

**DENDROBIUM AREA 3C  
LONGWALL 21  
END OF PANEL REPORT  
December 2023**



## EXECUTIVE SUMMARY

This End of Panel (EoP) report has been prepared in accordance with both Schedule 3 Condition 9 of the Dendrobium Development Consent (DA 60-03-2001) and Schedule 3 Condition 16 of the Longwall 21 Subsidence Management Plan (SMP) Approval. The EoP report outlines the measured and observed impacts during the extraction of Dendrobium Area 3C (DA3C) Longwall 21 and presents monitoring results and analyses compared to relevant impact assessment criteria and predictions in the DA3C SMP.

Dendrobium Longwall 21 is located within Consolidated Coal Lease 768 and is the first panel to be extracted in DA3C. Extraction of Longwall 21 commenced on 25 April 2023 and was completed on 6 August 2023. The extracted longwall has a length of 863 metres (m), a void width of 305 m (including first workings) and a maximum cutting height up to 3.9m.

The extraction of underground coal reserves from DA3C provides benefits at international, national, state and local levels. Illawarra Metallurgical Coal (IMC) provides an essential supply of coking coal to BlueScope Steel for its steelmaking production, and for export to overseas customers. Operations at Dendrobium Mine represent continuing significant capital and operating investments in the Southern Coalfield of New South Wales.

Continuing benefits occur through continuity of employment, export earnings and government revenue. From the operations of Dendrobium Mine, IMC paid approximately \$80 million in government royalties between July 2022 to June 2023.

Subsidence movements resulting from the extraction of Longwall 21 were monitored along lines and points within the SMP Area. The measured ground movements after the extraction of Longwall 21 are generally similar to or less than the predicted values.

During the extraction of Longwall 21, 36 new surface impacts were identified. These impacts are labelled as "DA3C\_LW21\_001" to "DA3C\_LW21\_036". These impacts were all observed on natural features and there were no impacts to built features identified.

No water quality Trigger Action Response Plans (TARPs) were triggered in the review period. Anomalous water quality effects are noted in streams that have been directly mined under by previous longwalls (e.g. WC21, SC10C, LA4, Donalds Castle Creek). Those effects include transient or persistent increases in electrical conductivity (EC), increases (or decreases) in pH and increases in dissolved metal concentrations such as Fe, Mn, Al and Zn. Dissolved iron concentrations in SC10 have declined during 2023, resulting in a decrease in the extent of iron staining on the watercourse.

Analysis of flow-corrected trends in water quality indicate that EC and dissolved sulfate, Fe, Mn and Zn are slightly elevated relative to baseline conditions at downstream monitoring sites DCC\_FR6 and SCK\_Rockbar 5. EC and dissolved sulfate and manganese are elevated compared with baseline at WC\_FR6.

In September 2023, DPE received a complaint regarding iron staining in Wongawilli Creek and requested further information in relation to the occurrence. The complaint related to observations of suspended iron oxides along a similar stretch of the watercourse which was previously reported in 2021. Subsequent investigation indicates that the recurrence of suspended iron in Wongawilli Creek is related to fluctuating and increasing concentrations

of iron at WC\_Pool 50 associated with discharge from an adjacent iron-rich spring. IMC has commissioned Stantec to undertake an assessment of the ecotoxic effects on aquatic flora and fauna due to elevated dissolved iron concentrations and associated iron precipitates following specialist consultant recommendations.

At the time of reporting, stream flow data for a key reference site (213200 O'Hares Creek @ Wedderburn) was not available from the WaterNSW web portal, nor through direct inquiry. Therefore, Assessments A to C could not be completed at the end of the Longwall 21 review period. Assessment D has been carried out. The full flow assessment will be presented in the Longwall 19A EoP Report.

Pools along Wongawilli Creek were observed to be full and flowing during the review period; no pools along Wongawilli Creek that are normally full have become dry as a result of mining.

Longwall 21 did not pass directly under any Lake Cordeaux tributaries and most pools are beyond the area of mining influence. However, a number of monitored pools located on mid-to upper tributary reaches recorded no-flow or were dry during August and September 2023. Given their distance from the longwall, the decline in pool levels are assumed to be related to dry conditions in 2023, contrasting with the wet conditions during the baseline for most of the pool monitoring sites. Longwall 21 passed within 400 m of Wongawilli Creek tributary WC24 and partially beneath WC20. There is no observed change in the outflow status of monitored pools on WC24 following the extraction of Longwall 21. Site WC20\_Rockbar17 became dry following passage of Longwall 21 beneath the watercourse. Surface cracking and flow diversion are expected in watercourses that are directly mined under (MSEC, 2019).

The mean total mine inflow during Longwall 21 extraction was 8.05 ML/day which represents a 28% decrease compared with the previous longwall (Longwall 19). The decrease brings the mean inflow back to a similar level observed during Longwalls 17 and 18, prior to the very high rainfall year in 2022. The net mine water balance is dominated by pumping from Area 3B (83 % of total), with Area 3C (where Longwall 21 is located) representing only 9.5 % of inflows. High inflows occurred in 2022 following the very high rainfall events. Those high inflows were managed by transferring water from Area 2 to Area 3A and Area 3B. No anomalous inflow due to intersecting water-bearing structures such as faults or dykes was reported during the extraction of Longwall 21.

Further information regarding the usage, recycling and treatment of mine water can be found in the [Dendrobium Mine Water Management Plan](#).

A review of shallow groundwater hydrographs at swamp sites within the area of influence of Longwall 21 indicates groundwater levels have declined at all swamps to levels below baseline. Recession rates remained consistent with those observed during the baseline period. The decline in shallow groundwater levels triggered Level 3 TARPs for all performance measure swamp sites including Swamps 9, 144 and 145 (09\_01, 09\_02, 144\_01 and 145\_01). However, based on the distance from the longwall and comparison with reference sites, the triggers are unlikely to be related to mining and instead reflect the wetter conditions experienced during the baseline monitoring period for most of the swamp sites. Potential mining effects at Swamp 144 should be reassessed as more data becomes available.

Similarly, average soil moisture levels declined to below baseline levels at all soil moisture sites within the mining area of influence (S09\_01, S09\_02, S144\_01 and S145\_01), triggering Level 3 TARPs. The declines in soil

moisture reflect broader declines across the region in response to drying conditions in 2023. Potential mining effects at Swamp 144 should be reassessed as more data becomes available.

Three Level 1 and two Level 2 impacts were observed in watercourses following commencement of extraction of Longwall 21. These were three rock fractures in WC20, iron staining in WC24 and WC20 and an increase in existing iron straining in isolated sections of Wongawilli Creek downstream of WC Pool 50. No changes in water quality in watercourses were identified.

Two Aboriginal cultural heritage sites were monitored, with no impacts related to the extraction of Longwall 21 observed.

## CONTENTS

EXECUTIVE SUMMARY .....	2
1. INTRODUCTION .....	8
1.1. Approval and Legislative Requirements .....	8
1.2. Economic Benefits .....	9
1.3. Stakeholder Consultation .....	9
2. PREDICTED AND OBSERVED SUBSIDENCE .....	11
2.1. Wongawilli Creek Closure Lines .....	13
2.2. Sandy Creek Waterfall Closure Lines .....	13
2.3. Wongawilli Creek Tributaries .....	14
2.4. Dendrobium Area 3C 3D monitoring points .....	15
2.5. 330 kV transmission line monitoring .....	16
2.6. ALS / LiDAR surveys .....	17
3. IMPACTS TO NATURAL FEATURES .....	20
3.1. Impacts to Wongawilli Creek .....	20
3.1.1. Iron Staining on Wongawilli Creek .....	20
3.2. Impacts to First and Second Order Streams .....	21
3.3. Impacts to Other Landscape Features .....	24
3.4. Surface Water Quality .....	34
3.5. Surface Water Hydrology .....	35
3.6. Deep Groundwater Hydrology .....	36
3.6.1. Mine Water Balance .....	36
3.6.2. Deep Groundwater Levels .....	37
3.6.3. Groundwater Chemistry .....	38
3.7. Impacts to Upland Swamps .....	38
3.7.1. Shallow Groundwater and Soil Moisture .....	38
3.7.2. Erosion in Upland Swamps .....	41
3.8. Terrestrial Ecology .....	41
3.9. Aquatic Ecology .....	41
3.10. Cultural Heritage .....	48
4. IMPACTS TO BUILT FEATURES .....	49
5. SUMMARY OF TARP TRIGGERS .....	50
6. LONGWALL 21 MONITORING PROGRAM .....	56
7. REFERENCES .....	60
8. APPENDIX A – IMPACTS, TRIGGERS AND RESPONSE .....	62

9. APPENDIX B – CORRECTIVE MANAGEMENT ACTIONS .....	77
10. APPENDIX C - SUMMARY OF ADDITIONAL CORRESPONDENCE SWAMP 144.....	98

## LIST OF FIGURES

Figure 1: Overview of subsidence monitoring sites, comprised of monitoring lines and monitoring points.....	12
Figure 2: Measured incremental closures for the HRS SCW closure lines due to Longwall 21 only.....	14
Figure 3: Measured incremental horizontal movements outside the mining area at Dendrobium mining area	15
Figure 4: Measured incremental vertical subsidence for TWR17-17 to TWR17-21 due to the mining of Longwall 21 only. ....	16
Figure 5: Measured incremental changes in surface level due to the mining of Longwall 21.....	17
Figure 6: Measured changes in surface level and predicted vertical subsidence for the cross-section across Longwall 21 near the mid-length of the longwall. ....	18
Figure 7: Measured changes in surface level and predicted vertical subsidence for the long-section along the centreline of Longwall 21. ....	19
Figure 8: Groundwater inflow from water balance for all mine areas (ML/d). ....	37
Figure 9: Overview of surface impacts and swamp triggers observed during the Longwall 21 monitoring period. ....	54
Figure 10: Overview of swamp triggers observed during the Longwall 21 monitoring period in DA3A and DA3B. ....	55
Figure 11: Overview of monitoring sites relevant to Longwall 19A active mining area. ....	59

## LIST OF TABLES

Table 1: Approval conditions excerpt from the Dendrobium Development Consent (DA60-03-2001 – MOD 9).	8
Table 2: Social Impact Variables Associated with Subsidence. ....	10
Table 3: Measured and predicted total closure at the Wongawilli Creek closure lines due to the mining of Longwall 6 to Longwall 21. ....	13
Table 4: Maximum measured and predicted incremental vertical subsidence and closure at the WC20 cross line due to the mining of Longwall 21 .....	14
Table 5: Summary of impacts identified on first and second order streams during the Longwall 21 monitoring period.....	22
Table 6: Summary of Impacts to other landscape features during the Longwall 21 monitoring period.....	24
Table 7: Summary of shallow groundwater level TARP status at Longwall 21 impact sites. ....	40
Table 8: Summary of soil moisture level TARP status at Longwall 21 impact sites. ....	40
Table 9: Summary of predicted and observed impacts to aquatic ecology associated with Longwall 21.....	43
Table 10: Summary of Aquatic Ecology TARP sites and their respective trigger levels.....	47
Table 11: Aboriginal cultural heritage sites status following the extraction of Longwall 21. ....	48
Table 12: Summary of predicted impacts in comparison to observed impacts relevant to Longwall 21. ....	49
Table 13: Summary of TARP Triggers during the extraction of Longwall 21. ....	50
Table 14: Summary of monitoring sites associated with the extraction of Longwall 21. Recommended monitoring sites associated with the extraction of Longwall 19A are also included (Figure 11).....	56
Table 15: Dendrobium Landscape TARPs. ....	62
Table 16: Dendrobium Area 3 Swamp TARP.....	64
Table 17: Dendrobium Area 3C Watercourse Impacts, Triggers and Response.....	67

## **ATTACHMENTS**

**Attachment A** – Longwall 21 SMP Approval

**Attachment B** – Subsidence Monitoring Report (MSEC)

**Attachment C1** – Landscape Report (IMCEFT)

**Attachment C2** – Longwall 21 Impact Reports (IMCEFT)

**Attachment D** – Surface Water and Shallow Groundwater Assessment (HGEO)

**Attachment E** – Groundwater Assessment (HGEO)

**Attachment F** – Aquatic Ecology Assessment (Stantec)

**Attachment G** – Heritage Assessment (Regal Heritage)

**Attachment H** – Terrestrial Ecology Assessment (Niche)

**Attachment I** – Agency correspondence regarding Swamp 144

# 1. INTRODUCTION

## 1.1. Approval and Legislative Requirements

Dendrobium Longwall 21 is located within Consolidated Coal Lease 768 and is the first panel to be extracted in DA3C. Extraction of Longwall 21 commenced on 25 April 2023 and was completed on 6 August 2023. The extracted longwall has a length of 863m, a void width of 305m (including first workings) and a maximum cutting height up to 3.9m.

This EoP report has been prepared in accordance with Schedule 3 Condition 9 of the Development Consent (DA60-03-2001 – MOD 9) (Table 1). The EoP report outlines the measured and observed impacts of Longwall 21 and the analyses of monitoring results compared to relevant impact assessment criteria and predictions made in the SMP and associated management plans and reports.

The Longwall 21 SMP was approved by the Department of Planning and Environment (DPE) on 19 December 2019.

Schedule 3 Conditions 9 and 10 of the Development Consent are provided in Table 1.

Table 1: Approval conditions excerpt from the Dendrobium Development Consent (DA60-03-2001 – MOD 9).

Development Consent Approval Condition	Relevant Section in EoP Report
<p>Schedule 3 of Development Consent DA60-03-2001 – MOD 9</p> <p>9. Within 4 months of the completion of each longwall panel, or as otherwise permitted by the Secretary, the Applicant must:</p> <p>(a) prepare an end-of-panel report:</p> <ul style="list-style-type: none"><li>reporting all subsidence effects (both individual and cumulative) for the panel and comparing subsidence effects with predictions;</li><li>describing in detail all subsidence impacts (both individual and cumulative) for the panel;</li><li>discussing the environmental consequences for watercourses, swamps, water yield, water quality, aquatic ecology, terrestrial ecology, groundwater, cliffs and steep slopes; and</li><li>comparing subsidence impacts and environmental consequences with predictions; and</li></ul> <p>(b) submit the report to the Department, Resources Regulator, WaterNSW, BCS, DPE Water and any other relevant agency to the satisfaction of the Secretary</p>	<p><i>Sections 2 to 8, Attachments B to H</i></p>



10. The Applicant must include a comprehensive summary, analysis and discussion of the results of monitoring of subsidence effects, subsidence impacts and environmental consequences in each Annual Review.

*The Annual Review (July to June) is submitted in September each year*

The impact predictions for Longwall 21 are described in the following reports:

- Dendrobium Area 3C SMP (November 2019)
- Dendrobium Area 3C Watercourse Impact, Monitoring, Management and Contingency Plan (WIMMCP) (August 2020);
- Dendrobium Area 3C Swamp Impact, Monitoring, Management and Contingency Plan (SIMMCP) (August 2020).

Impacts have been reported by the IMC Environmental Field Team (IMCEFT) and specialist consultants during and following mining.

## 1.2. Economic Benefits

The extraction of underground coal reserves from DA3C provides benefits at international, national, state and local levels. IMC provides an essential supply of coking coal to BlueScope Steel for its steelmaking production, and for export to overseas customers. Mining operations at Dendrobium Mine represents continuing significant capital and operating investments in the Southern Coalfield of New South Wales.

Continuing benefits occur through continuity of employment, income, export earnings and government revenue. South32's IMC Operations:

- Provide employment for approximately 2,000 people, with more than 90% of wages paid to workers residing in the Illawarra region.
- Result in expenditure of A\$800 million a year in the Illawarra region, of which A\$300 million is spent with more than 200 locally based suppliers.
- Contributes more than A\$1 million a year to support local community groups and organizations.

From the operations of Dendrobium Mine, IMC paid approximately \$80 million in government royalties between July 2022 and June 2023.

## 1.3. Stakeholder Consultation

Provision of monitoring data and ongoing information to the community has been undertaken during the extraction of DA3C. Information on IMC operations is provided to the community and key stakeholders through the following mechanisms:

- Dendrobium Community Consultative Committee (DCCC) meetings;
- Community information sheets and letter box drops;
- Media releases and other media activities;

- General community surveys and reports;
- Dendrobium Community Newsletter – distributed to the community;
- Updates and document uploads to the South32 Internet site: <http://www.south32.net/our-operations/australia/illawarra-coal/regulatory-document>;
- Annual Review reports;
- Frequent consultation with WaterNSW, BCD and Dam Safety NSW (i.e. technical working group committee); and
- Public enquiries can be submitted through a 24-hour free community call line (1800 102 210) and email ([illawarracommunity@south32.net](mailto:illawarracommunity@south32.net)).

IMC aims to mitigate the potential impacts subsidence may cause through various means outlined in Table 2.

Table 2: Social Impact Variables Associated with Subsidence.

Potential Impact	Monitoring Variables	Mechanism
Subsidence Impacts	<ul style="list-style-type: none"> <li>• Level of community concern relating to subsidence</li> <li>• Awareness of subsidence, its effects and management</li> <li>• Level of perceived community risk associated with subsidence</li> <li>• Level of satisfaction with the company's subsidence management practices</li> <li>• The extent to which the community attributes environmental, social and economic change within the community to mining activities</li> </ul>	<p>Inform via the DCCC meetings including presentations and data relating to subsidence and its potential impacts. Minutes are published publicly on the South32 website.</p> <p>A triennial telephone survey of residents in the communities in which IMC operates. The survey aims to determine the community's perception of the company's overall performance.</p> <p>Review the Social and Human Rights Impact assessment annually and consider actions as part of business planning at least every 5 years or if a change to an activity or host community could significantly alter impacts.</p>

## 2. PREDICTED AND OBSERVED SUBSIDENCE

Subsidence movements resulting from the extraction of Longwall 21 were monitored along lines and points within the SMP Area (Figure 1). A comparison of the observed and predicted movements has been prepared by Mine Subsidence Engineering Consultants (MSEC) and is included as **Attachment B**.

Monitoring points and lines associated with Longwall 21 include:

- Wongawilli Creek closure lines;
- Sandy Creek Waterfall (SCW) closure lines;
- Area 3C 3D monitoring points;
- 330 kV transmission line monitoring points;
- Tributary cross lines;
- Airborne laser scans (ALS) of the area.

The predicted subsidence effects have been obtained using the subsidence model presented in Report No. MSEC978 which supported the SMP Application for Longwall 21.

