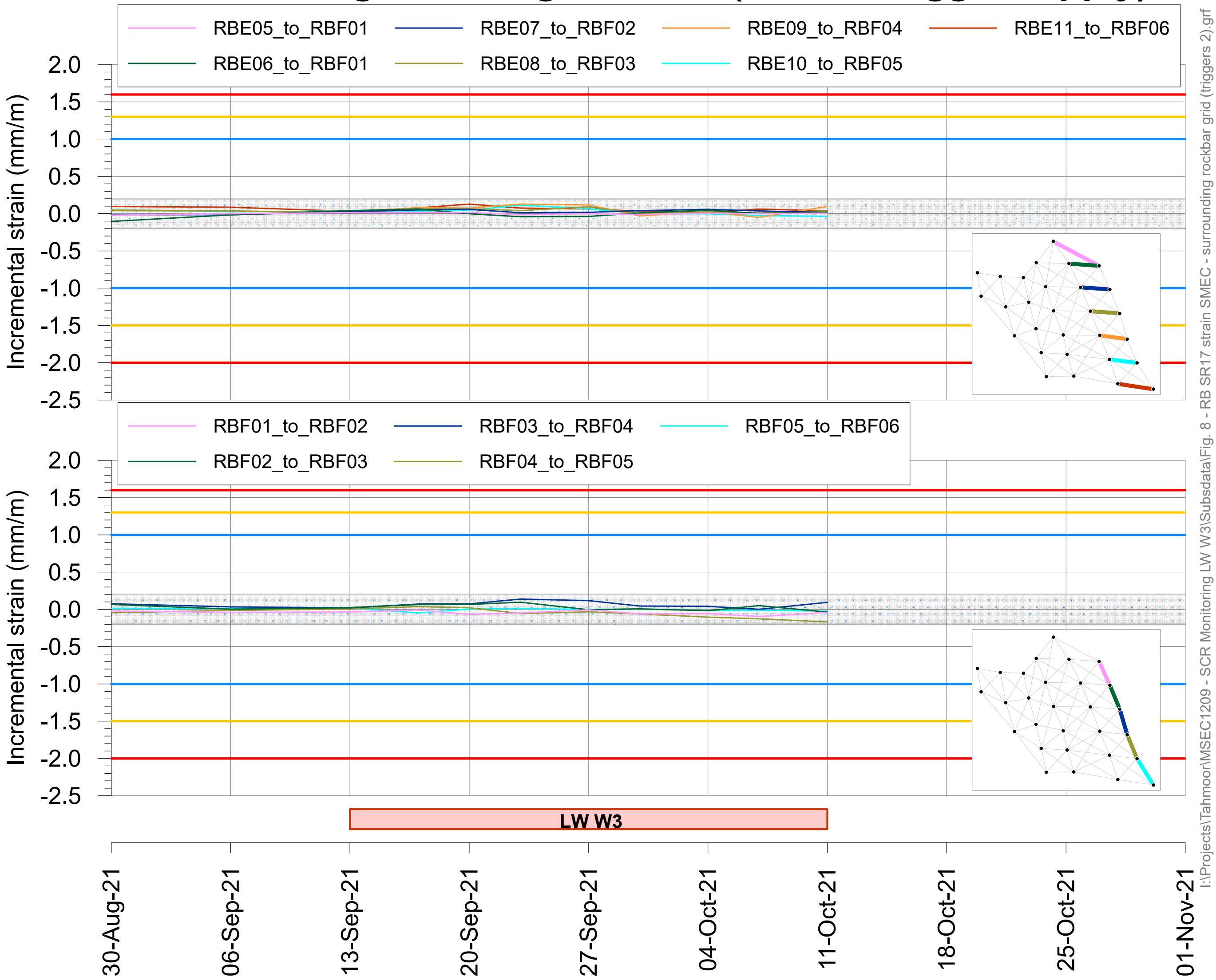


Fig. 6-R08

Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (SMEC - triggers apply)



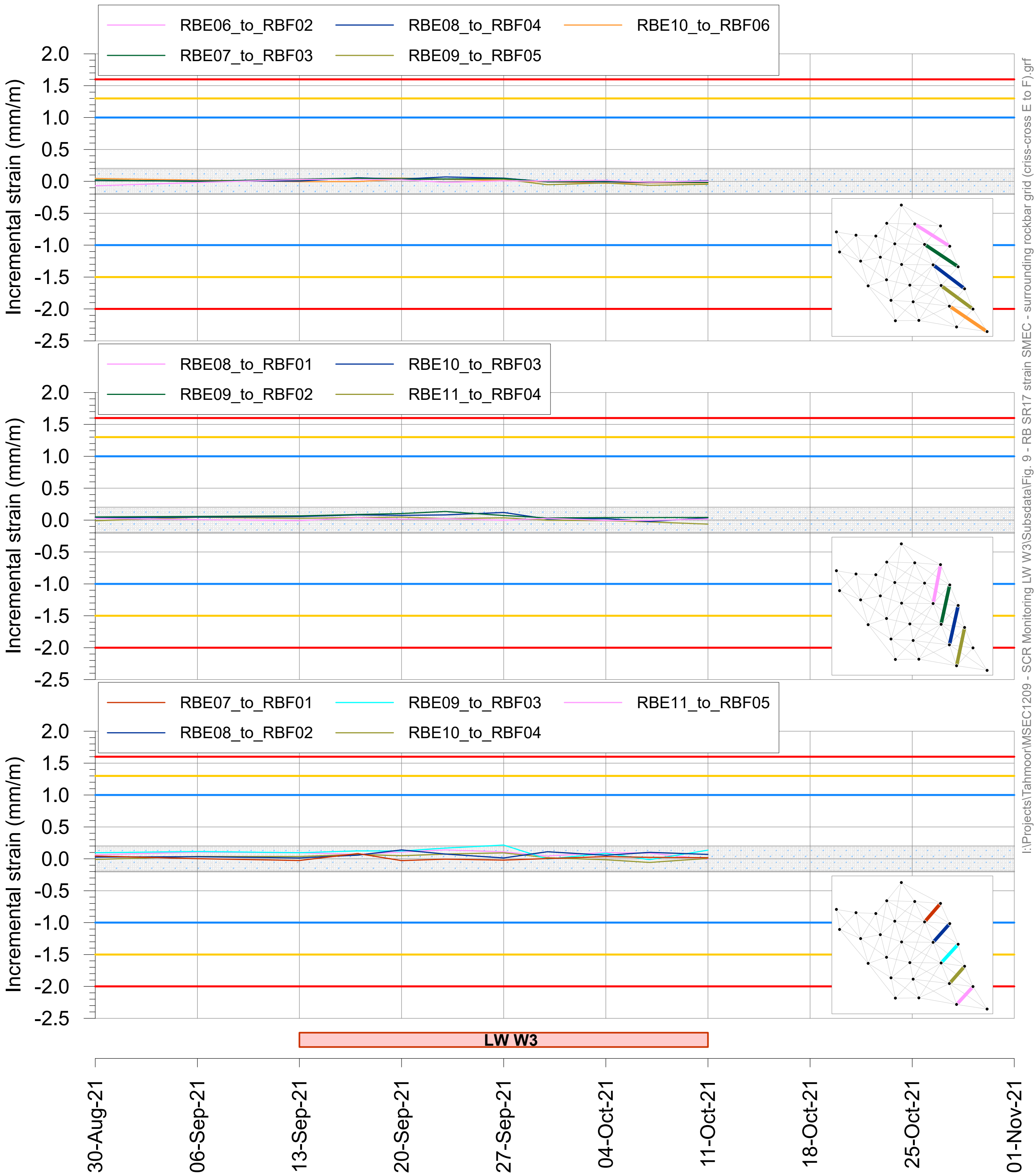
Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (SMEC - triggers apply)



msec

Fig. 8-R08

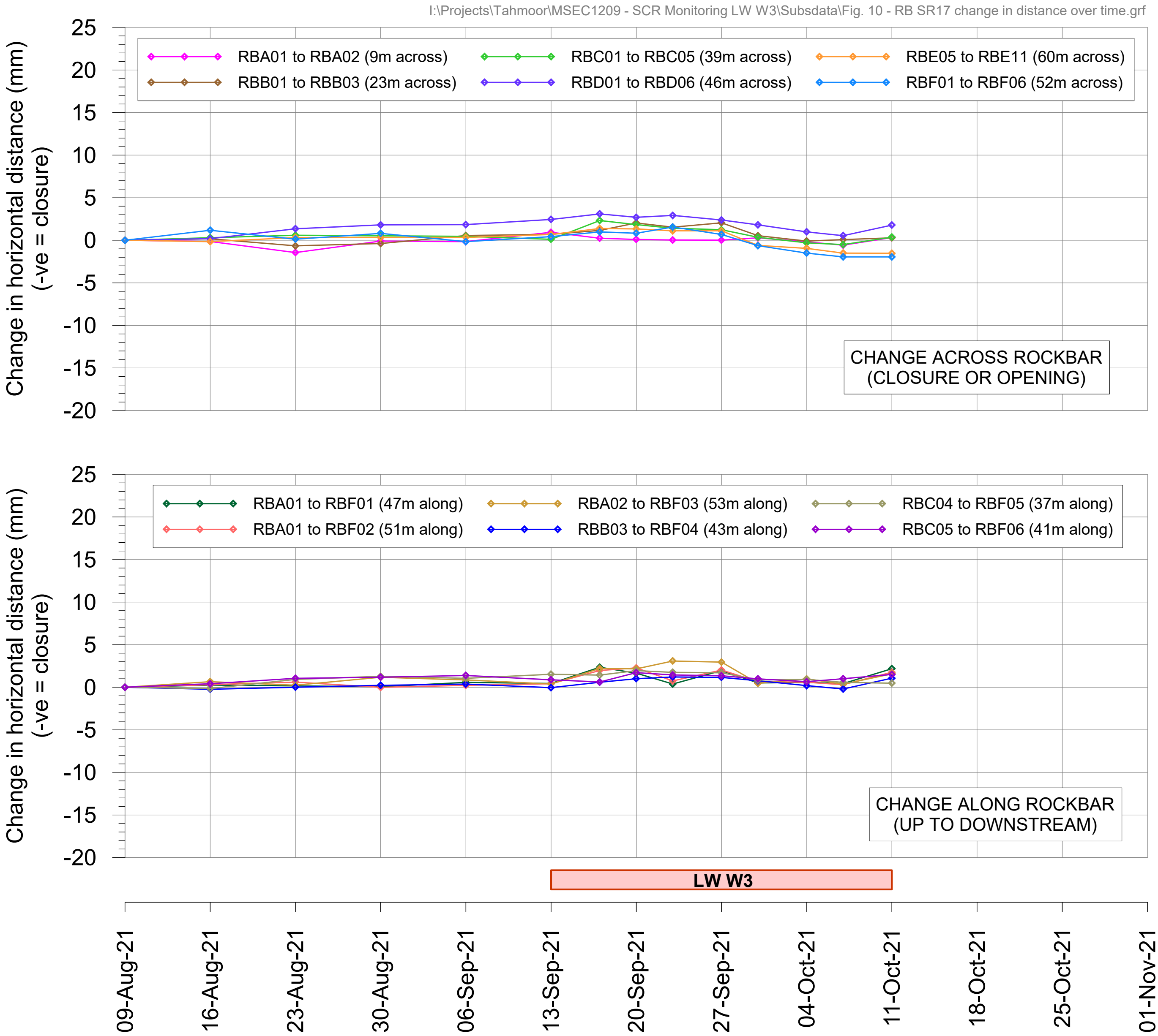
Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (SMEC - triggers apply)



msec

Fig. 9-R08

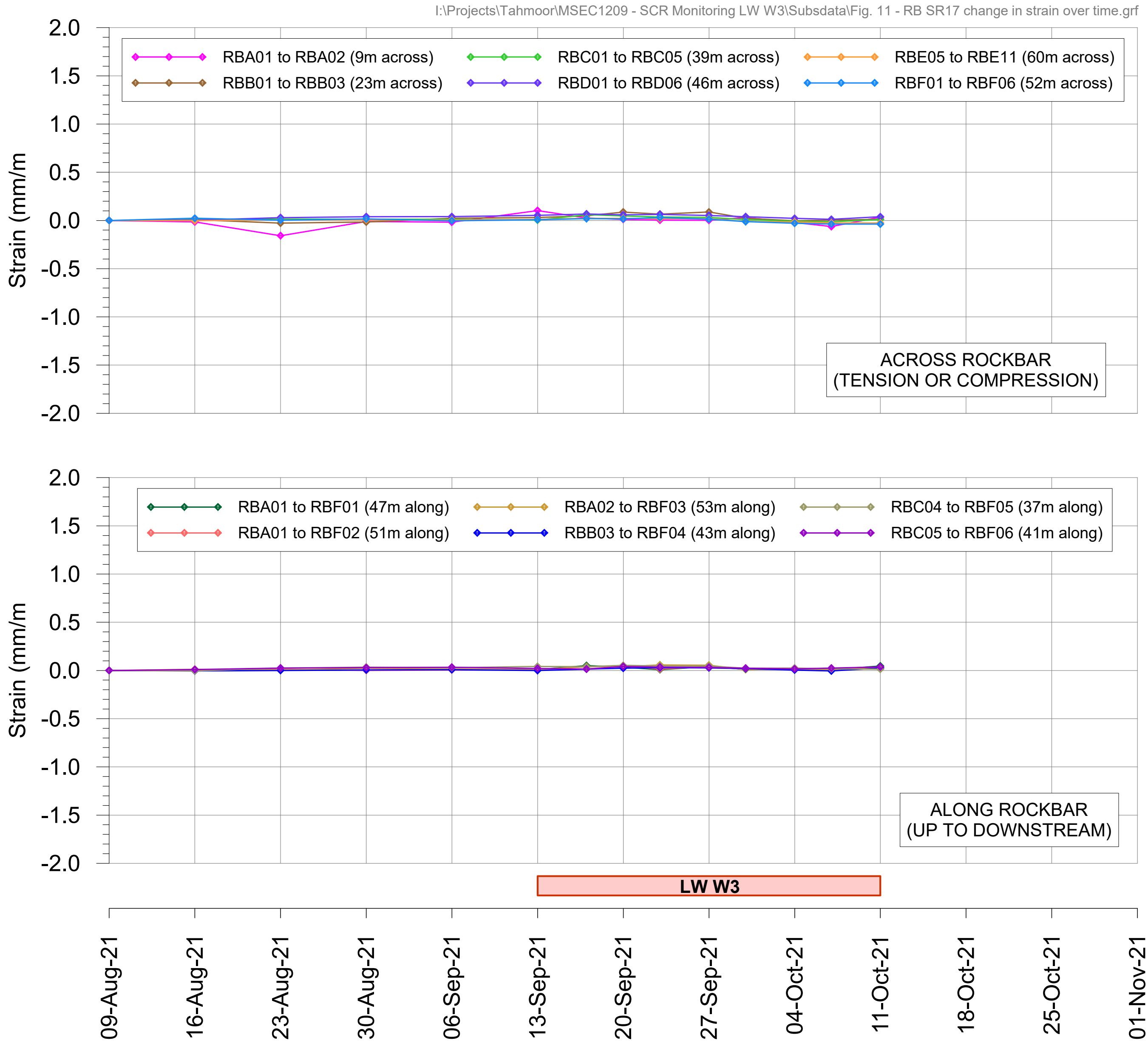
Tahmoor LW W3 - Rockbar SR17
Changes in distance along and across the rockbar



msec

Fig. 10-R08

Tahmoor LW W3 - Rockbar SR17
Changes in strain along and across the rockbar



msec

Fig. 11-R08

Tahmoor LW W3 - SCR Monitoring (SMEC - no triggers apply)

