



**WONGAWILLI CREEK AND
WATERFALL 54
MANAGEMENT STRATEGY**



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Appendices

Appendix A – Wongawilli Creek Waterfall 54 Trigger Action Response Plan

Review History

Revision	Description of Changes	Date	Approved
1	New Document-DRAFT	2019	GB
2	Updated to address Schedule 4, Condition 5 of the 3B SMP Approval	February 2020	GB
3	Updated to address Longwall 18 layout changes	August 2020	GB
A	Updated to address feedback from WaterNSW	October 2020	GB
B	Updated to include Wongawilli Creek approach TARP	March 2021	GB
C	Updated to incorporate Hebblewhite feedback	May 2021	GB
D	Updated to incorporate WaterNSW feedback	May 2021	GB
E	Updated with administrative changes	May 2021	GB

1 INTRODUCTION

1.1 Background

Wongawilli Creek Waterfall 54 (WC-WF54) is approximately 20 metres (m) high and located within the upper reaches of Wongawilli Creek, a tributary to Cordeaux River, which is part of the Metropolitan Special Catchment Area.

WC-WF54 is located adjacent to the Dendrobium Area 3B (DA3B) mining domain. The centreline of the waterfall is 440 m from the finishing end of Longwall 17 and over 1 kilometre (km) from the finishing end of Longwall 18.

The Longwall 18 Subsidence Management Plan (SMP) was approved by the Department of Planning, Industry and Environment (DPIE) 8 December 2020. This Management Strategy has been prepared to satisfy conditions within the DA3B SMP Approval, Schedule 3, Condition 13 and Schedule 4, Conditions 5(c), 9, 10(a) and 10(b).

1.2 Scope

The Wongawilli Creek and WC-WF54 Management Strategy has been prepared to monitor and manage the extraction of Longwall 17 and Longwall 18 and to ensure that the relevant DA3B performance measures are met.

1.3 Purpose

The Wongawilli Creek and WC-WF54 Management Strategy outlines the preliminary investigations undertaken to understand the waterfall structure, geology, predicted mining impacts and identify monitoring and management processes to ensure management outcomes are consistent with the Dendrobium Development Consent.

The Management Strategy also details the monitoring and trigger action response plans for mining of Longwall 17 as it approaches Wongawilli Creek at a distance between 600 m and 400 m as required by Schedule 3, Conditions 9 and 10.

2 REGULATORY REGIME

2.1 Development Consent

This Management Strategy has been developed to satisfy Schedule 3, Condition 2 of the Dendrobium Development Consent (DA 60-03-2001), which states:

The Applicant shall ensure that underground mining operations do not cause subsidence impacts at Sandy Creek and Wongawilli Creek other than "minor impacts" (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality) to the satisfaction of the Director-General.

2.2 Dendrobium Area 3B Subsidence Management Plan Approval

The SMP for Longwall 18 was approved by the Secretary DPIE 8 December 2020. This Management Strategy has been prepared to satisfy conditions within the DA3B SMP Approval. Relevant conditions and performance measures are presented in Table 1.

Table 1 Dendrobium Area 3B SMP Approval

Area 3B SMP Approval	
Watercourse Performance Measures (Condition 13)	
Waterfall WC-WF54	Negligible environmental consequences including: <ul style="list-style-type: none"> • no rock fall occurs at the waterfall or from its overhang; • no impacts on the structural integrity of the waterfall, its overhang and its pool; • negligible cracking in Wongawilli Creek within 30 m of the waterfall; and • negligible diversion of water from the lip of the waterfall.
Wongawilli Creek Donalds Castle Creek	Minor environmental consequences including: <ul style="list-style-type: none"> • minor fracturing, gas release and iron staining; and • minor impacts on water flows, water levels and water quality.
Watercourse Impact Monitoring, Management and Contingency Plan	
5. Prior to the extraction of Longwall 16, the Applicant must review the Watercourse Impact Monitoring, Management and Contingency Plan for Area 3B prepared under condition 4 of Schedule 3 of the development consent (DA 60-03-2001) to provide for achievement of the performance measures listed in Table 1 in consultation with WaterNSW, to the satisfaction of the Secretary. The revised plan must include: <p>...</p> <p style="padding-left: 40px;">c. a monitoring and management strategy for waterfall WCWF54, which considers adaptive management of mining to avoid impacts to the waterfall.</p>	
Longwall 17 – Limits on Approval	
9. The Applicant must set back Longwall 17 at least 600 metres from the centreline of Wongawilli Creek, subject to condition 10 below. <p>10. The Applicant may extend Longwall 17 (i.e. continue extraction), but not closer than 400 metres from the centreline of Wongawilli Creek, providing it can demonstrate:</p> <p style="padding-left: 40px;">a. the relevant watercourse performance measure for Wongawilli Creek (i.e. minor environmental consequences, see Table 1) has not been exceeded by longwall extraction and would not be exceeded by extraction of Longwall 17; and</p> <p style="padding-left: 40px;">b. detailed Trigger Action Response Plans that can accurately provide early warning of potential exceedances of this performance measure are approved and in place,</p> <p style="padding-left: 40px;">to the satisfaction of the Secretary.</p>	

In accordance with Schedule 4, Condition 5(c) prior to the extraction of Longwall 16, the Area 3B Watercourse Impact Monitoring Management and Contingency Plan (WIMMCP) was revised to include a monitoring and management strategy for Waterfall WC-WF54, which considers adaptive management of mining to avoid impacts to the waterfall.

This Management Strategy includes implementation of a Trigger Action Response Plan (TARP), comparative to the successful Sandy Creek Waterfall Management Plan (SCWMP) (2021).

2.3 Longwall 18 Layout

The length of Longwall 18 has been reduced at the eastern end to avoid an in seam geological feature. Longwall 18 contains a significant structurally disturbed zone along MG18 between cut-throws 7-8 which also extends into the longwall block. This zone appears to consist of a series of three faults with displacements 10 – 15 m, downthrown to the south and middle and has been investigated via a variety of exploration methods. A summary is available in the Geology of Longwall 18 Report (South32, 2020a).

3 WONGAWILLI CREEK WATERFALL 54 SETTING AND DEFINITION

3.1 Geomorphology

The waterfall is approximately 20 m in height with a 1 – 2 m undercut, and marks the point where the Wongawilli Creek valley transitions into a steeply-incised gorge (Photo 1 and Photo 2).

3.2 Geology

The surface mapping and geological modelling undertaken by Illawarra Metallurgical Coal (IMC) indicates that the base of Wongawilli Creek rises up through the stratigraphy as it runs from the south to the north. The section of Wongawilli Creek located within the DA3B Study Areas is founded in Bulgo Sandstone.



Photo 1: WC-WF54, looking upstream from the downstream pool.



Photo 2: WC-WF54, looking across stream from the eastern valley side.

3.3 Subsidence Predictions

The centreline of WC-WF54 is located 440 m south-east of Longwall 17. Cross-sections through Longwalls 17 and Wongawilli Creek, immediately downstream of the waterfall, are provided in Figure 1.