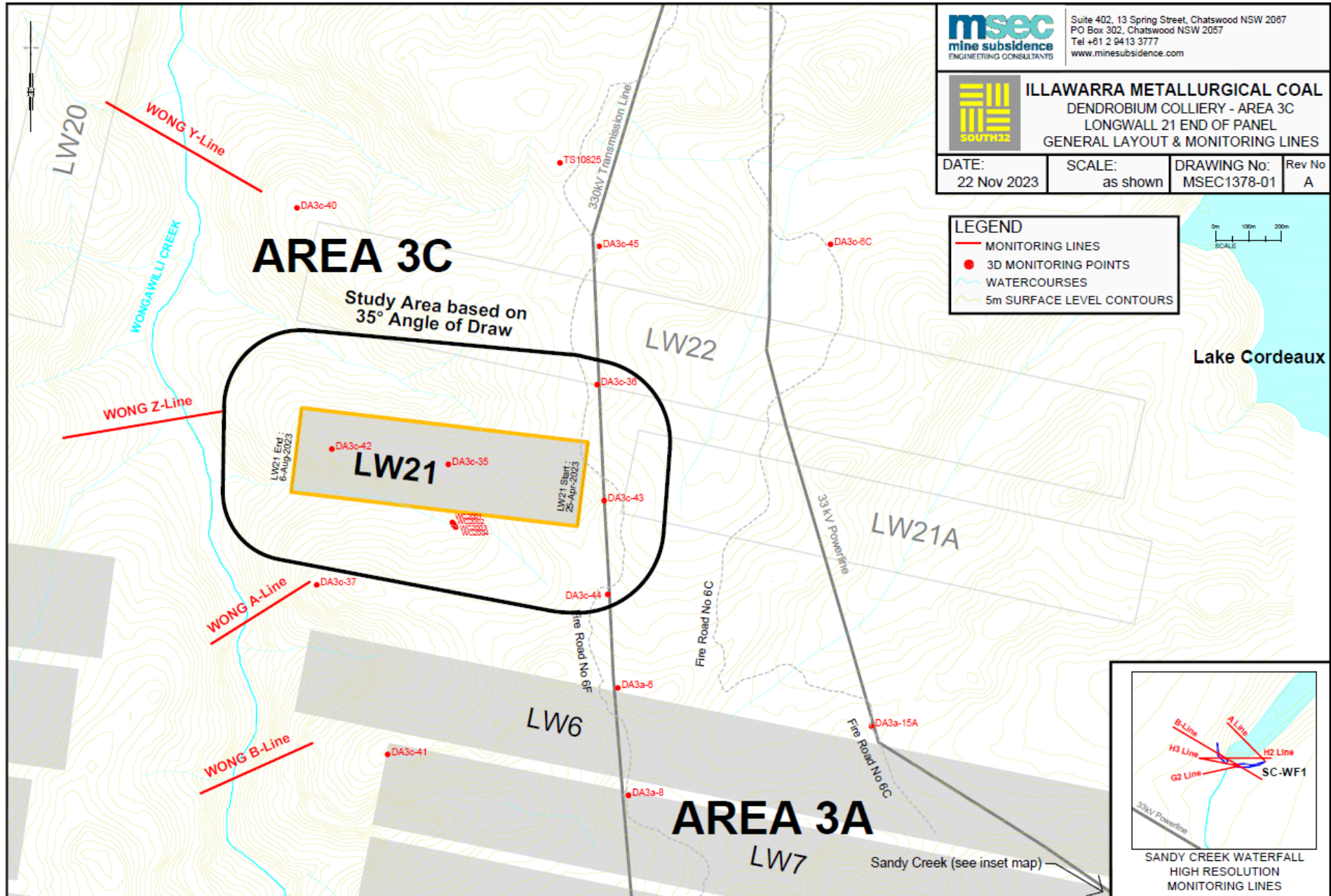


Figure 1: Overview of subsidence monitoring sites, comprised of monitoring lines and monitoring points

## 2.1. Wongawilli Creek Closure Lines

Closure movements across Wongawilli Creek have been measured by IMC using 2D survey techniques at the Wong A-Line, Wong B-Line, Wong Y-Line and Wong Z-Line (Figure 1). The Wong A-Line and Wong B-Line were installed in January 2013 and measured the movements due to the mining in Areas 3A, 3B and Longwall 21. The Wong Y-Line and Wong Z-Line were installed in March 2023 and measured the movements due to the mining of Longwall 21 only.

The measured total closures at the Wong A-Line and B-Line are less than the predicted total closures after the completion of Longwall 21. The Wong Y-Line and Wong Z-Line measured net opening movements which are likely due to survey tolerance and environmental effects, i.e. no measurable mining-related closure (Table 3).

The incremental movements at the Wongawilli closure lines due to the mining of Longwall 21 only are net extensions ranging between 5 mm and 25 mm. That is the net closures measured at the Wong A-Line and Wong B-Line reduced and the base readings at the Wong Y-Line and Wong Z-Line increased (i.e. opened) during the mining of Longwall 21.

It is considered that the ground movements measured using the Wongawilli Creek closure lines are consistent with the predictions provided in Report No. MSEC978 which supported the SMP Application for Longwall 21.

Table 3: Measured and predicted total closure at the Wongawilli Creek closure lines due to the mining of Longwall 6 to Longwall 21.

Location	Longwalls	Measured total closure (mm)	Predicted total closure (mm)
Wong A-Line	LW6 to LW21	104	180
Wong B-Line	LW6 to LW21	77	200
Wong Y-Line	LW21 only	-5 (opening)	130
Wong Z-Line	LW21 only	-9 (opening)	50

## 2.2. Sandy Creek Waterfall Closure Lines

Closure across SCW has been measured by IMC using the High-Resolution Survey (HRS) monitoring lines consisting of the H2-Line, H3-Line, G2-Line, A-Line and B-Line (Figure 2). The locations of these monitoring lines are shown in Figure 1. The HRS SCW monitoring lines each comprise two survey marks with one mark on each valley side.

In the latest survey, very low-level opening movements were measured along the HRS SCW A-Line, B-Line, H2-Line and H3-Line. It is likely that these movements are due to environmental effects where natural valley opening occurs during and shortly after the winter periods each year.

The maximum measured incremental closure is +0.1 mm at the G2-Line. This movement is within the order of the nominal tolerance of  $\pm 2$  mm when considering survey tolerance and environmental effects. That is, the mining-related movements are not measurable outside the nominal accuracy.

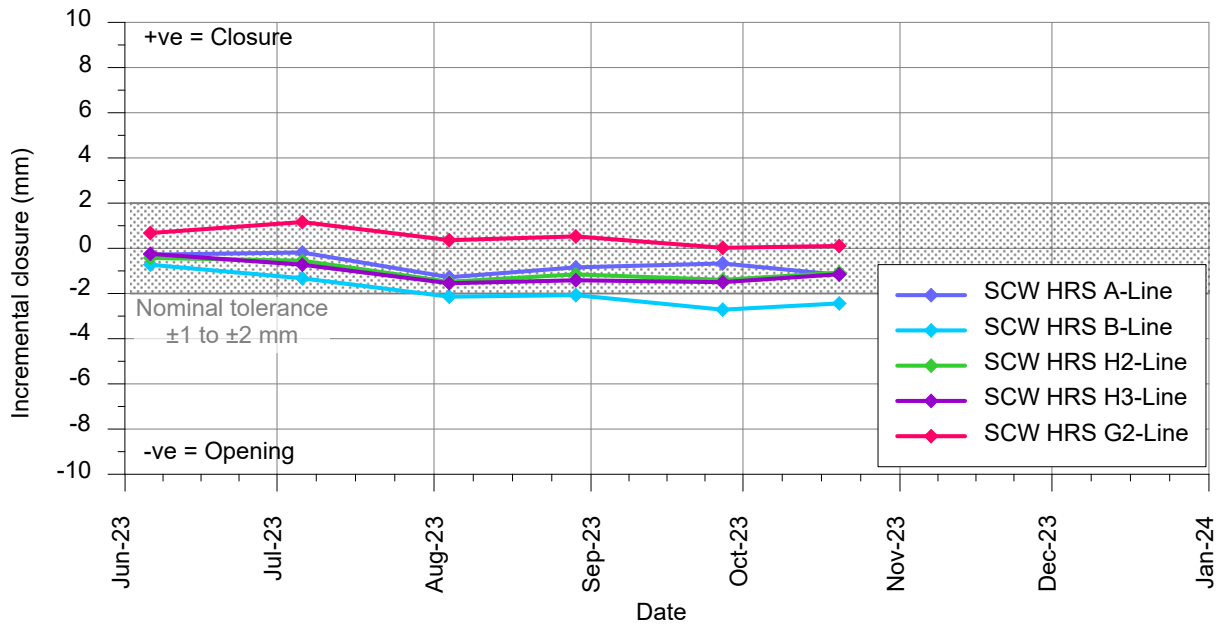


Figure 2: Measured incremental closures for the HRS SCW closure lines due to Longwall 21 only.

### 2.3. Wongawilli Creek Tributaries

The mine subsidence effects for a tributary to Wongawilli Creek have been measured by IMC using 2D survey techniques at the WC20 cross line. The location of this monitoring line is shown in Figure 1.

A summary of the maximum measured and predicted subsidence and closure at the WC20 cross line after the completion of Longwall 21 are provided in Table 4. The predicted subsidence value has been derived from the predicted subsidence contours illustrated in Report No. MSEC978. The predicted closure is based on a combination of the conventional horizontal movements and valley-related movements, taking the equivalent height of the valley within half-depth of cover from the valley base.

Table 4: Maximum measured and predicted incremental vertical subsidence and closure at the WC20 cross line due to the mining of Longwall 21

Type	Maximum incremental vertical subsidence (mm)	Maximum incremental closure (mm)
Measured	67	29
Predicted	< 50	200

The accuracies of the measured absolute levels of the survey marks are in the order of  $\pm 30$  mm. The accuracies of the measured closures are in the order of  $\pm 5$  mm.

The maximum measured incremental vertical subsidence at the WC20 Line of 67 mm is slightly greater than the maximum predicted vertical subsidence of less than 50 mm. However, the exceedance of 17 mm is within the order of survey accuracy for absolute height of  $\pm 30$  mm. The measured incremental closure at the monitoring line of 29 mm is less than the predicted closure of 200 mm.

It is therefore considered that the ground movements measured using the WC20 cross line are consistent with the predictions provided in Report No. MSEC978 which supported the SMP Application for Longwall 21.

## 2.4. Dendrobium Area 3C 3D monitoring points

Far-field horizontal movements near Longwall 21 have been measured by IMC using the DA3C 3D monitoring points. The locations of these monitoring points are shown in Figure 1.

The accuracies of the measured absolute positions (i.e. eastings and northings) are in the order of  $\pm 20$  mm. The greatest incremental horizontal movements occur directly above Longwall 21. The maximum measured incremental value is 439 mm at Mark DA3c-42 located on the side of a ridgeline above Longwall 21 towards the longwall finishing end. The vector is orientated towards the south in the downslope direction. The next greatest measured incremental value is 193 mm at Mark DA3c-35 located near the top of a ridgeline above Longwall 21 near the mid-length of the longwall. The vector is orientated towards the west in the direction of longwall retreat.

The comparison between the maximum measured incremental horizontal movements at the DA3A 3D monitoring points with those previously measured in Dendrobium Area 1 (DA1 3D) and Dendrobium Area 2 (DA2 3D) and Dendrobium Area 3B (DA3B 3D) is provided in Figure 3. The mean and the 95 % confidence level for the 3D monitoring data at Dendrobium Mine are also shown in this figure.

The measured incremental horizontal movements due to the mining of Longwall 21 are within the range of those measured at similar distances from previously mined longwalls at Dendrobium Mine.

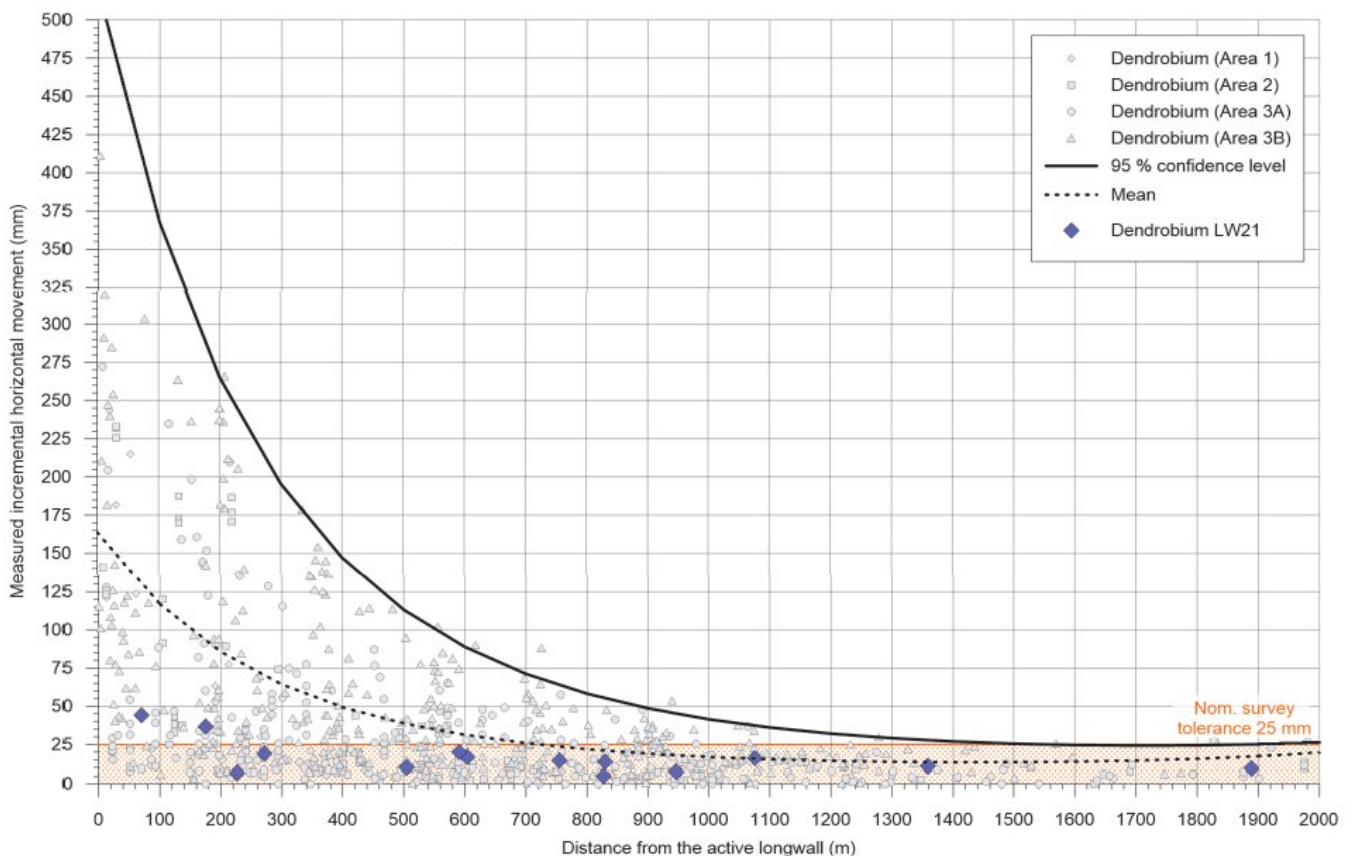


Figure 3: Measured incremental horizontal movements outside the mining area at Dendrobium mining area

## 2.5. 330 kV transmission line monitoring

The mine subsidence effects for the 330 kV transmission line have been measured by IMC using 2D monitoring points located on and around Towers TWR17-17 to TWR17-21. The locations of the transmission towers are shown in Figure 1.

The monitoring results were included in the subsidence review reports (MSEC1336, Rev. R01 to R18) which were issued during and after the mining of Longwall 21. The monitoring data was reviewed by IMC, MSEC and TransGrid and no additional management measures were required during mining. The measured incremental vertical subsidence movements for Towers TWR17-17 to TWR17-21 are illustrated in Figure 4. This figure presents the additional movements due to the mining of Longwall 21 only since the base survey.

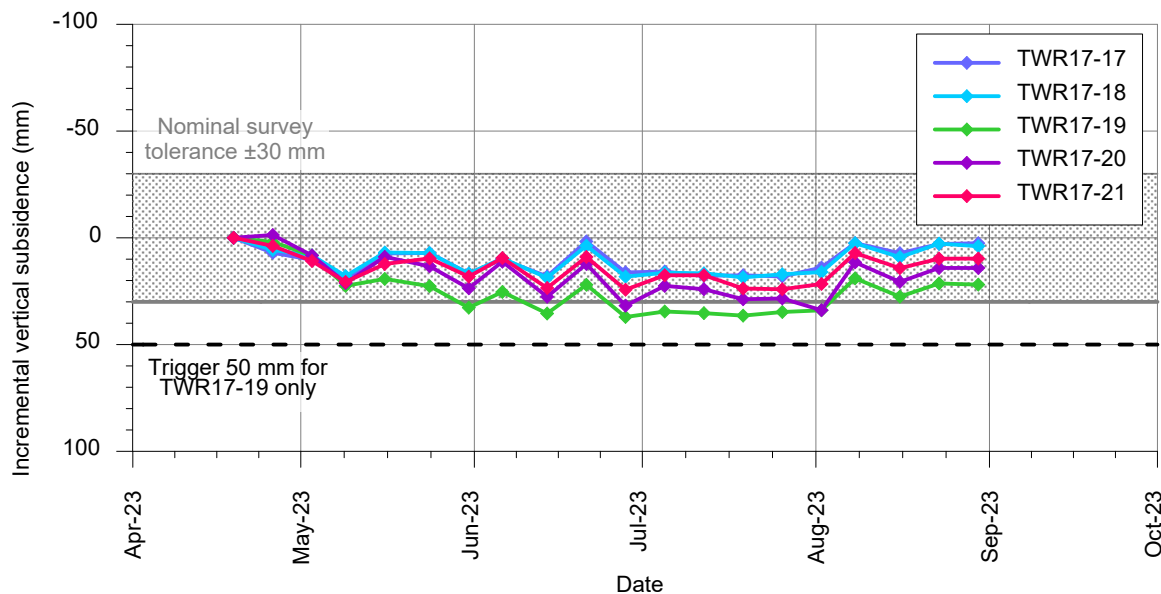


Figure 4: Measured incremental vertical subsidence for TWR17-17 to TWR17-21 due to the mining of Longwall 21 only.

In the final survey, the measured vertical subsidence movements at the towers were less than 30 mm which is in the order of survey tolerance for absolute height. Low-level vertical subsidence was measured at Tower TWR17-19 during mining which reduced to less than survey tolerance at the completion of mining.

The change in distance between Towers TWR17-19 and TWR17-20 was -23 mm (contraction). The movement slightly exceeded the predicted value of 20 mm; however, the change in distance is very small when compared to the overall distance between the two towers, of approximately 370 m, and therefore it represents a change of less than 0.01 %. The exceedance of 3 mm is in the order of survey tolerance. Otherwise, the measured incremental subsidence effects for the transmission line were less than the predicted values and less than the Level 1 triggers.

It is therefore considered that the ground movements measured using the 330 kV transmission line monitoring points are consistent with the predictions provided in Report No. MSEC978 which supported the SMP Application for Longwall 21.



## 2.6. ALS / LiDAR surveys

Changes in surface level due to the mining of Longwall 21 have been measured using ALS / Light Detection and Ranging (LiDAR) surveys. The initial surface level contours have been determined from the survey carried out in January 2010 before the commencement of Longwall 21. The post-mining surface level contours have been determined from the subsequent survey carried out in October 2023 after the completion of Longwall 21.

The measured incremental changes in surface level due to the mining of Longwall 21 only are shown in Figure 5. These contours have been determined by taking the differences between the surface levels measured before and after the mining of this longwall. The data located outside the 35° angle of draw have been removed for clarity.

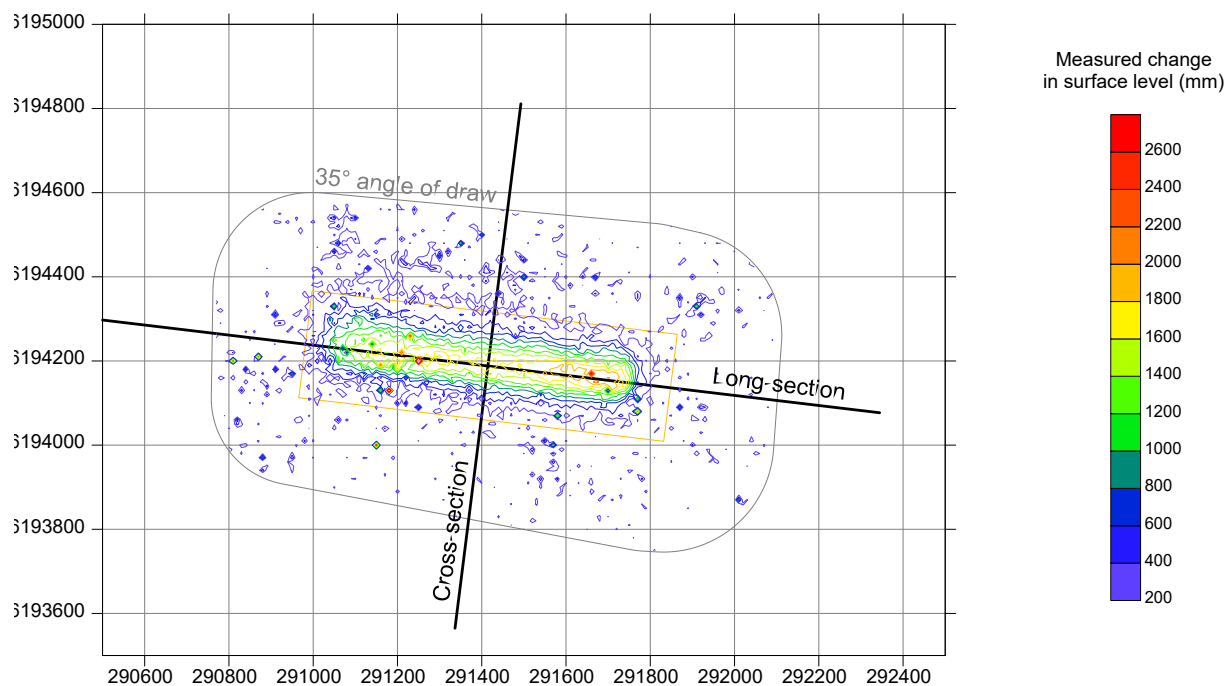


Figure 5: Measured incremental changes in surface level due to the mining of Longwall 21.