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. 12 - RB SR17 strain SMEC.grf

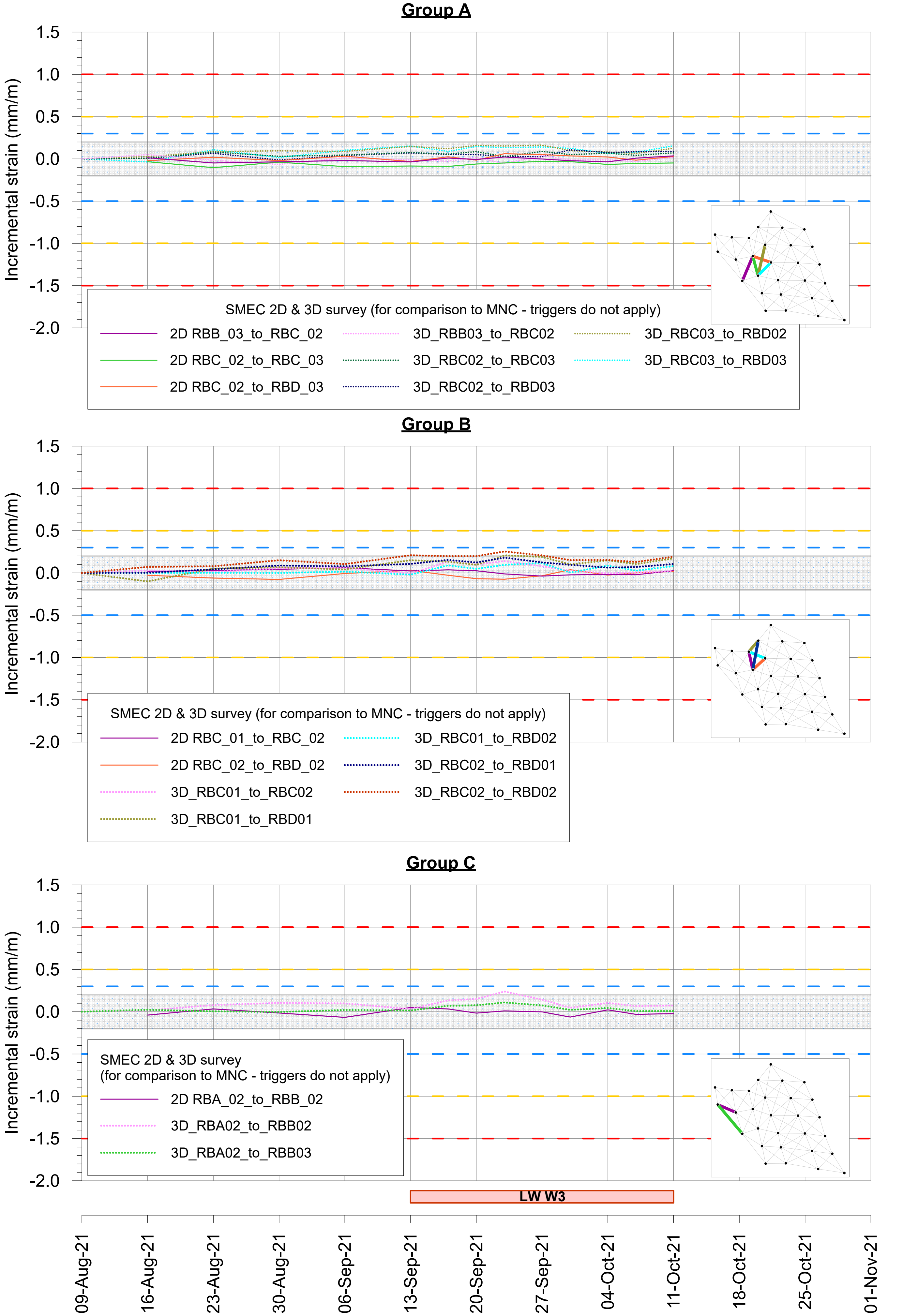


Fig. 12-R08

Tahmoor LW W3 - SCR Monitoring
Surrounding rockbar grid strain (SMEC - no triggers apply)

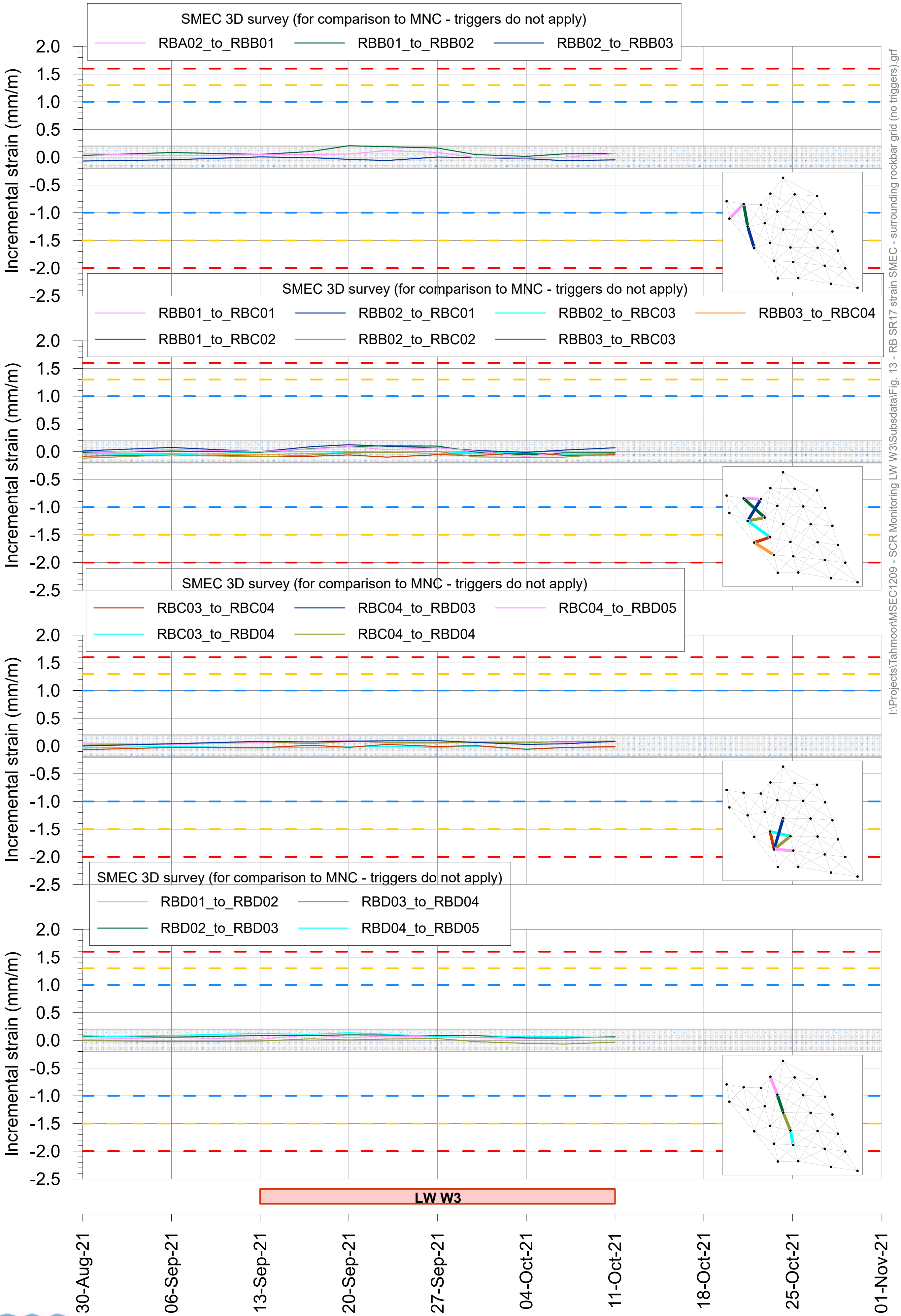
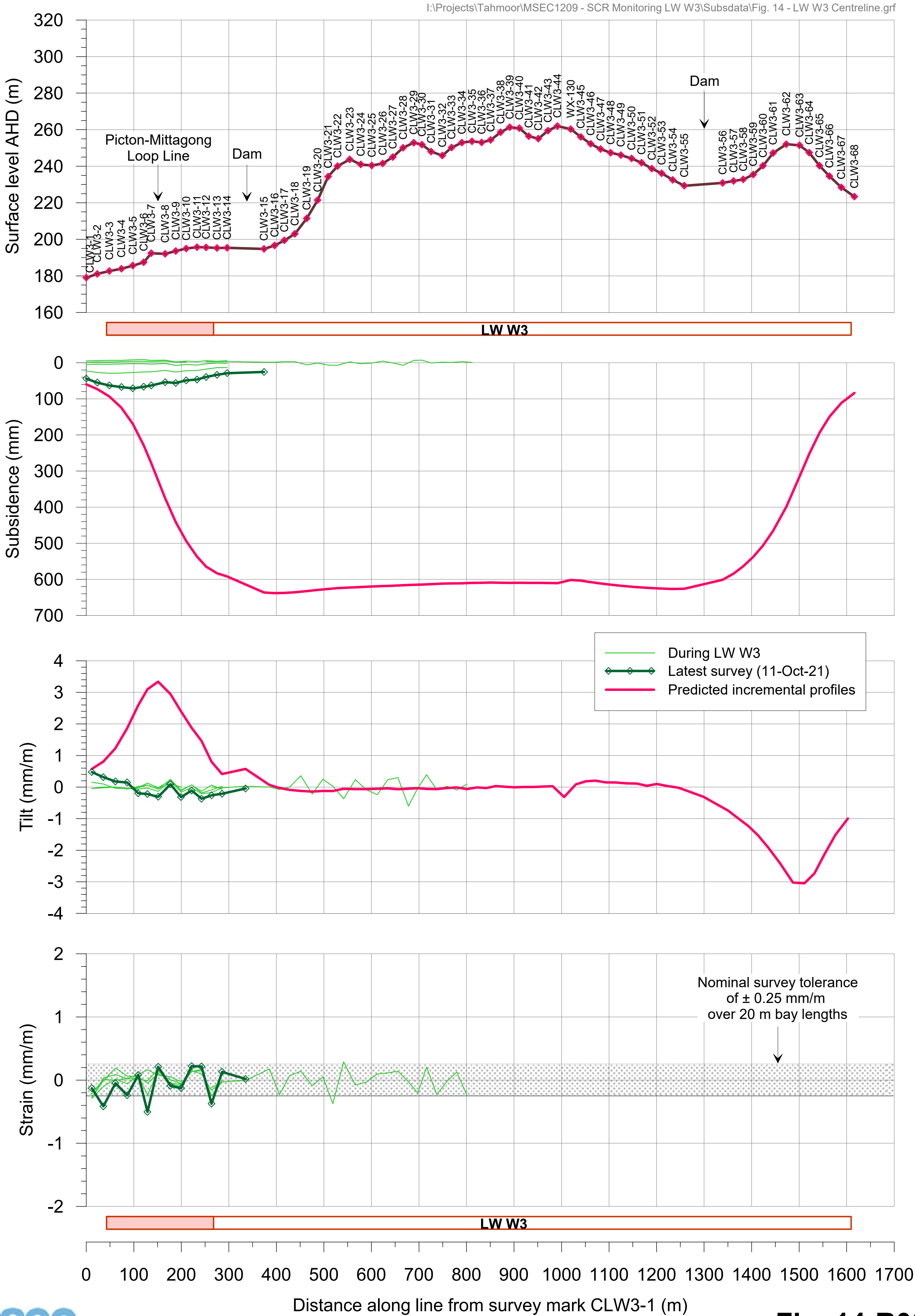


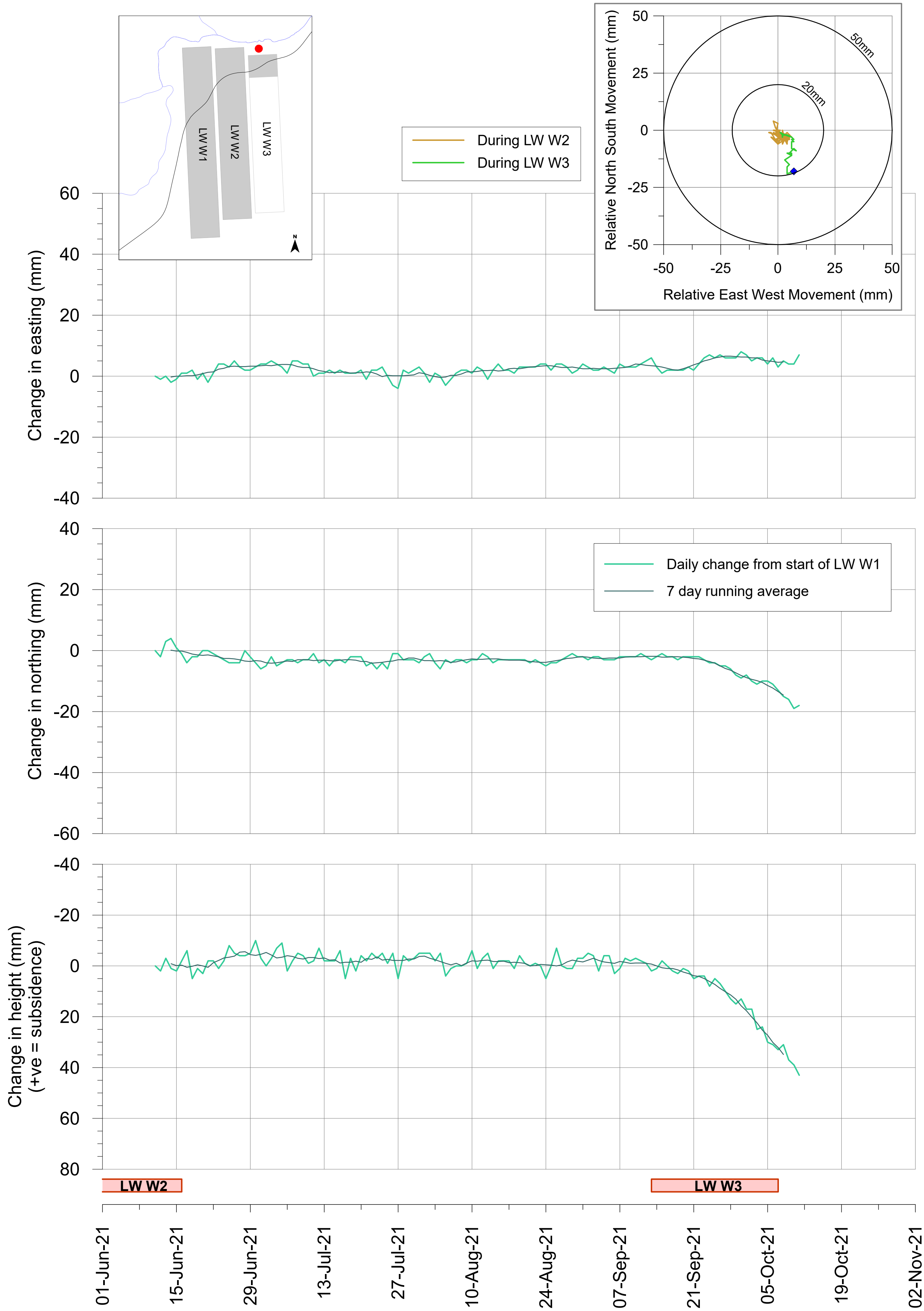
Fig. 13-R08

Tahmoor LW W3
Incremental subsidence profiles along LW W3 Centreline



Tahmoor LW W3 - GNSS Monitoring
Site 12A - south of Stonequarry Creek upstream of Rockbar SR17