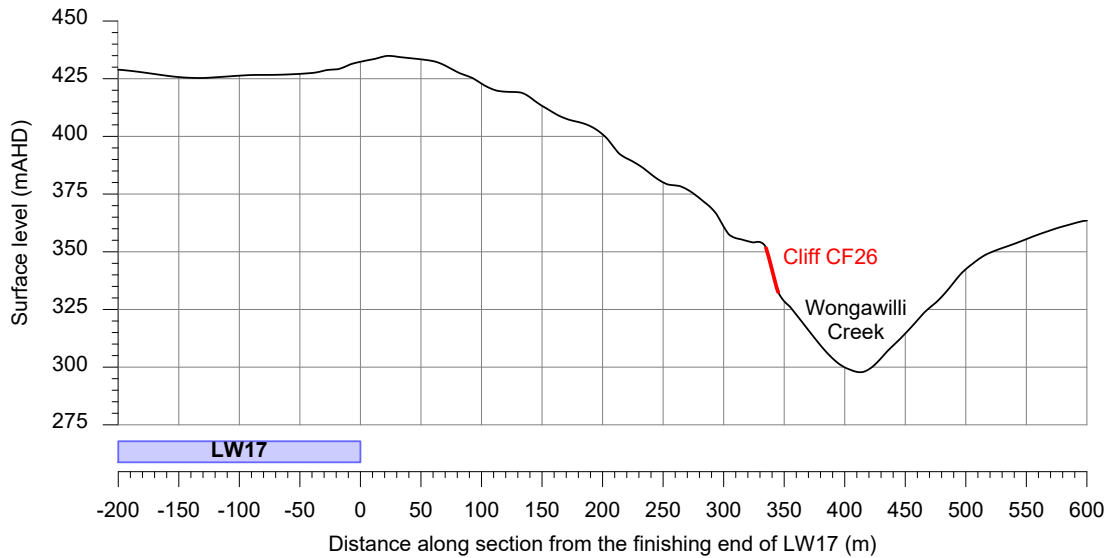


Figure 1: Section through Wongawilli Creek and the finishing end of Longwall 17 (looking north)

The waterfall is predicted to experience less than 20 mm vertical subsidence due to the extraction of Longwalls 9 to 18 (MSEC 2021). While it is possible that the waterfall could experience low levels of vertical subsidence, it is not expected to experience measurable tilts, curvatures or conventional strains. The maximum predicted total valley related effects at the waterfall, following the extraction of Longwall 17 are less than 20 mm upsidence and <27 mm closure (MSEC 2021). Whilst minor fracturing in the bed of Wongawilli Creek could occur, the likelihood of fracturing resulting in surface water flow diversions has been considered to be low.

Table 2 Maximum predicted total vertical subsidence, upsidence and closure at WC-WF54 following the extraction of Longwalls 16, 17 and 18

Location	Label	Maximum predicted total vertical subsidence (mm)	Maximum predicted total upsidence (mm)	Maximum predicted total closure (mm)
Waterfall	WC-WF54	< 20	< 20	<30

The Waterfall is located 1 km from the finishing (i.e. eastern) end of Longwall 18. At this distance, the waterfall is not expected to experience measurable conventional or valley related effects. It is unlikely, therefore, that adverse impacts would occur at the waterfall due to the mining of Longwall 18.

The waterfall is located within a “horse-shoe” shaped valley with cliffs and minor cliffs downstream of it on both sides of Wongawilli Creek. A similar shaped cliff is located at Elouera Colliery, along a tributary to Wongawilli Creek, where mining has occurred beneath and on both sides of the cliff. No adverse impacts have been observed at this waterfall due to this mining.

Based on the previous experience of mining in the vicinity of cliffs in the Southern Coalfield, the likelihood of a cliff instability at WC-WF54 is considered to be very low. It is possible, however, that isolated rockfalls could occur at or near the waterfall site due to mining, due to natural processes, or both.

4 MANAGEMENT STRATEGIES

4.1 Mine Planning

Wongawilli Creek Waterfall 54

Measurable vertical subsidence movements are not expected to occur at WC-WF54 due to the extraction of Longwall 17 as the longwall is setback approximately 440 m from the waterfall at its closest point. Due to the length of Longwall 18 being reduced at the eastern end to avoid an in seam geological feature, additional setbacks are not necessary.

Wongawilli Creek

Longwall 17 will be setback 400 m from Wongawilli Creek and was determined using the rockbar impact model, consistent with other longwalls in Areas 3A and 3B to limit predicted valley closure to 200 mm across the rockbars of Wongawilli Creek. South32 considered a range of distances for Longwall 17 to be setback from Wongawilli Creek during the mine planning process.

4.2 Adaptive Management Approach

IMC will manage WC-WF54 via an adaptive management approach. A robust monitoring program will be undertaken by IMC and the monitoring data will be reviewed by IMC and an independent expert on a regular basis. Results of the data review will inform the WC-WF54 TARP (Appendix A) with suitable actions implemented as required.

4.3 Independent Expert Review

Initially a WC-WF54 Technical Committee (TC) was proposed to review and interpret the results of investigative and monitoring data, including monitoring results as mining approached the waterfall. However, due to the revised layout of Longwall 18 and the revised subsidence predictions, it is proposed that the TC is not required. However, monitoring data will be routinely reviewed by IMC and an independent expert. The review of the monitoring data by the independent expert will provide the basis to inform IMC Steering Committee decisions.

5 MONITORING

5.1 Wongawilli Creek

IMC has conducted ongoing monitoring of watercourses in the Dendrobium area since 2001. This monitoring builds upon the understanding of processes within the watercourses, along with identifying and assessing any episodic or temporal changes.

The monitoring methods proposed to monitor Longwall 17 extraction for when it is between 600 – 400 m of Wongawilli Creek are consistent with the *Dendrobium Area 3B Watercourse Impact Monitoring, Management and Contingency Plan* (WIMMCP). These include:

- Observational monitoring;
- Water quality;
- Pool water level; and
- Surface water flow.

The surface water flow Assessment D (observation of no flow downstream of gauge WWU) for Wongawilli Creek would be the most suitable tool as an early warning metric to indicate if the exceedance of a performance measure may result due to the continued mining of Longwall 17.

Supplementary Monitoring Method

Data downloads will be undertaken for conducting surface flow TARP Assessments A – C on a fortnightly basis to provide an indication against performance measures (note WaterNSW data availability for one of the two reference gauges used in Assessment A-C is available every 2 months). These assessments would be used as a supplementary method to assess impacts against the performance measure.