The profiles of the measured changes in surface level reasonably match the predicted profiles of vertical subsidence along the cross-sections and long-section (Figure 6 and Figure 7). The maximum measured changes in surface level above Longwall 21, is typically less than the maximum predicted values. The measured maximum change in surface level exceeds the predicted maximum vertical subsidence along a small portion of the long section, however this is likely to be a localised data effect and not real movement.

The measured changes in surface level above the commencing and finishing ends of Longwall 21 for the long-section (refer Figure 7) are greater than the predicted subsidence in these locations. The measured profiles for change in surface level above the ends of the longwall are therefore steeper than the predicted subsidence profiles. The measured profiles above the ends of the longwall are also steeper than the measured profiles across the longwall (refer Figure 6), however they reasonably match the predicted profiles.

The measured changes in surface level are greater than the predicted vertical subsidence outside the mining

area for each of the cross-sections and long-section. However, this is due to the measurement tolerance and the effects of the horizontal movements and sloping terrain on the LiDAR surveys. The differences between the measured and predicted movements above solid coal are generally in the order of accuracy of the LiDAR surveys of  $\pm 200$  mm. There are localised areas where these differences exceed the measurement tolerance; however, these are artefacts of the LiDAR surveys and are not real movements.

It is considered that the ground movements measured using the LiDAR surveys are consistent with the predictions provided in Report No. MSEC978 which supported the SMP application for Longwall 21.

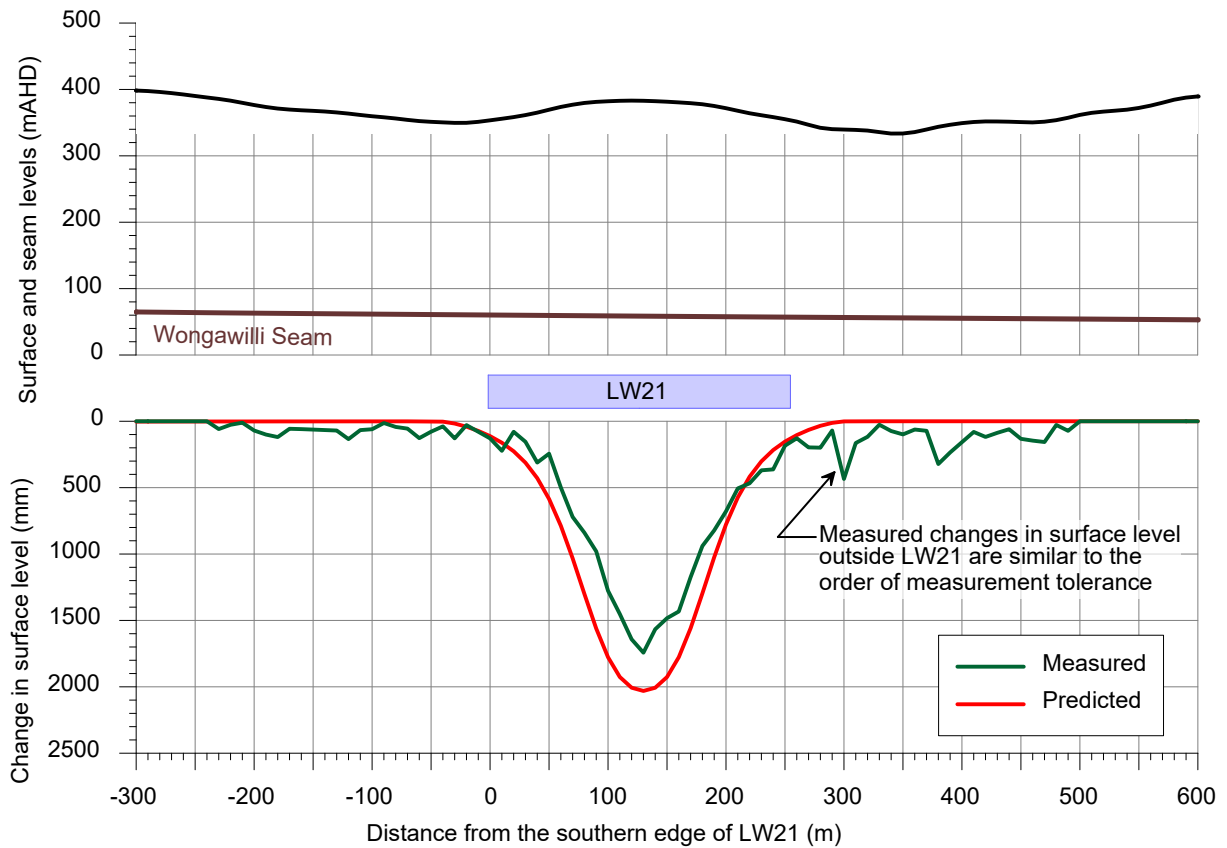


Figure 6: Measured changes in surface level and predicted vertical subsidence for the cross-section across Longwall 21 near the mid-length of the longwall.

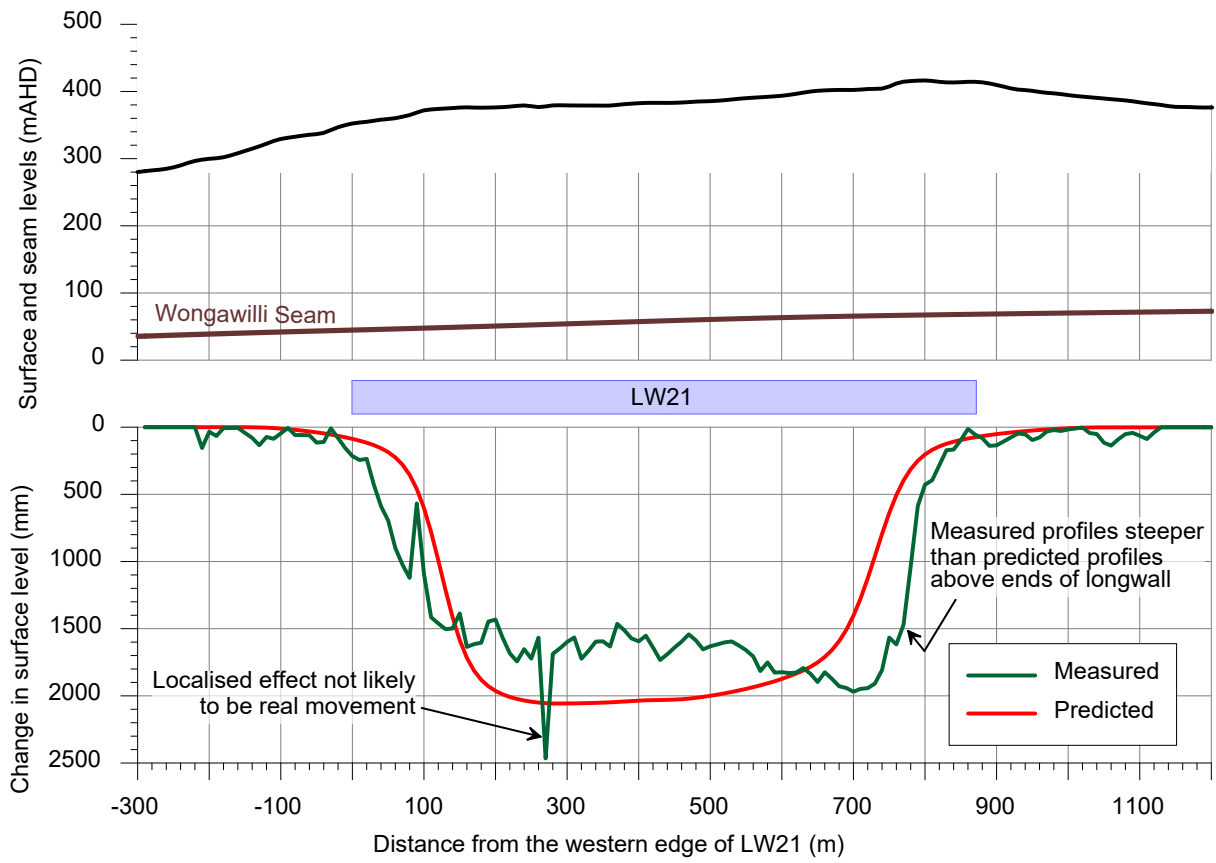


Figure 7: Measured changes in surface level and predicted vertical subsidence for the long-section along the centreline of Longwall 21.

### 3. IMPACTS TO NATURAL FEATURES

During the extraction of Longwall 21, 36 new surface impacts on natural features were identified. Other triggers are addressed in their respective sections, with further detail in the attached specialists' assessments.

The monitoring program for Longwall 21 was conducted in accordance with the SMP, WIMMCP and SIMMCP. The monitoring program is outlined in Section 6. The results of the IMCEFT monitoring are provided in **Attachment C1**; the impact reports submitted during the extraction of Longwall 21 are provided in **Attachment C2**. The results of monitoring undertaken by specialist consultants are provided in **Attachments D to H**. Figure 10 and Figure 11 illustrates the locations of surface impacts identified during the Longwall 21 monitoring period.

Subsidence includes vertical and horizontal movement of the land surface, which can result in surface and subsurface cracking, uplifting, buckling, dilation and tilting. These impacts can affect watercourse hydrology and morphology, swamp hydrology and ecological function, and other landscape features by means of surface cracking, which can lead to erosion and rockfalls. Potential mine subsidence impacts within DA3C are discussed in the DA3C SMP, WIMMCP and SIMMCP.

An overview of impacts observed during the extraction of Longwall 21 is provided in the following sections. For specific details on the impacts, refer to the relevant impact reports (**Attachment C2**).

#### 3.1. Impacts to Wongawilli Creek

##### 3.1.1. Iron Staining on Wongawilli Creek

In August 2021, an increase in iron staining (suspended iron floc) was observed along reaches of Wongawilli Creek adjacent to Areas 3A and 3B during routine monitoring. The observations were reported in an IMC impact report on 2/8/2021 (impact reference DA3B\_LW17\_031) and corresponded to a Level 3 TARP trigger. The source of the iron staining was identified as a spring located upslope from WC\_Pool 50. The iron staining was assessed and reported (HGEO, 2021b) in the Longwall 17 EoP. Updates to this iron staining were also provided in the Longwall 18 EoP (HGEO, 2022).

In September 2023, DPE received a complaint regarding iron staining in Wongawilli Creek and requested further information in relation to the occurrence. As of September 2023, iron staining and suspended iron oxides are evident from WC\_Pool 50, downstream to WC\_Pool 20. The extent of iron staining has fluctuated but is less extensive in September 2023 than when it was first reported in August 2021. The main source of the iron is a slope spring adjacent to WC\_Pool 50 with elevated concentrations of dissolved iron which flows into Wongawilli Creek. The spring reactivated in 2021 as a result of rising groundwater levels which was caused by higher-than-average rainfall between 2020 and 2022. Inspections carried out in October 2023 identified a further two iron seeps adjacent to WC\_Pool 50 (Impacts LW21\_035 and LW21\_036) (Photo 1 and Photo 2).

Episodes of suspended iron, characterised by orange coloured turbidity appear to be associated with spikes in dissolved iron concentration in WC\_Pool 50. The spikes occur during periods of low rainfall when stream flow is low and there is less dilution of slope spring discharge. While iron staining can occur naturally from spring discharges, the extent of iron precipitation and staining is greater than that typically seen in natural springs and

iron seeps. It is therefore possible that both the high flow rate and high iron concentration from the slope spring are partly due to groundwater flow through mine related fracture networks from approved mining in which there are relatively fresh reactive fracture surfaces.

It is possible that slope spring discharges are facilitated by subsidence fracturing associate with Longwall 6 (mined between 9/2/2010 and 28/3/2011), with the impact becoming evident as the mining induced depressed groundwater repressurised and springs reactivated in 2021.



Photo 1: DA3C\_LW21\_035, looking upslope, showing source of iron spring and staining. Taken: 9/10/2023.



Photo 2: DA3C\_LW21\_036, looking upslope, showing source of iron spring and staining. Taken: 9/10/2023.

### 3.2. Impacts to First and Second Order Streams

Five first and second order streams were monitored as part of the Longwall 21 monitoring program; WC20, WC21, WC24, WC24A and LC5. Impacts recorded to first and second order streams are presented below in Table 5, with Photo 3 to Photo 7 showing the impacts recorded.

Table 5: Summary of impacts identified on first and second order streams during the Longwall 21 monitoring period

\*\*A recent change to the reporting process has meant impact reports being uploaded to the Major Projects Planning Portal, following the initial report date, include a summary of stakeholder consultation. This has resulted in a Version 2 (V2) of reports with an accompanying revised date.

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_014	291470	6194009	Rock Fracturing	WC20	11/07/2023	2	Rock fracturing to rockbar on tributary WC20.	17/07/2023 (Version 2 (V2) uploaded 04/10/2023)
DA3C_LW21_015	291421	6194021	Rock Fracturing	WC20	11/07/2023	2	Rock fracturing to channel on tributary WC20.	17/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_017	291184	6194105	Rock Fracturing	WC20	26/07/2023	1	Rock fracturing and uplift to WC20_Rockbar 15.	31/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_020	291318	6194429	Iron Staining	WC24	1/08/2023	1	Iron staining in tributary WC24.	2/08/2023
DA3C_LW21_021	291547	6193965	Iron Staining	WC20	1/08/2023	1	Iron staining on the Swamp 144 basal step. Reported under the Watercourse TARP as iron occurs in the general drainage line and headwaters of WC20.	2/08/2023



Photo 3: *DA3C\_LW21\_014*, section of the rock fracturing. Taken on 11/07/2023.



Photo 4: *DA3C\_LW21\_015*, section of rock fracturing. Taken on 11/07/2023.



Photo 5: *DA3C\_LW21\_017*, section of rock fracturing. Taken on 26/07/2023.



Photo 6: *DA3C\_LW21\_021*, overview of the iron staining. Taken on 1/08/2023.



Photo 7: *DA3C\_LW21\_020*, section of iron staining in *WC24\_Channel 18*. Taken on 1/08/2023.

### 3.3. Impacts to Other Landscape Features

Impacts recorded on steep slopes, steps and general landscape features are presented below in Table 6, with Photo 8 to Photo 37 showing the impacts recorded.

Table 6: Summary of Impacts to other landscape features during the Longwall 21 monitoring period

\*\*A recent change to the reporting process has meant impact reports being uploaded to the Major Projects Planning Portal, following the initial report date, include a summary of stakeholder consultation. This has resulted in a Version 2 (V2) of reports with an accompanying revised date.

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_001	Rock Fracturing	Outcrop	06/06/2023	1	Rock fracturing to a small rock outcrop west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_002	Rock Fracturing and Rock Movement	LW21_RO1	06/06/2023	2	Rock fracturing and rock movement to a small rock outcrop at Landscape Monitoring Site LW21_RO1.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_003	Rock Fracturing and Rockfall	Outcrop and Step	06/06/2023	2	Rock fracturing and rockfall to an outcrop and a step west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_004	Rock Fracturing	Outcrop	06/06/2023	2	Rock fracturing on an outcrop west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_005	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracture on a rock outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_006	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracturing on a rock outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_007	Rock Fracturing and Rockfall	Outcrop	15/06/2023	2	Rock fracturing and rock fall on an outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_008	Rock Fracturing and Soil Cracking	Rock Step	19/06/2023	1	Rock fracturing/soil cracking to a rock step and bushland northeast of WC20.	20/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_009	Rock Fracturing	Rock Step	19/06/2023	1	Rock fracturing to a rock step west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_010	Rock Fracturing and Rock Movement/ Displacement	Outcrop	19/06/2023	2	Rock fracturing and associated rock movement/displacement at an outcrop west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_011	Rock Fracturing, Rock Displacement	Outcrop and Bushland	19/06/2023	1	Soil cracking, rock fracturing and associated rock displacement to an outcrop and bushland west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)



Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
	and Soil Cracking					
DA3C_LW21_012	Rock Fracturing	Rock Step	27/06/2023	1	Rock fracturing to rock step west of Fire Road 6F.	28/06/2023 (V2 uploaded 15/09/2023)
DA3C_LW21_013	Rock Fracturing	Outcrop	03/07/2023	1	Rock fracturing to rock outcrop west of Fire Road 6F.	04/07/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_016	Rockfall	Rock Step	11/07/2023	1	Small rockfall to step north of tributary WC20.	17/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_016 (Update)	Rockfall	Rock Step	26/07/2023	2	Rockfall to step north of tributary WC20.	31/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_018	Rock Fracturing	Rock Outcrop/Ledge	26/07/2023	1	Rock fracturing to rock outcrop/ledge.	31/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_019	Rock Fracturing	Rock Step	1/08/2023	1	Rock fracturing to rock step west of Fire Road 6F.	2/08/2023
DA3C_LW21_022	Rockfall	Rock Step	7/08/2023	1	Rockfall to rock outcrop/step west of Fire Road 6F	9/08/2023
DA3C_LW21_023	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_024	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_025	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing and rockfall to a rock outcrop north of tributary WC20.	8/09/2023
DA3C_LW21_026	Rockfall	Rock Outcrop	6/09/2023	1	Small rockfall and fracturing to step north of tributary WC20.	8/09/2023
DA3C_LW21_027	Rockfall	Rock Outcrop	6/09/2023	2	Rockfall to step north of tributary WC20 at Landscape Monitoring Site LW21_SS1.	8/09/2023
DA3C_LW21_028	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	8/09/2023
DA3C_LW21_029	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20 at Landscape Monitoring Site LW21_SS3.	8/09/2023
DA3C_LW21_030	Rock Fracturing	Rock Outcrop	12/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	14/09/2023

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_031	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_032	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_033	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_034	Rock Movement and Soil Cracking	Rock Outcrop	12/09/2023	2	Rock movement and soil cracking to rock outcrop north of tributary WC20.	14/09/2023
DA3C_LW21_035	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023
DA3C_LW21_036	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023



Photo 8: *DA3C\_LW21\_001*, showing detached rock piece. Taken on 06/06/2023.



Photo 9: *DA3C\_LW21\_002*, showing largest rock fracture in series. Taken on 06/06/2023.



Photo 10: *DA3C\_LW21\_003*, width of rock fracture. Taken on 06/06/2023.



Photo 11: *DA3C\_LW21\_004*, rock fracture width. Taken on 06/06/2023



Photo 12: *DA3C\_LW21\_005*, fracture to rock outcrop. Taken on 15/06/2023.



Photo 13: *DA3C\_LW21\_006*, fracturing to rock outcrop. Taken on 15/06/2023.



Photo 14: DA3C\_LW21\_007, fracturing and rock fall to outcrop. Taken on 15/06/2023.



Photo 15: DA3C\_LW21\_008, section of the rock fracture. Taken on 19/06/2023.



Photo 16: DA3C\_LW21\_009, maximum width of the rock fracture. Taken on 19/06/2023.



Photo 17: DA3C\_LW21\_010, Overview of the rock movement/displacement. Taken on 19/06/2023.



Photo 18: DA3C\_LW21\_011, section of rock fracturing. Taken on 19/06/2023.



Photo 19: DA3C\_LW21\_012, maximum width of the rock fracture. Taken on 27/06/2023.



Photo 20 : DA3C\_LW21\_013, section of the rock fracture. Taken on 03/07/2023.



Photo 21: DA3C\_LW21\_016, fragments of rockfall from step. Taken on 11/07/2023.



Photo 22: DA3C\_LW21\_016 (Update), looking at the rockfall. Taken on 26/07/2023.