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. G12A - GNSS.grf



msec

Fig. G12A-R08

Tahmoor LW W3 - GNSS Monitoring

Site 13 - north of Stonequarry Creek upstream of Rockbar SR17

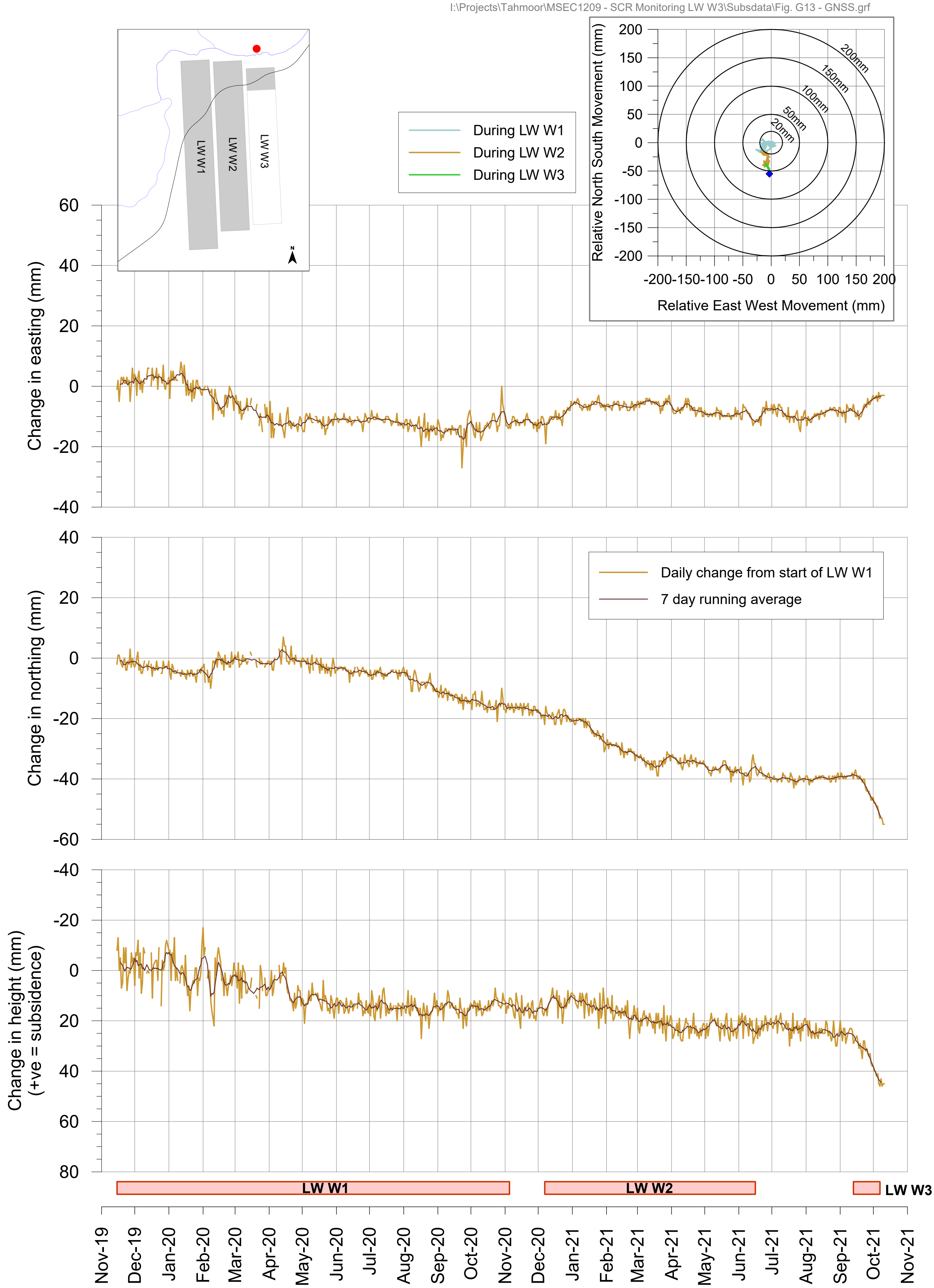


Fig. G13-R08

Tahmoor LW W2 - GNSS Monitoring

Site 14 - Northern side of Stonequarry Creek near 88.040km

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. G14 - GNSS.grf

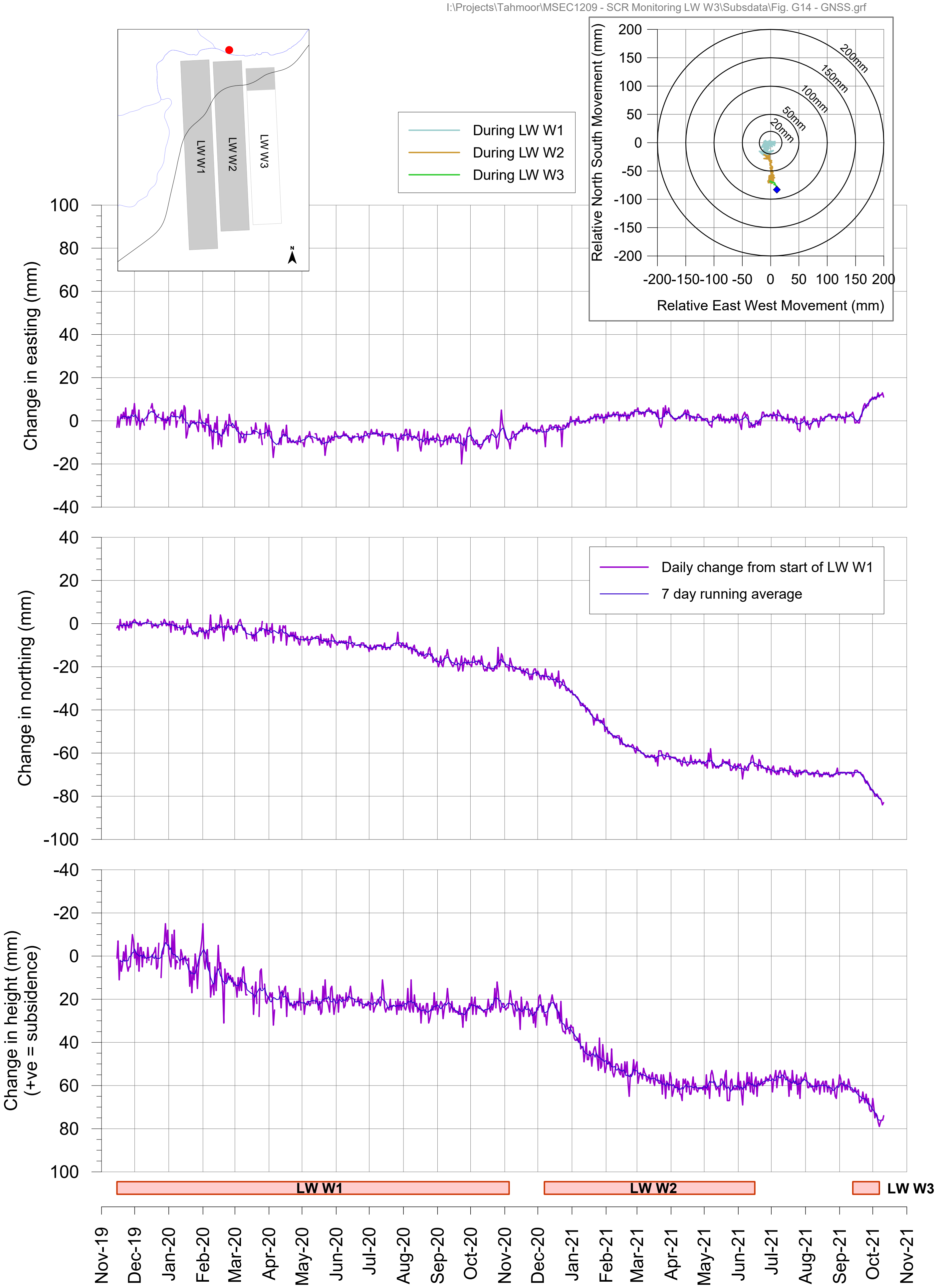
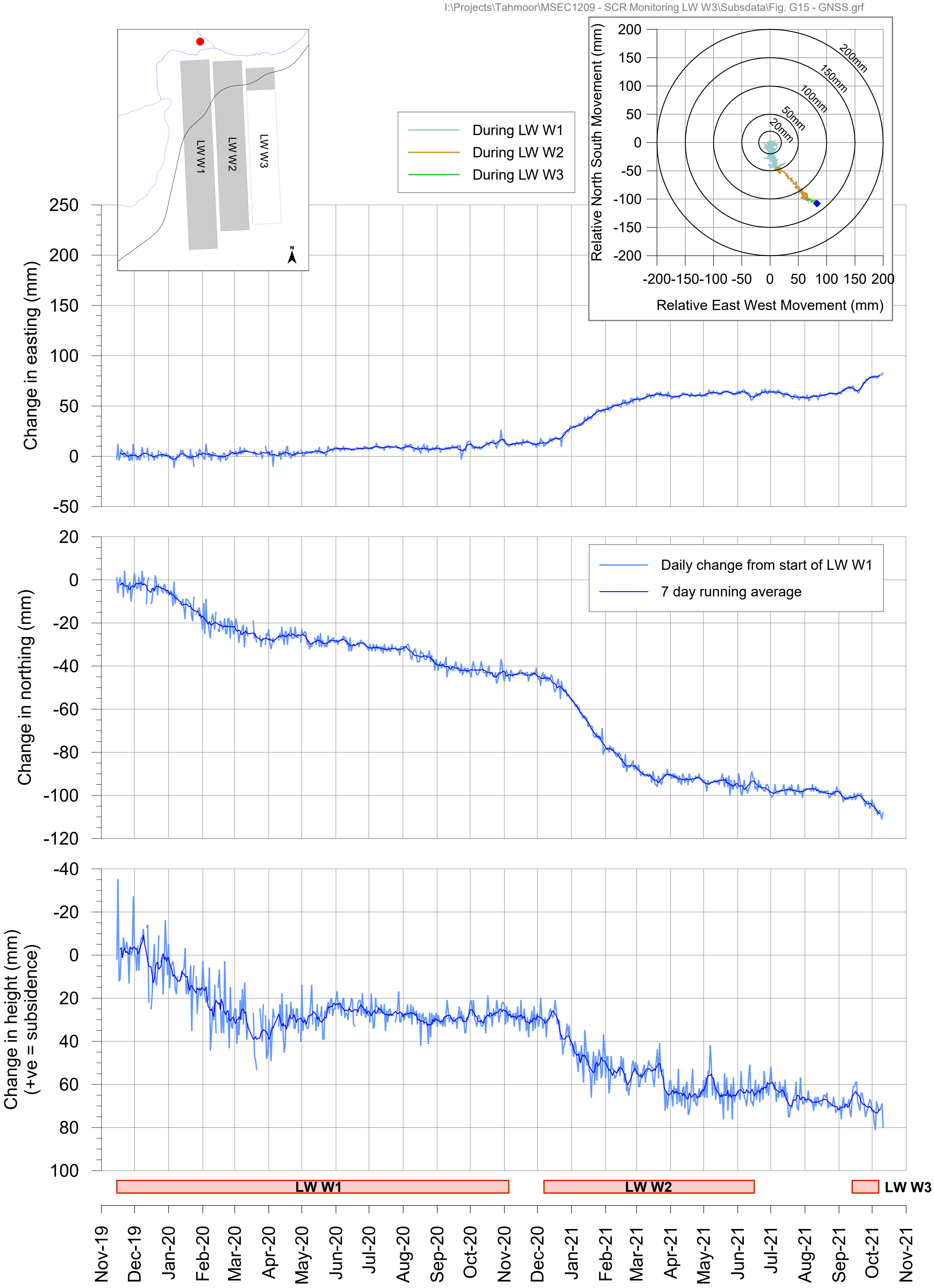