The Study Area of Wongawilli Creek based on the 600 m buffer is shown on Figure 2. The IMC Environmental Field Team would undertake routine weekly monitoring of the Wongawilli Creek Study Area when Longwall 17 extraction is progressing within the 600 – 400 m distance from Wongawilli Creek. Table 3 below details the type of monitoring, monitoring sites and the proposed increase in monitoring with the escalation of TARP trigger levels. Data from observational, water quality and pool water level monitoring will be reviewed within 24 hours of collection. Due to the data acquisition steps and processing required for surface water flow assessments A – D (noting the earlier comment regarding WaterNSW flow data availability), this would be processed within a week of collection. Roles and responsibilities related to this TARP are detailed in Section 8 of the 3B WIMMCP.

Table 3 Wongawilli Creek Study Area Monitoring

Monitoring	Sites	Frequency			
		No Trigger	Level 1	Level 2	Level 3
Observational	WC_Prop1, WC_Prop2, WC_Prop3, WC_Prop4, WC_Prop5, WC_Prop6 WC_Pool39, WC_Pool51	Weekly	Weekly	Weekly	Twice weekly
Water Quality	WC_Pool49, WC_Rockbar39	Weekly	Weekly	Weekly	Twice weekly
Pool Water Level	WC_Prop1, WC_Prop2, WC_Prop3, WC_Prop4, WC_Prop5, WC_Prop6 WC_Pool39, WC_Pool51	Weekly	Weekly	Weekly	Twice weekly
Surface Water Flow Assessments A - C	WWL	-	Fortnightly	Fortnightly	Fortnightly
Surface Water Flow Assessment D	Pools on Wongawilli Creek downstream of WWU ¹	Weekly	Weekly	Weekly	Twice weekly
		(if observational monitoring triggers this)			

5.2 Wongawilli Creek Waterfall 54

The monitoring plan for WC-WF54 has been developed with consideration of the SCWMP, which was successfully implemented during the extraction of Longwalls 6 to 8 in proximity to Sandy Creek Waterfall. Table 4 below details the type of monitoring, monitoring sites and the proposed increase in monitoring with the escalation of TARP trigger levels. The two main predicted deformation mechanisms: bedding plane shear and valley closure will be monitored. An overview of proposed monitoring sites is provided in Figure 3. The monitoring methods proposed to monitor WC-WF54 during extraction of Longwalls 17 and 18 include:

¹ Sites within the 600 m study area would be subject to increased monitoring frequency for Surface Water Flow Assessment D.

- Survey data;
- Observational monitoring;
- Hydrology; and
- Time domain reflectometry.

Table 4 Wongawilli Creek Waterfall 54 Monitoring

Monitoring	Sites	Frequency			
		No Trigger	Level 1	Level 2	Level 3
Survey	Lines A, B, C and D, WC12 and WC7 3D GNSS GPS	Monthly	Weekly	Weekly	Twice weekly
Observational	Sites upstream of WC-WF54 as listed in Table 3 and the lip of the waterfall	Monthly ²	Weekly	Weekly	Twice weekly
Hydrology	Pool54	Monthly ³	Weekly	Weekly	Weekly
Shear	TDR cable	Monthly ⁴	Weekly	Weekly	Twice weekly

Survey Data

The baseline survey monitoring has been completed with impact surveys to commence in-advance of the approaching Longwall 17, completed September 2019. A number of monitoring sites have been installed to characterise subsidence movements as mining activities (from Longwalls 16 – 18) approach WC-WF54. IMC have adopted the MSEC (2021) recommendation that WC-WF54 is monitored monthly during the last 600 m of extraction for Longwall 17. This represents mining when the longwall extraction face is located less than 1000 m from the centreline of the waterfall. The IMC Survey Team would undertake weekly monitoring of the WC-WF54 when Longwall 17 extraction is progressing within the 600 – 400 m distance from the Waterfall.

The subsidence movement ground monitoring for WC-WF54 consists of three high-resolution 2D survey lines across the waterfall and one longitudinal line in the creek bed (Lines A, B, C and D). These monitoring lines have been installed and will be measured on a monthly basis during the extraction of Longwalls 17 and 18 (see Table 4 for monitoring frequency) and have a relative accuracy of +/- 0.75 mm.

Wongawilli Creek Closure Line (E Line) – is located adjacent to the finishing end of Longwall 16 and measures closure across the Wongawilli Creek valley, approximately 800 m north of WC-WF54. There were no survey closure monitoring sites suitable adjacent to Longwall 17.

The WC12 Closure Lines are located approximately 50 m to the east of the finishing end of Longwall 16, approximately 790 m northwest of WC-WF54.

The WC7 Closure Line is located approximately 240 m to the northwest of WC-WF54.

Four 3D GPS marks have been installed at and near to WC-WF54 and will provide absolute 3D movements at an accuracy of +/- 20 mm in position and +/- 30 mm in Australian Height Datum (AHD).

² Monthly monitoring commenced in February 2021 and will continue until Longwall 17 reaches 200 m remaining, then increase to weekly.

³ Weekly assessments will be carried out once Longwall 17 reaches 200 m remaining.

⁴ Data is able to be downloaded remotely as required.

Primary 2D high resolution closure lines are intended to be the key metric to inform the status of the Waterfall. Secondary 2D high resolution closure lines (E Line, WC12, WC7) and the 3D GNSS GPS marks will be used to inform far field movements or movements generally occurring at distance from the Waterfall. These monitoring sites will provide early warning of the approach of mining-induced effects.