Photo 23: DA3C\_LW21\_018, section of rock fracturing. Taken on 26/07/2023.



Photo 24: DA3C\_LW21\_019, looking at the rock fracture. Taken on 1/08/2023.



Photo 25: DA3C\_LW21\_022 Overview of boulder fallen away from step. Taken 7/08/2023.



Photo 26: *DA3C\_LW21\_023*, maximum width of the rock fracture. Taken: 31/08/2023.



Photo 27: *DA3C\_LW21\_024*, section of the rock fracture. Taken: 31/08/2023.

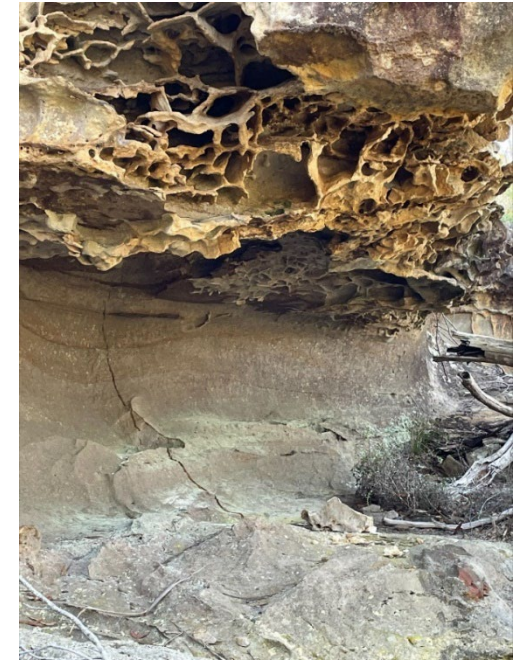


Photo 28: *DA3C\_LW21\_025*, section of the rock fracture in overhang. Taken: 06/09/2023.



Photo 29: *DA3C\_LW21\_026*, close-up section of rockfall. Taken 06/09/2023.



Photo 30: *DA3C\_LW21\_027*, overview of rockfall. Taken 06/09/2023.



Photo 31: *DA3C\_LW21\_028*, rock fracture. Taken 06/09/2023.



Photo 32: *DA3C\_LW21\_029*, section of rock fracture.  
Taken 6/09/2023.



Photo 33: *DA3C\_LW21\_030*, overview of rock fracture.  
Taken: 12/09/2023.



Photo 34: *DA3C\_LW21\_031*, overview of rock fracture.  
Taken: 12/09/2023. Note - measurement tape set to 0.5m for scale.





Photo 35: *DA3C\_LW21\_032*, overview of fracturing to rock step/overhang. Taken 12/09/2023.



Photo 36: *DA3C\_LW21\_033*, overview of rock fracture. Taken: 12/09/2023.



Photo 37: *DA3C\_LW21\_034*, width of soil crack. Taken 12/09/2023.

### 3.4. Surface Water Quality

The monitoring of water quality parameters provides a means of detecting and assessing the effects of streambed fracturing or induction of ferruginous springs. Monitoring includes measurement of field parameters such as pH, EC, dissolved oxygen (DO), oxygen reduction potential (ORP) and a suite of laboratory-tested analytes.

In general, stream salinity (measured by EC) has decreased between 2020 and 2022 due to higher-than-average rainfall and runoff during that period. Most watercourses, including upstream control sites show an increase in EC during 2023 corresponding with a return to dry conditions. Most watercourses also show a decline in DO during 2023 which, again, is related to low flow conditions during which disconnected pools are more common. No new water quality TARPs were triggered in the review period; however, anomalous water quality effects are noted in streams that have been directly mined under by previous longwalls (e.g. WC21, SC10C, LA4, Donalds Castle Creek). Those effects include transient or persistent increases in EC, increases (or decreases) in pH and increases in dissolved metal concentrations such as Fe, Mn, Al and Zn.

Analysis of flow-corrected trends in water quality indicate that EC and dissolved sulfate, Fe, Mn and Zn are slightly elevated relative to baseline conditions at downstream monitoring sites DCC\_FR6 and SCK\_Rockbar 5. EC and dissolved sulfate and manganese are elevated compared with baseline at WC\_FR6.

In September 2023, DPE received a complaint regarding iron staining in Wongawilli Creek and requested further information in relation to the occurrence. The complaint related to observations of suspended iron oxides along a similar stretch of the watercourse as was previously reported in 2021. Subsequent investigation indicates that the recurrence of suspended iron in Wongawilli Creek is related to fluctuating and increasing concentrations of iron at WC\_Pool 50 associated with discharge from an adjacent iron-rich spring. A recent report into the occurrence recommended that IMC commission an independent assessment of the ecotoxic effects on aquatic flora and fauna due to elevated dissolved iron concentrations and associated iron precipitates.

A gas release was observed in Wongawilli Creek at WC\_Pool 50 on 18 January 2023. The release is intermittent to continuous and emanates from the base of a sandstone step on the western side of the pool with smaller gas bubbles from the centre of the pool. An inspection carried out in September 2023 reported one light and intermittent gas release from the base of the same sandstone step. The gas emission at Pool 50 is very minor and is considered to have negligible environmental consequences.

Further details are presented in **Attachment D**.

### **3.5. Surface Water Hydrology**

The four-surface water hydrology assessment methods are as follows:

- (A) General hydrological behaviour compared with Reference Sites,
- (B) The frequency and duration of ecologically-significant cease-to-flow events compared with Reference Sites;
- (C) Changes to median flow compared with Reference Sites, which is now the agreed measure of the water resource availability in each sub-catchment; and
- (D) Comparison of qualitative flow data from gauging stations and semi-quantitative field observations by IMCEFT along the “middle reach” of Wongawilli Creek.

At the time of reporting, stream flow data for a key reference site (213200 O'Hares Creek @ Wedderburn) was not available from the WaterNSW web portal, nor through direct inquiry. Therefore, Assessments A to C could not be completed at the end of the Longwall 21 review period. The full flow assessment will be presented in the Longwall 19A EoP Report.

## 3.6. Deep Groundwater Hydrology

Groundwater monitoring at Dendrobium Mine is conducted in accordance with the Area 3C SMP (South32, 2019) and the Groundwater Management Plan contained therein. The aims of the Groundwater Management Plan are to:

- Monitor groundwater levels and quality, commencing at least one year prior to mining affecting the system;
- Project potential groundwater changes during mining (short term) and post-mining (long term) with particular attention to the effect of changes to groundwater regime, impact on the catchment yield and interaction with the stored waters;
- Identify hydraulic characteristics of overlying and intercepted groundwater systems, and determine changes to groundwater systems due to coal extraction and dewatering operations;
- Report any pumping tests and groundwater/surface water simulation studies; and
- Collect water level data from all agreed groundwater-monitoring locations.

Further details are presented in **Attachment E**.

### 3.6.1. Mine Water Balance

All movements of water via pumping stations are monitored and controlled in real-time through the System Control and Data Acquisition (SCADA) system and used to calculate a daily mine Water Balance. The Water Balance is an accurate measure of all water that enters, circulates and leaves the mine, including via air moisture and coal moisture content. Mine water seepage (groundwater inflow), which cannot be directly measured, is determined by mass balance for each goaf and is therefore known to a reasonable accuracy. Key metrics of the Mine Water Balance are reported against TARP levels to Dams Safety NSW monthly.

The mean total mine inflow during Longwall 21 extraction was 8.05 ML/day which represents a 28% decrease compared with the previous longwall (19). The decrease brings the mean inflow back to a similar level to the average observed during Longwalls 17 and 18, prior to the very high rainfall year in 2022. The net mine water balance is dominated by pumping from Area 3B (83 % of total), with Area 3C (where Longwall 21 is located) representing only 9.5 % of inflows. High inflows occurred in 2022 following the very high rainfall events. Those high inflows were managed by transferring water from Area 2 to Area 3A and Area 3B. No anomalous inflow due to intersecting water-bearing structures such as faults or dykes was reported during the extraction of Longwall 21.

The modern water component in mine inflow is monitored by analysing tritium in samples collected from goaf inflow and development seepage water samples. The results are reported monthly to Dams Safety NSW. Tritium is an isotope of hydrogen ( $^3\text{H}$ ), generated in the atmosphere through interactions with cosmic rays and through past atmospheric nuclear weapons testing (Clark, 2015). Tritium is incorporated into water molecules in rainfall and enters groundwater systems through recharge (rainfall and stream-bed infiltration). Tritium decays exponentially according to its half-life (12.32 years) and is typically only detectable in surface water samples and in groundwater that recharged within 4 to 5 half-lives (50 to 70 years). Detection of tritium above deep groundwater baseline levels in mine inflow samples would indicate a component of modern water in the sample

(as it does for samples from Area 2).

Tritium in samples collected from the Area 3B goaf outflow is typically within or close to baseline concentrations in deep groundwater, as defined by the 95th percentile (P95) level for samples collected from the Scarborough Sandstone. This implies a very low modern contribution to mine inflow in Area 3B. The median tritium content in Area 3B has increased slightly since 2020 and, in 2022 trended above 0.2 TU, noting that tritium in rainfall samples shows an increasing trend over the same period. The trend likely reflects a higher proportion of surface water inflow to the mine as a result of high rainfall in 2022 (and the preceding 2 years). The increasing trend may also reflect the redirection of inflow from Areas 2 and 3A through Area 3B during periods of peak inflow (HGEO, 2023).

As of the time of reporting, no analyses of tritium or carbon-14 for samples collected from Area 3C have been received from ANSTO.

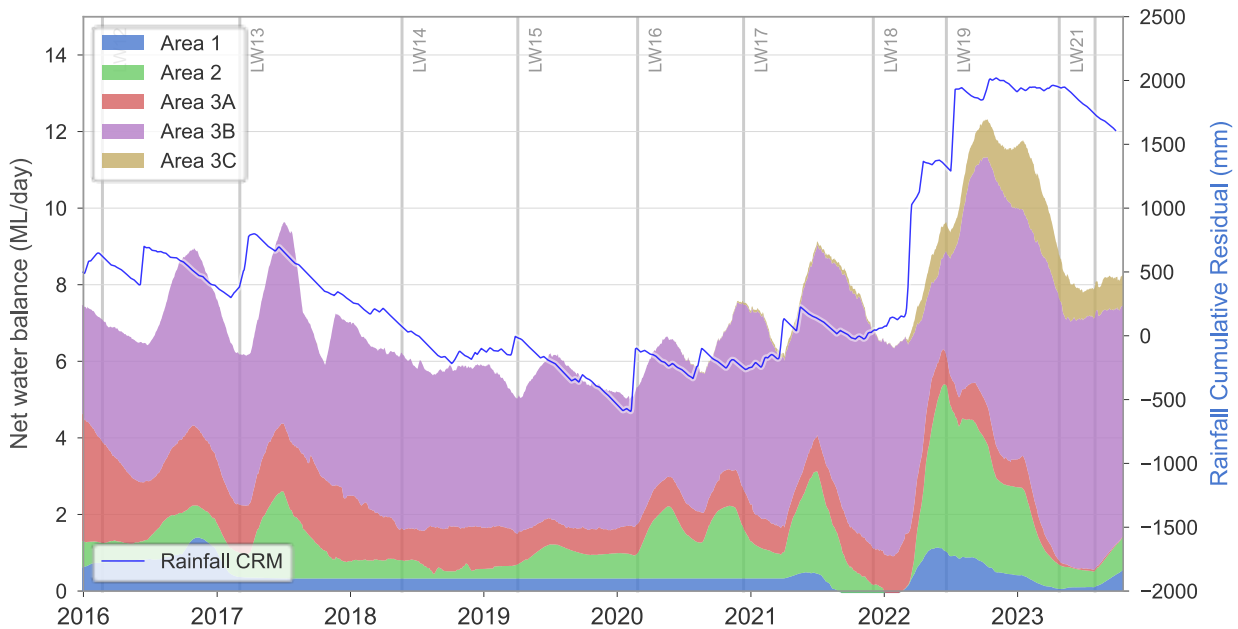


Figure 8: Groundwater inflow from water balance for all mine areas (ML/d).

### 3.6.2. Deep Groundwater Levels

Mining of Longwall 21 resulted in continued depressurisation of the target coal seam and overlying strata in line with numerical model predictions. Importantly, for piezometers adjacent to Lake Avon, observed head is similar to the numerical model prediction. Therefore, the model predictions are generally accurate for Longwall 21.

IMC has carried out investigation drilling above extracted longwalls in Areas 3A and 3B (HGEO, 2020a, 2020b, 2021a). The most recent drilling and re-installation was above Longwall 18 (S2521). Piezometers installed after longwall extraction indicate significant depressurisation throughout all strata and throughout the Hawkesbury Sandstone (HBSS) in most holes. Holes drilled above extracted longwalls provide evidence for groundwater perching and recovery in the years following mining. Drawdown in the HBSS reduces with distance and is typically negligible at distances greater than 1.2km from the goaf footprint.

Monitoring bore S2545 is located directly above Longwall 21. As Longwall 21 approached the monitoring bore, strata compression caused the groundwater pore pressure to increase, prior to shearing of the sensor cable, which is common for bores located directly above longwalls. The deeper sensors recorded relatively stable piezometric levels within the upper Bulgo Sandstone (BGSS), prior to rapid depressurisation and cable failure as Longwall 21 passed beneath the bore.

Monitoring bores S1892 and S2514 are located 153m south and 647m east of Longwall 21 respectively. S1892 shows relatively stable groundwater level in the HBSS, prior to rapid depressurisation during Longwall 21. Deeper strata show depressurisation associated with previous mining in Areas 3A and 3B. Groundwater levels in the deeper strata recovered slightly as mining in Area 3B moved southward, away from the bore site, before experiencing slight depressurisation just prior to, and during, Longwall 21. S2514 shows minor drawdown in the HBSS during Longwall 21 with evidence of drawdown due to mining in Area 3A to the south, prior to Longwall 21. The above effects are consistent with those observed near previous extracted longwalls and in line with expectations and numerical predictions.

### **3.6.3. Groundwater Chemistry**

Previous reviews have shown that there is no clear spatial pattern in the distribution of groundwater quality in HBSS and BGSS bores. Groundwater salinity was measured using EC and pH for all samples collected from monitoring bores in DA3A and DA3B. Adverse trends are identified where recent samples define a consistent freshening trend (decreasing EC). Such trends in bores located adjacent to water storage reservoirs may indicate migration of fresh surface waters towards the mine. Despite efforts to avoid the use of drilling additives during the installation of sampling pumps, it is still common for samples collected in the first few months or years following installation to be tainted by bentonite, cement grout or other compounds. Influence from grout or bentonite typically manifests as high EC and anomalously high pH (>8.5 to 11), making it difficult to discern background groundwater trends.

## **3.7. Impacts to Upland Swamps**

### **3.7.1. Shallow Groundwater and Soil Moisture**

Trigger values for subsidence-induced decreases in groundwater levels, at surface and near-surface monitoring sites at Area 3C swamps, have been established within the DA3C SIMMCP (South32, 2020c). Shallow groundwater level has been identified as an indicator of potential changes in ecosystem functionality of the swamps.

Changes to groundwater are reported when measurements of water level drop below baseline levels or when rates of recession exceed those recorded during baseline monitoring. Groundwater level hydrographs for each shallow piezometer are presented in **Attachment D**. Each hydrograph is plotted with ground elevation and the elevation of the piezometer base, longwall timing, groundwater level recession rate (in mm/day), and the dates that longwalls pass under (if relevant) a piezometer. Assessment of mining effects is based on these hydrographs.

The soil moisture TARP has been assessed by comparing the moisture content of the soil profile during the longwall assessment period against that of the baseline period. If the average soil moisture level drops below the minimum level recorded during the baseline period, a TARP is triggered.

A review of shallow groundwater hydrographs at swamp sites within the area of influence of Longwall 21 indicates groundwater levels have declined at all swamps to levels below baseline. Recession rates remained consistent with those observed during the baseline period. The decline in shallow groundwater levels triggered Level 3 TARPs for all performance measure swamp sites including Swamps 9, 144 and 145 (*09\_01, 09\_02, 144\_01 and 145\_01*). However, based on the distance from the longwall and comparison with reference sites, the triggers are unlikely to be related to mining and instead reflect the dry conditions in 2023, contrasting with the wetter conditions experienced during the baseline monitoring period for most of the swamp sites. Potential mining effects at Swamp 144 should be reassessed as more data becomes available.

Similarly, average soil moisture levels declined to below baseline levels at all soil moisture sites within the mining area of influence (*S09\_01, S09\_02, S144\_01 and S145\_01*), triggering Level 3 TARPs for all Area 3C sites. The declines in soil moisture reflect broader declines across the region in response to drying conditions in 2023. Potential mining effects at Swamp 144 should be reassessed as more data becomes available.

The IMCEFT report triggers when groundwater or moisture decrease below the baseline level during the mining period whilst the HGEO assessment is conducted following the completion of Longwall 21 and considers other factors such as longer-term climatic conditions and reference swamp comparisons.

Further details are presented in **Attachment D**.

Table 7: Summary of shallow groundwater level TARP status at Longwall 21 impact sites.

Swamp	Sensors and TARP triggers			HGEO Comment	IMCEFT ASSESSED LEVEL	HGEO ASSESSED LEVEL
	Not Triggered	Triggered	Not within mine influence			
9		09_01 09_02		Shallow groundwater levels dropped lower than baseline following end of Longwall 21. Recession rates similar to baseline.	3	3
144		144_01		Shallow groundwater levels and recessions consistent with previous and reference sites	3	3
145		145_01		Shallow groundwater levels and recessions consistent with previous and reference sites	3	3

Table 8: Summary of soil moisture level TARP status at Longwall 21 impact sites.

Swamp	Sensors and TARP triggers			HGEO Comment	IMCEFT ASSESSED LEVEL	HGEO ASSESSED LEVEL
	Not Triggered	Triggered	Not within mine influence			
9		S09_01 S09_02		Mean soil moisture dropped below baseline following Longwall 21.	3	3
144		S144_01		Mean soil moisture dropped below baseline following Longwall 21.	3	3
145		S145_01		Mean soil moisture dropped below baseline following Longwall 21.	3	3



### **3.7.2. Erosion in Upland Swamps**

The SIMMCP describes the monitoring and assessment to determine any areas of erosion in swamps resulting from mining. Mining induced tilting, cracking, desiccation and/or changes in vegetation health that could result in increased runoff and erosion, which in turn could alter water distribution in the swamp. TARPs have been established within the SIMMCP (See Appendix A: Table 16).

Impact assessment of Upland Swamp erosion includes analyses of ALS/LiDAR results, combined with infield observations. Following geoprocessing of ALS data potential areas of interest were highlighted for targeted infield verification, all these sites were inspected however, no erosion was identified in any swamps.

Following targeted in-field observations, no areas of erosion were identified during the Longwall 21 reporting period.

## **3.8. Terrestrial Ecology**

Niche Environmental and Heritage (Niche) completed the Terrestrial Ecology Report (Niche, 2023) which includes results from the 2022 reporting period. This is the latest report to include Dendrobium terrestrial ecology results, and was provided with the Longwall 19 EoP Report, available on the [South32 Website](#). Results from the 2023 reporting period are currently being collected and will be included in the annual terrestrial ecology report in 2024, which will be provided with the Longwall 19A EoP Report.

Assessment of terrestrial ecology is included in the Terrestrial Ecology Monitoring Program Annual Report 2022 (**Attachment H**).

## **3.9. Aquatic Ecology**

Stantec (formerly Cardno) was commissioned by IMC to undertake a review of the status of aquatic flora and fauna in relation to the extraction of Longwall 21 to support the EoP reporting. Stantec has been undertaking ongoing monitoring of watercourses within the DA3B and DA3A mining areas including the perennial Wongawilli Creek, Sandy Creek, Donalds Castle Creek and several associated first and second order ephemeral / intermittent tributaries.

The overall objective of the monitoring is to determine whether the extent and nature of observed impacts, primarily subsidence-induced fracturing of bedrock, flow diversion and loss of aquatic habitat, if any, are consistent with the predictions made in the Aquatic Flora and Fauna Assessment (AFFA) for Longwalls 20 and 21 (Cardno, 2019), SMP (South32, 2019) and Area 3C WIMMCP (South32, 2020).

