



**DENDROBIUM AREA 3B  
LONGWALL 17 END OF  
PANEL  
LANDSCAPE REPORT  
NOVEMBER 2021**



## **EXECUTIVE SUMMARY**

This report summarises the observed and measured subsidence effects on landscape features resulting from the extraction of Dendrobium Area 3B (DA3B) Longwall 17. Longwall 17 is the ninth panel extracted from DA3B. Extraction began on 12 December 2020 and was completed on 13 October 2021. The Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) conducts detailed monitoring and inspections of landscape features including swamps, watercourses, rock outcrops and landscape features within the mining area of DA3B. This monitoring was conducted in accordance with:

- Dendrobium Area 3B Subsidence Management Plan (SMP);
- Dendrobium Area 3B Watercourse Impact, Monitoring, Management and Contingency Plan (WIMMCP) (August 2020);
- Dendrobium Area 3B Swamp Impact, Monitoring, Management and Contingency Plan (SIMMCP) (October 2020 amendment); and
- Dendrobium Subsidence, Landscape Monitoring and Management Plan (SLMMP) (November 2012).

The Watercourse, Swamp and Landscape Trigger Action Response Plans (TARPs) form the basis of the impact assessments in this report.

A total of 40 surface impacts were identified by IMCEFT. Of these, 29 were surface impacts observed on natural features and 11 occurred on fire roads and access tracks. This report also contains an update on a Longwall 9 impact. Water quality triggers were also recorded during Longwall 17 and will be addressed in detail in the specialist Water and Shallow Groundwater Assessment of the final EoP Report.

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## Abbreviations

**CMA** – Corrective Management Action

**DPIE** - Department of Planning, Industry and Environment

**EoP** – End of Panel

**IMCEFT** – Illawarra Metallurgical Coal Environmental Field Team

**OEH** - Office of Environment and Heritage (former agency)

**SIMMCP** – Swamp Impact, Monitoring, Management and Contingency Plan

**SLMMP** – Subsidence Landscape Monitoring and Management Plan

**SMP** – Subsidence Management Plan

**TARP** – Trigger Action Response Plan

**WaterNSW** – previously Sydney Catchment Authority

**WIMMCP** – Watercourse Impact, Monitoring, Management and Contingency Plan

## Definitions

**Active Mining Area** – Within 400m of the active longwall.

# 1 OVERVIEW OF MONITORING PROGRAM

Landscape monitoring was conducted within the Longwall 17 mining area during baseline, active mining and post-mining periods. Baseline inspections were conducted up until the longwall was within 400m of each feature. When active mining occurred, within 400m of each feature, inspections increased to weekly until the longwall was at least 400m past the feature. Post-mining inspections continue as outlined in the relevant management plans.

## 1.1 Surface Monitoring for Longwall 17

IMCEFT and consultants conducted observations and measurements of surface and shallow groundwater levels, swamp soil moisture, surface water flows, surface water quality and inspections of key landscape features. This monitoring included targeted sites within swamps and watercourses as well as steep slopes, clifflines and other landscape features.

## Landscape Monitoring Summary (SLMMP)

In accordance with the Dendrobium Area 3B SMP Approval, landscape monitoring sites (Subsidence Landscape Monitoring and Management Plan [SLMMP] photo points) within the active mining area were monitored at monthly intervals. Monitoring photos from SLMMP sites are compared to baseline photos at each site (Photo 1 and Photo 2). Landscape monitoring sites (SLMMP photo points) were monitored before, during and after the Longwall 17 extraction period (Table 1). Longwall 17 post-mining inspections were undertaken, and no impacts were observed.



Photo 1: A3b-SS16, baseline inspection. Taken on 27/12/17.



Photo 2: A3b-SS16, post-mining inspection. Taken on 7/6/21.

Table 1: Summary of SLMMP sites associated with Longwall 17

Site Name	Easting	Northing	Impact Description
<b>A3b-SS15</b>	288717	6191468	No impacts observed
<b>A3b-SS16</b>	289207	6191506	Rock Fracturing during LW16, no further changes observed
<b>A3b-SS17</b>	290163	6191269	Rock Fracturing during LW16, no further changes observed
<b>A3b-SS18</b>	288812	6190998	No impacts observed
<b>A3b-SS19</b>	289020	6191108	No impacts observed
<b>A3b-SS20</b>	289245	6190585	No impacts observed
<b>A3b-SS21</b>	289633	6190858	No impacts observed

<b>AT4-slmp</b>	289092	6191569	Impacted during LW16, no further changes observed
<b>AT5-slmp</b>	290140	6191224	Soil Cracking during LW16, no changes observed
<b>AT6-slmp</b>	289502	6190991	No impacts observed
<b>AT7-slmp</b>	289222	6190861	No impacts observed
<b>AT8-slmp</b>	2902241	6190769	No impacts observed
<b>A3b_RailCorridor</b>	289990	6190730	Not inspected due to safety
<b>A3b-Step 1</b>	290270	6190570	Not inspected due to safety
<b>A3b-CF3</b>	290338	6190567	Not inspected due to safety

## 2 REFERENCE SITE MONITORING

Swamp reference sites are monitored in accordance with the SIMMCP (example reference swamps- Photo 3 and Photo 4). Data recorded from reference swamps is compared with data from impact monitoring sites relevant to previously mined and active longwalls.



Photo 3: Reference swamp site S87\_S02. Taken on 1/11/2021.



Photo 4: Reference swamp site S25\_S01. Taken on 4/09/2021.

### 3 TARP OVERVIEW

In accordance with the Dendrobium Area 3B SMP Approval, the SIMMCP and WIMMCP (and Environmental Management Plan) were revised during the extraction of Longwalls 9 and 10. Key government agencies including DPIE, WaterNSW and BCD were consulted during this process. This revision included updates to the TARPs, which address performance measures, specified in the approval conditions. Table 2 shows the TARPs used to date. In accordance with the Dendrobium Area 3B SMP Approvals, the SIMMCP and WIMMCP (and Environmental Management Strategy) were revised prior to the extraction of Longwall 14. Impacts to surface features observed during the extraction of Longwall 17 will be reported under the 2020 TARPs.

Table 2: History of management plan updates for DA3B. Highlighted Plans show those used for reporting during Longwall 17.

Aspect	Management Plan	TARP Date Range
Swamps	Swamp Impact, Monitoring, Management and Contingency Plan (October 2013)	10/10/2013 – 03/06/2014
	Swamp Impact, Monitoring, Management and Contingency Plan (June 2014)	04/06/2014 – 11/10/2015
	Swamp Impact, Monitoring, Management and Contingency Plan (October 2015)	12/10/2015 – 30/10/2017
	Swamp Impact, Monitoring, Management and Contingency Plan (October 2017)	31/10/2017 – 6/02/2020
	Swamp Impact, Monitoring, Management and Contingency Plan (February 2020)	07/02/2020 – 11/08/2020
	Swamp Impact, Monitoring, Management and Contingency Plan (August 2020; <i>Addendum A- October 2020</i> )	28/10/2020 - present
Watercourse	Watercourse Impact, Monitoring, Management and Contingency Plan (December 2013)	19/12/2013 – 03/06/2014
	Watercourse Impact, Monitoring, Management and Contingency Plan (June 2014)	04/06/2014 – 11/10/2015
	Watercourse Impact, Monitoring, Management and Contingency Plan (October 2015)	12/10/2015 – 30/10/2017
	Watercourse Impact, Monitoring, Management and Contingency Plan (October 2017)	31/10/2017 – 13/02/2020
	Watercourse Impact Monitoring, Management and Contingency Plan (February 2020)	14/02/2020 - 11/08/2020
	Watercourse Impact Monitoring, Management and Contingency Plan (August 2020)	12/08/2020 - present
Landscape	Dendrobium Area 3B Subsidence Management Plant (SMP), Volume 2 – Table 1.2 Dendrobium Landscape Impacts, Triggers and Response (November 2012)	12/11/2012 – Present





## **4 SUMMARY OF IMPACTS**

During the extraction of Longwall 17, 40 new surface impacts were identified (Table 3; Figure 2 and Figure 3). These impacts are labelled as *DA3B\_LW17\_001* to *DA3B\_LW17\_040*. Updates are provided for a Longwall 9 impact; this impact is labelled as *DA3B\_LW9\_019*. Four water quality triggers were also recorded. These triggers will be addressed in the Longwall 17 Surface Water assessment.

### **Impacts to Natural Features**

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 Dendrobium Area 3B are discussed in the Dendrobium Area 3B SMP, WIMMCP and SIMMCP.

An overview of impacts observed during the extraction of Longwall 17 is provided in the following sections. For specific details on the impacts listed in Table 3, refer to the relevant impact reports (attached separately to this report).

### **Landscape features**

Fractures and cracking observed during the extraction of Longwall 17 were assessed against the relevant TARP (for landscape, swamp or watercourse) and assigned a trigger value (Level 1, Level 2 or Level 3 where applicable). Trigger values for fractures and cracks were determined based on characteristics such as:

- Width and length;
- Whether the fracture contributed to any observable loss of surface water or water diversion; and
- Any erosion or potential for erosion caused by a fracture or crack.

Table 3: Summary of impacts and triggers associated with Longwall 17

Site ID	Eastings	Northings	Impact Type	Feature Affected	Identification Date	Trigger Level	Description	Refer to Impact Report/s Dated
DA3B_LW17_001	288554	6191211	Rock Fracturing, Uplift and Fragmentation.	LA2	5/02/2021	2	Rock fracturing, uplift and fragmentation to <i>LA2_Channel 6B</i> .	10/02/2021
DA3B_LW17_002	289050	6191110	Rock Fracturing, Uplift and Fragmentation.	LA2	10/02/2021	2	Rock fracturing, uplift and fragmentation to <i>LA2_Rockbar 25</i> .	16/02/2021
DA3B_LW17_003	289038	6191109	Rock Fracturing and uplift.	LA2	10/02/2021	2	Rock fracturing, uplift and fragmentation to <i>LA2_Rockbar 24</i> .	16/02/2021
DA3B_LW17_004	288700	6191113	Rock Fracturing & Uplift.	LA2	10/03/2021	2	Rock fracturing and uplift to <i>LA2_Rockbar 10</i> .	12/03/2021
DA3B_LW17_005	288723	6191096	Rock Fracturing	LA2	10/03/2021	2	Rock fracturing to <i>LA2_Pool 12</i> .	12/03/2021
DA3B_LW17_006	288752	6191099	Rock Fracturing, uplift and Soil Cracking	LA2	10/03/2021	2	Rock fracturing, soil cracking and uplift to <i>LA2_Pool 14</i> .	12/03/2021
DA3B_LW17_007	288700	6191113	Rock Fracturing & Uplift	LA2	10/03/2021	2	Rock fracturing and uplift to <i>LA2_Rockbar 14</i> .	12/03/2021
DA3B_LW17_008	288895	6191074	Rockfall	Steep Slope/Step	10/03/2021	2	Rockfall at Steep slope/step adjacent to LA2.	12/03/2021
DA3B_LW17_009	2889238	6191070	Rockfall	Steep Slope/Step	10/03/2021	2	Rockfall at Steep slope/step adjacent to LA2.	12/03/2021
DA3B_LW17_002 (Update)	289050	6191110	Rock Fracturing, Uplift and Fragmentation.	LA2	10/03/2021	2	Rock fracturing, uplift and fragmentation to <i>LA2_Rockbar 25</i> and <i>LA2_Pool 25</i> .	16/02/2021 & 12/03/2021

DA3B_LW17_003 (Update)	289038	6191109	Rock Fracturing, uplift and Rockfall.	LA2	10/03/2021	2	Rock fracturing, uplift and rockfall to LA2_Rockbar 24, LA2_Pool 24 and LA2_Step 24.	16/02/2021 & 12/03/2021
LA4_S1	288134	6192561	Water Quality Trigger	LA4	18/02/2021	2	Trigger for pH at LA4_S1.	17/03/2021
LA4_S1	288134	6192561	Water Quality Trigger	LA4	18/02/2021	2	Trigger for electrical conductivity at LA4_S1.	17/03/2021
DA3B_LW17_003 (Update)	289038	6191109	Rock Fracturing, uplift and Rockfall.	LA2	10/03/2021	2	Rock fracturing, uplift and rockfall to LA2_Rockbar 24, LA2_Pool 24 and LA2_Step 24.	16/02/2021, 12/03/2021, 14/04/2021
DA3B_LW17_010	288700	6191147	Rock Fracturing	Steep Slope/Step	13/04/2021	1	Rock Fracturing to step on the northern slope of LA2 valley	14/04/2021
DA3B_LW17_011	288721	6191139	Rock Fracturing	Steep Slope/Step	13/04/2021	2	Rock fracturing to step/steep slope.	14/04/2021
DA3B_LW17_012	288663	6191142	Rock Fracturing	LA2	13/04/2021	2	Rock fracturing and displacement around LA2_Pool 9 and upstream rockbar.	14/04/2021
DA3B_LW17_013	288651	6191158	Rock Fracturing	LA2	13/04/2021	2	Rock fracturing to LA2_Channel 8.	14/04/2021
DA3B_LW17_014	289658	6191068	Soil Cracking	FR6A	18/05/2021	2	Zone of soil cracking (multiple) extending over Fire Road 6A and adjacent clearing	20/05/2021
DA3B_LW17_015	289590	6190995	Soil Cracking	Access Track	18/05/2021	1	Soil cracking to access track to the west of FR6A	20/05/2021
DA3B_LW17_016	289395	6191018	Rock Fracturing	Rock Outcrop	25/05/2021	1	Rock fracturing to a rock outcrop, west of Fire Road 6A.	28/05/2021
DA3B_LW17_017	289523	6191142	Rock Displacement	Rock Outcrop	25/05/2021	1	Rock displacement from soil, west of Fire Road 6A.	28/05/2021

DA3B_LW17_018	289614	6191150	Soil Cracking	Fire Road 6A	25/05/2021	1	Soil cracking to <i>Fire Road 6A</i> .	28/05/2021
LA4_S1	288134	6192561	Water Quality Trigger	LA4	7/06/2021	3	Trigger for pH at LA4_S1.	9/06/2021
DA3B_LW17_019	289584	6191060	Soil Cracking and Rock Fracturing	Bushland	8/06/2021	3	Soil cracking and rock fracturing in bushland west of <i>Fire Road 6A</i> .	9/06/2021
DA3B_LW17_020	289639	6191117	Soil Cracking	Fire Road 6A	8/06/2021	1	Soil cracking to <i>Fire Road 6A</i> .	9/06/2021
DA3B_LW17_021	289613	6191009	Rock Fracturing	Steep Slope/Step	8/06/2021	1	Rock fracturing to step/steep slope.	9/06/2021
DA3B_LW17_022	289813	6190889	Rock Fracturing	Bushland	22/06/2021	1	Fracturing to rock outcrop in bushland to east of Fire Road 6A.	25/06/2021
DA3B_LW17_023	289765	6190961	Rock Fracturing	Bushland	22/06/2021	2	Fracturing to rock outcrop in bushland to east of Fire Road 6A.	25/06/2021
DA3B_LW17_024	289682	6190942	Rock Fracturing	Rock outcrop	24/06/2021	1	Fracturing to rock outcrop adjacent to Fire Road 6A	25/06/2021
LA4_S1	288134	6192561	Water Quality Trigger	LA4	1/07/2021	3	Trigger for electrical conductivity at LA4_S1.	6/07/2021
DA3B_LW17_025	287973	6192580	Iron Staining	LA5	1/07/2021	1	Iron staining in tributary LA5.	6/07/2021
DA3B_LW17_026	289876	6190939	Soil Cracking	Rail Corridor	7/07/2021	1	Soil cracking across rail corridor and adjacent bushland.	9/07/2021
DA3B_LW17_027	289871	6190919	Soil Cracking	Rail Corridor	7/07/2021	1	Soil cracking across rail corridor and adjacent bushland.	9/07/2021

DA3B_LW17_027 (Update)	289871	6190919	Soil Cracking	Rail Corridor	15/07/2021 (Update)	2	Soil cracking across rail corridor and adjacent bushland.	29/07/2021
DA3B_LW17_028	289997	6191083	Soil Cracking	Access Track	26/07/2021	1	Soil cracking to access track to the east of Swamp 14.	29/07/2021
DA3B_LW17_029	289892	6190893	Soil Cracking	Rail Corridor	26/07/2021	1	Soil cracking across rail corridor/ballast.	29/07/2021
DA3B_LW17_030	289675	6191031	Soil Cracking	Fire Road 6A	26/07/2021	1	Soil cracking along Fire Road 6A.	29/07/2021
DA3B_LW17_031	290859	6193467	Iron Staining	Wongawilli Creek	2/08/2021	3	Iron staining in Wongawilli Creek	9/08/2021
DA3B_LW9_019 (Update)	290241	6193909	Iron Staining	WC21	2/08/2021	3	Iron staining in Wongawilli Creek	9/08/2021
DA3B_LW17_032	290091	6190867	Rock Displacement	Steep Slope/Step	17/08/2021	1	Rock displacement from soil at the base of steep slope/step, east of Fire Road 6A.	25/8/2021
DA3B_LW17_033	289983	6191068	Soil Cracking	Access Track	23/08/2021	1	Soil cracking to an access track to the east of Swamp 14.	25/8/2021
DA3B_LW17_034	288736	6191097	Rock Fracturing	LA2	10/9/2021	2	Rock fracturing and cracking to LA2 tributary	21/09/2021
DA3B_LW17_035	289585	6191040	Rock Fracturing	Rock Outcrop	15/9/2021	1	Rock fracturing with an associated rockfall to a large rock outcrop/steep slope	21/09/2021
DA3B_LW17_036	289533	6191165	Rock Fracturing	Rock Outcrop	15/9/2021	1	Rock fracturing to a large rock outcrop/steep slope	21/09/2021
DA3B_LW17_037	289536	6191147	Rock Fracturing	Rock Outcrop	15/9/2021	2	Multiple rock fracturing to a large rock outcrop/steep slope	21/09/2021

DA3B_LW17_038	289567	6191065	Rock Movement	Rock Outcrop	15/9/2021	1	Rock movement and soil cracking to a large rock outcrop/steep slope	21/09/2021
DA3B_LW17_039	289778	6190934	Rock movement	Rock outcrop	21/10/2021	1	Rock movement, rock and soil profile separation at rock outcrop	8/11/2021
DA3B_LW17_040	289779	6190944	Rock fracture	Rock outcrop	21/10/2021	1	Rock fracturing to exposed rock outcrop	8/11/2021

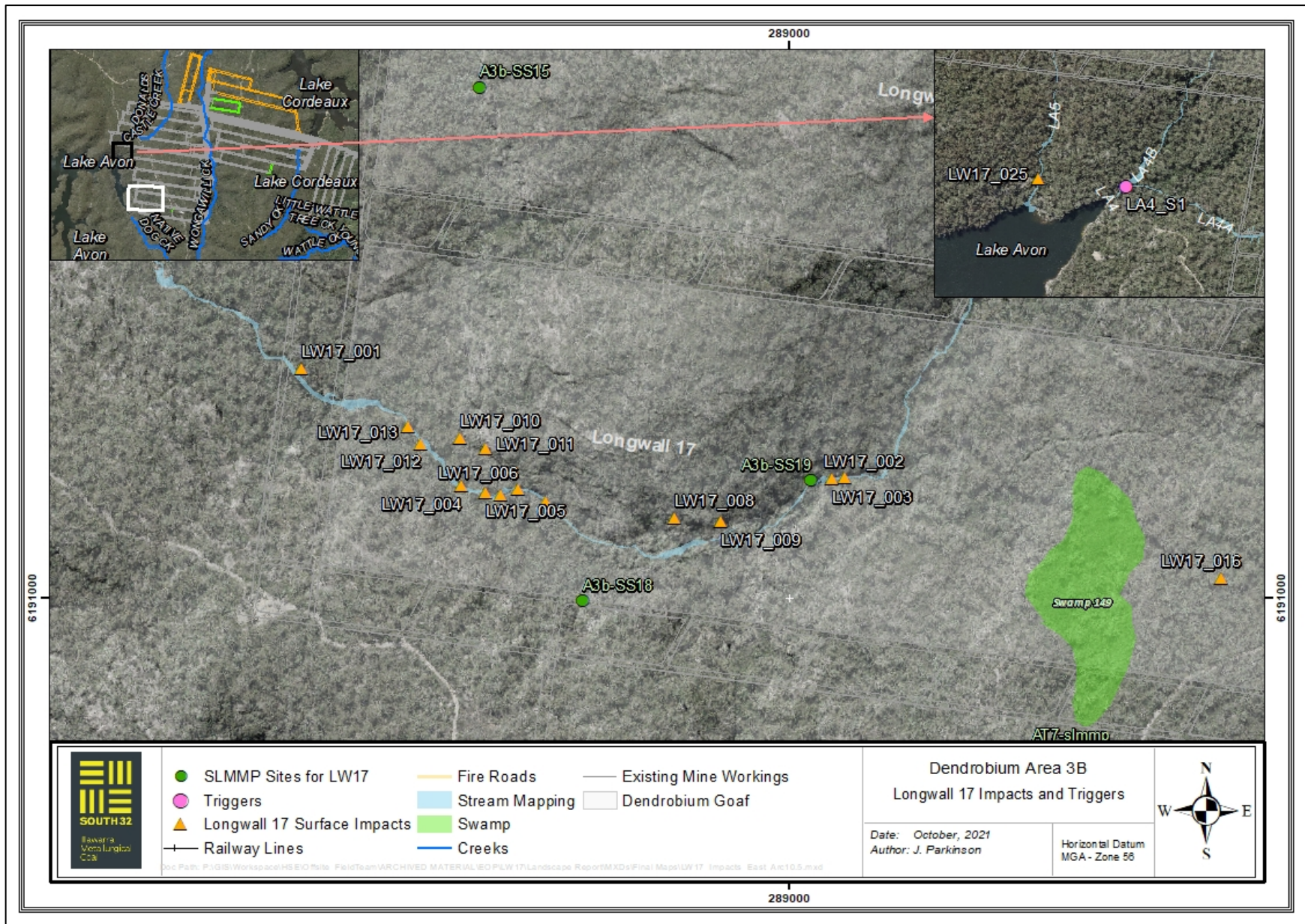


Figure 2: Map showing surface impacts and triggers recorded over western end of Longwall 17

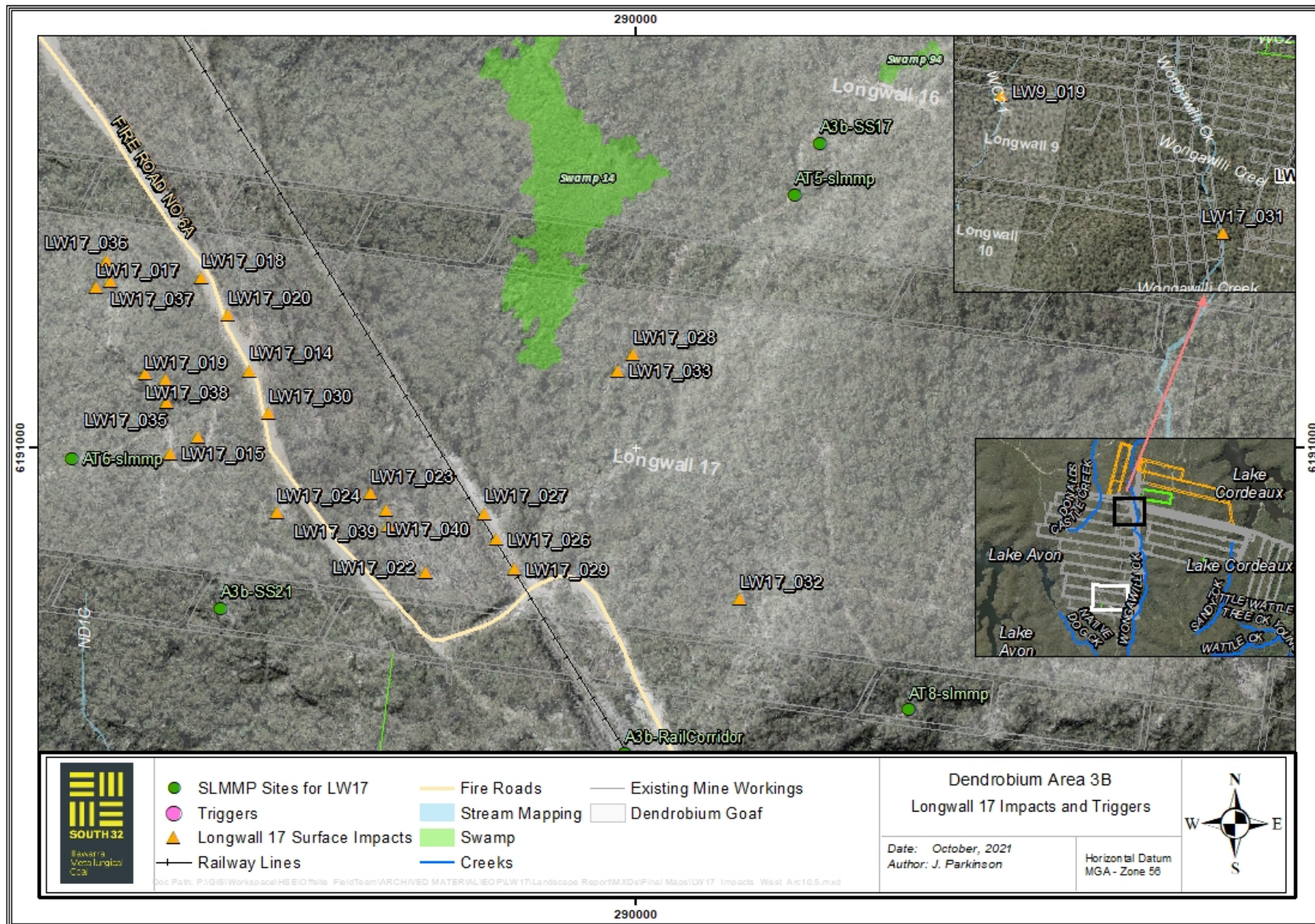


Figure 3: Map showing surface impacts and triggers recorded over eastern end of Longwall 17



## 5 IMPACTS TO FIRST AND SECOND ORDER STREAMS

### 5.1 LA2

#### DA3B\_LW17\_001 (E288554, N6191211)

DA3B\_LW17\_001 is located on LA2, a tributary to Lake Avon. The impacted feature is LA2\_Channel 6B which is situated approximately 40m west of the commencing end of Longwall 17 (Figure 2). The impact is comprised of two rock fractures, uplift and associated rock fragmentation (Photo 5 to Photo 8). The rock fracturing has a maximum measurable length of 1.7m, a width of 0.01m and a maximum measurable depth of 0.47m. The uplift has a width of 0.045m. While not evident during the latest inspection, flow diversion would occur if surface flow was present. On the 10<sup>th</sup> of September, the impact had increased by 0.007m in length, width had increased from 0.01m to 0.04m with measurable depth staying the same.

DA3B\_LW17\_001 is a Level 2 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that results in observable loss of surface water or erosion.



Photo 5: DA3B\_LW17\_001, looking at a section of rock fracturing. Taken on 10/09/2021.



Photo 6: DA3B\_LW17\_001, looking at a section of rock fracturing, uplift and fragmentation. Taken on 5/02/2021.



Photo 7: DA3B\_LW17\_001, looking at the width of uplift. Taken on 5/02/2021.



Photo 8: DA3B\_LW17\_001, looking at a section of rock fragmentation. Taken on 10/09/2021.

### **DA3B\_LW17\_004 (E288700, N6191113)**

*DA3B\_LW17\_004* is located on LA2, a tributary to Lake Avon (Figure 2). The impacted feature, LA2\_Rockbar 10, was mined beneath by Longwall 17 on 5 January 2021. The impact is comprised of multiple rock fractures and uplift within an area of 4m by 1m (Photo 9 and Photo 10). The largest rock fracture has a maximum length of 0.326m, a maximum width of 0.06m and a maximum measurable depth of 0.074m. No flow was present during the inspection; however some flow diversion could be expected during surface flow; as the fracture runs across the main flow path of the tributary. On the 10<sup>th</sup> of September the impact length had increased to 1.2m, no other changes had been identified. *DA3B\_LW17\_004* is a Level 2 trigger as per the DA3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 9: DA3B\_LW17\_004, looking at a section of rock fracturing. Taken on 10/09/2021.



Photo 10: DA3B\_LW17\_004, looking at the maximum width of the rock fracturing. Taken on 10/03/2021.

### **DA3B\_LW17\_005 (E288723, N6191096)**

*DA3B\_LW17\_005* is located on LA2, a tributary to Lake Avon (Figure 2). The impacted feature, LA2\_Pool 12, was mined beneath by Longwall 17 on 9 January 2021. The impact is comprised of multiple fractures within an area of 2.5m by 3m (Photo 11 and Photo 12). The largest rock fracture has a maximum length of 0.888m, a maximum width of 0.005m and a maximum measurable depth of 0.037m. No flow was present during the inspection however some flow diversion could be expected during surface flow; as the fracture runs across the main flow path of the tributary. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

*DA3B\_LW17\_005* is a Level 2 trigger as per the DA3B Watercourse (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 11: DA3B\_LW17\_005, looking at a section of rock fracturing. Taken on 10/03/2021.



Photo 12: DA3B\_LW17\_005, looking at the maximum width of the rock fracturing. Taken on 10/03/2021.

### DA3B\_LW17\_006 (E288752, N6191099)

DA3B\_LW17\_006 is located on LA2, a tributary to Lake Avon (Figure 2). The impacted feature, LA2\_Pool 14, was mined beneath by Longwall 17 on 17 January 2021. The impact is comprised of rock fracturing, soil cracking and uplift within an area of 4m by 2m (Photo 13 to Photo 15). The rock fracturing has a maximum length of 1m, a maximum width of 0.045m and a maximum measurable horizontal depth of 0.43m. The soil cracking has a maximum length of 0.59m, a maximum width of 0.002m and a maximum measurable depth of 0.124m. No flow was present during the inspection however some flow diversion could be expected during surface flow; as the fracture runs across the main flow path of the tributary. The impact was inspected on 10<sup>th</sup> of September 2021, the width of the impact had increased to 0.06 with no soil cracking visible.

DA3B\_LW17\_006 is a Level 2 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 13: DA3B\_LW17\_006, looking at a section of rock fracturing and uplift. Taken on 10/03/2021.



Photo 14: DA3B\_LW17\_006, looking at the width of the rock fracturing. Taken on 10/09/2021.



Photo 15: DA3B\_LW17\_006, looking at a section of soil cracking. Taken on 10/03/2021.

### **DA3B\_LW17\_007 (E288700, N6191113)**

*DA3B\_LW17\_007* is located on LA2, a tributary to Lake Avon (Figure 2). The impacted feature, *LA2\_Rockbar 14*, was mined beneath by Longwall 17 on 20 January 2021. The impact is comprised of 10 rock fractures and uplift within an area of 4m by 1.5m (Photo 16 and Photo 17). The largest rock fracture has a maximum length of 0.94m, a maximum width of 0.035m and a maximum measurable depth of 0.15m. No flow was present during the inspection however some flow diversion could be expected during surface flow; as the fracture runs across the main flow path of the tributary. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification. *DA3B\_LW17\_007* is a Level 2 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 16: DA3B\_LW17\_007, looking at a section of rock fracturing. Taken on 10/03/2021.



Photo 17: DA3B\_LW17\_007, looking at the width of the rock fracturing. Taken on 10/03/2021.

### **DA3B\_LW17\_002 Update (E289050, N6191110)**

DA3B\_LW17\_002 is located on LA2, a tributary to Lake Avon and was originally reported on 16 February 2021. The site was mined beneath by Longwall 17 on 21 February 2021. During the latest inspection, further fracturing, uplift and changes to existing fracturing were observed (Photo 18 and Photo 19). The impact site was originally localised to LA2\_Rockbar 25 but now extends into the downstream feature LA2\_Pool 25. However it is now connected to impact DA3B\_LW17\_003 through fracturing. The rock fracturing now has a maximum length of 4.2m, width of 0.136m and a maximum measurable depth of 1.640m. The impact was inspected on 10<sup>th</sup> of September 2021, an increase in length from 4.2m to 4.8m was observed as well as width increasing to 0.170m.

DA3B\_LW17\_002 remains a Level 2 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.
- Crack or fracture between 100 and 300m width at its widest point.



Photo 18: DA3B\_LW17\_002, looking at a section of rock fracturing. Taken on 10/09/2021.



Photo 19: DA3B\_LW17\_002, looking at the width of rock fracturing. Taken on 10/09/2021.

### **DA3B\_LW17\_003 (Update) (E289038, N6191109)**

Rock fracturing and rockfall to the step below LA2\_Pool 24 was previously reported (Photo 20). The latest inspection of the site revealed additional rock fracturing and an increase in volume of rockfall. The estimated volume of rock and sediment fallen from the step is now approximately 6m<sup>3</sup> (Photo 21). The rockfall has also disturbed some vegetation growing on the step. The impact was inspected on 10<sup>th</sup> of September 2021, a change was observed but was unable to measure due to safety concerns. DA3B\_LW17\_003 remains a Level 2 trigger as per the DA3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.
- Crack or fracture between 100 and 300m width at its widest point.
- Crack or fracture that (could) result in observable loss of surface water or erosion.
- Rockfall from cliff site (step), where characteristics of the cliff (step) have changed, and there has been significant ground disturbance.



Photo 20: DA3B\_LW17\_003, rockfall to step as shown in previous update report. Taken on 10/03/2021.



Photo 21: DA3B\_LW17\_003, latest condition of step showing additional fallen material. Taken on 10/09/2021.

### **DA3B\_LW17\_012 (E288663, N6191142)**

Impact *DA3B\_LW17\_012* includes fracturing which has resulted in a displaced section of rockbar on tributary LA2 (Figure 2). The displaced rock slab is 5.7m long, 1.2m wide and 0.35m thick and has dropped approximately 0.05m (Photo 22 to Photo 24). The longest observable fracture is approximately 7m long and 0.02m wide. Smaller additional fractures and uplift are also evident at the site (Photo 25). The fracturing extends across the flow path with flow diversion possible during surface flow at the site. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

*DA3B\_LW17\_012* is a Level 2 trigger as per the DA3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 22: DA3B\_LW17\_012, looking across rockbar. Taken on 10/09/2021.



Photo 23: DA3B\_LW17\_012, looking at width of displaced slab. Taken on 13/04/2021.



Photo 24: DA3B\_LW17\_012, looking at level of displacement fracture to step. Taken on 13/04/2021.



Photo 25: DA3B\_LW17\_012, additional smaller fracture and uplift. Taken on 10/09/2021.

### DA3B\_LW17\_013 (E288651, N6191158)

Impact DA3B\_LW17\_013 includes two rock fractures running along a sandstone channel on tributary LA2 (Figure 2). The fracturing is up to 8.3m long, 0.035m wide and has a measurable depth of up to 0.61m (Photo 26 to Photo 28). The fractures run along the flow path and if surface flow was present, would likely result in diversion of surface flow. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

DA3B\_LW17\_013 is a Level 2 trigger as per the DA3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that (could) result in observable loss of surface water or erosion.



Photo 26: DA3B\_LW17\_013, fractures running along channel. Taken on 13/04/2021.



Photo 27: DA3B\_LW17\_013, looking at width of fracture. Taken on 13/04/2021.



Photo 28: DA3B\_LW17\_013, looking at fracture depth. Taken on 13/04/2021.



### **DA3B\_LW17\_034 (E 288736, N 6191097)**

DA3B\_LW17\_034 is located on LA2, a tributary to Lake Avon (Figure 2). The impacted feature, LA2\_Pool 13, was mined beneath by Longwall 17 on 13 January 2021. The impact is comprised of a rock fracture running across the width of the pool (Photo 29 and Photo 30). The largest rock fracture has a maximum length of 0.9m, a maximum width of 0.004m and a maximum measurable depth of 0.07m. While not evident during the latest inspection, flow diversion may occur if surface flow was present.

DA3B\_LW17\_034 is a Level 2 trigger as per the DA3B Watercourse TARP (Table 9), specifically:

- Crack or fracture that results in observable loss of surface water or erosion.



Photo 29: DA3B\_LW17\_034, showing the length of rock fracturing. Taken 10/9/2021.



Photo 30: DA3B\_LW17\_034, showing the width of rock fracturing. Taken 10/9/2021.

## **5.2 LA5**

### **LA5 Iron staining (DA3B\_LW17\_025)**

LA5 is a small tributary of Lake Avon, immediately to the west of LA4, that flows southward from DA3B mining operations (Figure 2) The upper reaches of the LA5 sub catchment was mined beneath by Longwall 12 in March 2016. No surface impacts have been observed in LA5 prior to this latest inspection. During the latest inspection on 1 July 2021, iron staining was observed at site LA5\_S1, extending in to Lake Avon (Photo 31 and Photo 32). This was not evident during a previous inspection in April (Photo 33 and Photo 34).

This observation is a Level 1 trigger as per the DA3B Watercourse Impact, Monitoring Management and Contingency Plan (Table 9), specifically:

- Observable increase in iron staining within the mining area.

The iron staining has been assigned an impact ID of DA3B\_LW17\_025. Further discussion around water quality at LA5 will be included in a specialist report.



Photo 31: LA5\_S1, looking upstream. Taken on 1/07/2021.



Photo 32: LA5\_S1, looking downstream. Taken on 1/07/2021.



Photo 33: LA5\_S1, looking upstream. Taken on 13/04/2021.



Photo 34: LA5\_S1, looking downstream. Taken on 13/04/2021.

### 5.3 Wongawilli Creek

#### Wongawilli Creek Iron Staining (*DA3B\_LW17\_031*)

*DA3B\_LW17\_031* consists of an increase in iron staining in Wongawilli Creek. Iron staining has previously been reported in WC17 and WC21, two tributaries in the Wongawilli Creek sub-catchment, following the extraction of Longwalls 7, 9 and 13 (Figure 3). Iron staining was also observed during baseline stream mapping of Wongawilli Creek in 2007, prior to mining in Dendrobium Area 3

The recent influx of iron is evident in most stream features extending from *WC\_Pool 50* down to *WC\_Rockbar 12*. The distance between these features is approximately 2.9km. The source of the iron staining was identified as originating from a spring located on the valley slope of Wongawilli Creek, approximately 35m to the east, upslope from *WC\_Pool 50* (Photo 35 and Photo 36). The hillslope spring is not located within any named tributary and is releasing flow into Wongawilli Creek. The hillslope spring was first identified in March 2018, however during this inspection it was not observed to be outflowing into Wongawilli Creek. Upstream, between the spring's inflow to the Creek and WC17 confluence, is mostly unaffected with only a small amount of isolated iron staining, likely related to outflow from WC17. No changes are evident on Wongawilli Creek upstream of WC17.

Downstream of *WC\_Rockbar 12*, the iron staining is not observable at all features and is restricted to shallow sections of pools and rockbars with the deeper pools remaining unaffected. Photo 37 shows time comparison photos of locations along Wongawilli Creek.

*DA3B\_LW17\_031* is a Level 3 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Observable increase in iron staining within the mining area continues more than 600m from the longwall.



Photo 35: Hillslope spring with iron staining, looking upslope from Wongawilli Creek. Taken: 28/07/2021.



Photo 36: Outflow from spring, looking downstream to Wongawilli Creek. Taken: 28/07/2021.



Photo 37: *WC\_Pool 69*, looking upstream (site upstream of *WC17* confluence). Taken: 13/03/2015.



Photo 38: *WC\_Pool 69*, looking upstream (site upstream of *WC17* Creek confluence). Taken: 23/07/2021.



Photo 39: WC\_Pool 50, looking downstream. Taken 30/07/2015.



Photo 40: WC\_Pool 50, looking downstream. Taken 22/07/2021.



Photo 41: WC\_Rockbar 27, looking upstream. Taken 2/12/2015.



Photo 42: WC\_Rockbar 27, looking upstream. Taken 2/08/2021.



Photo 43: WC\_Pool 32, looking cross stream. Taken 20/06/2020.



Photo 44: WC\_Pool 32, looking cross stream. Taken 2/08/2021.



Photo 45: WC\_Rockbar 14, looking cross stream. Taken 22/06/2020.



Photo 46: WC\_Rockbar 14, looking cross stream. Taken 2/08/2021.



Photo 47: WC\_Rockbar 7, looking upstream. Taken 19/02/2007.



Photo 48: WC\_Rockbar 7, looking upstream. Taken 2/08/2021.

#### 5.4 WC21

##### **DA3B\_LW9\_019 (Update) (E290239, N6193905)**

Iron staining and associated change in water appearance of *WC21\_Pool 10* was initially observed 24 December 2013 (Photo 49). Further updates on WC21 have been reported with the extent of the iron not reaching Wongawilli Creek. During a recent inspection of WC21, the extent of the iron was observed to have extended to Wongawilli Creek (Photo 50 to Photo 52).

*DA3B\_LW9\_019* is a Level 3 trigger as per the Dendrobium Area 3B Watercourse TARP (Table 9), specifically:

- Observable increase in iron staining within the mining area continues more than 600m from the longwall.



Photo 49: WC\_21 Pool 10, looking upstream.  
Taken 24/12/2013.



Photo 50: WC21\_Pool 10, looking upstream.  
Taken 3/08/2021.



Photo 51: WC\_21 Confluence, looking  
upstream. Taken 2/08/2021.



Photo 52: WC\_21 Confluence, looking  
downstream towards Wongawilli Creek.  
Taken 2/08/2021.

## 6 IMPACTS TO OTHER LANDSCAPE FEATURES

### DA3B\_LW17\_008 (E288895, N6191074)

DA3B\_LW17\_008 is located at a steep slope/step approximately 30m north of tributary LA2 (Figure 2). The site was mined beneath by Longwall 17 on 5 February 2021. The impact is comprised of a large rockfall with associated displacement and fragmentation (Photo 53 to Photo 54). The impact was observed from a distance due to safety concerns, therefore the following values are estimates. The rockfall was estimated to be 20m in length by 3.5m in width and depth. The rockfall resulted in the dislodgment of variable sized rock fragments and boulders which is dispersed over an approximate area of 25m by 25m (625m<sup>2</sup>). The largest observable rock debris fragment is estimated to be 5m in length and 3m in width. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

DA3B\_LW17\_008 is a Level 2 trigger as per the Dendrobium Area 3B Landscape TARP ( Table 10), specifically:

- Rockfall or overhang collapse at a cliff site (step), where characteristics of the cliff have changed, and there has been significant ground disturbance.
- 



Photo 53: DA3B\_LW17\_008, looking at a section of rockfall. Taken on 10/03/2021.



Photo 54: DA3B\_LW17\_008, looking at a section of rockfall. Taken on 10/03/2021.



Photo 55: DA3B\_LW17\_008, looking at a section of rockfall. Taken on 10/03/2021.



Photo 56: DA3B\_LW17\_008, looking at a section of rockfall. Taken on 10/03/2021.

### **DA3B\_LW17\_009 (E288938, N6191070)**

DA3B\_LW17\_009 is located at a steep slope/step approximately 15m north of tributary LA2 (Figure 2). The site was mined beneath by Longwall 17 on 10 February 2021. The impact is comprised of a rockfall with associated displacement and fragmentation (Photo 57 to Photo 60). The impact was observed from a distance due to safety concerns, therefore the following values are estimates. The rockfall has an estimated length of 10m, width of 4m and a depth of 2m. The rockfall resulted in the dislodgment of variable sized rock fragments and boulders, with the largest estimated to be 4m in length by 3m in width. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

DA3B\_LW17\_009 is a Level 2 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Rockfall or overhang collapse at a cliff site (step), where characteristics of the cliff have changed, and there has been significant ground disturbance.



Photo 57: DA3B\_LW17\_009, looking at a section of rockfall. Taken on 10/03/2021.



Photo 58: DA3B\_LW17\_009, looking at a section of rockfall. Taken on 10/03/2021.



Photo 59: DA3B\_LW17\_009, looking at a section of rockfall. Taken on 10/03/2021.



Photo 60: DA3B\_LW17\_009, looking at a section of rockfall. Taken on 10/03/2021.



### **DA3B\_LW17\_010 (E 288700, N6191147)**

Impact *DA3B\_LW17\_010* consists of horizontal rock fracturing to a step on the northern slope of LA2 valley (Figure 2). The fracture is 2.5m long and 0.015m wide (Photo 61 and Photo 62). The fracturing appears stable. The impact was inspected on 10<sup>th</sup> of September 2021, the width of the impact had increased to 2.9m.

*DA3B\_LW17\_010* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length
- Crack or fracture up to 100mm wide



Photo 61: DA3B\_LW17\_010, fracturing along step. Taken on 13/04/2021.



Photo 62: DA3B\_LW17\_010, fracturing along step. Taken on 10/09/2021.

### **DA3B\_LW17\_011 (E288721, N6191139)**

Impact *DA3B\_LW17\_011* consists of two rock fractures to a step on the northern slope of LA2 valley (Figure 2; Photo 63 to Photo 66). The longest fracture is approximately 1.5m long and up to 0.15m wide. Measurements were estimated from a distance for safety reasons. The impact was inspected on 10<sup>th</sup> of September 2021 and remains unchanged from original identification.

*DA3B\_LW17\_011* is a Level 2 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture between 100mm and 300mm in width.



Photo 63: DA3B\_LW17\_011, fracture to step.  
Taken on 13/04/2021.



Photo 64: DA3B\_LW17\_011, zoomed in photo  
of fracture to step. Taken on 13/04/2021.



Photo 65: DA3B\_LW17\_011, fracture to step.  
Taken on 13/04/2021.



Photo 66: DA3B\_LW17\_011, zoomed in photo  
of fracture to step. Taken on 13/04/2021.

### **DA3B\_LW17\_016 (E 289395, N 6191018)**

Impact *DA3B\_LW17\_016* consists of rock fracturing to a rock outcrop, west of Fire Road 6A (Figure 2). The rock fracture has a maximum length of 8.3m, a maximum width of 0.025m and a maximum measurable depth of 0.26m (Photo 67 and Photo 68). The fracturing appears stable. The impact was inspected on 15<sup>th</sup> of September 2021 and length and width remained the same, but depth had increased to 0.150m.

*DA3B\_LW17\_016* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length
- Crack or fracture up to 100mm width



Photo 67: DA3B\_LW17\_016 – section of rock fracturing. Taken on 25/05/2021.



Photo 68: DA3B\_LW17\_016 – width of rock fracturing. Taken on 25/05/2021.

### **DA3B\_LW17\_017 (E 289523, N 6191142)**

Impact *DA3B\_LW17\_017* consists of rock displacement from soil, west of Fire Road 6A (Figure 2). The rock displacement has a maximum length of 4.6m, a maximum width of 0.045m and a maximum measurable depth of 0.16m (Photo 69 and Photo 70). The displacement appears stable. The impact was inspected on 15<sup>th</sup> of September 2021 and remains unchanged from original identification.

*DA3B\_LW17\_017* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length
- Crack or fracture up to 100mm width



Photo 69: DA3B\_LW17\_017 – section of rock displacement. Taken on 25/05/2021.



Photo 70: DA3B\_LW17\_017 – width of rock displacement. Taken on 25/05/2021.

### **DA3B\_LW17\_019 (E 289584, N 6191060)**

Impact *DA3B\_LW17\_019* consists of a 6m discontinuous soil crack and rock fracture in relatively flat bushland near a steep slope, west of Fire Road 6A (Figure 3). The soil cracking has a maximum continuous length of 2.4m, a maximum width of 0.6m and a maximum measurable depth of 0.7m

(Photo 71 to Photo 73). A tree has slumped into the soil cracking, however now appears stable. The impact was inspected on 15<sup>th</sup> of September 2021, length of the crack had increased to 3.3m and depth had increased to 0.9m, the width of the cracked remained the same.

DA3B\_LW17\_019 is a Level 3 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture over 300mm width



Photo 71: DA3B\_LW17\_019, looking at a section of soil cracking. Taken on 8/06/2021.



Photo 72: DA3B\_LW17\_019, looking at the maximum width of the soil cracking. Taken on 8/06/2021.



Photo 73: DA3B\_LW17\_019, looking at a section of soil cracking. Taken on 8/06/2021.

### **DA3B\_LW17\_021 (E 289613, N 6191009)**

Impact DA3B\_LW17\_021 consists of rock fracturing to a small rock ledge, west of Fire Road 6A (Figure 3). The largest rock fracture has a maximum length of 2.1m, a maximum width of 0.076m and the maximum measurable depth is greater than 1m (Photo 74 and Photo 75). The fracturing appears

stable. The impact was inspected on 15<sup>th</sup> of September 2021, the width of the impact has increased to 0.1m length and width remained the same.

*DA3B\_LW17\_021* is a Level 1 trigger as per the DA3B Landscape TARP (Table 1), specifically:

- Crack or fracture up to 10m in length
- Crack or fracture up to 100mm width



Photo 74: DA3B\_LW17\_021, looking at a section of rock fracturing. Taken on 8/06/2021



Photo 75: DA3B\_LW17\_021, showing width of rock fracturing. Taken on 8/06/2021.

#### **DA3B\_LW17\_022 (E 289813, N 6190889)**

Impact *DA3B\_LW17\_022* consists of a single rock fracture in bushland to the east of Fire Road 6A (Figure 3). The fracture has a maximum length of 1.1m, a maximum width of 0.013m and a maximum measurable depth of 0.096m (Photo 76 and Photo 77). The fracture appears stable. The impact was inspected on 21<sup>th</sup> of October 2021 and remains unchanged from original identification.

*DA3B\_LW17\_022* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length



Photo 76: DA3B\_LW17\_022, looking at length of fracture. Taken on 22/06/2021.



Photo 77: DA3B\_LW17\_022, looking at width of fracture. Taken on 22/06/2021.

**DA3B\_LW17\_023 (E 289765, N 6190961)**

Impact *DA3B\_LW17\_023* consists of multiple rock fractures to rock outcrops in bushland to the east of Fire Road 6A (Figure 3). The longest fracture was measured at over 10m, with a maximum width of 0.09m and a maximum measurable depth of 1.53m (Photo 78 and Photo 79). Additional fractures were also identified in the immediate area (Photo 80 and Photo 81). Some leaf litter covers part of the fractures. The fracturing appears stable. The impact was inspected on 21<sup>th</sup> of October 2021 and remains unchanged from original identification.

*DA3B\_LW17\_023* is a Level 2 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture between 10 and 30m in length



Photo 78: DA3B\_LW17\_023- looking at length of fracture. Taken on 22/06/2021



Photo 79: DA3B\_LW17\_023- showing width of fracture. Taken on 22/06/2021.



Photo 80: DA3B\_LW17\_023- looking fracture. Taken on 22/06/2021



Photo 81: DA3B\_LW17\_023- looking at smaller fracture. Taken on 22/06/2021

### **DA3B\_LW17\_024 (E 289682, N 6190942)**

Impact *DA3B\_LW17\_024* consists of rock fracturing to a rock outcrop adjacent to Fire Road 6A (Figure 3). The fracture has a discontinuous length of approximately 6.23m, with a maximum width of 0.045m and maximum measurable depth of 0.77m (Photo 82 and Photo 83). The fracturing appears stable. The impact was inspected on 21<sup>th</sup> of September 2021 and remains unchanged from original identification.

*DA3B\_LW17\_024* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length



Photo 82: *DA3B\_LW17\_024*, looking at a section of rock fracturing. Taken on 24/06/2021



Photo 83: *DA3B\_LW17\_024*, showing width of rock fracturing. Taken on 24/06/2021.

### **DA3B\_LW17\_032 (E 290091, N 6190867)**

Impact *DA3B\_LW17\_032* consists of rock displacement from soil at the base of a small step/steep slope east of Fire Road 6A (Figure 3). The displacement has a maximum length of 0.95m, a maximum width of 0.035m and maximum measurable depth of 0.5m (Photo 84 and Photo 85). The displacement appears stable. The impact was inspected on 21<sup>th</sup> of October 2021 and remains unchanged from original identification.

*DA3B\_LW17\_032* is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.



Photo 84: DA3B\_LW17\_032, showing the length of displacement. Taken on 17/08/2021.



Photo 85: DA3B\_LW17\_032, showing the width of the displacement. Taken on 17/08/2021.

### **DA3B\_LW17\_035 (E 289585, N 6191040)**

DA3B\_LW17\_035 is located at a steep slope/step approximately 85m to the west of Fire Road 6 (Figure 3). The site was mined beneath by Longwall 17 on 3 May 2021. The impact is comprised of rock fracturing and a rockfall, with associated displacement (Photo 86 to Photo 88). The impact was observed from a distance due to safety concerns, therefore the following values are estimates. The longest rock fracture was estimated to have a maximum length of 5m and a maximum width of 0.025m. The rockfall was estimated to have a volume of approximately 1.5m x 0.8m x 0.2m. The rockfall has resulted in the dislodgement of a singular boulder effecting a 2m<sup>2</sup> area. The size of the boulder was estimated to be approximately 1.5m by 0.8m by 0.2m (0.24m<sup>3</sup>). The rock fracturing and collapse appears to be stable.

DA3B\_LW17\_035 is a Level 1 trigger as per the Dendrobium Area 3B Landscape TARP (Table 10), specifically;

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.
- Rockfall from a cliff which is left mostly intact (<10% length), resulting in insignificant ground disturbance.



Photo 86: DA3B\_LW17\_035, showing the length of rock fracturing. Taken 15/9/2021.



Photo 87: DA3B\_LW17\_035, showing the rockfall associated with rock fracturing. Taken 15/9/2021.





Photo 88: DA3B\_LW17\_035, showing the rockfall associated with rock fracturing. Taken 15/9/2021.

### **DA3B\_LW17\_036 (E 289533, N 6191165)**

DA3B\_LW17\_036 is located at a steep slope/rock outcrop approximately 80m to the west of Fire Road 6 (Figure 3). The site was mined beneath by Longwall 17 on 23 April 2021. The impact consists of 10m discontinuous rock fracturing and soil cracking. The largest continuous rock fracture has a maximum length of 2m, a maximum width of 0.03m and a maximum measurable depth of 1.45m (Photo 89 to Photo 91). The rock fracturing appears to be stable.

DA3B\_LW17\_036 is a level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.



Photo 89: DA3B\_LW17\_036, looking at a section of rock fracturing, showing length. Taken 15/9/2021.



Photo 90: DA3B\_LW17\_036, looking at the width of the rock fracture. Taken 15/9/2021.



Photo 91: DA3B\_LW17\_036, Looking at a section of rock fracturing. Taken 15/9/2021

#### **DA3B\_LW17\_037 (E 289536, N 6191147)**

*DA3B\_LW17\_037* is located at a steep slope/rock outcrop approximately 90m to the west of Fire Road 6 (Figure 3). The site was mined beneath by Longwall 17 on 24 April 2021. The impact consists an area of rock fracturing to a rock outcrop (Photo 92 to Photo 95). The largest continuous crack is 2.8m in length, 0.26m in width and a maximum measurable depth of 1.2m. The rock fracturing appears stable.

*DA3B\_LW17\_037* is a level 2 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture between 100 to 300mm width.



Photo 92: DA3B\_LW17\_037, looking at the length of rock fracturing. Taken 15/9/2021.



Photo 93: DA3B\_LW17\_037, looking at a section of rock fracturing, showing width. Taken 15/9/2021.



Photo 94: DA3B\_LW17\_037, looking at a section of rock fracturing. Taken 15/9/2021.



Photo 95: DA3B\_LW17\_037, looking at the depth of rock fracturing. Taken 15/9/2021.

**DA3B\_LW17\_038 (E 289567, N 6191065)**

DA3B\_LW17\_038 is located at a steep slope/rock outcrop approximately 95m to the west of Fire Road 6 (Figure 3). The site was mined beneath by Longwall 17 on 29 April 2021. The impact consists of 11m in discontinuous soil cracking at the base of a rock outcrop/ steep slope. The rock displacement has a maximum length of 2.4m, a maximum width of 0.045m and a maximum measurable depth of 4.9m (Photo 96 to Photo 98). The rock displacement and soil cracking appear to be stable.

DA3B\_LW17\_038 is a Level 1 trigger as per the DA3B Landscape TARP (Table 10), specifically:

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.



Photo 96: DA3B\_LW17\_038, looking at a section of rock displacement/ soil cracking. Taken 15/9/2021.



Photo 97: DA3B\_LW17\_038, looking at a section of rock displacement, showing the width. Taken 15/9/2021.



Photo 98: DA3B\_LW17\_038, looking at the depth of rock displacement. Taken 15/9/2021

#### **DA3B\_LW17\_039 (E 289778, N 6190934)**

DA3B\_LW17\_039 is located on outcrop/step to the east of Fire Road 6A (Figure 3). Soil has moved away from the rock, creating a void. The void has a length of 1.350m, a width of up to 0.045m and a maximum measurable depth of 0.18m (Photo 99 to Photo 101).

DA3B\_LW17\_039 is a Level 1 trigger as per the Dendrobium Area 3B Landscape TARP (Table 10), specifically;

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.



Photo 99: DA3B\_LW17\_039, showing the length of void. Taken 21/10/2021.



Photo 100: DA3B\_LW17\_039 showing the width of the void. Taken 21/10/2021.

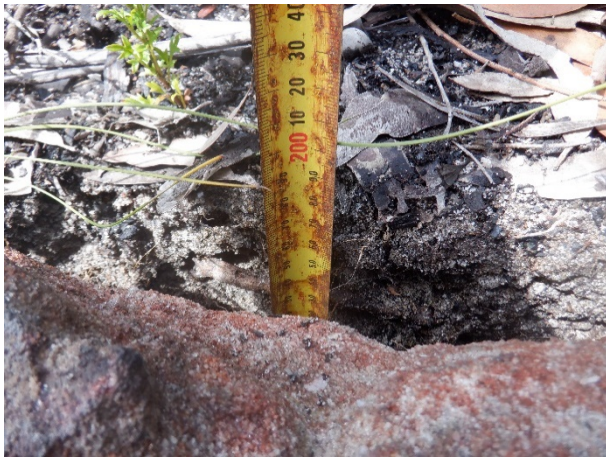


Photo 101: DA3B\_LW17\_039, showing the depth of rock movement. Taken 10/9/2021.

#### **DA3B\_LW17\_040 (E 289779, N 6190944)**

*DA3B\_LW17\_040* is located at a rock outcrop to the east of Fire Road 6A (Figure 3). The impact is comprised of rock fracturing. The fracture has length of 2.4m, a width of 0.05m and a maximum measurable depth of 1.75m (Photo 102 to Photo 104).

*DA3B\_LW17\_040* is a Level 1 trigger as per the Dendrobium Area 3B Landscape TARP (Table 10), specifically;

- Crack or fracture up to 10m in length;
- Crack or fracture up to 100mm width.



Photo 102: DA3B\_LW17\_040, showing the length of rock fracturing. Taken 21/10/2021.



Photo 103: DA3B\_LW17\_040, showing width of the rock fracturing. Taken 21/10/2021



Photo 104: DA3B\_LW17\_040, showing the depth of the rock fracturing. Taken 21/10/2021.

## 7 TARP TRIGGERS

### 7.1 Water Quality

#### LA4\_S1

LA4 is a small tributary of Lake Avon that flows southward from DA3B mining operations (Figure 2). The LA4 sub catchment was mined beneath by Longwall 12 in April 2016 and Longwall 13 in March 2017. Rock fracturing and subsequent flow diversion was recorded in the tributary following extraction of Longwall 12 and 13. Water quality parameters are recorded at LA4\_S1, with results on 1 July 2021 including a TARP level trigger for electrical conductivity (EC), as shown in Table 9. This is in addition to previously reported TARP exceedances for EC at the site.

Table 4: Electrical conductivity results and associated TARP level for LA4\_S1, on Lake Avon tributary LA4.

Site	Water Quality Parameter	Result on 18/02/2021	Result on 13/04/2021	Result on 1/07/2021	TARP Level
LA4_S1	Electrical Conductivity ( $\mu\text{S/cm}$ )	195	134	152	Above 129.8

A water quality trigger was also identified on 7 June 2021, for pH. This is in addition to previously reported pH triggers at LA4\_S1 (Table 5).

Table 5: pH results and associated TARP level for LA4\_S1, on Lake Avon tributary LA4.

Site	Water Quality Parameter	Result on 18/02/2021	Result on 13/04/2021	Result on 7/06/2021	TARP Level
LA4_S1	pH (pH Units)	4.13	4.19	4.45	Below 4.9

These observations contribute to a Level 3 trigger for EC and pH, as per the DA3B Watercourse Impact Monitoring, Management and Contingency Plan (Table 9), specifically:

- Three exceedances of the  $\pm 3$  standard deviation level from the baseline mean within six months.
  - EC: above 129.8  $\mu\text{S/cm}$
  - pH: below 4.9 pH units



Photo 105: LA4\_S1, looking upstream. Taken on 1/07/2021.



Photo 106: LA4\_S1, looking downstream. Taken on 1/07/2021

## **8 IMPACTS TO BUILT FEATURES**

A total of 10 surface impacts associated with built features were identified during the extraction of Longwall 17 (Table 3). These features include Fire Road 6A (FR6A), railway corridor ballast and some smaller unnamed access tracks.

### **8.1 Level 1 surface cracking**

A total of eight impacts (Table 3) to built features were reported as Level 1 in accordance with the DA3B SMP (Table 10), specifically:



Level 1: Crack at the surface, which should not result in any significant erosion or further ground movement.

Crack in a fire trail, which should not result in erosion or impede access.

Crack or fracture up to 100mm width.

Crack or fracture up to 10m length.

Erosion in a localised area, which would be expected to naturally stabilise without CMA and within the period of monitoring.



Photo 107: DA3B\_LW17\_015- soil crack on access track. Taken on 18/05/2021.



Photo 108: DA3B\_LW17\_015- showing width of soil crack on access track. Taken on 18/05/2021.



Photo 109: DA3B\_LW17\_018 – section of soil cracking. Taken on 25/05/2021.



Photo 110: DA3B\_LW17\_018 – soil crack naturally remediated. Taken 16/09/2021



Photo 111: DA3B\_LW17\_020- soil crack on Fire Road 6A. Taken on 8/06/2021



Photo 112: DA3B\_LW17\_020- Soil crack on Fire Road 6A naturally remediated. Taken on 16/09/2021.



Photo 113: DA3B\_LW17\_26, cracking extending across railway corridor. Taken on 7/07/2021.



Photo 114: DA3B\_LW17\_26, Remediated crack on railway corridor. Taken on 22/09/2021.



Photo 115: DA3B\_LW17\_028- soil cracking on access track. Taken on 26/07/2021.



Photo 116: DA3B\_LW17\_028- soil cracking on access track. Taken on 26/07/2021.



Photo 117: DA3B\_LW17\_029- soil cracking across rail corridor ballast. Taken on 26/07/2021.



Photo 118: DA3B\_LW17\_029- Remediated soil cracking across rail corridor ballast. Taken on 22/09/2021.



Photo 119: DA3B\_LW17\_030- soil cracking on Fire Road 6A. Taken on 26/07/2021.



Photo 120: DA3B\_LW17\_030- soil cracking on Fire Road 6A has been remediated, soil cracking to the side of the fire road remains. Taken on 21/09/2021.



Photo 121: DA3B\_LW17\_033, overview of the soil cracking. Taken on 23/08/2021.

Photo 122: DA3B\_LW17\_033, showing the width of soil cracking. Taken on 23/08/2021.

## 8.2 Level 2 surface cracking

Two impacts (Table 3) to built features were reported as Level 2 in accordance with the DA3B SMP (Table 10); specifically:

*Level 2: Crack or fracture between 100mm and 300mm width.*

*Crack in the fire trail, which could result in significant erosion or impede vehicle access.*

*Crack or fracture between 10m and 50m length.*



Photo 123: DA3B\_LW17\_014- Impact has been partially remediated. Some smaller cracks remain. Taken on 16/09/2021.



Photo 124: DA3B\_LW17\_014- soil cracking extending across Fire Road 6A and adjacent area. Taken on 18/05/2021.



Photo 125: DA3B\_LW17\_27- showing the width of cracking. Taken on 15/07/2021.

Photo 126: DA3B\_LW17\_27- Soil crack has been remediated over the railway ballast, cracking remains on either side. Taken on 22/09/2021.

### 8.3 Remediation

Following approval from WaterNSW, remediation was undertaken to surface cracking across the railway ballast off FR6A near Swamp 14. Minor soil cracks in other areas have, or are expected to continue to, infill through natural processes.

## 9 CURRENT AND FUTURE MONITORING

Monitoring undertaken during Longwall 17 and recommendations for future monitoring in Dendrobium Area 3B, particularly concerning Longwall 18, are outlined in (Table 6). These recommendations are based on monitoring commitments in the Dendrobium Area 3B SMP, WIMMCP and SIMMCP and the proximity of sites to future longwalls.

The monthly post mining period of 2 years has lapsed for the below features:

- Swamps 10 and 11- These will be monitored at a reduced frequency.

Table 6: Monitoring sites associated with Longwall 17 and monitoring proposed for Longwall 18

ASPECT	MONITORING SITES ASSOCIATED WITH LONGWALL 17	MONITORING REQUENCY	RECOMMENDED FUTURE MONITORING FOR LONGWALL 18
<b>Watercourses</b>	<b>Observational, Photo Point and Water Monitoring</b>		
	<ul style="list-style-type: none"> <li>• Donalds Castle Creek</li> <li>• Lake Avon</li> <li>• LA2</li> <li>• LA3</li> <li>• LA4A</li> <li>• Swamp 23</li> <li>• Swamps 10, 11, 13 and 14</li> <li>• WC12</li> <li>• WC15 and WC21</li> <li>• Wongawilli Creek</li> <li>• WC6, WC7, WC8, WC9</li> <li>• Swamp 35a/b</li> <li>• Native Dog Creek</li> <li>• ND1, ND1C</li> <li>• Waterfall 54</li> </ul>	<p>Monthly 2 years pre and post mining, weekly when longwall is within 400m of monitoring site</p> <p>SLMMP Sites: pre and post mining, monthly when longwall is within 400m of monitoring site</p>	<ul style="list-style-type: none"> <li>• Donalds Castle Creek</li> <li>• Lake Avon</li> <li>• LA2</li> <li>• LA3</li> <li>• Swamp 23</li> <li>• Swamps 13 and 14</li> <li>• WC12</li> <li>• WC15 and WC21</li> <li>• Wongawilli Creek</li> <li>• WC6, WC7, WC8, WC9</li> <li>• Swamp 35a/b</li> <li>• Swamps 149, 150, 151</li> <li>• Native Dog Creek</li> <li>• ND1, ND1C</li> </ul>
	<b>Water Quality</b>		
	<p><b>Wongawilli Creek</b></p> <ul style="list-style-type: none"> <li>• WWU1 (Wongawilli Creek headwaters)</li> <li>• WWU4 (Wongawilli Creek upstream)</li> <li>• WC_Pool 104 (Wongawilli Creek adjacent to LW17)</li> <li>• WC_Pool 87 (Wongawilli Creek adjacent to LW15)</li> <li>• WC_Pool 69 (Wongawilli Creek adjacent to LW12)</li> <li>• WWM2 (Wongawilli Creek adjacent to LW11)</li> </ul>	<p>Monthly monitoring during and post mining for two years until required</p>	<p><b>Wongawilli Creek</b></p> <ul style="list-style-type: none"> <li>• WWU1 (Wongawilli Creek headwaters)</li> <li>• WWU4 (Wongawilli Creek upstream)</li> <li>• WC_Pool 104 (Wongawilli Creek adjacent to LW17)</li> <li>• WC_Pool 87 (Wongawilli Creek adjacent to LW15)</li> <li>• WC_Pool 69 (Wongawilli Creek adjacent to LW12)</li> <li>• WWM2 (Wongawilli Creek adjacent to LW11)</li> </ul>

<ul style="list-style-type: none"> <li>• WC_Pool 49 (Wongawilli Creek downstream of LW9)</li> <li>• WC_FR6 (Wongawilli Creek downstream)</li> <li>• WC21_Pool 5 (Wongawilli Creek tributary downstream of mining)</li> <li>• WC21_Pool 30 (Wongawilli Creek tributaries over mining)</li> <li>• WC21_Pool 53 (Wongawilli Creek tributary over mining)</li> </ul> <ul style="list-style-type: none"> <li>• WC12_Pool 1 (Wongawilli Creek tributary downstream of mining)</li> <li>• WC15_Pool 9 (Wongawilli Creek tributary downstream of mining)</li> </ul> <p><b>Lake Avon and Tributaries</b></p> <ul style="list-style-type: none"> <li>• LA_1, LA1, LA2_Pool 5, LA3_Pool 4</li> </ul> <p><b>Donalds Castle Creek</b></p> <ul style="list-style-type: none"> <li>• DC_FR6 (Donalds Castle Creek lower)</li> <li>• DC_Pool 22 (Donalds Castle Creek downstream of mining)</li> <li>• DCL3 (Donalds Castle Creek further downstream site)</li> </ul> <p><b>Native Dog Creek</b></p> <ul style="list-style-type: none"> <li>• NDC_Pool 1</li> <li>• ND1_Pool 2</li> <li>• ND2_Pool 3</li> </ul> <p><b>Reference Site</b></p> <ul style="list-style-type: none"> <li>• LC5_S1</li> <li>• NDC1</li> <li>• CR36_S1</li> </ul>		<ul style="list-style-type: none"> <li>• WC_Pool 49 (Wongawilli Creek downstream of LW9)</li> <li>• WC_FR6 (Wongawilli Creek downstream)</li> <li>• WC21_Pool 5 (Wongawilli Creek tributary downstream of mining)</li> <li>• WC21_Pool 30 (Wongawilli Creek tributaries over mining)</li> <li>• WC21_Pool 53 (Wongawilli Creek tributary over mining)</li> <li>• WC12_Pool 1 (Wongawilli Creek tributary downstream of mining)</li> <li>• WC15_Pool 9 (Wongawilli Creek tributary downstream of mining)</li> </ul> <p><b>Lake Avon and Tributaries</b></p> <ul style="list-style-type: none"> <li>• LA_1, LA1, LA2_Pool 5, LA3_Pool 4</li> </ul> <p><b>Donalds Castle Creek</b></p> <ul style="list-style-type: none"> <li>• DC_FR6 (Donalds Castle Creek lower)</li> <li>• DC_Pool 22 (Donalds Castle Creek downstream of mining)</li> <li>• DCL3 (Donalds Castle Creek further downstream site)</li> </ul> <p><b>Native Dog Creek</b></p> <ul style="list-style-type: none"> <li>• NDC_Pool 1</li> <li>• ND1_Pool 2</li> <li>• ND2_Pool 3</li> </ul> <p><b>Reference Site</b></p> <ul style="list-style-type: none"> <li>• LC5_S1</li> <li>• NDC1</li> <li>• CR36_S1</li> </ul>	
<b>Swamps</b>	<b>Observational, Photo Point and Water Monitoring</b>		
	<ul style="list-style-type: none"> <li>• Swamps 10, 11, 13, 14 and 23, 35a/b</li> </ul>	Pre and post mining for two years, monthly when longwall is within 400m of monitoring site	<ul style="list-style-type: none"> <li>• Swamps 13, 14 and 23, 35a/b, 149, 150, 151</li> </ul>
	<b>Shallow Groundwater Level</b>		
	<ul style="list-style-type: none"> <li>• Swamp 05: 05_01, 05_04,</li> <li>• Swamp 10: 10_01</li> <li>• Swamp 11: S11-H1, S11-H2, S11-H3</li> <li>• Swamp 13: 13_01</li> <li>• Swamp 14: 14_01, 14_02</li> <li>• Swamp 23: 23_01, 23_02</li> <li>• Swamp 35a: 35a_01</li> <li>• Swamp 35b: 35b_01</li> </ul> <p><b>Reference Sites</b></p> <ul style="list-style-type: none"> <li>• Swamp 2: 02_S01</li> <li>• Swamp 7: 07_S05, 07_S06</li> <li>• Swamp 15A: S15a_S01, S15a_Piezo, S15a_S04, S15a_S06</li> <li>• Swamp 22: 22_01, 22_02</li> <li>• Swamp 25: S25_S01</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 removed 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, during and post mining (4 hour interval or similar)</li> <li>• Monitoring post mining for five years to be reviewed annually</li> </ul>	<ul style="list-style-type: none"> <li>• Swamp 13: 13_01</li> <li>• Swamp 14: 14_01, 14_02</li> <li>• Swamp 23: 23_01, 23_02</li> <li>• Swamp 35a: 35a_01</li> <li>• Swamp 35b: 35b_01</li> <li>• Swamp 149: 149_01</li> <li>• Swamp 150: 150_01</li> <li>• Swamp 151: 151_01</li> </ul> <p><b>Reference Sites</b></p> <ul style="list-style-type: none"> <li>• Swamp 2: 02_S01</li> <li>• Swamp 7: 07_S05, 07_S06</li> <li>• Swamp 15A: S15a_S01, S15a_Piezo, S15a_S04, S15a_S06</li> <li>• Swamp 22: 22_01, 22_02</li> <li>• Swamp 25: S25_S01</li> </ul>

	<ul style="list-style-type: none"> <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_S01, S88_S02</li> </ul>		<ul style="list-style-type: none"> <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_S01, S88_S02</li> </ul>
<b>Soil Moisture</b>			
	<ul style="list-style-type: none"> <li>• Swamp 11: S11_S01, S11_S02, S11_S05</li> <li>• Swamp 13: S13_S01, S13_S02, S13_S03</li> <li>• Swamp 14: 14_01, 14_02</li> <li>• Swamp 23: 23_02</li> <li>• Swamp 35a: 35a_01</li> <li>• Swamp 35b: 35b_01</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>• Swamp 2: S02_S01</li> <li>• Swamp 7: S07_S05, S07_S06</li> <li>• Swamp 15A: S15a_S01, S15a_Piezo, S15a_S04, S15a_S06</li> <li>• Swamp 22: 22_01, 22_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_S01, S88_S02</li> </ul>	<ul style="list-style-type: none"> <li>• 6 monthly baseline and reference site monitoring</li> <li>• Weekly monitoring when longwall is within 400m of swamp</li> <li>• 6 monthly monitoring for 2 years post mining</li> </ul>	<ul style="list-style-type: none"> <li>• Swamp 13: S13_S01, S13_S02, S13_S03</li> <li>• Swamp 14: 14_01, 14_02</li> <li>• Swamp 23: 23_02</li> <li>• Swamp 35a: 35a_01</li> <li>• Swamp 35b: 35b_01</li> <li>• Swamp 149: 149_01</li> <li>• Swamp 150: 150_01</li> </ul> <p><b>Reference Sites:</b></p> <ul style="list-style-type: none"> <li>• Swamp 2: S02_S01</li> <li>• Swamp 7: S07_S05, S07_S06</li> <li>• Swamp 15A: S15a_S01, S15a_Piezo, S15a_S04, S15a_S06</li> <li>• Swamp 22: 22_01, 22_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_S01, S88_S02</li> </ul>

Landscape	Targeted Sites		
	<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>• DA3-CF25</li> <li>• DA3-CF26</li> <li>• DA3-CF41</li> <li>• DA3-CF42</li> <li>• DA3-CF43</li> </ul> <p><b>Fire Trails</b></p> <p>Fire Road 6A (across active mining area)</p> <p>Fire Road 6N</p> <p>Fire Road 6P</p>	<ul style="list-style-type: none"> <li>• Monthly monitoring during any subsidence period</li> <li>• Monitoring to continue 6 monthly for 2 years following the completion of mining</li> </ul>	<p><b>Cliffs</b></p> <ul style="list-style-type: none"> <li>• No clifflines</li> </ul> <p><b>Fire Trails</b></p> <ul style="list-style-type: none"> <li>• Fire Road 6A (across active mining area)</li> <li>• Fire Road 6N</li> <li>• Fire Road 6P</li> <li>• Fire Road 6Q</li> </ul>
	<p>Continue monitoring of all mapped cliffs, steep slopes, watercourse, swamps and fire trail sites in subsidence area</p> <p>Continue general observation of active mining areas</p>	<ul style="list-style-type: none"> <li>• Weekly monitoring when longwall extraction is within 400m of feature</li> </ul>	<p>Continue monitoring of all mapped cliffs, steep slopes, watercourse, swamps and fire trail sites in subsidence area</p> <p>Continue general observation of active mining areas</p>



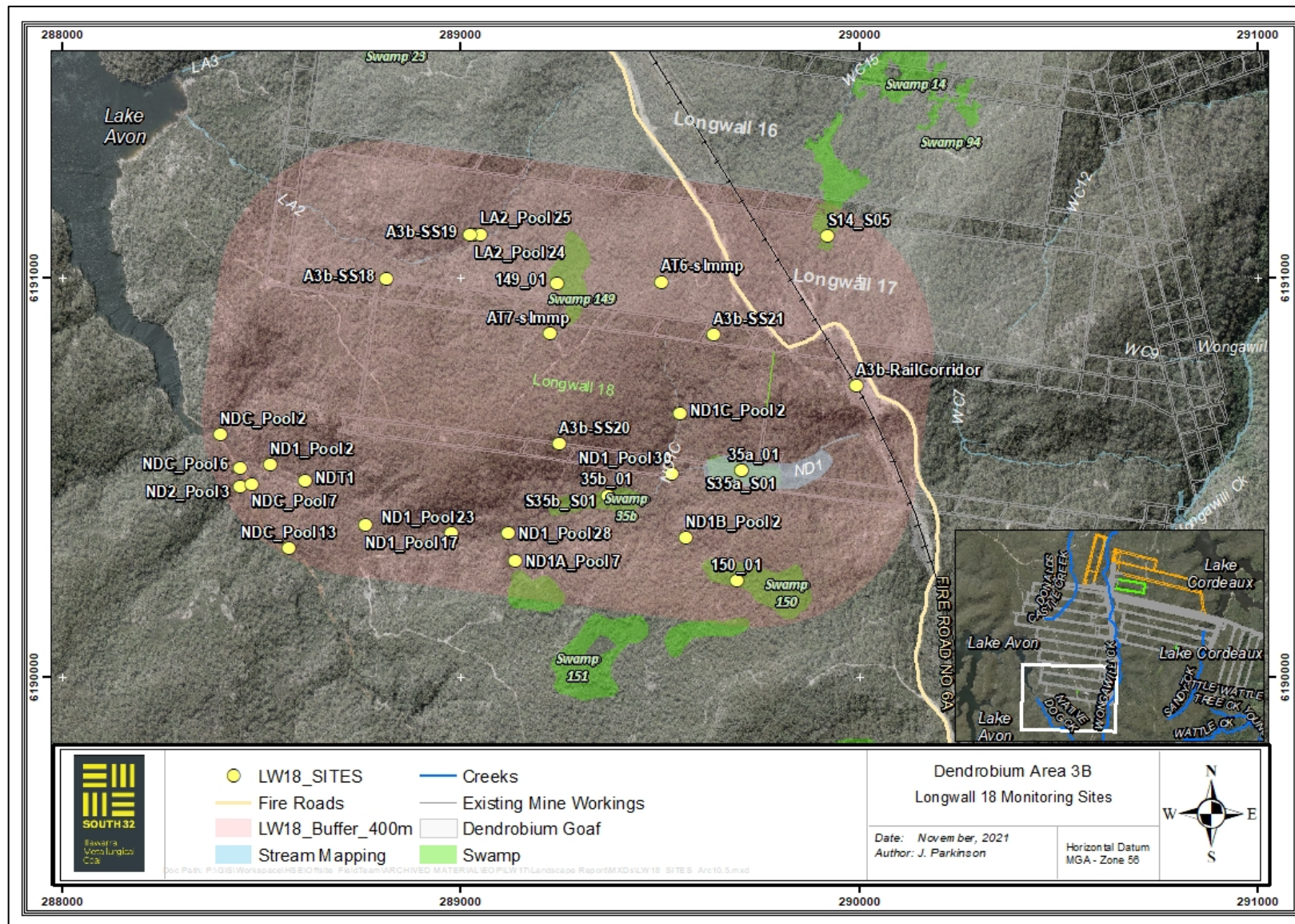


Figure 4: Monitoring sites relevant to Longwall 18

## 10 PREDICTED AND OBSERVED IMPACTS

The below table provides a summary of the predicted and observed impacts for Longwall 17 (Table 7)

Table 7: Dendrobium Area 3B Impacts, TARPs and Performance measures for Longwall 17

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
<b>Watercourses</b>					
<p><b>Wongawilli Creek &amp; Donalds Castle Creek</b></p> <p><i>Dendrobium Area 3B SMP Approval:</i></p> <p>Minor environmental consequences including:</p> <ul style="list-style-type: none"> <li>• <i>minor</i> fracturing, gas release and iron staining; and</li> <li>• <i>minor</i> impacts on water flows, water levels and water quality.</li> </ul> <p><i>Dendrobium Modified Development Consent:</i></p> <ul style="list-style-type: none"> <li>• Operations shall not cause subsidence impacts at Wongawilli Creek other than “minor</li> </ul>	<p>Minor environmental consequences including: minor fracturing, gas release and iron staining; and minor impacts on water flows, water levels and water quality.</p>	<p><u>Observational</u></p> <ul style="list-style-type: none"> <li>• Fracturing within Wongawilli Creek and/or Donalds Castle Creek resulting in diversion of flow such that &gt;10% of the pools (in Wongawilli Creek or Donalds Castle Creek) have water levels lower than baseline period</li> <li>• Measured surface water flow reduction in Wongawilli Creek and/or Donalds Castle Creek at its confluence with Cordeaux River that is greater than predicted by the groundwater model (to the satisfaction of the Director General - Condition 13 of the SMP) that cannot be</li> </ul>	<p><u>Observational</u></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>	<p>No Level 1 impacts observed</p>	

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
<p>impacts" (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality);</p> <ul style="list-style-type: none"> <li>• Operations will not result in reduction (other than negligible reduction) in the quality or quantity of surface water or groundwater inflows to Lake Cordeaux or Lake Avon or surface water inflow to the Cordeaux River at its confluence with Wongawilli Creek.</li> </ul>		<p>attributed to natural variation</p> <ul style="list-style-type: none"> <li>• Structural integrity of the bedrock base of any significant 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 the mining is observed in water at Wongawilli Creek downstream monitoring site WONGAWILLI CK (FR6)</li> </ul>	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <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>	<p>No Level 2 impacts observed</p>	
		<ul style="list-style-type: none"> <li>• Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at the Donalds Castle Creek downstream monitoring site Donalds Castle Ck (FR6)</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>	<p><b>Wongawilli Creek</b> Observable increase in iron staining within the mining area continues more than 600m from the longwall. <i>(Further discussed in Surface and Shallow Groundwater Assessment)</i></p>	<p>See impact report dated: -9/08/2021</p>

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
			<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>		
		<u>Pool Water Level</u> Fracturing resulting in diversion of flow such that >10% of the pools have water levels lower than baseline period	<u>Pool Water Level</u> <b>Level 1</b> <ul style="list-style-type: none"> <li>• Fracturing not resulting in diversion of flow</li> </ul>	No Level 1 impacts observed	
			<b>Level 2</b> <ul style="list-style-type: none"> <li>• Fracturing resulting in diversion of flow</li> </ul>	No Level 2 impacts observed	
			<b>Level 3</b> <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>	No Level 3 impacts observed	

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
	<p><b><u>Drainage lines</u></b></p> <ul style="list-style-type: none"> <li>• Changes in the natural gradient and stream alignment</li> <li>• Changes in the levels of ponding, flooding and scouring of the banks</li> <li>• Surface fracturing</li> <li>• Surface water diversion</li> <li>• Induction of ferruginous springs</li> </ul> <p><i>N.B. Not linked specifically to a performance measure</i></p>	<ul style="list-style-type: none"> <li>• Structural integrity of the bedrock base of any significant 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 the mining is observed in water at Wongawilli Creek downstream monitoring site Wongawilli CK (FR6)</li> <li>• Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at the Donalds Castle Creek downstream monitoring</li> </ul>	<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>• One exceedance of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period</li> </ul>	<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_025</b> – Iron staining present at LA5</li> </ul>	<p>See impact report dated: - 6/07/2021</p>

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
		<p>site Donalds Castle Ck (FR6)</p> <ul style="list-style-type: none"> <li>• Mining results in two consecutive exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period</li> </ul>	<p><b>Level 2</b></p> <ul style="list-style-type: none"> <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> <li>• Two exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period</li> </ul>	<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_001</b> – Rock fracturing, uplift and fragmentation to <i>LA2_Channel 6B</i>.</li> <li>• Impact <b>DA3B_LW17_002 (update)</b> – Rock fracturing, uplift and fragmentation to <i>LA2_Rockbar 25</i></li> <li>• Impact <b>DA3B_LW17_004</b> – Rock fracturing and uplift to <i>LA2_Rockbar 10</i>.</li> <li>• Impact <b>DA3B_LW17_005</b> - Rock fracturing to <i>LA2_Pool 12</i></li> <li>• Impact <b>DA3B_LW17_006</b> - Rock fracturing, soil cracking and uplift to <i>LA2_Pool 14</i>.</li> <li>• Impact <b>DA3B_LW17_007</b> - Rock fracturing and uplift to <i>LA2_Rockbar 14</i></li> <li>• Impact <b>DA3B_LW17_003 (Update)</b> - Rock fracturing, uplift and rockfall to <i>LA2_Rockbar 24, LA2_Pool 24 and LA2_Step 24</i>.</li> <li>• <b>LA4_S1</b> – Triggers for pH and electrical conductivity</li> </ul>	<p>See impact report dated: - 10/02/2021</p> <p>See impact report dated: - 16/02/2021 - 12/03/2021</p> <p>See impact report dated: - 12/03/2020</p> <p>See impact report dated: - 12/03/2021</p> <p>See impact report dated: -12/03/2021</p> <p>See impact report dated: -13/03/2021</p> <p>See impact report dated: -16/02/2021 &amp; -12/03/2021 &amp; - 14/04/2021</p> <p>See impact report dated: -17/03/2021</p> <p>See impact report dated:</p>

Performance Measure	Potential Impacts	<i>Exceeding Prediction</i>	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
				<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_012</b> - Rock fracturing and displacement around LA2_Pool 9 and upstream rockbar</li> <li>• Impact <b>DA3B_LW17_013</b> - Rock fracturing to LA2_Channel 8</li> <li>• Impact <b>DA3B_LW17_034</b> - Rock fracturing and cracking to LA2 tributary</li> </ul>	<p>-14/04/2021</p> <p>See impact report dated: -14/04/2021</p> <p>See impact report dated: -21/09/2021</p>

Performance Measure	Potential Impacts	Exceeding Prediction	TARP Trigger Level	Observed Impacts/Triggers	Additional Comments
			<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> <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> <li>• Three exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period</li> </ul>	<ul style="list-style-type: none"> <li>• <b>LA4_S1</b> – Three exceedances of the -3 standard deviation level from the baseline mean for pH. <i>(Further discussed in Surface and Shallow Groundwater Assessment)</i></li> <li>• <b>LA4_S1</b> – Three exceedances of the +3 standard deviation level from the baseline mean for electrical conductivity. <i>(Further discussed in Surface and Shallow Groundwater Assessment)</i></li> <li>• Impact <b>DA3B_LW9_019 (Update)</b> - Observable increase in iron staining within the mining area continues more than 600m from the longwall. <i>(Further discussed in Surface and Shallow Groundwater Assessment)</i></li> </ul>	<p>See impact report dated: -9/06/2021</p> <p>See impact report dated: -6/07/2021</p> <p>See impact report dated: -9/08/2021</p>



**SWAMPS**

	<p>Falls in surface or near-surface groundwater levels in swamps.</p> <p><i>N.B. not linked specifically to a performance measure and would not be considered a breach if predictions were exceeded.</i></p>		<p><b>Level 1</b>            Groundwater level lower than baseline level at any monitoring site within a swamp (in comparison to reference swamps); and/or            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>No Level 1 impacts observed</p>	
			<p><b>Level 2</b>            Groundwater level lower than baseline level at 50% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or            Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at a 50% of monitoring sites (within 400m of mining) within the swamp.</p>	<p>No Level 2 impacts observed</p>	

			<p><b>Level 3</b> Groundwater level lower than baseline level at &gt;80% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at &gt;80% of monitoring sites (within 400m of mining) within the swamp.</p>	No Level 3 impacts observed	
	<p>Falls in soil moisture levels in swamps.</p> <p><i>N.B. Not linked specifically to a performance measure and would not be considered a breach if predictions were exceeded.</i></p>		<p><b>Level 1</b> Soil moisture level lower than baseline level at any monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).</p>	No Level 1 impacts observed	
			<p><b>Level 2</b> Soil moisture level lower than baseline level at 50% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps)</p>	No Level 2 impacts observed	
			<p><b>Level 3</b> Soil moisture level lower than baseline level at &gt;80% of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps).</p>	No Level 3 impacts observed	

<b>LANDSCAPE</b>					
	<p>The cliffs located in the SMP Area are all located outside the extents of the proposed longwalls, at minimum distances of 30m to 460m at the closest points. It is possible therefore that some small isolated rockfalls could occur along the cliffs as a result of the extraction of the proposed longwalls. It is not expected however, that, any large scale cliff instabilities would occur</p>		<p><b>Level 1</b></p> <ul style="list-style-type: none"> <li>• Rockfall 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 100mm width</li> <li>• Crack or fracture up to 10m length</li> </ul>	<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_010</b> – Rock Fracturing to step on the northern slope of LA2 valley.</li> <li>• Impact <b>DA3B_LW17_015</b> – Soil cracking to access track to the west of FR6A.</li> </ul> <p>Impact <b>DA3B_LW17_016</b> – Rock fracturing to a rock outcrop, west of <i>Fire Road 6A</i></p> <ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_017</b> – Rock displacement from soil, west of <i>Fire Road 6A</i></li> <li>• Impact <b>DA3B_LW17_018</b> – <i>Soil cracking to Fire Road 6A</i></li> </ul>	<p>See impact report dated: - 14/04/2021</p> <p>See impact report dated: - 20/05/2021</p> <p>See impact report dated: - 28/05/2021</p> <p>See impact report dated: - 28/05/2021</p> <p>See impact report dated: - 28/05/2021</p>

	<p>based on previous experience.</p> <p>Impacts to steep slopes due to mining induced subsidence are most likely to occur in the form of surface cracks.</p> <p>Experience indicates that the likelihood of large-scale down-slope movements is extremely low due to the high depth of cover within the SMP Area.</p> <p>If tension cracks do develop it is possible that soil erosion may occur if the cracks are left untreated. Some remediation may therefore be required.</p>		<ul style="list-style-type: none"> <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>• Impact <b>DA3B_LW17_020</b> – Soil cracking to <i>Fire Road 6A</i></li> <li>• Impact <b>DA3B_LW17_021</b> – Rock fracturing to step/steep slope</li> <li>• Impact <b>DA3B_LW17_022</b> – Fracturing to rock outcrop in bushland to east of Fire Road 6A.</li> <li>• Impact <b>DA3B_LW17_024</b> – Fracturing to rock outcrop adjacent to Fire Road 6A</li> <li>• Impact <b>DA3B_LW17_026</b> – Soil cracking across rail corridor and adjacent bushland.</li> <li>• Impact <b>DA3B_LW17_028</b> – Soil cracking to access track to the east of Swamp 14.</li> <li>• Impact <b>DA3B_LW17_029</b> – Soil cracking across rail corridor/ballast.</li> <li>• Impact <b>DA3B_LW17_030</b> – Soil cracking along Fire Road 6A.</li> <li>• Impact <b>DA3B_LW17_032</b> – Rock displacement from soil at the base of steep slope/step, east of Fire Road 6A.</li> </ul>	<p>See impact report dated: - 9/06/2021</p> <p>See impact report dated: - 9/06/2021</p> <p>See impact report dated: - 25/06/2021</p> <p>See impact report dated: - 25/06/2021</p> <p>See impact report dated: - 9/07/2021</p> <p>See impact report dated: - 29/07/2021</p> <p>See impact report dated: - 29/07/2021</p> <p>See impact report dated: - 29/07/2021</p> <p>See impact report dated: - 25/08/2021</p>
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			<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_033</b> – Soil cracking to an access track to the east of Swamp 14</li> <li>• Impact <b>DA3B_LW17_035</b> – Rock fracturing with an associated rockfall to a large rock outcrop/steep slope</li> <li>• Impact <b>DA3B_LW17_036</b> – Rock fracturing to a large rock outcrop/steep slope</li> <li>• Impact <b>DA3B_LW17_038</b> – Rock movement and soil cracking to a large rock outcrop/steep slope</li> <li>• Impact <b>DA3B_LW17_039</b> – Rock movement, rock and soil profile separation at rock outcrop</li> <li>• Impact <b>DA3B_LW17_40</b> – Rock fracturing to exposed rock outcrop</li> </ul>	<p>See impact report dated: - 25/08/2021</p> <p>See impact report dated: - 21/09/2021</p> <p>See impact report dated: - 21/09/2021</p> <p>See impact report dated: - 21/09/2021</p> <p>See impact report dated: - 11/08/2021</p> <p>See impact report dated: - 11/08/2021</p>	
			<p><b>Level 2</b></p> <ul style="list-style-type: none"> <li>• Rockfall 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> </ul>	<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_008</b> - Rockfall at Steep slope/step adjacent to LA2.</li> <li>• Impact <b>DA3B_LW17_009</b> - Rockfall at Steep slope/step adjacent to LA2.</li> <li>• Impact <b>DA3B_LW17_011</b> – Rock fracturing to step/steep slope.</li> </ul>	<p>See impact report dated: - 12/03/2021</p> <p>See impact report dated: - 12/03/2021</p> <p>See impact report dated: - 14/04/2021</p>

		<ul style="list-style-type: none"> <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 300mm width</li> <li>• Crack or fracture between 10 and 50m 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>• Impact <b>DA3B_LW17_014</b> – Zone of soil cracking (multiple) extending over Fire Road 6A and adjacent clearing</li> <li>• Impact <b>DA3B_LW17_023</b> – Fracturing to rock outcrop in bushland to east of Fire Road 6A.</li> <li>• Impact <b>DA3B_LW17_027</b> – Soil cracking across rail corridor and adjacent bushland.</li> <li>• Impact <b>DA3B_LW17_037</b> – Multiple rock fracturing to a large rock outcrop/steep slope</li> </ul>	<p>See impact report dated: - 20/05/2021</p> <p>See impact report dated: - 25/06/2021</p> <p>See impact report dated: - 9/07/2021 - 29/07/2021</p> <p>See impact report dated: - 21/09/2021</p>
		<p><b>Level 3</b></p> <ul style="list-style-type: none"> <li>• Major cliff collapse where the characteristics of the cliff</li> </ul>	<ul style="list-style-type: none"> <li>• Impact <b>DA3B_LW17_019</b> – Soil cracking and rock fracturing in bushland west of Fire Road 6A.</li> </ul>	<p>See impact report dated: - 9/06/2021</p>

			<p>change significantly and there is significant ground disturbance that is unlikely to naturally stabilise within the monitoring period</p> <ul style="list-style-type: none"><li>• Crack or fracture over 300mm width</li><li>• Crack or fracture over 50m length</li><li>• Mass movement of a slope causing large areas of exposed soil with potential for further movement</li></ul>		
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## 11 APPENDIX A – TRIGGER ACTION RESPONSE PLANS

Table 8: Dendrobium Swamp Impacts, Triggers and Response Plan.

Performance Measures	Potential Impacts	Performance Triggers	Management Strategies	Offsets	Other Actions
<b>Negligible</b> erosion of the surface of the swamp	Gully erosion or similar	<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>	<ul style="list-style-type: none"> <li>a) upfront mine planning</li> <li>b) erosion monitoring (i.e. ALS, observation)</li> <li>c) coir logs</li> <li>d) knickpoint control</li> <li>e) water spreading</li> <li>f) weeding</li> <li>g) fire management</li> <li>h) reporting</li> <li>i) investigation and review</li> <li>j) update future predictions</li> </ul>	<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>Soil surface crack that causes erosion that is unlikely to stabilise within the monitoring period without intervention.</p> <p>Exceeding Prediction</p> <p>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 (ie 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><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>Swamp vegetation changes:</p> <ul style="list-style-type: none"> <li>- Swamp size</li> <li>- Species richness, distribution, composition</li> </ul>	<p>Swamp Size</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>	<ul style="list-style-type: none"> <li>a) upfront mine planning</li> <li>b) vegetation monitoring</li> <li>c) water spreading</li> <li>d) seeding/planting</li> <li>e) weeding</li> <li>f) fauna monitoring</li> <li>g) fire management</li> <li>h) grouting of controlling rockbars and bedrock base</li> </ul>	<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</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</p>

<p><b>No significant change</b> to the composition or distribution of species within the swamps</p>	<p>and diversity</p> <p>- Vegetation sub-communities</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>Exceeding Prediction: 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 Group.</p> <p>Ecosystem Functionality</p> <p><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>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><b>10 years</b>, with the agreement of the Secretary.</p>	<p>intensity and frequency of vegetation monitoring</p>
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		<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>Exceeding Prediction: 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>Species Composition and Distribution</p> <p><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</p>			
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		<p>stability or increase in species richness/diversity in reference swamps for <b>four</b> consecutive years.</p> <p>Exceeding Prediction: 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 (i.e. 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><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>Exceeding Prediction</p>	<p>a) upfront mine planning</p> <p>b) subsidence monitoring</p> <p>c) surface water monitoring</p> <p>d) groundwater monitoring</p> <p>e) grouting of controlling of controlling rockbars and bedrock base and/or use of other remediation techniques</p> <p>f) CMAs</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>	

		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.	g) reporting h) investigation and review i) update future predictions		
<b>Minor changes</b> in the ecosystem functionality of the swamps	Falls in surface or near-surface groundwater levels in swamps  N.B. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.	<u>Level 1:</u> Groundwater level lower than baseline level at any monitoring site within a swamp (in comparison to reference swamps); and/or  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).  <u>Level 2:</u> Groundwater level lower than baseline level at <b>50%</b> of monitoring sites (within 400m of mining) within a swamp (in comparison to reference swamps); and/or  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.  <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	a) upfront mine planning b) groundwater monitoring c) implementation of swamp research program d) weeding e) fire management f) reporting g) update future predictions		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

		Rate of groundwater level reduction exceeds rate of groundwater level reduction during baseline period at <b>&gt;80%</b> of monitoring sites (within 400m of mining) within the swamp.			
<b>Minor changes</b> in the ecosystem functionality of the swamps	Falls in soil moisture levels in swamps  N.B. Not linked specifically to a PM and would not be considered a breach if predictions were exceeded.	<p><u>Level 1:</u> Soil moisture level lower than baseline level at <b>any</b> monitoring sites (within 400m 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>	<ul style="list-style-type: none"> <li>a) upfront mine planning</li> <li>b) soil moisture monitoring</li> <li>c) water spreading</li> <li>d) weeding</li> <li>e) fire management</li> <li>f) reporting</li> <li>g) update future predictions</li> </ul>		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.

Table 9: Dendrobium Watercourse Impacts, Triggers and Response Plan.

Monitoring	Trigger	Action
<b>OBSERVATIONAL, PHOTO POINT AND WATER MONITORING</b>		
<p>Native Dog, Wongawilli and Donalds Castle Creeks, WC21, WC15, LA4, DC13, LA5, ND1, WC6, WC7, WC8, WC9, WC12, WC16 and WC18</p> <p>General observation of streams in active mining areas when longwall is within 400m</p> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Wongawilli Creek - minor environmental consequences</li> <li>Donalds Castle Creek - minor environmental consequences</li> <li>Waterfall WC-WF54 – negligible environmental consequences</li> </ul>	<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 OEH, DoPE, T&amp;I, Water NSW and other relevant resource managers</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> <p>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</p> <p>Crack or fracture between 10 and 50m length</p> <p>Soil surface crack that causes erosion that is likely to stabilise within the monitoring period without intervention</p> <p>Observable increase in iron staining within the mining area continues to outside the mining area i.e. 400m from the longwall</p>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to stakeholder 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> <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>Actions as stated for Level 2</li> <li>Site visit with OEH, DoPE, T&amp;I, Water NSW and other resource manager/s (if requested)</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Develop site CMA (subject to stakeholder feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with OEH, DoPE, T&amp;I, Water NSW and other stakeholders</li> <li>Completion of works following approvals and at a time agreed between BHPBIC, DoPE, T&amp;I and Water NSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>

Monitoring	Trigger	Action
	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>Structural integrity of the bedrock base of any significant 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 the mining is observed in water at Wongawilli Creek downstream monitoring site WONGAWILLI CK (FR6)</li> <li>Iron staining and associated increases in dissolved iron resulting from the mining is observed in water at the Donalds Castle Creek downstream monitoring site Donalds Castle Ck (FR6)</li> <li>Rockfall at WC-WF54 or its overhang</li> <li>Impacts on the structural integrity of WC-WF54, its overhang or its pool</li> </ul>	<ul style="list-style-type: none"> <li>Review relevant TARP and Management Plan in consultation with key stakeholders</li> <li>Actions as stated for Level 3</li> <li>Investigate reasons for the exceedance</li> <li>Update future predictions based on the outcomes of the investigation <ul style="list-style-type: none"> <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> </li> </ul>
<b>WATER QUALITY</b>		
<p>Wongawilli Creek Wongawilli Ck (FR6) 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>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Wongawilli Creek - minor environmental consequences</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 during the monitoring period: <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> <p><b>Level 2 *</b></p> <ul style="list-style-type: none"> <li>Two exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period: <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> <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 during the monitoring period: <ul style="list-style-type: none"> <li>pH 4.45</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an Impact Report to OEH, DoPE, T&amp;I, Water NSW and other relevant resource managers</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>Actions as stated for Level 1</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to stakeholder feedback)</li> </ul> <p><b>Level 3 *</b></p> <ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Site visit with OEH, DoPE, T&amp;I, Water NSW and other resource manager/s (if requested)</li> <li>Implement additional monitoring or increase frequency if required</li> </ul>



Monitoring	Trigger	Action
	<ul style="list-style-type: none"> <li>- EC 154.1 uS/cm</li> <li>- DO 50.5%</li> </ul>	<ul style="list-style-type: none"> <li>• Review relevant TARP and Management Plan in consultation with key stakeholders</li> <li>• Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> <li>- Limestone emplacement to raise pH where it is appropriate to do so</li> <li>- 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 BHPBIC, DoPE, T&amp;I and Water NSW (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 of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period: <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>• Actions as stated for Level 3</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>Donalds Castle Creek</p> <p>Donalds Castle Ck (FR6)</p> <p>Baseline means:</p> <ul style="list-style-type: none"> <li>• pH 5.41</li> <li>• EC 116.0 uS/cm</li> <li>• DO 85.6%</li> </ul> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>• Donalds Castle Creek - minor environmental consequences</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 during the monitoring period: <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 OEH, DoPE, T&amp;I, Water NSW and other relevant resource managers</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 exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period: <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>• Actions as stated for Level 1</li> <li>• Review monitoring frequency</li> <li>• Notify relevant technical specialists and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to stakeholder 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 during the monitoring period:</li> </ul>	<ul style="list-style-type: none"> <li>• Actions as stated for Level 2</li> <li>• Site visit with OEH, DoPE, T&amp;I, Water NSW and other resource manager/s (if requested)</li> <li>• Implement additional monitoring or increase frequency if required</li> </ul>

Monitoring	Trigger	Action
	<ul style="list-style-type: none"> <li>- pH 3.60</li> <li>- EC 185.8 uS/cm</li> <li>- DO 40.1%</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> </ul>	<ul style="list-style-type: none"> <li>• Review relevant TARP and Management Plan in consultation with key stakeholders</li> <li>• Collect laboratory samples and analyse for: <ul style="list-style-type: none"> <li>- pH, EC, major cations, major anions, Total Fe, Mn &amp; Al</li> <li>- Filterable suite of metals</li> </ul> </li> <li>• Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> <li>- Limestone emplacement to raise pH where it is appropriate to do so</li> <li>- 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 BHPBIC, DoPE, T&amp;I and Water NSW (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 of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period: <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>• Actions as stated for Level 3</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>Lake Avon</p> <p>Lake Avon tributary (LA4_S1)</p> <p>Baseline means:</p> <ul style="list-style-type: none"> <li>• pH 5.38</li> <li>• EC 90.8 uS/cm</li> <li>• DO 89.9%</li> </ul> <p>(24 months of baseline data available - to be updated with additional baseline data)</p>	<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 during the monitoring period: <ul style="list-style-type: none"> <li>- pH 4.90</li> <li>- EC 129.8 uS/cm</li> <li>- DO 69.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Continue monitoring program</li> <li>• Submit an Impact Report to OEH, DoPE, T&amp;I, Water NSW and other relevant resource managers</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 exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean during the monitoring period: <ul style="list-style-type: none"> <li>- pH 4.90</li> <li>- EC 129.8 uS/cm</li> <li>- DO 69.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Actions as stated for Level 1</li> <li>• Review monitoring frequency</li> <li>• Notify relevant technical specialists and seek advice on any CMA required</li> <li>• Implement agreed CMAs as approved (subject to stakeholder feedback)</li> </ul>
	<p><b>Level 3 *</b></p>	<ul style="list-style-type: none"> <li>• Actions as stated for Level 2</li> </ul>

Monitoring	Trigger	Action
<p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Lake Avon - negligible reduction in the quality of surface water inflows to Lake Avon</li> </ul>	<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 during the monitoring period: <ul style="list-style-type: none"> <li>pH 4.90</li> <li>EC 129.8 uS/cm</li> <li>DO 69.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Site visit with OEH, DoPE, T&amp;I, Water NSW and other resource manager/s (if requested)</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Review relevant TARP and Management Plan in consultation with key stakeholders</li> <li>Collect laboratory samples and analyse for: <ul style="list-style-type: none"> <li>pH, EC, major cations, major anions, Total Fe, Mn &amp; Al</li> <li>Filterable suite of metals</li> </ul> </li> <li>Develop site CMA (subject to stakeholder feedback). This may include: <ul style="list-style-type: none"> <li>Limestone emplacement to raise pH where it is appropriate to do so</li> <li>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 BHPBIC, DoPE, T&amp;I and Water NSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success</li> </ul>
	<p>Exceeding Prediction</p> <ul style="list-style-type: none"> <li>Mining results in two consecutive exceedances of the <math>\pm 3</math> standard deviation level (positive for EC, negative for pH and DO) from the baseline mean of the Lake Avon inflows during the monitoring period: <ul style="list-style-type: none"> <li>pH 4.90</li> <li>EC 129.8 uS/cm</li> <li>DO 69.5%</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</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>Mapped pools in the mining area:</p> <ul style="list-style-type: none"> <li>Wongawilli Creek</li> <li>Donalds Castle Creek</li> </ul> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Wongawilli Creek - minor environmental consequences</li> <li>Donalds Castle Creek - minor environmental consequences</li> </ul>	<p>Level 1 *</p> <ul style="list-style-type: none"> <li>Fracturing not resulting in diversion of flow</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Submit an Impact Report to OEH, DoPE, T&amp;I, Water NSW and other relevant resource managers</li> <li>Report in the End of Panel Report</li> <li>Summarise actions and monitoring in AEMR</li> </ul>
	<p>Level 2 *</p> <ul style="list-style-type: none"> <li>Fracturing resulting in diversion of flow</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved (subject to stakeholder feedback)</li> </ul>
	<p>Level 3 *</p>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> </ul>

Monitoring	Trigger	Action
	<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>Site visit with OEH, DoPE, T&amp;I, Water NSW and other resource manager/s (if requested)</li> <li>Implement additional monitoring or increase frequency if required</li> <li>Review relevant TARP and Management Plan in consultation with key stakeholders</li> <li>Develop site CMA (subject to stakeholder feedback). This may include: grouting of rockbar and bedrock base of any significant pool where it is appropriate to do so in consultation with OEH, DoPE, T&amp;I, Water NSW and other stakeholders</li> <li>Completion of works following approvals and at a time agreed between BHPBIC, DoPE, T&amp;I and Water NSW (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>Actions as stated for Level 3</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>Waterfall WC-WF54</p> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Waterfall WC-WF54 – negligible environmental consequences</li> </ul>	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>Fracturing in Wongawilli Creek within 30m of the waterfall which results in observable flow diversion</li> <li>Fracturing in Wongawilli Creek which results in observable flow diversion from the lip of the waterfall</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</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>Wongawilli Creek and Donalds Castle Creek</p> <p>Lake Avon and Cordeaux River</p>	<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, DRG, WaterNSW.</li> <li>Report in the End of Panel Report.</li> <li>Summarise actions and monitoring in AEMR.</li> </ul>

<p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> <li>Wongawilli Creek - minor environmental consequences</li> <li>Donalds Castle Creek - minor environmental consequences</li> <li>Lake Avon - negligible reduction in the quantity of surface water inflows to Lake Avon<sup>1</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>2</sup></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>Actions as stated for Level 1</li> <li>Review monitoring frequency.</li> <li>D) → carry out Water Flow Assessment Method D.</li> <li>Submit letter report to DPIE, DRG and WaterNSW and seek advice on any CMA required.</li> <li>Implement agreed CMAs as approved (subject to agency feedback).</li> </ul>
<p>Surface water flow Reference sites (as in Table 1.1):</p> <ul style="list-style-type: none"> <li><u>Wongawilli Creek - WWU</u> (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><b>Level 3</b></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>Actions as stated for Level 2</li> <li>Offer site visit with BCD, DPIE, DRG, 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, DRG, WaterNSW.</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> <li>Review relevant TARP and Management Plan in consultation with key agencies.</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>Hydrological changes are assessed by comparing pre- and post-mining observed flows from impact or assessment sites to flow data from the reference sites.</p> <p>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.</p>	<p><b>Exceeding Prediction</b></p> <p>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".</p>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</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>Tributaries of Wongawilli Creek and Donalds Castle Creek and other affected watercourses not subject to performance measures</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, DRG, WaterNSW.</li> <li>Report in the End of Panel Report.</li> <li>Summarise actions and monitoring in AEMR.</li> </ul>
<p>Surface water flow Reference sites (as in Table 1.1):</p> <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><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> <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>Actions as stated for Level 1</li> <li>Review monitoring frequency.</li> <li>Submit letter report to DPIE, DRG and WaterNSW and seek advice on any CMA required.</li> <li>Implement agreed CMAs as approved (subject to agency feedback).</li> </ul>
<p>Hydrological changes are assessed by comparing pre- and post-mining observed flows from impact or assessment sites to flow data from the reference sites. 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.</p>	<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, DRG, 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, DRG, WaterNSW.</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> <li>Review relevant TARP and Management Plan in consultation with key agencies.</li> </ul>

<sup>1</sup> Surface water inflows calculation = [Impacts at gauged catchments (LA1 + LA2 + LA3 + LA4 + LA6+ NDT1 + ND2) + estimated impacts at ungauged but undermined catchments ( e.g. LA5)] / [total inflow to LA].

<sup>1</sup> Flow reduction as determined from measured at flow gauging station WWL\_A.

Table 10: Dendrobium Landscape Impacts, Triggers and Response Plan.

Monitoring	Trigger	Action
Landscape Features		
<p>DENDROBIUM AREA 3B Cliffs All mapped cliff sites in subsidence area Refer to Dendrobium Area 3B SMP Figures 18.1 for location of sites</p>	<p><b>Level 1 *</b></p> <ul style="list-style-type: none"> <li>Rockfall 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 100mm width</li> <li>Crack or fracture up to 10m 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>Report impacts to key stakeholders</li> <li>Summarise impacts and Report in the End of Panel Report and AEMR</li> </ul>
	<p><b>Level 2 *</b></p> <ul style="list-style-type: none"> <li>Rockfall 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 300mm width</li> <li>Crack or fracture between 10 and 50m 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>Actions as stated for Level 1</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>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</p>
	<p><b>Level 3 *</b></p>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Immediately notify DoPI, DPIM, SCA, resource managers and relevant technical specialists and seek advice on any CMA required</li> </ul>

Monitoring	Trigger	Action
	<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 300mm width</li> <li>Crack or fracture over 50m length</li> <li>Mass movement of a slope causing large areas of exposed soil with potential for further movement</li> </ul>	<ul style="list-style-type: none"> <li>Site visits with stakeholders if required</li> <li>Review monitoring program and modify if necessary within 1 month</li> <li>Implement increased monitoring if required within 2 weeks</li> <li>Develop site CMA in consultation with key stakeholders within 1 month, (pending stakeholder availability) and seek approvals</li> <li>Completion of works following approvals</li> <li>Issue CMA report within 1 month of works completion</li> <li>Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion</li> <li>Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul> <p>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</p>
Sandy Creek Waterfall	<p><b>Exceeding Prediction</b></p> <ul style="list-style-type: none"> <li>Rockfall at Sandy Creek Waterfall or from its overhang</li> <li>Structural integrity of the waterfall, its overhang and its pool are impacted</li> <li>More than negligible cracking within 30m of the waterfall</li> <li>More than negligible diversion of water from the lip of the waterfall</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 3</li> <li>Investigate reasons for the exceedance</li> <li>Update future predictions based on the outcomes of the investigation</li> </ul>
<b>Terrestrial Flora and Fauna</b>		
<p>A number of sites located across and around Areas 2, 3A and 3B Refer Dendrobium Area 3A SMP Figure 21.1, 21.2 and 21.3 and Dendrobium Area 3B Figure 20.1 for location of sites</p>	<p><b>Level 1 *</b></p> <ul style="list-style-type: none"> <li>Vegetation impacted by mining (by rockfalls, soil slippage, gas emissions) that is likely to naturally regenerate within the monitoring period</li> </ul>	<ul style="list-style-type: none"> <li>Continue monitoring program</li> <li>Report impacts to key stakeholders</li> <li>Summarise impacts and Report in the End of Panel Report and AEMR</li> </ul>
<p>General observation of active mining areas</p>	<p><b>Level 2 *</b></p> <ul style="list-style-type: none"> <li>Vegetation impacted by mining (by rockfalls, soil slippage, gas emissions) that is unlikely to naturally regenerate within the monitoring period</li> <li>Statistically significant difference between Before After Control Impact sites as a result of mining</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 1</li> <li>Review monitoring frequency</li> <li>Notify relevant technical specialists and seek advice on any CMA required</li> <li>Implement agreed CMAs as approved</li> </ul>



Monitoring	Trigger	Action
	<p>Level 3 *</p> <ul style="list-style-type: none"> <li>Vegetation impacted by mining that is not responding to CMAs</li> </ul>	<ul style="list-style-type: none"> <li>Actions as stated for Level 2</li> <li>Immediately notify OEH, DoPI, DPI, SCA, other resource managers and relevant technical specialists and seek advice on any CMA required</li> <li>Site visits with stakeholders if required</li> <li>Review monitoring program and modify if necessary within 1 month</li> <li>Implement increased monitoring if required within 2 weeks</li> <li>Develop site CMA in consultation with key stakeholders within 1 month, (pending stakeholder availability) and seek approvals</li> <li>Completion of works following approvals</li> <li>Issue CMA report within 1 month of works completion</li> <li>Conduct initial follow up monitoring &amp; reporting within 2 months of CMA completion</li> <li>Review the relevant TARP and Management Plan in consultation with key stakeholders</li> </ul>

\* These may be revised in consultation with DoPI and DPI and other key stakeholders following analysis of natural variability within the pre-mining baseline data. These TARPs relate to Dendrobium Area 3B and impacts resulting from mining in Areas 1, 2 and 3A were managed under previous TARPs.