Fig. G14-R08

Tahmoor LW W2 - GNSS Monitoring

Site 15 - Near commencing end of LW W1

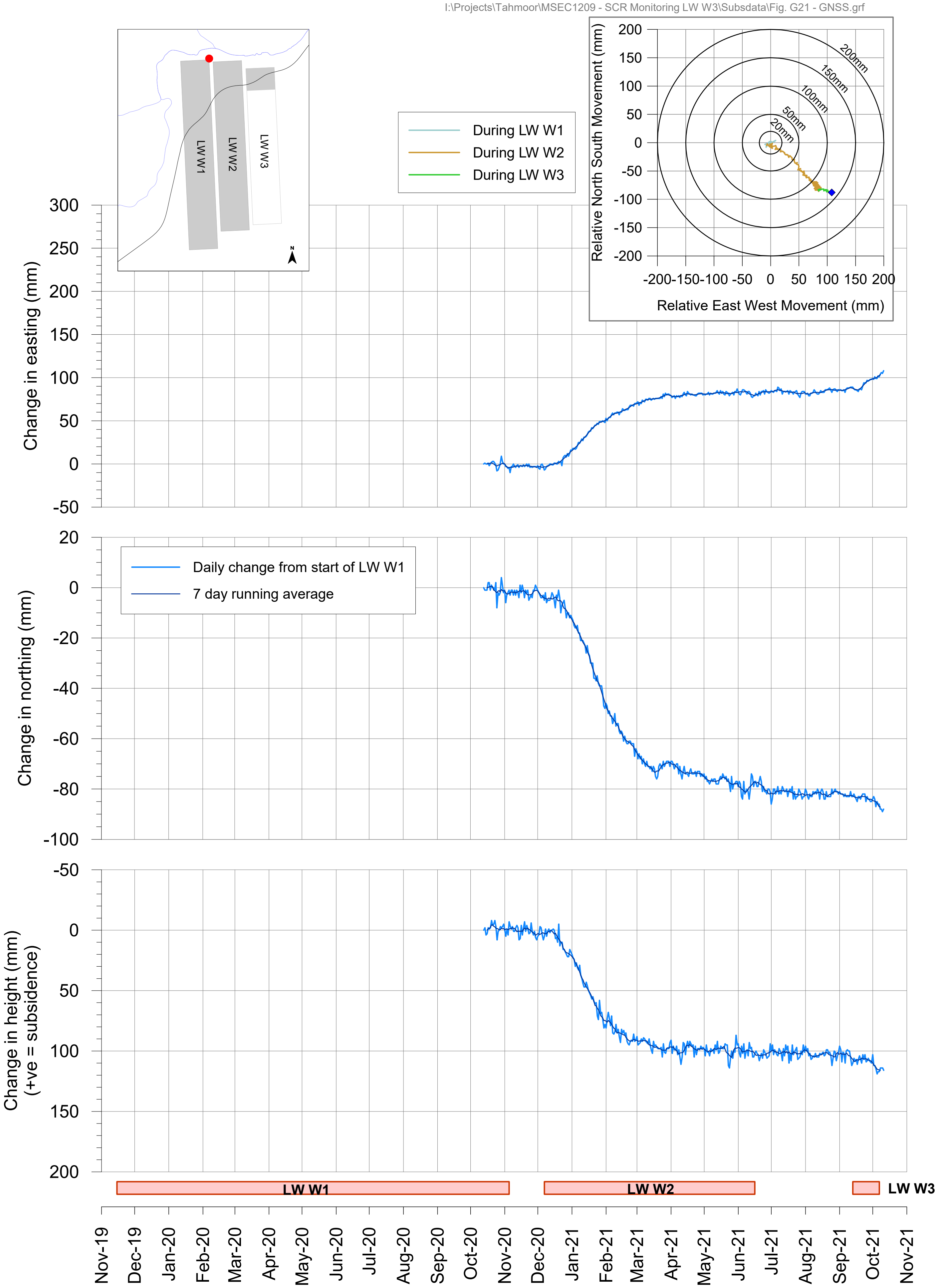


msec

Fig. G15-R08

Tahmoor LW W2 - GNSS Monitoring
Site 21 - LW W1-2 commencing ends

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. G21 - GNSS.grf

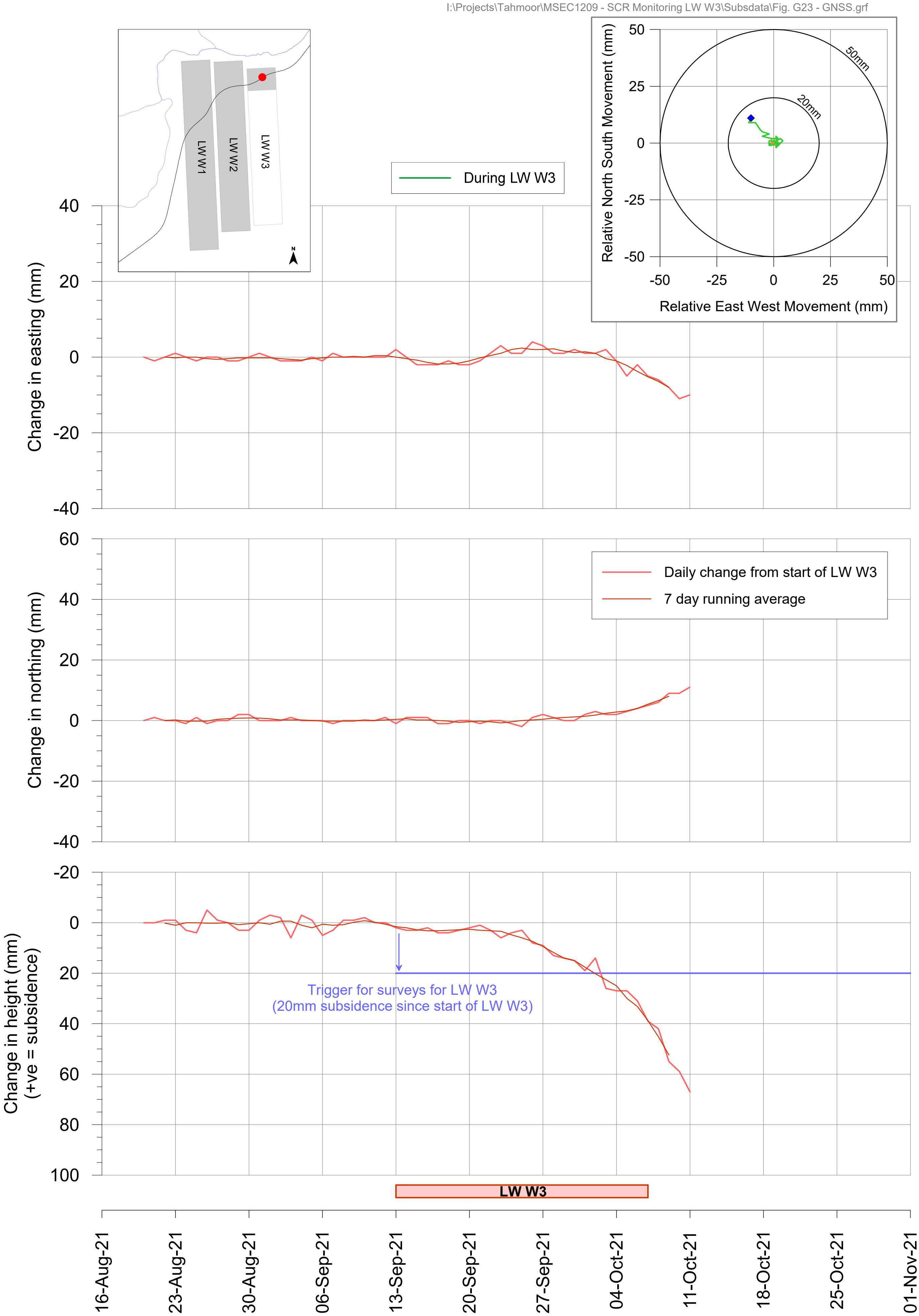


msec

Fig. G21-R08

Tahmoor LW W3 - GNSS Monitoring
Site 23 - PMLL at 87.740km

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. G23 - GNSS.grf

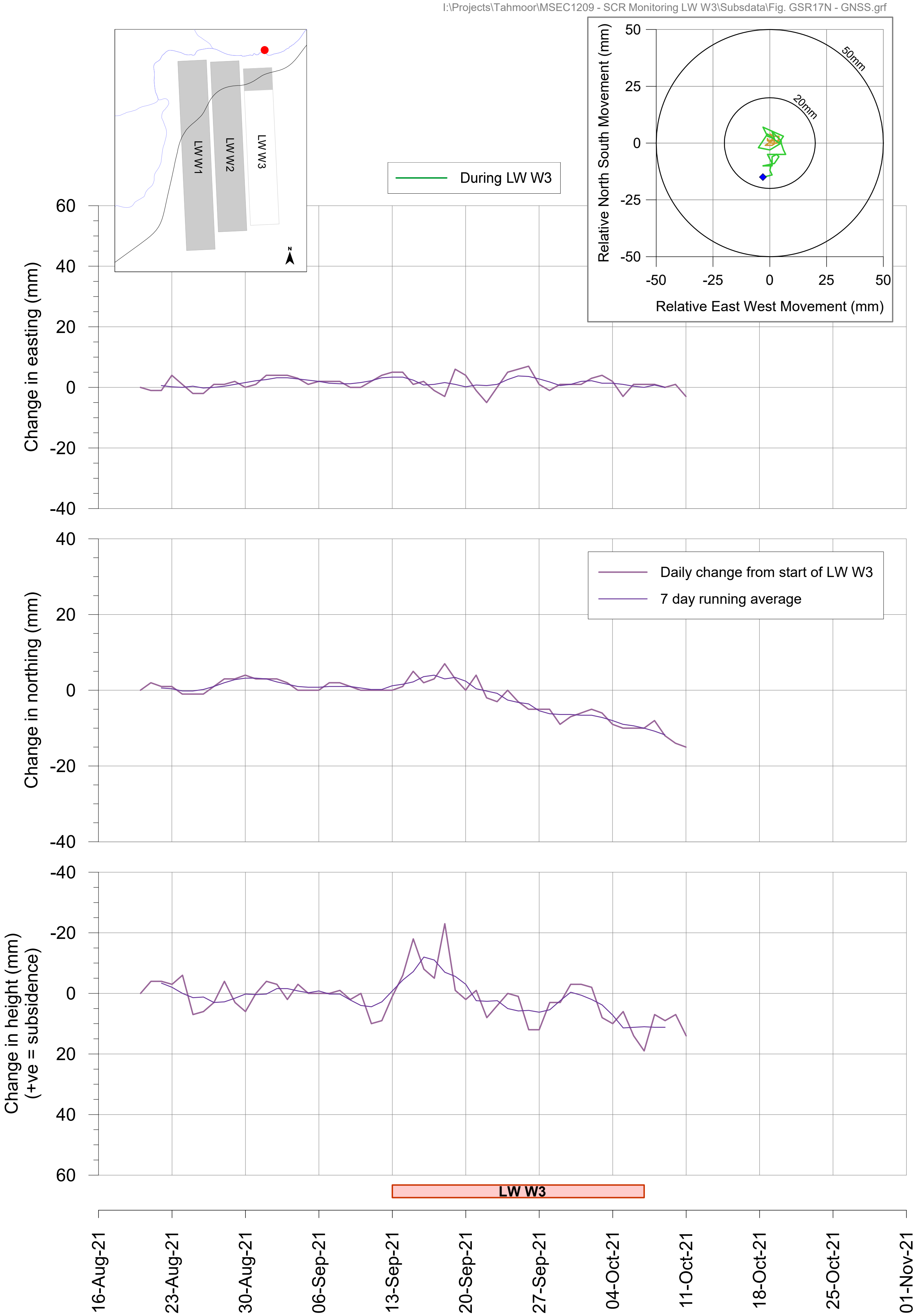


msec

Fig. G23-R08

Tahmoor LW W3 - GNSS Monitoring
Site SR17N - Northern side of rockbar

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. GSR17N - GNSS.grf

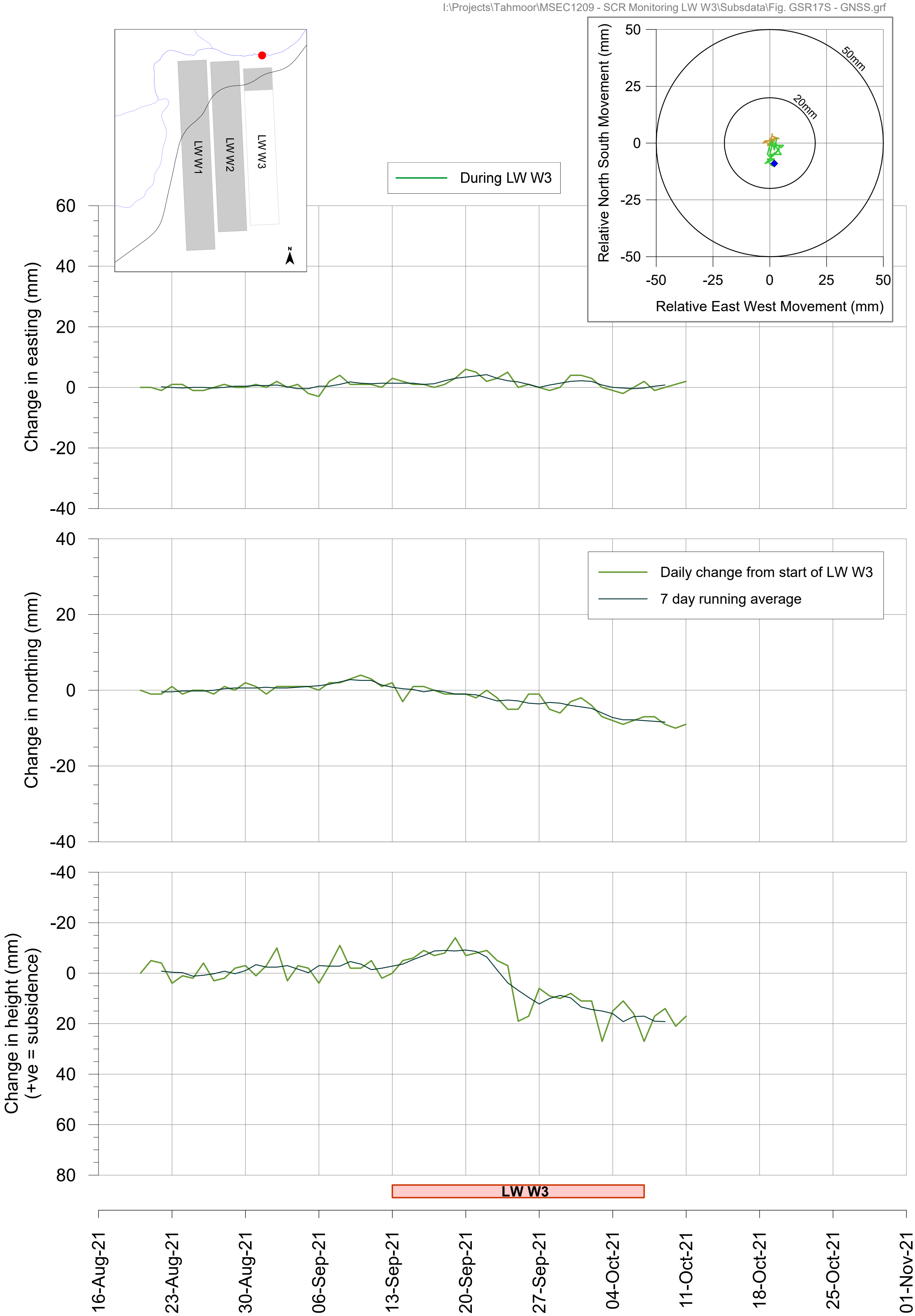


msec

Fig. GSR17N-R08

Tahmoor LW W3 - GNSS Monitoring
Site SR17S - Southern side of rockbar

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. GSR17S - GNSS.grf



msec

Fig. GSR17S-R08

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 13
During the mining of LW W3 for Stonequarry Creek Rockbar