The monitoring requirements recommended in the AFFA and SMP for Longwall 21 incorporates a Before, After, Control, Impact (BACI) sampling design. The program monitors mine subsidence impacts on the aquatic environment with collection of at least two years of baseline data followed by monitoring during extraction, and at least two years of post-extraction monitoring. The following indicators were monitored at impact and control

sites within and outside the SMP area for DA3C as a measure of aquatic health:

- > Aquatic habitat condition - using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman et al., 1997).
- > Macroinvertebrates, including threatened species of dragonfly (Adams emerald dragonfly and Sydney hawk dragonfly) - using AUSRIVAS and standardised artificial collectors.
- > Limited *in-situ* water quality – using a portable probe.
- > Fish abundance using backpack electrofishing and bait traps.

Only relatively minor impacts were observed in watercourses following commencement of extraction of Longwall 21. These were three rock fractures in WC20, iron staining in WC24 and WC20 and an increase in existing iron staining in isolated sections of Wongawilli Creek downstream of WC Pool 50. No changes in water quality in watercourses were identified (HGEO, 2023).

Although flow diversions may occur due to two of the three fractures in WC20 that are located in the main channel, any reduction in availability and connectivity of aquatic habitat and associated impacts to aquatic biota in the naturally ephemeral / intermittent WC20 would also be minor. The third fracture in WC20 was located outside of the main flow path and would not be expected to result in flow diversions, and, thus, would not be expected to impact aquatic habitat and biota. Localised iron staining in WC20 and WC24 would not be associated with significant impacts to aquatic habitat and biota given these ephemeral / intermittent tributaries provide aquatic habitat of limited value and represent a very small component of the total aquatic habitat in the Dendrobium Mine area.

In the absence of changes in water quality in Wongawilli Creek associated with the ongoing gas release in WC\_Pool 50, and any change in aquatic habitat noted during the recent aquatic ecology surveys in Wongawilli Creek in April, June and September 2023, any associated impacts to aquatic ecology are expected to be negligible. Monitoring and assessment of iron staining in the Dendrobium Mine Area and associated impacts to aquatic ecology will continue as part of the ongoing DA3 monitoring program, with further aquatic ecology surveys of the 2023 monitoring period to be completed in November 2023.

Table 9 compares the predicted impacts against the observed impacts and Table 10 summarises the aquatic ecology assessment against the TARPs.

Further details of the Aquatic Ecology Assessment methodology can be found in **Attachment F**.

Table 9: Summary of predicted and observed impacts to aquatic ecology associated with Longwall 21.

Attribute	Predicted Physical Impacts	Predicted Impacts on Aquatic Ecology	Observed Impacts to Aquatic Ecology
<i>Wongawilli Creek</i>			
Ponding, flooding and scouring of stream banks due to tilt	Adverse changes in the potential for ponding, flooding or scouring of the banks along the creek due to the mining-induced tilt are unlikely.	Measurable effects on the availability and connectivity of most aquatic habitats are unlikely.	None identified by IMCEFT during extraction of Longwall 21.
Fracturing of bedrock and diversion of surface flows	<p>The overall likelihood of significant fracturing resulting in surface water flow diversions at the rockbars along Wongawilli Creek is 7% (based on the rate of rockbar fractures experienced in DA3B due to extraction of Longwalls 9 to 12).</p> <p>Minor fracturing could occur along the creek at distances up to approximately 400 m from the proposed longwall (0.9 km of watercourse length).</p>	<p>Seventeen rockbars are located in Wongawilli Creek within 600 m of Longwalls 20 and 21. Based on the predicted fracture rate, it would be expected that on average one of these would experience fracturing associated with flow diversions. The potential drainage of smaller pools would represent a relatively minor impact in the context of the length of pool habitat within the Study Area (365 m). The loss of the largest pool (100 m in length) does, however, represent a relatively large impact to aquatic habitat. However, based on the low rate of fracture that would result in flow diversions and the size range of associate pools, the probability of fracturing resulting in large reduction in pool habitat is expected to be low.</p>	<p>No reductions in pool water levels and flow or changes in water quality observed by IMC during extraction of Longwall 21, and thus no suggestion of impacts occurring to aquatic habitat and biota.</p>

<p>Water Quality and Availability</p>	<p>Baseflow to Wongawilli Creek may decline by 0.20 ML/day (approximately 1.6 % of mean annual flow) due to groundwater depressurisation following longwall extraction (HGeo ,2019). The cumulative effects of DA3B and Longwalls 20 and 21 would be to further reduce flows by about 1.3 ML/d. This could result in zero flow conditions up to 44% of the time (i.e. 146 out of 365 days) compared with natural conditions (10 % of the time), although 12 % to 15 % of the time (an increase from 37 to between 44 and 54 days per year) is considered more likely based on available pre and post-mining data (HGeo, 2019). The effect on overall catchment yield of the Cordeaux River catchment are expected to be negligible.</p> <p>Impacts to water quality due to mining are expected to be minor in stream reaches within subsidence affected areas (HGeo, 2019). Effects are likely to include slight and temporary changes in water salinity, pH and iron content with local discolouration of streambeds and rock faces by iron hydroxide.</p>	<p>An overall reduction in base flow and increase in the number of zero flow days would impact aquatic habitat and biota in Wongawilli Creek. Although the reduction in baseflow would be small, the predicted increase in zero flow days would reduce longitudinal connectivity in the watercourse and possibly also the amount of aquatic habitat available to biota if pool levels also decrease during these periods. If pools do not drain completely then these would provide refuge for aquatic biota until flow returns. It is expected that such impacts to aquatic habitat and biota would be restricted to sections of Wongawilli Creek adjacent to mining, as there would be negligible impact to the overall yield of the Cordeaux River catchment.</p> <p>Impacts to aquatic habitat and biota due to changes in water quality appear unlikely as only minor changes in water quality are expected.</p>	<p>Iron staining and the single gas release during extraction of Longwall 21 not associated with any water quality triggers. No evidence of impacts to aquatic biota during observations in April, June and September 2023.</p>
---------------------------------------	---	---	---

Attribute	Predicted Physical Impacts	Predicted Impacts on Aquatic Ecology	Observed Impacts to Aquatic Ecology
<i>Tributaries of Wongawilli Creek</i>			
Ponding, flooding and scouring of stream banks due to tilt	Although predicted changes in grade (3%) are larger as a proportion of the natural grade (10% to 20%), compared with that for creeks, it is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the banks along these drainage lines due to subsidence induced tilt. It is possible that localised increased ponding could develop in some isolated locations, where the natural grades are small and where the drainage lines exit the mining area.	Localised changes in habitat availability and connectivity may occur along the drainage lines due to tilt but these effects will be difficult to detect due to the large variability in grade and natural flows within these ephemeral systems. The impacts resulting from the changes in surface water flows are expected to be small in comparison with those which occur during natural flooding conditions. Consequently, impacts to aquatic habitat and biota due to tilt, if any, are expected to be minor and localised.	No impacts observed due to tilt.

<p>Fracturing of bedrock and diversion of surface flows</p>	<p>Fracturing is expected to occur along the sections of the drainage lines that are located directly above Longwall 21 (WC20). Fracturing can also occur outside the extents the proposed longwalls, with minor and isolated fracturing occurring at distances up to approximately 400 m. Surface water flow diversions are also likely to occur along the sections of drainage lines that are located directly above the proposed longwalls.</p> <p>In times of heavy rainfall, most of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds.</p>	<p>Fracturing induced flow diversions in the highly ephemeral drainage lines directly above longwalls would result in a reduction in the amount of aquatic habitat. However, smaller drainage lines such as these are limited in habitat value for aquatic biota. Flow diversions would reduce the volume and duration of flow in these ephemeral drainage lines. Approximately 200 m of first order stream WC20 occurs directly above Longwall 21 and approximately 1.5 km occurs within the Study Area. These lengths represent a very small proportion of that present in the wider Cordeaux River Catchment.</p>	<p>Some minor rock fracturing was observed in tributary WC20. Although flow diversions may occur, the natural ephemeral nature of WC20 indicates that any reduction in availability and connectivity of aquatic habitat and associated impacts to aquatic biota in WC20 would be minor.</p>
<p>Water quality</p>	<p>Impacts to water quality due to mining are expected to be minor in stream reaches within subsidence affected areas (HGEO, 2019). Effects are likely to include temporary changes in water salinity, pH and iron content with local discolouration of streambeds and rock faces by iron hydroxide.</p>	<p>Minor impacts to water quality are unlikely to represent substantial risks to aquatic habitat and biota in drainage lines.</p>	<p>Iron staining in WC24 and basal step of WC20 were not associated with any water quality triggers. No impacts to water quality in drainage lines observed. Thus, no associated impacts to aquatic habitat and biota are expected.</p>

Table 10: Summary of Aquatic Ecology TARP sites and their respective trigger levels.

TARP	Wongawilli Creek
Level 1 – Reduction in aquatic habitat for 1 year	Not triggered
Level 2 – Reduction in aquatic habitat for 2 years following the active subsidence period (i.e., when a longwall within 400m of a feature, such as a creek, is completed)	Not triggered
Level 3 – Reduction in aquatic habitat for >2 years or complete loss of habitat following the active subsidence period	Not triggered

### 3.10. Cultural Heritage

Following the extraction of Longwall 21, an inspection of Aboriginal cultural heritage sites within the Longwall 21 study area (as defined in Niche 2022) was conducted on 6<sup>th</sup> October 2023.

Two Aboriginal Cultural heritage were inspected:

- Browns Road 20 (AHIMS ID# 52-2-1647) and;
- Dendrobium 3C Shelter-1 (AHIMS ID# 52-2-4500).

Neither of these sites demonstrated any impacts from the extraction of Longwall 21.

Table 11: Aboriginal cultural heritage sites status following the extraction of Longwall 21.

AHIMS Number	Site Name	Observed Subsidence Related Changes
52-2-1647	Browns Road Site 20	No impacts related to the extraction of Longwall 21 were observed.
52-2-4500	Dendrobium 3C Shelter-1	No impacts related to the extraction of Longwall 21 were observed.

Further details of the Cultural Heritage Assessment can be found in **Attachment G**.



## 4. IMPACTS TO BUILT FEATURES

The built features in proximity to Longwall 21 are shown in **Attachment B** and include: fire trails and other access tracks, Cordeaux Dam and survey control marks.

No impacts to built features were observed during the extraction of Longwall 21. Comparisons between the MSEC assessments and the reported impacts for the built features due to the mining of Longwall 21 are provided in Table 12.

It is considered that the observed impacts on the built features due to the mining of Longwall 21 are similar to or less than the MSEC assessments provided in Report No. MSEC978 which supported the SMP Application for that longwall.

Table 12: Summary of predicted impacts in comparison to observed impacts relevant to Longwall 21.

Built feature	MSEC assessed impacts	Reported impacts
<b>Fire trails and four-wheel drive tracks</b>	Cracking of unsealed road surfaces	No soil cracking reported along Fire Road 6F. Rock fracturing observed in rock outcrops located west of this road and directly above Longwall 21. Refer to the IMC landscape report for further details. <b>Attachment C1</b>
<b>Cordeaux Dam</b>	Adverse impacts not anticipated.	No reported impacts on the dam walls. Refer to associated groundwater report for estimates of seepage losses from the stored water. <b>Attachment E</b>
<b>Survey control marks</b>	Vertical and horizontal movements which could require re-establishment.	No reported damage to the survey control marks. The marks to be re-established after completion of mining, as required.

## 5. SUMMARY OF TARP TRIGGERS

A summary of TARP triggers during the extraction of Longwall 21 are presented below in Table 13; additionally, an overview of Longwall 21 surface impacts and triggers is presented in Figure 9 and Figure 10.

Table 13: Summary of TARP Triggers during the extraction of Longwall 21.

\*\*A recent change to the reporting process has meant impact reports being uploaded to the Major Projects Planning Portal, following the initial report date, include a summary of stakeholder consultation. This has resulted in a Version 2 (V2) of reports with an accompanying revised date.

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_001	Rock Fracturing	Outcrop	06/06/2023	1	Rock fracturing to a small rock outcrop west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_002	Rock Fracturing and Rock Movement	LW21_RO1	06/06/2023	2	Rock fracturing and rock movement to a small rock outcrop at Landscape Monitoring Site LW21_RO1.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_003	Rock Fracturing and Rockfall	Outcrop and Step	06/06/2023	2	Rock fracturing and rockfall to an outcrop and a step west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_004	Rock Fracturing	Outcrop	06/06/2023	2	Rock fracturing on an outcrop west of Fire Road 6F.	09/06/2023 (V2 uploaded 17/07/2023)
DA3C_LW21_005	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracture on a rock outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_006	Rock Fracturing	Outcrop	15/06/2023	1	Rock fracturing on a rock outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_007	Rock Fracturing and Rockfall	Outcrop	15/06/2023	2	Rock fracturing and rock fall on an outcrop northeast of WC20.	19/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_008	Rock Fracturing and Soil Cracking	Rock Step	19/06/2023	1	Rock fracturing/soil cracking to a rock step and bushland northeast of WC20.	20/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_009	Rock Fracturing	Rock Step	19/06/2023	1	Rock fracturing to a rock step west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_010	Rock Fracturing and Rock Movement/ Displacement	Outcrop	19/06/2023	2	Rock fracturing and associated rock movement/displacement at an outcrop west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_011	Rock Fracturing, Rock Displacement and Soil Cracking	Outcrop and Bushland	19/06/2023	1	Soil cracking, rock fracturing and associated rock displacement to an outcrop and bushland west of Fire Road 6F.	20/06/2023 (V2 uploaded 14/09/2023)
144_01	Groundwater	Swamp 144	22/06/2023	3	Groundwater recession rate greater than baseline	28/06/2023 (V2 uploaded 15/09/2023)
S144_01	Soil Moisture	Swamp 144	27/06/2023	3	Average soil moisture level below the baseline level	28/06/2023 (V2 uploaded 15/09/2023)
DA3C_LW21_012	Rock Fracturing	Rock Step	27/06/2023	1	Rock fracturing to rock step west of Fire Road 6F.	28/06/2023 (V2 uploaded 15/09/2023)
DA3C_LW21_013	Rock Fracturing	Outcrop	03/07/2023	1	Rock fracturing to rock outcrop west of Fire Road 6F.	04/07/2023 (V2 uploaded 14/09/2023)
DA3C_LW21_014	Rock Fracturing	Watercourse	11/07/2023	2	Rock fracturing to rock-bar on tributary WC20.	17/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_015	Rock Fracturing	Watercourse	11/07/2023	2	Rock fracturing to channel on tributary WC20.	17/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_016	Rockfall	Rock Step	11/07/2023	1	Small rockfall to step north of tributary WC20.	17/07/2023 (V2 uploaded 04/10/2023)
Swamp 15a	Groundwater	Swamp	12/07/2023	1	Groundwater trigger at one site in Swamp 15a. (Longwall 19 mining area)	17/07/2023 (V2 uploaded 04/10/2023)
Swamp 15a	Soil Moisture	Swamp	12/07/2023	2	Soil moisture triggers at three sites within Swamp 15a. (Longwall 19 mining area)	17/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_016 (Update)	Rockfall	Rock Step	26/07/2023	2	Rockfall to step north of tributary WC20.	31/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_017	Rock Fracturing	Watercourse	26/07/2023	1	Rock fracturing and uplift to WC20_Rockbar 15.	31/07/2023 (V2 uploaded 04/10/2023)
DA3C_LW21_018	Rock Fracturing	Rock Outcrop/Ledge	26/07/2023	1	Rock fracturing to rock outcrop/ledge.	31/07/2023 (V2 uploaded 04/10/2023)

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_019	Rock Fracturing	Rock Step	1/08/2023	1	Rock fracturing to rock step west of Fire Road 6F.	2/08/2023
DA3C_LW21_020	Iron Staining	Watercourse	1/08/2023	1	Iron staining in tributary WC24.	2/08/2023
DA3C_LW21_021	Iron Staining	Rock Step	1/08/2023	1	Iron staining on the Swamp 144 basal step. Reported under the Watercourse TARP as iron occurs in the general drainage line and headwaters of WC20.	2/08/2023
DA3C_LW21_022	Rockfall	Rock Step	7/08/2023	1	Rockfall to rock outcrop/step west of Fire Road 6F	9/08/2023
S145_01	Soil Moisture	Swamp	4/08/2023	3	Soil moisture trigger at one site in Swamp 145	9/08/2023
09_02	Groundwater	Swamp	4/08/2023	2	Groundwater trigger at one site in Swamp 9	9/08/2023
Swamp 15a (update)	Soil Moisture	Swamp	11/08/2023	3	Soil moisture trigger recorded two additional sites (total now five) in Swamp 15a.	18/08/2023 (V2 uploaded 04/10/2023)
S12_04	Soil Moisture	Swamp	29/08/2023	3	Soil moisture trigger recorded in Swamp 12 (Longwall 19 mining area).	4/09/2023
S150_01	Soil Moisture	Swamp	29/08/2023	3	Soil moisture trigger recorded in Swamp 150 (Longwall 18 mining area).	4/09/2023
09_01	Groundwater	Swamp	30/08/2023	3	Groundwater trigger at second site in Swamp 9 (LW21 mining area).	4/09/2023
S09_01	Soil Moisture	Swamp	30/08/2023	3	Soil moisture trigger recorded in Swamp 9 (LW21 mining area).	4/09/2023
S09_02	Soil Moisture	Swamp	30/08/2023	3	Soil moisture trigger recorded in Swamp 9 (LW21 mining area).	4/09/2023
DA3C_LW21_023	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_024	Rock Fracturing	Rock Outcrop	31/08/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	4/09/2023
DA3C_LW21_025	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing and rockfall to a rock outcrop north of tributary WC20.	8/09/2023

Site ID	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3C_LW21_026	Rockfall	Rock Outcrop	6/09/2023	1	Small rockfall and fracturing to step north of tributary WC20.	8/09/2023
DA3C_LW21_027	Rockfall	Rock Outcrop	6/09/2023	2	Rockfall to step north of tributary WC20 at Landscape Monitoring Site LW21_SS1.	8/09/2023
DA3C_LW21_028	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	8/09/2023
DA3C_LW21_029	Rock Fracturing	Rock Outcrop	6/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20 at Landscape Monitoring Site LW21_SS3.	8/09/2023
DA3C_LW21_030	Rock Fracturing	Rock Outcrop	12/09/2023	1	Rock fracturing to a rock outcrop north of tributary WC20.	14/09/2023
DA3C_LW21_031	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_032	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_033	Rock Fracturing	Rock Step	12/09/2023	1	Rock fracturing to a rock step north of tributary WC20.	14/09/2023
DA3C_LW21_034	Rock Movement and Soil Cracking	Rock Outcrop	12/09/2023	2	Rock movement and soil cracking to rock outcrop north of tributary WC20.	14/09/2023
Swamp 15b	Soil Moisture	Swamp	19/09/2023	3	Soil moisture trigger recorded at one additional site (total now four) in Swamp 15b (Longwall 19 mining area).	21/09/2023
S34_01	Soil Moisture	Swamp	27/09/2023	3	Soil moisture trigger recorded in Swamp 34 (Longwall 19 mining area).	28/09/2023
DA3C_LW21_035	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023
DA3C_LW21_036	Iron Staining	Bushland	9/10/2023	1	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	11/10/2023