Observational Monitoring

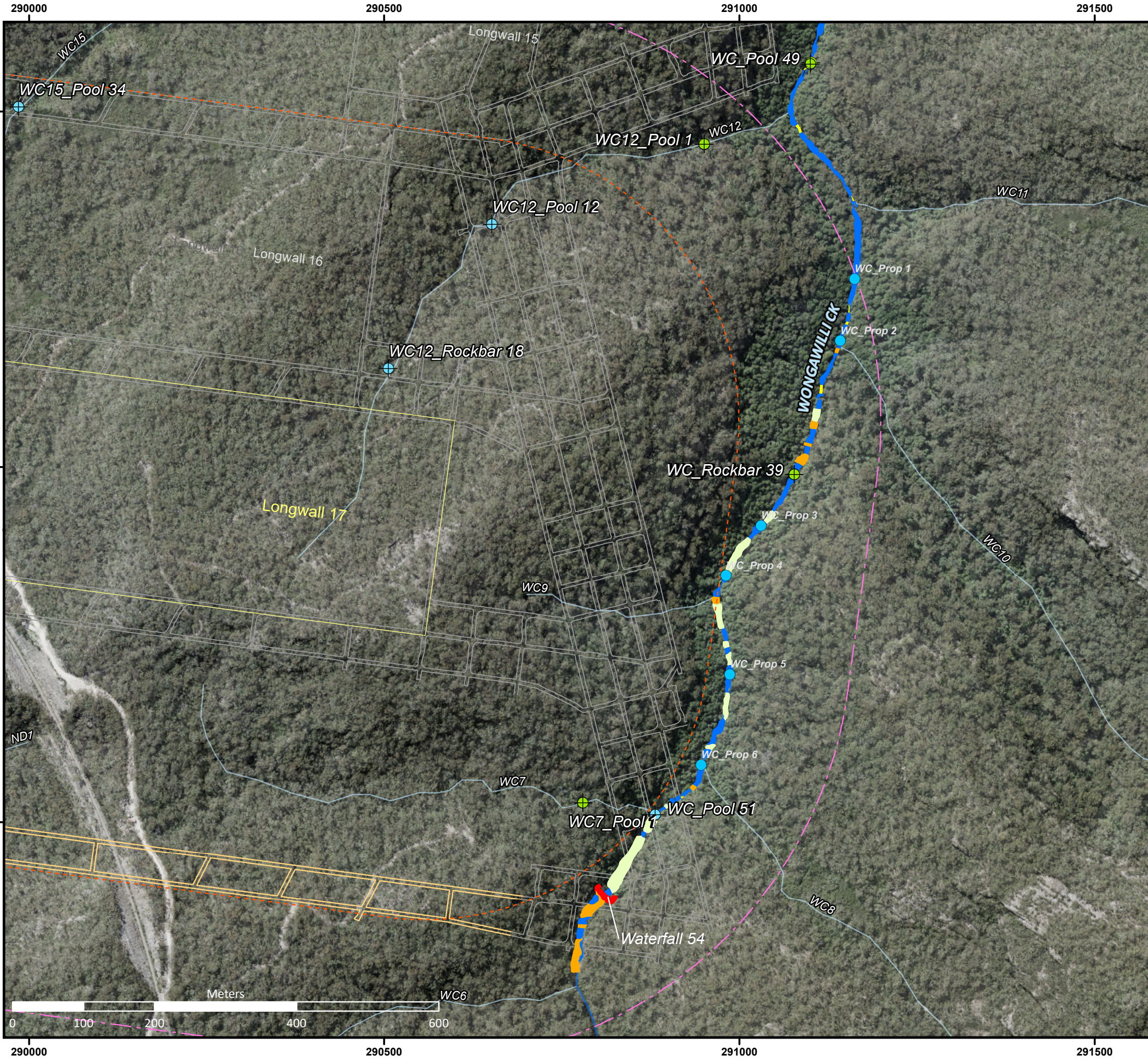
Regular visual inspections will be conducted, including taking photographic records of the creek, waterfall and lip of the waterfall. This will provide evidence of the effectiveness of the overall monitoring and management program for WC-WF54.

Hydrology

Installation of a concrete weir or similar in the upstream pool, or lip of the waterfall to provide an additional flow monitoring site was investigated by IMC. It was determined that this installation would have significant safety and aesthetic issues and would not meet the objectives of Schedule 3, Condition 13 of the DA3B SMP Approval to have no more than negligible impacts. A water level monitoring instrument with a data logger has been installed in the pool directly upstream of WC-WF54.

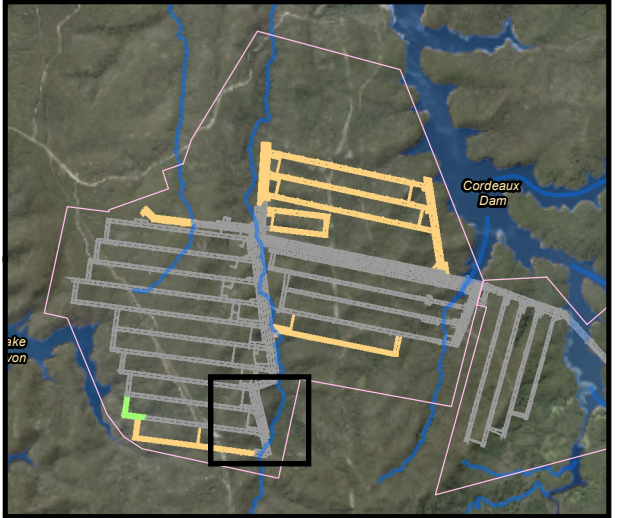
Pre-mining water level recession rate data will be compared to post-mining to monitor potential impacts. Recession rates also will be correlated with daily flow monitoring data from the upstream WWU flow monitoring site.

Visually, there is a clear relationship or correlation between the two hydrographs in Figure 4. They are both responsive to rainfall and decline or recede with a similar gradient. Differences in the magnitude of the stage and recession rate are due to differences in the geometry of the pools (the pool at WWU is larger in area than that at WF54, while the control cross-section at WF54 is wider than that at WWU).



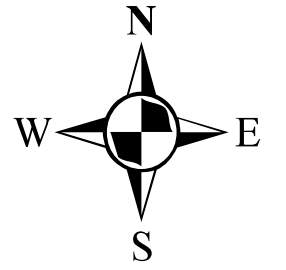
**DENDROBIUM
LONGWALL 17 SMP
Wongawilli Creek TARP**
Figure 2

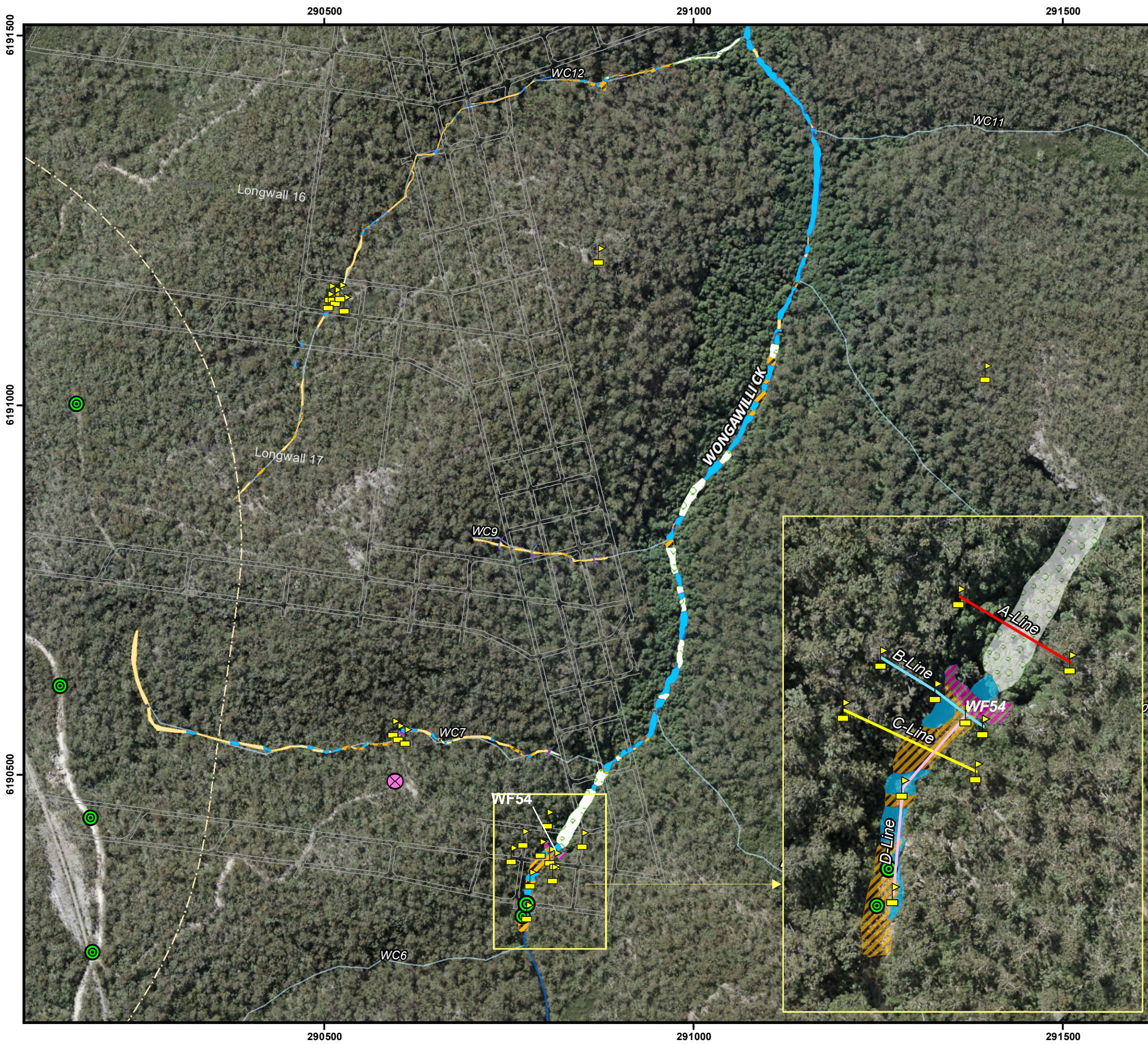
- Water Quality and Observation Site
 - Water Observation Site
 - Water Observation Site (Proposed)
 - Creeks
 - Tributaries
 - Longwall 17- Approved Panel
 - Study Area (600m)
 - Mining Area (400m)
 - Existing Mine Workings
 - Approved Mine Layouts
 - Proposed Longwall Layout
- Geomorphological Mapping**
- Pool
 - Channel
 - Rockbar
 - Step/Waterfall
 - Boulder Field