Reporting Period	23 October 2021 to 29 October 2021	
Length of extraction	375 m	as at 28 October 2021. LW stopped on 28 October in light of observation of new fracture observed on south east corner of Rockbar, 40 metres downstream of heritage site.
Closest distance of LW W3 face to Rockbar	515 m	to Mark C02 (LW moving away)
Distance travelled by LW since previous report	82 m	Since 20 October. LW commenced 13 September 2021
Maximum incremental subsidence at Rockbar Mark C02 due to LW W3	29 mm	on 28 October 2021.
Maximum increase in subsidence at Rockbar Mark C02 since previous survey	3 mm	from 21 October to 28 October.
Weather and flow conditions	High temperatures, gale force winds and large hailstones on 23 Oct. High temperatures on 28 Oct. Trickle flow over rockbar along main channel.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
GNSS				
GNSS unit above commencing end of LW W3 (Site 23)	Continuous		N/A	Subsidence increasing and minor horizontal movements developing. The GNSS unit is gradually turning from a northwards to southwards direction to chase the retreating LW face.
GNSS unit (Site 12A)	Continuous		N/A	Minor subsidence developing. Minor horizontal movements developing towards the south and east.
GNSS unit (Site 13)	Continuous		N/A	Minor subsidence developing. Minor horizontal movements developing towards the south and east.
GNSS unit (Site SR17N)	Continuous		N/A	No measurable subsidence observed. Very minor horizontal movements developing towards the south.
GNSS unit (Site SR17S)	Continuous		N/A	Very minor subsidence developing. Very minor horizontal movements developing towards the south.
High resolution surveys across Rockbar				
High resolution closure lines	25 & 28 Oct	Daily		HRC-C Line extended to 2.1 mm exceeding Blue trigger on 25 Oct. No measurable change on 28 Oct. HRC-D line extended from 2.9 mm to 3.6 mm this week. HRC-E line extended from 2.7 mm to 3.9 mm this week. HRC-G line extended from 2.2 mm to 3.7 mm this week. HRC-A Line has reduced in closure from -2.0 mm to 1.1 mm this week. HRC-B Line has changed from -0.2 mm closure to 0.8 mm extension this week.
3D surveys across grinding groove sites (3D array)	25 & 28 Oct	Daily		Results within survey tolerances across grinding groove sites.
Ground surveys across Rockbar				
Absolute 3D surveys	-	Monthly		Last survey 4 October. Minor changes observed.
Relative 3D surveys	25 & 28 Oct	Twice weekly		Minor changes observed. Very gradual closure up to 3 mm between Marks RBF04 and RBF05 where fracture observed. Marks RBF04, RBF05 and RBE11 gradually closing relative to remainder of rockbar. Mark RBF04 is gradually rising relative to adjacent marks.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Ground surveys				
Valley closure lines across Stonequarry Creek and Cedar Creek	27 Oct	Weekly	N/A	Minor subsidence and closure developing. Closure developing up to 15 mm at confluence of Cedar and Stonequarry Creeks.
Rockbar / valley closure lines across Stonequarry Creek	27 Oct	Weekly	N/A	Minor subsidence and closure developing. Changes across SQ113 upstream of rockbar are within survey tolerance. Gradually increasing closure across SQ114 downstream of rockbar from -3 mm to -5 mm this week.
LW W3 Centreline	25 Oct	Weekly	N/A	Subsidence developing gradually above LW W3, current trends are consistent with predictions.
Visual inspections				
Detailed visual inspection	25 & 28 Oct	Daily		Fractures observed in localised area between Marks RBF04 and RBF05, at the end of an existing joint on 28 Oct. Inspection by geotechnical engineers from PSM and SCT on 28 Oct, who confirm fracturing is compressive in nature and appears to be mining-induced. A potential opening of an existing joint has been identified to the east of Mark RBF04 and has been added to the monitoring program. Further geotechnical investigations have been scheduled for 30 Oct. No changes observed across remainder of the rockbar, including across the grinding groove area.
Geotechnical monitoring				
Inclinometer surveys	28 Oct	Weekly	N/A	Ongoing, minor (less than 4 mm) cumulative tilt observed towards the south observed this week. Shear developing at 20 metres depth, consistent with normal ground behaviour around longwall panels.
In situ stress monitoring	28 Oct	Weekly	N/A	Compression in NW-SE direction is levelling off.
Surface and groundwater monitoring				
Surface water monitoring	-	Download monthly	N/A	Changes consistent with periods of rainfall and dry weather.
Groundwater monitoring	-	Download monthly	N/A	Groundwater recharge observed along Stonequarry and Cedar Creeks.

Other management actions since previous report:

- Longwall has been stopped in light of the observation of fracturing in accordance with the Management Plan.

Any additional and/or outstanding management actions:

- Technical Committee is currently investigating in accordance with the Management Plan. The following actions are recommended at this stage.

1. LW to remain stopped until at least 1 Nov until review by Technical Committee has been completed.
2. An inspection by the structural geologist has been scheduled for 30 Oct.
3. Additional HRC-H Line has been installed across the downstream extremity of the rockbar site on 29 Oct.
    a. Baseline survey will occur on 30 Oct.
    b. HRC Lines will be surveyed daily until next scheduled Technical Committee meeting on 1 Nov.
4. MNC's 3D array will be extended to include the E and F marks.
    a. Baseline survey will occur on 30 Oct.
    b. The 3D array will be surveyed daily until next scheduled Technical Committee meeting on 1 Nov.
5. Visual inspection will be conducted daily until next scheduled Technical Committee meeting on 1 Nov.
6. Joint monitoring will commence across the identified potentially opened joint to the east of Mark RBF04.
    a. Changes across the joint will be measured daily.
7. The Technical Committee will reconvene on 1 Nov to assess the latest observations and make further recommendations.

Consultation with stakeholders since previous report:

- Technical Committee meetings held 26, 28 and twice on 29 October.
- Steering Committee meeting held 28 and 29 October.

Forecast whether continued longwall mining is likely to cause greater than negligible subsidence impacts, environmental consequences or loss of heritage value:

- In light of the observation of fracturing on 28 October, the longwall has been stopped pending further investigations by the Technical Committee.
- The site of fracturing is located downstream of the road crossing, 40 metres south east from the heritage site.
- The visual observations correlate with the survey results, with gradual development of compressive strain prior to fracturing.
- Compressive strain has not been observed across the grinding groove sites.

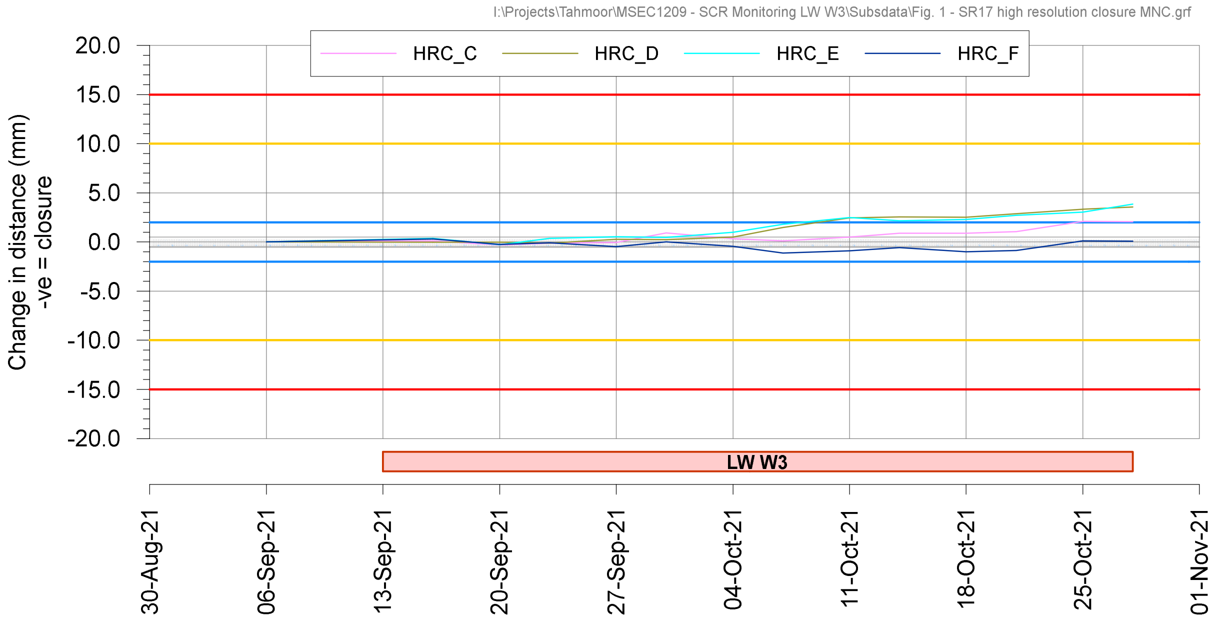
The Technical Committee is currently investigating and will provide a recommendation whether longwall extraction can continue or to relocate the longwall at the completion of the investigations in accordance with the Management Plan.

Copy of Report to:

Peter Vale, Executive General Manager Coal Operations
Clint Mason, Head of Tahmoor Coal Operations
David Corbett, Tahmoor Coal Technical Services Manager
Malcolm Waterfall, Tahmoor Coal, Mining Engineering Manager
Zina Ainsworth, Tahmoor Coal Environment and Community Manager

Stephen O'Donoghue, Director Resource Assessments – DPIE
Gabrielle Allan, Principal Planning Officer - DPIE

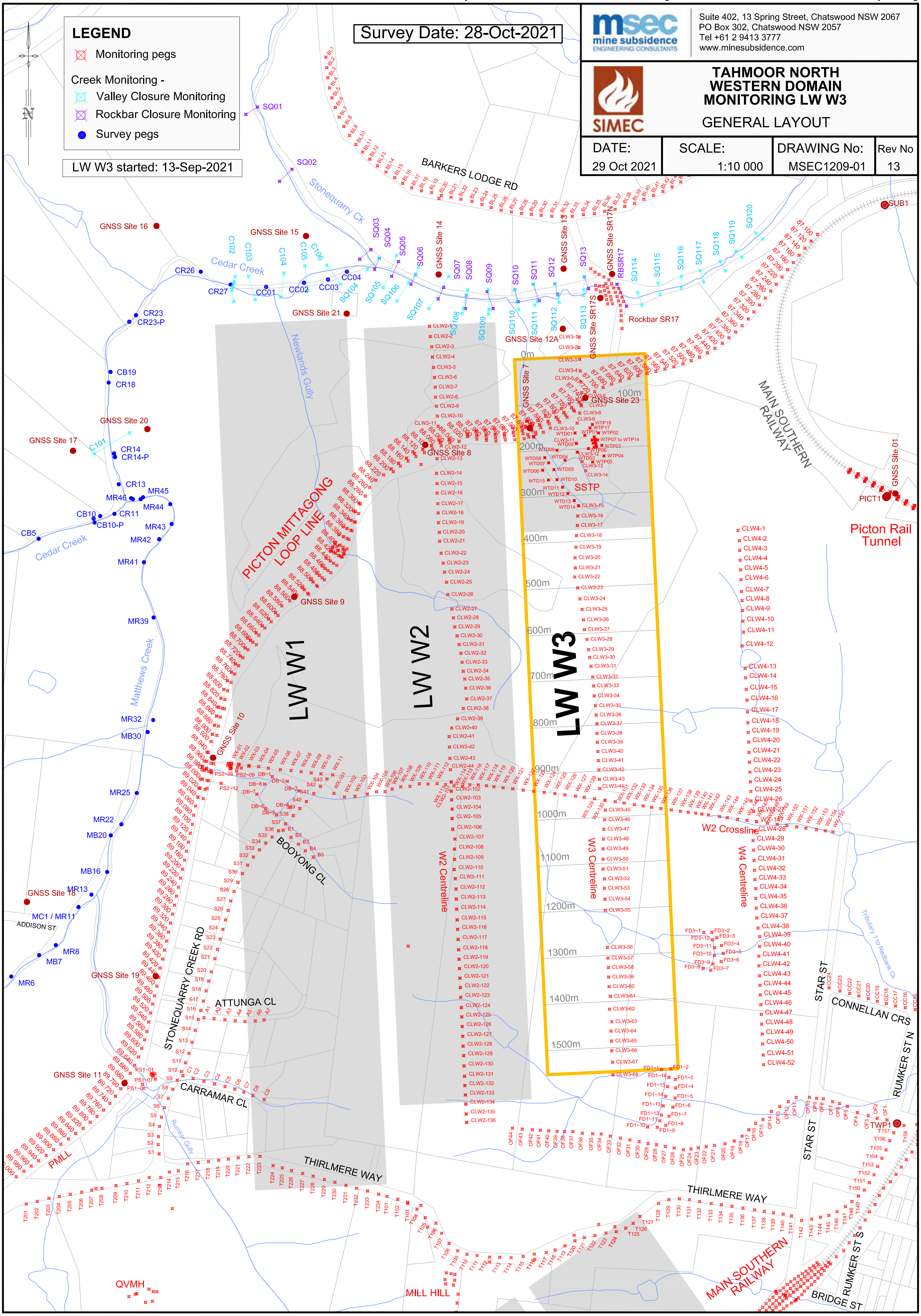
All Technical Committee Members



Photograph courtesy MNC Consulting

Rockbar SR17 on 28 October 2021

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-01 General Layout.dwg



TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 41
During the mining of LW W3 for Stonequarry Creek Rockbar

SIMEC

Reporting Period	12 February 2022 to 18 February 2022	
Length of extraction	1359 m	as at 17 February 2022
Closest distance of LW W3 face to Rockbar	1500 m	to Mark C02 (LW moving away)
Distance travelled by LW since previous report	37 m	since 10 February 2022 (Thursday to Thursday)
Maximum incremental subsidence at Rockbar Mark C02 due to LW W3	50 mm	on 17 February 2022
Maximum increase in subsidence at Rockbar Mark C02 since previous survey	0 mm	No measurable change from 11 February to 17 February
Weather and flow conditions	Surface water flows have reduced to normal levels, only preventing survey of mark E09.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
GNSS				
GNSS unit above commencing end of LW W3 (Site 23)	Continuous		N/A	The GNSS unit is gradually moving in a southward direction, chasing the retreating LW face. Rates of change have reduced.
GNSS unit (Site 12A)	Continuous		N/A	Minor subsidence developing at reduced rates of change. Minor horizontal movements developing towards the south.
GNSS unit (Site 13)	Continuous		N/A	Minor subsidence developing at reduced rates of change. Minor horizontal movements developing towards the south and east. Unit confirmed by site inspection to have been disturbed in early January (protective fence removed).
GNSS unit (Site SR17N)	Continuous		N/A	Very minor subsidence developing at reduced rates of change. Very minor horizontal movements developing towards the south.
GNSS unit (Site SR17S)	Continuous		N/A	Very minor subsidence developing at reduced rates of change. Very minor horizontal movements developing towards the south.
High resolution surveys across Rockbar				
High resolution closure lines	17 Feb	Weekly	Blue	HRC-C line extended from 4.9 mm to 5.4 mm. HRC-D line extended from 5.3 mm to 5.4 mm. HRC-E line reduced in extension from 8.0 mm to 7.6 mm. HRC-F line extended from 4.5 mm to 5.1 mm HRC-G line remained at 7.9 mm. HRC-B line extended from 0.2 mm to 0.4 mm HRC-A line reduced in extension from 4.6 mm to 4.5 mm HRC-H line extended from 0.3 mm to 0.4 mm
3D surveys across grinding groove sites (3D array)	17 Feb	Weekly	Green	Results within survey tolerances across grinding groove sites. Minor changes observed last week.
Ground surveys across Rockbar				
Absolute 3D surveys	-	Monthly	Green	Last survey 17 January. Minor changes observed.
Relative 3D surveys	14 Feb	Weekly	Blue	Little to no measurable change observed over the last month, within survey tolerances. Measured strain between RBF04 and RBF05 slightly exceeds Blue trigger level for the first time. Strain measured by MNC between E10 and E11 has exceeded 1 mm/m but is not a trigger under the management plan. Strain measured by MNC between E10 and F05 has returned below 1 mm/m. The Technical Committee notes that it has been managing this site in accordance with the Yellow trigger level since fractures were first observed on 28 Oct 2021.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Ground surveys				
Valley closure lines across Stonequarry Creek and Cedar Creek	-	Monthly	N/A	Last survey 24 January. Survey marks for SQ01 to SQ09 removed as requested by landowner. Small changes (4 mm or less) for remaining survey lines.
Rockbar / valley closure lines across Stonequarry Creek	14 Feb	Weekly	N/A	Minor subsidence and closure developing. Changes across SQ113 upstream of rockbar are within survey tolerance. No change in closure this week across SQ114 and SQ115 downstream of rockbar.
LW W3 Centreline	16 Feb	Monthly	N/A	Subsidence developing gradually above LW W3, current trends are consistent with predictions. Rates of change reducing to low levels above commencing end of panel.
Visual inspections				
Detailed visual inspection	14 Feb 17 Feb	Twice a week		No changes observed across the rockbar over the last month, including across the grinding groove area.
Geotechnical monitoring				
Inclinometer surveys	-	End of LW	N/A	Last survey 11 January. Minor ongoing movement above shear at 20 metres depth.
In situ stress monitoring	19 Feb	Fortnightly	N/A	All strain gauges are showing no change or only the slightest hint of stretching.
Surface and groundwater monitoring				
Surface water monitoring	-	Download monthly	N/A	Download up to 8 December. Water levels were generally higher during the month of November as a result of high levels of rainfall during this period.
Groundwater monitoring	-	Download fortnightly	N/A	Download up to 31 December. Minor changes in groundwater levels observed along Stonequarry Creek.