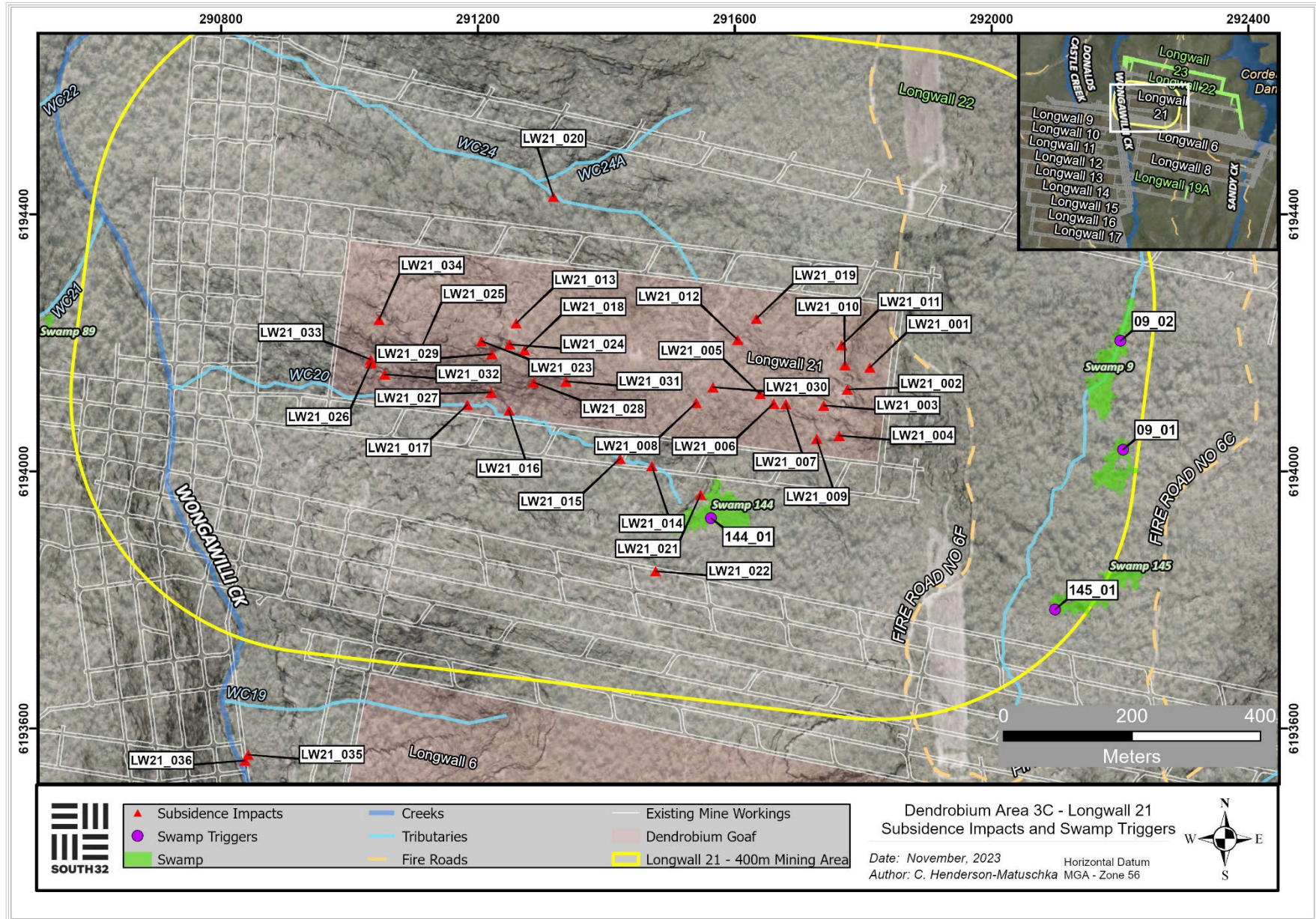


Figure 9: Overview of surface impacts and swamp triggers observed during the Longwall 21 monitoring period.

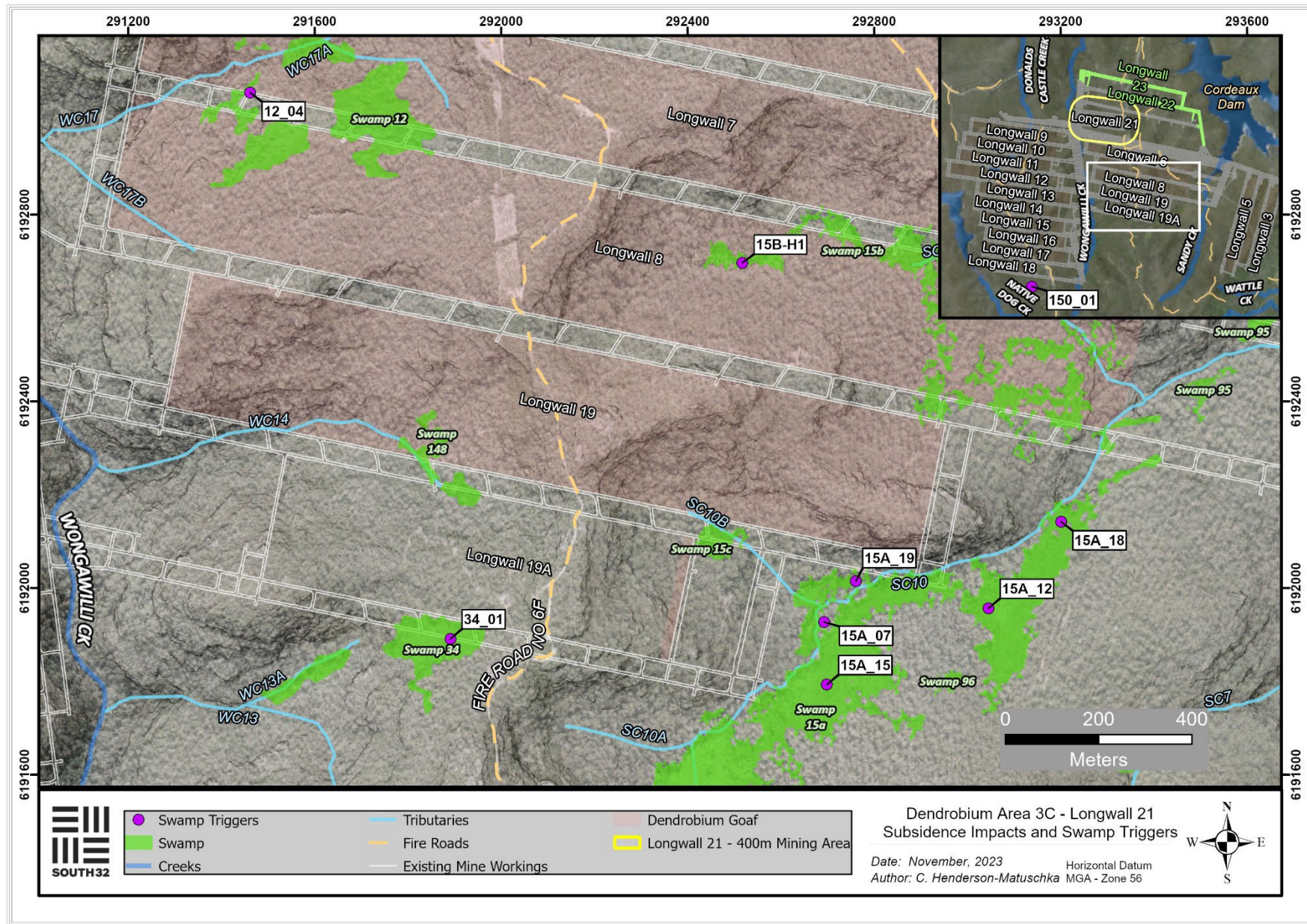


Figure 10: Overview of swamp triggers observed during the Longwall 21 monitoring period in DA3A and DA3B.

## 6. LONGWALL 21 MONITORING PROGRAM

Table 14: Summary of monitoring sites associated with the extraction of Longwall 21. Recommended monitoring sites associated with the extraction of Longwall 19A are also included (Figure 11).

Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Longwall 19A Recommended Future Monitoring
<b>Watercourses</b>	<b>Observational, photo point and water monitoring</b>		
	<ul style="list-style-type: none"> <li>Wongawilli Creek</li> <li>WC20</li> <li>WC21</li> <li>WC24</li> <li>WC24A</li> <li>LC5</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>CR36</li> </ul>	<p>Monthly 2 years pre and post mining, weekly when longwall is within 400m of monitoring site.</p> <p>Reference sites 6 monthly.</p> <p>Landscape Sites: pre and post mining, monthly when longwall is within 400m of monitoring site.</p>	<ul style="list-style-type: none"> <li>WC13</li> <li>WC13A</li> <li>WC14</li> <li>SC10</li> </ul>
	<b>Water Quality</b>		
	<ul style="list-style-type: none"> <li>Wongawilli Creek (WC_Pool 49, WC_Pool 46, WC_Pool 45, WC_Pool 44, WC_Channel 10, WWU1, WWU4, Wongawilli Creek (FR6))</li> <li>WC20 (WC20_Pool 8, WC20_Rockbar 17)</li> <li>WC24 (WC24_Pool 10, WC24_Pool 22)</li> <li>WC24A (WC24A_Pool 1)</li> <li>LC5 (LC5_Pool 26, LC5_S1) Lake Cordeaux (LC_1)</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>CR36_S1</li> </ul>	<p>Monthly monitoring pre, during and post mining for two years.</p>	<ul style="list-style-type: none"> <li>WC13, (WC13_Pool 3)</li> <li>WC13A (WC13A_Pool 4)</li> <li>WC14 (WC14_Pool 3, WC14_Pool 16)</li> <li>SC10 (SC10_Pool 26a, SC10_Pool 31, SC10_Pool 34)</li> </ul>
<b>Swamps</b>	<b>Observational, Photo Point and Water Monitoring</b>		
	<ul style="list-style-type: none"> <li>Swamps 9, 144 and 145</li> </ul>	<p>Pre and post mining for 2 years, monthly when longwall is within 400 m of monitoring site.</p> <p>Weekly inspection and pool water levels when longwall is within 400 m of monitoring site.</p> <p>Reference sites 6-monthly.</p>	<ul style="list-style-type: none"> <li>Swamps 15a, 34 and 148</li> </ul>



Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Longwall 19A Recommended Future Monitoring
	<p><b>Shallow Groundwater Level</b></p> <ul style="list-style-type: none"> <li>Swamp 9: 09_01, 09_02</li> <li>Swamp 144: 144_01</li> <li>Swamp 145: 145_01</li> </ul> <p><b>Reference Sites</b></p> <ul style="list-style-type: none"> <li>Swamp 22: 22_01, 22_02</li> <li>Swamp 24: 24_01</li> <li>Swamp 25: 25_01</li> <li>Swamp 33: 33_01, 33_03</li> <li>Swamp 84: 84_02</li> <li>Swamp 85: 85_01, 85_02</li> <li>Swamp 86: 86_01, 86_02</li> <li>Swamp 87: 87_01, 87_02</li> <li>Swamp 88: 88_01, 88_02</li> </ul> <p><b>Soil Moisture</b></p> <ul style="list-style-type: none"> <li>Swamp 9: S09_01, S09_02</li> <li>Swamp 144: S144_01</li> <li>Swamp 145: S145_01</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>Swamp 22: S22_01, S22_02</li> <li>Swamp 24: S24_S01</li> <li>Swamp 25: S25_S01</li> <li>Swamp 33: S33_S01, S33_S03</li> <li>Swamp 84: S84_S02</li> <li>Swamp 85: S85_S01, S85_S02</li> <li>Swamp 86: S86_S01, S86_S02</li> <li>Swamp 87: S87_S01, S87_S02</li> <li>Swamp 88: S88_01, S88_02</li> </ul>	<p>For open hole sites:</p> <ul style="list-style-type: none"> <li>Monthly monitoring pre, during and post mining for two years to be reviewed annually</li> <li>Reference sites 6 monthly</li> </ul> <p>For instrumented sites:</p> <ul style="list-style-type: none"> <li>Automatic groundwater level monitoring pre, during and post mining (1-hour interval or similar)</li> <li>Monitoring post mining for five years to be reviewed annually</li> </ul> <p>For manually measured sites:</p> <ul style="list-style-type: none"> <li>Monthly monitoring for 2 years baseline and post mining and 6-monthly reference sites</li> <li>Weekly monitoring when longwall is within 400 m of monitoring site</li> </ul> <p>For instrumented sites:</p> <ul style="list-style-type: none"> <li>Automatic soil moisture monitoring pre, during and post</li> <li>Monitoring post mining for five years to be reviewed annually</li> </ul>	<ul style="list-style-type: none"> <li>Swamp 15: 15a_03, 15a_04, 15a_06, 15a_07, 15a_08, 15a_09, 15a_11, 15a_12, 15a_15, 15a_18, 15a_19</li> <li>Swamp 34: 34_01</li> <li>Swamp 148: 148_01</li> </ul> <p><b>Reference Sites</b></p> <ul style="list-style-type: none"> <li>Swamp 22: 22_01, 22_02</li> <li>Swamp 24: 24_01</li> <li>Swamp 25: 25_01</li> <li>Swamp 33: 33_01, 33_03</li> <li>Swamp 84: 84_02</li> <li>Swamp 85: 85_01, 85_02</li> <li>Swamp 86: 86_01, 86_02</li> <li>Swamp 87: 87_01, 87_02</li> <li>Swamp 88: 88_01, 88_02</li> </ul> <ul style="list-style-type: none"> <li>Swamp 15a: S15a_03, S15a_04, S15a_07, S15a_12, S15a_15, S15a_18, S15a_19</li> <li>Swamp 34: S34_01</li> <li>Swamp 148: S148_01</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>Swamp 22: S22_01, S22_02</li> <li>Swamp 24: S24_S01</li> <li>Swamp 25: S25_S01</li> <li>Swamp 33: S33_S01, S33_S03</li> <li>Swamp 84: S84_S02</li> <li>Swamp 85: S85_S01, S85_S02</li> <li>Swamp 86: S86_S01, S86_S02</li> <li>Swamp 87: S87_S01, S87_S02</li> <li>Swamp 88: S88_01, S88_02</li> </ul>
<b>Landscape</b>	<p><b>Targeted Sites</b></p> <p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>DA3-CF13</li> </ul> <p><b>Fire Trails</b></p> <ul style="list-style-type: none"> <li>Fire Road 6F (across active mining area)</li> </ul>	<p>Monthly monitoring during any subsidence period. Monitoring to continue 6 monthly for 2 years following the completion of mining.</p>	<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>DA3-CF7</li> <li>DA3-CF17</li> <li>DA3-CF18</li> <li>DA3-CF24</li> </ul> <p><b>Fire Trails</b></p> <ul style="list-style-type: none"> <li>Fire Road 6F (across active mining area)</li> </ul>

Aspect	Monitoring Sites Associated with Longwall 21	Monitoring Frequency	Longwall 19A Recommended Future Monitoring
	<b>Inspection of Active Mining Area – Landscape Features, Vegetation, Watercourses</b>		
	Continue monitoring of all mapped cliff, steep slope, watercourse, swamp and firetrail sites in subsidence area.  Continue general observation of active mining areas.	Weekly monitoring when longwall extraction is within 400m of feature.	Continue monitoring of all mapped cliff, steep slope, watercourse, swamp and fire trail sites in subsidence area.  Continue general observation of active mining areas.

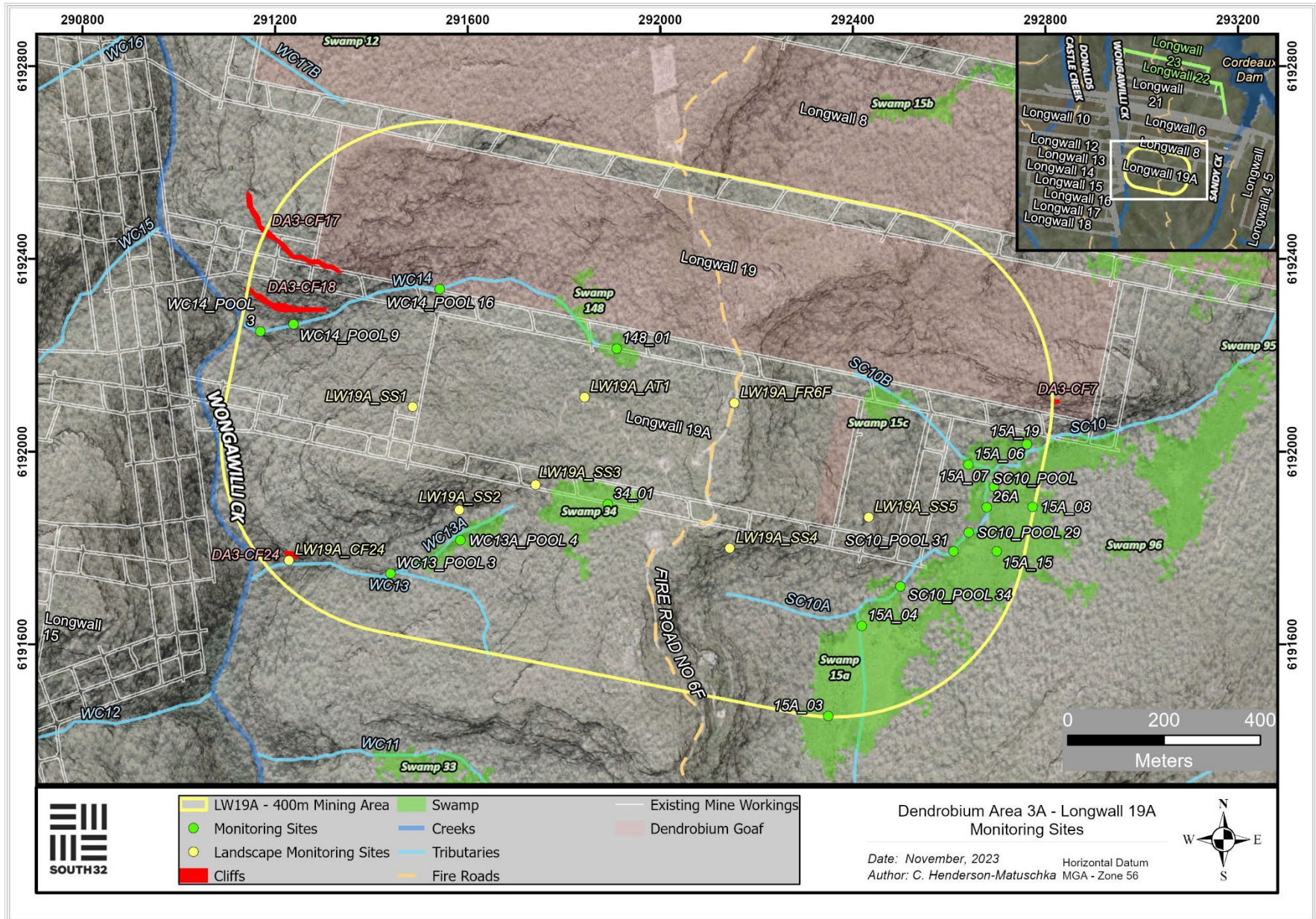


Figure 11: Overview of monitoring sites relevant to Longwall 19A active mining area.

## 7. REFERENCES

- Cardno 2019. Longwalls 20 and 21 Subsidence Monitoring Plan. Aquatic Flora and Fauna Assessment. (No. 59917149), Report by Cardno for South32 Illawarra Metallurgical Coal
- Chessman, B.C Grouns, J.E and Kotlash, A.R., 1997. Objective derivation of macroinvertebrate family sensitivity grade numbers for the SIGNAL biotic index: Application to the Hunter River system, New South Wales. *Marine and Freshwater Research*, 48, pp. 159-172.
- Clark, I., 2015. *Groundwater geochemistry and isotopes*. CRC Press, Boca Raton, Florida, USA.
- HGEO, 2019. Dendrobium Mine. Assessment of surface water flow and quality effects of proposed Dendrobium Longwalls 20 and 21 (No. D18301). Report by HGEO Pty Ltd for South32 Illawarra Metallurgical Coal.
- HGEO, 2020a. Investigation into the height of fracturing above extracted longwalls in Area 3, Dendrobium (No. D19341), Report by HGEO Pty Ltd for South32 Illawarra Metallurgical Coal.
- HGEO, 2020b. Effects of Longwall 16 extraction on overlying strata and groundwater conditions, Dendrobium Area 3B (No. D20374), Report by HGEO Pty Ltd for South32 Illawarra Metallurgical Coal.
- HGEO, 2021a. Effects of Longwall 17 extraction on overlying strata and groundwater conditions, Dendrobium Area 3B (No. D21158), Report by HGEO Pty Ltd for South 32 Illawarra Metallurgical Coal.
- HGEO, 2021b. Iron-staining in Wongawilli Creek, August 2021 (No. D21162), Report by HGEO Pty Ltd for South32 Illawarra Metallurgical Coal.
- HGEO, 2023. Dendrobium Area 3C Longwall Surface Water and Shallow Groundwater Assessment: Longwall 21 (Area 3C) (No. D23231). Report by HGEO Pty Ltd for South 32 Illawarra Metallurgical Coal.
- HGEO, 2023. Dendrobium Mine - Monthly report on water quality sampling for the Dams Safety NSW: Illawarra Metallurgical Coal (No. D23233), Report by HGEO Pty Ltd for South 32 Illawarra Metallurgical Coal.
- MSEC, 2019. Subsidence Predictions and Impact Assessments for the Natural and Built Features due to the Extraction of the Proposed Longwalls 20 and 21 in Area 3C at Dendrobium Mine (No. MSEC978 RevD). Report by Mine Subsidence Engineering Consultants for South32 Illawarra Coal.
- Niche, 2022. Aboriginal Cultural heritage Management Plan Dendrobium Colliery Area 3C Longwalls 21, 22 and 23. (No. 6261). A report prepared for South 32 Illawarra Metallurgical Coal.
- Niche, 2023. Dendrobium Areas 3A and 3B: Terrestrial Ecology Monitoring Program Annual Report 2022. (No. 7290). Prepared for South32 Illawarra Metallurgical Coal.
- Regal Heritage, 2023. Dendrobium Colliery Longwall 21 End of Panel Report – Aboriginal Cultural Heritage Assessment (No. 1079). Prepared for South32 Illawarra Metallurgical Coal.
- South32, 2019. Longwalls 20 and 21 Subsidence Management Plan (Management Plan No. B). South32 Illawarra Metallurgical Coal.