Date: October, 2020
Author: J. Carlon

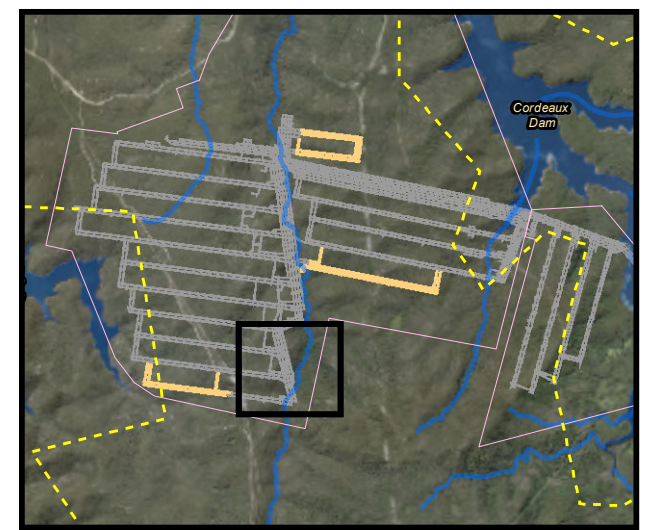
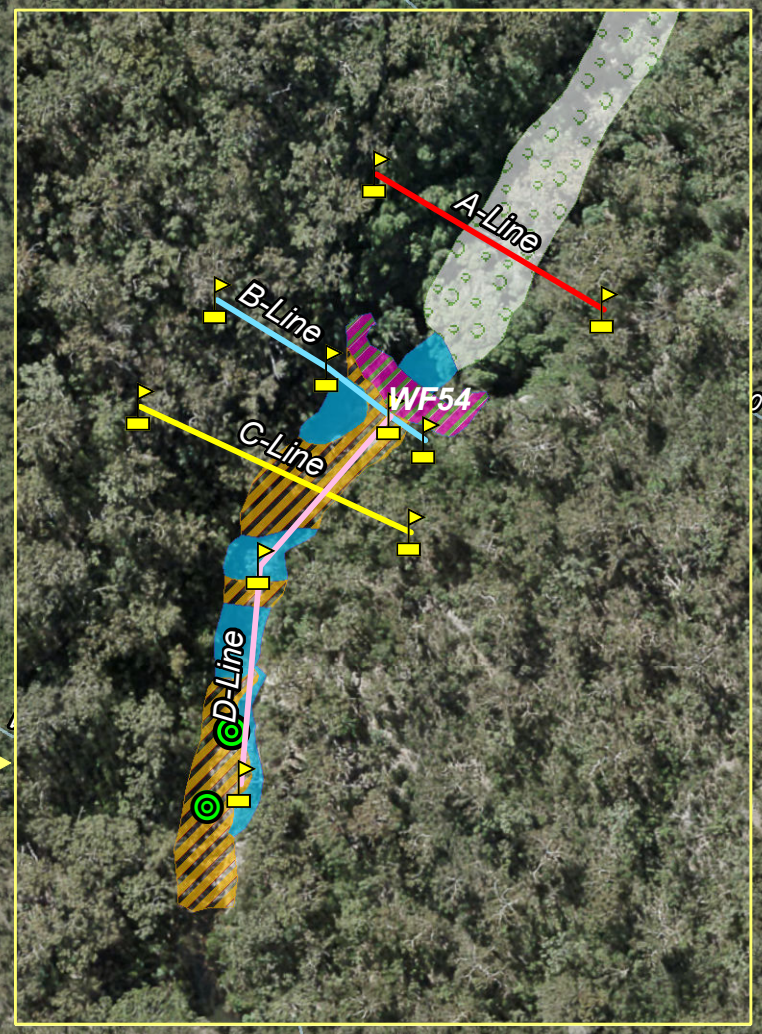
Version 1
Horizontal Datum
MGA - Zone 56





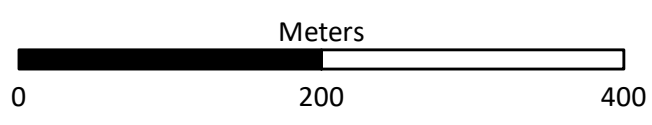
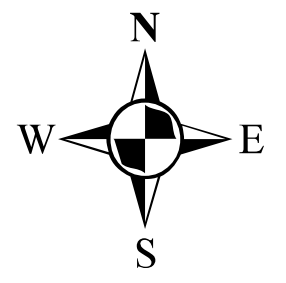
**DENDROBIUM
LONGWALL 18 SMP
Waterfall 54 Monitoring
Figure 3**

- 2D Survey Lines
- 3D GPS
- TDR
- Stream Features**
- Waterfall/Step
- Pool
- Channel
- Rockbar
- Boulder Field
- Creeks
- Tributaries
- Existing Mine Workings
- Proposed Longwall Layout
- Dam Safety NSW Notification Areas
- Dendrobium Development Consent Area