Other management actions since previous report:
- Nil.

Any additional and/or outstanding management actions:
- Technical Committee reviewed the latest observations on 18 February. The longwall face is 1500 m from the rockbar. Monitoring results indicate little to no measurable changes at the rockbar, including where fracturing has occurred. Further fracturing may develop between Marks RBF04 and RBF05, RBE10 and RBE11.

Based on the above, the Technical Committee advises that changes at the rockbar can be effectively monitored and managed with surveys and inspections twice a week.

Consultation with stakeholders since previous report:
- Technical Committee meeting held 18 February. Next meeting on 4 March. Weekly reports will continue.

Forecast whether continued longwall mining is likely to cause greater than negligible subsidence impacts, environmental consequences or loss of heritage value:

The Technical Committee continues to investigate and assess the latest monitoring results in accordance with the Management Plan. Based on monitoring results to date, continued longwall mining is not likely to result in the occurrence of greater than negligible subsidence impacts, environmental consequences or loss of heritage value.

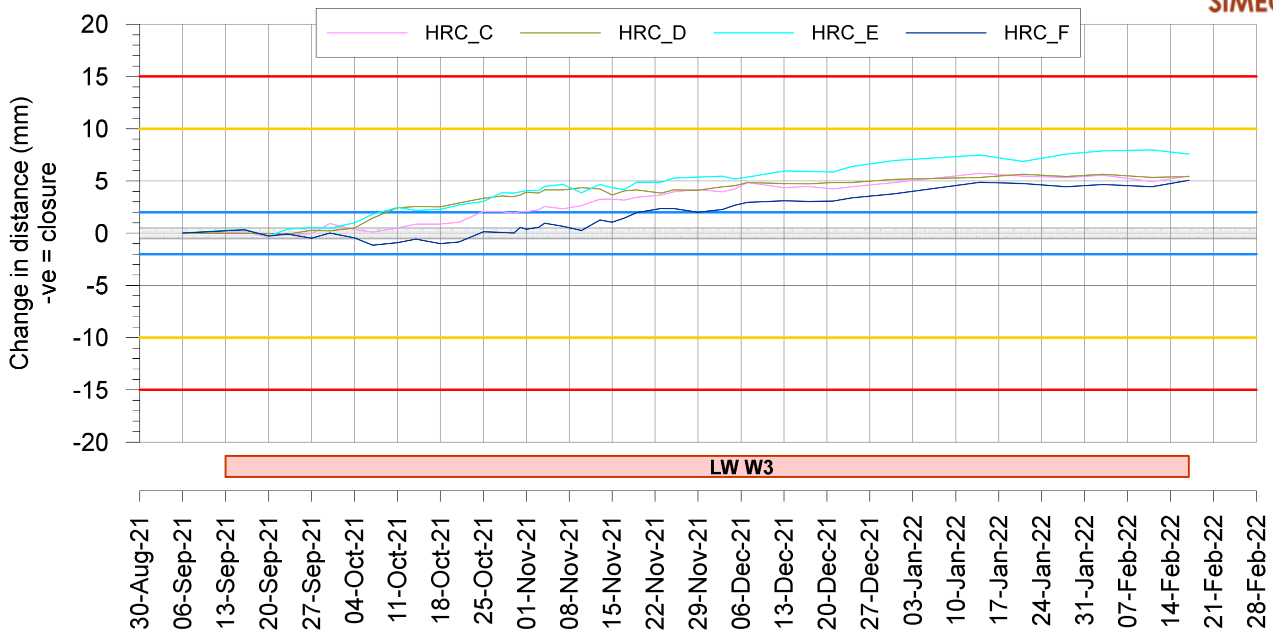
Copy of Report to:

Peter Vale, Executive General Manager Coal Operations
Clint Mason, Head of Tahmoor Coal Operations
David Corbett, Tahmoor Coal Technical Services Manager
Malcolm Waterfall, Tahmoor Coal Mining Engineering Manager
Zina Ainsworth, Tahmoor Coal Environment and Community Manager

Stephen O'Donoghue, Director Resource Assessments – DPIE
Gabrielle Allan, Principal Planning Officer - DPIE

All Technical Committee Members

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\Subsdata\Fig. 1 - SR17 high resolution closure MNC.grf



Photograph courtesy MNC Consulting

Rockbar SR17 on 17 February 2022

I:\Projects\Tahmoor\MSEC1209 - SCR Monitoring LW W3\AcadData\MSEC1209-01 General Layout.dwg

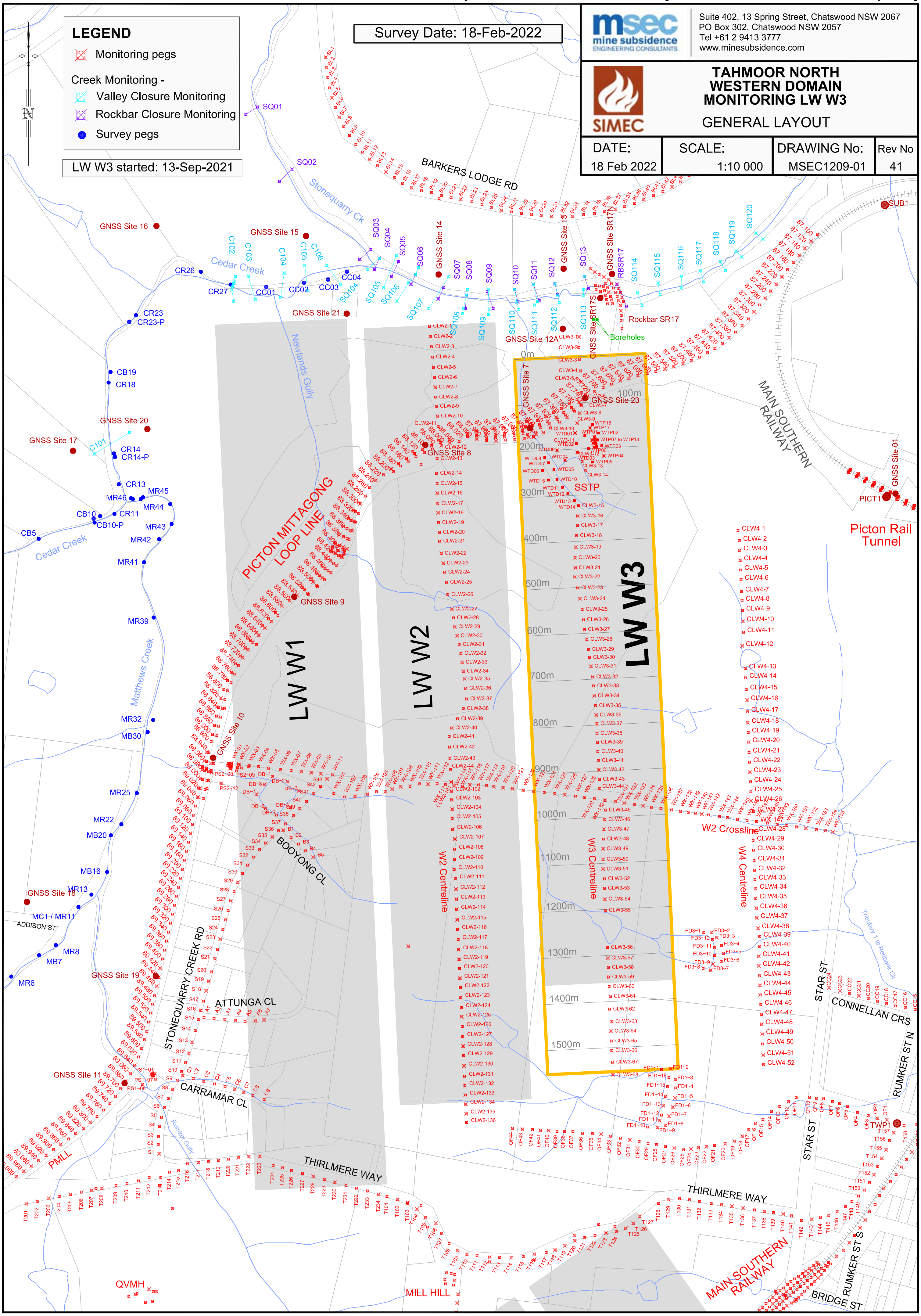
msec mine subsidence ENGINEERING CONSULTANTS
Suite 402, 13 Spring Street, Chatswood NSW 2067
PO Box 302, Chatswood NSW 2057
Tel +61 2 9413 3777
www.minesubsidence.com

SIMEC

TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W3

GENERAL LAYOUT

DATE:	SCALE:	DRAWING No:	Rev No
18 Feb 2022	1:10 000	MSEC1209-01	41



Appendix G – Main Southern Railway Status Report

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 10
During the mining of LW W3 adjacent to the Main Southern Railway

SIMEC

Reporting Period	10 November 2021 to 16 November 2021	
Length of extraction of LW W3	498 m	as at 16 November 2021
Closest distance of LW W3 face to Railway	460 m	to 87.600 km (LW alongside)
Distance travelled by LW since previous report	49 m	Since 9 November LW commenced 13 September 2021
Maximum incremental subsidence along Railway due to LW W3	2 mm	at 88.240 km as at 15 November 2021
Maximum increase in subsidence since previous survey	8 mm	at 87.400 km and 87.440 km (9 November to 15 November 2021)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 2 November. Results within survey tolerance.
2D ground survey	15 Nov	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Subsidence (approx. 250 mm) developing above LW W3. Minor horizontal movements to the south and west.
Long bay length survey	15 Nov	Weekly	N/A	Minor ground shortening of 7 mm developing between 87.300 km and 87.400 km. Result does not appear to correlate with 2D surveys.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	16 Nov	Weekly		No significant changes.
Inspections by Track Certifier	16 Nov	Daily		No issues observed.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Very minor changes this month.
Absolute 3D survey of structure	10 Nov	Monthly		No measurable changes in distances across the abutments this month.
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Nov	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Nov	Monthly		No measurable changes in distances across the base of the arch this month.
Crack gauges	15 Nov	Monthly		Changes in crack widths less than trigger level.
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Nov	Monthly		No measurable changes in distances across tops of the abutments this month. Small increase in closure at the base of the arch on the Down side this month, exceeding the monitoring review point trigger. Rainfall prior to survey. Prisms will be checked next week.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Small movements to the east and south.
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.
Absolute 3D / relative 3D survey of prisms inside tunnel	10 Nov	Abs. Monthly Rel. Weekly		Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	10 Nov	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes			Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels.
Inclinometer	-	Monthly	N/A	Last readings 25 October. No measurable changes observed.
Track centre and clearance	16 Nov	Weekly		No measurable changes observed. Tahmoor Coal will conduct an additional kinematic envelope survey at the Sydney portal to reconfirm baseline conditions during the next scheduled ARTC possession weekend in Nov 2021.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	10 Nov	Monthly		Minor changes in distances across the base of the arch and along the tunnel this month.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Nov	Monthly		Minor changes across the abutments this month.
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Nov	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed. Results are showing signs the prisms require a clean.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Pedestrian Overbridge (86.100 km)				
Local 3D survey of structure	10 Nov	Monthly	🟢	Minor changes this month.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	10 Nov	Monthly	🟢	Minor changes this month.
Picton Viaduct (85.42km)				
GNSS unit (Site 0)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
GNSS unit (Site 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.
Precision 2D ground survey	15 Nov	Weekly	🟢	Results within survey tolerance. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Local 3D survey of ground pegs	10 Nov	Monthly	N/A	Minor changes observed this month.
Local 3D survey of structure	10 Nov	Monthly	🟢	Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly		🟢	Very minor changes observed.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 28 October. Irregular movements observed in first re-survey at PVD1. The survey result does not correlate with other monitoring results, including inclinometers PVD2 and PVD3. The survey will be checked.
Track geometry	-	Monthly	N/A	Last survey 8 November. No issues reported.
Visual inspection	15 Nov	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	16 Nov	Monthly	🟢	Changes in crack widths less than trigger level.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Nov	Monthly	🟢	Minor changes this month.
Retaining wall (84.867 km)				
Local 3D survey of wall	10 Nov	Monthly	N/A	Minor changes in tilt from top to base of wall this month.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Nov	Monthly	🟢	Minor change between abutments this month.
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous		🟢	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month. VBP2 could not be measured due to bridge abutment works.
Local 3D survey of structure	-	Monthly	N/A	Last survey 9 November. Minor changes between abutments this month. Maintenance works are obstructing views to some marks.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	11 Nov	Monthly	N/A	Minor changes this month.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 2 November. Minor changes observed. Some pegs on Down crest at B260, B300 and B320 appear to have been slightly disturbed. Further surveys required to confirm.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 1 November. No issues observed.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 2 November. Minor changes observed.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 1 November. No issues observed.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Install prior to last 400 m of extraction.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 1 November. No issues observed.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 1 November. No issues observed.

Management Actions

Other management actions since previous report:

- Nil

Any additional and/or outstanding management actions:

- Kinematic envelope survey of Sydney portal of Picton Tunnel during November possession weekend.

Consultation with stakeholders since previous report:

- RMG meeting held on 19 November

Forecast whether continued longwall mining is likely to cause:

A. Track closure for any period unacceptable to ARTC

B. Impact on the safety of operations on the Main Southern Railway

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.

Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	Ross Barber
Date	19 November 2021

Copy of Report to:

Steve Chance, Area Manager – Moss Vale to Port Botany, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 14
During the mining of LW W3 adjacent to the Main Southern Railway

SIMEC

Reporting Period	8 December 2021 to 14 December 2021	
Length of extraction of LW W3	793 m	as at 14 December 2021
Closest distance of LW W3 face to Railway	675 m	to 87.640 km (LW alongside)
Distance travelled by LW since previous report	77 m	since 7 December 2021
Maximum incremental subsidence along Railway due to LW W3	1 mm	at 87.700 km and 87.020 km on 14 December 2021
Maximum increase in subsidence since previous survey	4 mm	at 87.620 km (7 December to 14 December 2021)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 29 November. Results within survey tolerance.
2D ground survey	14 Dec	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Subsidence (approx. 305 mm) developing above LW W3. Horizontal movements to the south and west.
Long bay length survey	14 Dec	Weekly	N/A	Minor ground shortening of 5 mm developing between 87.300 km and 87.400 km. Minor (2 mm) decrease this week.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	14 Dec	Weekly		No significant changes.
Inspections by Track Certifier	14 Dec	Daily		No issues observed.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Very minor changes this month.
Absolute 3D survey of structure	10 Dec	Monthly		No measurable changes in distances across the abutments this month.
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Dec	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed. Results are showing signs the prisms require a clean.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Dec	Monthly		No measurable changes in distances across the base of the arch this month.
Crack gauges	9 Dec	Monthly		Changes in crack widths less than trigger level.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Dec	Monthly	🟢	No measurable changes in distances across tops of the abutments this month. Small increase in closure at the base of the arch on the Down side on 10 November, exceeding the 5 mm monitoring review point trigger. Rainfall prior to survey. A structural inspection was completed on 30 November, with no immediate concerns. Cause is likely due to build up of moisture behind wingwall. A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall. The RMG has reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm. A small decrease in closure was measured at the base of the arch on the Down side this month.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Small movements to the west and north.
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.
Absolute 3D / relative 3D survey of prisms inside tunnel	14 Dec	Abs. Monthly Rel. Weekly	🟢	Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	14 Dec	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes		🟢	Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. Prisms cleaned on 27 November.
Inclinometer	-	Monthly	N/A	Last readings 24 November. No measurable changes observed.
Track centre and clearance	14 Dec	Weekly	🟢	No measurable changes observed. Tahmoor Coal conducted a kinematic envelope survey at the Sydney portal to reconfirm baseline conditions during the ARTC possession weekend.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	10 Dec	Monthly	🟢	Minor changes in distances across the base of the arch and along the tunnel this month.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Dec	Monthly	🟢	Minor changes across the abutments this month. Small increase in closure near the top of the arch on the Up side this month, close to the 20 mm monitoring review point trigger.
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Dec	Monthly	🟢	No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly		🟢	Very minor changes observed. Results are showing signs the prisms require a clean.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Pedestrian Overbridge (86.010 km)				
Local 3D survey of structure	10 Dec	Monthly		Minor changes this month.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	10 Dec	Monthly		Minor changes this month.
Picton Viaduct (85.42km)				
GNSS unit (Site 0)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
GNSS unit (Site 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.
Precision 2D ground survey (valley closure)	14 Dec	Weekly		Measured horizontal openings and closures between ends of Viaduct (valley closure) are less than survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm.
Local 3D survey of ground pegs	8 Dec	Monthly	N/A	Minor changes observed this month.
Local 3D survey of structure	8 Dec	Monthly		Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly			Very minor changes observed.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 24 November. Irregular movements observed in first re-survey at PVD1. The survey result does not correlate with other monitoring results, including inclinometers PVD2 and PVD3. This month's survey found no change. Cause may have been due to vehicle loading.
Track geometry	15 Dec	Monthly	N/A	No issues reported.
Visual inspection	15 Dec	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	15 Dec	Monthly		Changes in crack widths less than trigger level on 15 December.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Dec	Monthly		Minor changes this month.
Retaining wall (84.867 km)				
Local 3D survey of wall	10 Dec	Monthly	N/A	Minor changes in tilt from top to base of wall this month.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Dec	Monthly		Minor change between abutments this month.
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous			Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month. VBP2 could not be measured due to bridge abutment works.
Local 3D survey of structure	-	Monthly	N/A	Last survey 7 December. Minor changes between abutments this month. Maintenance works are obstructing views to some marks.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	9 Dec	Monthly	N/A	Minor changes this month.

SIMEC

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 29 November. Minor changes observed. Some pegs on Down crest at B260, B300 and B320 appear to have been slightly disturbed. This week's survey found similar results.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 22 November. No issues observed.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 29 November. Small changes observed. Small changes in closure measured on the Down side.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 22 November. No issues observed.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 29 November. Results are within survey tolerance.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 22 November. No issues observed.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Installed 8 December.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 22 November. No issues observed.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 22 November. No issues observed.

Management Actions

Other management actions since previous report:
- Nil.

Any additional and/or outstanding management actions:
- Nil.

Consultation with stakeholders since previous report:
- RMG meeting held on 17 December
- ARTC and Tahmoor Coal governance meeting on 17 December

Forecast whether continued longwall mining is likely to cause:

A. Track closure for any period unacceptable to ARTC

B. Impact on the safety of operations on the Main Southern Railway

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.

Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	Ross Barber
Date	17 December 2021

Copy of Report to:

Steve Chance, Area Manager – Moss Vale to Port Botany, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Ian Cochran, Bridges and Structures Specialist, ONRSR
Michael Irons, Property Manager – Wagga, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 19
During the mining of LW W3 adjacent to the Main Southern Railway

SIMEC

Reporting Period	12 January 2022 to 18 January 2022	
Length of extraction of LW W3	1075 m	as at 18 January 2022
Closest distance of LW W3 face to Railway	780 m	to 88.660 km (LW alongside)
Distance travelled by LW since previous report	50 m	since 11 January 2022
Maximum incremental subsidence along Railway due to LW W3	6 mm	at 87.520 km and 87.640 km on 17 January 2022
Maximum increase in subsidence since previous survey	4 mm	at 88.600 km (11 January to 17 January)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred.	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 4 January. Results within survey tolerance.
2D ground survey	17 Jan	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Subsidence (approx. 325 mm) developing above LW W3, with minor changes observed. Horizontal movements to the south.
Long bay length survey	17 Jan	Weekly	N/A	Minor (1 mm) increase in ground shortening between 87.300 km and 87.400 km this week, after no change last week. Minor ground shortening of 6 mm between 87.500 km and 87.600 km. No change this week.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	18 Jan	Weekly		No significant changes.
Inspections by Track Certifier	18 Jan	Daily		No issues observed.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Very minor changes this month.
Absolute 3D survey of structure	13 Jan	Monthly		No measurable changes in distances across the abutments this month.
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	13 Jan	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	13 Jan	Monthly		No measurable changes in distances across the base of the arch this month. Sideways shear displacements on the Up Side are approaching the Blue monitoring review point.
Crack gauges	19 Jan-	Monthly		Changes in crack widths less than trigger level.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	13 Jan	Monthly		No measurable changes in distances across tops of the abutments this month. Small increase in closure at the base of the arch on the Down side on 10 Nov, exceeding the 5 mm monitoring review point trigger. Rainfall prior to survey. A structural inspection was completed on 30 Nov, with no immediate concerns. A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall. The RMG has reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm. A small decrease in closure was measured at the base of the arch on the Down side this month.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Minor changes to the west this week.
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month.
Absolute 3D / relative 3D survey of prisms inside tunnel	17 Jan	Abs. Monthly Rel. Weekly		Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	17 Jan	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes			Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. Prisms cleaned on 27 November.
Inclinometer	-	Monthly	N/A	Last readings 17 December. No measurable changes observed.
Track centre and clearance	17 Jan	Weekly		No measurable changes observed.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	13 Jan	Monthly		Minor changes in distances across the base of the arch and along the tunnel this month.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	13 Jan	Monthly		Minor changes across the abutments this month. Small increase in closure near the top of the arch on the Up side (supporting PMLL track) this month, exceeding the 20 mm monitoring review point trigger. Structural inspection conducted 7 Jan with no immediate concerns observed. Trains not running on PMLL track until 5 Feb 2022.
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	No survey this month due to construction works.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across the base of the arch on 10 December. No survey this month due to construction works.
Laser distancemeters	Hourly			Very minor changes observed. The prisms were cleaned of soot, spider webs and surface sprayed on 12 Jan.

SIMEC

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Pedestrian Overbridge (86.010 km)				
Local 3D survey of structure	13 Jan	Monthly	🟢	Minor changes this month.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	13 Jan	Monthly	🟢	Minor changes this month.
Picton Viaduct (85.42km)				
GNSS units (Site 0 and 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units.
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month.
Precision 2D ground survey between ends of Viaduct (valley closure)	17 Jan	Weekly	🟢	0 mm to 3 mm closure measured on Down side, 0 mm to 2 mm closure measured on Up side. Measurements are less than survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm.
Local 3D survey of ground pegs	13 Jan	Monthly	N/A	Minor changes observed this month.
Local 3D survey of structure	13 Jan	Monthly	🟢	Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly		🟢	Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 17 December. Minor changes observed last month.
Track geometry	12 Jan	Monthly	N/A	No issues reported.
Visual inspection	19 Jan	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	-	Monthly	🟢	Changes in crack widths less than trigger level on 15 December.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	13 Jan	Monthly	🟢	Minor changes this month.
Retaining wall (84.867 km)				
Local 3D survey of wall	13 Jan	Monthly	N/A	Minor changes in tilt from top to base of wall this month.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	13 Jan	Monthly	🟢	Minor change between abutments this month.
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous		🟢	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes this month. VBP2 has been replaced and normalised.
Local 3D survey of structure	11 Jan	Monthly	N/A	Minor changes between abutments this month. Maintenance works are obstructing views to some marks.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	12 Jan	Monthly	N/A	Minor changes on this month.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 4 January. Minor changes observed. Some pegs on Down crest at B260, B300 and B320 appear to have been slightly disturbed. Minor changes observed this month. Most prisms on the Up side toe are obscured by vegetation regrowth, preventing survey.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 4 January. No issues observed.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 4 January. Small changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 4 January. No issues observed.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 4 January. Small changes observed this month.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 4 January. No issues observed.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Negligible changes observed.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 4 January. No issues observed.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 4 January. No issues observed.
Cutting 88.700km-89.050km	-	Monthly	N/A	Last survey and inspection 4 January. No issues observed. Peg D88840 has moved slightly into the cutting since the baseline survey.

Management Actions

Other management actions since previous report: • Nil

Any additional and/or outstanding management actions: • Nil.

Consultation with stakeholders since previous report: • RMG meeting held on 21 January

Forecast whether continued longwall mining is likely to cause:

A. Track closure for any period unacceptable to ARTC

B. Impact on the safety of operations on the Main Southern Railway

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.

Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	Ross Barber
Date	21 January 2022

Copy of Report to:

Steve Chance, Area Manager – Moss Vale to Port Botany, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Ian Cochran, Bridges and Structures Specialist, ONRSR
Michael Irons, Property Manager – Wagga, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 23
During the mining of LW W3 adjacent to the Main Southern Railway

Reporting Period	**9 February 2022 to 15 February 2022**	
Length of extraction of LW W3	1349 m	as at 15 February 2022
Closest distance of LW W3 face to Railway	630 m	to 89.340 km (LW alongside)
Distance travelled by LW since previous report	50 m	since 8 February 2022
Maximum incremental subsidence along Railway due to LW W3	5 mm	at 87.460 km, 87.500 km and 87.520 km on 15 February 2022
Maximum increase in subsidence since previous survey	4 mm	at 88.760 km (8 February to 15 February)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred.	

Summary of monitoring and inspections

Monitoring Activity	**Date**	**Current Frequency**	**Highest Trigger**	**Comments**
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 1 February. Results within survey tolerance.
2D ground survey	15 Feb	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Minor continued horizontal movements to the south.
Long bay length survey	15 Feb	Weekly	N/A	Minor changes observed.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	15 Feb	Weekly	(not mining related)	Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC plan to conduct drainage and reconditioning works to correct the bog holes at both sites in May possession.
Inspections by Track Certifier	15 Feb	Daily		No issues observed with exception of bog holes.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Very minor changes this month.
Absolute 3D survey of structure	10 Feb	Monthly		No measurable changes in distances across the abutments this month.
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	9 Feb	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan, resulting in a 1.4mm step change at US1 to DS1.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	9 Feb	Monthly		No measurable changes in distances across the base of the arch this month.
Crack gauges	-	Monthly		Changes in crack widths less than trigger level on 30 January.
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Feb	Monthly		No measurable changes in distances across tops of the abutments on 10 February. The 5 mm monitoring review point trigger was exceeded at the base of the arch on the Down side on 10 Nov. A structural inspection was completed on 30 Nov, with no immediate concerns. A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall. The RMG reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Minor changes to the south and west this week.
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Absolute 3D / relative 3D survey of prisms inside tunnel	15 Feb	Abs. Monthly Rel. Weekly		Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	15 Feb	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes			Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. Prisms cleaned on 27 November.
Inclinometer	-	Monthly	N/A	Last readings 1 February. No measurable changes observed.
Track centre and clearance	15 Feb	Weekly		No measurable changes observed from prism surveys.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	10 Feb	Monthly		Minor changes in distances across the base of the arch and along the tunnel this month.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Feb	Monthly		Minor changes across the abutments on 10 February. Small increase in closure near the top of the arch on the Up side (supporting PMLL track) on 13 January, exceeding the 20 mm monitoring review point trigger. Structural inspection conducted 7 Jan with no immediate concerns observed. Trains not running on PMLL track until 5 Feb 2022. Additional monitoring installed. Geotech investigation confirmed reasonably substantial footing in competent clay soils. Structural inspection and assessment advise the changes are not due to mine subsidence. As recommended, the Blue trigger level has been adjusted from 20 mm to 25 mm.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	14 Feb	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed. The prisms were cleaned of soot, spider webs and surface sprayed on 12 Jan.
Pedestrian Overbridge (86.010 km)				
Local 3D survey of structure	10 Feb	Monthly		Minor changes this month.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	10 Feb	Monthly		Minor changes this month.
Picton Viaduct (85.42km)				
GNSS units (Site 0 and 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units.
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Precision 2D ground survey between ends of Viaduct (valley closure)	15 Feb	Weekly		0 mm to 1 mm closure measured on Down side, 0 mm to 2 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm.
Local 3D survey of ground pegs	8 Feb	Monthly	N/A	Minor changes observed this month.
Local 3D survey of structure	8 Feb	Monthly		Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly			Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 1 February. Minor changes observed in the last month.
Track geometry	15 Feb	Monthly	N/A	No issues reported.
Visual inspection	15 Feb	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	16 Feb	Monthly		Changes in crack widths less than trigger level.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	10 Feb	Monthly		Minor changes this month.
Retaining wall (84.867 km)				
Local 3D survey of wall	10 Feb	Monthly	N/A	Small changes in tilt from top to base of wall this month. Surveyed tilt from Pegs RTW11 to RTW6 has increased this month and is approaching the monitoring review point trigger.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Very minor changes this month.
Local 3D survey of structure	10 Feb	Monthly		Minor change between abutments this month.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous			Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	8 Feb	Monthly	N/A	Minor changes between abutments this month. Maintenance works are obstructing views to some marks.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	9 Feb	Monthly	N/A	Very minor changes this month.
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 1 February. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which appear to have been slightly disturbed last month. No change to measured small widening on the Down toe at 87.380 km. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed.
Extensometer	Every 15 minutes			Minor changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 3 February. No issues observed.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 1 February. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 3 February. No issues observed.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 1 February. Minor changes observed this month.
Extensometer	Every 15 minutes			Negligible changes observed.
Visual inspection	-	Monthly	N/A	Last inspection 3 February. No issues observed.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Negligible changes observed with sensor repaired.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 3 February. No issues observed.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 3 February. No issues observed.
Cutting 88.700km-89.050km	-	Monthly	N/A	Last inspection 3 February. No issues observed. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey.

Management Actions	
Other management actions since previous report: ● Nil	
Any additional and/or outstanding management actions: ● Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related).	
Consultation with stakeholders since previous report: ● RMG meeting held on 18 February ● Tahmoor Coal advised ARTC of poor track condition on the Up Main at Sydney end of Tunnel and north of Connellan Crescent at 89 km. ARTC have scheduled undercutting works for May possession.	
Forecast whether continued longwall mining is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.	
Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	Ross Barber
Date	18 February 2022

Copy of Report to:

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC

Michael Irons, Property Manager – Wagga, ARTC

Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC

Clint Mason, Production Manager, Tahmoor Mine

Ian Cochran, Bridges and Structures Specialist, ONRSR

Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 27
During the mining of LW W3 adjacent to the Main Southern Railway

Reporting Period	**16 March 2022 to 22 March 2022**	
Length of extraction of LW W3	1552 m	as at 21 March 2022 LW W3 finished extraction on 21 March 2022
Closest distance of LW W3 face to Railway	510 m	to 89.50 km
Distance travelled by LW since previous report	3 m	since 15 March 2022
Maximum incremental subsidence along Railway due to LW W3	7 mm	at 88.86 km on 21 March 2022
Maximum increase in subsidence since previous survey	4 mm	at 14 locations between 88.00 km and 88.98 km (16 March to 21 March)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred. ARTC have imposed a 40/40 TSR on the Up Main due to track condition (not mining related). Track reopened 16 March following closure due to embankment slip at 86.200 km due to heavy rainfall.	