South32, 2020b. Dendrobium Area 3C Watercourse impact monitoring management and contingency plan (Management Plan No. Rev E). South32 Illawarra Metallurgical Coal.

South32, 2020c. Dendrobium Area 3C Swamp impact monitoring management and contingency plan (Management Plan No. Rev E). South32 Illawarra Metallurgical Coal.

South32, 2023. End of Panel Landscape Report Dendrobium Area 3C. Dendrobium Area 3C Longwall 21 End of Panel Landscape Report. December 2023. South32 Illawarra Metallurgical Coal.

## 8. APPENDIX A – IMPACTS, TRIGGERS AND RESPONSE

Table 15: Dendrobium Landscape TARPs.

Landscape Features		
<p><b>Longwall 21 Study Area</b></p> <p><b>Cliffs</b> All mapped cliff sites in subsidence area</p> <p><b>Steep Slopes</b> Mapped steep slopes in subsidence area</p> <p><b>Fire Trails</b> All mapped fire trails in subsidence area</p>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Rock fall from a cliff which is left mostly intact (&lt;10% length), resulting in insignificant ground disturbance</li> <li>• Surface movement or rock displacement with negligible soil surface exposed</li> <li>• Crack at the surface, which should not result in any significant erosion or further ground movement</li> <li>• Crack in a fire trail which should not result in erosion or impede access</li> <li>• Crack or fracture up to 100 mm width</li> <li>• Crack or fracture up to 10 m length</li> <li>• Erosion in a localised area which would be expected to naturally stabilise without CMA and within the period of monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to key stakeholders</li> <li>• Summarise impacts and report in the EOP and AR</li> </ul>

	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Rock fall or overhang collapse at a cliff site, where characteristics of the cliff have changed, and there has been significant ground disturbance</li> <li>• Surface movement or rock displacement that has exposed significant areas of soil</li> <li>• A crack at the surface, which could result in significant erosion or movement at the surface</li> <li>• A crack at the surface with potential risk to safety and/or fauna entrapment</li> <li>• A crack in the fire trail, which could result in significant erosion or impede vehicle access</li> <li>• Crack or fracture between 100 and 300 mm width</li> <li>• Crack or fracture between 10 and 50 m length</li> <li>• Significant erosion at any location, which is not likely to naturally stabilise within the period of monitoring, or is located in a sensitive area e.g. swamps, creek, lake shore, and may result in increased sediment transport to Cordeaux Dam, or has been previously identified as Level 1, but is not likely to naturally stabilise within the monitoring period</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Notify relevant technical specialists and seek advice on any CMA required</li> <li>• Provide safety signage and barricades as appropriate</li> <li>• Implement approved repairs to ensure safety and serviceability on fire trails</li> <li>• Implement agreed CMAs as approved</li> </ul> <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Major cliff collapse where the characteristics of the cliff change significantly and there is significant ground disturbance that is unlikely to naturally stabilise within the monitoring period</li> <li>• Crack or fracture over 300 mm width</li> <li>• Crack or fracture over 50 m length</li> <li>• Mass movement of a slope causing large areas of exposed</li> <li>• Soil with potential for further movement</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Immediately notify stakeholders and technical specialists and seek advice on any CMA required</li> <li>• Offer site visit with stakeholders</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> </ul> <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>

Table 16: Dendrobium Area 3 Swamp TARP.

Performance Measures	Potential Impacts	Performance Triggers	Management Strategies	Offsets	Other Actions
<p><b>Negligible</b> erosion of the surface of the swamp</p>	<p>Gully erosion or similar</p>	<p><u>Level 1:</u> The increase in length of erosion within a swamp (compared to its pre-mining length) is <b>2%</b> of the swamp length or area; and/or</p> <p>Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring.</p> <p><u>Level 2:</u> The increase in length of erosion within a swamp (compared to its pre-mining length) is <b>3%</b> of the swamp length or area; and/or</p> <p>Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention; and/or</p> <p>Gully knickpoint forms or an existing gully knickpoint becomes active.</p> <p><u>Level 3:</u> The increase in length of erosion within a swamp (compared to its pre-mining length) is <b>4%</b> of the swamp length or area; and/or</p> <p>Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention.</p> <p><u>Exceeding Prediction:</u> Mining results in the total length of erosion within a swamp (compared to its pre-mining length) to increase <b>&gt;5%</b> of the length or area of the swamp compared to any increase in total erosion length in a reference swamp (i.e. increase in length or area of erosion in an impact swamp less any increase in length or area in erosion in a reference swamp is <b>&gt;5%</b>).</p>	<p>a.) upfront mine planning</p> <p>b.) erosion monitoring (i.e. ALS, observation)</p> <p>c.) coir logs</p> <p>d.) knickpoint control</p> <p>e.) water spreading</p> <p>f.) weeding</p> <p>g.) fire management</p> <p>h.) reporting</p> <p>i.) investigation and review</p> <p>j.) update future predictions</p>	<p>Offset required <b>immediately</b>, if no remediation considered practicable.</p> <p>Offset required <b>2 years</b> following remediation, if it is ineffective.</p> <p>This period can be extended to <b>5 years</b>, with the agreement of the Secretary.</p>	
<p><b>Minor changes</b> in the size of the swamps</p> <p><b>Minor changes</b> in the ecosystem functionality of the swamps</p> <p><b>No significant change</b> to the composition or distribution of species within the swamps</p>	<p>Swamp vegetation changes:</p> <ul style="list-style-type: none"> <li>- Swamp size</li> <li>- Species richness, distribution, composition, and diversity</li> <li>- Vegetation sub-communities</li> </ul>	<p><b>Swamp Size</b></p> <p><u>Level 1:</u> A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for two consecutive monitoring periods, greater than observed in the Control Group, and exceeding the standard error (SE) of the Control Group.</p> <p><u>Level 2:</u> A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for three consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><u>Level 3:</u> A trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for four consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><u>Exceeding Prediction:</u> Mining results in a trending decline in the extent of an upland swamp (combined area of groundwater dependent communities) for five consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control</p>	<p>a.) upfront mine planning</p> <p>b.) vegetation monitoring</p> <p>c.) water spreading</p> <p>d.) seeding/planting</p> <p>e.) weeding</p> <p>f.) fauna monitoring</p> <p>g.) fire management</p> <p>h.) grouting of controlling rockbars and bedrock base and/or use of other remediation techniques</p> <p>i.) reporting</p> <p>j.) investigation and review</p> <p>k.) update future predictions</p>	<p>Offset required <b>immediately</b>, if no remediation considered practicable.</p> <p>Offset required <b>5 years</b> following remediation, if it is ineffective.</p> <p>This period can be extended to <b>10 years</b>, with the agreement of the Secretary.</p>	<p>Monitoring period for swamp size is related to capture of Lidar data at the end of each longwall ~ 1 year</p> <p>Triggers for groundwater decline result in increased intensity and frequency of vegetation monitoring</p>



		<p>Group.</p> <p><b>Ecosystem Functionality</b>  <u>Level 1:</u> A trending decline in the extent of any individual groundwater dependent community within a swamp for two consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><u>Level 2:</u> A trending decline in the extent of any groundwater dependent community within a swamp for three consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><u>Level 3:</u> A trending decline in the extent of any groundwater dependent community within a swamp for four consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><u>Exceeding Prediction:</u> Mining results in a trending decline in the extent of a groundwater dependent community within a swamp for five consecutive monitoring periods, greater than observed in the Control Group, and exceeding the SE of the Control Group.</p> <p><b>Species Composition and Distribution</b>  <u>Level 1:</u> A <b>2%</b> (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for <b>two</b> consecutive years; and/or</p> <p><u>Level 2:</u> A <b>5%</b> (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for <b>three</b> consecutive years.</p> <p><u>Level 3:</u> An <b>8%</b> (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for <b>four</b> consecutive years.</p> <p><u>Exceeding Prediction:</u> Mining results in a <b>&gt;10%</b> (or otherwise statistically significant) decline in species richness or diversity during a period of stability or increase in species richness/diversity in reference swamps for <b>five</b> consecutive years.</p>			
<p><b>Maintenance or restoration</b> of the structural integrity of the bedrock base of any significant permanent pool or controlling rockbar within the swamps</p>	<p>Subsidence impacts (ie cracking) on bedrock base or controlling rockbar</p>	<p><u>Level 1:</u> Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of <b>10%</b> compared to baseline for the pool (in addition to any decrease in reference pools).</p> <p><u>Level 2:</u> Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of <b>20%</b> compared to baseline for the pool (in addition to any decrease in reference pools).</p>	<p>a.) upfront mine planning  b.) subsidence monitoring  c.) surface water monitoring  d.) groundwater monitoring  e.) grouting of controlling of</p>	<p>Offset required <b>immediately</b>, if no remediation considered practicable.</p> <p>Offset required <b>2 years</b> following remediation, if it is ineffective.</p>	

		<p><u>Level 3:</u> Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water of <b>20%</b> compared to baseline for the pool for <b>&gt;20%</b> of the time over a period of <b>1</b> year (in addition to any decrease in reference pools).</p> <p><u>Exceeding Prediction:</u> Structural integrity of the bedrock base of any significant permanent pool or controlling rockbar cannot be restored, i.e. pool water level within the swamp after CMAs continues to be <b>&gt;20%</b> lower than baseline for <b>&gt;20%</b> of the time over a period of <b>1</b> year.</p>	<p>controlling rockbars and bedrock base and/or use of other remediation techniques</p> <p>f.) CMAs</p> <p>g.) reporting</p> <p>h.) investigation and review</p> <p>i.) update future predictions</p>	<p>This period can be extended to <b>5 years</b>, with the agreement of the Secretary.</p>	
<p><b>Minor changes</b> in the ecosystem functionality of the swamps</p>	<p>Falls in surface or near-surface groundwater levels in swamps</p> <p><i>NB. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.</i></p>	<p><u>Level 1:</u> Groundwater level lower than baseline level at any monitoring site within a swamp (in comparison to reference swamps); and/or</p> <p>Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at any monitoring site (measured as average mm/day during the recession curve).</p> <p><u>Level 2:</u> Groundwater level lower than baseline level at <b>50%</b> of monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps); and/or</p> <p>Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at a <b>50%</b> of monitoring sites (within 400m of mining) within the swamp.</p> <p><u>Level 3:</u> Groundwater level lower than baseline level at <b>&gt;80%</b> of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or</p> <p>Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at <b>&gt;80%</b> of monitoring sites (within 400 m of mining) within the swamp.</p>	<p>a.) upfront mine planning</p> <p>b.) groundwater monitoring</p> <p>c.) implementation of swamp research program</p> <p>d.) weeding</p> <p>e.) fire management</p> <p>f.) reporting</p> <p>g.) update future predictions</p>		<p>Triggers for groundwater decline result in increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars</p>
<p><b>Minor changes</b> in the ecosystem functionality of the swamps</p>	<p>Falls in soil moisture levels in swamps</p> <p><i>NB. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.</i></p>	<p><u>Level 1:</u> Soil moisture level lower than baseline level at <b>any</b> monitoring sites (within 400 m of mining) within a swamp (in comparison to reference swamps).</p> <p><u>Level 2:</u> Soil moisture level lower than baseline level at <b>50%</b> of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).</p> <p><u>Level 3:</u> Soil moisture level lower than baseline level at <b>&gt;80%</b> of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).</p>	<p>a.) upfront mine planning</p> <p>b.) soil moisture monitoring</p> <p>c.) water spreading</p> <p>d.) weeding</p> <p>e.) fire management</p> <p>f.) reporting</p> <p>g.) update future predictions</p>		<p>Triggers of soil moisture decline result in increased intensity and frequency of vegetation monitoring and/or further investigations of subsidence impacts on bedrock base and rockbars</p>

Table 17: Dendrobium Area 3C Watercourse Impacts, Triggers and Response

<b>OBSERVATIONAL MONITORING</b>		
<p><b>Donalds Castle Creek and Wongawilli Creek</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>• Donalds Castle Creek - minor environmental consequences</li> <li>• Wongawilli Creek - minor environmental consequences</li> </ul> <p>General observation of streams in active mining areas when longwall is within 400m</p>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion</li> <li>• Crack or fracture up to 10m length with no observable loss of surface water or erosion</li> <li>• Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring</li> <li>• Observable release of strata gas at the surface</li> <li>• Observable increase in iron staining within the mining area</li> <li>• Observation that a pool on a subject Creek is dry</li> <li>• Observation that the subject Creek has ceased to flow</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Observation that a single pool on a subject Creek is dry in consecutive monitoring events</li> <li>• Observation that two or more pools on a subject Creek are dry in a single monitoring event</li> <li>• Observation that the subject Creek has ceased to flow in consecutive monitoring event</li> <li>• Crack or fracture between 100 and 300mm width at its widest point or any fracture which results in observable loss of surface water or erosion</li> <li>• Crack or fracture between 10 and 50m length</li> <li>• Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention</li> <li>• Observable increase in iron staining within the mining area continues to outside the mining area i.e. 400m from the longwall</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Carry out Water Flow Assessment Method D</li> <li>• Review monitoring frequency</li> <li>• Submit letter report to BCD, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Crack or fracture over 300mm width at its widest point</li> <li>• Crack or fracture over 50m length</li> <li>• Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water</li> <li>• Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW</li> </ul>

	<ul style="list-style-type: none"> <li>• Gas release results in vegetation dieback, mortality or loss of aquatic habitat</li> <li>• Observable increase in iron staining within the mining area continues more than 600m from the longwall</li> </ul>	<ul style="list-style-type: none"> <li>• Completion of works following approvals and at a time agreed between S32, DPIE, WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>• Structural integrity of the bedrock base of any significant permanent pool or controlling rockbar cannot be restored i.e. pool water level within the pool after CMAs continues to be lower than baseline period</li> <li>• Gas release results in vegetation dieback that does not revegetate</li> <li>• Gas release results in mortality of threatened species or ongoing loss of aquatic habitat</li> <li>• Iron staining and associated increases in dissolved iron resulting from mining is observed in water at Donalds Castle Creek downstream monitoring site Donalds castle Creek (FR6)</li> <li>• Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at Wongawilli Creek downstream monitoring site Wongawilli Creek (FR6)</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 3</i></li> <li>• Investigate reasons for the exceedance</li> <li>• Update future predictions based on the outcomes of the investigation</li> <li>• Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<p><b>DC13, LC5, WC20, WC21, WC22, WC23, WC24, WC25, WC26, WC27 and WC29</b></p> <p>General observation of streams in active mining areas when longwall is within 400m</p>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Crack or fracture up to 100mm width at its widest point with no observable loss of surface water or erosion</li> <li>• Crack or fracture up to 10m length with no observable loss of surface water or erosion</li> <li>• Erosion in a localised area (not associated with cracking or fracturing) which would be expected to naturally stabilise without CMA and within the period of monitoring</li> <li>• Observable release of strata gas at the surface</li> <li>• Observable increase in iron staining within the mining area</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AEMR</li> </ul>

	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Crack or fracture between 100 and 300mm width at it's widest point or any fracture which results in observable loss of surface water or erosion</li> <li>• Crack or fracture between 10 and 50m length</li> <li>• Soil surface crack that causes erosion that is likely to stabilize within the monitoring period without intervention</li> <li>• Observable increase in iron staining within the mining area continues outside the mining area i.e. 400m from the longwall</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to BCD, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Crack or fracture over 300mm width at it's widest point</li> <li>• Crack or fracture over 50m length</li> <li>• Fracturing observed in the bedrock base of any significant permanent pool which results in observable loss of surface water</li> <li>• Soil surface crack that causes erosion that is unlikely to stabilize within the monitoring period without intervention</li> <li>• Gas release results in vegetation dieback, mortality or loss of aquatic habitat</li> <li>• Observable increase in iron staining within the mining area continues more than 600m from the longwall</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> </ul>

**WATER QUALITY**

<p><b>Wongawilli Creek</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>• Wongawilli Creek - minor environmental consequences</li> </ul> <p>Wongawilli Creek (FR6)</p> <p>Baseline means:</p> <ul style="list-style-type: none"> <li>• pH 5.98</li> <li>• EC 98.8 uS/cm</li> <li>• DO 89.5%</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• One exceedance of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>– pH 4.45</li> <li>– EC 154.1 uS/cm</li> <li>– DO 50.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AEMR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Two non-consecutive exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>– pH 4.45</li> <li>– EC 154.1 uS/cm</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>

	<ul style="list-style-type: none"> <li>- DO 50.5%</li> </ul>	
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.45</li> <li>- EC 154.1 uS/cm</li> <li>- DO 50.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> <li>• Develop site CMA (subject to agency feedback). This may include: <ul style="list-style-type: none"> <li>o Limestone emplacement to raise pH where it is appropriate to do so</li> </ul> </li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>• Mining results in two consecutive exceedances or three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.45</li> <li>- EC 154.1 uS/cm</li> <li>- DO 50.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 3</i></li> <li>• Investigate reasons for the exceedance</li> <li>• Update future predictions based on the outcomes of the investigation</li> <li>• Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<p><b>Donalds Castle Creek</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>• Donalds Castle Creek – minor environmental consequences</li> </ul> <p>Donalds Castle Creek (FR6)</p> <p>Baseline means:</p> <ul style="list-style-type: none"> <li>• pH 5.41</li> <li>• EC 116 uS/cm</li> <li>• DO 85.6%</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• One exceedance of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 3.60</li> <li>- EC 185.8 uS/cm</li> <li>- DO 40.1%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AEMR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Two non-consecutive exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 3.60</li> <li>- EC 185.8 uS/cm</li> <li>- DO 40.1%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>

	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 3.60</li> <li>- EC 185.8 uS/cm</li> <li>- DO 40.1%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> <li>• Collect laboratory samples and analyse for: <ul style="list-style-type: none"> <li>o pH, EC, major cations, major anions, Total Fe, Mn &amp; Al</li> <li>o Filterable suite of metals</li> </ul> </li> <li>• Develop site CMA (subject to agency feedback). This may include: <ul style="list-style-type: none"> <li>o Limestone emplacement to raise pH where it is appropriate to do so</li> </ul> </li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE, Resources Regulator and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>• Mining results in two consecutive exceedances or three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 3.60</li> <li>- EC 185.8 uS/cm</li> <li>- DO 40.1%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 3</i></li> <li>• Investigate reasons for the exceedance</li> <li>• Update future predictions based on the outcomes of the investigation</li> <li>• Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<p><b>Lake Cordeaux</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>• Lake Cordeaux - negligible reduction in the quality of surface water inflows to Lake Cordeaux</li> </ul> <p>LC5_S1</p> <p>Baseline means:</p> <ul style="list-style-type: none"> <li>• pH 5.54</li> <li>• EC 102.4 uS/cm</li> <li>• DO 93.6%</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• One exceedance of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.16</li> <li>- EC 254.9 uS/cm</li> <li>- DO 61.2%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AEMR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Two non-consecutive exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.16</li> <li>- EC 254.9 uS/cm</li> <li>- DO 61.2%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>

	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.16</li> <li>- EC 254.9 uS/cm</li> <li>- DO 61.2%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> <li>• Collect laboratory samples and analyse for: <ul style="list-style-type: none"> <li>o pH, EC, major cations, major anions, Total Fe, Mn &amp; Al</li> <li>o Filterable suite of metals</li> </ul> </li> <li>• Develop site CMA (subject to agency feedback). This may include: <ul style="list-style-type: none"> <li>o Limestone emplacement to raise pH where it is appropriate to do so</li> <li>o Grouting of fractures in rockbar and bedrock base of any significant pool where flow diversion results in pool water level lower than baseline period</li> </ul> </li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE, DRG and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>• Mining results in two consecutive exceedances or three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean within six months: <ul style="list-style-type: none"> <li>- pH 4.16</li> <li>- EC 254.9 uS/cm</li> <li>- DO 61.2%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 3</i></li> <li>• Investigate reasons for the exceedance</li> <li>• Update future predictions based on the outcomes of the investigation</li> <li>• Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<b>POOL WATER LEVEL</b>		
<p><b>Donalds Castle Creek and Wongawilli Creek</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>• Donalds Castle Creek - minor environmental consequences</li> <li>• Wongawilli Creek - minor environmental consequences</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Single pool on a subject creek is dry</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Carry out Water Flow Assessment Method D.</li> <li>• Submit letter report to DPIE, Resources Regulator and WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Single pool on a subject creek is dry in consecutive monitoring events</li> <li>• Two or more pools on a subjects Creek are observed as dry in a single monitoring event</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>



	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>Fracturing resulting in diversion of flow such that &lt;10% of the pools have water levels lower than baseline period</li> </ul>	<ul style="list-style-type: none"> <li><i>Actions stated for Level 2</i></li> <li>Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Review relevant TARP and Management Plan in consultation with key agencies</li> <li>Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW</li> <li>Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>Fracturing resulting in diversion of flow such that &gt;10% of the pools have water levels lower than baseline period</li> </ul>	<ul style="list-style-type: none"> <li><i>Actions stated for Level 3</i></li> <li>Investigate reasons for the exceedance</li> <li>Update future predictions based on the outcomes of the investigation</li> <li>Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<b>SURFACE WATER FLOW</b>		
<p><b>Donalds Castle Creek, Wongawilli Creek, Lake Cordeaux and Cordeaux River</b></p> <p><b>Relevant Performance Measure(s):</b></p> <ul style="list-style-type: none"> <li>Donalds Castle Creek - minor environmental consequences</li> <li>Wongawilli Creek - minor environmental consequences</li> <li>Lake Cordeaux - negligible reduction in the quantity of surface water inflows to Lake Cordeaux<sup>2</sup></li> <li>Cordeaux River - negligible reduction in the quantity of surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek<sup>3</sup></li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>A) Lower flow than expected (additional 10-15% of days where Q% lower than Reference Q%)</li> <li>B) 5-10% increase in cease-to-flow frequency beyond natural)</li> <li>C) Reduction in Q50 (10-15% beyond natural)</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an Impact Report to BCD, DPIE, Resources Regulator and WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>A) Lower flow than expected (additional 15-20% of days where Q% lower than Reference Q%).</li> <li>B) 10-20% increase in cease-to-flow frequency (beyond natural)</li> <li>C) 15-20% reduction in Q50 (beyond natural)</li> <li>D) Observation that the subject Creek has ceased to flow at spatially consecutive monitoring sites.</li> </ul>	<ul style="list-style-type: none"> <li><i>Actions as stated for Level 1</i></li> <li>Review monitoring frequency</li> <li>D) → carry out Water Flow Assessment Method D</li> <li>Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p>	<ul style="list-style-type: none"> <li><i>Actions as stated for Level 2</i></li> <li>Offer site visit with BCD, DPIE, Resources Regulator , WaterNSW</li> </ul>

<p><b>Surface Water Flow Reference Sites</b> (as in Table 1.1):</p> <ul style="list-style-type: none"> <li>• Wongawilli Creek - WWU (Wongawilli Creek upstream);</li> <li>• O'Hares Creek at Wedderburn (213200);</li> <li>• (other such sites, if necessary, include Woronora River 2132101 and Bomaderry Creek 215016)</li> </ul> <p>NB. This section of the TARP contains four Water Flow Assessment Methods, labelled A, B, C and D, which are specified in detail in Watershed HydroGeo (2019) Hydrological changes are assessed by comparing pre- and post-mining observed flows from impact or assessment sites to flow data from reference sites.</p> <p><i>Natural variability ('NV') will be defined as the 'average' change at the selected reference sites. Triggers may occur when the apparent impact at a site (NV + x% change) could be less than maximum observed variability at one of the reference sites.</i></p> <p><sup>2</sup>Surface water inflows calculation = [Impacts at gauged catchments (SCL2) + LC5 + estimated impacts at ungauged but undermined catchments] / [total estimated inflow to LC].</p> <p><sup>3</sup>Flow reduction as determined from measured at flow gauging station WWL_A.</p>	<ul style="list-style-type: none"> <li>• A) Lower flow than expected (additional &gt;20% of days where Q% lower than Reference Q%)</li> <li>• B) &gt;20% increase in cease-to-flow frequency (beyond natural)</li> <li>• C) &gt;20% reduction in Q50 (beyond natural)</li> </ul>	<ul style="list-style-type: none"> <li>• Implement additional monitoring or increase frequency if required</li> <li>• Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> <li>• Review relevant TARP and Management Plan in consultation with key agencies</li> </ul>
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>• Measured surface water flow reduction, based on Assessment Methods C, D, to be compared against predictions made in contemporary groundwater modelling conducted to the satisfaction of the Secretary to assess whether effects that cannot be explained by natural variability "exceed prediction".</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 3</i></li> <li>• Investigate reasons for the exceedance</li> <li>• Update future predictions based on the outcomes of the investigation</li> <li>• Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent</li> </ul>
<p><b>Tributaries of Donalds Castle Creek and Wongawilli Creek and other affected watercourses not subject to performance measures</b></p>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• A) Lower flow than expected (additional 10-20% of days where Q% lower than Reference Q%)</li> <li>• B) 5-10% increase in cease-to-flow frequency (beyond natural)</li> <li>• C) 10-20% reduction in Q50 (beyond natural)</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AR</li> </ul>
<p><b>Surface water flow Reference Sites</b> (as in (as in Table 1.1):</p>	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• A) Lower flow than expected (additional 20-30% of days where Q% lower than Reference Q%)</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> </ul>

<ul style="list-style-type: none"> <li>Wongawilli Creek - WWU (Wongawilli Creek upstream);</li> <li>O'Hares Creek and Wedderburn (213200);</li> <li>(other such sites, if necessary, include Woronora River 2132101 and Bomaderry Creek 215016)</li> </ul> <p>NB. This section of the TARP contains four Water Flow Assessment Methods, labelled A, B, C and D, which are specified in detail in Watershed HydroGeo (2019).</p> <p><i>Natural variability ('NV') will be defined as the 'average' change at the selected reference sites. Triggers may occur when the apparent impact at a site (NV + x% change) could be less than maximum observed variability at one of the reference sites.</i></p>	<ul style="list-style-type: none"> <li>B) 10-20% increase in cease-to-flow frequency (beyond natural)</li> <li>C) 20-30% reduction in Q50 (beyond natural)</li> </ul>	<ul style="list-style-type: none"> <li>Submit letter report to DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>A) Lower flow than expected (additional &gt;30% of days where Q% lower than Reference Q%)</li> <li>B) &gt;20% increase in cease-to-flow frequency (beyond natural)</li> <li>C) &gt;30% reduction in Q50 (beyond natural)</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> <li>Review relevant TARP and Management Plan in consultation with key agencies</li> </ul>

## AQUATIC ECOLOGY

<p><b>Pool water level, interconnectivity between pools and loss of connectivity, noticeable alteration of habitat</b></p> <ul style="list-style-type: none"> <li>Donalds Castle Creek catchment – 1 site</li> <li>Wongawilli Creek catchment – 8 sites</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>Reduction in aquatic habitat for 1 year</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an Impact Report to BCD, DPIE, Resources Regulator and WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>Reduction in aquatic habitat for 2 years following active subsidence period</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring frequency</li> <li>Submit letter report to DPIE, BCD, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>Reduction in aquatic habitat for &gt;2 years following the active subsidence period</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Offer site visit with BCD, DPIE, MEG, WaterNSW</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Review relevant TARP and Management Plan in consultation with key agencies</li> <li>Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is</li> </ul>

		<p>appropriate to do so in consultation with BCD, DPIE, Resources Regulator, WaterNSW</p> <ul style="list-style-type: none"> <li>• Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
<b>TERRESTRIAL FAUNA – THREATENED FROG SPECIES</b>		
<p><b>Pool water level, interconnectivity between pools and loss of connectivity, noticeable alteration of habitat</b></p> <ul style="list-style-type: none"> <li>• Donalds Castle Creek catchment – 2 sites</li> <li>• Wongawilli Creek catchment – 2 sites</li> </ul>	<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Reduction in habitat for 1 year</li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Report in the End of Panel Report</li> <li>• Summarise actions and monitoring in AR</li> </ul>
	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Reduction in habitat for 2 years following the active subsidence period</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 1</i></li> <li>• Review monitoring frequency</li> <li>• Submit letter report to DPIE, BCD, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to agency feedback)</li> </ul>
	<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Reduction in habitat for &gt; 2 years following the active subsidence period</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Actions as stated for Level 2</i></li> <li>• Offer site visit with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Implement additional monitoring or increase frequency if required • Review relevant TARP and Management Plan in consultation with key</li> <li>• Develop site CMA (subject to agency feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with BCD, DPIE, Resources Regulator and WaterNSW</li> <li>• Completion of works following approvals and at a time agreed between S32, DPIE and WaterNSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>

## 9. APPENDIX B – CORRECTIVE MANAGEMENT ACTIONS

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_001	1	06/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_002	2	06/06/2023	Rock Fracturing and Rock Movement	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trials</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_003	2	06/06/2023	Rock Fracturing and Rockfall	No	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an impact report to key stakeholders</li> <li>• Summarise impacts and report in the EOP and AR</li> <li>• Review monitoring frequency</li> <li>• Notify relevant technical specialists and seek advice on any CMA required</li> <li>• Provide safety signage and barricades as appropriate</li> <li>• Implement approved repairs to ensure safety and serviceability on fire trials</li> <li>• Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>• The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>• Data provisions supplied to BCD</li> </ul>
DA3C_LW21_004	2	06/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an impact report to key stakeholders</li> <li>• Summarise impacts and report in the EOP and AR</li> <li>• Review monitoring frequency</li> <li>• Notify relevant technical specialists and seek advice on any CMA required</li> <li>• Provide safety signage and barricades as appropriate</li> <li>• Implement approved repairs to ensure safety and serviceability on fire trials</li> <li>• Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>• The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>• Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_005	1	15/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_006	1	15/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_007	2	15/06/2023	Rock Fracturing and Rockfall	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trials</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_008	1	19/06/2023	Rock Fracturing and Soil Cracking	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_009	1	19/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_010	2	19/06/2023	Rock Fracturing and Rock Movement/ Displacement	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trials</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_011	1	19/06/2023	Rock Fracturing, Rock Displacement and Soil Cracking	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>



Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
144_01	3	22/06/2023	Groundwater	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 144 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>See Appendix C for status of all CMAs for Swamp 144 and additional correspondence with relevant stakeholders</li> </ul>
S144_01	3	27/06/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 144 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>See Appendix C for status of all CMAs for Swamp 144 and additional correspondence with relevant stakeholders</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_012	1	27/06/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>
DA3C_LW21_013	1	03/07/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>
DA3C_LW21_014	2	11/07/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources regulator, WaterNSW</li> <li>Report in End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> <li>Review monitoring frequency</li> <li>Submit letter report BDC, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>Implement agreed CMA's as approved (subject to agency feedback)</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_015	2	11/07/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an impact report to BCD, DPIE, Resources regulator, WaterNSW</li> <li>• Report in End of Panel Report</li> <li>• Summarise actions and monitoring in AEMR</li> <li>• Review monitoring frequency</li> <li>• Submit letter report BDC, DPIE, Resources Regulator and WaterNSW and seek advice on any CMA required</li> <li>• Implement agreed CMA's as approved (subject to agency feedback)</li> </ul>		<ul style="list-style-type: none"> <li>• The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>• Data provisions supplied to BCD</li> </ul>
DA3C_LW21_016	1	11/07/2023	Rockfall	No	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an impact report to key stakeholders</li> <li>• Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>• The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>• Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
Swamp 15a	1	12/07/2023	Groundwater	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 15a data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>Review of distance and swamp impact report sent to WaterNSW</li> </ul>
Swamp 15a	2	12/07/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 15a data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>Review of distance and swamp impact report sent to WaterNSW</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_016 (Update)	2	26/07/2023	Rockfall	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trails</li> <li>Implement agreed CMA's as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Erected caution tape at site of rockfall</li> </ul>
DA3C_LW21_017	1	26/07/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources regulator, WaterNSW</li> <li>Report in End of Panel Report</li> <li>Summarise impacts and report in the AEMR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>
DA3C_LW21_018	1	26/07/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_019	1	1/08/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_020	1	1/08/2023	Iron Staining	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_021	1	1/08/2023	Iron Staining	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_022	1	7/08/2023	Rockfall	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
S145_01	3	4/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 145 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
09_02	2	4/08/2023	Groundwater	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 9 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>
Swamp 15a (update)	3	11/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 15a data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>The report was uploaded to the Major Projects Planning Portal following agency consultation</li> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>



Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
S12_04	3	29/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 12 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>
S150_01	3	29/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 150 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
09_01	3	30/08/2023	Groundwater	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 9 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>
S09_01	3	30/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 9 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
S09_02	3	30/08/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 9 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> </ul>
DA3C_LW21_023	1	31/08/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_024	1	31/08/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_025	1	6/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_026	1	6/09/2023	Rockfall	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_027	2	6/09/2023	Rockfall	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trails</li> <li>Implement agreed CMA's as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_028	1	6/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_029	1	6/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
DA3C_LW21_030	1	12/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_031	1	12/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_032	1	12/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> </ul>
DA3C_LW21_033	1	12/09/2023	Rock Fracturing	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	<ul style="list-style-type: none"> <li>Data provisions supplied to BCD</li> </ul>

Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
DA3C_LW21_034	2	12/09/2023	Rock Movement and Soil Cracking	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to key stakeholders</li> <li>Summarise impacts and report in the EOP and AR</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Provide safety signage and barricades as appropriate</li> <li>Implement approved repairs to ensure safety and serviceability on fire trails</li> <li>Implement agreed CMA's as approved</li> </ul>	<ul style="list-style-type: none"> <li>Report to be uploaded to the Major Projects Planning Portal following agency consultation</li> </ul>	TBA
Swamp 15b	3	19/09/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 15b data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>Awaiting agency feedback</li> </ul>



Site/Impact ID	Trigger Level	Identification Date	Impact Type	Exceeding predictions?	Corrective management actions completed	Corrective management actions yet to be completed	Outcomes
S34_01	3	27/09/2023	Soil Moisture	No	<ul style="list-style-type: none"> <li>Continue Monitoring Program</li> <li>Submit an Impact Report to key stakeholders</li> <li>Analysis of Swamp 34 data by relevant technical experts and results provided in End of Panel Report</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required</li> <li>Implement agreed CMAs as approved</li> </ul>		<ul style="list-style-type: none"> <li>Advised groundwater technical specialists to reassess groundwater impacts with results to be included in EOP report</li> <li>Swamp monitoring continuing as per SIMMCP</li> <li>Awaiting agency feedback</li> </ul>
DA3C_LW21_035	1	9/10/2023	Iron Staining	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> </ul>		<ul style="list-style-type: none"> <li>Awaiting agency feedback</li> </ul>
DA3C_LW21_036	1	9/10/2023	Iron Staining	No	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an impact report to BCD, DPIE, Resources Regulator, WaterNSW</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> </ul>		<ul style="list-style-type: none"> <li>Awaiting agency feedback</li> </ul>

## 10. APPENDIX C - SUMMARY OF ADDITIONAL CORRESPONDENCE REGARDING SWAMP 144

In response to Impact Report dated 28 June 2023, DPE issued a letter (**Attachment I**) to IMC requesting “*that ongoing monitoring data is provided to BCD as requested and that this data, together with a summary of any additional correspondence with WaterNSW and BCD and the status of all corrective management actions for impacts to Swamp 144, is reported in the End of Panel Report for Longwall 21.*”

### Swamp 144 Data

Data requested by BCD is included in **Attachment D**. This data was requested to be provided on a three-monthly basis and was provided to BCD via MoveltCloud on 3/10/2023. It is next due 3/1/2023.

### Status of CMAs

Corrective Management Action (CMA)	Outcomes
Continue Monitoring Program	Ongoing monitoring is undertaken in accordance with SIMMCP.
Submit and Impact Report to key stakeholders	Impact report dated 28 June was submitted to BCD, WaterNSW, DPE and Resources Regulator. Version 2 of the report was uploaded to the Major Projects planning portal on 15/09/2023.
Analysis of Swamp 144 data by relevant technical experts and results provided in End of Panel Report	Swamp 144 shallow groundwater and soil moisture data was assessed by specialist consultants HGEO with the Surface Water and Shallow Groundwater Assessment provided in <b>Attachment D</b> .
Summarise impacts and report in the End of Panel and the Annual Review	Shallow groundwater and soil moisture triggers at Swamp 144 are summarised and presented in <b>Section 3.7.1</b> of the Longwall 21 End of Panel Report and will also be provided in the FY24 Annual Review.
Review monitoring frequency	Near surface groundwater levels and soil moisture levels at Swamp 144 are logged hourly.
Notify relevant technical specialists and seek advice on any Corrective Management Actions (CMAs) required	Experts in hydrogeology from HGEO analysed the Swamp 144 data as part of the Longwall 21 End of Panel Report. It was recommended that this data be re-evaluated as part of the next End of Panel assessment. Ideally this re-evaluation should be carried out over a period of average rainfall conditions.
Provide safety signage and barricades as appropriate	N/A

Implement approved repairs to ensure safety and serviceability on fire trails	N/A
Implement agreed CMAs as approved	Swamp 144 data will be re-evaluated as part of the next End of Panel assessment (Longwall 19A) Ideally this re-evaluation should be carried out over a period of average rainfall conditions.  No other additional CMAs were recommended by agencies or experts.
A follow-up inspection of the impact sites will be undertaken following completion of Longwall 21	N/A

### **Additional Correspondence with WaterNSW:**

WaterNSW letter dated 30 August 2023 identified the Level 3 trigger for Swamp 144 – groundwater recession rate greater than baseline and average soil moisture level below the baseline level noting there is one monitoring location in Swamp 144. The letter acknowledged that while soil moisture and groundwater levels are not specifically linked to a swamp performance measure, the observed decline in soil moisture and groundwater levels are early and reliable indicators of irreversible changes in swamp hydrology on which ecosystem functionality is dependent. WaterNSW expressed concern the performance measure of minor consequences for Swamp 144 and negligible consequences for Swamp 15a will be exceeded. The letter also noted the reported triggers occurred at distances greater than 61 m, indicating the 61 m setback from longwalls is inadequate to prevent hydrological impacts to swamps over Dendrobium mine warranting further assessment.

In response, IMC provided a review of the empirical model and noted that the Longwall 19A SMP was approved on 11 August 2023 requiring a setback of Longwall 19A to be at least 120 metres to the west of Swamp 15a.

### **Additional Correspondence with BCD:**

Requested data was provided via Moveitcloud on 3/10/2023. Furthermore, a condition of the Longwall 19A SIMMCP (dated 25 October 2023) requires IMC to establish a data sharing agreement with BCD.

IMC and Agency correspondence in the matters addressed above are provided in **Attachment I**.