Date: March, 2021
Author: B. Agland

Version 1
Horizontal Datum
MGA - Zone 56



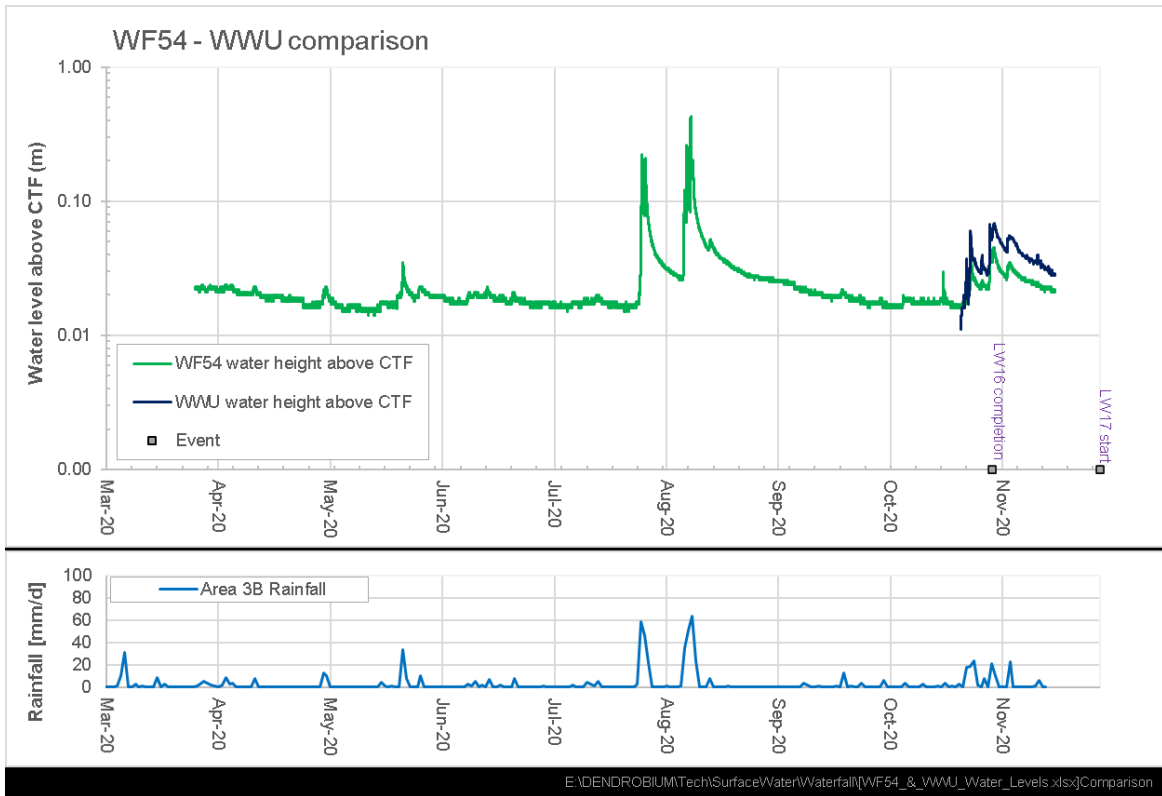


Figure 4 Comparative hydrograph of WF54 and WWU (from Orpheus instruments)

The 'baseline' or pre-mining period for hydrology will cease when Longwall 17 reaches 600 m remaining. This distance has been selected because it is approximately the same distance as the end of Longwall 16 from WC-WF54. At this time, the relationship between WWU and WF54 Pool should cover more of the range in rainfall and water level to enable more robust assessment of the 'post-mining' behaviour.

From that time, the relationship between WF54 and WWU water levels will be used to estimate the 'expected' WF54 water level in relation to the recorded WWU water level at that time.

Time Domain Reflectometry

A Time Domain Reflectometry (TDR) monitoring site has been installed to monitor bedding-plane shear near WC-WF54. It is approximately 220 m from WF54 at its closest point. The TDR monitoring site will provide information and early warning on the potential development of bedding-plane shear as mining approaches WC-WF54.

6 TRIGGER ACTION RESPONSE PLAN

A TARP has been developed to provide early identification of a potential exceedance of performance measures for Longwalls 17 and 18. Environmental monitoring parameters which would inform the TARP level for Wongawilli Creek include observational monitoring, water quality, pool water level, surface water flow (Assessments A -C) on Wongawilli Creek. Surface water flow assessment D could be triggered by the results of observational monitoring at sites within the Wongawilli Creek Study Area based on the 600 m buffer along Wongawilli Creek downstream of the WWU gauging station. The Wongawilli Creek TARPs are provided in Appendix A of the DA3B WIMMCP (South32 2020b).

The TARP for WC-WF54 has been based on the successful SCWMP and are included in Appendix A. The TARP uses changes in behaviour and rate of subsidence movement change as key assessment criteria. An independent

expert will review any changes in behaviour or rates of change from the monitoring data (for WC-WF54 related data) and will report the findings to the Steering Committee to make informed management decisions. Environmental monitoring parameters which would inform the TARP level for WC-WF54 include survey data, observational monitoring, water monitoring and TDR.

The TARPs relate to identifying, reporting, assessing and responding to potential impacts to Wongawilli Creek and WC-WF54 (including impacts greater than predicted) from subsidence in DA3B.

The TARPs represent actions (including reporting) to be taken upon reaching each defined trigger level. If required, a Corrective Management Action (CMA) is developed in consultation with stakeholders to manage an observed impact in accordance with relevant approvals.

7 REVIEW AND REPORTING

7.1 Wongawilli Creek Performance Measures

The performance measures and indicators have been derived from the Dendrobium Development Consent. These performance measures have been and will continue to be applied to DA3B mining:

- Operations shall not cause subsidence impacts at Wongawilli Creek other than “minor impacts” (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality);

The impact assessment for Wongawilli Creek (in part) is based on the potential for Type 3 impacts, defined as *fracturing in rockbar or upstream pool resulting in reduction in standing water level based on current rainfall and surface water flow*. MSEC (2017) states “the maximum predicted total closure along the section of Wongawilli Creek within the Study Area is 60 mm after Longwall 17”.

The total length of Wongawilli Creek located within a distance of 400 m of previously extracted longwalls is 2 km and one rockbar/pool has been observed to be impacted by fracturing. This rate of impact along Wongawilli Creek due to the previous mining, therefore, is considered to be low and consistent with model predictions.

Fracturing has occurred in Pool 43a along Wongawilli Creek due to the previous mining in Areas 3A and 3B. The impact site is located 200 m west of Longwall 6 and 410 m east of Longwall 9. The fracturing was first observed during the extraction of Longwall 9. Pool water levels below baseline conditions have been observed in this pool at low flow conditions during the mining of Longwall 13. This site has therefore been considered a Type 3 impact. The conclusions from Watershed HydroGeo (2018) were that low flows and pool levels were explained by the following:

- Although a fracture caused by mine subsidence is present in the base of Pool 43a, water levels in the pool were declining prior to that fracture occurring.
- Extended dry conditions from April 2017 driving high soil moisture deficits and low flow in watercourses across the region.
- Groundwater levels in the upper Bulgo Sandstone and lower Hawkesbury Sandstone in the vicinity of Pool 43a of Wongawilli Creek have declined, with these declines occurring since the extraction of Longwall 6 and continuing to present day. The draw down of groundwater is consistent with that predicted in various groundwater modelling to date.
- Multiple observations of low flow or dry conditions along the reach of Wongawilli Creek between Longwalls 6 and 12 indicate a mining effect. The distribution is consistent with the consequence of groundwater

draw down (previous point). Because the distribution of low flow or dry conditions begins upstream of the fracture in Pool 43a, this adds further weight to that feature not being responsible for low flows/pool levels.

- Comparison of predicted baseflow losses from groundwater modelling and the magnitude of incoming surface flows at WWU (~0.2 ML/d) indicates that actual flow losses due to mining are less than or similar to the predicted losses (approximately 0.3 ML/d).
- While such losses are inferred for the 'middle reach' of Wongawilli Creek (adjacent to mining), no effect on flows is discerned at the downstream gauging station WWL.

Watershed (2018):

“The finding of this assessment is that rainfall is the dominant process contributing to low pool water levels in Wongawilli Creek, and the severe rainfall deficit has reduced available water in the catchment to the extent that mining effects are now obvious. It is expected that while the drought continues, pool levels and river flows will remain low, consistent with historically low rainfall. When rainfall increases, surface flows and pool levels should recover, although there could be a lag while the significant soil moisture deficit is overcome.”

Since the end of the drought period (mid February 2020), Pool 43a has been observed to hold water and Wongawilli Creek has not ceased to flow at this pool.

In December 2015, DPIE published a report on an interagency investigation into the environmental impacts of mining in Area 3B. It concluded that there had been no breach of the conditions or performance criteria in the Consent or SMP approval.

Longwall 15 End of Panel

The Longwall 15 End of Panel (EoP) Report concluded that the Wongawilli Creek performance measure of minor environmental consequences had not been exceeded (see Section 5.4 of EoP Surface Water and Shallow Groundwater Assessment: Longwall 15 (HGEO [2020])).

Longwall 16 End of Panel

Longwall 16 EoP Report concluded “Changes to stream flow characteristics are not evident at the downstream gauge on Wongawilli Creek Lower (WWL), despite mining-related effects being clear and significant at upstream tributaries (e.g. WC21, WC15)” and that the Wongawilli Creek performance measure of minor environmental consequences had not been exceeded (see Section 7.2 of EoP Surface Water and Shallow Groundwater Assessment: Longwall 16 (HGEO [2021])).

7.2 Monitoring Data Review

The monitoring data review processes for Wongawilli Creek and WC-WF54 are outlined in Table 5. Key monitoring data is remotely downloaded to ensure that current data is readily available to take actions if required.

Table 5 Monitoring and Data Review

Review	Responsibility	Frequency
Survey	IMC Survey Team	Monthly / Weekly / Biweekly
Observational	IMCEFT	Monthly / Weekly / Biweekly
Hydrology	IMCEFT and consultant	Monthly / Weekly
Shear	TDR cable	Monthly / Weekly / Biweekly
Independent Expert	Independent Expert	Monthly / Weekly / Biweekly

Survey monitoring closure data will be provided to MSEC in accordance with the TARP level monitoring frequency. This data will be reviewed and used to update the predicted valley-related effects at the waterfall due to the mining of Longwall 17 and Longwall 18 based on an analysis of relevant ground monitoring data from Dendrobium Mine and the Southern Coalfield. A summary report which provides updated predictions, monitoring frequency recommendations and actions will be provided to IMC and the independent expert.

Other monitoring data for WC-WF54 will be provided to the suitably qualified independent expert for review, consistent with the escalation of TARP levels detailed in Appendix A i.e. on a monthly, weekly or daily basis.

Monitoring data and reports will be provided to the Independent Expert within 48 hours of its collection and availability respectively.

7.3 Area 3B SMP Condition 10

Condition 10 of the Area 3B SMP Approval states:

The Applicant may extend Longwall 17 (ie continue extraction), but not closer than 400 metres from the centreline of Wongawilli Creek, providing it can demonstrate:

(a) the relevant watercourse performance measure for Wongawilli Creek (ie minor environmental consequences, see Table 1) has not been exceeded by longwall extraction and would not be exceeded by extraction of Longwall 17; and

(b) detailed Trigger Action Response Plans that can accurately provide early warning of potential exceedances of this performance measure are approved and in place,

to the satisfaction of the Secretary.

In accordance with Condition 10, before Longwall 17 can proceed closer than 600 m to the Wongawilli Creek centreline, South32 must secure the approval of the Secretary.

Once Longwall 17 has progressed to within approximately 800 m of Wongawilli Creek, South32 will provide a summary of monitoring results regarding the Wongawilli Creek performance measure of “minor impacts” to DPIE for assessment against Condition 10.

7.4 Management Strategy Review

The Wongawilli Creek and WC-WF54 Management Strategy has been reviewed during the extraction of Longwall 16 and revised prior to the extraction of Longwall 17. The TARP will be reviewed during the extraction of Longwall 17 and 18 based on new, unexpected or trends in monitoring results.

7.5 Reporting

The DPIE and Water NSW will be notified within 24 hours in the event of IMC becoming aware of:

- Failure of the monitoring system;
- Any TARP action, including reporting or any decision to stop mining; or
- Any exceedance of the Consent or performance measures.

8 REFERENCES

HGEO (2020) *End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 15 (Area 3B)*. May 2020.

HGEO (2021) *End of Panel Surface Water and Shallow Groundwater Assessment: Longwall 16 (Area 3B)*.

MSEC (2021) *Dendrobium – Area 3B – Waterfall 54 monitoring and reporting Review of the closure predictions due to LW17 and LW18*. Report for IMC.

South32 (2021) *Sandy Creek Waterfall Management Plan*. January 2021.

South32 (2020a) *Longwall 18 Geology Report*. July 2020.

South32 (2020b) *Area3B Watercourse Impact Monitoring, Management and Contingency Plan*. August 2020.

Watershed Hydrogeo (2018) *Dendrobium Area 3B Analysis of low flow and pool levels on Wongawilli Creek*. October 2018.

Appendix A – Wongawilli Creek Waterfall 54 Trigger Action Response Plan

OBSERVATIONAL MONITORING		
<p>Wongawilli Creek Waterfall 54</p> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> • Waterfall WC-WF54 – negligible environmental consequences <ul style="list-style-type: none"> - no rock fall occurs at WF54 or from its overhang; - the structural integrity of the waterfall, its overhang and its pool are not impacted; - cracking in Wongawilli Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and - negligible diversion of water occurs from the lip of the waterfall 	<p>Level 1</p> <ul style="list-style-type: none"> • Visible fracturing, ecological impact or water diversion on Wongawilli Creek due to mining of Longwalls 17 or 18 	<ul style="list-style-type: none"> • Continue monthly monitoring program • Submit an Impact Report to BCS, DPIE, MEG and WaterNSW • Report in the End of Panel Report • Summarise actions and monitoring in AR • Independent expert to advise on monitoring frequency
	<p>Level 2</p> <ul style="list-style-type: none"> • Visible fracturing, ecological impact or water diversion within 300 – 150 m of WC-WF54 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 1</i> • Increase monitoring to weekly • Submit letter report to DPIE, MEG and Water NSW and seek advice on any CMA required • Implement agreed CMAs as approved (subject to agency feedback)
	<p>Level 3</p> <ul style="list-style-type: none"> • Visible fracturing, ecological impact or water diversion within 150 m of WC-WF54 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Increase monitoring frequency to twice weekly • Offer site visit with BCS, DPIE, MEG and WaterNSW • Develop site CMA (subject to agency feedback). This may include: grouting of rockbar where it is appropriate to do so in consultation with BCS, DPIE, MEG and Water NSW • Completion of works following approvals and at a time agreed between S32, DPIE, MEG and Water NSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success • Review relevant TARP and Management Plan in consultation with key agencies
	<p>Exceeding Prediction</p> <ul style="list-style-type: none"> • Mining results in rock fall at WC-WF54 or its overhang • Mining results in impacts on the structural integrity of WC-WF54, its overhang or its pool • Mining results in greater than negligible cracking in Wongawilli Creek within 30 m of the waterfall; and • Mining results in greater than negligible diversion of water from the lip of the waterfall. 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent

VALLEY CLOSURE		
<p>Wongawilli Creek Waterfall 54</p> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> Waterfall WC-WF54 – negligible environmental consequences <ul style="list-style-type: none"> no rock fall occurs at WF54 or from its overhang; the structural integrity of the waterfall, its overhang and its pool are not impacted; cracking in Wongawilli Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and <p>Primary 2D high resolution closure lines across WC-WF54:</p> <ul style="list-style-type: none"> A Line B Line C Line <p>Primary 2D high resolution closure lines along WC-WF54:</p> <ul style="list-style-type: none"> D Line 	<p>Level 1</p> <ul style="list-style-type: none"> No measurable movement on primary 2D high resolution lines beyond Longwall 17 baseline steady state 	<ul style="list-style-type: none"> Continue monthly monitoring program Summarise actions and monitoring in AR Independent expert to advise on monitoring frequency
	<p>Level 2</p> <ul style="list-style-type: none"> Repeatable measurable movement on primary 2D high resolution lines consistent with low level mining influence 	<ul style="list-style-type: none"> Actions as stated for Level 1 Increase monitoring to weekly
	<p>Level 3</p> <ul style="list-style-type: none"> Increased rate of movement on primary 2D high resolution lines indicating increasing risk of unacceptable deformation 	<ul style="list-style-type: none"> Actions as stated for Level 2 Increase monitoring frequency to twice weekly Offer site visit with BCS, DPIE, MEG and Water NSW Develop site CMA (subject to agency feedback). This may include: grouting of rockbar where it is appropriate to do so in consultation with BCS, DPIE, MEG and Water NSW Completion of works following approvals and at a time agreed between S32, DPIE, MEG and Water NSW (i.e. may be after mining induced movements and impacts are complete), including monitoring and reporting on success Review relevant TARP and Management Plan in consultation with key agencies The IMC Steering Committee will seek the advice of the independent expert prior to continuing mining past the next cut-through that is closest to the Longwall 17 face position
	<p>Exceeding Prediction</p> <ul style="list-style-type: none"> Mining results in rock fall at WC-WF54 or its overhang Mining results in impacts on the structural integrity of WC-WF54, its overhang or its pool Mining results in greater than negligible cracking in Wongawilli Creek within 30 m of the waterfall 	<ul style="list-style-type: none"> Actions as stated for Level 3 Investigate reasons for the exceedance Update future predictions based on the outcomes of the investigation Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent
WATER FLOW		
<p>Wongawilli Creek Waterfall 54</p> <p>Relevant Performance Measure(s):</p> <ul style="list-style-type: none"> Waterfall WC-WF54 – negligible environmental consequences 	<p>Level 1</p> <ul style="list-style-type: none"> Observed WF54 pool water levels outside expected Min-Max range for up to 10% of records any 7-day period but returning to within expected Min-Max range 	<ul style="list-style-type: none"> Report in the End of Panel Report Summarise actions and monitoring in AR Independent Expert to advise on monitoring frequency
	<p>Level 2</p>	<ul style="list-style-type: none"> Actions as stated for Level 1 Implement agreed CMAs as approved (subject to agency feedback)

<ul style="list-style-type: none"> - the structural integrity of the waterfall, its overhang and its pool are not impacted; - cracking in Wongawilli Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and - negligible diversion of water occurs from the lip of the waterfall 	<ul style="list-style-type: none"> • Observed WF54 pool water levels outside expected Min-Max range for up to 25% of records any 7-day period but returning to within expected Min-Max range 	
	<p>Level 3</p> <ul style="list-style-type: none"> • Observed WF54 pool water levels outside expected Min-Max for more than 25% of records any 7-day period 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Review relevant TARP and Management Plan in consultation with key agencies
	<p>Exceeding Prediction</p> <ul style="list-style-type: none"> • Mining results in greater than negligible diversion of water from the lip of the waterfall 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide residual environmental offset for any mining impact where CMAs are unsuccessful as required by Condition 14 Schedule 3 of the Development Consent
SHEAR		
<p>Waterfall WC-WF54</p> <p>Relevant Performance Measure(s): Waterfall WC-WF54 – negligible environmental consequences</p> <p>Time-domain Reflectometry</p>	<p>Level 1</p> <ul style="list-style-type: none"> • No measurable movement beyond Longwalls 17 baseline steady state 	<ul style="list-style-type: none"> • Continue monthly monitoring program • Report in the End of Panel Report • Summarise actions and monitoring in AR
	<p>Level 2</p> <ul style="list-style-type: none"> • Multiple measurable movement consistent with low level mining influence 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 1</i> • Increase monitoring to weekly
	<p>Level 3</p> <ul style="list-style-type: none"> • Shear movements result in failure of the TDR cable 	<ul style="list-style-type: none"> • <i>Actions as stated for Level 2</i> • Independent expert to advise on monitoring frequency • Review relevant TARP and Management Plan in consultation with key agencies

NSW Government Agencies

Department of Planning, Industry and Environment (DPIE)

Biodiversity and Conservation Science Directorate (BCS)

Department of Mining, Exploration and Geosciences (MEG)

WaterNSW