Summary of monitoring and inspections

Monitoring Activity	**Date**	**Current Frequency**	**Highest Trigger**	**Comments**
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 8 March. Results within survey tolerance.
2D ground survey	21 Mar	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Minor continued horizontal movements to the south.
Long bay length survey	21 Mar	Weekly	N/A	Minor changes observed.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	21 Mar	Weekly	(not mining related)	Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC have imposed a 40/40 TSR on the Up Main. ARTC plan to conduct tamping with drainage and reconditioning works to correct the bog holes at both sites in May possession.
Inspections by Track Certifier	21 Mar	Daily		No issues observed with exception of bog holes.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February.
Absolute 3D survey of structure	-	Monthly		No measurable changes in distances across the abutments on 10 February.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across the base of the arch on 9 February.
Laser distancemeters	Hourly			Very minor changes observed. Noisy readings during periods of heavy rainfall.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across the base of the arch on 9 February.
Crack gauges	-	Monthly		Changes in crack widths less than trigger level on 9 March..
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across tops of the abutments on 10 February.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Further increase in westerly movement following heavy rain events in March 2022, as observed after similar heavy rain events.
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Absolute 3D / relative 3D survey of prisms inside tunnel	21 Mar	Abs. Monthly Rel. Weekly		Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	21 Mar	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes			Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. System was cleaned following the heavy rainfall events.
Inclinometer	-	Monthly	N/A	Last readings 11 March. No measurable changes observed.
Track centre and clearance	21 Mar	Weekly		No measurable changes observed from prism surveys. Increasing change in Cant observed at southern end of Tunnel on 3 March, which will need to be checked next week (delayed by heavy rainfall). Change in track centres at 87.780 km likely due to effects of weather as there is no measurable change across the width of the tunnel. The result will be checked.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	-	Monthly		Minor changes in distances across the base of the arch and along the tunnel on 10 February.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February.
Local 3D survey of structure	18 Mar	Monthly		Additional closure following heavy rainfall this month.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across the base of the arch on 14 February.
Laser distancemeters	Hourly			Very minor changes observed. Noisy readings during periods of heavy rainfall. The system cabinet was disabled on 10 March to facilitate repair of embankment slip. The cabinet will be reinstated after works have been completed (more works to complete).
Pedestrian Overbridge (86.010 km)				
Local 3D survey of structure	-	Monthly		Minor changes on 10 February.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	-	Monthly		Minor changes on 10 February.
Picton Viaduct (85.42km)				
GNSS units (Site 0 and 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units.
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Precision 2D ground survey between ends of Viaduct (valley closure)	21 Mar	Weekly		0 mm to 3 mm closure measured on Down side, 0 mm to 1 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm.
Local 3D survey of ground pegs	-	Monthly	N/A	Minor changes observed on 8 February
Local 3D survey of structure	-	Monthly		Minor changes between abutments and bases of piers on 8 February. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly			Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 10 March. Minor changes observed in the last month.
Track geometry	21 Mar	Monthly	N/A	No issues reported.
Visual inspection	21 Mar	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	-	Monthly		Changes in crack widths less than trigger level on 16 March.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Local 3D survey of structure	-	Monthly		Minor changes on 10 February.
Retaining wall (84.867 km)				
Local 3D survey of wall	-	Monthly	N/A	Small changes in tilt from top to base of wall on 10 February. Surveyed tilt from Pegs RTW11 to RTW6 has increased this month and is approaching the monitoring review point trigger.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February.
Local 3D survey of structure	-	Monthly		Minor change between abutments on 10 February.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous			Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February.
Local 3D survey of structure	-	Monthly	N/A	Minor changes between abutments on 8 February. Maintenance works are obstructing views to some marks.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February.
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Survey at end of LW W3	N/A	Last survey 8 March. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which were previously disturbed. Peg on Down toe at 87.380 km could not be measured this month. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed. ARTC authorised change to Stage 3 subsidence management. Monthly surveys will cease, and a final survey will be conducted at the end of LW W3.
Extensometer	Every 15 minutes		N/A	Minor changes observed, including in response to recent rainfall events.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 8 March. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed, with minor changes this month. Uplift recorded at 88.14 km on Down side toe.
Extensometer	Every 15 minutes			Negligible changes observed, including in response to recent rainfall events.
Visual inspection	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Culvert at 87.918 km is blocked or partially blocked.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 8 March. Minor changes observed this month.
Extensometer	Every 15 minutes			Negligible changes observed, including in response to recent rainfall events.
Visual inspection	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Minor changes observed, including in response to recent rainfall events.
Visual inspection	-	-	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. It is recommended to clear blockage from the Up side cess near 87.62 km to prevent ponded water affecting formation.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. New cracks observed in Up side access road at 88.32 km on 10 March, resulting noticeable tilt of redundant power pole. Geotechnical inspection on 13 March confirmed no issues to safety of track or rail operations. Additional survey marks recommended to understand cause during mining of LW W4.
Cutting 88.700km-89.050km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Minor surface erosion of fretting shale materials noted. Last survey 8 March. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey.
Management Actions				
Other management actions since previous report: ● Nil				
Any additional and/or outstanding management actions: ● Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related). ARTC have imposed a 40/40 TSR on the Up Main and plan to conduct tamping with drainage and reconditioning works during May possession.				
Consultation with stakeholders since previous report: ● RMG meeting held on 25 March				
Forecast whether residual subsidence is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly residual subsidence movements are not likely to result in the occurrence of either A or B above.				
Certified by Tahmoor Coal				
Name	Ross Barber			
Position	Project Manager			
Signature	Ross Barber			
Date	25 March 2022			

Copy of Report to:

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC

Michael Irons, Property Manager – Wagga, ARTC

Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC

Clint Mason, Production Manager, Tahmoor Mine

Ian Cochran, Bridges and Structures Specialist, ONRSR

Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 29
During the mining of LW W3 adjacent to the Main Southern Railway

Reporting Period	23 March 2022 to 29 March 2022	
Length of extraction of LW W3	1552 m	LW W3 finished extraction on 21 March 2022
Closest distance of LW W3 face to Railway		
Distance travelled by LW since previous report		
Maximum incremental subsidence along Railway due to LW W3	8 mm	at 88.86 km on 29 March 2022
Maximum increase in subsidence since previous survey	4 mm	at 14 locations between 88.00 km and 88.98 km (21 March to 29 March)
Safety Incidents	No incidents reported	
Rail Operations	No delays incurred. ARTC have imposed a 40/40 TSR on the Up Main due to track condition (not mining related).	

Summary of monitoring and inspections

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Railway Track				
3D ground survey	-	Monthly	N/A	Last survey 8 March. Results within survey tolerance.
2D ground survey	29 Mar	Weekly	N/A	Results within survey tolerance.
GNSS unit above centreline of LW W3 (Site 23)	Continuous		N/A	Minor continued horizontal movements to the south. The unit has been relocated in preparation for LW W4.
Long bay length survey	29 Mar	Weekly	N/A	Minor changes observed.
Rail stress	Every 5 mins			Measurements within tolerances.
Track geometry survey	28 Mar	Weekly	(not mining related)	Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC have imposed a 40/40 TSR on the Up Main. ARTC plan to conduct tamping with drainage and reconditioning works to correct the bog holes at both sites in May possession.
Inspections by Track Certifier	29 Mar	Daily		No issues observed with exception of bog holes.
Bridge Street Overbridge (91.030 km)				
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Very minor changes this month.
Absolute 3D survey of structure	18 Mar	Monthly		No measurable changes in distances this month.
Thirlmere Way Underbridge (89.326 km)				
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Small horizontal movements to the east and north.
Local 3D survey of structure	18 Mar	Monthly		No measurable changes in distances across the base of the arch this month.
Laser distancemeters	Hourly			Very minor changes observed.
Visual inspection	-	-	N/A	Inspections commence during Stage 2 management.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Connellan Crescent Overbridge (89.080 km)				
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Small horizontal movements to the east and north.
Local 3D survey of structure	18 Mar	Monthly		No measurable changes in distances across the base of the arch this month.
Crack gauges	-	Monthly		Changes in crack widths less than trigger level on 9 March.
Ballast Top Subway (88.133 km)				
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	18 Mar	Monthly		No measurable changes in distances across tops of the abutments this month.
Picton Tunnel (87.85 km)				
GNSS unit (Site 1)	Continuous		N/A	Further increase in westerly movement following heavy rain events in March 2022, as observed after similar heavy rain events.
Far-field Absolute 3D survey	-	Monthly	N/A	Minor changes on 9 February. Access issues prevented survey this month.
Absolute 3D / relative 3D survey of prisms inside tunnel	28 Mar	Abs. Monthly Rel. Weekly		Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels.
Absolute 3D / 2D ground survey leading into tunnel	28 Mar	Abs. Monthly Rel. Weekly	N/A	Results within survey tolerance.
Laser distancemeters	Every 15 minutes			Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels.
Inclinometer	-	Monthly	N/A	Last readings 11 March. No measurable changes observed.
Track centre and clearance	28 Mar	Weekly		No measurable changes observed from prism surveys. Increased change in Cant observed at southern end of Tunnel on 3 March has not been repeated by recent surveys. Change in track centres at 87.780 km likely due to effects of weather as there is no measurable change across the width of the tunnel. The result is slightly less than trigger level this week. Prism 20H found destroyed this week.
Visual inspection	Daily		N/A	No issues reported. No new cracks observed.
Mushroom Tunnel				
Local 3D survey of prisms inside tunnel	-	Monthly		Minor changes in distances across the base of the arch and along the tunnel on 10 February. Access issues prevented survey this month.
Visual inspection	Daily		N/A	No issues reported.
Ballast Top Subway (86.838 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February. Access issues prevented survey this month.
Local 3D survey of structure	18 Mar	Monthly		Additional closure near the top of the arch on the Up side following heavy rainfall this month, approaching the monitoring review point trigger of 25 mm.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Argyle Street Underbridge (86.16 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February. Access issues prevented survey this month.
Local 3D survey of structure	-	Monthly		No measurable changes in distances across the base of the arch on 14 February. Access issues prevented survey this month.
Laser distancemeters	Hourly			Very minor changes observed. Noisy readings during periods of heavy rainfall. The system cabinet was disabled on 10 March to facilitate repair of embankment slip. The cabinet will be reinstated after works have been completed (more works to complete).
Pedestrian Overbridge (86.010 km)				
Local 3D survey of structure	18 Mar	Monthly		Minor changes this month.
Pedestrian Overbridge (85.846 km)				
Local 3D survey of structure	18 Mar	Monthly		Minor changes this month.
Picton Viaduct (85.42km)				
GNSS units (Site 0 and 2)	Continuous		N/A	Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units.
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Small horizontal movement to the north this month.
Precision 2D ground survey between ends of Viaduct (valley closure)	29 Mar	Weekly		0 mm to 2 mm closure measured on Down side, 0 mm to 1 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm.
Local 3D survey of ground pegs	29 Mar	Monthly	N/A	Minor changes observed this month.
Local 3D survey of structure	29 Mar	Monthly		Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level.
Laser distancemeters	Hourly			Minor changes observed.
Rail stress	Every 5 mins		N/A	Measurements within tolerances.
Inclinometer	-	Monthly	N/A	Last readings 10 March. Minor changes observed in the last month.
Track geometry	-	Monthly	N/A	Last inspection 21 March. No issues reported.
Visual inspection	21 Mar	Weekly	N/A	No issues reported.
Visual inspection by UAV including crack gauges	-	Monthly		Changes in crack widths less than trigger level on 16 March.
Prince Street Overbridge (85.17 km)				
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Minor changes this month.
Local 3D survey of structure	18 Mar	Monthly		Minor changes this month.
Retaining wall (84.867 km)				
Local 3D survey of wall	18 Mar	Monthly	N/A	Small changes in tilt from top to base of wall on this month. Vegetation cleared this month. Survey results returned to low levels of tilt.
Matthews Lane Overbridge (84.551 km)				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes on 9 February. Access issues prevented survey this month.
Local 3D survey of structure	-	Monthly		Minor change between abutments on 10 February. Access issues prevented survey this month.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Victoria Bridge over Stonequarry Creek				
GNSS unit (Site 3)	Continuous			Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week.
Far-field Absolute 3D survey	18 Mar	Monthly	N/A	Minor changes at VBP1 on eastern end. Small horizontal movement to the east and north at new mark VBP2 this month.
Local 3D survey of structure	29 Mar	Monthly	N/A	Continued minor changes between abutments. Devegetation works are required to complete survey.
Abbotsford Road Bridge over Stonequarry Creek				
Far-field Absolute 3D survey	-	Monthly	N/A	Very minor changes this month.
Embankment and Culvert at 87.331 km				
Absolute 3D survey	-	Survey at end of LW W3	N/A	Last survey 8 March. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which were previously disturbed. Peg on Down toe at 87.380 km could not be measured this month. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed. ARTC authorised change to Stage 3 subsidence management. Monthly surveys will cease, and a final survey will be conducted at the end of LW W3.
Extensometer	Every 15 minutes		N/A	Minor changes observed, including in response to recent rainfall events.
Embankment and Culvert at 88.100 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 8 March. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed, with minor changes this month. Uplift recorded at 88.14 km on Down side toe.
Extensometer	Every 15 minutes			Negligible changes observed, including in response to recent rainfall events.
Visual inspection	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Culvert at 87.918 km is blocked or partially blocked.
Embankment and Culvert at 88.500 km				
Absolute 3D survey	-	Monthly	N/A	Last survey 8 March. Minor changes observed this month.
Extensometer	Every 15 minutes			Negligible changes observed, including in response to recent rainfall events.
Visual inspection	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March.
Embankment and Culvert at 89.300 km				
Absolute 3D survey	-	-	N/A	Surveys commence during Stage 2 management.
Extensometers	Every 15 minutes		N/A	Minor changes observed, including in response to recent rainfall events.
Visual inspection	-	-	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March.

Monitoring Activity	Date	Current Frequency	Highest Trigger	Comments
Cuttings				
Cutting 87.540km-87.669km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. It is recommended to clear blockage from the Up side cess near 87.62 km to prevent ponded water affecting formation.
Cutting 88.200km-88.400km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. New cracks observed in Up side access road at 88.32 km on 10 March, resulting noticeable tilt of redundant power pole. Geotechnical inspection on 13 March confirmed no issues to safety of track or rail operations. Additional survey marks recommended to understand cause during mining of LW W4.
Cutting 88.700km-89.050km	-	Monthly	N/A	Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Minor surface erosion of fretting shale materials noted. Last survey 8 March. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey.

Management Actions
Other management actions since previous report: ● Nil
Any additional and/or outstanding management actions: ● Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related). ARTC have imposed a 40/40 TSR on the Up Main and plan to conduct tamping with drainage and reconditioning works during May possession.
Consultation with stakeholders since previous report: ● RMG meeting held on 2 April
Forecast whether residual subsidence is likely to cause: **A. Track closure for any period unacceptable to ARTC** **B. Impact on the safety of operations on the Main Southern Railway** Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly residual subsidence movements are not likely to result in the occurrence of either A or B above.

Certified by Tahmoor Coal	
Name	Ross Barber
Position	Project Manager
Signature	Ross Barber
Date	2 April 2022

Copy of Report to:

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations