WAMBO COAL PTY LIMITED



SOUTH BATES EXTENSION UNDERGROUND MINE

EXTRACTION PLAN
LONGWALLS 21 TO 24

APPENDIX A
WATER MANAGEMENT PLAN

Peabody

WAMBO COAL PTY LIMITED
SOUTH BATES EXTENSION UNDERGROUND MINE

WATER MANAGEMENT PLAN
LONGWALLS 21 - 24



PREPARED BY
WAMBO COAL PTY LIMITED

January 2021
Project No. WAM-09-15
Document No. 01030970

DOCUMENT CONTROL

Document No.	WMP LW21-24
Title	Water Management Plan for South Bates Extension Underground Mine Longwalls 21 to 24
General Description	Management of potential subsidence effects, subsidence impacts and environmental consequences on surface water resources, groundwater resources and flooding for the mining of Longwalls 21 to 24 at the South Bates Extension Underground Mine
Key Support Documents	Wambo Coal Water Management Plan Wambo Coal Surface Water Management Plan Wambo Coal Groundwater Management Plan United Wambo and Wambo Water Monitoring Program

Revisions

Rev No	Date	Description	By	Checked
A	March 2020	Original Draft for Consultation	WCPL and Resource Strategies	
B	July 2020	Final for Submission (minor changes to address comments, update monitoring program and update longwall layout)	WCPL and Resource Strategies	
C	January 2021	Inclusion of recently approved SW & GW Management Plans and Water Monitoring Program	WCPL	

The nominated Coordinator for this document is	Manager: Environment and Community

TABLE OF CONTENTS

Section			Page
1	INTRODUCTION		2
	1.1	PURPOSE AND SCOPE	2
	1.2	STRUCTURE OF THE WATER MANAGEMENT PLAN	6
	1.3	CONSULTATION ON THE WATER MANAGEMENT PLAN	12
2	PERFORMANCE MEASURE		13
3	PREDICTED SUBSIDENCE IMPACTS AND ENVIRONMENTAL CONSEQUENCES		14
	3.1	SURFACE WATER	14
		3.1.1 Background	14
		3.1.2 Potential Subsidence Impacts and Environmental Consequences	14
	3.2	GROUNDWATER	18
		3.2.1 Background	18
		3.2.2 Potential Subsidence Impacts and Environmental Consequences	19
4	MONITORING		21
5	MANAGEMENT MEASURES		23
6	ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES		25
7	CONTINGENCY PLAN		28
8	REFERENCES		29

LIST OF TABLES

Table 1	Water Management Plan Requirements
Table 2	Supporting Documents – Reference Summary
Table 3	Water Performance Measure
Table 4	Water Management Plan Monitoring Program Overview
Table 5	Water Management Plan Key Management Measures
Table 6	Water Performance Measure and Performance Indicators
Table 7	Monitoring of Environmental Consequences against Performance Indicators and Measures

LIST OF FIGURES

Figure 1	Regional Location
Figure 2	Approved Wambo Coal Mine Layout
Figure 3	Wambo Coal Mine Environmental Management System
Figure 4	Locations of Surface Water and Groundwater Monitoring Sites
Figure 5	Aerial Photograph of North Wambo Creek in the Vicinity of Longwalls 21 to 24
Figure 6	Monitoring of Environmental Consequences against Performance Indicators and Measures

LIST OF ATTACHMENTS

Attachment 1	Water Management Plan Trigger Action Response Plan
Attachment 2	Wambo Water Management Plan
Attachment 3	Surface Water Management Plan
Attachment 4	Groundwater Management Plan
Attachment 5	United Wambo and Wambo Water Monitoring Program

INTRODUCTION

The Wambo Coal Mine is an open cut and underground coal mining operation located approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW) (**Figure 1**). The Wambo Coal Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

The South Bates Extension Underground Mine is a component of the approved Wambo Coal Mine. The South Bates Extension Underground Mine commenced in Longwall 17 in December 2018 and involves extraction of coal by longwall mining methods from the Whybrow Seam within Coal Lease (CL) 397, Mining Lease (ML) 1594, ML 1572 and Mining Lease Application (MLA) 557 (**Figure 2**).

The potential environmental impacts of the existing Wambo Coal were assessed in the *Wambo Development Project Environmental Impact Statement* (the Wambo Development Project EIS) (WCPL, 2003). Development Consent DA 305-7-2003 for the Wambo Coal Mine was granted on 4 February 2004 by the then NSW Minister for Urban Affairs and Planning under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979*.

An application to modify the Development Consent (DA 305-7-2003 MOD 17) to allow the development of the South Bates Extension Underground Mine (Longwalls 17 to 25) in the Whybrow Seam was approved in December 2017. The application was accompanied by the *South Bates Extension Modification Environmental Assessment* (South Bates Extension Modification EA) (WCPL, 2017).

1.1 PURPOSE AND SCOPE

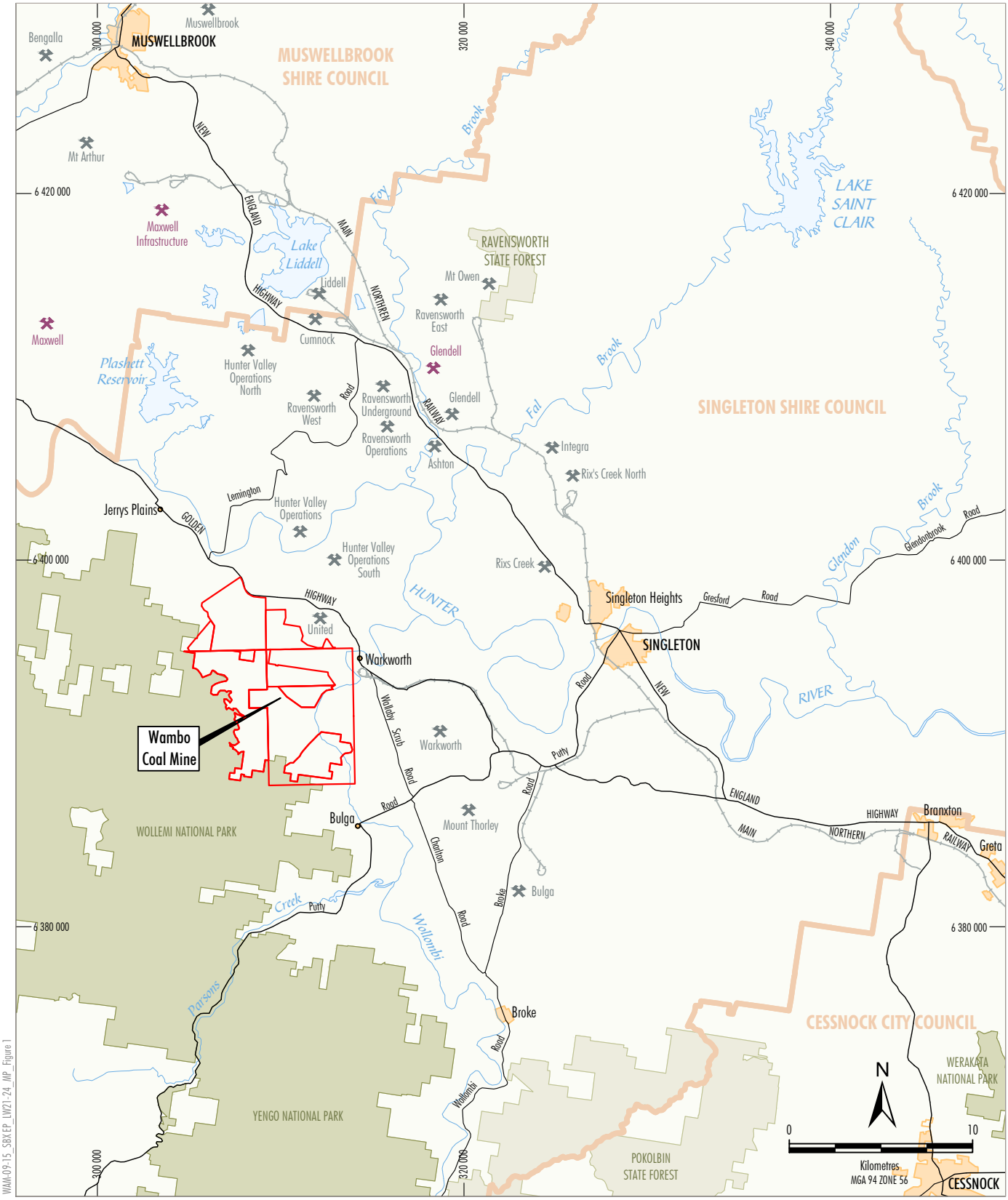
Purpose: This WMP for Longwalls 21 to 24 outlines the management of potential environmental consequences of the proposed secondary workings described in the Extraction Plan on water resources.

Scope: This WMP covers surface water resources, groundwater resources and flooding within the Longwalls 21 to 24 Application Area (**Figure 2**).

This WMP has been prepared in accordance with Condition B7(f) of Schedule 2 of the Development Consent (DA 305-7-2003) as a component of the South Bates Extension Underground Mine Longwalls 21 to 24 Extraction Plan.

Management plan requirements applicable to the preparation of this WMP, and where each of these requirements is addressed within this WMP, are summarised in **Table 1**.

This WMP has been prepared by WCPL, with assistance from Resource Strategies. The WMP draws on the conclusions of reports by Alluvium (2020) and SLR Consulting Pty Ltd (SLR) (2020) that form part of the Extraction Plan. The appointment of the team of suitably qualified and experienced experts (which includes representatives from WCPL, Alluvium, SLR and Resource Strategies) has been endorsed by the Secretary of the Department of Planning, Industry and Environment (DPIE).





LEGEND
- Mining and Coal Lease Boundary
- Local Government Boundary
- Mining Operation
- Proposed Mining Operation (Application lodged)

Source: NSW Department of Industry (2021); Geoscience Australia (2009)

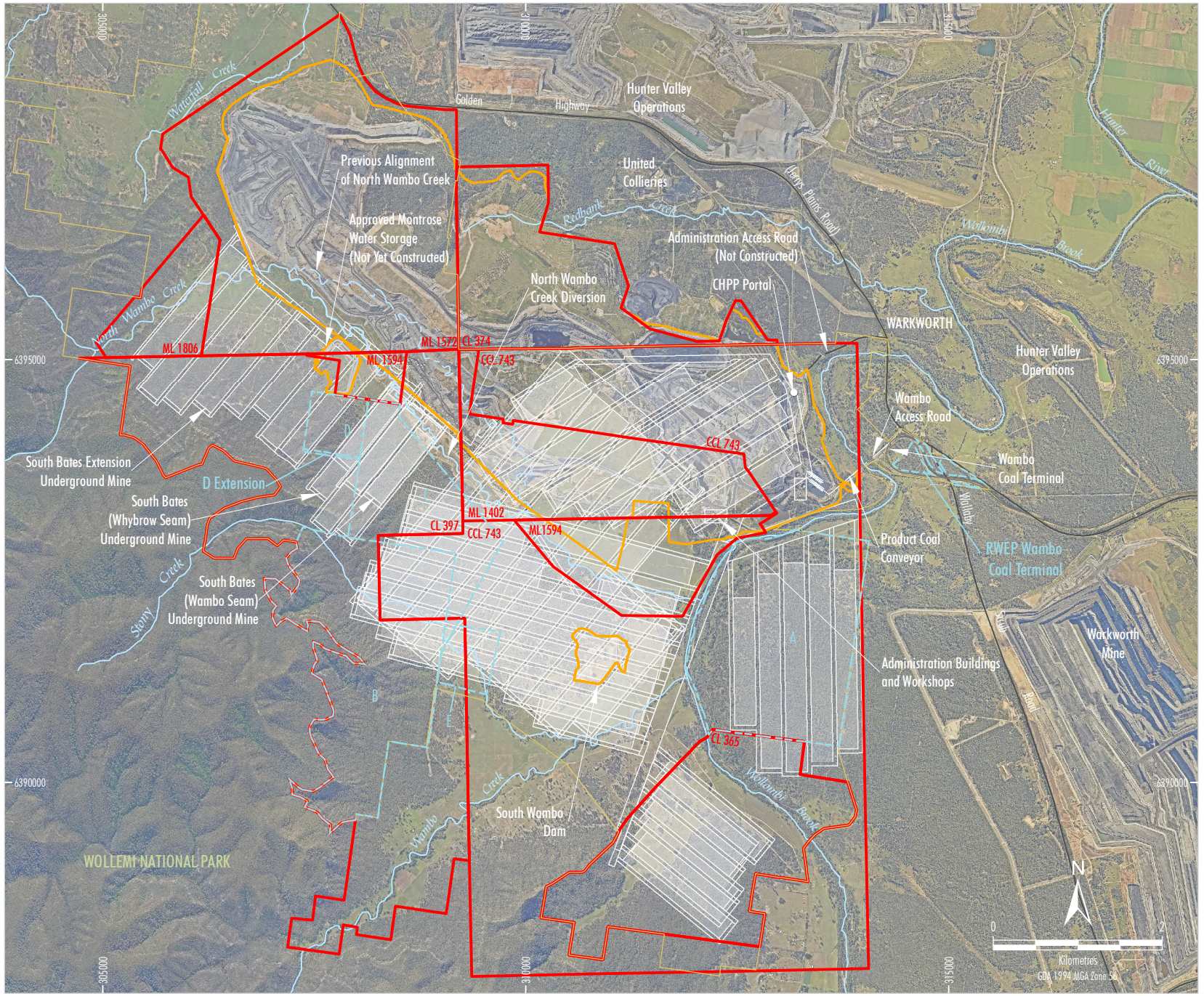
Peabody

WAMBO COAL MINE

Regional Location

Figure 1

WAM-09-15_SBX EP_LW21-24_MP_Figure 1



Peabody

WAMBO COAL MINE

Approved Wambo Coal Mine Layout

Figure 2

Table 1
Water Management Plan Requirements

Development Consent (DA 305-7-2003) Condition	WMP Section
Condition B7 of Schedule 2 *B7. The Applicant must prepare an Extraction Plan for all second workings on the site to the satisfaction of the Planning Secretary. Each Extraction Plan must:* *...*	
(c) provide updated predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent;	Addressed in **Section 3**.
(d) describe in detail the performance criteria to be implemented to ensure compliance with the performance measures in Table 1 and Table 2, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition B104, including:	Addressed in **Table 2**.
(i) a trigger action response plan to identify risks and specific follow up actions to avoid exceedances of the performance measures; and	Addressed in **Attachment 1**.
(ii) a contingency plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of the performance measures, or where any such exceedance appears likely;	Addressed in **Section 7**.
(f) include a: *(i) **Water Management Plan**, which has been prepared in consultation with EPA, DPIE Water and NRAR, which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on surface water resources, groundwater resources and flooding, and which includes:*	Management of potential impacts and/or environmental consequences on water are addressed in **Section 5**. Performance measures and performance indicators relevant to water are presented in **Section 2** and **Section 6** respectively.
• *surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources (level, yield and quality);*	Addressed in **Table 2**.
• *a program to monitor and report on compliance with the surface and groundwater impact assessment criteria;*	Addressed in **Table 7**.
• *a program to monitor and report on groundwater inflows to underground workings; and*	Addressed in **Table 2**.
• *a program to manage and monitor impacts on privately-owned licensed bores;* *...*	Addressed in **Table 2**.

1.2 STRUCTURE OF THE WATER MANAGEMENT PLAN

This WMP forms part of WCPL's Environmental Management System for the Wambo Coal Mine. The relationship of this WMP to the Wambo Coal Mine Environmental Management System is shown on **Figure 3**.

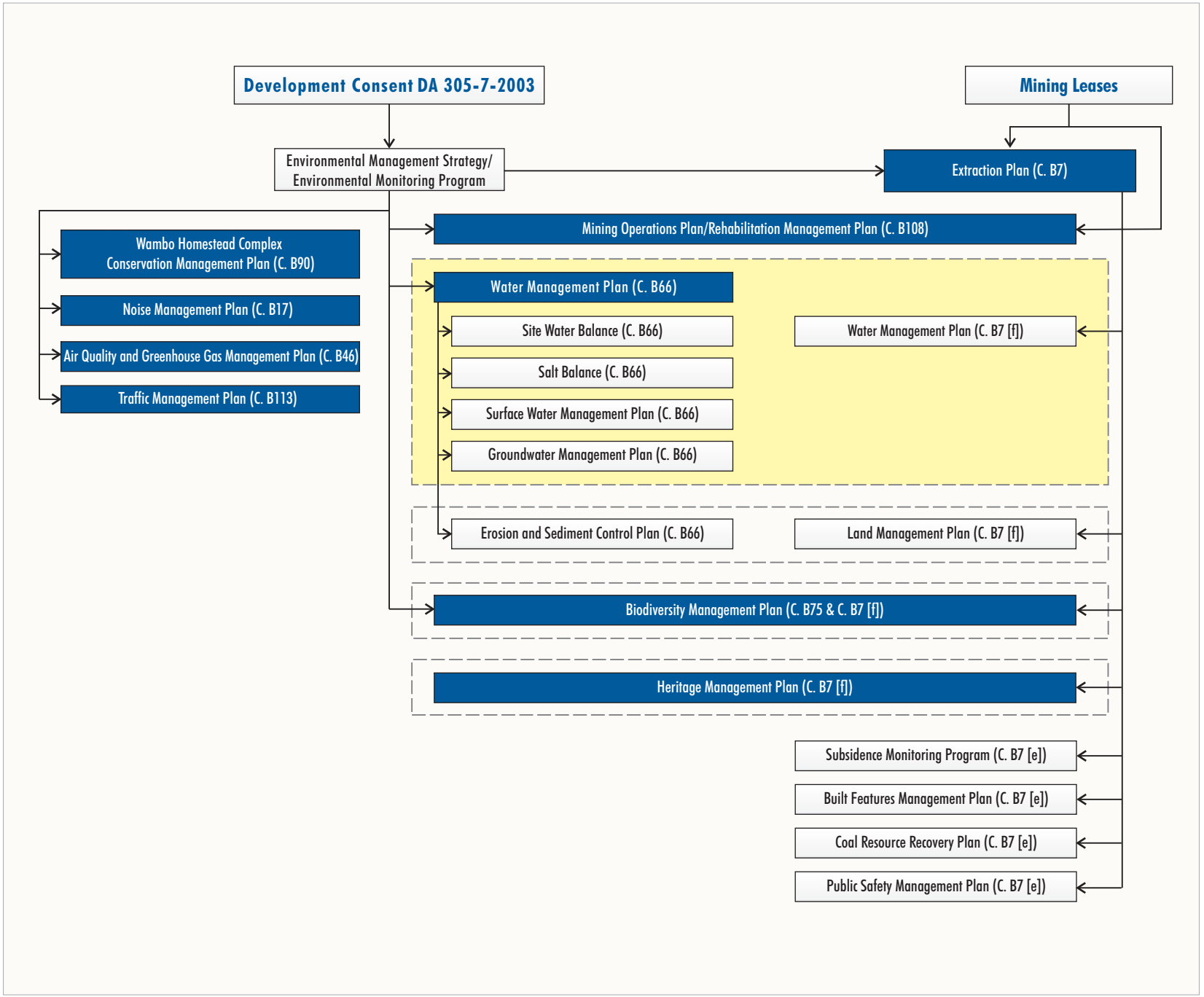
Following approval of the United Wambo Joint Venture Project (Modification 16) in 2019, DPIE issued a revised Development Consent (DA 305-7-2003) for the Wambo Coal Mine. In accordance with Condition B66, Schedule 2 of DA 305-7-2003, WCPL is preparing a contemporary Water Management Plan, including a Site Water Balance, Salt Balance, Erosion and Sediment Control Plan, Surface Water Management Plan and Groundwater Management Plan[1].

As these plans are still in preparation, and to avoid duplication of existing Environmental Management Plans, this WMP references the existing WCPL Water Management Plan, and its components, including the:

- Surface Water Management Plan (SWMP);
- Groundwater Management Plan (GWMP); and
- United Wambo and Wambo Water Monitoring Program (WMonP).

The Wambo Water Management Plan, SWMP, GWMP and WMonP are included in **Attachments 2, 3, 4 and 5**, respectively. The sections of the SWMP, GWMP and WMonP relevant to the WMP are summarised in **Table 2**, with the monitoring site locations shown in **Figure 4**. Previous versions of the Extraction Plan reference the Surface and Groundwater Response Plan (SGWRP) however this information is now incorporated into the recently approved GWMP and SWMP.

[1]



Peabody

WAMBO COAL MINE

Wambo Coal Mine
Environmental Management System

Figure 3

Table 2
Supporting Documents – Reference Summary

WMP Component	Existing Program/Plan Reference	Section Description
Description of the existing environment	GWMP Section 3 – Existing Groundwater Conditions and Baseline Data	Section 3 of the GWMP includes an overview of the hydrogeology in proximity to the Wambo Coal Mine.
	SWMP Section 3 – Existing Surface Water Conditions and Baseline Data	Section 3 of the SWMP includes an overview of the hydrological features in proximity to the Wambo Coal Mine.
Surface water monitoring	SWMP Section 6.1.1 – Surface Water Quality	Water sampling is undertaken at sites along Wollombi Brook, North Wambo Creek, the North Wambo Creek Diversion, Wambo Creek (also known as South Wambo Creek), and Stony Creek. The location of these sites is presented in **Figure 4**. Parameters monitored include pH, electrical conductivity (EC) and total suspended solids (TSS). Metals and ions are sampled at a subset of sites. Sampling is only undertaken during flow periods to ensure that increased solute concentration (caused by evaporation) does not cause incorrect sample results.
	SWMP Section 6.1.2 – Mine Water Quality	A number of monitoring sites relevant to mine water are sampled as described in Table A of the WMonP. Mine water storage dams including Eagles Nest Dam, Box Cut Dam, Gordon Below Franklin Dam, Homestead Open Cut and C11 Void are sampled monthly for pH and EC.
	SWMP Section64.1.3 – Surface Water Flows	WCPL monitors flow in North Wambo Creek, the North Wambo Creek Diversion, Wambo Creek and Stony Creek using continuous flow monitoring stations. Surface water flow monitoring data for Wollombi Brook is sourced from Department of Industry – Water (DI-Water) operated flow gauging stations, located at Warkworth (FM10) and Bulga (FM11) (**Figure 4**).
	SWMP Section 6.1.6 – Riparian Vegetation and Creek Bed Stability	A program to monitor for potential subsidence impacts to fluvial geomorphology commenced in October 2006. The program aims to distinguish natural erosion from mine subsidence associated instability, through pre-mining and post-mining survey mapping in North Wambo Creek, the North Wambo Creek Diversion, Wambo Creek and Stony Creek and annual transect monitoring of riparian vegetation.
	SWMP Section 6.1.6 – Diversion and Subsidence Monitoring Program	This section of the SWMP provides a consolidated description of the monitoring methodology for the North Wambo Creek Diversion.

Table 2 (Continued)
Supporting Documents – Reference Summary

WMP Component	Existing Program/Plan Reference	Section Description
Groundwater monitoring	GWMP Section 6 – Groundwater Monitoring Program	Section 6 of the GWMP summarises the WCPL groundwater monitoring program including the monitoring network, measured parameters and monitoring frequency.
	GWMP Section 6.1 – Monitoring Network, Parameters and Frequency	The WCPL groundwater monitoring network is presented in **Figure 4**. Standpipe monitoring sites are regularly monitored for water level, pH and EC. The GWMP takes into account the existing site groundwater data, both from WCPL and the neighbouring United Colliery, as well as the historical and current mining operations.
	GWMP Section 6.1.2 – Inflows to Underground Workings	Dewatering volumes and underground water levels will be recorded on a daily basis during pumping. This data will be incorporated into the site water balance on an annual basis to allow calculation of groundwater inflows including loss of groundwater from alluvium and to verify whether WCPL holds sufficient groundwater licence entitlements.
Surface water impact assessment criteria	SWMP Section 4.1 – Surface Water Impact Assessment Criteria	Section 4.1 of the SWMP summarises the surface water impact assessment criteria adopted for Wollombi Brook, North Wambo Creek, Wambo Creek, Stony Creek and Waterfall Creek. If monitoring data exceed these criteria an investigation is undertaken to identify any adverse impacts on water resources or water quality.
	SWMP Section 6.4 – Data Review and Investigation	Section 6.4 of the SWMP outlines the procedure for review of data collected as part of the SWMP, as well as the investigation and response protocol implemented if water quality monitoring data are found to exceed the water quality criteria (i.e. if the trigger levels are exceeded).
Groundwater impact assessment criteria	GWMP Section 4 – Groundwater Triggers	Trigger levels have been developed for groundwater quantity and quality. Shallow bore trigger levels are listed in Table 11 of the GWMP.
	GWMP Section 6.4 – Data Review and Investigation	Section 6.4 of the GWMP outlines the procedure for review of data collected as part of the GWMP, as well as the investigation and response protocol implemented if water quality monitoring data are found to exceed the water quality criteria (i.e. if the trigger levels are exceeded).
Program to manage and monitor impacts on privately-owned licensed bores	GWMP Section 7.3 – Impacts on Groundwater	Section 7.3.1.1 of the GWMP details the investigation undertaken in the event that a trigger level is exceeded or a complaint is received in relation to loss of groundwater supply. If the investigation identifies groundwater impacts attributable to WCPL activities, appropriate measures will be developed in consultation with relevant agencies and any affected adjacent landowners.
	GWRP Section 7.3 and SWMP Section 7.3.4 – Unforeseen Impacts	This section details the general response procedure initiated in the event that an unforeseen surface or groundwater impact is detected.

Table 2 (Continued)
Supporting Documents – Reference Summary

WMP Component	Existing Program/Plan Reference	Section Description
Responsibilities	SWMP Section 7 – Responsibilities	This section summarises the SWMP responsibilities and timing of SWMP tasks.
	GWMP Section 10 – Responsibilities	This section summarises the GWMP responsibilities and timing of GWMP tasks.
	WMonP Section 5 – Responsibilities	This section summarises the WMonP responsibilities and timing of WMonP tasks.

An overview of the main text sections and attachments of this WMP is presented below:

Section 1 Provides an introduction to the WMP, including the purpose and scope of the WMP and the context of the WMP in relation to WCPL's Environmental Management System for the Wambo Coal Mine.

Section 2 Describes the performance measures relevant to water.

Section 3 Summarises the predicted subsidence impacts and environmental consequences resulting from the extraction of Longwalls 21 to 24.

Section 4 Provides a summary of the monitoring of the North Wambo Creek and North Wambo Creek Diversion that will be undertaken in relation to Longwalls 21 to 24.

Section 5 Describes the management measures that will be implemented for the North Wambo Creek.

Section 6 Describes how monitoring data will be used to assess the extraction of Longwalls 21 to 24 against the relevant performance indicators and performance measures.

Section 7 Provides a Contingency Plan to manage any unpredicted impacts and their consequences.

Section 8 Lists the documents referred to in **Sections 1 to 7** of this WMP.

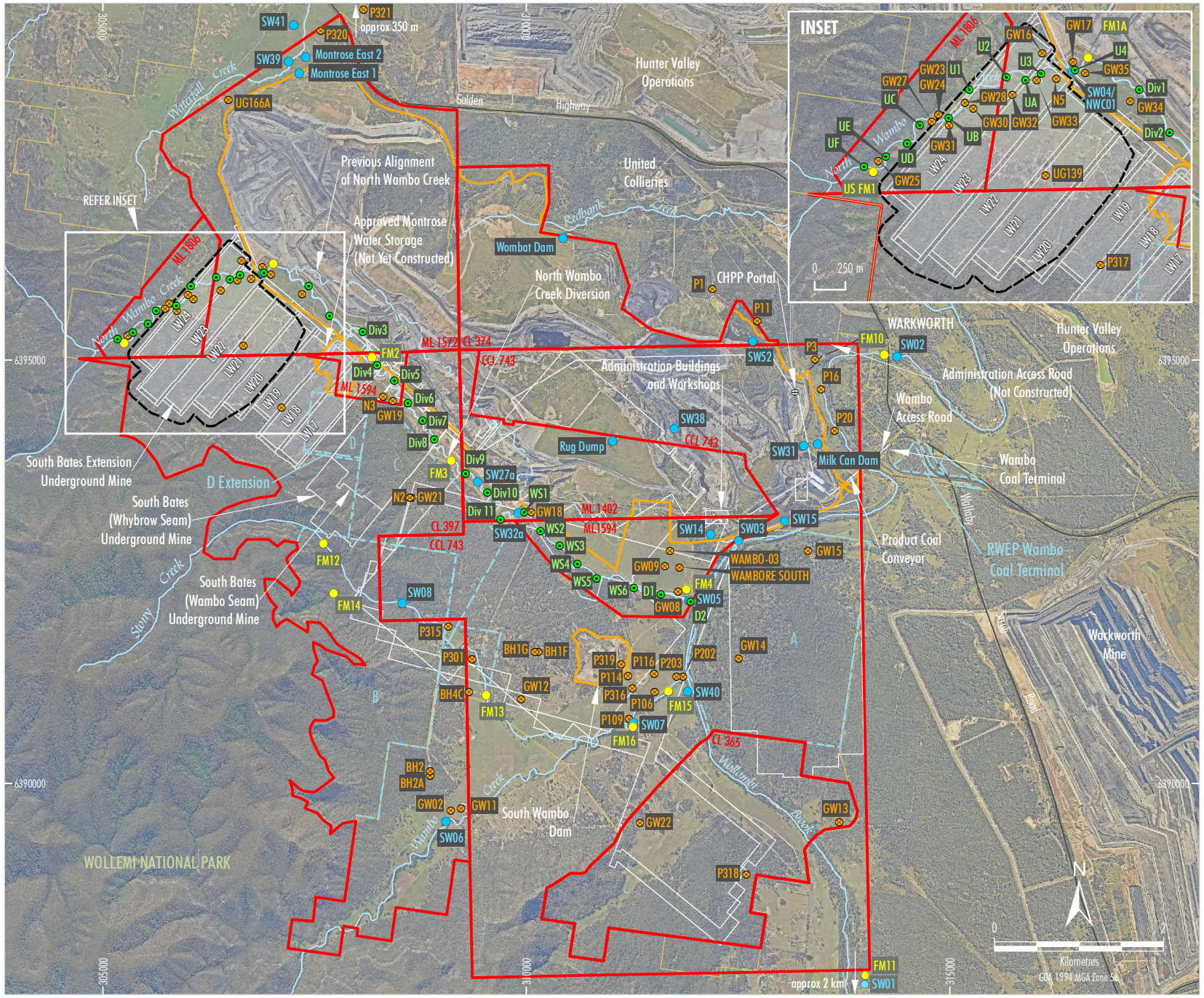
Attachment 1 Provides a Trigger Action Response Plan (TARP) for this WMP which is a simple and transparent snapshot of the monitoring of environmental performance and, where required, the implementation of management and/or contingency measures.

Attachment 2 Provides a copy of the Wambo Water Management Plan (Version 2).

Attachment 3 Provides a copy of the SWMP (Version 2).

Attachment 4 Provides a copy of the GWMP (Version 2).

Attachment 5 Provides a copy of the WMonP (Version 2).



LEGEND

- WCPL Owned Land
- Mining and Coal Lease Boundary
- Existing/Approved Surface Development Area
- Approved Underground Development
- Remnant Woodland Enhancement Program (RWEP) Area
- Extraction Plan Application Area
- Groundwater Monitoring Site
- Surface Water Quality Monitoring Site
- Surface Water Flow Monitoring Site
- Diversion and Subsidence Monitoring Site

Source: WCPL (2021); NSW Spatial Services (2021)
Orthophoto: WCPL (May 2019)

Peabody

WAMBO COAL MINE

Locations of Surface Water and Groundwater Monitoring Sites

Figure 4

WAM-09-15_SBX EP_LW 21-24_WMP_201E

1.3 CONSULTATION ON THE WATER MANAGEMENT PLAN

This WMP builds upon consultation conducted as part of:

- the development and review of referenced components of the existing Wambo Water Management Plan (the GWMP, SWMP, the previously approved SGWRP and the WMonP);
- the WMPs prepared for Longwalls 11 to 16 and Longwalls 17 to 20; and
- the consultation conducted during the preparation and the assessment of DA 305-7-2003 MOD 17.

Consultation undertaken relevant to the WMPs for Longwalls 11 to 16 and Longwalls 17 to 20 and DA 305-7-2003 MOD 17 has included the following:

- A draft WMP for Longwalls 11 to 16 (Version D) was provided to the Department of Primary Industries Water (DPI Water) (now DPIE–Water) and the Environment Protection Authority (EPA) in December 2016 for consultation.
- Version E of the WMP for Longwalls 11 to 16 was provided to DPI Water (now DPIE-Water), EPA, Division of Resources and Geoscience (DRG) (now NSW Resources Regulator [NSW RR]) and the Department of Planning & Environment (DP&E) (now DPIE) in January 2017.
- The EPA indicated it would not be providing comments on the WMP for Longwalls 11 to 16 in January 2017.
- Comments were received from DP&E (now DPIE) on Version E of the WMP for Longwalls 11 to 16 in May 2017.
- A revised WMP for Longwalls 11 to 16 (Version F) was submitted in July 2017.
- The South Bates Extension Modification EA in support of DA 305-7-2003 MOD 17 was placed on public exhibition from 30 March to 2 May 2018.
- The EPA's submission on the South Bates Extension Modification EA (2 May 2017) raised no subsidence-related or water-related issues.
- The Crown Lands & Water Division (CLWD) (now NSW Natural Resources Access Regulator [NRAR]), made submissions on the South Bates Extension Modification EA and Responses to Submissions on 29 June 2017, 12 October 2017 and 2 November 2017.
- The CLWD (now NRAR) provided comments on Site Water Management Plan components on 19 December 2017.
- The DPI-Water (now DPIE-Water) and the EPA were provided with draft revisions to the following plans for consultation on 10 April 2018:
  - Groundwater Monitoring Program;
  - Surface Water Monitoring Program; and
  - Surface and Groundwater Response Plan (SGWRP).
- The WMP (Revision A) for Longwalls 17 to 20 was provided to the DI-Water (now DPIE-Water), EPA, DRG (now NSW RR) and DP&E (now DPIE) in April 2018.
- The NRAR provided comments on the GWMP and SGWRP on 5 June 2018 (dated 30 May 2018).
- WCPL provided a response to the four comments raised by NRAR on 26 June 2018. These comments were addressed through the provision of additional information (such as bore logs and investigation reports) and no changes to this WMP, the GWMP or SGWRP were considered necessary to address NRAR's comments.

- WCPL met with NRAR on 26 September 2018. NRAR was briefed on the proposed revision to the layout of Longwalls 17 to 20 and the amendment of this Extraction Plan. The proposed investigations in support of the Groundwater Dependent Ecosystem Study and the results of the South Wambo Dam investigation were also discussed (neither issue is related to this Extraction Plan). No specific requests for updates to this WMP, the GWMP, the SWMP or the SGWRP were made at this meeting.

The GWMP, SWMP and WMonP include an appendix that outlines how comments received on the plans have been considered and addressed.

Consultation undertaken for this WMP (i.e. for Longwalls 21 to 24) has included:

- An email was sent to NRAR 3 March 2020 requesting a meeting to discuss, among other things, the proposed approach for managing the interaction between the Extraction Plan and the complex-wide management plans.
- A draft WMP for Longwalls 21 to 24 (Version A) and a tracked change version (identifying differences between this document and the Longwalls 17 to 20 WMP) has been provided to the EPA, DPIE-Water and NRAR in March 2020 for consultation.
- A meeting with DPIE-Water and NRAR was held on 9 April 2020. The WMP (including the proposed approach for managing the interaction between the Extraction Plan and the complex-wide management plans) was discussed and no comments were received from DPIE-Water or NRAR.

2 PERFORMANCE MEASURE

This WMP has been developed to manage the potential environmental consequences of the proposed secondary workings described in the Extraction Plan on surface water resources, groundwater resources and flooding in accordance with Condition B7(f) of Schedule 2 of the Development Consent (DA 305-7-2003).

In accordance with Conditions B1 and B4 of Schedule 2 of the Development Consent (DA 305-7-2003), WCPL must ensure that underground mining operations comply with the subsidence impact performance measures listed in Tables 1 and 2 of Schedule 2 of the Development Consent (DA 305-7-2003). The performance measure specified in Table 1 of Schedule 2 of the Development Consent (DA 305-7-2003) relevant to water is listed in **Table 3**.

Table 3
Water Performance Measure

Feature	Subsidence Impact Performance Measure
Wollombi Brook	Negligible subsidence impacts[1] and environmental consequences[2]. Release of water from the site only in accordance with EPL requirements.

Source: Table 1 of Schedule 2 of the Development Consent (DA 305-7-2003).

[1] A subsidence impact is defined by the Development Consent (DA 305-7-2003) as "*physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and subsidence and surface depressions or troughs*".

[2] An environmental consequence is defined by the Development Consent (DA 305-7-2003) as "*The environmental consequences of subsidence impacts, including: damage to infrastructure, buildings and residential dwellings; loss of surface flows to the subsurface; loss of standing pools; adverse water quality impacts; development of iron bacterial mats; cliff falls; rock falls; damage to heritage items; impacts on aquatic ecology; ponding*".

Section 6 provides a summary of the analysis of monitoring data that will be undertaken to assess the impact of Longwalls 21 to 24 against the performance measure.

3 PREDICTED SUBSIDENCE IMPACTS AND ENVIRONMENTAL CONSEQUENCES

3.1 SURFACE WATER

3.1.1 Background

Wambo is situated adjacent to Wollombi Brook, south-west of its confluence with the Hunter River (**Figures 1 and 2**). Wollombi Brook drains an area of approximately 1,950 square kilometres and joins the Hunter River some 5 km north-east of the Wambo Coal Mine. The Wollombi Brook sub-catchment is bound by the Myall Range to the south-east, Doyles Range to the west, the Hunter Range to the south-west and Broken Back Range to the north-east (Hunter Catchment Management Trust, 2002).

The majority of lands within WCPL mining tenements drain via Wambo Creek, Stony Creek, North Wambo Creek and Redbank Creek to Wollombi Brook, while Waterfall Creek drains directly to the Hunter River (**Figure 2**).

A section of North Wambo Creek has been diverted to avoid the Wambo Open Cut (**Figure 2**). The North Wambo Creek Diversion was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007).

3.1.2 Potential Subsidence Impacts and Environmental Consequences

Approved Subsidence Impacts and Environmental Consequences

The approved subsidence impacts and environmental consequences relating to surface water associated with the South Bates Extension Underground Mine are described in the South Bates Extension Modification EA (WCPL, 2017). Advisian (2016) prepared a surface water assessment in support of the South Bates Extension Modification EA.

Wollombi Brook

The potential environmental consequences to Wollombi Brook described in the South Bates Extension Modification EA (WCPL, 2017) include:

- no measurable impact on flows in Wollombi Brook when licensed extraction of water is permitted (flow greater than 38 megalitres per day); and
- negligible change in water quality with the implementation of mitigation measures in upstream areas impacted by subsidence.

North Wambo Creek Diversion

Approximately 1,000 metres (m) of the North Wambo Creek Diversion has been undermined by Longwalls 11 to 16 at South Bates Underground Mine and Longwall 17 at the South Bates Extension Underground Mine.

Direct (1st order) subsidence impacts on the North Wambo Creek Diversion as a result of the extraction of Longwalls 21 to 24 are expected to be negligible.

North Wambo Creek (Upstream of the North Wambo Creek Diversion)

North Wambo Creek crosses directly above Longwalls 23 and 24. This section of the creek is a fifth order ephemeral stream with a shallow incision into the natural surface soils. The total length of North Wambo Creek located directly above Longwalls 23 and 24 (as proposed in this Extraction Plan) is 1.2 km.

Approved subsidence impacts and environmental consequences on North Wambo Creek include the creation of ephemeral or semi-permanent pools, changes in grade, potential for flow diversion and cracking of surface soil and underlying rock.

Other Ephemeral Drainage Lines

The unnamed ephemeral drainage lines above Longwalls 21 to 24 have shallow incisions into the natural surface soils, with some isolated bedrock outcropping along the upper reaches (Advisian, 2016).

Potential subsidence impacts and environmental consequences on ephemeral drainage lines identified in the South Bates Extension Modification EA (WCPL, 2017) include:

- development of topographical depressions and potential for ponding in areas of low topographic relief (i.e. above the north-eastern ends of the longwall panels); and
- cracking of surface soil and underlying rock that may result in temporary changes in surface flow and/or sediment loads prior to remediation.

No significant change in the water quality in the ephemeral drainage lines is expected as a result of the South Bates Extension Underground Mine (Advisian, 2016).

Overview of Revised Predicted Subsidence Effects and Impacts

Predicted subsidence parameters for Longwalls 17 to 25 were provided in the subsidence assessment prepared by MSEC (2017) in the South Bates Extension Modification EA (WCPL, 2017).

This WMP has been informed by predictions of subsidence effects and impacts prepared by MSEC (2020) for Longwalls 21 to 24 only. MSEC (2020) has considered a revised longwall layout with shortened finishing ends for Longwalls 21 to 24.

Wollombi Brook

As summarised in **Table 3**, the Development Consent (DA 305-7-2003) includes a performance measure specific to Wollombi Brook.

Wollombi Brook is located more than 4 km from Longwalls 21 to 24 and would not be directly affected by subsidence associated with Longwalls 21 to 24. Notwithstanding, performance indicators have been developed for Wollombi Brook and are detailed in **Section 6**.

North Wambo Creek Diversion

The North Wambo Creek Diversion is located 330 m north-east of Longwall 22 (at its closest point to Longwalls 21 to 24). MSEC (2020) predicts that, at this distance, the extraction of Longwalls 21 to 24 would result in maximum vertical subsidence to the North Wambo Creek Diversion of less than 20 millimetres (mm). While the North Wambo Creek Diversion could experience very low levels of subsidence, it is not expected to experience measurable tilts, curvatures or strains. This is consistent with previous subsidence effect predictions.

Potential direct (1st order) subsidence impacts to the North Wambo Creek Diversion are considered unlikely as a result of extracting Longwalls 21 to 24 (MSEC, 2020).

North Wambo Creek (Upstream of the North Wambo Creek Diversion)

North Wambo Creek is located directly above Longwalls 23 and 24, with a total length of 1.2 km to experience direct subsidence as a result of the extraction of the longwalls. It is noted that, due to the shortened finishing ends of the longwalls, the length of creek above Longwalls 23 and 24 has reduced by approximately 0.3 km compared to the previous layout assessed by MSEC (2017).

MSEC (2020) predicts that extraction of Longwalls 21 to 24 would result in maximum vertical subsidence to the North Wambo Creek of 1,950 mm, maximum tilt of 70 millimetres per metre (mm/m), >3.0 km^{-1} hogging curvature and >3.0 km^{-1} sagging curvature. This is consistent with previous subsidence effect predictions.

Potential direct (1st order) subsidence impacts to the North Wambo Creek include (MSEC, 2020):

- Surface cracking and heaving above Longwalls 23 and 24 (similar to that observed above Longwall 11) and minor cracking along the section of the North Wambo Creek not located directly above the longwalls.
- Changes in grade along the North Wambo Creek.
- Creation of two topographical depressions along the North Wambo Creek directly above Longwalls 23 and 24. The depressions are estimated to be up to 1.4 m deep, with overall lengths up to 300 m.
- Potential for increased connectivity between the workings and the North Wambo Creek (noting that an increase in water make in the workings was not observed during the extraction of Longwalls 11 to 16 or Longwall 17 beneath the North Wambo Creek Diversion).

Other Ephemeral Drainage Lines

Ephemeral drainage lines are located directly across the extents of Longwalls 21 to 24 and are expected to experience the full range of predicted subsidence movements consistent with previous subsidence impact predictions. This includes localised increased ponding and surface cracking.

Overview of Revised Predicted Environmental Consequences

An assessment of potential subsidence effects and impacts on the North Wambo Creek, North Wambo Creek Diversion and ephemeral drainage lines was prepared by MSEC (2020) as part of the Extraction Plan. Alluvium (2020) has undertaken detailed modelling to further quantify the environmental consequences and to design appropriate mitigation works to minimise the potential for increased scour or increased sediment loads (Surface Water Technical Report) in consideration of the subsidence effects predicted by MSEC (2020).

Consistent with subsidence impact predictions, there are no expected environmental consequences for Wollombi Brook.

North Wambo Creek Diversion

MSEC (2020) concluded there is no predicted subsidence within North Wambo Creek Diversion caused by the extraction of Longwalls 21 to 24. Modelling by Alluvium (2020) concluded that potential geomorphic impacts may occur as a result of further reduction of bedload sediment transport into North Wambo Creek Diversion, increasing erosion potential, should flow actually get to the diversion. The potential for flow to reach the diversion will be reduced.

Management and remediation measures to mitigate the risk of scour and leakage associated with Longwalls 21 to 24 are summarised in **Section 5**.

North Wambo Creek (Upstream of the North Wambo Creek Diversion)

Modelling by Alluvium (2020) concluded that the extraction of Longwalls 21 to 24 will increase in-channel storage when compared to existing conditions. As well as increasing in-channel storage, the subsidence of Longwalls 21 to 24 will result in ponding of water at the north-eastern ends of all of the panels.

Modelling also identified that a possible meander cutoff could develop across the Longwalls 23 and 24 pillar towards the finishing (north-eastern) end of the panels. Alluvium (2020) concluded that, if the meander cutoff were to form, the length of North Wambo Creek would be decreased by 150-200 m, therefore increasing the channel grade. However erosion of an elevated section of bed over the Longwalls 23 and 24 pillar is likely to occur, which would reinstate flows down the existing North Wambo Creek channel (Alluvium, 2020).

In accordance with the suggestions made by Alluvium (2020), WCPL proposes to monitor this area of North Wambo Creek following completion of subsidence of Longwalls 23 and 24 to identify if stream bank and bed stabilisation measures need to be implemented.

The impact of Longwalls 21 to 24 (including Longwalls 17 to 20) on flow from a pure surface water perspective in North Wambo Creek is relatively small and is estimated to result in a reduction in flow volume of 8.7% for a 2 year Annual Recurrence Interval rainfall event.

WCPL proposes to maintain any in-channel ponding, as it results in minimal impacts on flows in North Wambo Creek, and works to allow free drainage of the pools would require significant disturbance of the North Wambo Creek.

Alluvium (2020) considers that an increase in suspended sediments in North Wambo Creek and North Wambo Creek Diversion is possible from increased erosion, however management measures can be put in place to reduce the risk of an increase in suspended sediments to negligible.

SLR (2020) estimates that increased leakage from the North Wambo Creek to the underground workings could conservatively be up to 0.19 megalitres per day (ML/day) (69 ML/year) during periods of flow prior to remediation. As outlined in the SWMP, monitoring of flows on North Wambo Creek is undertaken at two sites upstream of the North Wambo Creek Diversion (US FM1 and FM1).

Until February 2020, no flow events had been recorded at US FM1 since its installation in December 2017. US FM1 flowed for 18 days between 9 February and 27 February 2020. This equates to flow being recorded at US FM1 on North Wambo Creek approximately 8 days per year (on average). It should be noted that this is heavily influenced by the extended period of flow recently observed in February 2020, following drought conditions.

Flow events at FM1 have been recorded a total of 72 times since its installation in 2008 (it should be noted that these events primarily occurred between 2008-2009 and between 2015-2016, with three events recently recorded from 9 February to 11 February 2020). This equates to flow being recorded at FM1 on North Wambo Creek approximately 6 days per year (on average).

Management and remediation measures to mitigate the risk of scour and leakage associated with Longwalls 21 to 24 are summarised in **Section 5**.

Other Ephemeral Drainage Lines

Surficial and subsurface erosion responses can be expected where cracks occur as a result of Longwalls 21 to 24 in colluvial and alluvial sediments (Alluvium, 2020). The sediments across this terrain above Longwalls 21 to 24 can be dispersive, which makes them prone to changes in rates of erosion (Alluvium, 2020).

The geometry of flow paths towards North Wambo Creek and North Wambo Creek Diversion would also change as a result of Longwalls 21 to 24 (Alluvium, 2020). The changes in flow paths have been identified by Alluvium (2020) based on the software CatchmentSIM using the predicted subsidence digital terrain model (DTM).

Without appropriate mitigation measures, the changes in flow paths may result in the streamlines over Longwall 23 becoming discontinuous at the northern extent of the panel with no defined entry point into North Wambo Creek. This indicates that ponding will occur in this area and creation of a new flow entry point, which will potentially lead to erosion (headcut) where it enters North Wambo Creek. Mitigation measures to manage this risk are summarised in **Section 5** and described in detail in Alluvium (2020).

3.2 GROUNDWATER

3.2.1 Background

The hydrogeological regime of the Wambo Coal Mine area comprises two main systems (Australasian Groundwater and Environmental Consultants [AGE], 2003):

- a Quaternary alluvial aquifer system of channel fill deposits associated with Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek; and
- underlying Permian strata that includes weathered sandstone and siltstone (regolith) and unweathered Permian aged coal measures characterised as hydrogeologically “tight” and hence very low yielding to essentially dry sandstone and lesser siltstone and low to moderately permeable coal seams which are the prime water bearing strata within the Permian sequence.

The alluvial flow in North Wambo Creek has been altered by historical and existing mining operations including the removal of alluvium across the full width of the channel, with consequent desaturation of the adjacent upstream and downstream alluvium.

As described in **Section 3.1.1**, a section of North Wambo Creek has been diverted to avoid the Wambo Open Cut (**Figure 2**). The North Wambo Creek Diversion (**Figure 2**) was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007).

Historical and ongoing open cut and underground mining within the Wambo Coal Mine area (including adjoining mining operations) has created significant groundwater sinks and this has generated a regional zone of depressurisation within the Permian coal measures.

3.2.2 Potential Subsidence Impacts and Environmental Consequences

Approved Subsidence Impacts and Environmental Consequences

The approved subsidence impacts and environmental consequences relating to groundwater associated with the South Bates Extension Underground Mine are described in the South Bates Extension Modification EA (WCPL, 2017). HydroSimulations (2017) prepared a groundwater assessment in support of the South Bates Extension Modification EA informed by contemporary, peer reviewed numerical modelling techniques.

Alluvial Aquifers

In regard to potential environmental consequences on alluvial aquifers, HydroSimulations (2017) concluded the following as part of the South Bates Extension Modification EA:

- *The alluvium adjacent to the South Bates Extension footprint has been disconnected from the regional alluvial system due to the removal of alluvium downstream of the longwalls by the approved open cut mining operations (and associated construction of the North Wambo Creek Diversion).*
- *The alluvium adjacent to the South Bates Extension footprint has been affected by open cut mining activities, with several metres of drawdown in the alluvium observed to date.*
- *There are no bores above the South Bates Extension footprint that are used for irrigation, domestic or stock use.*

…

- *There is expected to be negligible impact on the highly productive alluvium associated with the Wollombi Brook and Hunter River as a result of the Modification.*

…

- *The Modification would not result in reduced beneficial uses of the alluvium (from a water quality perspective).*

Permian Aquifers

In regard to potential environmental consequences on Permian aquifers, HydroSimulations (2017) concluded the following as part of the South Bates Extension Modification EA:

- *For the Modification, inflows to South Bates Underground are predicted to peak at a maximum of about 1.0 ML/d at the end of 2018.*

…

- *The Modification would not have a significant impact on water levels in the Permian coal measures from a regional perspective due to the regional zone of depressurisation within the Permian coal measures created by historical and ongoing open cut and underground mining.*
- *The Wambo Coal Mine would not lower the beneficial use category of the groundwater within the Permian aquifers, as there would be no migration of groundwater away from the underground mining areas in the Permian aquifers either during mining or following completion of mining activities.*

Overview of Predicted Environmental Consequences

A groundwater assessment review, supported by review of the numerical model outputs, was prepared by SLR (2020) as part of the Extraction Plan for Longwalls 21 to 24 (Groundwater Technical Report, **Technical Report 2**).

The groundwater assessment review considered the cumulative predicted impacts on groundwater during the period of extraction of Longwalls 21 to 24 (SLR, 2020).

Following a review of monitoring data, SLR (2020) concluded revision of the potential cumulative environmental consequences for groundwater is not required. Of note to Longwalls 21 to 24, SLR (2020) concluded:

- Groundwater drawdowns of up to 200 m are expected in the Whybrow Seam, due to extraction of Longwalls 21 to 24.
- Extraction of Longwalls 21 to 24 would not have a significant impact on water levels in the Permian coal measures from a regional perspective due to the regional zone of depressurisation within the Permian coal measures created by historical and ongoing open cut and underground mining.
- Minor additional leakage from the natural North Wambo Creek is predicted due to extraction of Longwalls 21 to 24, however, surface remediation is required to maintain the long-term flow regime along North Wambo Creek. This is dependent on surface water flows, with flows along North Wambo Creek dependent on peak rainfall periods.
- There are no private registered bores that would be likely to be affected by 2 m drawdown or more as a result of the incremental impacts of Longwalls 21 to 24.

4 MONITORING

Surface water and groundwater monitoring will be undertaken in accordance with the programs outlined in the SWMP, the GWMP and the WMonP (**Section 1.2**). Specific monitoring for Longwalls 21 to 24 is outlined in **Table 4**.

To account for Longwalls 21 to 24, revisions to the Surface Water Management Plan and Groundwater Management Plans incorporated a number of augmentations to the existing monitoring programs. These additional components of the monitoring program include installation of six additional subsidence and diversion monitoring points along North Wambo Creek as a result of recommendations made by Alluvium (2020) and nine additional groundwater monitoring sites along North Wambo Creek (GW27 to GW35)[2]. These sites have been included in **Table 4** and are shown on **Figure 4**.

SLR (2020) reviewed the current groundwater monitoring program and concluded it provides appropriate and sufficient coverage for Longwalls 21 to 24, but included recommendations for ongoing review of the condition of the bores to ensure bores are not impacted by subsidence. The bores should be remediated/replaced as required, to maintain a long-term monitoring network.

Table 4
Water Management Plan Monitoring Program Overview

Monitoring Component	Parameters	Timing/Frequency	Responsibility
Pre-Mining			
Diversion and subsidence monitoring program, including six additional sites (UA, UB, UC, UD, UE and UF).	As outlined in the SWMP, including: • Index of Diversion Condition; and • riparian vegetation.	Annually in accordance with the SWMP.	Environment and Community Manager
Monitoring of surface water quality and flow monitoring sites (SW04, SW27a, US FM1, FM1, FM2, FM3).	In accordance with the SWMP and WMonP.	In accordance with the SWMP and WMonP.	Environment and Community Manager
Monitoring of groundwater sites (GW16, GW17, N3, N5, P317, UG139, GW23, GW24, GW25).	In accordance with the GWMP and WMonP.	In accordance with the GWMP and WMonP.	Environment and Community Manager
Monitoring of additional alluvial groundwater sites along North Wambo Creek (GW27 to GW35)[2].	• Depth to water. • EC. • pH. • Temperature.	Bi-monthly.	Environment and Community Manager
During Mining			
Longwalls 21 to 24 subsidence monitoring lines as described in the Subsidence Monitoring Program.	Monitoring parameters include: • subsidence; • tilt; • tensile strain; • compressive strain; and • absolute horizontal translation.	Monitoring during secondary extraction of Longwalls 21 to 24 in accordance with the Subsidence Monitoring Program.	Mine Surveyor
Diversion and subsidence monitoring program, including six additional sites (UA, UB, UC, UD, UE and UF).	As outlined in the SWMP, including: • Index of Diversion Condition; and • riparian vegetation.	Annually in accordance with the SWMP.	Environment and Community Manager

[2] Monitoring of GW29 was discontinued as it was established that GW30 was more accurate.

Table 4 (Continued)
Water Management Plan Monitoring Program Overview

Monitoring Component	Parameters	Timing/Frequency	Responsibility
During Mining (continued)			
Visual inspection of North Wambo Creek.	Surface cracks. Surface ponding.	Weekly inspections when extraction is occurring within 100 m of North Wambo Creek.	Environment and Community Manager
Visual inspection of drainage line flow paths.	Evidence of erosion or channelisation.	Following a rainfall event of greater than 40 mm in 24 hours.[1]	Environment and Community Manager
Monitoring of surface water quality and flow monitoring sites (SW04, SW27a, US FM1, FM1, FM2, FM3).	In accordance with the SWMP and WMonP.	In accordance with the SWMP and WMonP.	Environment and Community Manager
Monitoring of groundwater sites (GW16, GW17, N3, N5, P317, UG139, GW23, GW24, GW25).	In accordance with the GWMP and WMonP.	In accordance with the GWMP and WMonP.	Environment and Community Manager
Monitoring of additional alluvial groundwater sites along North Wambo Creek (GW27 to GW35).	• Depth to water. • EC. • pH. • Temperature.	Bi-monthly.	Environment and Community Manager
Inflows to underground workings.	Dewatering volumes and underground water levels in accordance with the GWMP.	Recorded during pumping.	Environment and Community Manager
Post-Mining			
Diversion and subsidence monitoring program, including six additional sites (UA, UB, UC, UD, UE and UF).	As outlined in the SWMP, including: • Index of Diversion Condition; and • riparian vegetation.	Annually in accordance with the SWMP.	Environment and Community Manager
Visual inspection of surface areas which required remediation.	Stabilisation of erosion and groundcover.	Monthly inspections until monitoring confirms stabilisation of erosion and groundcover is >60%.	Environment and Community Manager
Visual inspection of drainage line flow paths.	Evidence of erosion or channelisation.	Following a rainfall event of greater than 40 mm in 24 hours up to 6 months following completion of mining.[1]	Environment and Community Manager
Monitoring of surface water quality and flow monitoring sites (SW04, SW27a, US FM1, FM1, FM2, FM3).	In accordance with the SWMP and WMonP.	In accordance with the SWMP and WMonP.	Environment and Community Manager
Monitoring of groundwater sites (GW16, GW17, N3, N5, P317, UG139, GW23, GW24, GW25).	In accordance with the GWMP and WMonP.	In accordance with the GWMP and WMonP.	Environment and Community Manager
Monitoring of additional alluvial groundwater sites along North Wambo Creek (GW27 to GW35).	• Depth to water. • EC. • pH. • Temperature.	Bi-monthly.	Environment and Community Manager

[1] Inspection to occur once access is practicably available following the rainfall event. Inspections would not occur for subsequent rainfall events within 7 days of previous inspection.

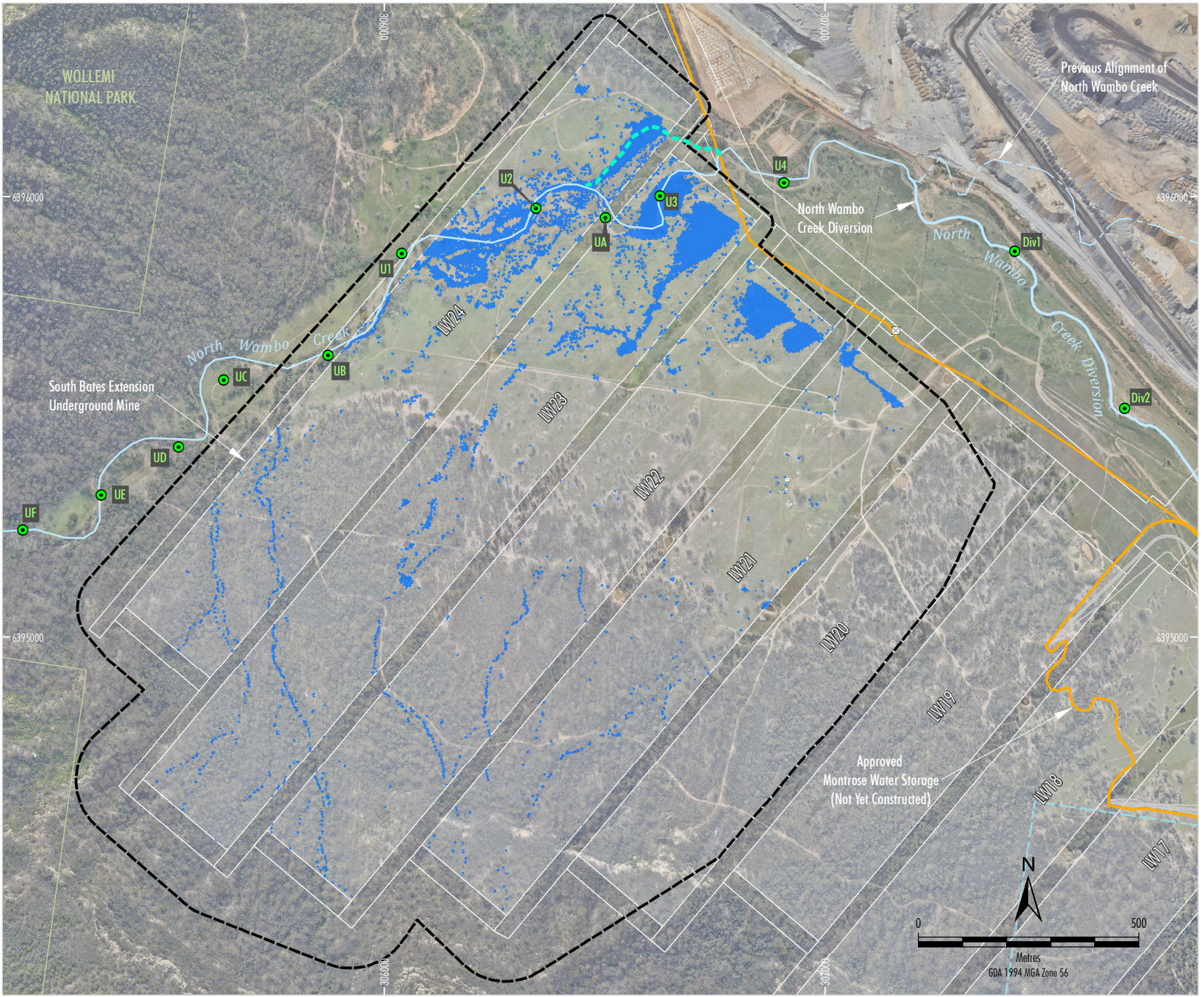
5 MANAGEMENT MEASURES

Management measures to remediate impacts on water resources resulting from the extraction of Longwalls 21 to 24 will be undertaken in accordance with **Table 5**, the surface and groundwater response plans in the SWMP and GWMP, and the measures proposed in **Section 6**.

Table 5
Water Management Plan Key Management Measures

Management Measure	Timing/Frequency	Responsibility
Pre-Mining		
Stockpile sufficient materials and make equipment and necessary resources available for: • sealing any surface cracks (particularly in areas that are predicted to be ponded); and • installation of scour protection works.	Prior to commencement of secondary extraction of Longwalls 21 to 24.	Environment and Community Manager
During Mining		
Remediation of surface cracks[1] along North Wambo Creek and in other areas where practicable using conventional earthmoving equipment (e.g. a backhoe) including: • infilling of surface cracks with soil or other suitable materials; or • locally re-grading and re-compacting the surface.	When required during secondary extraction of Longwalls 21 to 24.	Environment and Community Manager
Stabilisation of any areas of surface cracking or erosion using erosion protection measures (e.g. vegetation planting).	When required during secondary extraction of Longwalls 21 to 24.	Environment and Community Manager
Review of remediation measures and implementation of additional measures if required, in accordance with the TARP (**Attachment 1**).	Ongoing during mining.	Environment and Community Manager
Post-Mining		
Review of areas that may be vulnerable to instabilities along the North Wambo Creek and North Wambo Creek Diversion (as shown on **Figure 5**) and implementation of vegetation management and channel stabilisation (if necessary) through measures such as timber pile field alignment training, armouring and/or channel reconfiguration.	To be installed following completion of secondary extraction of Longwalls 21 to 24.	Environment and Community Manager
Review of remediation measures and implementation of additional measures if required, in accordance with the TARP (**Attachment 1**).	Following completion of secondary extraction of Longwalls 21 to 24.	Environment and Community Manager
Post-subsidence assessment of impacts to Stony Creek and drainage lines and implementation of any minor remedial works.	Following completion of secondary extraction of Longwalls 21 to 24.	Environment and Community Manager

[1] Minor cracks that develop are not expected to require remediation as geomorphologic processes will result in natural filling of these cracks over time.



LEGEND

- Existing/Approved Surface Development Area
- Approved Underground Development
- Ventilation Shaft
- Remnant Woodland Enhancement Program (RWEP) Area
- Extraction Plan Application Area
- Potential North Wambo Creek Meander Cutoff
- Potential Ponding Areas Overlying Longwalls 21 to 24 (2 Year ARI)
- Diversion and Subsidence Monitoring Site

Source: WCPL (2020); MSEC (2020); Alluvium (2020); NSW Spatial Services (2019)
Orthophoto: WCPL (May 2019)

Peabody

WAMBO COAL MINE

Aerial Photograph of North Wambo Creek in the Vicinity of Longwalls 21 to 24

Figure 5

WAM-09-15_SBX EP_LW 21-24_WMP_202D

6 ASSESSMENT OF PERFORMANCE INDICATORS AND MEASURES

In accordance with Condition D5 of Schedule 2 of the Development Consent (DA 305-7-2003), performance indicators have been developed for the performance measure listed in **Table 3**. The proposed performance indicators are summarised in **Table 6**.

Monitoring conducted to inform the assessment of the extraction of Longwalls 21 to 24 against the performance indicators for the performance measure relating to Wollombi Brook includes:

- monitoring in accordance with the SWMP and the WMonP; and
- monitoring in accordance with the GWMP and the WMonP.

Table 6
Water Performance Measure and Performance Indicators

Performance Measure	Performance Indicator(s)
Negligible subsidence impacts[1] and environmental consequences[2] to Wollombi Brook.	• The performance indicators will be considered to have been exceeded if the **surface water quality in Wollombi Brook exceeds the surface water quality criteria in the SWMP**. • The performance indicators will be considered to have been exceeded if the **groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP**. • The performance indicators will be considered to have been exceeded if the **groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP**.
Release of water from the site only in accordance with EPL requirements.	• The performance indicator will be considered to have been exceeded if **water is released from the site, and it is not in accordance with the EPL requirements**.

[1] A subsidence impact is defined by the Development Consent (DA 305-7-2003) as "*physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and subsidence and surface depressions or troughs*".

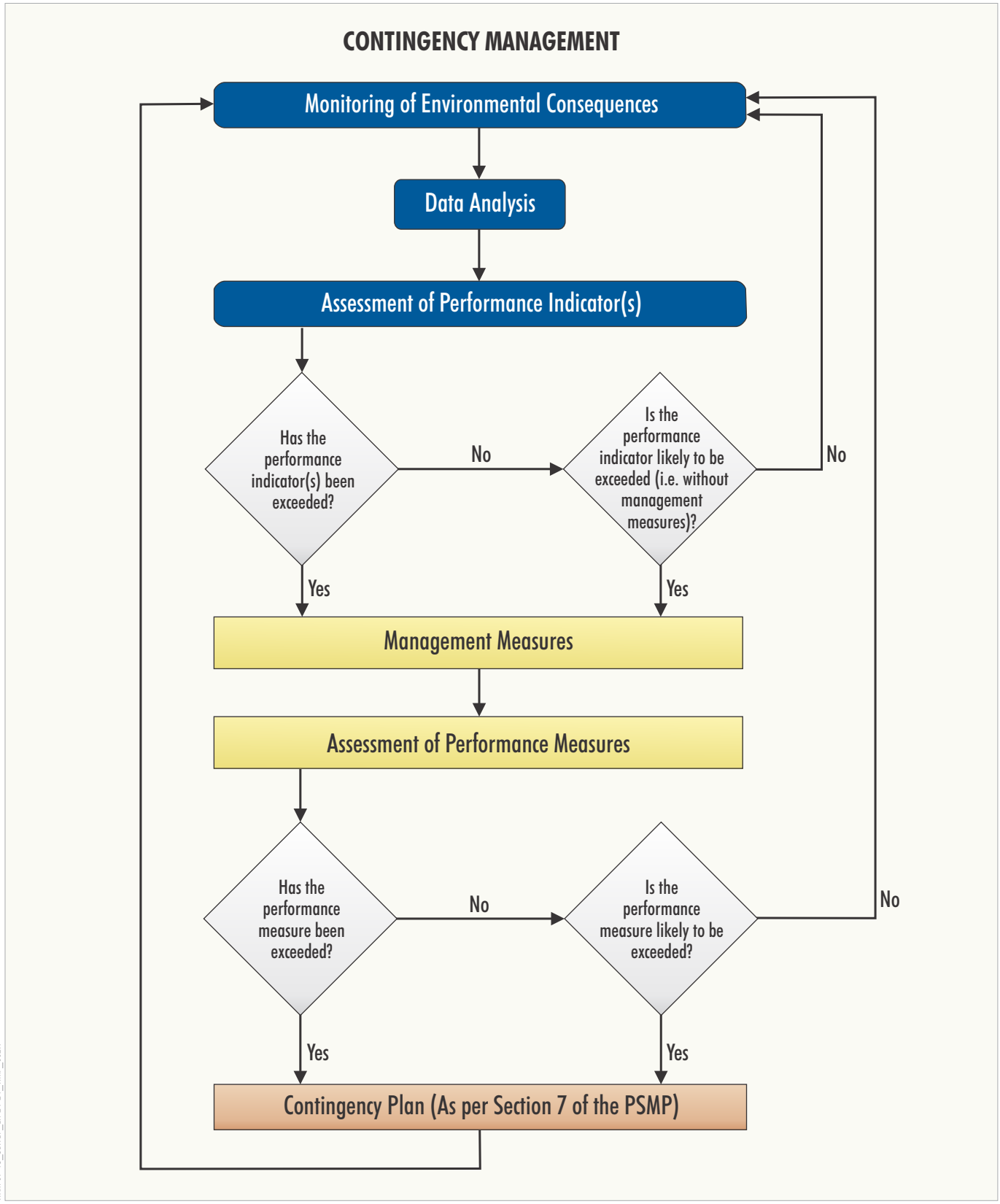
[2] An environmental consequence is defined by the Development Consent (DA 305-7-2003) as "*The environmental consequences of subsidence impacts, including: damage to infrastructure, buildings and residential dwellings; loss of surface flows to the subsurface; loss of standing pools; adverse water quality impacts; development of iron bacterial mats; cliff falls; rock falls; damage to heritage items; impacts on aquatic ecology; ponding*".

Monitoring results will be used to assess the extraction of Longwalls 21 to 24 against the performance indicators and performance measure as detailed in **Table 7**. The monitoring process and subsequent assessment of performance indicators and measures is outlined in **Figure 6**.

If data analysis indicates a performance indicator has been exceeded or is likely to be exceeded, an assessment will be made against the performance measure. If the performance measure is considered to have been exceeded, the Contingency Plan will be implemented (**Section 7**). If data analysis indicates that the performance measure has not been exceeded, WCPL will continue to monitor.

Table 7
Monitoring of Environmental Consequences against Performance Indicators and Measures

Performance Measure	Monitoring of Environmental Consequence			Data Analysis to Assess against Performance Indicator(s)	Performance Indicator	Assessment of Performance Indicator	Assessment of Performance Measure	Potential Relevant Management and Contingency Measure
	Site	Parameter	Frequency					
Negligible subsidence impacts and environmental consequences to Wollombi Brook.	• Surface water quality monitoring sites listed in Tables A and B of the WMonP. • FM10. • FM11.	• pH. • EC. • Surface water flow.	• Monthly/Rainfall event. • Continuous.	• Analysis of surface water quality monitoring data in accordance with the SWMP.	• The surface water quality in the Wollombi Brook does not exceed the surface water quality criteria listed in Table 13 of the SWMP.	• The performance indicators will be considered to have been exceeded if the surface water quality in Wollombi Brook exceeds the surface water quality criteria listed in Table 13 of the SWMP. • If data analysis indicates the performance indicators have been exceeded, an assessment will be made against the performance measure (**Figure 6**).	• A preliminary investigation will be conducted to determine the likely cause of the performance indicator exceedance. No further hydrological and/or hydrogeological analysis will be conducted where: – the exceedance is not a result of underground extraction (e.g. climatic variations); or – the exceedance is of the groundwater level criteria or groundwater quality criteria and the exceedance is isolated to one or more alluvial bores that are not located in proximity to Wollombi Brook. • The performance measure is exceeded if subsidence, groundwater and surface water monitoring data and hydrological and/or hydrogeological analysis indicate subsidence from development of Longwalls 21 to 24 has resulted in: – a greater than negligible change in Wollombi Brook surface water flow (e.g. stream baseflow); or – a greater than negligible change in Wollombi Brook water quality. • The above analysis will include consideration of streamflow gauging sites FM10 and FM11 listed in the SWMP (i.e. DPIE-Water Gauging Stations Wollombi Brook at Bulga and Wollombi Brook at Warkworth). • The above analysis will be peer reviewed by a specialist approved by the DPIE. • The results of the above analysis will be reported to the DPIE, NSW Environment Protection Authority (EPA) and DPIE-Water. • If the performance measure has been exceeded, the Contingency Plan will be implemented (**Section 7**).	• Implementation of stream flow loss remediation techniques (e.g. injection grouting or installation of a geomembrane). • Provision of offsets (i.e. retirement of an equivalent volume of water licence). • Implementation of erosion and sediment control measures and stabilisation techniques. • Additional monitoring (e.g. increase in monitoring frequency). • Consideration of changes to longwall extraction geometry in consultation with relevant regulatory authorities.
	• Groundwater monitoring sites listed in Tables D and E of the WMonP. • FM10. • FM11.	• Water level. • Surface water flow.	• Every two months or as specified in Tables D and E of the WMProg • Continuous.	• Analysis of groundwater level monitoring data in accordance with the GWMP.	• The groundwater levels in alluvial bores do not exceed the groundwater level criteria listed in Table 11 of the GWMP.	• The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria listed in Table 11of the GWMP. • If data analysis indicates the performance indicators have been exceeded, an assessment will be made against the performance measure (**Figure 6**).		
	• Groundwater monitoring sites listed in Tables Dand E of the GWMP. • FM10. • FM11.	• pH. • EC. • Surface water flow.	• Every two months or as specified in Tables D and Eof the GWMP. • Continuous.	• Analysis of groundwater quality monitoring data in accordance with the GWMP.	• The groundwater quality in alluvial bores does not exceed the groundwater quality criteria listed in Table 11 of the GWMP.	• The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria listed in Table 11 of the GWMP. • If data analysis indicates the performance indicators have been exceeded, an assessment will be made against the performance measure (**Figure 6**).		



WAM-09-15_SBX.EP_LW121-24_WMP_002A

Peabody

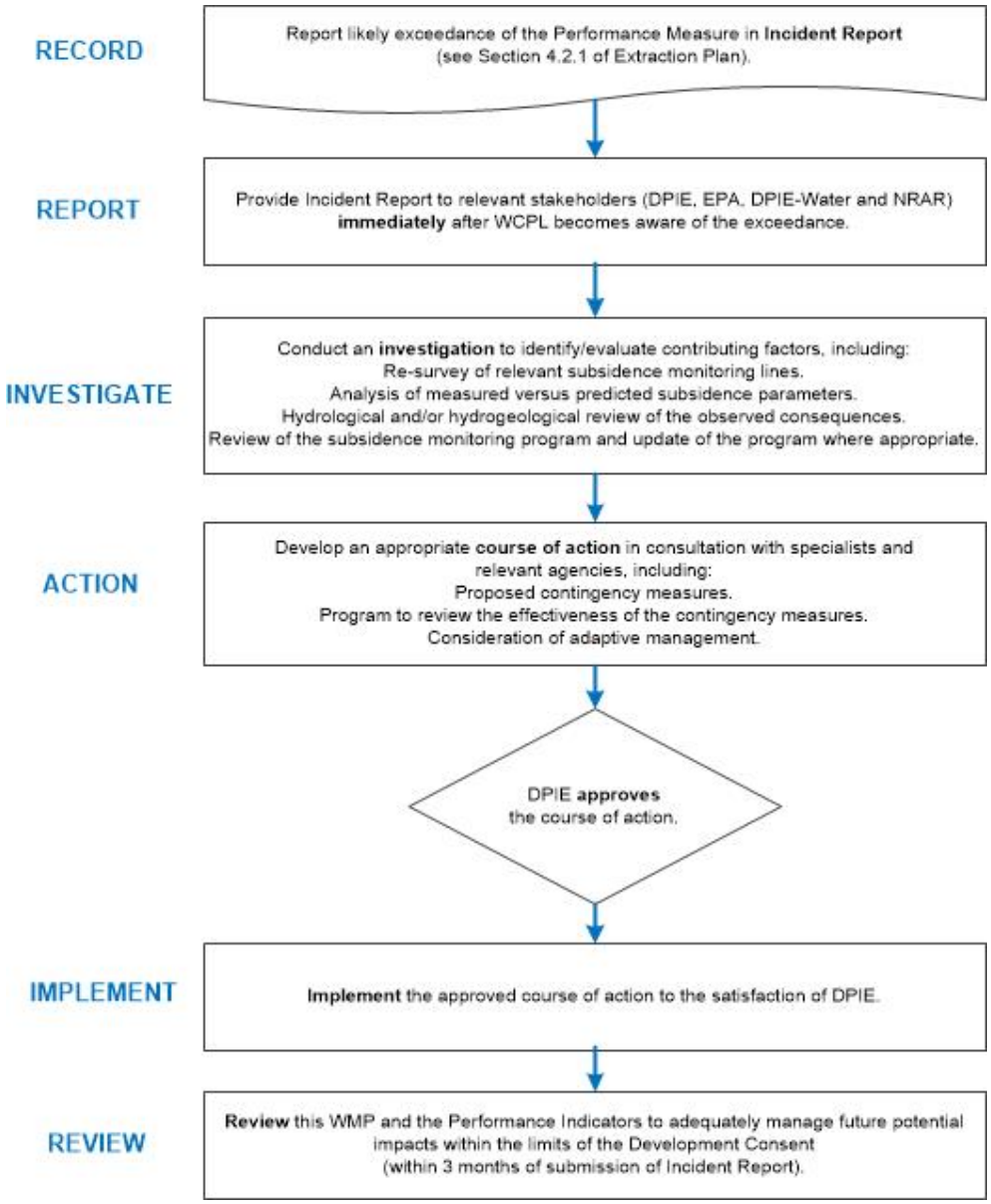
WAMBO COAL MINE

Monitoring of Environmental Consequences against Performance Indicators and Measures

Figure 6

7 CONTINGENCY PLAN

In the event the Wollombi Brook performance measure summarised in **Table 6** is considered to have been exceeded or is likely to be exceeded, in accordance with the schematic presented in **Figure 6**, WCPL will implement the following Contingency Plan:



The framework for the various components of the WMP are summarised in the WMP TARP which is included as **Attachment 1**. The WMP TARP illustrates how the various predicted subsidence impacts, monitoring components, performance measures and responsibilities are structured, and the framework for management and contingency actions.

8 REFERENCES

Advisian (2016) *South Bates Extension Modification Surface Water Assessment*. Report prepared for Wambo Coal Pty Limited.

Alluvium (2020) *Surface Water Technical Report for South Bates Extension Underground Mine (Longwalls 21-24).* Report prepared for Wambo Coal Pty Limited.

Australasian Groundwater and Environmental Consultants (2003) *Wambo Development Project Groundwater Impact Assessment.*

Gilbert & Associates (2003) *Wambo Development Project Surface Water Assessment.*

Hunter Catchment Management Trust (2002) *Integrated Catchment Management Plan for the Hunter Catchment 2002.*

Mine Subsidence Engineering Consultants (2017) *South Bates Extension Modification Subsidence Assessment – Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Modification Application for the South Bates Extension Modification*. Report MSEC848 prepared for Wambo Coal Pty Limited.

Mine Subsidence Engineering Consultants (2020) *South Bates Extension Subsidence Assessment – Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Extraction Plan Application for the South Bates Extension WYLW21 to WYLW24*. Report MSEC1080 prepared for Wambo Coal Pty Limited.

SLR Consulting Pty Ltd (2020) *SBE LW21-24 Groundwater Technical Review – Underground Mine Longwalls 21-24 Groundwater Assessment in Support of the Extraction Plan*.

Wambo Coal Pty Limited (2003) *Wambo Development Project Environmental Impact Statement.*

Wambo Coal Pty Limited (2007) *North Wambo Creek Diversion Plan.*

Wambo Coal Pty Limited (2017) *South Bates Extension Underground Mine Modification – Environmental Assessment*.

ATTACHMENT 1

WATER MANAGEMENT PLAN
TRIGGER ACTION RESPONSE PLAN

Table A1-1
Water Management Plan Trigger Action Response Plan

Condition	Normal	Level 1	Level 2
	Normal Conditions	**Management Measures**	**Restoration/Contingency Phase**
Trigger	• No visible cracks along North Wambo Creek or North Wambo Creek Diversion. • Existing flow paths along North Wambo Creek maintained. • Dewatering volumes and underground water levels at normal conditions and not significantly influenced by climatic conditions. • Predicted impacts on other surface water and groundwater as described in **Section 3**.	• Cracks observed along North Wambo Creek or North Wambo Creek Diversion. • Meander cutoff developed on North Wambo Creek resulting in flow diversion. • Dewatering volumes and underground water levels are elevated and responding significantly to climatic conditions. • Impacts requiring remediation observed on ephemeral drainage lines/overland flow paths. • Groundwater or surface water impacts greater than expected.	• Functionality of North Wambo Creek or North Wambo Creek Diversion materially affected. • Dewatering volumes and underground water levels continue to respond significantly to climatic conditions following remediation. • The Wollombi Brook performance measure has been exceeded, or is likely to be exceeded.
Action	• Conduct monitoring, consistent with **Tables 4 and 7**, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan). • Assess the environmental consequences of the subsidence in accordance with **Section 6** and the response plans outlined in the SWMP and GWMP. • Assess the need for management measures in accordance with **Section 5** and the response plans outlined in the SWMP and GWMP.	• Implement management measures, as required, in accordance with **Section 5** and the response plans outlined in the SWMP and GWMP. • Continue monitoring, consistent with **Tables 4 and 7**, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan).	• Implement Contingency Plan described in **Section 7**. • Develop action plan for additional measures, including consideration of: – additional scour protection, crack remediation and/or stabilisation; and/or – isolation sealing of the diversion cutting, for example through injection grouting or installation of low permeability material; and/or – channel stabilisation.
Frequency	• Frequency consistent with **Table 5**, the GWMP, SWMP and response plans outlined in the SWMP and GWMP.	• As required, in accordance with **Section 6** and the response plans outlined in the SWMP and GWMP.	• As required, in accordance with **Section 7**.
Position of Decision Making	• Environment and Community Manager.	• Environment and Community Manager.	• General Manager. • Implementation of additional management measures will be undertaken in consultation with NSW RR and DPIE-Water.

Note: GWMP refers to the Wambo Coal Groundwater Management Plan.
SWMP refers to the Wambo Coal Surface Water Management Plan.
WMonP refers to the United Wambo and Wambo Water Monitoring Program.
NSW RR refers to the NSW Resources Regulator.
DPIE-Water refers to the Water Division in the Department of Planning, Industry and Environment.

ATTACHMENT 2

WAMBO WATER MANAGEMENT PLAN

WAMBO
WATER MANAGEMENT PLAN

Document No. WA-ENV-MNP-509
November 2020

Document Control

Document No.	WA-ENV-MNP-509
Title	Wambo Water Management Plan
General Description	Water Management at the Wambo Coal Mine
Document Owner	WCPL Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked
1	August 2020	New overarching water management plan for the Wambo Coal Mine and Coal Handling Facilities. Addresses requirements of DA305-7-2003, DA177-8-2004 and EPL 529.	WCPL	CB
2	November 2020	Address minor comments from DPIE	WCPL	-

CONTENTS

1.0 INTRODUCTION 1

1.1 BACKGROUND 1
1.2 PURPOSE AND OBJECTIVES 4
1.3 SCOPE 5
1.4 RELATIONSHIP WITH OTHER DOCUMENTS 1
1.5 INTEGRATION WITH UNITED WATER MANAGEMENT SYSTEM 2
1.6 STAKEHOLDER CONSULTATION 3
1.7 SUMMARY OF COMMITMENTS 3

2.0 STATUTORY AND OTHER REQUIREMENTS 4

2.1 LEGISLATION 4
2.2 POLICIES, GUIDELINES AND STANDARDS 6
2.3 PROJECT APPROVAL 10
2.4 ENVIRONMENT PROTECTION LICENCE 529 17
2.5 WATER LICENCES 17
2.6 MINING TENEMENTS AND EXPLORATION LICENCES 18

3.0 BASELINE DATA 21

3.1 EXISTING ENVIRONMENT 21
3.2 BASELINE MONITORING DATA 27

4.0 PLANNING 28

4.1 WATER MANAGEMENT TYPES 28

5.0 IMPLEMENTATION 29

5.1 WATER MANAGEMENT SYSTEM 29
5.2 SITE WATER BALANCE 34
5.3 SITE SALT BALANCE 34
5.4 GROUNDWATER MODEL 34
5.5 SECURITY OF SUPPLY 35
5.6 TRAINING AND COMMUNICATION 35

6.0 MEASUREMENT AND EVALUATION 36

6.1 SITE WATER AND SALT BALANCE 36
6.2 GROUNDWATER INFLOWS 36
6.3 WATER STRUCTURE INSPECTIONS 36
6.4 WATER MONITORING 36

7.0 COMMUNITY COMPLAINT RESPONSE 38

8.0 ADAPTIVE MANAGEMENT 39

8.1 EXCEEDANCES OF CRITERIA AND/OR PERFORMANCE MEASURES 39

8.2 UNFORESEEN IMPACTS 39

8.3 FAILURE TO COMPLY WITH OTHER STATUTORY REQUIREMENTS 40

8.4 PROVISION OF COMPENSATORY WATER 40

9.0 REVIEW AND REPORTING 41

9.1 REVIEW 41

9.2 REPORTING 41

10.0 ACCOUNTABILITIES 44

11.0 REFERENCES 45

11.1 RELATED DOCUMENTS 45

11.2 REFERENCE INFORMATION 45

APPENDIX A - EVIDENCE OF CONSULTATION 46

APPENDIX B - WMP SUMMARY OF COMMITMENTS 70

APPENDIX C - OTHER REQUIREMENTS RELATING TO WATER MANAGEMENT 75

Tables

Table 1: Summary of the Approved Wambo Coal Mine 3
Table 2: Water Management Documents Related to this WMP 2
Table 3: DA305-7-2003 Requirements for this WMP 10
Table 4: DA305-7-2003 Water Management Performance Measures 14
Table 5: DA177-8-2004 Water Management Performance Measures 16
Table 6: Water Access and Surface Water Licences 17
Table 7: Groundwater Extraction Licences 18
Table 8: Mining Tenement Conditions relevant to this WMP 18
Table 9 Water Categories and Design Criteria 28
Table 10: Summary of Water Storages Managed and Utilised by Wambo 29
Table 11: Water Extraction and Discharge Points 33
Table 11: WMP Accountabilities 44
Table 12: Related Documents 45
Table 13: Reference Information 45

Figures

Figure 1: Wambo Coal Regional Location 2
Figure 2: Approved United Wambo Project – Phase 2 1
Figure 3: Wambo Water Management Plan Structure 1
Figure 4: Wollombi Brook Catchment Context 23
Figure 5: Project Area Catchment Context 24
Figure 6: Location of Alluvium in Lower Reaches of Creeks 26
Figure 7: Water Management System – Managed and Utilised by Wambo 32

Important information about this Water Management Plan

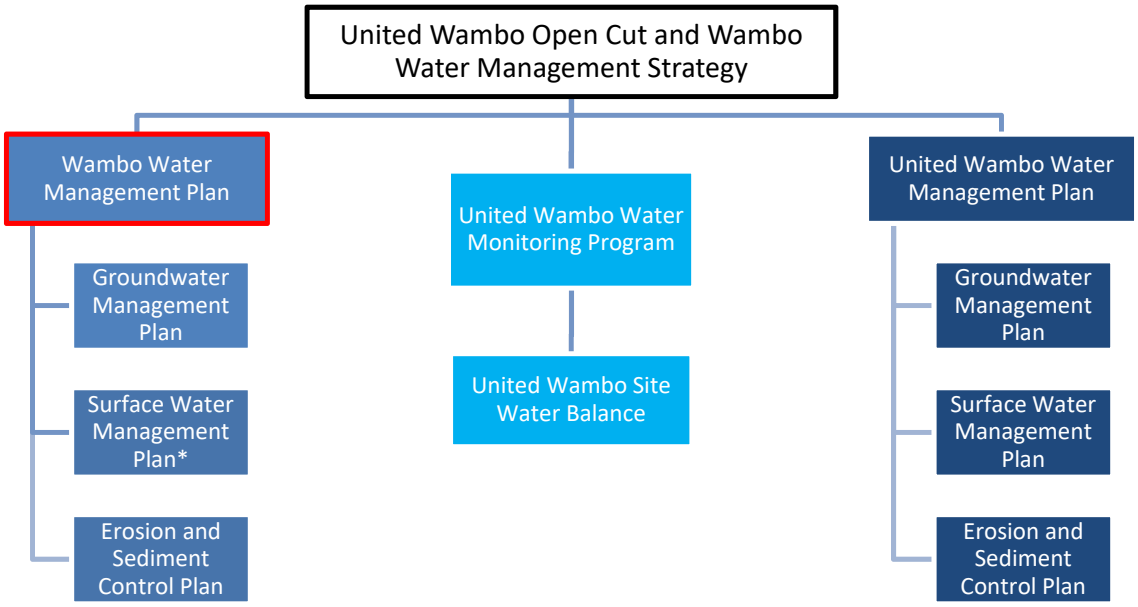
This Water Management Plan (WMP) applies to **Phase 2** mining operations at the Wambo Coal Mine, as defined in the Notification of Modification for Development Approval (DA) 305-7-2003, dated 29 August 2019, i.e.

> *The phase of the development that comprises underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure within the green operational area identified in Figure 2 of Appendix 2 (of DA305-7-2003) and associated surface development.*

The Phase 2 approved operational mining area is shown on Figure 2 (Section 1.3). Water management associated with the United Wambo Open Cut Project is described in the United Wambo Water Management Plan.

The figure below shows the water management documents relevant to this WMP. This WMP sits under the United Wambo Open Cut and Wambo Water Management Strategy (Water Strategy) and includes reference to the combined United Wambo Open Cut and Wambo Water Monitoring Program (WMProg) and combined United Wambo Open Cut and Wambo Site Water Balance (SWB). This WMP should be read in conjunction with the Wambo WMP sub plans (refer to figure below) and the combined Water Strategy, WMProg and SWB.

Further detail on how water will be managed across the two operations can be found in the Water Strategy (WA-ENV-MNP-509.7).



Key:

Document applies to both operations – controlled by Wambo Coal Pty Ltd

Document applies to Wambo Phase 2 operations – controlled by Wambo Coal Pty Ltd

Document applies to United Wambo Phase 2 operations – controlled by United Wambo JV

* Wambo SWMP incorporates the North Wambo Creek Diversion Management Plan

1.0 Introduction

1.1 Background

The Wambo Coal Mine (Wambo) is situated approximately 15 kilometres west of Singleton, near the village of Warkworth, New South Wales (**Figure 1**). Wambo is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

Several open cut and underground mine operations have been conducted at Wambo since mining operations commenced in 1969. Mining under the current Development Consent (DA 305-7-2003) commenced in 2004 and permits both open cut, underground operations and associated activities to be conducted. The latest modification to DA305-7-2003 (Mod 16), approved by the Independent Planning Commission of NSW on 29 August 2019, requires development at Wambo to be undertaken in the following stages:

- Phase 1 - open cut mining operations at Wambo open cut mine, underground mining operations at Wambo underground mine and the operation of Wambo mine infrastructure (including minor upgrades to this infrastructure) within the green operational area identified in Figure 1 of Appendix 2[1]
- Phase 2 - underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure within the green operational area identified in Figure 2 of Appendix 2[2] and associated surface development
- Phase 3 - following the cessation of underground mining operations that includes mine closure.

The operation of WCPL's rail and coal loading infrastructure is undertaken in accordance with DA177-8-2004. The latest modification to DA177-8-2004 (Modification 3) was approved by the Independent Planning Commission of NSW on 29 August 2019.

The approved run-of-mine (ROM) coal production rate is 14.7 million tonnes per annum (Mtpa) and all product coal is transported from Wambo by rail. A summary of the approved Wambo Coal Mine is provided in **Table 1**.

[1] Of DA305-7-2003 (Mod 16)
[2] Of DA305-7-2003 (Mod 16)

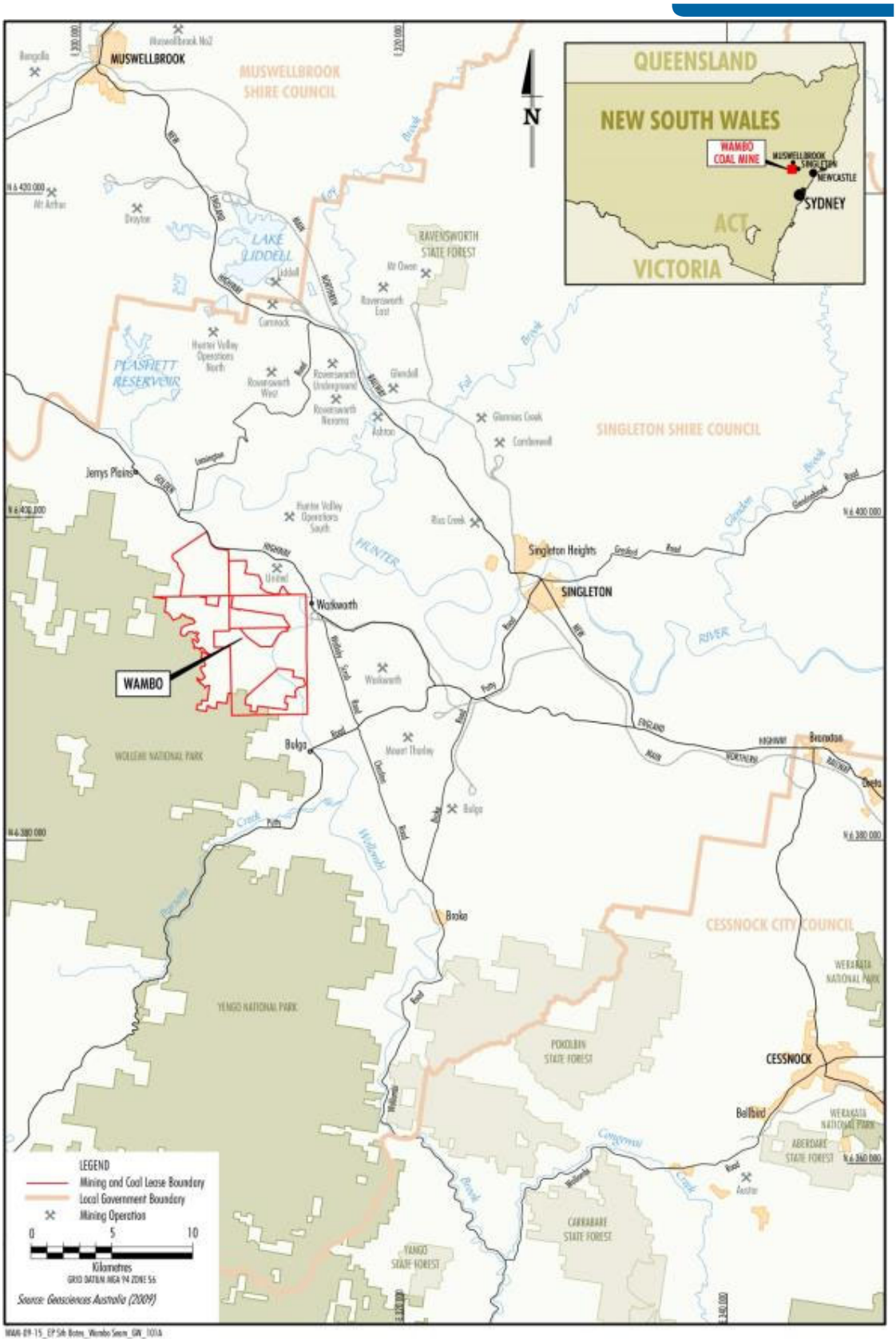


Figure 1: Wambo Coal Regional Location

Table 1: Summary of the Approved Wambo Coal Mine

Component	Approved WCPL[1]
Life of Mine	• 38 years (until 31 August 2042).
Open Cut Mining	• Open cut mining operations only during Phase 1 activities.
	• A maximum of 8 Mt of ROM coal may be extracted from Wambo Open Cut in an any calendar year (during Phase 1)
	• An estimated total open cut ROM coal reserve of 98 Mt.
Underground Mining	• Underground mining of up to 9.75 Mtpa of ROM coal in any calendar year.
	• Underground ROM coal reserves are estimated at 161.3 Mt.
Subsidence commitments and management.	• The subsidence impact performance measures listed in Conditions B1 and B4, Schedule 2, Part B of the Development Consent (DA 305-7-2003).
ROM Coal Production Rate	• Up to 14.7 Mtpa of ROM coal from the Wambo Mining Complex and United Wambo open cut coal may be processed at the Wambo CHPP in any calendar year.
Total ROM Coal Mined	• 259.3 Mt.
Waste Rock Management	• Waste rock deposited in open cut voids and in waste rock emplacements adjacent open cut operations.
Total Waste Rock	• 640 million bank cubic metres.
Coal Washing	• CHPP capable of processing approximately 1,800 tonnes per hour.
Product Coal	• Production of up to 11.3 Mtpa of thermal coal predominantly for export.
Coal Handling and Preparation Plant Reject Management	• Coarse rejects and tailings would be incorporated, encapsulated and/or capped within open cut voids (that would comprise part of United's operations during Phase 2).
Coal Transportation	• Carried out until 31 August 2042.
Total CHPP Rejects	• Approximately 40.3 Mt of coarse rejects and approximately 24.5 Mt of tailings.
Water Supply	• Make-up water demand to be met from runoff recovered from tailings storage areas, operational areas, dewatering, licensed extraction from Wollombi Brook and Hunter River.
Surface Facilities	• Construction of surface facilities within the approved surface development area.
Mining Tenements	• CL 365, CL 374, CL 397, CCL 743, ML 1402, ML 1572, ML 1594, ML1806, , Authorisation (A) 444 and Exploration Licence(EL) 7211.

Note to Table 1: [1] Development Consents DA305-7-2003 and DA177-8-2004 (as modified August 2019)

1.1.1 Mining History

Substantial coal mining activity has occurred historically and is continuing currently in the vicinity of Wambo, by a number of companies, with development across several coal seams. Coal is extracted by means of both underground and open cut mining methods. Coal mines neighbouring Wambo include United Colliery to the north and east of Wambo, Mt Thorley Warkworth to the south-east, and a number of open cut and underground mines to the north and east within the Hunter Valley Operations, as shown in **Figure 1**.

Open cut mining at Wambo commenced in 1969. During the 1970s, development consents were issued for a range of open cut and underground mining operations. The Whybrow, Redbank Creek, Wambo and Whynot Seams have primarily been mined by open cut methods at Wambo. The Wambo Seam was also mined for a short period in the Wambo No. 1 Underground Mine, however was abandoned due to hydrological issues. The Whybrow Seam was also mined from the Ridge Underground in this early period.

The Wollemi Underground Mine commenced production in 1997 and was placed under care and maintenance in October 2002 after the available longwall reserves were exhausted. Open cut operations were suspended between March 1999 and August 2001. Following the closure of the Wollemi Underground Mine in October 2002, open cut operations were expanded to maintain an overall production rate of 3 Mtpa of product coal.

Development of the North Wambo Underground Mine (NWU) commenced in November 2005, with longwall operations in the Wambo Seam commencing in October 2007. Longwall extraction at NWU finished in January 2016. Underground mining previously occurred both above and below the Wambo Seam at NWU. The adjacent United Colliery mined the lower Arrowfield Seam until 2010 (United Underground Mine) directly beneath portions of the NWU.

Development of the South Bates Underground Mine (SBU) commenced in October 2014 and longwall mining commenced in the Whybrow Seam (Longwalls 11 to 13) in February 2016. Mining operations progressed to the Wambo Seam (Longwalls 14 to 16) in July 2017. Approval was granted in December 2017 (MOD17) for mining of nine additional longwall panels in the Whybrow seam at the South Bates Extension Underground (Longwalls 17 to 25). Mining commenced in Longwall 17 in December 2018.

1.2 Purpose and Objectives

This WMP has been developed to address all water related requirements of DA305-7-2003, DA177-8-2004 and Environment Protection Licence (EPL) 529 as relevant to Phase 2 mining operations at Wambo Coal Mine.

The key objectives of water management at Wambo are to:

- satisfy regulatory requirements, including meeting required performance criteria;
- segregate clean waters from active mining areas, where possible, to reduce the volume of mine affected water requiring subsequent storage and treatment;
- segregate mine impacted water and runoff from undisturbed and revegetated areas with better water quality to minimise the volume of mine impacted water that requires reuse;
- reuse mine impacted water within the water management system (WMS) to reduce reliance on raw/clean water; and
- minimise adverse effects on downstream waterways (including hydraulic and water quality impacts).

The WMP has also been prepared in accordance with Condition D5 of DA305-7-2003.

In recognition of the requirements of Condition B66 (a) of DA305-7-2003, this WMP prepared by WCPL has been reviewed by suitably experienced and qualified persons:

- Mr Chris Bonomini (Umwelt) – Surface Water, Erosion and Sediment Control and Site Water Balance ; and
- Ms Claire Stephenson (SLR Consulting) - Groundwater.

A letter confirming DPIE's endorsement of these experts is provided in **Appendix A.**

1.3 Scope

This WMP applies to all Phase 2 operational activities at the Wambo Coal Mine including all underground mining operations, CHPP and train loading operations. It does not apply to open cut mining operations (associated with the United Wambo Open Cut Project) (**Figure 2**).

This WMP addresses the relevant conditions of WCPL's development approvals, EPL 529, water licences and all relevant mining / exploration leases and licences as detailed in **Section 2.0.**

The WMP applies to all employees and contractors working for, or on behalf of, WCPL within the project approval boundary.

This WMP provides the framework for the management of water onsite at Wambo and outlines:

- the water management strategy;
- detailed performance criteria; and
- the United Wambo water balance.

Further information on the relationship between this WMP and other relevant management plans and documents is included in **Section 1.4.**

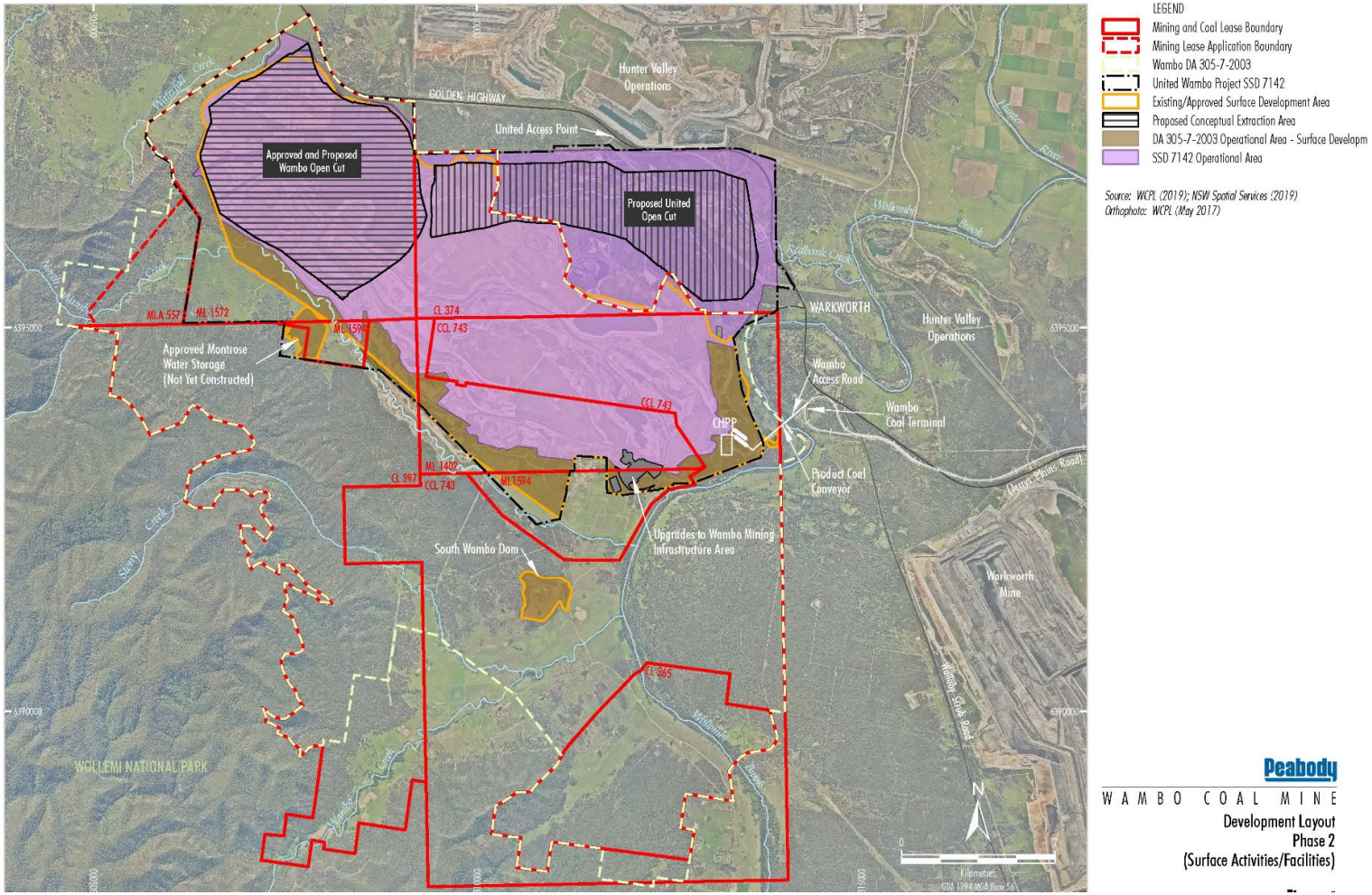


Figure 2: Approved United Wambo Project – Phase 2

1.4 Relationship with Other Documents

This WMP is part of a set of documents that have been developed to manage surface and ground water impacts for Wambo. These documents and their relationship to this WMP are shown in **Figure 3** and described in **Table 2.**

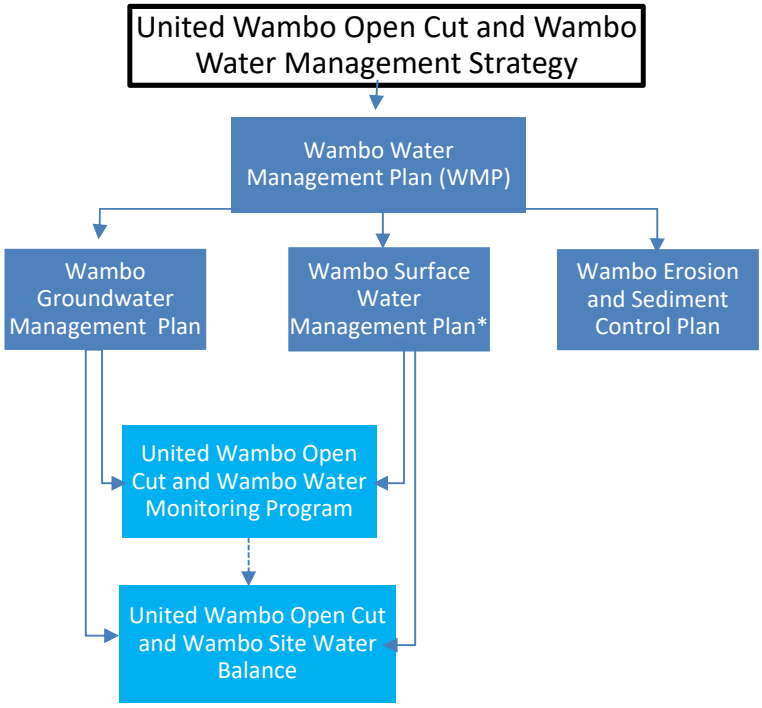


Figure 3: Wambo Water Management Plan Structure

Notes to **Figure 3**:

Shared Document with United Wambo Open Cut Operations (refer **Table 2**)

Wambo Document (refer **Table 2**)

* SWMP incorporates the North Wambo Creek Diversion Management Plan (NWCD MP)

This WMP also forms part of WCPL's Environmental Management System and should be read in conjunction with the Wambo ***Environmental Management Strategy*** (***EMS***) (WA-ENV-MNP-501).

All incidents reported at Wambo, including water-related incidents, are managed in accordance with the Wambo ***Pollution Incident Response Management Plan*** (***PIRMP***) (WA-ENV-MNP-502).

Mining operations and rehabilitation, including demolition and rehabilitation of water management infrastructure, is detailed in the Wambo ***Mining Operations Plan/Rehabilitation Management Plan*** (***MOP/RMP***).

Table 2: Water Management Documents Related to this WMP

Document ID	Document Name	Relationship to this WMP	Applies to	Purpose
WA-ENV-MNP-509.7	United Wambo Open Cut and Wambo Water Management Strategy	Overarching management strategy	United Wambo Open Cut and Wambo	Internal document that describes how water is managed at the mining complex and clearly articulates the relationship between the two Water Management Plans, Water Monitoring Program and Site Water Balance.
WA-ENV-MNP-509.8	United Wambo Open Cut and Wambo Water Monitoring Program	Shared sub plan to WMP	United Wambo Open Cut and Wambo	To clearly document the shared monitoring program and triggers for surface and ground water for the mining complex.
WA-ENV-MNP-509-4	United Wambo Open Cut and Wambo Site Water (SWB) and Salt Balance (SSB)	Shared sub plan to WMP	United Wambo Open Cut and Wambo	To clearly document the site water and salt balances for the mining complex.
WA-ENV-MNP-509-1	Wambo Groundwater Management Plan (GWMP)	Sub plan to WMP	Wambo	To describe how ground water is managed at Wambo.
WA-ENV-MNP-509-2	Wambo Surface Water Management Plan (SWMP)	Sub plan to WMP	Wambo	To describe how surface water is managed at Wambo.
WA-ENV-MNP-509-3	Wambo Erosion and Sediment Control Plan (ESCP)	Sub plan to WMP	Wambo	To describe how erosion and sediment control is managed at Wambo.
WA-ENV-MNP-509-6	North Wambo Creek Diversion Management Plan (NWCD MP)	Appendix to SWMP	Wambo	To describe how the North Wambo Creek Diversion is managed by Wambo.
-	United Wambo Open Cut and Wambo Water Asset Management Plan	Internal management plan	United Wambo Open Cut and Wambo	Internal document that describes how water assets will be managed by Wambo and United Wambo.

1.4.1 Obsolete Plans

Prior to the approval of Modification 16 to DA305-7-2003 WCPL was required to prepare a ***Surface and Groundwater Response Plan*** (**SGWRP**). As the ***SGWRP*** is no longer required under the modified DA 305-7-2003, relevant information from the ***SGWRP*** (WA-ENV-MNP-509.4) has been incorporated into the revised ***SWMP*** and ***GWMP***. This includes the Trigger Action Response Plans (TARPs) that were developed in consultation with DPIE Water and DPIE.

In addition, the ***North Wambo Creek Diversion Management Plan*** (***NWCD MP***), which was required under DA305-7-2003 prior to Modification 16, is no longer required. Prior to the approval of Modification 16, WCPL were in the process of updating the ***NWCD MP*** in consultation with DPIE Water and DPIE. The updated ***NWCD MP*** (Version 2) was submitted to the DPIE on 28 July 2020. The ***NWCD MP*** (Version 2) has been appended to the ***SWMP***. WCPL may seek to incorporate the content of the ***NWCD MP*** into the ***SWMP*** during future revisions of the ***SWMP*** as the ***NWCD MP*** is no longer required under the consent.

1.5 Integration with United Water Management System

The water management system for the United Wambo Open Cut Project has been designed to build on the existing United WMS and integrate with the existing water management system at Wambo.

During Phase 2, water management at the Wambo Underground, CHPP, and train loading facilities will continue to be undertaken in accordance with this WMP (as described in **Section 1.4**). Water management at the Wambo Open Cut will be undertaken in accordance with the United Wambo Water Management Plan during Phase 2.

1.6 Stakeholder Consultation

As required by Condition B66 of DA 305-7-2003, the WMP must be prepared in consultation with DPIE Water and the EPA, to the satisfaction of the Planning Secretary. A copy of this WMP (including all sub plans) was provided to DPIE Water and the EPA 26 August 2020. The EPA provided correspondence dated 4 September 2020 advising that it is not the role of the EPA to review such plans. No comments were received from DPIE Water/NRAR.

This WMP (and sub plans) has been prepared in consultation with Wambo's technical water experts:

- Mr Chris Bonomini (Umwelt Australia)– Surface Water, Site Water Balance and Erosion and Sediment Control;
- Ms Claire Stephenson (SLR Consulting) – Groundwater; and
- Mr Rohan Lucas (Alluvium) – North Wambo Creek Diversion Management Plan.

Correspondence in relation to the WMP and endorsement of experts is attached as **Appendix A**. A summary of how comments from DPIE Water, the Independent Expert Scientific Committee (IESC) and DPIE have been addressed in previous versions of the WMP is also provided in **Appendix A**.

Version 2 of the WMP was approved by DPIE 20 November 2020.

1.7 Summary of Commitments

A Summary of Commitments relating to this WMP is included in **Appendix B**.

2.0 Statutory and Other Requirements

2.1 Legislation

The main legislation relevant to this WMP (and sub plans) is:

- *Environmental Planning & Assessment Act 1979* (EP&A Act);
- *Protection of the Environment Operations Act 1997 (POEO Act)*; and
- *Water Act 1912; and*
- *Water Management Act 2000 (WM Act).*

Other legislation referenced in this WMP includes the *Mining Act 1992*, *Fisheries Management Act 1994* and *Local Government Act 1993*.

2.1.1 Environmental Planning & Assessment Act 1979

WCPL received Development Consent (DA305-7-2003) in accordance with the EP&A Act from DPIE, formerly NSW Department of Planning and Environment (DP&E), on 4 February 2004. This Consent was for the development of open cut and underground mining operations at the Wambo coal mine. The most recent modification to DA305-7-2003 was granted by the Independent Planning Commission of NSW on 29 August 2019 (Mod 16). DA305-7-2003 stipulates requirements related to this WMP (refer to **Section 2.3.1** and **Appendix C**).

WCPL received Development Consent (DA177-8-2004) in accordance with the EP&A Act from DPIE, formerly NSW Department of Planning and Environment (DP&E), on 16 December 2004. This Consent was for the development of rail and coal loading infrastructure adjacent to the Wambo Coal Mine. The most recent modification to DA177-8-2004 was granted by the Independent Planning Commission of NSW on 29 August 2019 (Mod 3). DA177-8-2004 stipulates requirements related to this WMP (refer to **Section 2.3.2** and **Appendix C**).

2.1.2 Protection of the Environment Operations Act 1997

Activities that do, or may, lead to pollution of waters in NSW are regulated by the NSW Environment Protection Agency (EPA) under the POEO Act. Where discharge of waters is permitted it is strictly controlled by licence conditions such that discharges do not result in significant impacts on water resources.

Wambo operates under EPL No. 529, issued by the EPA under the authority of the POEO Act. Condition L1.1 of EPL 529 (Wambo) requires compliance with Section 120 of the POEO Act, which prohibits pollution of waters.

The EPL stipulates requirements related to this WMP (refer to **Section 2.4**).

All holders of EPLs are required to prepare a Pollution Incident Response Management Plan (PIRMP) in accordance with section 153A of the POEO Act (refer **Section 1.4**).

2.1.3 Water Act 1912

The *Water Act 1912* governs access, trading and allocation of licences associated with both surface and underground water for water sources where a Water Sharing Plan (WSP) has not commenced. The elements to which the *Water Act 1912* applies include extraction of water from a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

The Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources (NFPR WSP) commenced for the Permian and Triassic hard-rock units on 1 July 2016. WCPL's licences under the *Water Act 1912* have been converted to licences under the *Water Management Act 2000*.

2.1.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions.

An amendment to the WM Act (section 60I) came into effect on 1 March 2013. This amendment provides that it is *an offence for a person without an access licence to take, remove or divert water from a water source, or relocate water from one part of an aquifer to another part of an aquifer, in the course of carrying out a mining activity.* Various activities are captured by the provisions of the amendment including mining, mineral exploration and petroleum exploration.

The area covered by this WMP is located within the following Water Sharing Plan (WSP) areas:

- Hunter Unregulated and Alluvial Water Sources 2009 (HUA WSP);
- Hunter Regulated River Water Source 2016 (HRR WSP); and
- North Coast Fractured and Porous Rock Groundwater Sources (NFPR WSP).

Any interference and extraction of surface or ground water throughout the WMP area generally requires a water access licence (WAL) under the WM Act. United and Wambo hold a number of WALs under the WM Act, as described in **Section 2.5.**

2.1.4.1 Hunter Unregulated and Alluvial Water Sources Sharing Plan

The HUA WSP commenced in August 2009. This WSP regulates the interception and extraction of surface water and alluvium within the Hunter region and is categorised into four extraction management units (EMUs). These EMUs are further broken down into water sources. Wambo is located predominantly within the Lower Wollombi Brook water source.

At the commencement of the WSP (in August 2009), the groundwater (alluvial) entitlement within the Lower Wollombi Brook water source was 5,071 megalitres per year (ML/year) shared between 38 licences. WCPL currently holds one alluvial aquifer licence (WAL 23897, Licence 20AL211371, 70 shares) within the Lower Wollombi Brook water source of the HUA WSP (refer **Section 2.5.1**).

2.1.4.2 Hunter Regulated River Water Source Sharing Plan

The HRR WSP commenced on 1 July 2016 and covers the Hunter River surface water flows and highly connected alluvials. United Wambo currently hold groundwater licences to abstract 1,306ML/year from the Hunter Regulated River Alluvial water source (Hunter River) (refer **Section 2.5.2**).

2.1.4.3 North Coast Fractured and Porous Rock Groundwater Sources

The NFPR WSP commenced on 1 July 2016. This WSP regulates the interception and extraction of water from the Permian and Triassic hard-rock units, including coal seams.

WCPL's licences previously held under the *Water Act 1912* have been converted to licences under the NFPR WSP. WCPL holds 1,647 ML of entitlements under the Sydney Basin North Coast water source. United holds a further 300 ML of entitlements (refer **Section 2.5.2**).

2.2 Policies, Guidelines and Standards

The following policies, guidelines and standards are relevant to this WMP (and sub plans):

- *NSW Aquifer Interference Policy 2012* (see **Section 2.2.1**);
- *NSW State Groundwater Policy Framework Document 2007* (see **Section 2.2.2**);
- Draft *Groundwater Monitoring Guidelines for Mine Sites within the Hunter Region* (DIPNR, 2003) (see **Section 2.2.3**);
- *Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities* (NSW Department of Industry, Water (DPIE Water (formally DPI Water)) 2014) (**Section 2.2.4**);
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) (**Section 2.2.5**);
- *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales* (DEC, 2004) (**Section 2.2.6**);
- Australian Standard/New Zealand Standard (AS/NZS) 5667:1998 (**Section 2.2.7**);
- Water Reporting Requirements for Mines (DWE Water updated) (**Section 2.2.8**);
- *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008), otherwise known as the "Blue Book" (**Section 2.2.9**);
- Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012) (**Section 2.2.10**); and
- Draft *Guidelines for the Design of Stable Drainage Lines on Rehabilitated Mine sites in the Hunter Coalfields* (DIPNR undated) (**Section 2.2.11**).

2.2.1 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) was finalised in September 2012 and clarifies the water licensing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining. Many aspects of this Policy will be given legal effect in the future through an Aquifer Interference Regulation. Stage 1 of the Aquifer Interference Regulation commenced on 30 June 2011.

This Policy outlines the water licensing requirements under the *Water Act 1912* and *WM Act*:

A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void) even where that water is not being used consumptively as part of the activity's operation.

Under the *WM Act*, a water licence gives its holder a share of the total entitlement available for extraction from the groundwater source. The WAL must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The AIP requires that potential impacts on groundwater sources, including their users and Groundwater Dependent Ecosystems (GDEs), be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable.

The Level 1 minimal impact considerations for less productive groundwater sources are relevant to the groundwater sources at Wambo and are as follows:

- **Water table**: less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m decline cumulatively at any water supply work unless make good provisions should apply.
- **Water pressure**: a cumulative pressure head decline of not more than 40% of the 'post-water sharing plan' pressure head above the base of the water source to a maximum of a 2 m decline at any water supply work.
- **Water quality**: any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. For alluvial water sources, there should be no increase of more than 1% per activity in the long-term average salinity in a highly connected surface water source at the nearest point to the activity.

2.2.2 NSW State Groundwater Policy

The objective of the *NSW State Groundwater Policy Framework Document* (NSW Government 1997) is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. NSW groundwater policy has three component parts:

- NSW Groundwater Quantity Protection Policy;
- NSW Groundwater Quality Protection Policy; and
- NSW Groundwater Dependent Ecosystems Policy.

The principles of the *NSW Groundwater Quantity Protection Policy* include:

- Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn;
- Groundwater extraction shall be managed to prevent unacceptable local impacts; and

- All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

The criteria and management practices developed as part of this document will seek to follow the principles of this policy.

The objective of the *NSW Groundwater Quality Protection Policy* is the ecologically sustainable management of the State's groundwater resources so as to:

- Slow and halt, or reverse any degradation in groundwater resources;
- Direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater;
- Establish a methodology for reviewing new developments with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource; and
- Establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps or groundwater protection zones.

Groundwater triggers will be developed as part of the ***GWMP*** where they will seek to follow the objectives of this policy.

The *NSW Groundwater Dependent Ecosystem Policy* was designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of these dependent ecosystems are maintained or restored for the benefit of present and future generations.

2.2.3 Draft Groundwater Monitoring Guidelines

The former NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) developed the '*Draft Groundwater Monitoring Guidelines for Mine Sites within the Hunter Region*' in September 2003. This draft guideline is still used by DPIE Water as the benchmark for groundwater monitoring programs at mine sites within the Hunter Region.

2.2.4 Groundwater Monitoring and Modelling Plans Guideline

DPI Water developed the '*Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities'* in February 2014, to assist in the development of Groundwater Monitoring and Modelling Plans. These plans are required as a standard condition of licence for exploration (drilling) under the Mining Act 1992.

Condition B66d(vi) of DA305-7-2003 require WCPL to develop a GWMP that is consistent with this document (refer ***GWMP***). The ***GWMP*** also meets the requirements of Condition 12 of EL7211, which requires the development of a Groundwater Monitoring and Modelling Plan (GWMMP) for EL7211 (refer **Section 2.6**).

2.2.5 ANZECC Water Quality Guidelines

The ANZECC Guidelines were prepared in 2000 as part of Australia's *National Water Quality Management Strategy* (NWQMS). These guidelines were updated in 2018 and include recommended criteria or limits for fresh and marine water quality. These criteria have been adopted for some surface water monitoring locations, where baseline data is unavailable. Further detail is provided in the ***SWMP***.

2.2.6 Approved Methods for Sampling and Analysis of Water Pollutants in NSW

In 2004 the then Department of Environment and Conservation (DEC) published the *Approved Methods for Sampling and Analysis of Water Pollutants in NSW*. This document lists the sampling and analysis methods to be used when complying with the requirements of the POEO Act and regulations.

2.2.7 Australian Standard 5667:1998 for Water Quality Sampling

Australian Standard 5667:1998 Water Quality - Sampling applies to this WMP (and sub plans). Relevant parts include:

- Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples
- Part 4: Guidance on sampling from lakes, natural and man-made
- Part 6: Guidance on sampling of rivers and streams

2.2.8 Water Reporting Requirements for Mines

As part of the water balance monitoring, water imported to site, water used onsite and water discharged from site will be monitored in accordance with *Water Reporting Requirements for Mines* (DWE Water undated). Further detail on water balance monitoring is provided in the ***Site Water Balance (SWB)***.

2.2.9 The "Blue Book"

WCPL is required to design, install and maintain erosion and sediment controls in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008), otherwise known as the "Blue Book".

Condition B66(d)(iii) of DA305-7-2003 also requires WCPL to develop an Erosion and Sediment Control Plan (ESCP) that is consistent with the requirements of the Blue Book.

2.2.10 Minimum Construction Requirements for Water Bores in Australia

Condition 26 of EL7211 requires that WCPL construct, maintain and decommission all boreholes in accordance with standards equivalent to or exceeding the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2012).

2.2.11 Draft Guidelines for the Design of Stable Drainage Lines on Rehabilitated Mine Sites in the Hunter Coalfields

The Draft *Guidelines for the Design of Stable Drainage Lines on Rehabilitated Mine sites in the Hunter Coalfields* (DIPNR undated) (Draft Guidelines) provide for the long-term stability of drainage lines on mine sites. Drainage lines require the application of control structures to mitigate against erosion and sediment discharge. The Draft Guidelines outline the elements of drainage design that include specific erosion control techniques and revegetation of areas adjacent to the drainage lines to control soil erosion of spill over areas

WCPL has considered the Draft Guidelines in the preparation of the ***ESCP***.

2.3 Project Approval

2.3.1 DA305-7-2003 Conditions of Consent

DA305-7-2003 requirements related to the development of this WMP are summarised in **Table 3**. Water management performance measures, as specified in Condition B62 of DA305-7-2003, are listed in **Table 4.**

Other conditions within DA305-7-2003 relevant to water management are included in **Appendix C (Table A).**

Table 3: DA305-7-2003 Requirements for this WMP

Condition	Condition Details	WMP Section
B66	The Applicant must prepare a Water Management Plan for the Wambo Mining Complex to the satisfaction of the Planning Secretary. This plan must:	**This document**
	(a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary;	**Section 1.6 and Appendix A**
	(b) be prepared in consultation with DPIE Water and the EPA;	**Section 1.6 and Appendix A**
	(c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures (see Table 8 of DA305-7-2003);	**GWMP, SWMP & ESCP**
	(d) include a: (i) Site Water Balance that includes details of: • predicted annual inflows and outflows on the site; • sources and security of water supply for the life of the development (including authorised entitlements and licences); • water storage capacity; • water use and management on the site, including any water transfers or sharing with neighbouring mines; • licensed discharge points and limits; and • reporting procedures, including the annual preparation of an updated site water balance;	**Section 5.2 and SWB**
	(ii) Salt Balance that includes details of: • sources of saline material on the site; • saline material and saline water management on the site; • measures to minimise discharge of saline water from the site; and • reporting procedures, including the annual preparation of an updated salt balance;	**Section 5.3 and SWB (which includes the SSB)**

Condition	Condition Details	WMP Section
	(iii) Erosion and Sediment Control Plan, that: • is consistent with the requirements of *Managing Urban Stormwater: Soils and Construction – Volume 1: Blue Book* (Landcom, 2004) and *Volume 2E: Mines and Quarries* (DECC, 2008); • identifies activities that could cause soil erosion, generate sediment or affect flooding; • describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and manage flood risk; • describes the location, function, and capacity of erosion and sediment control structures and flood management structures; and • describes what measures would be implemented to maintain (and if necessary decommission) the structures over time;	**ESCP**
	(iv) Surface Water Management Plan, that includes: • detailed baseline data on surface water flows and quality of watercourses and/or water bodies potentially impacted by the development, including: ○ stream and riparian vegetation health; ○ channel stability (geomorphology); and ○ water supply for other surface water users; • a detailed description of the surface water management system; • detailed plans, design objectives and performance criteria for water infrastructure, including: ○ any approved creek diversions or restoration works associated with the development; ○ water run-off diversions and catch drains; ○ water storages and sediment dams; ○ emplacement areas and tailings storages; and ○ reinstated drainage networks on rehabilitated areas of the site; • detailed performance criteria, including trigger levels for identifying and investigating any potentially adverse impacts associated with the development, on: ○ downstream surface water flows and quality Including Wollombi Brook, North Wambo, South Wambo, and Stony Creeks); ○ channel stability; ○ downstream flooding impacts; ○ stream and riparian vegetation health; ○ water supply for other water users; and ○ post-mining water pollution from rehabilitated areas of the site; • a program to monitor: ○ compliance with the relevant performance measures	**SWMP and WMProg**

Condition	Condition Details	WMP Section
	listed in Table 8 and the performance criteria established above; ○ controlled and uncontrolled discharges and seepage/leachate from the site; ○ surface water inflows, outflows and storage volumes to inform the Site Water Balance; ○ impacts on water supply for other users; and ○ the effectiveness of the surface water management systems and the measures within the Erosion and Sediment Control Plan; • reporting procedures for the results of the monitoring program; and • a plan to respond to any exceedances of the performance measures or performance criteria, and repair, mitigate and/or offset any adverse surface water impacts of the development;	
	(v) Groundwater Management Plan, which is consistent with *Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities* (DPI Water, 2014) and includes: • detailed baseline data of groundwater levels, yield quality for groundwater resources and groundwater dependent ecosystems potentially impacted by the development, including groundwater supply for other water users; • a detailed description of the groundwater management system; • groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts associated with the development, on: ○ regional and local aquifers (alluvial and hardrock); ○ groundwater supply for other water users such as privately-owned licensed groundwater bores; and ○ groundwater dependent ecosystems; • a program to monitor and evaluate: ○ compliance with the relevant performance measures listed in Table 8, and the performance criteria established above, including monitoring of regional groundwater levels and quality during the life of the development and at least 10 years post-mining; ○ water loss/seepage from water storages into the groundwater system (particularly from South Wambo Dam and Montrose East Dam); ○ groundwater inflows, outflows and storage volumes to inform the Site Water Balance; ○ any hydraulic connectivity between the alluvial and hardrock aquifers; ○ impacts on groundwater dependent ecosystems; ○ impacts on groundwater supply for other water users; and ○ the effectiveness of the groundwater management systems; • reporting procedures for the results of the monitoring program; • a plan to respond to any exceedances of the groundwater performance criteria, and repair, mitigate, compensate and/or	**GWMP and WMProg**

Condition	Condition Details	WMP Section
	offset any adverse groundwater impacts of the development; and • a program to periodically validate the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and	
	(vi) a protocol to report on the measures, monitoring results and performance criteria identified above, in the Annual Review referred to in condition D10.	**Section 9.0**
D5	**Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include where relevant:	**Section 2.2**
	(a) summary of relevant background or baseline data;	**Section 3.0 (see also SWMP, GWMP & ESCP)**
	(b) details of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Section 2.0 and Appendix C**
	• any relevant limits or performance measures and criteria;	**Table 4 and Table 5 (see also SWMP, GWMP & ESCP)**
	• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Refer SWMP, GWMP & ESCP**
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 2.3.2**
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Entire document (see also SWMP, GWMP & ESCP)**
	(e) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures set out pursuant to paragraph (d);	**Monitoring - Section 6.0 (see also SWMP, GWMP & ESCP)** **Reporting - Section 9.0**
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 8.0. See also SWMP, GWMP & ESCP**
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 9.0**
	(h) a protocol for managing and reporting any: • incident, non-compliance or exceedance of any impact assessment criterion and performance criterion;	**Section 9.0** **Section 9.0**
	• complaint; or	**Section 7.0**
	• failure to comply with other statutory requirements; and	**Section 9.0**

Condition	Condition Details	WMP Section
	(i) a protocol for periodic review of the plan.	**Section 9.1**
	Note: The Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.	**Noted**

Table 4: DA305-7-2003 Water Management Performance Measures

Feature	Performance Measure[1]	WMP Section
Water management – general	• Maintain separation between clean, dirty and mine water • Minimise the use of clean and potable water • Maximise water recycling, reuse and sharing opportunities • Minimise the use of make-up water from external sources • Design, install, operate and maintain water management infrastructure in a proper and efficient manner	**Section 4.1 See also SWMP, GWMP & ESCP**
Alluvial aquifers (including Wollombi Brook alluvium and excluding North Wambo Creek alluvium)	• Negligible impacts beyond those predicted in the document/s listed in condition A2(c), including: • negligible change in groundwater levels; • negligible change in groundwater quality; and • negligible impact to other groundwater users	**GWMP**
Erosion and sediment control works	• Design, install and maintain erosion and sediment controls in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008) • Design, install and maintain any infrastructure within 40 metres of watercourses in accordance with the guidance series for *Controlled Activities on Waterfront Land* (DPI Water, 2012) • Design, install and maintain any creek crossings generally in accordance with the *Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* (NSW Fisheries, 2003)	**SWMP & ESCP**
Clean water diversions and storage infrastructure	• Design, install and maintain the clean water system to capture and convey the 100 year ARI flood event • Maximise, as far as reasonable, the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site	**SWMP**
Sediment dams	• Design, install and maintain sediment dams in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008)	**SWMP & ESCP**

Feature	Performance Measure[1]	WMP Section
Above-ground mine water storages	• Design, install and maintain mine water storage infrastructure to avoid unlicensed or uncontrolled discharge of mine water	**SWMP**
Prescribed dams under the Dams Safety Act 1978 or Dams Safety Act 2015 (including South Wambo Dam)	• Design, constructed and operated to the satisfaction of DSC • Drained prior to the commencement of secondary workings in underlying longwalls, to the satisfaction of DSC	**Section 5.1.6**
Tailings storages	• Design and maintain tailings storage areas to encapsulate and prevent the release of tailings seepage/leachate	**Section 4.1.3**
Overburden emplacements	• Design, install and maintain emplacements to encapsulate and prevent migration of tailings, acid forming and potentially acid forming materials, and saline and sodic material • Design, install and maintain out-of-pit emplacements to prevent and/or manage long term saline seepage	**Section 4.1.3**
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard	**Section 5.1.8**
Creek diversion and restoration works (including the North Wambo Creek Diversion)	• Diverted creek lines are hydraulically and geomorphologically stable in the long term • Incorporate erosion control measures based on vegetation and engineering revetments • Incorporate persistent/permanent pools for aquatic habitat • Revegetate with suitable native species	**SWMP (NWCD MP)**
Aquatic, riparian and groundwater dependent ecosystems	• Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c) • Maintain or improve baseline channel stability • Develop site-specific in-stream water quality objectives in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006)	**SWMP**

Note:

1. The performance measures in **Table 4** do not apply to water management structures constructed prior to the approval of Modification 16 (to DA305-7-2003).

2.3.2 DA177-8-2004 Conditions of Consent

There are no specific requirements in DA177-8-2004 for the development of a WMP however conditions relevant to water management with DA177-8-2004 have been addressed in this WMP. These conditions, and where they have been addressed in this WMP, are included in **Appendix C (Table B).**

Water management performance measures, as specified in Condition B9 of DA177-8-2004, are listed in **Table 5.**

Table 5: DA177-8-2004 Water Management Performance Measures

Feature	Performance Measure	WMP Section
Water management – general	• Maintain separation between clean, dirty and mine water • Minimise the use of clean and potable water • Maximise water recycling, reuse and sharing opportunities • Design, install, operate and maintain water management infrastructure in a proper and efficient manner	**Section 4.1 See also SWMP, GWMP & ESCP**
Sediment dams	• Design, install and maintain sediment dams in accordance with the guidance series *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom, 2004) and *2E Mines and Quarries* (DECC, 2008) and the requirements under the POEO Act or *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.	**SWMP & ESCP**
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard	**Section 5.1.8**
Above-ground storage tanks containing materials likely to cause environmental harm	• Imperviously bunded with a capacity of 110% that of the largest container stored within the bund • Designed and constructed in a manner which prevents the ingress of rainwater into the tanks • Clearly labelled to identify content	**Section 5.1.8**

2.3.3 2016 EA Commitments

There are a number of commitments relating to water management and monitoring within the following documents:

- *United Wambo Open Cut Coal Mine Project Environmental Impact Statement* (Umwelt, 2016);
- *United Wambo Open Cut Coal Mine Project Surface Water Assessment* (Umwelt, 2016a); and
- *United Wambo Open Cut Coal Mine Project Groundwater Impact Assessment* (AGE, 2016).

These commitments relate to the United Wambo Open Cut Mine Project, however some of them are relevant to the shared water monitoring program and site water balance. For reference these commitments are summarised in **Appendix C** (**Table C**)**.** Further detail on how these commitments have been met is provided in the ***WMProg*** and ***SWB.***

2.3.4 Independent Environmental Audit Recommendations

In 2017 Hansen Bailey conducted an Independent Environmental Audit of the Wambo Coal Mine, in accordance with the requirements of Condition D11 of DA305-7-2003 and DA177-8-2004 (Hansen Bailey, 2018). Recommendations from the audit report relating to this WMP, and where they are addressed, are contained in **Appendix C (Table D).**

2.4 Environment Protection Licence 529

Under EPL 529, Wambo may discharge water into the Hunter River system in accordance with the Hunter River Salinity Trading Scheme (HRSTS) through a designated Licenced Discharge Point (LDP). The HRSTS is a cap-and- trade system designed to facilitate saline discharges into the Hunter River by its many industrial and agricultural users, without compromising sustainable water quality. The HRSTS is administered under the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.*

There is currently one LDP in the Wambo EPL 529. As of July 2020, Wambo currently holds 51 credits under the HRSTS.

The EPL 529 conditions relevant to this WMP are included in **Appendix C** (**Table E**).

2.5 Water Licences

2.5.1 Water Access and Surface Water Licences

As discussed in **Section 2.1.3**, United and Wambo hold a number of WALs under the WM Act for the HRR WSP and HUA WSP. **Table 6** presents the WALs held by United and Wambo.

WCPL will report performance against relevant surface water licence conditions in the Annual Review (refer **Section 9.2.1**).

Table 6: Water Access and Surface Water Licences

Licence No	Water Source	Category	Holder	Share Component (units)	Tenure Type
WAL718	Hunter Regulated River Water Source	Regulated River (High Security)	Wambo	1000	Continuing
WAL8599	Hunter Regulated River Water Source	Regulated River (High Security)	Wambo	6	Continuing
WAL8600	Hunter Regulated River Water Source	Regulated River (General Security)	Wambo	868	Continuing
WAL8604	Hunter Regulated River Water Source	Supplementary Water	Wambo	240	Continuing
WAL10541	Hunter Regulated River Water Source	Regulated River (High Security)	United	300	Continuing
WAL1369	Hunter Regulated River Water Source	Regulated River (Supplementary)	Wambo and United	15	Continuing
WAL15459	Hunter Regulated River Water Source	Regulated River General Security)	Wambo and United	21	Continuing
WAL18445	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	United	200	Continuing

Licence No	Water Source	Category	Holder	Share Component (units)	Tenure Type
WAL18549	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	United	100	Continuing
WAL18437	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	Wambo	350	Continuing
WAL 23897	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Aquifer	Wambo	70	Continuing

2.5.2 Groundwater Licences

United and Wambo also hold WALs under the WM Act for the NFPR WSP, for the operation of groundwater extraction. **Table 7** presents the WALs held by United and Wambo.

WCPL will report performance against relevant groundwater licence conditions in the Annual Review (refer **Section 9.2.1**).

Table 7: Groundwater Extraction Licences

Licence No	Description	Category	Holder	Share Component (units)	Tenure Type
WAL 42373[1]	Dewatering bores	Aquifer	Wambo	1549	Continuing
WAL41532	Dewatering	Aquifer	Wambo	98	Continuing
WAL41510	Dewatering	Aquifer	United	300	Continuing

1. Consolidated licence including WALs 39735, 39738, 39803, 41494, 41528 and 41520.

WCPL also holds a number of licences for groundwater monitoring bores under the *Water Act 1912*. Details of groundwater monitoring bores are included in the ***GWMP***. Monitoring of these bores is included in the ***WMProg.***

2.6 Mining Tenements and Exploration Licences

Mining operations and exploration activities at Wambo must be operated in accordance with the conditions of various mining tenements and exploration licences/authorities (refer to the ***MOP/RMP*** for more detail). Conditions relevant to water management and where they are addressed in this WMP are summarised in **Table 8**.

Table 8: Mining Tenement Conditions relevant to this WMP

Tenement/ Licence	Condition No	Condition Description	WMP Section
EL7211[1]	10	**Erosion and sediment control** The licence holder must prevent erosion and pollution of watercourses resulting from the conduct of prospecting	**ESCP**

Tenement/ Licence	Condition No	Condition Description	WMP Section
		operations by implementing effective erosion and sediment control measures.	
EL7211[1]	11	The planning, design and construction of erosion and sediment control measures must be conducted generally in accordance with *Managing Urban Stormwater: Soils and Construction* (DECC 2007), as amended or replaced from time to time.	**ESCP**
EL7211[1]	12	**Groundwater Monitoring and Modelling Plan** Prior to conducting prospecting operations involving the construction and use of boreholes, the licence holder must: a) Prepare a Groundwater Monitoring and Modelling Plan in consultation with the NSW Office of Water; b) Ensure the Groundwater Monitoring and Modelling Plan: i. describes methods for identifying aquifers, their depths, behaviour, containing layers and connectivity with surrounding aquifers or surface water systems; ii. describes methods for collection of data relevant to the type, quantity and quality of water contained within aquifer systems likely to be encountered during prospecting operations; iii. provides for the future development of a conceptual model of regional groundwater behaviour; iv. provides for the future development of a calibrated computer model of regional groundwater behaviour, to enable the impacts of any proposed mining operations to be assessed; v. describes how records of all data collected will be maintained; vi. describes the staging process for implementation of the plan; and vii. is prepared in accordance with any additional requirements prescribed by the Secretary. c) The Groundwater Monitoring and Modelling Plan must address the requirements identified in b)i) and b)vii) in a level of detail commensurate with the scale, timing and potential impact of the proposed operations; d) have the Groundwater Monitoring and Modelling Plan approved by the Minister; and e) Implement and comply with the approved Groundwater Monitoring and Modelling Plan.	**GWMP**
EL7211[1]	26	**Drilling** The licence holder must: a) Construct, maintain and decommission all boreholes and petroleum wells in accordance with standards equivalent to or exceeding the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2012), as amended or replaced from time to time. Where this condition is inconsistent with other conditions set out in this exploration licence, those conditions prevail to the extent of that inconsistency. b) Ensure that the construction, operation, maintenance and decommissioning of boreholes does not cause or enhance: i. hydraulic connection between aquifers; ii. contamination or cross-contamination of aquifers; iii. the escape of natural or noxious gases; iv. the uncontrolled surface discharge of ground waters;	**Sections 2.2.10 & 5.1.7 and GWMP**

Tenement/ Licence	Condition No	Condition Description	WMP Section
		v. collapse of the surrounding surface; or vi. hazards to persons, stock and wildlife.	
		e) Contain all drill cutting, fluids and groundwater returned to the surface as part of the drilling process in above-ground tanks or in-ground sumps pending recirculation or disposal. In-ground sumps must be lined with an impermeable barrier where there is a potential risk of contamination from drill cuttings or fluids;	**GWMP and SWMP**
EL7211[1]	39	**Rehabilitation** The licence holder must ensure that all water land and wetland crossings that are disturbed during prospecting operations are rehabilitated such that the natural flow of water is unimpeded and bank stability is maintained to prevent erosion.	**SWMP**
ML1594, ML1572 & CL374	15	**Exploratory Drilling** c) all drill holes are permanently sealed with cement plugs to prevent surface discharge of any groundwaters;	**GWMP**
		e) if any drill hole meets an artesian or sub-artesian flow it is effectively sealed to prevent contamination of aquifers.	**GWMP**
ML1594, ML1572 & CL374	16	**Prevention of Soil Erosion and Pollution** Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution (including sedimentation) or soil contamination or erosion, unless otherwise authorised by a relevant approval, and in accordance with an accepted Mining Operations Plan. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters. The lease holder must observe and perform any instructions given by the Director-General in this regard.	**SWMP**
CCL743 & ML1402	17	**Exploratory Drilling** b) iii) all drill holes are permanently sealed with cement plugs to prevent surface discharge of any groundwaters;	**GWMP**
		b) v) if any drill hole meets an artesian or sub-artesian flow it is effectively sealed to prevent contamination of aquifers.	**GWMP**
CCL743 & ML1402	18	**Prevention of Soil Erosion and Pollution** Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution (including sedimentation) or soil contamination or erosion, unless otherwise authorised by a relevant approval, and in accordance with an accepted Mining Operations Plan. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters. The lease holder must observe and perform any instructions given by the Director-General in this regard.	**SWMP**

1. EL7211 is expected to be handed over to the United Wambo Open Cut late 2020

3.0 Baseline Data

3.1 Existing Environment

The existing environment is described in detail in the EIS (Umwelt 2016) and summarised with respect to water in the sections below.

3.1.1 Rainfall

Wambo is located in the Upper Hunter Valley near the NSW township of Jerry's Plains. The area experiences a dry temperate to sub-tropical climate with hot humid summers and cool drier winters. The annual average rainfall is some 650 mm.

3.1.2 Geological Setting

The Permian age Wittingham Coal Measures comprise economic coal seams in the project area, along with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone, and conglomerate. The coal measures plunge in a general west to south-westerly direction, with the Wittingham Coal Measures outcropping to the north and east of the project area, near the Hunter River. The Permian sediments are unconformably overlain by thin Quaternary alluvial deposits. These deposits consist of silt, sand and gravel in the alluvial floodplain of the Wollombi Brook. To the east of the Wollombi Brook is a sequence of aeolian sands, known as the Warkworth Sands Formation, that form a thin capping on the underlying Permian bedrock.

The Permian coal measures are also unconformably overlain by the Triassic Narrabeen Group, which formed from uplift during the Triassic. The Narrabeen Group comprises primarily consolidated sandstone that form the ridge lines and high plateau areas within the Wollemi National Park.

Surficial weathering occurs across the project area. The weathering profile is typically present as a thin heterogeneous layer of unconsolidated and highly weathered material (regolith) overlying fresh bedrock.

The following main stratigraphic units occur within the project area and immediate surrounds (from youngest to oldest):

- Quaternary sediments (alluvium);
- Triassic Narrabeen Group;
- Permian Newcastle Coal Measures; and
- Permian Wittingham Coal Measures.

3.1.3 Topography and Vegetation

The project area is gently undulating, with elevation ranging between 60 m Australian Height Datum (AHD) in the east and 215 mAHD in the west. Outside of the project area, the topography grades into the flat alluvial lands associated with the adjacent water courses (50 mAHD to 60 mAHD) and rises to between 300 mAHD and 650 mAHD toward the Wollemi National Park escarpment to the west.

Due to historical farming and mining, the majority of the project area is cleared of vegetation. Wollemi National Park is densely vegetated with various plant communities, including open forests dominated by eucalypt species.

3.1.4 Surface Water Catchment Context

The mine site is within the lower Wollombi Brook catchment near its confluence with the Hunter River. Wollombi Brook drains an area of approximately 1,950 km^2 (Gilbert and Associates, 2003) and joins the Hunter River some 5 km north- east of Wambo (**Figure 4**).

Surface runoff from the majority of land within the WCPL's project area drains to Wollombi Brook via a series of generally easterly flowing creeks including South and North Wambo Creek, Stony Creek, Waterfall Creek and Redbank Creek. South Wambo Creek and its main tributary Stony Creek rise in the Wollemi National Park escarpment south of the mine and drain the southern and south-western parts of the mining lease area. Waterfall Creek drains the north end of the mining lease area. Relatively smaller parts of the northern side of the site drain to Redbank Creek in the United Collieries lease area (**Figure 5**).

North Wambo Creek, which also has its headwaters in the Wollemi escarpment, drains the central parts of the mining lease. A section of North Wambo Creek has been diverted to avoid the Wambo open cut (**Figure 5**). The North Wambo Creek Diversion was constructed in 2008, accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007b).

Further detail on sub-catchment sizes as well as detailed baseline data for surface water flows and quality in the vicinity of Wambo is presented in the ***SWMP.***

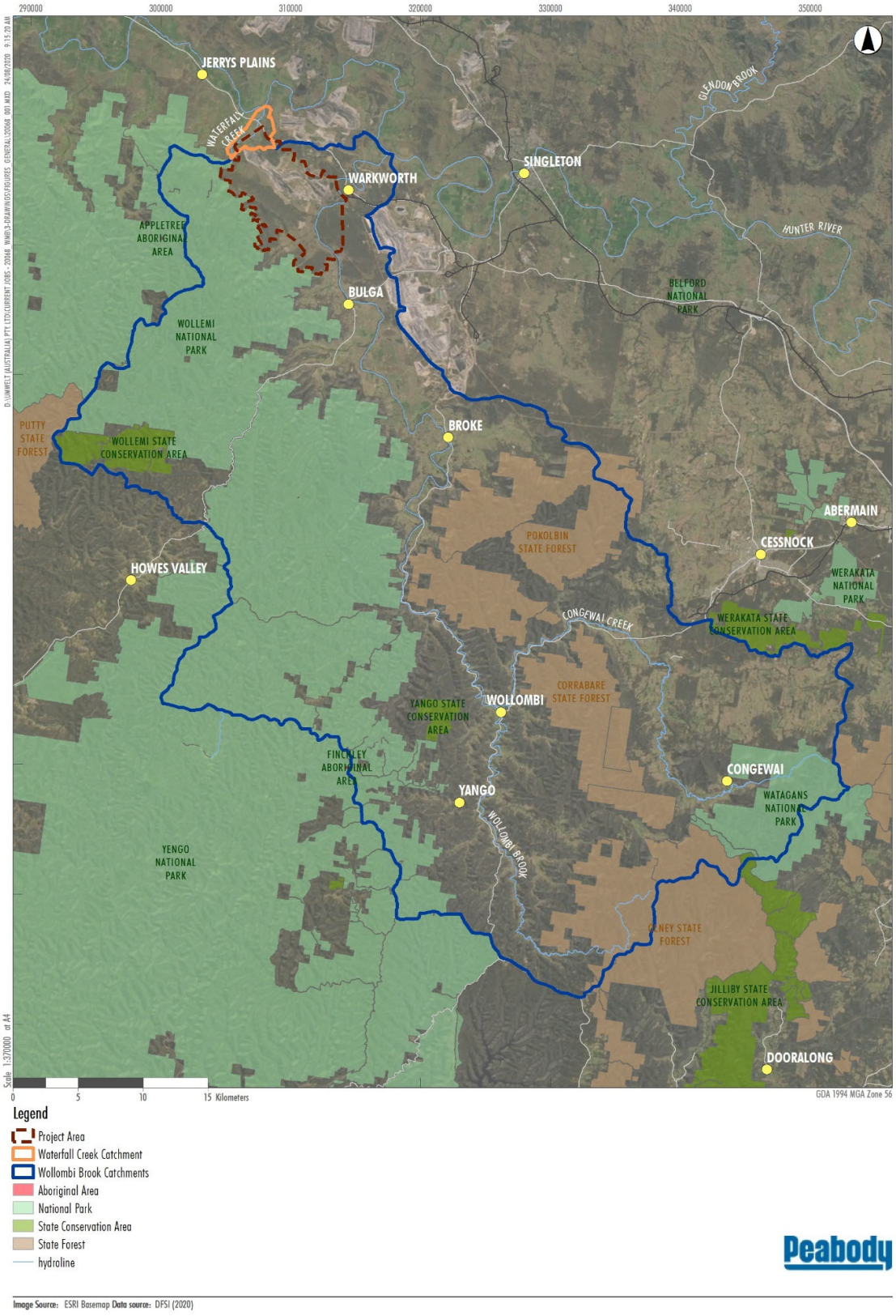


Figure 4: Wollombi Brook Catchment Context

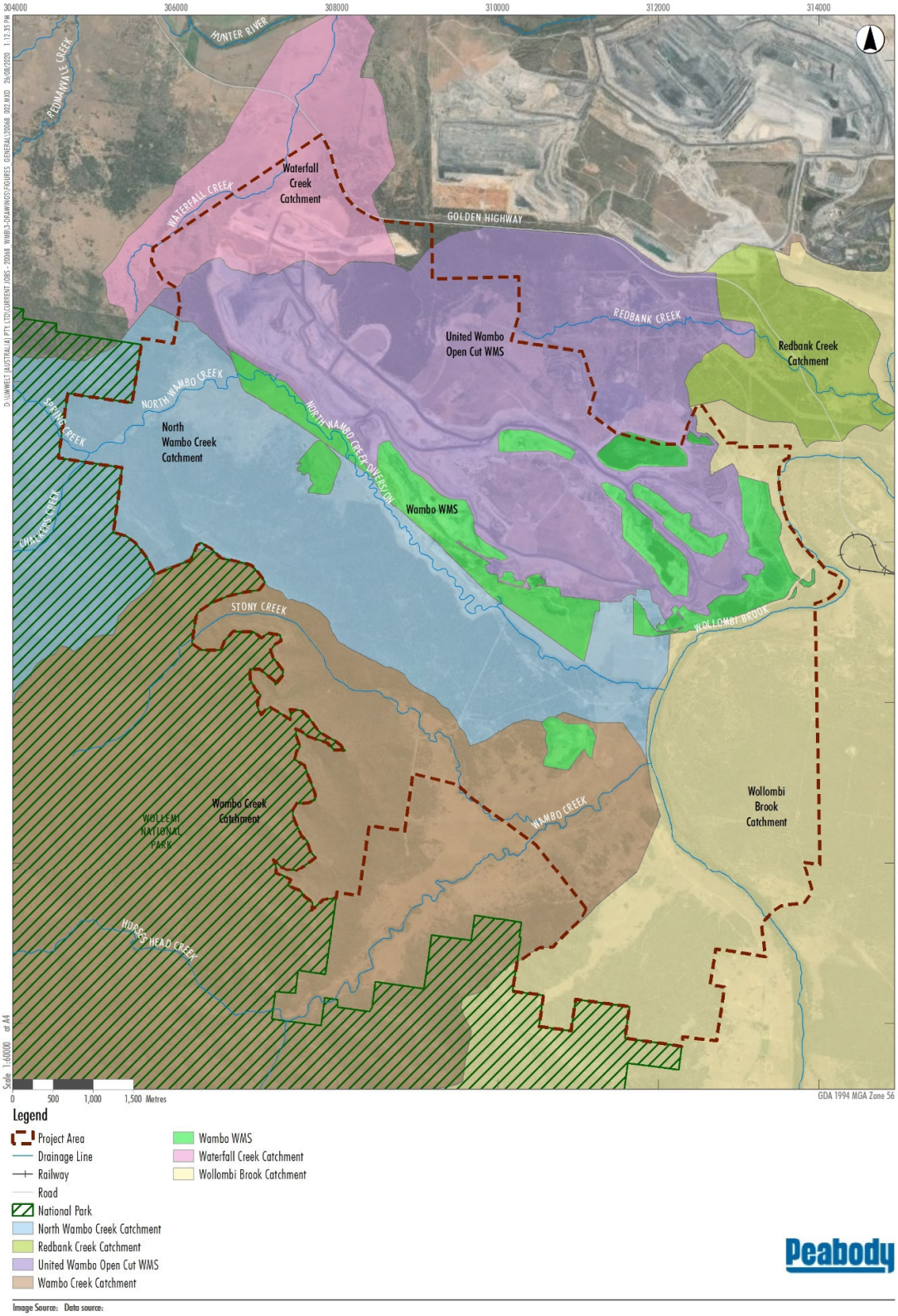


Figure 5: Project Area Catchment Context

3.1.5 Hydrogeology

The hydrogeological regime of the Wambo area and surrounds comprises two main systems (HydroSimulations, 2014):

- Quaternary alluvial aquifer system of channel fill deposits associated with Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek.
- Underlying Permian strata consisting of:
    - hydrogeologically "tight" and hence very low yielding to essentially dry sandstone and lesser siltstone; and
    - low to moderately permeable coal seams, which are the prime water-bearing strata within the Permian measures.
- Triassic Narrabeen Group described as:
    - Unconformably overlying the Permian coal measures and comprising lithic to quartzose sandstone, conglomerate, mudstone and siltstone. The Narrabeen Group is not present in the mine disturbance footprint but does form the ridges and high plateau within Wollemi National Park.

3.1.5.1 Quaternary Alluvium

The alluvium in the vicinity of the Wambo forms an unconfined shallow aquifer. The alluvium within the Wambo area is generally less than 15 m thick (Heritage Computing, 2012). Previous studies indicate that the alluvium of Wambo Creek is 4 to 7 m deep and is discontinuous, probably due to bedrock highs (HLA-Envirosciences, 1999). The alluvium of North Wambo Creek near its confluence with Wollombi Brook was found to vary between 7 and 19 m (GHD, 2007). The extent of alluvium interpreted from the TEM study is typically of a narrower alluvial body along both the lower reaches of (South) Wambo Creek and North Wambo Creek than is mapped in the publcly available mapping (HydroSimulations, 2014) (refer **Figure 6**).

A section of North Wambo Creek has been diverted to skirt the Wambo Open Cut. Groundwater conditions within the North Wambo Creek alluvium have been locally altered by historical and existing mining operations, including removal of alluvium with progression of open cut mining (Montrose Pit).

Based on a review of groundwater quality and the results of the search of the NSW Bore Database (refer ***GWMP***) the typical yield of the alluvial aquifer is likely to be less than 5 litres per second (L/s) and the salinity varies from low to very high. Based on this information the environmental value of the alluvial groundwater is considered to be 'primary industry' (specifically stock watering) and potentially irrigation.

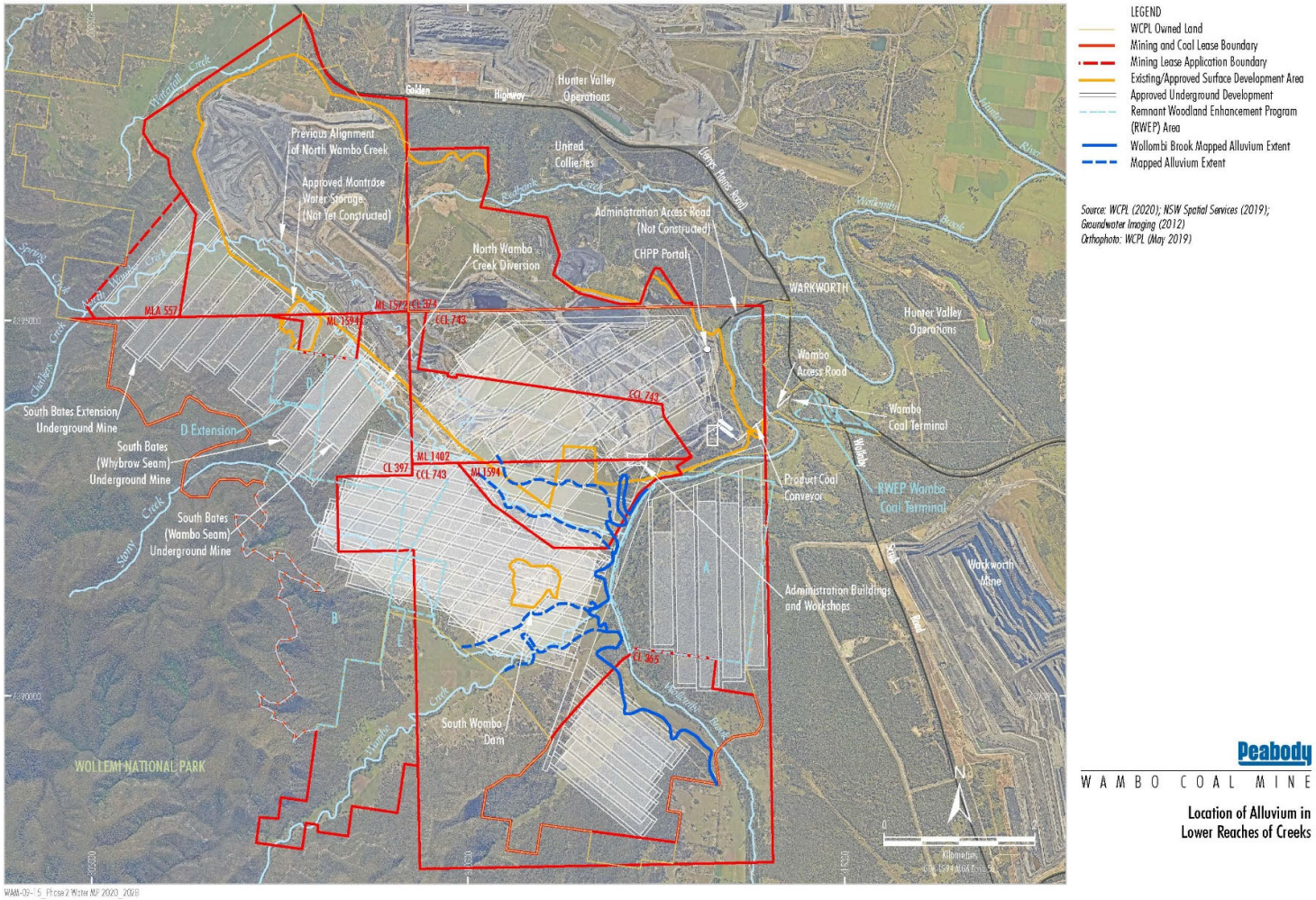


Figure 6: Location of Alluvium in Lower Reaches of Creeks

3.1.5.2 Permian Groundwater Sources

The fractured and porous groundwater sources within the Permian strata consist of both the coal seams and the interburden layers. The Permian strata includes the Wittingham Coal Measures intersected at site, and the overlying Newcastle Coal Measures.

Groundwater flow in the coal measures is influenced by the local geomorphology and structural geology, with unconfined conditions where the coal measures occur at outcrop, becoming confined as they dip towards the south-west. Pre-mining regional groundwater flow is generally towards the north-east. The regolith is variably saturated and shows unsaturated groundwater conditions. Previous and ongoing open cut and underground mining within the Wambo area and adjoining mining operations has resulted in a regional zone of depressurisation within the Permian coal measures (HydroSimulations, 2020).

The permeability of the fresh Permian coal measures is generally low and decreases with depth. This is due to tightening of joints between rock units as depth increases. The coal seams generally have higher permeability than the interburden layers. Overall, the Permian groundwater sources are low yielding and brackish to saline. The weathered coal measures (regolith) show variable permeability dependent on the insitu material (i.e. siltstone, sandstone, conglomerate). Water quality within the regolith is variable dependent on recharge sources, including rainfall recharge and upward seepage from underlying fresh Permian coal measures.

Detailed baseline data with regard to groundwater levels and quality in the vicinity of the project is presented in the ***GWMP.***

3.2 Baseline Monitoring Data

Baseline monitoring data for surface and ground water is included in the ***SWMP*** and ***GWMP***.

4.0 Planning

4.1 Water Management Types

Wambo categorises water into three types to effectively manage water and to mitigate any potential for environmental harm to occur. Each type of water requires different management measures to minimise the risk of contamination of downstream drainage systems. A description of the water quality and potential sources for the three categories of water are summarised in **Table 9.**

Table 9 Water Categories and Design Criteria

Water Category	Description	Target Design Criteria
Clean Water	Runoff from undisturbed or rehabilitated areas.	Intercept, convey and/or release, where practicable, to downstream environment.
Dirty Water	Runoff from disturbed areas, such as active overburden emplacement areas or overburden emplacement areas where vegetation is not fully established.	Managed in line with the Blue Book (*Managing Urban Stormwater: Soils and Construction Volume 1 and Volume 2E*).
Mine Water	Water exposed to coal or used in coal processing and runoff within mining infrastructure areas or coal stockpile areas. Mine water includes water associated with groundwater inflows into open cut pits.	Mine water storages to have sufficient freeboard to contain runoff for events up to and including the 1% 24 hour AEP (annual exceedance probability) storm event.

4.1.1 Clean Water Management

The existing clean water management system includes a series of clean water drains and dams around the perimeter of operational areas in order to minimise the volume of runoff from the upstream catchments entering the surface facilities. Clean water controls will be augmented with the construction of new drains and dams as required to accommodate any changes to the surface facilities disturbance footprint (increase or decrease).

4.1.2 Dirty Water Management

Runoff from areas disturbed by mining (including the CHPP) is collected in open cuts and mine water storages. These storages are used as priority sources of water for the CHPP and dust suppression. Runoff from haul roads is treated in sediment traps or is diverted to mine water storages. Runoff from rehabilitated and establishing revegetated mine areas is directed to sediment retention storages. These are either allowed to drain to local drainages or, depending upon the water quality, are directed to mine water storages.

Additional information on the management of dirty water and a table showing the water control structures at Wambo is contained within the ***ESCP*** and ***SWMP***.

4.1.3 Mine Water Management

Mine water will be contained in storages (including open cut pits or sumps and underground voids). The water management system is designed to minimise the risk of discharges of mine water to downstream watercourses.

Tailing storage areas will be suitably designed, installed and maintained to encapsulate and prevent the migrating of tailings seepage offsite. Oil-water separators treat water exposed to hydrocarbons within the infrastructure areas.

5.0 Implementation

5.1 Water Management System

The site water management strategy for Wambo and United Wambo is based on the containment and re-use of mine water and on the control of sediment that may be potentially carried with runoff from disturbed areas such as the waste rock emplacements. The water management system (WMS) controls waters generated from development and operational areas while diverting upstream water around such areas. It includes both permanent structures that will continue to operate post-closure and temporary structures that will only be required until the completion of rehabilitation works. The WMS includes:

- Up-catchment diversion structures;
- Water storage dams;
- Sediment dams;
- Water transfer infrastructure (i.e. pumps and pipelines);
- Licenced Discharge Points; and
- The North Wambo Creek Diversion.

The WMS operates predominately as a closed, self-contained system. The water balance of the system fluctuates with climatic conditions and as the extent of the mining operations evolves over time.

CHPP tailings are currently discharged to the Homestead Inpit Tailings Dam and from Q1 2021 will be discharged into a new facility constructed within the Homestead Main Pit. Water liberated from the settled tailings is pumped from the decant location to various water storages for reuse primarily by the CHPP. An extensive reticulation system has been developed to transfer water between open cuts, underground operations and mine water storages, to source water from Wollombi Brook and the Hunter River, to facilitate controlled releases to Wollombi Brook (in accordance with EPL 529 and the Hunter River Salinity Trading Scheme) and to provide water to the adjacent United Collieries operation. A schematic of the WMS is provided in the ***SWB***.

The available water sources and the relatively large surface and underground storage capacity for mine water have provided Wambo and Wambo United with significant flexibility to manage the water system.

5.1.1 Wambo Water Management Strategy

The water management strategy for Wambo includes all underground operations (South Bates and South Bates extension) including South Bates Pit, as well as all tailings storage facilities and water storages, as shown on **Figure 7** and in **Table 10.**

Table 10: Summary of Water Storages Managed and Utilised by Wambo

Storage	Max Operational Volume (ML)
Main Homestead In-pit tailings dam[1]	600
Eagles Nest	80
South Dam[2, 3]	500
CHPP Dams (including Gordon Below Franklin)	82

Storage	Max Operational Volume (ML)
C11 Void[3]	340
West Cut Dam	35
Roses Pit Sump	35
Admin Boxcut	80
South Bates Sump	35
Glen Munro Boxcut Sump	120
Underground Workings (including United, Wambo Workings, South Bates and South Bates Extended)	>8,000[3]

1. Scheduled to be decommissioned in 2021
2. To be recommissioned in 2021, subject to approval
3. Capacity, not operational volume

Excess water from both the United Wambo Open Cut and Wambo underground will be discharged via the Wambo licensed discharge points in accordance with Wambo EPL 529 under the HRSTS. The *Wambo Coal Water Asset Management Plan* sets out the schedule and plans of the complex water assets.

Dirty and Mine Water

Runoff from rehabilitation areas at Wambo will be captured via a series of drains and dams constructed in accordance with the ***ESCP***. The dams will be dewatered to the major water storages. Erosion and sediment controls will be implemented as required for all proposed disturbance areas.

Wambo will manage the water associated with the following tailings storage facilities (TSF):

- North East Tailings Dam;
- Hunter Pit Tailings Dam;
- Homestead Main Pit TSF; and
- South Bates Pit TSF (proposed for future storage)

5.1.2 Additional Water Management Infrastructure

Water is transferred around the site using pump and pipeline infrastructure. The pipeline network is dynamic and may change over time based on need and location of mining and in-pit water.

Where possible, all sections of mine water pipelines will run through mine water catchments so that any leaks in the pipes in these areas will flow into mine water storages.

In the event that a dirty or mine water pipeline is located in a clean water catchment, additional controls will be implemented to mitigate offsite discharges. Differential flow meters or pressure sensors will be installed to detect potential losses. This system is to be linked by telemetry to readily detect and mitigate potential pipeline failure incidents. The system will cease pumping at a pre-defined trigger level, which minimises spillage risk.

Pipelines should be buried across creeks and drainage lines and should be double skinned or sleeved to minimise physical damage and/or to contain potential leakages. Where burial is not practical or for existing pipelines that are suspended across creeks, measures are to be implemented to confirm that they are to be adequately supported to prevent damage from creek flows and or flood debris.

5.1.3 Erosion and Sediment Controls

Erosion and sediment control measures at Wambo will be implemented and undertaken in accordance with the ***ESCP.***

The objective of the ***ESCP*** will be to ensure that appropriate structures and programs of work are in place to:

- Identify activities that could cause erosion and generate sediment;
- Describe the location, function and capacity of erosion and sediment control structures required to minimise soil erosion and the potential for transport of sediment downstream;
- Ensure erosion and sediment control structures are appropriately maintained;
- Fulfil the statutory conditions of the project approval; and
- Meet the requirements of the Blue Book (Landcom 2004 and DECC 2008) and the Draft *Guidelines for the Design of Stable Drainage Lines on Rehabilitated Mine sites in the Hunter Coalfields* (DIPNR undated).

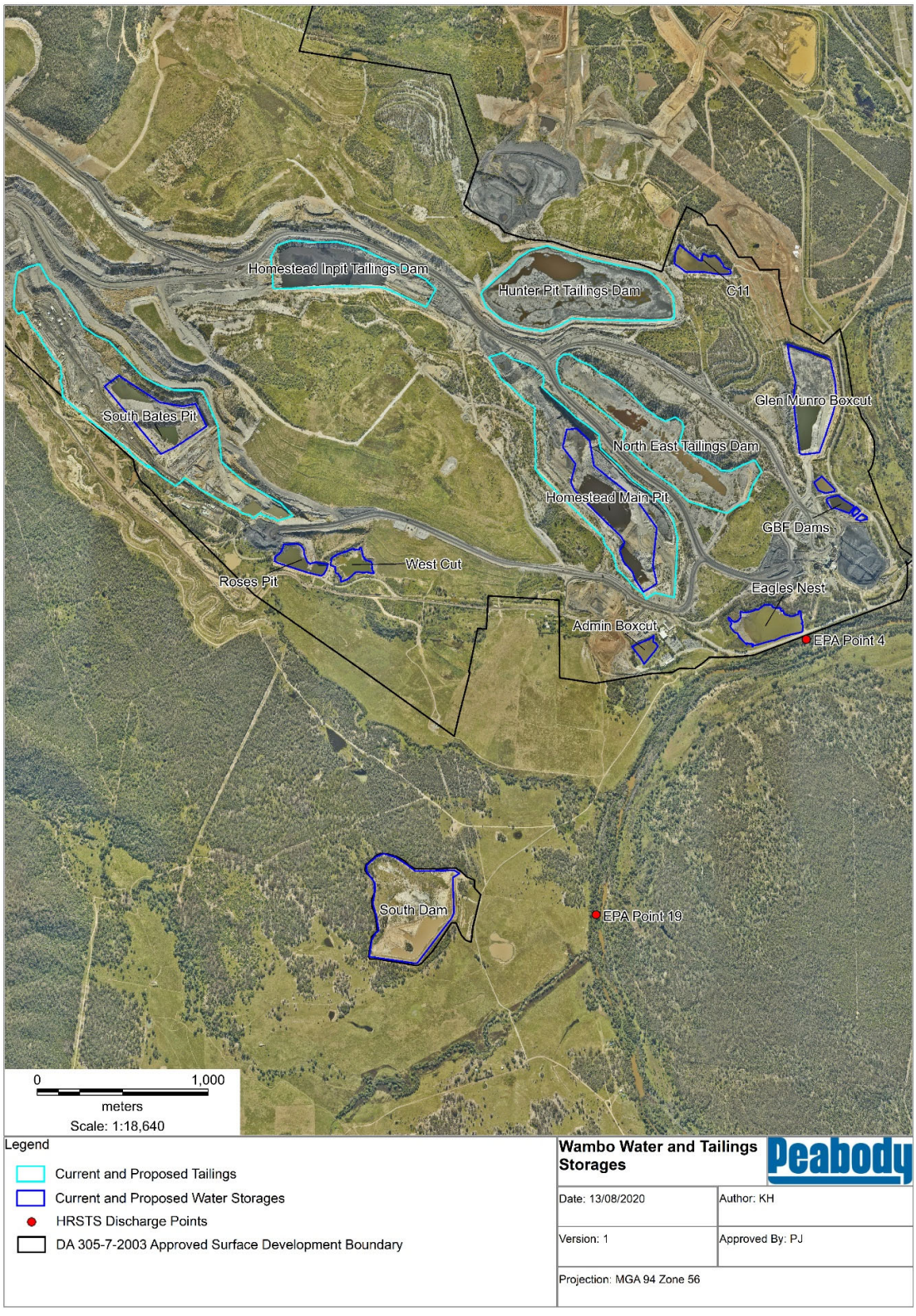


Figure 7: Water Management System Managed and Utilised by Wambo

5.1.4 Water Extraction and Discharges

Water will be extracted from the Hunter River and Wollombi Brook as required and approved under the existing WALs (refer **Section 2.5.1**). Surplus water will be discharged as required and in accordance with EPL 529 and consistent with the provisions of the HRSTS. Discharges will be monitored prior to release to ensure compliance with the requirements of the HRSTS and in accordance with EPL conditions. Details of the extraction and discharge points are listed in **Table 11**, including planned future points. This table does not include Erosion and Sediment Control discharge points.

Table 11: Water Extraction and Discharge Points

Identification	Capacity (ML/day)	Type	Existing or Planned
Hunter River Pump	6.5 – 8.4	Extraction	Existing
Wollombi Brook Pump	8	Extraction	Existing
Bore BH2A	2.3	Extraction	Existing
Bore DW4C (Arrowfield Seam – United Workings)	8	Extraction	Existing
HRSTS - Eagles Nest	70	Discharge	Existing
HRSTS – South Dam	250	Discharge	Planned

5.1.5 Water Transfers

A key objective of the Wambo water management system is to allow for water sharing between the United and Wambo operations to optimise the overall water balance through maximising water recycling, minimising external water demand and water discharge and to provide operational flexibility. The water management system outlined in **Section 5.1.1** has been designed to facilitate this. Water can also be imported from and exported to United Wambo water management system and the neighbouring Mt Thorley Warkworth (MTW) and Hunter Valley Operations (HVO). Water will be imported and exported on an as needs basis subject to commercial agreements.

5.1.6 Prescribed Dams

WCPL has three prescribed dams onsite:

- Wambo Hunter Pit Tails Dam;
- South Wambo Dam (currently decommissioned); and
- North East Tailings Dam.

Hunter Pit and North East Tailings Dam are operated and maintained in accordance with an Operations and Maintenance Manual (OMM) and a Dam Safety Emergency Plan (DSEP). If/when South Wambo Dam is recommissioned, an OMM and DSEP will be developed and implemented in line with the requirements of the Dams Safety Act 2015.

Further information on the inspections and management of Prescribed dams is included in the ***SWMP***.

5.1.7 Decommissioning

Decommissioning of boreholes will be undertaken in accordance with standards equivalent to or exceeding the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2012). Further information on decommissioning of bores is included in the ***GWMP***.

Rehabilitation objectives and strategies for the decommissioning of water management structures including dams is included in the ***SWMP***.

5.1.8 Hydrocarbon and Chemical Management

Any chemical and hydrocarbon products are stored in bunded areas in accordance with the relevant Australian Standards.

Above-ground storage tanks containing materials likely to cause environmental harm will be:

- Imperviously bunded with a capacity of 110% that of the largest container stored within the bund;
- Designed and constructed in a manner which prevents the ingress of rainwater into the tanks; and
- Clearly labelled to identify content.

5.2 Site Water Balance

The site water balance model was revised by Jacobs in 2020 and includes both the United Wambo Open Cut and the Wambo Underground, CHPP and rail facility. Inflows to the water balance included groundwater flows from the open cuts and underground. The average groundwater flow was predicted to be 256 ML/year from the open cuts and 505 ML/year from the underground.

Further detail on the site water balance is included in the ***SWB***.

The site water balance will be recalculated on an annual basis and reported in the Annual Review (**Section 9.2.1**).

5.3 Site Salt Balance

A site salt balance has been developed as an extension of the site water balance for Wambo (refer **Section 5.2**). The salt balance model allows the salt load and salinity of water to be predicted, which is an important consideration for the management of water on-site. Given the integrated nature of the United Wambo and Wambo water management systems, the water balance assessment has included consideration of water use and make in the Wambo and United pits as well as the Wambo underground, CHPP and train loading facility.

Salt transfers were simulated within the site water balance model in parallel with the water transfers. The site salt balance provides the expected salt loads and concentration of salt associated with each water transfer within the model.

Further detail on the site salt balance is included in the ***SWB***.

The site salt balance is reviewed on an annual basis, in association with the review of the site water balance, and the results are reported in the Annual Review (refer **Section 9.2.1**).

5.4 Groundwater Model

Several groundwater models have been constructed within the Wambo area to simulate the stresses on the groundwater environment from mining activities i.e. Wambo, Mt Thorley Warkworth and Hunter Valley Operations (HVO) models. The most recent modelling prepared for WCPL is based on the HydroSimulations (2016a) model that was developed as part of the groundwater assessment for the South Bates Underground Mine Modification (MOD 12)

application (HydroSimulations, 2016a) and was subsequently used for the South Bates Extension Modification (Modification 17 in July 2017) (HydroSimulations 2017)..

Numerical modelling was undertaken to inform the Groundwater Assessments detailed above and to quantify the likelihood and magnitude of potential impacts. On each occasion the Groundwater Assessment was peer reviewed by Kalf and Associates (Dr Frans Kalf) who concluded that the hydrogeological description, conceptualisation, model design, simulations and reporting had been conducted in a professional manner.

More recently groundwater modelling has been undertaken to inform the Wambo GDE Study (HydroSimulations, 2019) and the South Bates Extension Extraction Plan for Longwalls 21-24 (SLR, 2020). The hydrogeological model predicts the lateral zone of impact of depressurisation of aquifers due to current and future mining activity. In addition, the hydrogeological model predicts groundwater inflows into the underground workings over the life of the mine.

Periodic re-calibration of the model will be undertaken based on observed piezometric heads and groundwater inflow data. This periodic review and recalibration of the groundwater model is being undertaken by SLR for completion in Q4 2020.

Results from monitoring undertaken as part of the ***WMProg*** will be compared to groundwater model predictions, as part of the Annual Review process (refer **Section 9.2.1**). As required by Condition B66 (v) of DA305-7-2003, Wambo will implement a program to periodically validate the groundwater model, including an independent review of the model every three years, and comparison of monitoring results with model predictions (refer **Section 9.1.2**). This process will be coordinated by Wambo and reported on in the Annual Review.

Further detail on the groundwater model is included in the ***GWMP***.

5.5 Security of Supply

Wambo receives water from rainfall and catchment runoff captured in surface storages, groundwater inflows, water imported from other mines and licenced extraction from boreholes, the Hunter River and Wollombi Brook.

The water balance model will be updated throughout the mine life to forecast supply reliability as part of the water management planning process. In the event of reductions in the forecast reliability due to low rainfall conditions, water conservation measures (such as the use of synthetic dust suppressants) will be implemented.

5.6 Training and Communication

Regular workforce communication days and toolbox talks allow for discussion of the objectives and requirements of this and any other relevant Plans.

Selected site personnel whose duties directly involve the management of water at Wambo will undertake specific training in regards to site operational procedures which incorporate water management measures. This training will be undertaken annually and when there is a change in personnel in key roles.

6.0 Measurement and Evaluation

6.1 Site Water and Salt Balance

WCPL has developed a separate document to address the requirements of DA305-7-2003 and SSD 7142 relevant to the site water and salt balance for both operations i.e. the ***SWB***.

The ***SWB*** provides information on:

- the United Wambo Water Management System;
- sources of water;
- water use;
- the water balance model;
- the salt balance;
- review and reporting requirements; and
- responsibilities for site personnel specific to the water balance.

Both operations will monitor rainfall, water usage, fresh water imported to site, the transfers of water around site and the volume of water stored in designated storages on the site.

The monitoring data is used to update the site water balance annually and track water inventory. The results from the site water balance are reported in the Annual Review.

6.2 Groundwater Inflows

As part of the ongoing water balance monitoring the groundwater inflows to the mining pits and underground will be reviewed monthly. This will be undertaken by review of available data (including flow metering data or pump hours, site daily rainfall data and site survey data) to estimate groundwater inflows to the mining operations.

Groundwater inflows will be compared to predicted inflows as outlined in the ***GWMP.***

6.3 Water Structure Inspections

Routine inspections of water structures, including dams, drop structures, diversion drains and erosion and sediment control structures, as well as inspections following significant rainfall events, will be conducted by Wambo personnel. Water structures are inspected to assess the capacity, structural integrity and effectiveness and identify any maintenance requirements.

Further detail is presented in the ***ESCP.***

The frequency of pipeline inspections will be determined through risk assessment, however all major operational pipelines and high risk pipelines are to be inspected weekly when in use, as a minimum. Minor pipelines and low risk pipelines within the mine containment system are to be inspected on a risk based approach. Inspections are also to be completed prior to commissioning or recommissioning a pipeline. Inspection frequency is risk based depending on water quality being transferred and the environment in which the pipeline is located.

6.4 Water Monitoring

Water monitoring is undertaken on key water storages and receiving waterways around Wambo. Refer to the S***WMP*** and ***WMProg*** for further detail.

Water monitoring is undertaken for groundwater levels and quality as part of the groundwater monitoring program. Refer to the ***GWMP*** and ***WMProg*** for further detail.

Monitoring results are reported in the Annual Review (refer **Section 9.2.1**) and made available on the WCPL website.

7.0 Community Complaint Response

All water related community complaints received by WCPL will be recorded within the Community Complaints Register. The Environment and Community (E&C) Manager (or delegate) will investigate the complaint, which will include, where possible, contacting the complainant within 24 hours to discuss the complaint. A review of the effectiveness of the corrective or preventative actions will be conducted within a month of the complaint and the relevant work procedures updated if required.

Preliminary investigations will commence as soon as practicable upon receipt of a complaint to establish if WCPL is responsible. All efforts will be made to determine the likely causes contributing to the complainant's concerns.

WCPL will address the complainant's concerns such that a mutually acceptable outcome is achieved. If a mutually beneficial outcome cannot be reached, WCPL may refer the matter to the Planning Secretary for resolution.

Details of all community complaints will be included in the Monthly Environment Monitoring Report. WCPL will retain a copy of the Community Complaints Register for at least four years. The Community Complaints Register is posted on the WCPL website.

8.0 Adaptive Management

Potential water-related impacts are detailed in the *Wambo Development Project Environmental Impact Statement (EIS)* (Wambo Coal, 2003), various Environmental Assessments associated with Development Consent Modifications including the recent *United-Wambo Project Environmental Assessment* (Umwelt, 2016).

This WMP has been developed to manage and monitor water-related risks associated with the Wambo underground mining operations, to minimise the likelihood of exceedances of the criteria and/or performance measures detailed in the relevant development approvals and licences.

8.1 Exceedances of Criteria and/or Performance Measures

If an exceedance of these criteria and/or performance measures occurs, WCPL will, at the earliest opportunity:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Undertake an investigation into the cause of the exceedance and contributing factors. This investigation may involve collaboration with personnel at the United Wambo Open Cut Operations, depending on the nature, location and potential cause of the exceedance;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to DPIE describing those options and any preferred remediation measures or other course of action; and
- Implement remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary.

8.2 Unforeseen Impacts

In the event that any unforeseen surface water or ground water impacts are detected, the following general response procedure will be initiated:

- Check and validate the data/information which indicates an unforeseen impact;
- Notify DPIE, EPA and other relevant agencies immediately after becoming aware of the impact;
- In the event of an apparently anomalous monitoring result, conduct a resample/retest where possible;
- Review the unforeseen impact, including consideration of:
    - Any relevant monitoring data; and
    - Current mine activities and land management practices in the relevant catchment, including other mining activities;
- Commission an investigation by an appropriate specialist into the unforeseen impact;
- Provide a preliminary investigation report to DPIE, EPA and relevant agencies within 7 days of identifying the unforeseen impact;
- Implement appropriate contingency/remedial measures;
- Implement additional monitoring to measure the effectiveness of the mitigation measures, where necessary;

- Communicate results of investigation and subsequent contingency and remedial measures to government agencies as required; and
- Review and update the WMP and resubmit to DPIE.

8.3 Failure to Comply with Other Statutory Requirements

Statutory requirements relating to this WMP are summarised in **Section 2.0** and **Appendix C** as well as in the related sub plans i.e. ***SWMP, GWMP*** and ***ESCP***.

These requirements include compliance with development approvals (DA305-7-2003 & DA177-8-2004), EPL 529, various water licences and mining tenements.

WCPL monitors compliance with these statutory requirements on an ongoing basis, including during regular reviews and reporting of monitoring data and as part of Annual Reviews and compliance audits (e.g. Independent Environmental Audits).

In the event that WCPL identifies a failure to comply with a statutory requirement (other than those relating to unpredicted impacts – refer **Section 8.2**), WCPL will:

- Undertake an investigation into the failure;
- Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and
- Report the non-compliance in accordance with the requirements of the development consent.

8.4 Provision of Compensatory Water

WCPL is required to provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with DPIE Water, and to the satisfaction of the Planning Secretary.

In the event that WCPL receives a complaint from a landholder regarding their water supply, WCPL will investigate the complaint to determine if the impact was caused by WCPL's mining operations. If this can be proven, WCPL will consult with DPIE Water on appropriate compensatory water supply arrangements, in accordance with Conditions B56 – B59 of DA305-7-2003.

9.0 Review and Reporting

9.1 Review

9.1.1 Environmental Performance

WCPL's environmental performance is reviewed annually by the WCPL E&C Manager (or delegate) and reported on as part of the Annual Review process (refer **Section 9.2.1**).

9.1.2 Validation of Predictions

Every year the site water balance, surface and ground water take will be validated by comparing predicted results to monitoring results collected over the life of the development. This will be undertaken as part of the Annual Review process (refer **Section 9.2.1).**

In accordance with Condition B66 (v) WCPL will periodically validate the groundwater model and commission an independent review of the model every three years. A comparison of monitoring results with modelled predictions will also be undertaken.
Further detail on the groundwater model is included in the ***GWMP***.

9.1.3 Management Plan Review

This WMP and associated documents will be reviewed in accordance with DA305-7-2003 and the ***EMS***. A full review will be undertaken prior to new underground mining areas being developed and/or within three months of:

- the submission of an Annual Review;
- the submission of a water-related incident report;
- the submission of an Independent Environmental Audit: or
- any modification to the conditions of consent (unless the conditions require otherwise).

The review process is also to reflect changes in environmental legislation and guidelines and changes in technology or operational procedures. If any significant modifications to the WMS are required as an outcome of the review, relevant government agencies will be consulted regarding the changes and the revised Plan will be submitted to DPIE for approval by the Secretary within 6 weeks.

9.2 Reporting

9.2.1 Annual Review

The WCPL E&C Manager will be responsible for reporting any significant findings regarding the implementation of this WMP in the WCPL Annual Review. The report will include:

- any amendments to licensing or statutory approvals;
- a summary of any complaints or incidents relating to the performance of the Water Management System over the reporting period;
- a summary of monitoring results collected over the reporting period and assessment against the relevant performance measures and criteria;
- a summary of water extracted from Wollombi Brook and the Hunter River during the relevant water reporting period/s;
- an evaluation of any trends in monitoring results over the life of the operation;
- any non-compliance recorded during the reporting period and the actions taken to rectify the non-compliance and avoid recurrence;

- identification of any discrepancies between the predicted and actual impacts of United Wambo and an analysis of the potential cause of any significant discrepancies; and
- a summary of the management actions to be implemented over the next year to improve the environmental performance of the site.

In accordance with Condition B53 of DA305-7-2003 WCPL will also report on water extracted or discharged from the site each year (direct and indirect) in the Annual Review, including water taken under each water licence.

Yearly reporting of the water level and quality results from the monitoring network will be included in the Annual Review. An experienced hydrogeologist will review measured water levels and determine when water levels deviate significantly from that predicted by the groundwater model and determine the reason for this deviation. The review will consider the impact of mining, and other factors that could result in declining water levels including climatic conditions, rainfall recharge and pumping from private (and mine owned) bores.

Future annual groundwater monitoring reviews will comment on the interaction/connectivity of the open cut and underground area and on the degree of match of the predicted versus observed water levels. This information will be included in each Annual Review.

The Annual Review will also identify if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suites should be undertaken.

The WCPL Annual Review will be provided to DPIE and other relevant agencies prior to the end of March each year. A copy of the Annual review will also be made available on the WCPL website.

9.2.2 EPL Annual Return

WCPL will prepare and submit an Annual Return in the approved form comprising a certified Statement of Compliance and a signed Monitoring and Complaints Summary to the EPA at the end of each EPL reporting period.

The Annual Return for the reporting period will be supplied to the EPA by registered post not later than 60 days after the end of each reporting period. WCPL will retain a copy of the Annual Return for a period of at least four years after the Annual Return was due to be supplied to the EPA.

The sewage treatment system maintenance program required by Condition O2.6 of EPL 529 (refer ***SWMP***) will be submitted annually to the EPA with the Annual Return.

9.2.3 HRSTS Reporting

WCPL will compile a written report of the activities under the HRSTS for each scheme year i.e. 1 July to 30 June. The written report will be submitted to the EPA' s regional office within 60 days after the end of each scheme year and will be in a form and manner approved by the EPA. The information will be used by the EPA to compile an annual scheme report.

9.2.4 Reporting of Incidents

Any incident which occurs within the site boundary or is associated with WCPL's operations will be immediately reported by the employee or contractor who has been associated with or witnessed the incident. The method for reporting incidents is outlined in the ***PIRMP*** and the ***EMS.***

In accordance with Condition R2 of EPL 529 and the ***PIRMP***, WCPL must notify the EPA of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident. Notifications will be made by telephoning the Environment Line service on **131 555**.

WCPL must also notify DPIE and any other relevant agencies immediately after it becomes aware of an incident, as outlined in Section 5.4 of the PIRMP. The notification must be in writing and identify the development (Wambo Coal Mine, DA305-7-2003) and set out the location and nature of the incident.

WCPL will provide written details of the incident to relevant agencies within seven days of the incident.

9.2.5 Reporting of Non-Compliances

Within seven days of becoming aware of a non-compliance with any of the conditions of DA305-7-2003, WCPL must notify DPIE of the non-compliance. The notification must be in writing to the compliance mailbox via the Major Project's website and must:

- identify the development (Wambo Coal Mine (DA305-7-2003)),
- set out the condition of DA305-7-2003 that the development is non-compliant with,
- detail why it does not comply and the reasons for the non-compliance (if known); and
- detail what actions have been, or will be, undertaken to address the non-compliance.

9.2.6 Reporting of Results

A comprehensive summary of the water monitoring results will be made publicly available on the WCPL website:

https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports

Information on the website will be updated regularly, as required by DA305-7-2003.

9.2.7 Website Updates

WCPL will ensure that any information relevant to water management and monitoring is uploaded to the website (and kept up to date). This includes:

- Current statutory approvals;
- Approved strategies, plans or programs required under the DA305-7-2003;
- A community complaints register;
- Minutes of Community Consultative Committee (CCC) meetings;
- Annual Reviews;
- A copy of any Independent Audits and WCPL's response to any recommendations in any audit; and
- Any other matter required by the Planning Secretary.

WCPL has made provision on its website for comments/ enquiries by members of the community. Email enquiries can be made at WamboCommunity@peabodyenergy.com.

10.0 Accountabilities

Table 12 outlines the accountabilities associated with this WMP.

Table 12: WMP Accountabilities

Role	Accountabilities for this document
Operations Manager	Provide adequate resources for the implementation of this Plan.
Environment and Community Manager	Implement the WMP (and sub-plans). Ensure that monitoring, periodic environmental inspections and visual assessments after high rainfall events are undertaken. Provide that the Training and Communication, Monitoring and Review and Improvement requirements of this Plan are met. Investigate and report all incidents involving the failure or damage to Water Management Structures.
Environmental Advisor	Assist the E&C Manager as required in the implementation of this Plan. Investigate and report all incidents involving the failure or damage to Water Management Structures.
Task Coordinators	Provide that the requirements of this Plan are met through compliance with WCPL procedures. Report all incidents involving the failure or damage to Water Management Structures.
All contractors	Undertake works in accordance with the objectives and principles of this Plan (where relevant). Report all incidents involving the failure or damage to Water Management Structures.
All personnel	Undertake works in accordance with the objectives and principles of this Plan (where relevant). Report all incidents involving the failure or damage to Water Management Structures.

11.0 References

11.1 Related Documents

Related documents, listed in **Table 13** below, are internal or United Wambo documents directly related to or referenced from this document.

Table 13: Related Documents

Document ID	Title
WA-ENV-MNP-501	Wambo Environmental Management Strategy (WCPL EMS)
WA-ENV-MNP-502	Wambo Pollution Incident Response Management Plan (WCPL PIRMP)
WA-ENV-MNP-509.7	United Wambo Open Cut and Wambo Water Management Strategy
-	United Wambo Open Cut and Wambo Water Asset Management Plan
WA-ENV-MNP-509.8	United Wambo Open Cut and Wambo Water Monitoring Program
WA-ENV-MP-513	Wambo Mining Operations Plan/Rehabilitation Management Plan
WA-ENV-MNP-509.1	Wambo Groundwater Management Plan
WA-ENV-MNP-509.2	Wambo Surface Water Management Plan
WA-ENV-MNP-509.3	Wambo Erosion and Sediment Control Plan
WA-ENV-MNP-509.4	Wambo Surface and Ground Water Response Plan
WA-ENV-MNP-509.5	United Wambo Open Cut and Wambo Site Water Balance (including Salt Balance)
WA-ENV-MNP-509.6	North Wambo Creek Diversion Management Plan
UWOC-1689771511-365	United Wambo Water Management Plan
UWOC-1689771511-370	United Wambo Groundwater Management Plan
UWOC-1689771511-364	United Wambo Surface Water Management Plan
UWOC-1689771511-369	United Wambo Erosion and Sediment Control Plan

11.2 Reference Information

Reference information, listed in **Table 14** below, is information that is directly related to the development of this document or referenced from within this document.

Table 14: Reference Information

Reference	Title
DA 305-7-2003	*Wambo Coal Mine Notice of Modification of DA305-7-2003 (Modification 16)*
EPL 529	*Environment Protect Licence 529 for Wambo Coal Mine*
WCPL 2003	*Wambo Development Project Environmental Impact Statement (EIS), July 2003*
SSD 7142	*United Wambo Open Cut Coal Mine Development Consent SSD 7142*
Umwelt 2016a	*United Wambo Open Cut Coal Mine Project – Surface Water Assessment*
SLR Consulting	*SLR (2020a) SBE LW21-24 Groundwater Technical Review. Report for Wambo Coal Pty Ltd. Report No.665.10008.R02*
AGE 2016	*United Wambo Open Cut Coal Mine Project – Groundwater Impact Assessment*
Umwelt 2016b	*United Wambo Open Cut Coal Mine Project – Environmental Impact Statement* (EIS)

APPENDIX A - Evidence of Consultation

Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Mine
PMB 1
Singleton NSW 2330

20/11/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003-i)
Water Management Plan

I refer to the Wambo Water Management Plan (WMP), submitted in accordance with condition B66 of the approval for the Wambo Coal Mine (DA 305-7-2003-i). I understand that revisions to the WMP are required prior to Phase 2 of operations between the Wambo Coal Mine and United Wambo Joint Venture, which are scheduled to start on 1 December 2020.

I note that the WMP includes the following sub – plans:
- Site Water Balance;
- Salt Balance;
- Erosion and Sediment Control Plan;
- Surface Water Management Plan (including the North Wambo Creek Diversion Management Plan);
- Groundwater Management Plan; and
- Water Monitoring Plan.

The Department notes that the Site Water Balance, Salt Balance and Water Monitoring Program cover both the Wambo Coal Mine and United Wambo Joint Venture operations.

The Department has carefully reviewed the WMP and is satisfied that it adequately addresses the relevant requirements of the approval. Accordingly, the Planning Secretary has approved the WMP (Revision 2, November 2020) for Phase 2 of the operations. Please continue to operate in accordance with the previously approved WMP until Phase 2 commences.

Please also ensure that the approved plan is placed on the project website at the earliest convenience. If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Planning, Industry & Environment

Ms Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton, NSW, 2330

02/09/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Endorsement of Water Expert

I refer to your letter dated 13 August 2020, requesting the Planning Secretary's approval of a suitably qualified person to prepare the Water Management Plan, required by condition B66 of the Wambo Coal Mine Development Consent (DA 305-7-2003).

This plan includes several sub-management plans including a Site Water Balance, Surface Water Management Plan, Monitoring Program, Groundwater Management Plan and Erosion and Sediment Control Plan. I also note that it is proposed to combine the Wambo and United Wambo (SSD 7142) Site Water Balance and Monitoring Program under condition A23(d). These joint aspects of the Water Management Plan would be prepared by Chris Bonomini from Umwelt Australia.

I note that previously endorsed experts for Wambo, Ms Claire Stephenson and Dr Noel Merrick from SLR and Mr Rohan Lucas from Alluvium will remain the endorsed experts for groundwater and the North Wambo Creek Diversion.

The Department has reviewed the nomination and information you have provided and is satisfied that all four experts are suitably qualified and experienced. Consequently, I can advise that the Planning Secretary approves the additional appointment of Chris Bonomini to prepare the relevant sections of the Water Management Plan alongside the existing endorsed experts.

If you wish to discuss the matter further, please contact Sarah Clibborn on (02) 82 896 184 or via email at sarah.clibborn@planning.nsw.gov.au.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton NSW 2330

28/05/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Approval of Experts

I refer to your correspondence of 23 April, requesting the Secretary's approval of suitably qualified persons to prepare the following environmental management plans for the Wambo Coal Mine (DA 305-7-2003):

- Air Quality and Greenhouse Gas Management Plan, required by condition B46; and
- Groundwater Management Plan required by condition B66(v).

The Department has reviewed the nominations and information you have provided and is satisfied that the following experts are suitably qualified and experienced:

- Shane Lakmaker (Jacobs) – Air Quality; and
- Claire Stephenson (SLR Consulting) – Groundwater.

I note that the Department recently approved the following experts to prepare the Wambo Extraction Plan for Longwalls 21 – 22:

- Dr Noel Merrick, (SLR Consulting) – Groundwater;
- Mr Rohan Lucas, (Alluvium) – Surface water;
- Mr Peter Kuskie, (South East Archaeology) – Aboriginal Cultural heritage; and
- Mr Martin Sullivan, (Eco Logical Australia) – Biodiversity.

The Department is satisfied that these experts are also suitably qualified and experienced to assist in the preparation of site environmental management plans in their field of expertise.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)
as nominee of the Secretary

Planning, Industry & Environment

Mr Peter Jaeger
Environment and Community Manager
Wambo Coal Pty Limited
PMB 1
Singleton NSW 2330

28/02/2020

Dear Mr Jaeger

Wambo Coal Project (DA 305-7-2003)
Endorsement of Experts

I refer to your letter dated 11 February 2020, requesting the Secretary's approval of suitably qualified persons to prepare the Extraction Plan for Longwalls 21 to 24 for the Wambo Coal Project (DA 305-7-2003).

The Department has reviewed the nominations and information you have provided and is satisfied that these experts are suitably qualified and experienced. Consequently, I can advise that the Secretary approves the appointment of the following experts to prepare the Extraction Plan for Longwalls 21 to 24:

- Mr Joshua Hunt (Resource Strategies) - Extraction Plan preparation;
- Mr James Barbato (Mine Subsidence Engineering Consultants) - Subsidence;
- Mr Rohan Lucas (Alluvium) - Surface Water;
- Dr Noel Merrick (SLR Consulting) - Groundwater;
- Mr Martin Sullivan (Eco Logical Australia) – Biodiversity; and
- Mr Peter Kuskie (South East Archaeology) - Aboriginal cultural heritage.

In relation the upcoming revisions of complex-wide management plans, to align with the commencement of United Wambo Phase 2, it is recommended that the Department's Water Group is consulted on this approach.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
A/Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Evidence of Consultation on the WMP and Sub Plans

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
4 June 2015 - DPIE – Email from Jessie Evans re Wambo 10A Extraction Plan (NOW Comments)		
The Department has received comments from NOW in regards to the Wambo LW 8-10A Extraction Plan. I have attached these for your careful consideration and response. NOW has raised a number of issues, and in particular has concerns regarding the Groundwater Management Plan. Could you please provide a response to NOWs concerns at your earliest possible convenience.	WCPL provided a response to recommendations made by NOW via email on 17 June 2015 – see below.	See below
3 June 2015 - DPIE Water (formerly NSW Office of Water (NOW)) - Extraction Plan for NWU LWs 8-10a (Groundwater Management)		
It is recommended with respect to the exceedance of groundwater level triggers: • WCPL must investigate the drivers for declining water levels (rather than omitting bores from the monitoring program when bores go dry). Notification to the Office of Water is required as part of the response procedure within 3 months of such an event.	Five bores are proposed to be removed from the groundwater monitoring program (GW14, GW18, GW19, P5 and P6). Only two samples (August 2011 and December 2011) have been obtained from GW14 since its installation in 2011 (these samples may have been associated with groundwater levels stabilising following drilling). This bore is located to the east of Wollombi Brook and is far removed from mining activities associated with the Wambo Coal Mine. Only one sample (August 2010) has been obtained from GW18. GW19 has been consistently dry since installation and no valid samples have been obtained from this bore. GW18 and GW19 are located immediately downstream and upstream of the North Wambo Creek Diversion, respectively. The alluvial flow in North Wambo Creek has been altered by the historical and existing mining operations including the removal of alluvium across the full width of the channel with consequent desaturation of the adjacent upstream and downstream alluvium associated with the approved and constructed North Wambo Creek Diversion. Bores P5 and P6 have been covered by the approved Wambo Coal Mine waste rock emplacement. WCPL considers removal of these five bores from the groundwater monitoring program is justified as outlined above. Trigger levels are not proposed for a further four bores along North Wambo Creek (GW08, GW09, GW16 and GW17). WCPL has initiated an investigation for bores GW08 and GW09 as outlined further below. Trigger levels will not be developed for these bores until this investigation is complete.	**GWMP** (Section 6.0) and **WMProg**)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
	GW16 and GW17 are located upstream of the North Wambo Creek Diversion and in close proximity to the approved open cut. There are no groundwater users located in the vicinity of North Wambo Creek upstream of the North Wambo Creek Diversion. Therefore, a trigger level for these two bores is not considered warranted.	
• Where the driver for declining shallow bore water levels exceeding trigger levels cannot be linked to the prevailing climatic influence or miscellaneous sampling error, additional groundwater modelling is required to re-assess if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities. As part of WCPL's response procedure, a report summarising the assessment is to be submitted to the Office of Water.	WCPL has initiated an investigation into the monitored declining water levels in GW08 and GW09. As described in Section 6.1.3 of the revised GWMP, a preliminary investigation report will be provided to the OP&E and NOW by 30 September 2015. This report will include preliminary conclusions regarding the potential licensing implications and a process and timetable for any further investigation work (including potential additional numerical hydrogeological modelling work).	**GWMP** (Section 5.4)
• Where the updated modelled aquifer interference take of water from the Lower Wollombi Brook Water Source (encapsulating Wambo and North Wambo Creek) exceeds the estimates as predicted in WPCL's Groundwater Impact Assessment by 100% or more, WCPL must re-evaluate the associated ecological impacts and any influence on a low now cease to pump criteria specified in the relevant WSP. The reference value triggering this response procedure must be cl early documented in the GWMP.	As described in Section 6.1.3 of the revised GWMP, where the investigation for GW08 and GW09 indicates a revised predicted take from alluvial water sources that exceeds the previous estimates by more than 100%, WCPL would consider other potential associated impacts (e.g. on ecology) and any influence on a low now cease to pump criteria specified in the HUA WSP.	**GWMP** (Section 5.4)
• The trigger levels in Table 11 of the GWMP outlines a minimum and maximum depth to water level. These values, plus any new bores added to the list, and the bores proposed to be dropped, must be presented in Australian Height Datum.	Table 11 of the GWMP has been revised to include trigger levels presented in Australian Height Datum.	**GWMP** (Table 11)
It is recommended with respect to the exceedance of groundwater quality triggers: • Appropriate water quality baseline data has not been captured and presented in way that can be used for before and after impact. Salinity data for a number of bores has fluctuated considerably which is not consistent with a more stable groundwater environment. The use of major ion analysis and ONQC procedures should be reviewed to inform if the salinity measurements reported are accurate and if so the drivers to cause such variability in the results.	The GWMP has been revised to include annual comprehensive analysis of major ions standpipe bores. A description of data management procedures has been included in Section 5.3.2.	**GWMP** (Section 6.1 - Monitoring) (see also **WMProg**) **GWMP** (Section 6.3 – Data Management Procedures)
• Due to the concerns with the potential for cross aquifer interconnection, water quality performance measures are essential to the impact assessment. Water quality performance measures should be defined and added to the GWMP.	The GWMP has been revised to include groundwater quality trigger levels in Section 5.4.	**GWMP** (Section 4.2 - Triggers) **GWMP** (Section 4.3 – Performance Criteria)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
It is recommended with respect to the exceedance of predicted mine inflows: • There is a discrepancy between the GWMP which outlines a monthly measurement and annual assessment of mine inflows, whilst the 'Subsidence Response Strategy' indicates metering of weekly dewatered volumes. It should be consistently reported weekly, in the GWMP as this will improve the understanding of inflow and assist with groundwater management and the triggers for exceedance.	Section 5.2.5 of the GWMP has been updated to clarify that dewatering values are recorded internally on a daily basis (during active pumping). As outlined in the North Wambo Creek Subsidence Response Strategy, these values are reviewed weekly for any indication that pumping rates are higher than normal (which would trigger an investigation). Dewatering values are also reviewed annually (as outlined in the GWMP) to determine the inflows from groundwater sources and to verify whether WCPL holds sufficient groundwater licence entitlements.	**GWMP** (Section 6.1.2 – Monitoring of Inflows) **GWMP** (Section 5.2 – Annual Site Water Balance) **GWMP** (Section 7.3.3 – Response Plan)
• Where the annual assessment for mine inflows exceeds the peak estimate as predicted in WCPL's Groundwater Impact Assessment by 50% or more, WCPL shall: ○ investigate if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities. ○ where there is an increased take from the Lower Wollombi Brook Water Source, investigate any influence on a low flow cease to pump criteria specified in the relevant WSP. ○ define the mine inflow volume value triggering this response procedure within the GWMP. ○ As part of WCPL's response procedure, a report summarising the assessment is to be submitted to the Office of Water.	Section 5.2.5 of the GWMP has been updated to include the recommended response procedure. The mine inflow volume that would trigger the response procedure has been defined in the GWMP i.e. 563 ML/annum, which is 50 % more than the peak estimate predicted by HydroSimulations (2014) [375 ML/annum) for the North Wambo Underground Mine).	**GWMP** (Section 6.1.2 – Inflows to Underground Workings) Note: inflow volume has been updated for SBU) **GWMP** (Section 7.3.3 – Response Plan)
• WCPL must notify the Office of Water as soon as practicable on become aware of any take of water in excess of its licensed entitlement	Section 5.2.5 of the GWMP has been updated to include this statement.	**GWMP** (Section 6.1.2)
It is recommended with respect to monitoring leakage from dams: • The closest bore to South Dam is Piezometer 114 representative of Wambo Creek alluvium. South Dam contains produced water from the mine and P114 shows a sharp rise in salinity to a level on par with water in the dam. This indicates probable leakage occurring from the dam that warrants further investigation. However, as the proponent proposes not to utilise water quality as a performance measures, no direct response is proposed. Significant leakage to the nearby alluvial aquifer could risk a change in the beneficial use of the aquifer. Trigger levels with regard to salinity must be set to investigate and determine if remediation is required.	WCPL has initiated an investigation into the monitored increasing salinity levels in P114. Wambo South Water Dam is currently not in use for the period of secondary extraction for Longwall 9, Longwall 10 and Longwall 10A at the North Wambo Underground Mine. Wambo South Water Dam has been drained as far as practical since January 2015. Therefore, any possible leakage mechanism that may have impacted bore P114 may no longer be present.	**GWMP** (Table 12 – triggers) and **GWMP** (Section 6.1.3 – Monitoring) Note two additional bores have now been established in the vicinity of P114 (P316 and P319) (see also **WMProg**) **GWMP** (Section 6.4.2 - Investigation)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
• A report summarising any special assessment for the above recommendations should be provided within 6 months	As described in Section 6.1.4 of the revised GWMP, a preliminary investigation report will be provided to the DP&E and NOW by 30 November 2015.	**GWMP** (section 6.4.2) – Report provided to DPIE and NRAR/DPIE Water on 22 Nov 2018[1]
3 June 2015 - DPIE Water (formerly NSW Office of Water (NOW)) - Extraction Plan for NWU LWs 8-10a (Surface Water Management)		
The Office of Water recommends the proponent and the Department of Planning and Environment develop a consultation process with affected landholders to address existing and potential degradation which occurs as a result of mining subsidence. This should focus on incorporating natural processes for channel recovery particularly using large timber controls to maintain bed level (bed sills), bank toe protection (timber bank revetment) and creation of scour pools by using 'forced' controls such as engineered log jams as an adjunct to revegetation of both banks of both watercourses.	All land above the North Wambo Underground Mine is owned by WCPL. Therefore there are no other affected landholders associated with the North Wambo Underground Mine Extraction Plan for Longwalls 8 to 10A. Advisian (2015) concluded it is unlikely Wambo Creek and Stony Creek would experience adverse impacts from the North Wambo Underground Mine, and mitigation measures are unlikely to be required. In the unlikely event that any mitigation measures are required, these would be developed in consultation with the Department of Planning and Environment and the NSW Office of Water, and would aim to incorporate natural processes for channel recovery.	N/A
21 October 2015 – DPIE – Email from Scott Brooks re WMP (and Sub Plans)		
We (DPIE) will need some type of water balance and the info for the evaporation sprays if you want to use them. See also below comments.		**SWB** (Water balance)
SGWRP (version 8) • 2.7 North Wambo Creek Diversion Performance Criteria - Given the problems with the NWCD this section should refer to other management plans or have a section referring to erosion and the potential for sediment generation and loss from the system.		**SGWRP** obsolete **NWCD MP** (Appendix D to **SWMP**) includes NWCD performance criteria
SWMP (version 8) • 1.4.1 Environmental Planning & Assessment Act 1979 (Table 3) - (NOW) Currently called DPI Water		**WMP** and Sub Plans now reference DPIE Water
• 2.2.3.2 Stream Flow (Table 7) - (No flow data available) Is this because the SWC never runs?		**SWMP** (Table 10) – no flow events recorded for South Wambo Creek for period of record
• 4.1 Monitoring Network, Parameters and Frequency - (Mine water monitoring is undertaken for operational management purposes only. This data is not reported publicly). This would appear to		**SWMP** (Section 6.1.2). This data not reported publicly.

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
conflict with Schedule 6 Condition 12 requiring the publishing of monitoring results.		
• 4.1.5 Riparian Vegetation and Creek Bed Stability - The NWCD has its own rehab management plan. This management plan should refer to it and it may need to be updated.		**SWMP** (Section 6.1.6 - Monitoring) – see also **BMP** and **NWCD MP** (Appendix D of **SWMP**)
• 4.1.6 Monitoring of Discharge Flows in the North Wambo Creek Diversion - What did NOW ask for. This should be included.		**SWMP** (Section 6.1.7 - Monitoring) – see also **NWCD MP** (Appendix D of **SWMP**)
• 6.1 Review - (Review every two years) Usually 3 years		**WMP** Section 11.1.3 and **SWMP** (Section 9.1.2)
GWMP (Version 9) • 2.2.3.1 Alluvial Water Sources - (Investigation into increase in EC) This will need to be reported in the AEMR		**WMP** Section 9.2.1 (Annual Review)
• 3.1.3 Permian Monitoring Locations- Need to discuss why we monitor if the results cannot result in action.		**GWMP** (Section 4.1.2)
• 3.2 Trigger Values for Groundwater Quality - (Bi-monthly monitoring) This will need to be defined. Twice a month or every 2 months		**GWMP** (Section 4.2)
• 4.1.6 Chitter Dam and Wambo South Water Dam Monitoring Program -Need some comment here if the dam will be recommissioned if it is found to be leaking.		**GWMP** (section 6.1.3)
• 6.1 Review - (Review every two years) Review is normally every 3 years.		**WMP** Section 11.1.3 and **GWMP** (Section 9.1.3)
ESCP • No comment on ESCP		
6 November 2015 - DPIE Water Comments on GWMP		
DPI Water recommended that the groundwater monitoring program be revised to address the loss of bores from the North Wambo Creek alluvium.	WCPL is installing additional groundwater monitoring locations in 2017.	**GWMP** (Section 6) See also **WMProg**
DPI Water noted that groundwater trigger levels in the GWMP are not referenced in Australian Height Datum (AHD).	Section 3.1.1 of the GWMP has been amended to include absolute trigger levels in m AHD.	**GWMP** (Table 11)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
DPI Water requested that P114 and P116 of the Wambo Creek alluvial trigger bores within the subsided area be nested or paired with deeper interburden bores to assess the direction of flow between Permian and alluvial aquifers during the post mining period.	WCPL is installing additional piezometers in this area in 2017.	**GWMP** (Section 6) See also **WMProg**
DPI Water noted that Table 3 of the GWMP should be updated to reflect that: • the combined extraction limit of 20BL166910, 20BL173032, 20BL173033, 20BL173034 and 20BL173035 is 450 ML; • the combined extraction limit of 20BL173040, 20BL168017 and 20BL172061 is 750 ML; and • 20BL166906 has been cancelled.	The GWMP has been updated with the latest groundwater licence information.	**GWMP** (Table 4 – Groundwater Licences)
DPI requested that Table 3 of the GWMP is updated to include all Water Access Licences (including regulated river access licences). DPI Water recommends that WCPL provide clarification regarding which licences relate to the operation of Wambo mine and which are used to account for passive water take.	Table 3 of the GWMP lists groundwater entitlements. Section 1.4.2 of the GWMP has been revised to include a reference to the SWMP for a list of surface water entitlements.	**GWMP** (Table 4 – Groundwater Licences) and **SWMP** (Table 5 – Surface Water Licences)
DPI Water indicated that the GWMP should address its previous comment that where the updated modelled aquifer interference take of water from the Lower Wollombi Brook Water Source exceeds the estimates as predicted in WPCL's Groundwater Impact Assessment by 100% or more, WCPL must re-evaluate the associated ecological impacts and any influence on a low flow cease to pump criteria specified in the relevant WSP. The reference value triggering this response procedure must be clearly documented in the GWMP.	This comment has been addressed in the SGWRP.	**GWMP** (Section 6.1.2 – Inflows to Underground Workings) Note: inflow volume has been updated for SBU) and **GWMP** (Section 7.3.3 – Response Plan)
DPI Water referred to the Assessment of Groundwater Trends in GW08 and GW09 prepared by HydroSimulations (29 September 2015) and commented that vertical connection with North Wambo Creek and Wambo Creek is more significant than modelled. DPI Water recommended that an appropriate timeframe be set where the groundwater conceptualisation and numerical model will be updated.	The groundwater conceptualisation was reviewed as a result of monitoring results in GW08 and GW09. The numerical model was recalibrated to capture the monitoring data in GW08 and GW09 and reported in HydroSimulations (2016a).	**GWMP** (Section 6.4.1)
6 November 2015 - DPIE Water Comments on SWMP		

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
DPI Water notes that WCPL states that it currently holds two water access licences (WAL No. 23897 and 718) within the Wollombi Brook water source, however WAL 718 is within the Hunter Regulated River water source.	Section 1.4.4 has been revised to outline the surface water entitlements held by WCPL, including WAL 23897, WAL 718 and regulated river licences. Groundwater entitlements are described in the GWMP.	**SWMP** (Section 2.6) and **GWMP** (Section 2.4)
DPI Water requested further detail on the comments in Table 7 of the SWMP regarding "NA" and "No flow data available".	WCPL has included the following notes to Table 8 (previously Table 7) of the SWMP: • NA – Parameter not available in data summary records. • No flow data available – Flow data not available due to damage to station or unreliable sensor responses. • WCPL has recently updated its data management procedures for the flow gauging stations to improve data capture and recording.	**SWMP** (Table 10)
DPI Water recommends that SWMP performance indicators should include exceedance of the stream flow impact assessment criteria in addition to the "number of exceedances of surface water impact assessment criteria".	Footnote 1 to Table 12 has been revised as follows to clarify that the performance indicators refer to both the surface water quality and surface water flow impact assessment criteria: *An exceedance occurs when water quality results exceed the 80th Percentile Trigger Value after three consecutive sampling events or the surface flow impact assessment criteria are met (refer to SGWRP for TARP)*	**SWMP** (Table 19 – TARP for Impacts on Surface Water Flows) and **SWMP** (Table 20 – TARP for Impacts on Surface Water Quality)
DPI Water recommends that after detection of an exceedance during one surface water quality sampling event, the frequency of monitoring is increased to weekly and that contingency actions be implemented following two further exceedances. DPI Water notes that sampling could return to monthly once sampling indicates that parameters are within trigger levels.	The impact assessment criteria for surface water quality have been set based on the 20th and 80th percentile of the available dataset for each site. The surface water quality impact assessment criteria seek to identify persistent statistical variation from baseline data, and therefore there are triggers for two and three consecutive exceedances of the criteria. Initiating additional monitoring in response to one exceedance would add significant additional monitoring burden for reasonably regular events that could be associated with natural water quality variations. The majority of watercourses at Wambo are ephemeral, which also makes this recommendation impractical. Increasing monitoring frequency following two consecutive exceedances has been addressed in the SGWRP.	**SWMP** (Section 4.1 - Triggers) **SWMP** (Table 20 – TARP for Impacts on Surface Water Quality)
DPI Water notes that the nearest flow monitoring site downstream of Longwalls 11 to 13 on North Wambo Creek appears to be at the confluence to Wollombi Brook. DPI Water recommends that WCPL investigate options to install a flow monitoring site immediately downstream of the predicted area of subsidence in order to monitor accurately the surface water losses as a result of Longwalls 11 to 13 (and separate these losses from other sources).	WCPL has a monitoring site immediately downstream of Longwalls 11 to 13 (site FM3). The SWMP includes site FM3 in the monitoring program.	**SWMP** (Section 6.0) and WMProg
6 November 2015 - DPIE Water Comments on SGWRP		

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
In relation to Table 3 of the SGWRP, DPI Water requested further detail on the triggers and responses for impacts on private bores, in particular: • DPI Water expressed concerns about the trigger for a Level 2 Contingency Response, in particular if private bores are unable to sustain extraction for licensed and basic rights purposes with a 2 m drawdown. • DPI Water expressed concerns about the trigger for a Level 2 Contingency Response, in particular that action (i.e. a Level 2 Contingency Response) may only be initiated when three consecutive monitoring rounds show a decline at the trigger level. • DPI Water recommended that relevant agencies be notified of trigger exceedances as part of regular reporting requirements. • DPI Water expressed concerns about the timing for provision of compensatory water supplies to affected landholders.	WCPL recognises that bores in some circumstance (e.g. in shallow aquifers) may not be able to maintain a sustainable yield for a drawdown less than 2 m. WCPL also recognises that three months of drawdown greater than 2 m would be significant in some circumstances. The Trigger Action Response Plan (TARP) for private bores has been structured so that receipt of a new complaint from a landholder in relation to decreasing levels in a private bore automatically initiates a Level 2 Contingency Response. WCPL considers that this mitigates the risks identified by DPI Water. In response to DPI Water's comment regarding notification of relevant agencies, Table 3 of the SGWRP has been revised to include the following Action for a Level 2 Response Contingency Phase: *•Notify DP&E and DPI water of contingency response.* The Plan phase for a Level 2 Response Contingency Phase in Table 3 of the SGWRP has been revised to address DPI Water's comments as follows: *•If preliminary or subsequent investigations ~~determine~~ indicate that compensatory water supplies are to be initiated, as a direct result from Wambo's operations, then Wambo will commence consultation with the affected Landowners to establish an agreed suitable compensatory supply of water, until further monitoring can ~~determine signs of increasing water levels~~ establish these are no longer required.* *•Review and update the WMP and resubmit to DP&E.*	**GWMP** (Table 16 – TARP for Impacts on Private Bores)
In relation to Table 4 of the SGWRP, DPI Water expressed concern that the TARP for impacts on surface water flows does not include mitigation measures only further monitoring.	The Action phase of the TARP for impacts on surface water flows outlines the process for undertaking a preliminary investigation, including engaging a suitably qualified hydrologist. The Plan phase of the TARP includes developing appropriate mitigation measures in consultation with relevant government agencies (including DPI Water) where it is shown that a flow loss has occurred that is greater than modelled. The Plan phase of the TARP for a Level 2 Response Contingency Phase in Table 4 of the SGWRP has been revised to clarify that mitigation measures may include stream remediation works: *•If confirmation of a flow loss which is greater than modelled has occurred Wambo will notify the relevant government agencies and in consultation develop appropriate measures to mitigate the loss of surface water flows in the surface water streams (e.g. stream remediation techniques).*	**SWMP** (Table 19 – TARP for Impacts on Surface Water Flows)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
	WCPL considers that detail on mitigation measures for unforeseen impacts should not be foreshadowed in detail but developed at the time in consultation with relevant government agencies.	
In relation to Table 5 of the SGWRP, DPI Water recommended that after detection of an exceedance during one surface water quality sampling event, the frequency of monitoring is increased to weekly and that contingency actions be implemented following two further exceedances. DPI Water notes that sampling could return to monthly once sampling indicates that parameters are within trigger levels.	The impact assessment criteria for surface water quality have been set based on the 20th and 80th percentile of the available dataset for each site. The surface water quality impact assessment criteria seek to identify persistent statistical variation from baseline data, and therefore there are triggers for two and three consecutive exceedances of the criteria. Initiating additional monitoring in response to one exceedance would add significant additional monitoring burden for reasonably regular events that could be associated with natural water quality variations. In response to the comment from DPI Water, WCPL has amended the Action phase for a Level 1 Response Management Measures (i.e. two consecutive exceedances of the surface water impact assessment criteria) in Table 5 of the SGWRP as follows: •*Increase ~~Maintain~~ monitoring of surface water site(s) to fortnightly to identify if water quality results are trending back to long term averages as identified in the SWMP.* •*If any water quality exceeds the 80th Percentile Trigger Value (three consecutive samples), then go to Level 2 Response.*	**SWMP** (Table 20 – TARP for Impacts on Surface Water Quality)
In relation to Section 2.5 of the SGWRP, DPI Water noted that all loss of surface flow needs to be accounted for through appropriate licences during operation of the mine and prior to the take of water.	WCPL recognises that use of licensing as an offset measure would be in addition to the licence required for other operational purposes. Section 2.5 of the SGWRP has been clarified as follows: *Appropriate management measures will be developed and implemented in consultation with relevant government agencies and may include the relinquishment of an equivalent portion of water access licences as a direct offset for potential groundwater inflows into the Mine (HydroSimulations, 2014) (i.e. in addition to licences already held to account for water take).*	**SWMP** (Section 7.3.3)
27 November 2015 – DPIE – Approval of WMP (and Sub Plans)		
The Department is satisfied that the plans generally address the relevant conditions of the project approval (DA305-7-2003) and the Secretary approves the plans. The plans come into force on 30 November 2015.	See above consideration WCPL provided a response to recommendations made by DPIE Water on 6 November 2015 - see above.	See above

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
The Department notes that DPIE Water are expected to comment on the Extraction Plan for SBU LWs 11-13 and that should these comments require significant changes to any component of the WMP then these changes be made and the plans resubmitted for review and approval.		
17 January 2016 – DPI Water – Response to updated Extraction Plan and Water Management Plan – SBU Extraction Plan LWs 11-13		
Reference is made to the revised Extraction Plan and Water Management Plans for the Wambo South Bates (Whybrow Seam) Underground Mine Extraction Plan Longwalls 11-13 dated December 2015 and the response to DPI Water comments. DPI Water provides the following further comments		
Water Licensing Wambo Coal Pty Ltd (WCPL) notes in its response that it is in the process of conducting a licensing review to confirm that it holds appropriate licences prior to the commencement of South Bates Underground Mine. DPI Water requests that WCPL liaise with DPI Water to ensure that sufficient entitlement is held and licences are nominated to account for the predicted take of water prior to commencement. As previously requested, WCPL must provide an updated table that includes the maximum predicted take of water from surface water, alluvial groundwater and Permian groundwater pre and post remediation and the specific licences nominated to account for this take. This should be incorporated into the Water Management Plan.		**GWMP** (Table 4 – Groundwater Licences) and **SWMP** (Table 5 – Surface Water Licences)
Groundwater DPI Water made a number of comments regarding revision of the monitoring program, including concerns regarding the loss of bores and triggers in the North Wambo Creek alluvium. WCPL responded that the following statement had been included in the groundwater management plan: “Specific trigger levels for GW08 and GW09 have not been established however if GW08 and GW09 do not recover within 12 months of the cessation of dewatering pumping, WCPL may consider installing replacement bores that allow monitoring of the alluvium and underlying interburden material…”. It is recommended that this issue be discussed in a meeting between DPI Water and the proponent to ensure that DPI Water concerns regarding monitoring are resolved. DPI Water recommended that an appropriate timeframe be set where the groundwater conceptualisation and numerical models are updated to acknowledge the increased hydraulic connection and provide a more		N/A

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
accurate estimate of the take of water. WCPL responded that whilst the vertical hydraulic conductivity above the previous bord and pillar workings in the Wambo Seam is higher than previously adopted, there is no evidence to support any lateral extension of higher connectivity away from the workings. DPI Water recommends that this issue be further discussed and resolved in the meeting proposed above with the proponent. DPI Water still has some concerns regarding groundwater monitoring and management, as outlined above. It is recommended these concerns be resolved at a subsequent meeting; however, it is not considered that the issues should delay the commencement of work.		
25 May 2017 and 5 July 2017 – DPIE Comments on WMP (and Sub Plans)		
GWMP • Update the GWMP to reflect the modified layout for LWs 14-16 and the most up-to-date and recommended monitoring regime provided in Technical Report 2.	The GWMP has been revised to reflect the latest layout for LWs 14-16 (e.g. see Figure 3). There was no additional monitoring recommended by Technical Report 2 of the Extraction Plan for the South Bates Underground mine. It is noted that this report describes some sites that have been removed from the program due to disturbance by open cut operations (e.g. P5 and P6).	**GWMP** (Figure 3) and **GWMP** (Section 6.0 – Monitoring). See also **WMProg**.
• Replace Figure 3 with the approved longwall layout for LWs 11-16 (as approved by the Extraction Plan on 16 May 2017).	Figure 3 has been revised.	**GWMP** (Figure 3)
• Provide evidenced of consultation with DRG and DPI-Water in relation to this version of the GWMP, and indicate how many matters raised have been addressed.	Section 1.5 and this Appendix have been revised to include further detail on consultation.	This table
• Replace Figure 5 with the location of the approved longwall layout for LWs 11-16.	Figure 5 has been revised to show the location of mapped alluvium in the lower reaches of the creeks over the latest approved underground mine layout.	**GWMP** (Figure 3)
• Update Section 2.2.1 to include a discussion of the latest approved mining operations in the South Bates Underground Mine.	Section 2.2.1 has been revised to discuss the latest status of mining at Wambo.	**WMP** Section 1.1.1 (Mining History)
• Update Section 2.2.2 to describe the current groundwater monitoring network. Replace Figure 7 with Figure 4 in Technical Report 2.	Section 2.2.2 has been revised with the latest groundwater monitoring network.	**GWMP** (Section 6.0 – Monitoring). See also **WMProg**.
• Update the data summaries in Section 2.2.3 (including Table 8) to include the last 3 years of data.	The data in Table 8 (HARTT Analysis Results for Shallow Monitoring Bores) was used to generate the groundwater impact assessment criteria. It is not considered appropriate to continue to update baseline data during mining operations, as it may skew the impact assessment criteria. Monitoring results during operations are presented in Annual Reviews.	**GWMP** (Table 8 – HARTT Analysis)
• Update the discussion on the hydrogeological model in Section 2.2.5.	Section 2.2.5 has been revised to refer to the latest hydrogeological model for the approved mine.	**GWMP** (section 3.6)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
• Update the ground water triggers in Section 3.0 to reflect the latest data for the South Bates Underground.	The trigger levels in Section 3.0 are for bores with a broad spatial extent and are designed for all open cut and underground mining operations at Wambo. It is not considered appropriate to revise trigger levels to incorporate mine affected data.	**GWMP** (Section 4.0 – triggers). See also **WMProg**
• Update Section 4.1.5 to reflect inflow estimates and triggers for South Bates Underground Mine inflows (based on 2015 HydroSimulations estimates). • Liaise with DPI-Water in relation to the inflow "trigger", procedures for exceedances and licence implications.	Section 4.1.5 has been revised for the South Bates Underground Mine based on the same methodology that was used for North Wambo Underground Mine. This methodology was developed in consultation with DPI Water.	**GWMP** (Section 6.1.2)
• Update Section 4.0 and Table 12 to reflect the most up-to-date and current groundwater monitoring regime.	Table 12 reflects the latest groundwater monitoring network. Note that Table 6 includes a note that GW14 has been dry since December 2011, GW18 has been dry since October 2010 and GW19 has been dry since monitoring began in 2009.	**GWMP** (Section 6.0) and **WMProg**.
• Update Section 4.1.6 to reflect the current status of mining and monitoring results in the vicinity of these structures.	Section 4.1.6 has been revised to reflect that the Chitter Dam has been decommissioned.	**GWMP** (Section 6.1.3)
• Update the GWMP to reflect the modified layout for LWs 14-16 and the most up-to-date and recommended monitoring regime provided in Technical Report 2.	The GWMP has been revised to reflect the latest layout for LWs 14-16 (e.g. see Figure 3). There was no additional monitoring recommended by Technical Report 2 of the Extraction Plan for the South Bates Underground mine. It is noted that this report describes some sites that have been removed from the program due to disturbance by open cut operations (e.g. P5 and P6).	**GWMP** (Figure 3)
25 May 2017 and 5 July 2017 – DPIE Comments on WMP (and Sub Plans)		
SWMP • Update the SWMP to reflect the modified layout for LWs 14-16 and the most up-to-date and recommended monitoring regime provided in Technical Report 3.	The SWMP has been revised to reflect the latest layout for LWs 14-16 (e.g. see Figure 3) and to reflect the monitoring regime recommended by Alluvium in Technical Report 3 of the Extraction Plan (see Section 4.1.7).	**SWMP** (Figure 2)
• Replace Figure 3 with the approved longwall layout for LWs 11 16 (as approved by the Extraction Plan on 16 May 2017).	Figure 3 has been revised.	**SWMP** (Figure 2)
• Provide evidence of consultation with DRG and DPI-Water in relation to this version of the SWMP, and indicate how many matters raised have been addressed.	Section 1.5 and this Appendix have been revised to include further detail on consultation.	This table
• Replace Figure 4 with the location of the approved longwall layout for LWs 11-16. Include the location and labelling of surface waters.	Figure 4 has been revised to show the location of mapped alluvium in the lower reaches of the creeks over the latest approved underground mine layout.	**GWMP** (Figure 3)
• Update Section 2.2.1 to include a discussion of the latest approved mining operations in the South Bates Underground Mine.	Section 2.2.1 has been revised to discuss the latest status of mining at Wambo.	**WMP** Section 2.1.1

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
• Update Figure 5 and Table 5 to reflect the monitoring points approved in the Extraction Plan.	Figure 5 and Table 5 have been revised to show the latest monitoring locations.	**WMProg**
• Update the data summaries in Section 2.2.3 (Tables 6 & 7 and Figures 6 & 7) to include the last 3 years of data.	The data in Table 6 (Surface Water Quality Ranges) was used to generate the surface water impact assessment criteria. It is not considered appropriate to continue to update baseline data during mining operations, as it may skew the impact assessment criteria. Monitoring results during operations are presented in Annual Reviews. Notwithstanding, Table 7 has been revised to include more recent flow monitoring data.	**SWMP** (Section 3.4 – Review of Baseline Data)
• Discuss the surface water quality impact criteria in Table 11 with the Department and DPI-Water.	The surface water impact assessment criteria for EC and TSS have been developed for low flow conditions based on 80th percentile of recorded concentrations and for high flow conditions based on maximum recorded concentrations. This is considered appropriate. The high salinity observed in the downstream section of North Wambo Creek (site SW05) was also observed in the 2003 Environmental Impact Statement for the Wambo Development Project. WCPL considers that the surface water quality impact assessment criteria in the SWMP are appropriate triggers for determining unanticipated changes to water quality at site SW05.	**SWMP** (Section 3.0 – Surface Water Impact Assessment Criteria)
• Indicate on Figure 5 and in Section 3.1 that the LDP is SW15.	Figure 5 and Section 3.1 have been revised.	**SWMP** (Section 6.1.9) and **WMProg**
• Confirm the number and location of monitoring sites and make the information in Section 4.1, Table 13 and Figure 5 consistent.	Section 4.1, Table 13 and Figure 5 are now consistent.	**SWMP** (Section 6.0) and **WMProg**
• Provide a summary of the bank and bed stability monitoring program applicable to the LW11 to 16 subsidence areas (Note: this may require an update of the programs in the FFMP).	The bed and bank stability monitoring program has been in operation at Wambo since 2006, and includes monitoring along natural creek lines (North Wambo Creek, Wambo Creek and Stony Creek) and the North Wambo Creek Diversion (including areas above Longwalls 11 to 16). Section 4.1.5 has been revised to refer to the latest Biodiversity Management Plan (which is proposed to address the requirements of the FFMP). Section 4.1.7 presents further detail on the specific monitoring that will occur for Longwalls 11 to 16.	**SWMP** (Section 6.1.6) and **BMP** **SWMP** (Section 6.1.8 – Subsidence Monitoring) – see also **NWCD MP** (Appendix D of **SWMP**)
• Provide a program to monitor the effectiveness of the ESCP.	Section 4.1.4 has been revised.	**SWMP** (Section 6.1.5). See also **ESCP**

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
25 May 2017 and 5 July 2017 – DPIE Comments on WMP (and Sub Plans)		
SGWRP • Update the SGWRP to reflect the modified layout for LWs 14-16.	The SGWRP has been revised to reflect the latest layout for LWs 14-16 (e.g. see Figure 3).	**GWMP** (Figure 3)
• Replace Figure 3 with the approved longwall layout for LWs 11-16 (as approved by the Extraction Plan on 16 May 2017).	Figure 3 has been revised.	**GWMP** (Figure 3)
• Revise TARPs to reflect revisions to the SWMP and GWMPs and make relevant to mining in LW14-16.	The TARPs in Sections 2.3 and 2.4 are designed to account for all open cut and underground mining operations at Wambo (including Longwalls 14 to 16). A North Wambo Creek Subsidence Response Strategy (NWCSRS) is appended to the SGWRP that deals specifically with the South Bates Underground Mine.	**GWMP** (Section 7.0) and **SWMP** (Section 7.0) Note: NWCSRS is now appended to **NWCD MP** (Appendix D of **SWMP**)
• Discuss acceptable triggers for the relinquishment of water extraction rights with DPI-Water and include SGWRP.	It is most appropriate to consider the relinquishment of water extraction rights to compensate for post mining closer to the end of the mine life. WCPL understands that this staged approach is available under the Development Consent. DPI Water did not express any concerns with this approach in its review of the SGWRP.	**SWMP** (Section 7.3.3)
• Include response times for key actions within the TARPs.	Additional clarification on the timing of actions has been included. Section 4.4 outlines response times for reportable environmental incidents.	**GWMP** (Section 7.0) and **SWMP** (Section 7.0)
31 July 2017 – Independent Expert Scientific Committee (IESC) Comments on SWMP (Revision 11)		
Monthly monitoring of metals and ions (including sulfate) is needed to establish a baseline and to develop suitable trigger values. After this period, event-based monitoring (including multiple samples to capture different stages of the hydrograph such as the rising and falling limbs), and regular monitoring at a frequency which captures the natural variability of the system as identified from the baseline data, will need to continue to allow prompt identification and investigation of exceedances of the trigger values.	WCPL will increase the sampling program to include monthly monitoring of metals and ions on six surface water monitoring locations (as outlined in Table 14) until March 2020. Representative sites surrounding WCPL are as follows: • USFM01 – upstream North Wambo Creek • SW01- located upstream of Wambo Coal Operations; • SW02- located downstream of Wambo Coal Operations; • SW04 - North Wambo Creek upstream of North Wambo Creek Diversion; • SW06 - South Wambo Creek upstream of Wambo Coal former operations; and • SW08 - Stony Creek.	**SWMP** (Section 6.0 - Monitoring) and **WMProg**
The data used to calculate trigger values should be provided. The IESC is concerned that data from impacted sites was used to set trigger values. Data and associated metadata should be presented to show that only pre-impact data has been used in the calculation of the trigger values.	It is noted that mining first commenced in the Wambo area in 1969. Therefore, while the use "pre impact" data to characterise baseline conditions is ideal, it is not feasible at Wambo.	**SWMP** (Section 3.4 – Review of Baseline Data)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
Water quality monitoring in the upstream reach of North Wambo Creek has historically occurred infrequently (i.e. four samples collected over 13 years) due to the intermittent nature of North Wambo Creek in this reach. Suitable reference sites need to be identified and monitored by the proponent to enable the calculation of appropriate trigger values for incorporation into TARPs. The reference sites must not be impacted by mining. The current trigger values represent water quality which has been impacted by mining, making these unsuitable for identifying potential mining impacts.	Monitoring site SW04 referred to in the IESC's comments is located upstream of Wambo and has not been directly impacted by mining to date. It is noted that the IESC's suggestion to establish a reference site comparable to the upstream reaches of North Wambo Creek would encounter similar practical difficulties associated with obtaining a suitable number of samples in a highly ephemeral system with a high proportion of sub-surface flow. Quality monitoring will commence at US FM1 (upper reaches of North Wambo Creek). No additional monitoring sites are proposed at this stage.	**SWMP** (Section 6.0 - Monitoring) and **WMProg**
Trigger values should be calculated using the 20th and 80th percentiles as outlined in the ANZECC/ARMCANZ Guidelines (2000), not the less conservative 10th and 90th percentiles used by the proponent. Trigger values and associated TARPs should be initiated based on a single recorded exceedance of the 20th or 80th percentile values and not multiple exceedances over numerous months. A subsequent consecutive exceedance should initiate another level of the TARP.	Although ANZECC and ARMCANZ (2000) recommend 80th percentile values as being suitable for trigger values, a trigger would be initiated 20 percent of the time due to natural causes. Therefore, for the trigger to be a meaningful indicator of a possible mining effect, an investigation is to be triggered when the 90th percentile value is exceeded on two consecutive monitoring events.	**SWMP** (Section 4.1 – Triggers) and **SWMP** (Section 7.3.1 – TARPs)
Further information regarding the water management system is needed. The water management plan should include this information and an up-to-date version of the water management system schematic.	This information is presented in Site Water Balance Revision 2 (WA-ENV-MNP-509.5), a component of the Site Water Management Plan.	**WMP** Section 6.1 and **SWB**
While the proponent has committed to updating the water balance annually it is unclear if this includes a commitment to update any other models that underpin the predictions of the water balance model. These should be regularly reviewed and updated as needed.	Regular reviews and updates to the numerical model have been undertaken as part of modifications to the Wambo Coal Mine. A site water balance was completed in support of the Extension of the Approved South Bates Mine (DA305-7-203, MOD 17, February 2017). Details on the assumptions of the model are included in the United Wambo Open Cut Coal Mine Project Site Water Balance (JV SWB), a component of the Surface Water Assessment completed in July 2016. The WCPL Site Water Balance document (WA-ENV-MNP-509.5, approved by DP&E in 2015) will be revised to incorporate the findings of the JV SWB and resubmitted for consultation and approval. A review of the site water balance against model predictions is undertaken annually and presented in the Annual Review.	**GWMP** (Section 5.3 – Groundwater Model Validation) and **GWMP** (Section 9.1.2 – Validation of Predictions) See also **SWB**
31 July 2017 – Independent Expert Scientific Committee (IESC) Comments on GWMP		
Groundwater quality data for contaminants such as metals and other ions (e.g. sulfate) was not provided in the EA or in the proponent's environmental reporting (from July 2015 onwards (Peabody Energy 2017)) despite the proponent's groundwater monitoring plan stating that monitoring for these parameters had commenced in July 2015 (Peabody Energy 2015a). The current sampling frequency (i.e. annual)	Water quality triggers are defined for EC and pH as sufficient indicators of potential water quality impacts in the context of beneficial use, the criterion in the Aquifer Interference Policy.	**GWMP** (Table 12 – Triggers)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
will not provide data that is suitable for use in calculating or applying trigger values.		
The current groundwater monitoring network does not contain any bores that are able to detect and provide early warning of potential drawdown in private bores located to the north, northwest and west of the proposed project. There are no monitoring bores located to the southwest and south of the proposed project; therefore, potential drawdown propagation in the direction of the World Heritage-listed Wollemi National Park will not be monitored. The IESC recommends that monitoring bores be installed in these areas and that the proponent commits to replace or repair any current monitoring bores which are damaged due to the proposed project such as through subsidence.	Additional groundwater monitoring bores have been and are being installed to the north and north-west of the Modification 17 area (P320, P321 and UG166A). There are no groundwater users (environmental or third-party users) to the south-west and south of the Modification 17 area, and therefore no additional groundwater monitoring to the south-west and south is proposed.	**GWMP** (Section 6.0) See also **WMProg**
Water quality monitoring (for contaminants such as metals and ions) should be expanded to include the Permian aquifer. Sampling frequency in the Permian aquifer should be at least six-monthly, with frequency increased to a minimum of three-monthly in the alluvial aquifer where higher hydraulic conductivity and connectivity to surface water will cause more rapid changes in water quality parameters.	Water quality sampling is conducted in Permian bores P202, P203, GW12, GW21, GW22. There is limited use of the Permian aquifers and therefore further sampling is not considered warranted.	**GWMP** (Section 6.0) See also **WMProg**
Baseline water quality data should be collected from representative reference bores in areas of the aquifers where mining impacts have not occurred.	Bore holes GW23, GW24, GW25 and GW26 were drilled late 2017 in North Wambo Creek. These bores will provide representative data prior to the commencement of mining in the South Bates Underground Extension Area (LW18-25)	**GWMP** (Section 6.0) See also **WMProg**
The data used to calculate trigger values for both groundwater levels and quality should be provided. The IESC is concerned that data from impacted sites was used to set trigger values. Data and associated metadata (including for reference bores) should be presented to show that only pre-impact data has been used in the calculation of the trigger values.	It is noted that mining first commenced in the Wambo area in 1969. Therefore, while the use of “pre-impact” data to characterise baseline conditions is ideal, it is not feasible at Wambo. A full statistical analysis for data up to April 2015 is included as Table 7.	**GWMP** (Table 8)
Trigger values should be calculated using the 20th and 80th percentiles as outlined in the ANZECC/ARMCANZ Guidelines (2000), not the less conservative 10th and 90th percentiles used by the proponent. Trigger values and associated TARPs should be initiated based on a single recorded exceedance of the 20th or 80th percentile values and not multiple exceedances over numerous months. A subsequent consecutive exceedance should initiate another level of the TARP.	As described in Section 3.2 of the GWMP, although ANZECC and ARMCANZ (2000) recommend 80th percentile values as being suitable for trigger values, a trigger would be initiated 20% of the time due to natural causes. Therefore, for the trigger to be a meaningful indicator of a possible mining effect, an investigation is to be triggered when the 90th percentile value is exceeded on two or three consecutive monitoring events.	**GWMP** (Sections 4.1 and 4.2)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
The groundwater management plan should include commitments from the proponent to undertake a thorough review of the groundwater model given it has been revised over a number of years to accommodate multiple modifications to mining at the Wambo Mine Site. This makes it difficult to identify the calibration and parameterisation history of the model and hence to appraise its ability to accurately predict project-specific and cumulative impacts.	The regular reviews and updates to the numerical model undertaken as part of modifications to the Wambo Coal Mine has improved the performance of the numerical model through regular re-calibration and validation. The most recent calibration of the numerical model is documented in the MOD 12 Environmental Assessment (HydroSimulations, 2016a). The most recent validation and model run is documented in the MOD 17 Environmental Assessment (HydroSimulations, 2017). Both reports are in the public domain.	**GWMP** (Sections 3.6 and 3.7)
The groundwater management plan should include commitments from the proponent to regularly validate the groundwater model predictions. The groundwater management plan should include commitments from the proponent to regularly update the groundwater model as recommended by the Australian Groundwater Modelling Guidelines (Barnett et al. 2012).	WCPL undertakes a comprehensive review of groundwater monitoring results annually against the groundwater model predictions in the Annual Review (Condition 5, Schedule 6 of the Development Consent DA 305-7-2003). In addition, as part of each Extraction Plan application, WCPL is required to present a revised assessment of potential impacts and environmental consequences incorporating relevant monitoring data obtained since the approval (Condition 22D, Schedule 4 of the Development Consent DA 305-7-2003).	**GWMP** (Sections 9.1.1 and 9.2.1 – Annual Review)
The groundwater management plan should include commitments from the proponent to clearly define the level of variance between groundwater observations and model predictions that will trigger a review of the groundwater model.	A review of monitoring results against the numerical model predictions is undertaken annually and presented in the Annual Review. It is not considered appropriate to define a set level of variance given the complexity of the natural environment and the influence of other potential factors (e.g. climatic conditions or changes in mine progression).	**GWMP** (Sections 9.1.2 and 9.2.1 – Annual Review)
December 2017 – DPIE Water (formerly CLWD) Comments on WMP (Revision F)		
…CLWD recommends the following is undertaken prior to the Department of Planning's endorsement of the WMP		
The Department of Planning and Environment engages an independent expert to advise if leakage from South Wambo Dam has resulted in contamination of the alluvial aquifer of South Wambo Creek;	Noted. HydroSimulations has prepared a report (under review) titled Update on Possibility of Mine Water Seepage to Wollombi Brook (April 2018)	**GWMP** (Section 6.4.2) – Report provided to DPIE and NRAR/DPIE Water on 22 Nov 2018[1]
In consultation with Crown Lands and Water, WCPL expands the observation bore network within and beneath the area of alluvial aquifers and mapped GDEs. This is to ensure that future groundwater model revisions can capture and predict important localised impacts;	SLR completed installation of monitoring bores in the North Wambo Creek alluvium in 2017. The lack of alluvial groundwater present during the drilling (despite recent rain at the time of the drilling) does not support further drilling.	**GWMP** (Section 6) See also **WMProg**
The WMP set a requirement to measure water quality for water seeping into the open cut and underground mine workings	WCPL conducts monitoring though an extensive network of boreholes. Further investigations will be conducted in 2018 to seek improvements to the overall site water management and direct monitoring of seepage into the open cut or underground workings. The water quality of inflows to the underground workings and the open cut are measured indirectly through monthly water quality monitoring of mine water storages.	**SWMP** (Section 6.1.10) See also **WMProg**

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
	This is the most practical method to routinely sample for water quality. An unexpected increase in water make or change in water quality of mine water storages would be investigated by Wambo. If warranted, direct measurement of water quality at the source of inflow may be conducted. (Refer to Section 4.1.9.)	
The Surface and Ground Water Trigger Action Response Plan must link to monitoring bores with defined thresholds listed in the Groundwater Monitoring Plan. Observation sites listed for North Wambo Creek alluvium have no defined triggers that hold WCPL accountable to impacts and the licensable take of water.	The Mine is approved to have an impact on North Wambo Creek alluvium and the licensable take of water has been predicted by HydroSimulations (2016a, 2017). WCPL is held accountable to its licensing volumes through the monitoring of inflow volumes.	**GWMP** (Table 17 – TARP for Impacts on North Wambo Creek Alluvium)
25 March 2018 – DPIE Letter – ESCP and EMS		
The Department has reviewed the Erosion and Sediment Control Plan (Revision 9) for the Wambo Mine Complex and is considers that the ESCP does not adequately address the relevant requirements of DA305-7-2003 and DA177-8-2004. The Department's comments are enclosed in Attachment A.	N/A	N/A
The ESCP does not address the requirements of Managing Urban Stormwater: Soils and Construction – Volume 2E mines and quarries (DECC 2008), Appendix C: Erosion and sediment control planning. Action Required: Revise the ESCP to ensure consistency with Managing Urban Stormwater: Soils and Construction – Volume 2E mines and quarries (DECC 2008), Appendix C	The following sections make reference to Managing Urban Stormwater: Soils and Construction – Volume 2E mines and quarries (DECC 2008), Appendix C (also known as the Blue Book): • Section 1.2 – Purpose; • Section 4.1 – Principles; • Table 4 – Sediment Dam Risk Analysis; • Section 5.1 - Design Guidelines ; • Section 6.6 – Worked Water; • Section 6.8 – Subsidence Management; and • Section 7.1 – All Control Structures.	**ESCP**: • Section 4.2.1 – Principles • Table 7: Design Criteria **WMP:** • Section 3.2 (Policies, Guidelines and Standards) • Table 9: Design Criteria • Section 4.1.2 (Dirty Water Management) • Section 5.1.3 (Erosion and Sediment Controls)
Section 5. discusses the 'Design Guidelines' and Appendix D 'Design Principles'. However it is unclear if the current sediment and erosion controls have been constructed in accordance with the referenced guidelines and principles. Action Required: Integrate the descriptions of erosion and sediment control structures, location, function and capacity. For example, update Table 5 to include the type of erosion and sediment control structure at	Refer to Section 5.0. In March 2018, SLR finalised an assessment of existing dam capacities at Wambo against the requirements of the Blue Book and current best practice. The SLR report concludes 'where the existing dam storage capacity is known, all of the sediment dams comply with the Blue Book requirements and all of the mine water dams are sufficiently sized to contain runoff from the 100 year ARI, 24 hour duration and 72 hour duration design storm events'	**ESCP** (Section 5.1.1 – ESC Management Structures)

Comment	Consideration of Comment in previous versions of the WMP	Where addressed in this WMP
each location. Include a reference to the relevant design principles applied to each structure.		
The use of the word 'should' throughout the ESCP is to be replaced with 'shall' or 'will' or similar. Please check the document for noncommittal wording and replace.	Complete, refer to changes throughout in blue font.	**ESCP** (font now black)
The ESCP does not reference the additional mining lease required by the approval of the South Bates Underground Extension (MOD17). All mining lease areas need to be included with the lease boundaries shown on the mine layout plan.	A Mining Lease Application has not yet been lodged for the portion of South Bates Underground Extension not currently subject to a Mining Lease. The Approved Wambo Coal Mine Layout (Figure 3) will be revised to include the new Mining Lease, once approved.	**ESCP** (Figure 1)
Section 3.4 (hydrology) should include comment on the area subject to MOD 17 that comprises a section of North Wambo Creek above the diversion	See text added to Section 3.4.	**ESCP** (Section 3.3)
Condition 4, Schedule 6 outlines the requirements of all management plans. Please ensure the ESCP addresses these requirements.	The requirements of Condition 4, Schedule 6 are listed in Table 2 which also provides section links to where each requirement is addressed in the ESCP.	**ESCP** (Table 1)
27 June 2018 – DPIE Letter - ESCP		
The Department has reviewed the Erosion and Sediment Control Plan (Revision 10) for the Wambo Mine Complex and is satisfied that it adequately addresses the relevant requirements of DA305-7-2003 and DA177-8-2004. As such the Secretary approved this management plan.	N/A	N/A
7 September 2018 – DPIE Letter - Extraction Plan for SBU LWs 17-20		
The Department has reviewed the Extraction Plan and is satisfied that it meets the Da requirements. The Department is awaiting confirmation from NRAR that the Water Management Plan and subsequent information satisfactorily satisfies their concerns. The Department will further liaise with WCPL, if necessary, once this information is received. Nevertheless, the Water Management Plan can be considered approved and should be implemented.	N/A	N/A
4 June 2019 – DPIE Letter - Comments on Extraction Plan for SBU LWs 17-20 (Revised Layout)		
The Secretary approves the revised Extraction Plan for Longwalls 17-20.	N/A	N/A

1. *Report titled "Update on Possibility of Mine Water Seepage to Wollombi Brook" (HydroSolutions, 2018) was provided to DPIE and NRAR/DPIE Water Group on 22 November 2018. Findings of the report were presented on 26 September 2018. A general update on issues was provided on 9 April 2020.*

APPENDIX B - WMP Summary of Commitments

Water Management Plan – Summary of Commitments

Note: The list of commitments in this appendix is in addition to those explicitly required by Development Consent conditions.

WMP Section	Commitment	Timing
1.4	As the monitoring program is now shared with the United Wambo Open Cut Mine, a separate shared document has been developed and will be submitted to DPIE for review and approval (**WMProg**).	Prior to Phase 2 commencing
2.2.2	Groundwater triggers will be developed as part of the **GWMP** where they will seek to follow the objectives of the NSW State Groundwater Policy.	As required
2.2.8	Water imported to site, water used onsite and water discharged from site will be monitored in accordance with Water Reporting Requirements for Mines (DWE Water undated).	As required
2.5.1 and 2.5.2	WCPL will report performance against relevant water licence conditions in the Annual Review.	Annually
4.1.1	Clean water controls will be augmented with the construction of new drains and dams as required to accommodate any changes to the surface facilities disturbance footprint (increase or decrease).	As required
4.1.2	The dirty water management system will be constructed in accordance with Managing Urban Stormwater: Soils and Construction (the Blue Book), Volumes 1 and 2E – Mines and Quarries (Landcom 2004 and DECC 2008).	As required
	As mining progresses, runoff from disturbed areas will be managed within the water management system and reused or, if water quality meets required guidelines (refer United Wambo Surface Water Management Plan), released to downstream waterways.	As required
	Where the dams form part of permanent infrastructure, they will be designed with spillways suitable for conveyance of the 100 year ARI peak flow event, with 300 mm freeboard provided, assuming dams are full.	As required
	The dams will spill into natural undisturbed clean water areas in the event that the design rainfall depth is exceeded and be released from site.	As required
4.1.3	Mine water will be contained in storages (including open cut pits and underground voids), suitably designed, installed and maintained to convey and contain runoff from the 100 year, 24 hour ARI storm event.	Ongoing
	Tailing storage areas will be suitably designed, installed and maintained to encapsulate and prevent the migrating of tailings seepage offsite. Overburden will be monitored for saline seepage as per the United Wambo Surface Water Management Plan.	Ongoing
5.1.1	The Wambo water management system (WMS) will be constructed and modified as and when required so as to support the infrastructure and mine development.	As required
	Wambo will manage the water associated with the following tailings storage facilities (TSF) - North East Tailings Dam, Hunter Pit Tailings Dam, Homestead Main Pit TSF and South Bates Pit TSF (proposed for future storage)	As required
	In the event that a dirty or mine water pipeline is located in a clean water catchment, additional controls will be implemented to mitigate offsite discharges	As required
	Pipelines should be buried across creeks and drainage lines and should be double skinned or sleeved to minimise physical damage and/or to contain potential leakages.	As required
5.1.2	Where possible, all sections of mine water pipelines will run through mine water catchments so that any leaks in the pipes in these areas will flow into mine water storages.	As required
	In the event that a dirty or mine water pipeline is located in a clean water catchment, additional controls will be implemented to mitigate offsite discharges including differential flow meters or pressure sensors and pump cut offs at pre-determined levels.	As required

WMP Section	Commitment	Timing
5.1.3	Erosion and sediment control measures at Wambo will be implemented and undertaken in accordance with the **ESCP**.	As required
5.1.4	Water will be extracted from the Hunter River and Wollombi Brook as required and approved under the existing WALs.	As required
	Surplus water will be discharged as required and in accordance with EPL 529 and consistent with the provisions of the HRSTS. Discharges will be monitored prior to release to ensure compliance with the requirements of the HRSTS and in accordance with EPL conditions.	As required
5.1.5	Water will be imported and exported on an as needs basis subject to commercial agreements.	As required
5.1.7	Decommissioning of boreholes will be undertaken in accordance with standards equivalent to or exceeding the Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012).	As required
5.1.8	Above-ground storage tanks containing materials likely to cause environmental harm will be: • Imperviously bunded with a capacity of 110% that of the largest container stored within the bund; • Designed and constructed in a manner which prevents the ingress of rainwater into the tanks; and • Clearly labelled to identify content.	At all times
5.2 and 5.3	The site water and salt balance will be recalculated on an annual basis and reported in the Annual Review.	Annually
5.4	Results from monitoring undertaken as part of the **WMProg** will be compared to groundwater model predictions, as part of the Annual Review process.	Annually
	The groundwater model will be validated every 5 years, using data collected from the water monitoring program. This process will be coordinated by Wambo and reported on in the Annual Review.	Annually
5.5	The water balance model will be updated throughout the mine life to forecast supply reliability as part of the water management planning process.	As required
	In the event of reductions in the forecast reliability due to low rainfall conditions, water conservation measures (such as the use of synthetic dust suppressants) will be implemented.	As required
5.6	General training on the aspects of the WMP (and sub plans) will be provided to all employees and contractors through the WCPL site induction process.	Ongoing
	Selected site personnel whose duties directly involve the management of water at Wambo will undertake specific training in regards to site operational procedures which incorporate water management measures. This training will be undertaken annually and when there is a change in personnel in key roles.	Annually and as required
6.1	WCPL will monitor rainfall, water usage, fresh water imported to site, the transfers of water around site and the volume of water stored in designated storages on the site.	Ongoing
6.2	As part of the ongoing water balance monitoring the groundwater inflows to the mining pits and underground will be reviewed quarterly. This will be undertaken by review of available data (including flow metering data or pump hours, site daily rainfall data and site survey data) to estimate groundwater inflows to the mining operations.	Quarterly
6.3	Routine inspections of water structures, including dams, drop structures, diversion drains and erosion and sediment control structures, as well as inspections following significant rainfall events (greater than 25 mm in 24 hours), will be conducted by Wambo personnel.	As per **ESCP**

WMP Section	Commitment	Timing
	The frequency of pipeline inspections will be determined through risk assessment, however all major operational pipelines and high risk pipelines are to be inspected weekly when in use, as a minimum.	Weekly when in use
7.0	All water related community complaints will be recorded within the Community Complaints Register.	As received
	The Monthly Environment Monitoring Report will include details of all community complaints.	Monthly
8.1	If an exceedance of these criteria and/or performance measures occurs, WCPL will, at the earliest opportunity: • Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; • Undertake an investigation into the cause of the exceedance and contributing factors. This investigation may involve collaboration with personnel at the United Wambo Open Cut Operations, depending on the nature, location and potential cause of the exceedance; • Consider all reasonable and feasible options for remediation (where relevant) and submit a report to DPIE describing those options and any preferred remediation measures or other course of action; and • Implement remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary.	As required
8.2	WCPL will respond to identified unforeseen water impacts in accordance with the procedure described in **Section 8.2**	As required
8.3	In the event that WCPL identifies a failure to comply with a statutory requirement, WCPL will: • Undertake an investigation into the failure; • Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and Report the non-compliance in accordance with the requirements of the development consents.	As required
8.4	In the event that WCPL receives a complaint from a landholder regarding their water supply, WCPL will investigate the complaint to determine if the impact was caused by WCPL's mining operations. If this can be proven, WCPL will consult with DPIE Water on appropriate compensatory water supply arrangements.	As required
9.1.1	Review Wambo's environmental performance as part of the Annual Review.	Annually
9.1.2	Every year the site water balance, surface water take and groundwater model will be validated by comparing predicted results to monitoring results collected over the life of the development. This will be undertaken as part of the Annual Review process.	Annually
	Every five years the validity of the model predictions will be assessed and if the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for simulation of mining.	5 yearly
9.1.3	Review the WMP prior to new underground mining areas being developed and/or within three months of: • the submission of an Annual Review; • the submission of a water-related incident report; • the submission of an Independent Environmental Audit: or • any modification to the conditions of consent (unless the conditions require otherwise).	As required

WMP Section	Commitment	Timing
9.2.1	Report on the following in the Annual Review: • any significant findings regarding the implementation of the WMP • details of any incidents or non-compliances relating to water • water extracted or discharged from the site each year (direct and indirect), including water taken under each water licence. • montioring results including water level and quality • comment on the interaction/connectivity of the open cut and underground area and on the degree of match of the predicted versus observed water levels • predictions, actual and licensing requirements	Annually
	An experienced hydrogeologist will review measured water levels and determine when water levels deviate significantly from that predicted by the groundwater model and determine the reason for this deviation. The review will consider the impact of mining, and other factors that could result in declining water levels including climatic conditions, rainfall recharge and pumping from private (and mine owned) bores.	
	The Annual Review will also identify if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suites should be undertaken.	
	Provide the Annual Review to DPIE and other relevant agencies prior to the end of March each year and make a copy available on the WCPL website.	By the end of March
9.2.4	Report incidents as per the **Section 9.2.4**.	As required
9.2.5	Report non compliances as per the **Section 9.2.5**.	As required
9.2.6	Report results as per the **Section 9.2.6**.	As required
9.2.7	Keep WCPL website up to date.	As required

APPENDIX C - Other Requirements Relating to Water Management

Table A: DA305-7-2003 Conditions relevant to Water Management

<table>
<tr><th>Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>B51</td><td>Soil Erosion
The Applicant must install and maintain suitable erosion and sediment control measures on the site, in accordance with the relevant requirements in the guidance series Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004) and 2E Mines and Quarries (DECC, 2008).</td><td>Section 5.1.3 and ESCP</td></tr>
<tr><td>B52</td><td>Water Supply
The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply.</td><td>Section 5.4</td></tr>
<tr><td>B53</td><td>The Applicant must report on water extracted or discharged from the site each year (direct and indirect) in the Annual Review, including water taken under each water licence.

Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development, including during rehabilitation and post mine closure.</td><td>Section 9.2.1</td></tr>
<tr><td>B54</td><td>Pollution of Waters
Except as may be expressly provided by an EPL, the Applicant must comply with section 120 of the POEO Act while carrying out the development.</td><td>Section 2.1.2</td></tr>
<tr><td>B55</td><td>Discharge Limits
Except as may be expressly provided by an EPL or the Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002, the Applicant must:
(a) not discharge more than 250 ML/day in total from the licensed discharge point/s at the development; and
(b) ensure that the discharges from licensed discharge point/s comply with the limits in Table 7.

Table 7: Discharge limits
<table><tr><th>Pollutant</th><th>Units of measure</th><th>100 percentile concentration limit</th></tr><tr><td>pH</td><td>pH</td><td>6.5 to 9.5</td></tr><tr><td>Total suspended solids</td><td>mg/litre</td><td>120</td></tr></table>Note: This condition does not authorise the pollution of waters by any other pollutants.</td><td>SWMP and WMProg</td></tr>
<tr><td>B56</td><td>Compensatory Water Supply
The Applicant must provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with DPIE Water, and to the satisfaction of the Planning Secretary.</td><td>Section 8.4</td></tr>
<tr><td>B57</td><td>The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributable to the development. Equivalent water supply should be provided (at least on an interim basis) as soon as practicable after the loss is identified, unless otherwise agreed with the landowner.</td><td></td></tr>
<tr><td>B58</td><td>If the Applicant and the landowner cannot agree on whether the loss of water is to be attributed to the development or the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution.</td><td></td></tr>
</table>

Condition	Requirements	Section
B59	If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide compensation, to the satisfaction of the Planning Secretary. Note: *The Water Management Plan (see condition B66) is required to include trigger levels for investigating potentially adverse impacts on water supplies.*	
B60	**Water Management** The Applicant may receive water from, and transfer water to, neighbouring mines including HVO, MTW and United Wambo open cut coal mine.	**Section 5.4**
B61	The Applicant may integrate the site water management system with water management for the Wambo train loading facility and United Wambo open cut coal mine.	**Sections 1.5 and 4.1**
B64	**Groundwater Dependent Ecosystem Study** Within 12 months of the determination of Modification 17, or as otherwise agreed with the Planning Secretary, the Applicant must commission and provide to the Planning Secretary for approval, a Groundwater Dependent Ecosystem Study report. This study must: (a) be prepared by suitably qualified and experienced person/s whose appointment has been endorsed by the Planning Secretary; (b) be developed in consultation with DPIE Water; (c) provide advice on the likely level of groundwater dependence of the vegetation in the South Bates Extension Area given current groundwater levels and expert knowledge of the vegetation communities in the region; (d) in the event it is considered that vegetation communities in the vicinity of the South Bates Extension Area are groundwater dependent (either entirely or partially), provide advice on the likelihood that subsidence associated with the South Bates Extension Area could cause adverse impacts and how any such impacts would manifest; (e) consider to what degree the cumulative impacts of adjacent mining operations may have already impacted groundwater dependent vegetation across the South Bates Extension Area; (f) provide any recommendations that would assist in assessing the potential fracture interconnections between surface water resources and hard rock aquifers that may impact on groundwater dependent vegetation; and (g) include a management and/or remediation program that describes measures that could be implemented to ensure compliance with the performance measures in Table 1 or Table 8 for any groundwater dependent endangered ecological community.	**GWMP**
B65	The Applicant must take into account the findings of the Groundwater Dependent Ecosystem Study and not less than 2 years of monitoring results obtained under condition B7 in the preparation of any Extraction Plan for Longwalls 23 – 25.	**Noted**

Table B: DA177-8-2004 Conditions relevant to Water Management

Condition	Requirements	Section
B4	**Soil Erosion** The Applicant must install and maintain suitable erosion and sediment control measures on the site, in accordance with the relevant requirements in the guidance series Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004) and 2E Mines and Quarries (DECC, 2008).	**Section 5.1.3 and ESCP**
B5	**Water Supply** The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply. Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development, including during rehabilitation and post mine closure.	**Section 5.4**
B6	**Pollution of Waters** Except as may be expressly provided by an EPL, the Applicant must comply with section 120 of the POEO Act while carrying out the development.	**Section 2.1.2**
B7	**Water Management** The Applicant may receive water from, and transfer water to, neighbouring mines including HVO, MTW, Wambo mine and United Wambo open cut coal mine.	**Section 5.4**
B8	The Applicant may integrate the site water management system with water management for Wambo mine and United Wambo open cut coal mine.	**Sections 1.5 and 4.1**

Table C: EA Commitments relevant to Water Management and Monitoring

EA Reference	Commitment	Where addressed
Surface Water Assessment (Umwelt, 2016a)		
Appendix 11, Section 6.3.1	Any significant change in pH (in sediment dams) will trigger further analysis of metal/metalloid concentrations in runoff water and this requirement will be included in the Surface Water Monitoring Program.	**WMProg**
Appendix 11, Section 8.0	The existing monitoring program will be updated as part of the implementation of the Project, including development of specific triggers around low pH and associated monitoring of metals/metalloids.	**WMProg**
Appendix 11, Section 9.2.2	As part of the water balance monitoring, water imported to site, water used onsite and water discharged from site will be monitored in accordance with Water Reporting Requirements for Mines (NOW undated).	**WMProg and SWB**
Appendix 11, Section 9.2.5	Flow monitoring on the Wambo Creek and North Wambo Creek, and Wollombi Brook (by DPIE Water) will continue to be undertaken on a continuous basis as documented in the existing water monitoring plans. The flow monitoring will be undertaken by Wambo, although this data will be shared with United.	**WMProg**
Groundwater Assessment (AGE, 2016)		
Appendix 12, Section 10.2	The full groundwater quality suite will be expanded in order to include key analytes to determine any changes in beneficial groundwater use (i.e. livestock drinking water). The revised full suite will include: • physio-chemical indicators – pH, electrical conductivity, total dissolved solids; • major ions – calcium, fluoride, magnesium, potassium, sodium, chloride, sulphate; • total alkalinity as CaCO3, HCO3, CO3; and dissolved and total metals – aluminium, arsenic, barium, boron, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, silver, vanadium and zinc.	**WMProg**
Appendix 12, Section 10.2	Similar to the water level monitoring, yearly reporting of the water quality results from the monitoring network should be included in the annual review. The annual review should consider if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken.	**Section 9.2.1**
Appendix 12, Section 10.3	Trigger levels will be derived for water quality parameters as part of the development of the Water Management Plan.	**WMProg**
Appendix 12, Section 10.3.1	Should post mining water quality data for these selected key parameters reach the trigger levels, then further detailed analysis of all water quality data will occur. Should this analysis indicate trends not consistent with historical variation, then the mitigation process and strategies will be implemented.	**WMProg**

EA Reference	Commitment	Where addressed
Appendix 12, Section 10.3.2	An annual review should compare the measured groundwater levels in the monitoring bores with the model predicted levels. Judgement of an experienced hydrogeologist will determine when water levels deviate significantly from that predicted by the groundwater model and determine the reason for this deviation. The review should consider the impact of mining, and other factors that could result in declining water levels including climatic conditions, rainfall recharge and pumping from private (and mine owned) bores.	**Section 9.2.1**
Appendix 12, Section 10.3.2	Water levels in bores located outside the predicted zone of influence will be assessed annually against a trigger level. If groundwater levels fall below the 5th percentile water level established from the preceding 24 months for a period of 30 days or over, a triggering event occurs.	**WMProg**
Appendix 12, Section 10.4	It is recommended that monitoring of mine water seepage be undertaken, particularly to identify seepage rates and quality. Samples should be collected of pumped seepage with the objective of providing an early indication of any mixing of shallow alluvial groundwaters with the Permian strata. Water quality analysis should be similar as for the groundwater monitoring bores. The seepage monitoring program should include: • measurement of water pumped from the mining areas using flow meters or other suitable gauging apparatus; • monitoring quality of water pumped from the mining areas (full water quality suite); • correlation of rainfall records (and catchments) with mining area seepage records so groundwater and surface water can be separated; and monitoring of coal moisture content.	**WMProg**
Appendix 12, Section 10.5	Every five years the validity of the model predictions would be assessed and if the data indicates significant divergence from the model predictions, an updated groundwater model would be constructed for simulation of mining.	**Section 9.1.2**
Appendix 12, Section 10.6	It is recommended data management and reporting includes: • annual assessment of departures from identified monitoring data trends and comparison against specified trigger levels; • formal review of depressurisation of coal measures and alluvial aquifers should be undertaken annually by a suitably qualified hydrogeologist, with the frequency reviewed as the Project progresses; • annual reporting (including all water level, water quality and mine water seepage data); and all groundwater data should be stored in a database customised for the Project and with suitable QA/QC controls.	**WMProg**
Appendix 12, Section 10.7	Should monitoring indicate the changes in groundwater levels and quality, and surface waters are more extensive or significant than predicted, mitigation measures will be considered.	**Section 8.2**

Table D: 2017 IEA Recommendations relevant to Water Management and Monitoring (Hansen Bailey, 2018)

Recommendation (as per Table 9 of the 2017 IEA Report (Hansen Bailey, 2018))	Section
It is recommended that WCPL also collect water quality data from sediment dams in order to characterise the quality of runoff from non-coal affected catchments.	**SWMP and WMProg**
Consideration should be made to directly monitor the quality of groundwater seepage reporting to the underground and open-cut workings.	**GWMP and WMProg**
It is suggested that the salt balance be updated annually to include the seepage quality monitoring data.	**Section 5.3 and SWB**
WCPL should determine the frequency of monitoring to apply for the salt balance model.	**SWB and WMProg**
Section 2.2.16 of the Site Water Management Plan outlines rehabilitation objectives for decommissioning water management structures on site. It is recommended that this section is improved by providing a high level strategy for the decommissioning of water management structures (including the management of water during the decommissioning process) as part of any future update of the Site Water Management Plan.	**SWMP**
It is recommended that the Site Water Management Plan is updated to include the predicted salt balance.	**SWB and WMProg**
The GWMP should be updated with the suggestions provided by NSW government subsequent to approval of the GWMP in November 2015 and resubmitted. Updates should include: • A more contemporary reference to groundwater sampling techniques; • Amendment of the text relating to purging of groundwater bores to be consistent with the latest guidelines; • Outline the methods of water quality data upload from the laboratory; • The bore labels in Figure 7 need to be clear for all bores; and • General update of text relating to historical or proposed activities.	**GWMP and WMProg**
Update GWMP to include Montrose Dam prior to its construction.	**GWMP**
AGE made the following recommendations for future groundwater modelling and assessments (see Appendix F): • Future groundwater modelling updates/reports need a clear description of the interactions/connectivity of the open cut and underground area and how this is represented in the modelling; • Future groundwater modelling updates/reports should comment on the interaction/connectivity of the open cut and underground areas and whether it is visible in the observational data;	**Section 9.2.1**
Future annual groundwater monitoring reviews should comment on the interaction/connectivity of the open cut and underground area and on the degree of match of the predicted versus observed water levels. The predictions, actual and licensing requirements should be included in a tabular format in each Annual Review.	**Section 9.2.1**
The status of the single groundwater licence under the *Water Management Act* 2000 should be regularly followed up with DPI-Water	**Table 7**[1]

1. Refer WAL 42373

Table E: EPL Conditions relevant to Water Management

<table>
<tr><th>Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>P1.3</td><td>The following points referred to in the table are identified in this licence for the purposes of monitoring and/or the setting of limits for discharges or pollutants to water from the point.
<table>
<tr><th>EPA ID No</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Location Description</th></tr>
<tr><td>4</td><td>Discharge of saline water under the Hunter River Salinity Trading Scheme (HRSTS) Discharge quality Volume monitoring</td><td>Discharge of saline water under the Hunter River Salinity Trading Scheme (HRSTS) Discharge quality Volume monitoring</td><td>HRSTS Outlet from Eagles Nest Dam at co-ordinates 313132 6393073 (Easting Northing) labelled as EPA4 on plan titled “Wambo Mine Environment Protection Licence 529 Plan of Premises – Monitoring Sites” DWG 2160-2 dated 3/3/2017 APE Ref DOC17/147944</td></tr>
<tr><td>9</td><td>Surface Water Monitoring</td><td></td><td>Surface water quality must be measured at locations representative of impacts likely to be experienced outside the premises as a result of the operation of the mine</td></tr>
<tr><td>18</td><td>Discharge quality monitoring</td><td>Discharge quality monitoring</td><td>STP Discharge monitoring point at coordinates 312057 6393219 (Easting and Northing) defined as STPD1 on plan titled “Wambo Mine Environment Protection Licence 529 Plan of Premises – Monitoring Sites” DWG 2160-2 dated 3/3/2017 APE Ref DOC17/147944</td></tr>
</table></td><td>SWMP and WMProg</td></tr>
<tr><td>L1.1</td><td>Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.</td><td>Noted</td></tr>
<tr><td>L2.1</td><td>For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.</td><td>Noted</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>L2.2</td><td>Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.</td><td>Noted</td></tr>
<tr><td>L2.3</td><td>To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.</td><td>Noted</td></tr>
<tr><td>L2.4</td><td>Water and/or Land Concentration Limits
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>50 percentile concentration limit</th><th>90 percentile concentration limit</th><th>3DGM percentile concentration limit</th><th>100 percentile concentration limit</th></tr>
<tr><td>pH</td><td>pH</td><td></td><td></td><td></td><td>6.5-9.5</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams per litre</td><td></td><td></td><td></td><td>120</td></tr>
</table></td><td>SWMP and WMProg</td></tr>
<tr><td>L3.1</td><td>For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) Liquids discharged to water; or
b) Solids or liquids applied to the area
Must not exceed the volume/mass limit specified for that discharge point or area.
<table>
<tr><th>Point</th><th>Unit of Measure</th><th>Volume/Mass limit</th></tr>
<tr><td>4</td><td>Megalitres per day</td><td>250</td></tr>
</table></td><td>SWMP and WMProg</td></tr>
<tr><td>O2.2</td><td>The licensee is responsible for the correct operation of the sewage treatment system on their premises.</td><td rowspan="5">SWMP</td></tr>
<tr><td>O2.3</td><td>Correct operation involves regular supervision and system maintenance. The licensee must be aware of the system management requirements and must ensure that the necessary service contracts are in place.</td></tr>
<tr><td>O2.4</td><td>The sewage treatment system must be serviced by a suitably qualified and experienced wastewater technician at least once in each quarterly period and a minimum of four times per year.</td></tr>
<tr><td>O2.5</td><td>The licensee must record each inspection an any actions required or recommended by the technician including all results of tests performed on the sewage treatment system by the technician as required in Condition O2.4.</td></tr>
<tr><td>O2.6</td><td>The licensee must prepare a sewage treatment system maintenance program. The program must include:
a) Certification from the system provider that the sewage treatment system is operating within its capacity;
b) Date, time and results of all routine maintenance procedures undertaken to the sewage treatment system; and</td></tr>
</table>

Condition	Requirements	Section
	c) Provide written records of each quarterly inspection.	
O4.1	Effluent application must not occur in a manner that causes ponding or surface runoff.	**SWMP**
O4.2	Spray from the effluent application must not drift beyond the boundary of the effluent discharge utilisation area.	
O4.3	The quantity of effluent/solids applied to the utilisation area must not exceed the capacity of the area to effectively utilise the effluent/solids. For the purpose of this condition, 'effectively utilise' include the use of the effluent/solids for pasture or crop production, as well as the ability of the soil to absorb the nutrient, salt, hydraulic load and organic material.	
O4.4	The licensee must ensure that the effluent discharge utilisation area perimeter is fenced and signposted "Effluent Re-Use Area Keep Out" and controlled in a manner to ensure the exclusion of persons from that area.	
M1.1	The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.	**SWMP and WMProg**
M1.2	All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form; b) kept for at least 4 years after the monitoring or event to which they relate took place; and c) produced in a legible form to any authorised officer of the EPA who asks to see them.	
M1.3	The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.	
M2.1	For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:	**SWMP and WMProg**
M2.3	Water and/ or Land Monitoring Requirements	

<table>
<tr><th>Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td></td><td>
POINT 4
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Continuous during discharge</td><td>A probe designed to measure the range 0 to 10,000 uS/cm</td></tr>
<tr><td>pH</td><td>pH</td><td>Continuous during discharge</td><td>In line instrumentation</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Daily during any discharge</td><td>Grab sample</td></tr>
</table>
POINT 9
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Every 2 months</td><td>Grab sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Every 2 months</td><td>Grab sample</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Every 2 months</td><td>Grab sample</td></tr>
</table>
POINT 18
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Faecal Coliforms</td><td>colony forming units per 100 millilitres</td><td>Quarterly during discharge</td><td>Grab sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Quarterly during discharge</td><td>Grab sample</td></tr>
</table>
</td><td></td></tr>
<tr><td>M3.2</td><td>Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.</td><td>SWMP and WMProg</td></tr>
<tr><td>M5.1</td><td>Recording of pollution complaints</td><td>Section 7.0</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td></td><td>The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.</td><td rowspan="4"></td></tr>
<tr><td>M5.2</td><td>The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.</td></tr>
<tr><td>M5.3</td><td>The record of a complaint must be kept for at least 4 years after the complaint was made.</td></tr>
<tr><td>M5.4</td><td>The record must be produced to any authorised officer of the EPA who asks to see them.</td></tr>
<tr><td>M6.1</td><td>Telephone Complaints Line
The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.</td><td rowspan="2">Section 7.0</td></tr>
<tr><td>M6.2</td><td>The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.</td></tr>
<tr><td>M7.1</td><td>Requirement to monitor volume or mass
For each discharge point or utilisation area specified below, the licensee must monitor:
a) the volume of liquids discharged to water or applied to the area;
b) the mass of solids applied to the area;
c) the mass of pollutants emitted to the air;
at the frequency and using the method and units of measure, specified below.
POINT 4<table><tr><th>Frequency</th><th>Unit of Measure</th><th>Sampling Method</th></tr><tr><td>Continuous</td><td>megalitres per day</td><td>In line instrumentation</td></tr></table></td><td rowspan="2">SWMP and WMProg</td></tr>
<tr><td>M9.1</td><td>HRSTS Monitoring
The licensee must continuously operate and maintain communication equipment which makes the conductivity and flow measurements, taken at Point 4 available to the ""Service provider"" within one hour of those measurements being taken and makes them available in</td></tr>
</table>

Condition	Requirements	Section
	the format specified in the ""Hunter River Salinity Trading Scheme Discharge Point Site Equipment"" as published by the Department of Land and Water Conservation on 7 May 2002.	
M9.2	The licensee must ensure that all monitoring data is within a margin of error of 5% for conductivity measurements and 10% for discharge flow measurement.	
M9.3	The licensee must mark monitoring point(s) number 4, with a sign which clearly indicates the name of the licensee, whether the monitoring point is up or down stream of the discharge point(s) and that it is a monitoring point for the Hunter River Salinity Trading Scheme.	
R1.1	**Annual return documents** The licensee must complete and supply to the EPA an Annual Return in the approved form comprising: 1. a Statement of Compliance; 2. a Monitoring and Complaints Summary; 3. a Statement of Compliance - Licence Conditions; 4. a Statement of Compliance - Load Based Fee; 5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan; 6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and 7. a Statement of Compliance - Environmental Management Systems and Practices. At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.	**Section 9.2.2**
R1.2	An Annual Return must be prepared in respect of each reporting period, except as provided below.	
R1.5	The Annual Return for the reporting period must be supplied to the EPA via eConnect EPA or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').	
R1.6	The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.	
R1.7	Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by: a) the licence holder; or b) by a person approved in writing by the EPA to sign on behalf of the licence holder.	
R2.1	**Notification of environmental harm** Notifications must be made by telephoning the Environment Line service on 131 555.	**Section 9.2.4**
R2.2	The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred. Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.	

Condition	Requirements	Section
R3.1	**Written Report** Where an authorised officer of the EPA suspects on reasonable grounds that: a) where this licence applies to premises, an event has occurred at the premises; or b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence, and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.	**Section 9.2.4**
R3.2	The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.	**Noted**
R3.3	The request may require a report which includes any or all of the following information: a) the cause, time and duration of the event; b) the type, volume and concentration of every pollutant discharged as a result of the event; c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort; e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants; f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and g) any other relevant matters.	**Section 9.2.4**
R3.4	The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.	**Noted**
R4.1	HRSTS Reporting The licensee must compile a written report of the activities under the Scheme for each scheme year. The scheme year shall run from 1 July to 30 June each year. The written report must be submitted to the EPA' s regional office within 60 days after the end of each scheme year and be in a form and manner approved by the EPA. The information will be used by the EPA to compile an annual scheme report."	**Section 9.2.3**
R4.3	The sewage treatment system maintenance program required by Condition O2.6 must be submitted annually to the EPA with the Annual Return.	**Section 9.2.2**
R4.4	The licensee must retain a copy of each report required by Condition O2.5 for 3 years from the date each report is made.	**Noted**

ATTACHMENT 3

WAMBO COAL PTY LIMITED
SURFACE WATER MANAGEMENT PLAN

WAMBO
SURFACE WATER MANAGEMENT PLAN

Document No. WA-ENV-MNP-509.2
November 2020

Document Control

Document No.	WA-ENV-MNP-509.2
Title	Wambo Surface Water Management Plan
General Description	Surface Water Management at Wambo Coal Mine and Coal Handling Facilities
Document Owner	WCPL Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked	Signature
1	August 2020	New Surface Water Management Plan (Version 1) for Wambo Mine, following approval of DA305-7-2003 (Modification 16) & DA177-8-2004 (Modification 3). Replaces the Wambo Surface Water Monitoring Program (Version 12).	WCPL	CB	
2	November 2020	Changes to address minor comments from DPIE	WCPL		

CONTENTS

1.0 INTRODUCTION 1

1.1 PURPOSE AND OBJECTIVES 1
1.2 SCOPE 1
1.3 RELATIONSHIP TO OTHER MANAGEMENT PLANS 3
1.4 PREPARATION OF THE SWMP 4
1.5 STAKEHOLDER CONSULTATION 4
1.6 STATEMENT OF COMMITMENTS 5

2.0 STATUTORY REQUIREMENTS 6

2.1 LEGISLATION, POLICIES, GUIDELINES AND STANDARDS 6
2.2 DA305-7-2003 CONDITIONS OF CONSENT 6
2.3 DA177-8-2004 CONDITIONS OF CONSENT 9
2.4 EPL 529 CONDITIONS 9
2.5 INDEPENDENT ENVIRONMENTAL AUDIT RECOMMENDATIONS 9
2.6 SURFACE WATER LICENCE CONDITIONS 10
2.7 ADDITIONAL REGULATOR REQUIREMENTS 11

3.0 EXISTING ENVIRONMENT AND BASELINE DATA 12

3.1 EXISTING ENVIRONMENT 12
3.2 WATER SUPPLY FOR SURFACE WATER USERS 15
3.3 SURFACE WATER MONITORING NETWORK 15
3.4 REVIEW OF BASELINE DATA 18
3.5 SITE WATER BALANCE 27

4.0 IMPACT ASSESSMENT AND PERFORMANCE CRITERIA 28

4.1 SURFACE WATER IMPACT ASSESSMENT CRITERIA 28
4.2 SURFACE WATER PERFORMANCE CRITERIA 30

5.0 SURFACE WATER MANAGEMENT MEASURES 32

5.1 SITE WATER MANAGEMENT SYSTEM 32
5.2 WATER SUPPLY AND WATER SHARING 35
5.3 PRESCRIBED DAMS AND TAILINGS 35
5.4 SEWAGE TREATMENT PLANT OPERATION AND MAINTENANCE 36
5.5 CHEMICAL AND HYDROCARBON STORAGE 36
5.6 EROSION AND SEDIMENT CONTROL 36
5.7 ANNUAL SITE WATER BALANCE AND SALT BALANCE 36
5.8 MANAGEMENT OF THE LOCOMOTIVE PROVISIONING FACILITY 36

5.9 DECOMMISSIONING OF WATER MANAGEMENT STRUCTURES 38
5.10 INSPECTIONS 38
5.11 AUDITING 38
6.0 SURFACE WATER MONITORING PROGRAM 39
6.2 SAMPLING METHODOLOGY 46
6.3 DATA MANAGEMENT PROCEDURES 47
6.4 DATA REVIEW AND INVESTIGATION 47
7.0 SURFACE WATER RESPONSE PLAN 48
7.1 ADAPTIVE MANAGEMENT 48
7.2 INCIDENT DEFINITION 48
7.3 IMPACTS ON SURFACE WATER 48
7.4 FAILURE TO COMPLY WITH OTHER STATUTORY REQUIREMENTS 55
8.0 COMMUNITY COMPLAINT RESPONSE 57
9.0 REVIEW AND REPORTING 58
9.1 REVIEW 58
9.2 REPORTING 58
10.0 RESPONSIBILITIES 60
11.0 REFERENCES 61
APPENDIX A: EVIDENCE OF CONSULTATION 62
APPENDIX B: SWMP SUMMARY OF COMMITMENTS 69
APPENDIX C: EPL CONDITIONS RELEVANT TO THIS SWMP 74
APPENDIX D: NORTH WAMBO CREEK DIVERSION MANAGEMENT PLAN 82

Tables

Table 1: DA305-7-2003 Requirements for this SWMP 6
Table 2: DA305-7-2003 Surface Water Management Performance Measures 8
Table 3: DA177-8-2004 Surface Water Management Performance Measures 9
Table 4: 2017 IEA Recommendations relevant to this SWMP 10
Table 5: Surface Water Licences for United and Wambo 10
Table 6: Additional Surface Water Monitoring Program Requirements 11
Table 7: Catchment Areas of Local Creeks* 15
Table 8: Surface Water Monitoring Locations 16
Table 9: Surface Water Quality Ranges – Local Watercourses 19
Table 10: Stream Flow Monitoring Data Summary 20
Table 11: Stream Flow Summary for Historical Monitoring Sites 23
Table 12: North Wambo Creek – Baseline Assessment Hydraulic Model Results* 25
Table 13: Discharge Limits and Requirements 28
Table 14: Surface Water Flow Impact Assessment Condition 29
Table 15: Surface Water Quality Impact Criteria 29
Table 16: Surface Water Performance Criteria 30
Table 17: Performance Indicators 31
Table 18: Diversion and Subsidence Monitoring Program – Operational Monitoring 43
Table 19: TARP for Impacts on Surface Water Flows 49
Table 20: TARP for Impacts on Surface Water Quality 50
Table 21: TARP for Breach of EPL 529 Limits 51
Table 22: TARP for Impacts on North Wambo Creek Alluvium 52
Table 23: TARP for North Wambo Creek Diversion Performance 54
Table 24: SWMP Responsibilities 60

Figures

Figure 1: Approved Wambo Coal Mine – Phase 2 2
Figure 2: Wambo Water Management Plan 3
Figure 3: Wollombi Brook Catchment Context 13
Figure 4: Project Area Catchment Context 14
Figure 5: Wambo Surface Water Monitoring Locations 17
Figure 6: Flow Duration Curves Wollombi Brook Upstream and Downstream of the Mine 22
Figure 7: Recorded Daily Rainfall and Flow/No Flow Days – North Wambo Creek at FM2 23
Figure 8: Recorded Daily Rainfall and Flow/No Flow Days – North Wambo Creek at FM4 23
Figure 9: Extents of North Wambo Creek 26
Figure 10: Water Management System (Jacobs, 2020) 34
Figure 11: Diversion and Subsidence Monitoring Locations 45

1.0 Introduction

1.1 Purpose and Objectives

This Surface Water Management Plan (SWMP) has been developed by Wambo Coal Pty Ltd (WCPL) to address the relevant requirements of WCPL's development consents DA305-7-2003 and DA177-8-2004, as relevant to Phase 2 mining operations at the Wambo Coal Mine (Wambo). This SWMP also addresses the relevant conditions of Environmental Protection Licence (EPL) 529.

The key objectives of surface water management at Wambo are to:

- satisfy regulatory requirements, including meeting required performance criteria;
- ensure there are negligible impacts to adjacent surface water users (both consumptive users and the environment);
- reuse mine impacted water within the WMS to reduce reliance on raw/clean water; and
- minimise adverse effects on downstream waterways (including hydraulic and water quality impacts).

This SWMP has also been prepared in accordance with Condition D5 of DA305-7-2003 (Management Plan Requirements).

1.2 Scope

This SWMP applies to all Phase 2 operational activities at the Wambo Coal Mine, including underground mining operations, CHPP and train loading operations (**Figure 1**). It does not apply to open cut mining operations associated with the United Wambo Open Cut Project.

This SWMP applies to all employees and contractors working for, or on behalf of WCPL within the project approval boundary (**Figure 1**).

This SWMP covers all surface water management activities undertaken within Wambo's mining authorisations and approved mining areas. This SWMP has been prepared to manage surface water impacts from Wambo on local surface water systems.

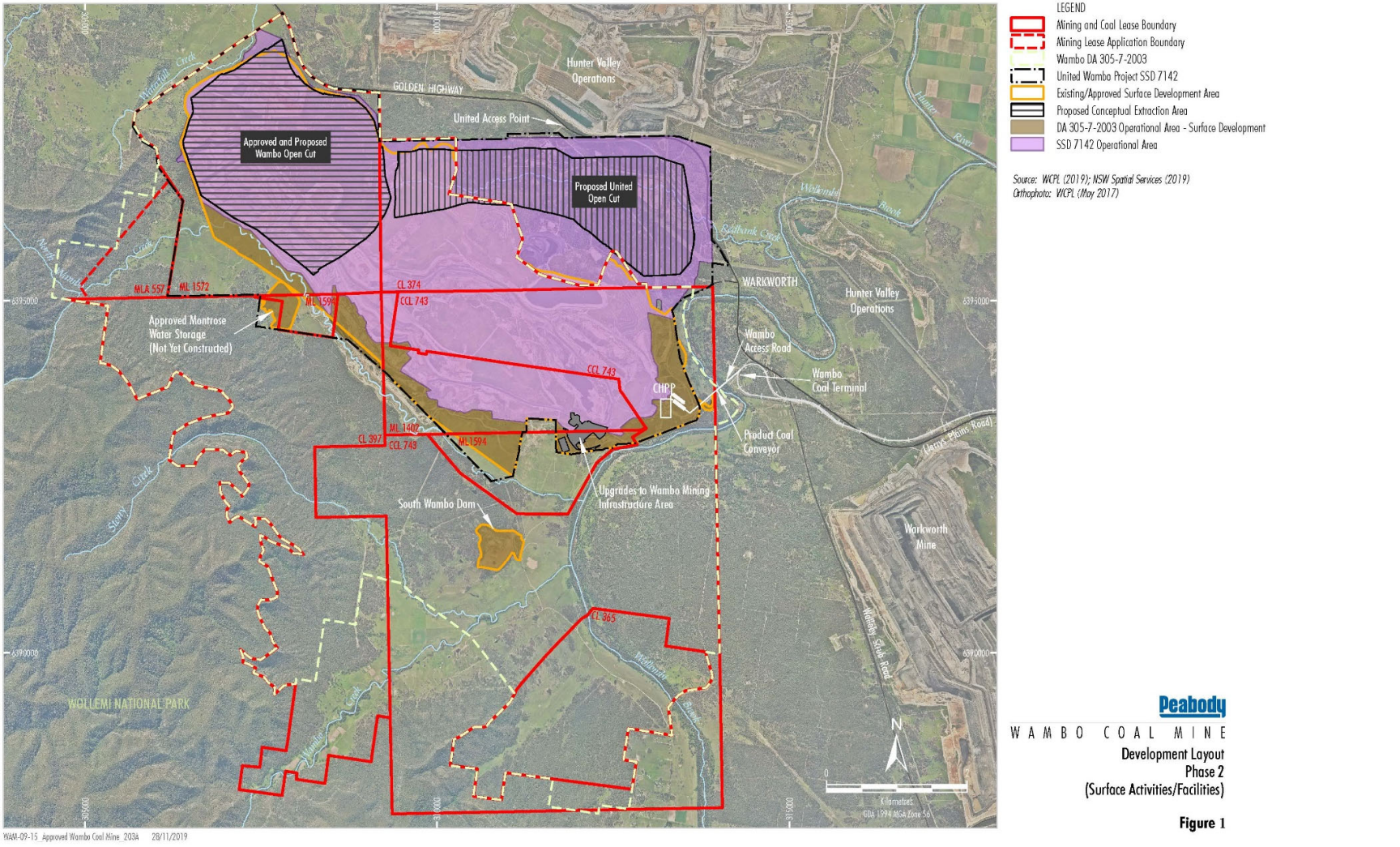


Figure 1: Approved Wambo Coal Mine – Phase 2

1.3 Relationship to other Management Plans

This SWMP is part of a set of documents that together form the WCPL Water Management Plan (WMP) for the Wambo Coal Mine (**Figure 2**). The WMP is one of a series of Environmental Management Plans that together forms part of the WCPL Environmental Management System.

As part of Phase 2 operations, WCPL has combined the surface and ground water monitoring programs at Wambo with the United Wambo Open Cut surface and ground water monitoring programs. This combined monitoring program is now contained within the new ***United Wambo Open Cut and Wambo Water Monitoring Program (WMProg)*** (WA-ENV-MNP-509.8). A brief description of WCPL's surface water monitoring program is included in **Section 6.0** of this SWMP however the monitoring program itself is now included in the ***WMProg.***

As part of the United Wambo Open Cut Project Environmental Assessment (Umwelt 2016), WCPL's site water balance (and salt balance) was expanded to include the United Wambo Open Cut project. The ***United Wambo Open Cut and Wambo Site Water Balance*** (***SWB***) (WA-ENV-MNP-509.4) is now a shared document, managed by WCPL. The ***SWB*** also contains the salt balance will be updated annually using monitoring data from the ***WMProg.***

This SWMP should be read in conjunction with the other components of the Water Management Plan, particularly the overarching Wambo ***Water Management Plan*** (WA-ENV-MNP-509), ***WMProg*** (WA-ENV-MNP-509.8) and the Wambo ***Environmental Management Strategy*** (***EMS***) (WA-ENV-MNP-501).

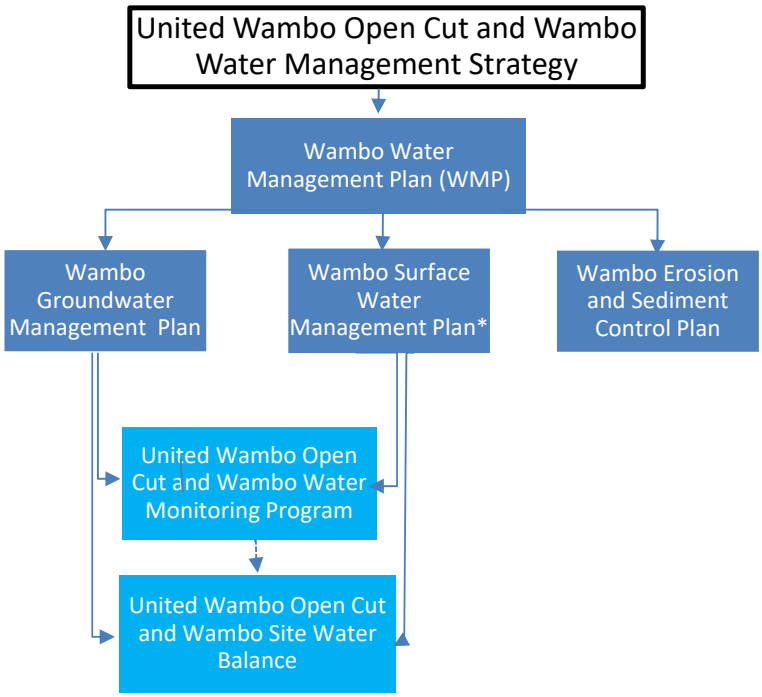


Figure 2: Wambo Water Management Plan

Notes to **Figure 2**:

Shared Document with United Wambo Open Cut Operations (refer Table 2 **of *WMP***)

Wambo Document (refer Table 2 **of *WMP***)

* SWMP incorporates the ***North Wambo Creek Diversion Management Plan*** (***NWCD MP***) – refer **Section 1.3.1**

1.3.1 Obsolete Plans

Prior to Modification 16 of DA305-7-2003, WCPL was required to prepare a ***Surface and Groundwater Response Plan*** (***SGWRP***) for the Wambo Coal Mine, and a ***North Wambo Creek Diversion Management Plan*** (***NWCD MP***) for management of the North Wambo Creek Diversion.

The ***SGWRP*** detailed WCPL's response to observed impacts on surface and ground water as a result of WCPL's operations. Following approval of Modification 16, the Surface Water Response Plan has now been incorporated into this SWMP (refer **Section 7.0**). The Groundwater Response Plan has been incorporated into the ***GWMP***.

The ***NWCD MP*** is no longer required by consent (DA305-7-2003, Modification 16) however, due to the complexities associated with the diversion and also the history of consultation on this plan, WCPL has retained the ***NWCD MP*** as a standalone plan at this stage (refer **Appendix D**). The status of this plan will be reviewed during future SWMP updates.

1.4 Preparation of the SWMP

In recognition of the requirements of Condition B66(a) of DA305-7-2003, this SWMP prepared by WCPL has been reviewed by a suitably experienced and qualified persons. Mr Chris Bonomini from Umwelt was endorsed 2 September 2020. Mr Rohan Lucas from Alluvium Consulting also remains endorsed, and will assist with rehabilitation and remediation works in the North Wambo Creek Diversion (refer **Section 1.5.2** regarding NSW Department of Planning, Industry and Environment (DPIE)).

1.5 Stakeholder Consultation

1.5.1 History of Consultation

There is a long history of consultation with various stakeholders regarding WCPL's Water Management Plan. Over the years WCPL has undertaken extensive consultation with government agencies, the Wambo Community Consultative Committee (CCC) and affected landholders in relation to management plan updates, including for various extraction plans.

Prior to the approval of DA305-7-2003 Modification 16 (in August 2019), this consultation was undertaken for WCPL's Surface Water Monitoring Program. The last update to the WCPL Surface Water Monitoring Program (version 12) was undertaken in consultation with DPIE, as part of the Extraction Plan for South Bates Underground Extension LW17-20. This update addressed comments from the DPIE and Independent Expert Scientific Committee (IESC) and built on consultation undertaken on previous versions of the document.

A summary of historic consultation, including how comments from DPIE Water, the IESC and DPIE have been addressed in previous versions of the SWMP, is provided in **Appendix A.**

1.5.2 Consultation for this SWMP

On 11 February 2020 WCPL sought approval from DPIE for the appointment of Mr Rohan Lucas as the suitably qualified surface water expert for the preparation of the South Bates Underground Extension (SBUE) Extraction Plan for Longwalls 21-24. Mr Lucas was approved by DPIE on 28 February 2020 (refer to correspondence in **Appendix A**). On 29 May 2020, DPIE confirmed that Mr Lucas was suitably qualified to assist in the preparation of the management plans.

On 3 August 2020 WCPL wrote to DPIE and requested endorsement for Mr Bonomini, to assist in the preparation of the other water management plans required under the Consent. Mr Bonomini was endorsed 2 September 2020.

As required by Condition B66 (b) of DA305-7-2003, WCPL must prepare this SWMP in consultation with DPIE Water and the EPA, to the satisfaction of the Planning Secretary. This SWMP (including all appendices was provided to DPIE Water and EPA for review and comment 26 August 2020. The EPA provided correspondence dated 4 September 2020 advising that it is not the role of the EPA to review management plans. No comments were received from DPIE Water/NRAR.

Version 2 of the SWMP was approved by DPIE 20 November 2020. Correspondence in relation to the SWMP is attached as **Appendix A**.

1.6 Statement of Commitments

A Summary of Commitments for this SWMP is included in **Appendix B**.

2.0 Statutory Requirements

This SWMP has been prepared to fulfil all statutory requirements relating to surface water management at the Wambo Coal Mine, including:

- Relevant legislation, policies, guidelines and standards;
- DA305-7-2003 and DA177-8-2004 Conditions of Consent (CoC);
- Environment Protection Licence (EPL 529) conditions;
- Recommendations from the 2017 Independent Environmental Audit (Hansen Bailey, 2018);
- Surface Water Access Licence conditions; and
- Requirements from regulators on additional monitoring requirements for the North Wambo Creek Diversion (NWCD).

There are no commitments in the *United Wambo Open Cut Project Environmental Impact Assessment* (Umwelt, 2016) relevant to this SWMP, however there are commitments relating to surface water management and monitoring for the United Wambo Open Cut project that are addressed as part of the shared ***WMProg*** and ***SWB***. Further information on these commitments and how they have been addressed is contained in the United Wambo Surface Water Management Plan.

2.1 Legislation, Policies, Guidelines and Standards

The legislation relevant to this SWMP is described in Section 2.1 of the ***WMP.***

The policies, guidelines and standards relevant to this SWMP are described in Section 2.2 of the ***WMP.***

2.2 DA305-7-2003 Conditions of Consent

WCPL received development consent (DA305-7-2003) in accordance with the *Environmental Planning & Assessment Act 1979* (EP&A Act) from DPIE, formerly NSW Department of Planning and Environment (DP&E), on 4 February 2004. The most recent modification to DA305-7-2003 was granted by the Independent Planning Commission of NSW on 29 August 2019 (Modification 16).

DA305-7-2003 requirements related to the development of this SWMP are summarised in **Table 1.** Surface water management performance measures relevant to this SWMP, as specified in Condition B62 of DA305-7-2003, are listed in **Table 2.**

Table 1: DA305-7-2003 Requirements for this SWMP

Condition	Condition Details	SWMP Section
B66	(iv) Surface Water Management Plan, that includes:	**Entire document**
	(iv) detailed baseline data of surface water flows and quality of watercourses and/or waterbodies potentially impacted by the development, including: ○ stream and riparian vegetation health; ○ channel stability (geomorphology); and ○ water supply for other surface water users;	**Section 3.0**
	(v) a detailed description of the surface water management system;	**Section 5.1**

Condition	Condition Details	SWMP Section
	(vi) detailed plans, design objectives and performance criteria for water infrastructure including: ○ any approved creek diversions or restoration works associated with the development; ○ water run-off diversions and catch drains; ○ water storages and sediment dams; ○ emplacement areas and tailings storages; and ○ reinstated drainage networks on rehabilitated areas of the site;	**Section 5.1.1 (see also Appendix D for NWCD MP)**
	(vii) detailed performance criteria, including triggers for identifying and investigating any potentially adverse impacts associated with the development, on: ○ downstream surface water flows and quality (including Wollombi Brook, North Wambo, South Wambo, and Stony Creeks); ○ channel stability; ○ stream and riparian vegetation heath; ○ water supply for other water users; and ○ post-mining water pollution from rehabilitated areas of the site;	**Section 4.0**
	• a program to monitor: ○ compliance with the relevant performance measures listed in Table 8 and the performance criteria established above; ○ controlled and uncontrolled discharges and seepage/leachate from the site; ○ impacts on water supply for other water users; ○ surface water inflows, outflows and storage volumes to inform the Site Water Balance; and ○ the effectiveness of the surface water management system and the measures within the Erosion and Sediment Control Plan;	**Section 6.0 (see also WMProg)**
	• reporting procedures for the results of the monitoring program;	**Section 9.2**
	• a plan to respond to any exceedances of the surface water performance criteria, and repair, mitigate, compensate and/or offset any adverse surface water impacts of the development; and	**Section 7.0**
D5	**Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include where relevant:	**Section 2.1**
	(a) summary of relevant background or baseline data;	**Section 3.0**
	(b) details of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Section 2.0**
	• any relevant limits or performance measures and criteria;	**Table 2, Table 3 and Section 4.0**
	• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	**Section 4.0**
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 2.0**
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Sections 5.0 and 6.0**
	(e) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures set out pursuant to paragraph (d);	**Monitoring – Section 6.0 Reporting - Section 9.0**

Condition	Condition Details	SWMP Section
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 7.0**
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 9.2.1**
	(h) a protocol for managing and reporting any: • incident, non-compliance or exceedance of any impact assessment criterion and performance criterion;	**Managing – Section 7.0** **Reporting – Section 9.2.4**
	• complaint; or	**Section 8.0**
	• failure to comply with other statutory requirements; and	**Section 7.4**
	(i) a protocol for periodic review of the plan.	**Section 9.1**

Table 2: DA305-7-2003 Surface Water Management Performance Measures

Feature	Performance Measure[1,2]	SWMP Section
Water management – general	• Maintain separation between clean, dirty and mine water • Minimise the use of clean and potable water • Maximise water recycling, reuse and sharing opportunities • Minimise the use of make-up water from external sources • Design, install, operate and maintain water management infrastructure in a proper and efficient manner	**Section 5.1 (See also WMP, GWMP & ESCP**
Clean water diversions and storage infrastructure	• Design, install and maintain the clean water system to capture and convey the 100 year ARI flood event • Maximise, as far as reasonable, the diversion of clean water around disturbed areas on the site, except where clean water is captured for use on the site	**Section 5.1 (see also ESCP)**
Above-ground mine water storages	• Design, install and maintain mine water storage infrastructure to avoid unlicensed or uncontrolled discharge of mine water	**Section 5.1.1**
Prescribed dams under the Dams Safety Act 1978 or Dams Safety Act 2015 (including South Wambo Dam)	• Design, constructed and operated to the satisfaction of NSW Dams Safety Committee (DSC) • Drained prior to the commencement of secondary workings in underlying longwalls, to the satisfaction of DSC 2000) and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006)	**Section 5.3**

Notes to **Table 2**:

1. The performance measures in **Table 2** do not apply to water management structures constructed prior to the approval of Modification 16 (to DA305-7-2003).
2. Performance measures relating to erosion and sediment controls are addressed in the ***ESCP.***

Other DA305-7-2003 conditions relating to general water management are addressed in the ***WMP.***

2.3 DA177-8-2004 Conditions of Consent

WCPL received Development Consent (DA177-8-2004) in accordance with the EP&A Act from the NSW DPIE on 16 December 2004. The most recent modification to DA177-8-2004 was granted by the Independent Planning Commission of NSW on 29 August 2019 (Mod 3).

Surface water management performance measures, as specified in Condition B9 of DA177-8-2004, are listed in **Table 3.**

Table 3: DA177-8-2004 Surface Water Management Performance Measures

Feature	Performance Measure[1, 2]	SWMP Section
Water management – general	• Maintain separation between clean, dirty and mine water • Minimise the use of clean and potable water • Maximise water recycling, reuse and sharing opportunities • Minimise the use of make-up water from external sources • Design, install, operate and maintain water management infrastructure in a proper and efficient manner	**Section 5.1 (See also WMP, GWMP & ESCP**
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standard	**Sections 5.5 and 5.8.1**
Above-ground storage tanks containing materials likely to cause environmental harm	• Imperviously bunded with a capacity of 110% that of the largest container stored within the bund • Designed and constructed in a manner which prevents the ingress of rain water into the tanks • Clearly labelled to identify contents	**Sections 5.5 and 5.8.1**

Notes to **Table 3**:

1. The performance measures in **Table 3** do not apply to water management structures constructed prior to the approval of Modification 3 (to DA177-8-2004).
2. Performance measures relating to erosion and sediment controls are addressed in the ***ESCP.***

Other DA177-8-2004 conditions relating to general water management are addressed in the ***WMP.***

2.4 EPL 529 Conditions

The EPA issued EPL 529 on 27 September 2000 under the *Protection of the Environment Operations Act 1997 (*POEO Act). The EPL permits activities that may impact on surface and ground water to occur across the site, subject to the EPL conditions (**Appendix C**). With the exception of these conditions, WCPL must comply with section 120 of the POEO Act.

In consultation with the EPA, the EPL will be modified (as required) to reflect any relevant modified development consent conditions.

Under EPL 529 and the Hunter River Salinity Trading Scheme (HRSTS), WCPL are required to monitor discharges from a designated licenced discharge point. **Section 4.1** provides further information on discharge requirements under the HRSTS.

2.5 Independent Environmental Audit Recommendations

In 2017 Hansen Bailey conducted an Independent Environmental Audit of the Mine, in accordance with the requirements of Condition D11 of DA305-7-2003 and DA177-8-2004

(Hansen Bailey, 2018). Recommendations from the audit report relating to this SWMP, and where they are addressed, are contained in **Table 4.**

Table 4: 2017 IEA Recommendations relevant to this SWMP

Recommendation	SWMP Section
It is recommended that WCPL also collect water quality data from sediment dams in order to characterise the quality of runoff from non-coal affected catchments.	**Section 6.1.4**
Consideration should be made to directly monitor the quality of groundwater seepage reporting to the underground and open-cut workings.	**Section 6.1.10**
It is suggested that the salt balance be updated annually to include the seepage quality monitoring data.	**Sections 6.1.10 and 5.7**
WCPL should determine the frequency of monitoring to apply for the salt balance model.	**Section 6.1.10**
Section 2.2.16 of the Site Water Management Plan outlines rehabilitation objectives for decommissioning water management structures on site. It is recommended that this section is improved by providing a high level strategy for the decommissioning of water management structures (including the management of water during the decommissioning process) as part of any future update of the Site Water Management Plan.	**Section 5.9**
It is recommended that the Site Water Management Plan is updated to include the predicted salt balance.	**Section 3.5**

2.6 Surface Water Licence Conditions

Both United and Wambo hold Water Access Licences (WALs) under the Water Sharing Plan for the Hunter Regulated River (2004) and the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (2009) for extraction of water from the Wollombi Brook and Hunter River. **Table 5** presents the WALs held by United and Wambo.

Groundwater entitlements are outlined in the ***GWMP***.

Table 5: Surface Water Licences for United and Wambo

Licence No	Water Source	Category	Holder	Share Component	Tenure Type
WAL718	Hunter Regulated River Water Source	Regulated River (High Security)	Wambo	1000 units	Continuing
WAL8599	Hunter Regulated River Water Source	Regulated River (High Security)	Wambo	6 units	Continuing
WAL8600	Hunter Regulated River Water Source	Regulated River (General Security)	Wambo	868 units	Continuing
WAL8604	Hunter Regulated River Water Source	Supplementary Water	Wambo	240 units	Continuing
WAL10541	Hunter Regulated River Water Source	Regulated River (High Security)	United	300 units	Continuing
WAL1369	Hunter Regulated River Water Source	Regulated River (Supplementary)	Wambo and United	15 units	Continuing
WAL15459	Hunter Regulated River Water Source	Regulated River General Security)	Wambo and United	21 units	Continuing

Licence No	Water Source	Category	Holder	Share Component	Tenure Type
WAL18445	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	United	200 units	Continuing
WAL18549	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	United	100 units	Continuing
WAL18437	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Unregulated River	Wambo	350 units	Continuing
WAL 23897	Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)	Aquifer	Wambo	70 units	Continuing

WCPL will report performance against relevant surface water licence conditions in the Annual Review (refer **Section 9.2.1**).

2.7 Additional Regulator Requirements

In April 2008, the North Wambo Creek Diversion Plan was approved subject to the additional requirements shown in **Table 6.** These requirements have been addressed in this SWMP.

Table 6: Additional Surface Water Monitoring Program Requirements

Regulator	Requirement	SWMP Section
DPIE	1. The SWMP must be updated to include at least two additional surface monitoring sites within the area of the North Wambo Creek Diversion footprint to replace those to be discontinued in the old North Wambo Creek footprint i.e. SW27 & SW32 have been replaced by SW41, SW47 and SW48. 2. The company must comply with the requirements of the Department of Water and Energy (DWE) and the Department of Primary Industries (DPI) as outlined in the attached letters to the company ….	**Section 6.0 and WMProg** **See below**
DPI-Water (formerly NSW Office of Water (NOW)/ Department of Water and Energy (DWE))	DWE grants approval to the detailed design plans for the constructed diversion channel, subject to the following; Monitoring of discharge flows, and calculation of bankfull discharge capacities and velocities along the channel shall occur at the first discharge event along the diversion channel, and then thereafter as directed by the DWE; Comparative performance with agreed reaches upstream and downstream of the diversion shall occur, together with agreed stable reaches of control catchments, as approved by DWE; Reporting on performance of the diversion channel shall occur annually (in AEMR).	**Section 6.1.7** **Section 6.1.7** **Section 9.2.1**

3.0 Existing Environment and Baseline Data

3.1 Existing Environment

The existing environment is described in detail in the EIS (Umwelt 2016) and summarised (with respect to water) in Section 3.1 of the ***WMP***. This includes information on:

- Rainfall;
- Geological setting; and
- Topography and vegetation.

3.1.1 Surface Water Context

The mine site is within the lower Wollombi Brook catchment near its confluence with the Hunter River. Wollombi Brook drains an area of approximately 1,950 km^2 (Gilbert and Associates, 2003) and joins the Hunter River some 5 km north- east of Wambo (**Figure 3**).

Surface runoff from the majority of land within the WCPL's project area drains to Wollombi Brook via a series of generally easterly flowing creeks including South and North Wambo Creek, Stony Creek, Waterfall Creek and Redbank Creek. South Wambo Creek and its main tributary Stony Creek rise in the Wollemi National Park escarpment south of the mine and drain the southern and south-western parts of the mining lease area. Waterfall Creek drains the north end of the mining lease area. Relatively smaller parts of the northern side of the site drain to Redbank Creek in the United Collieries lease area (**Figure 4**).

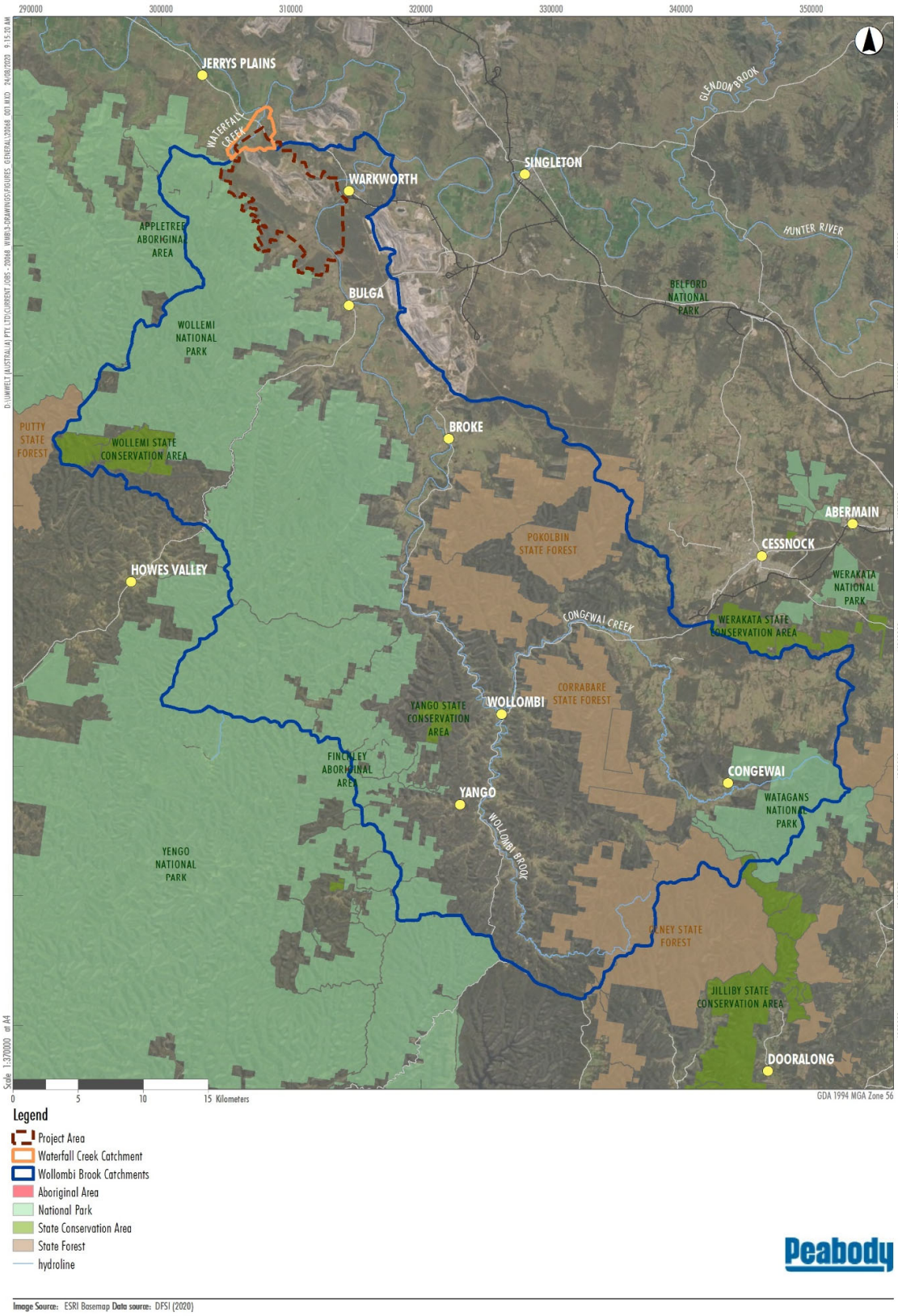


Figure 3: Wollombi Brook Catchment Context

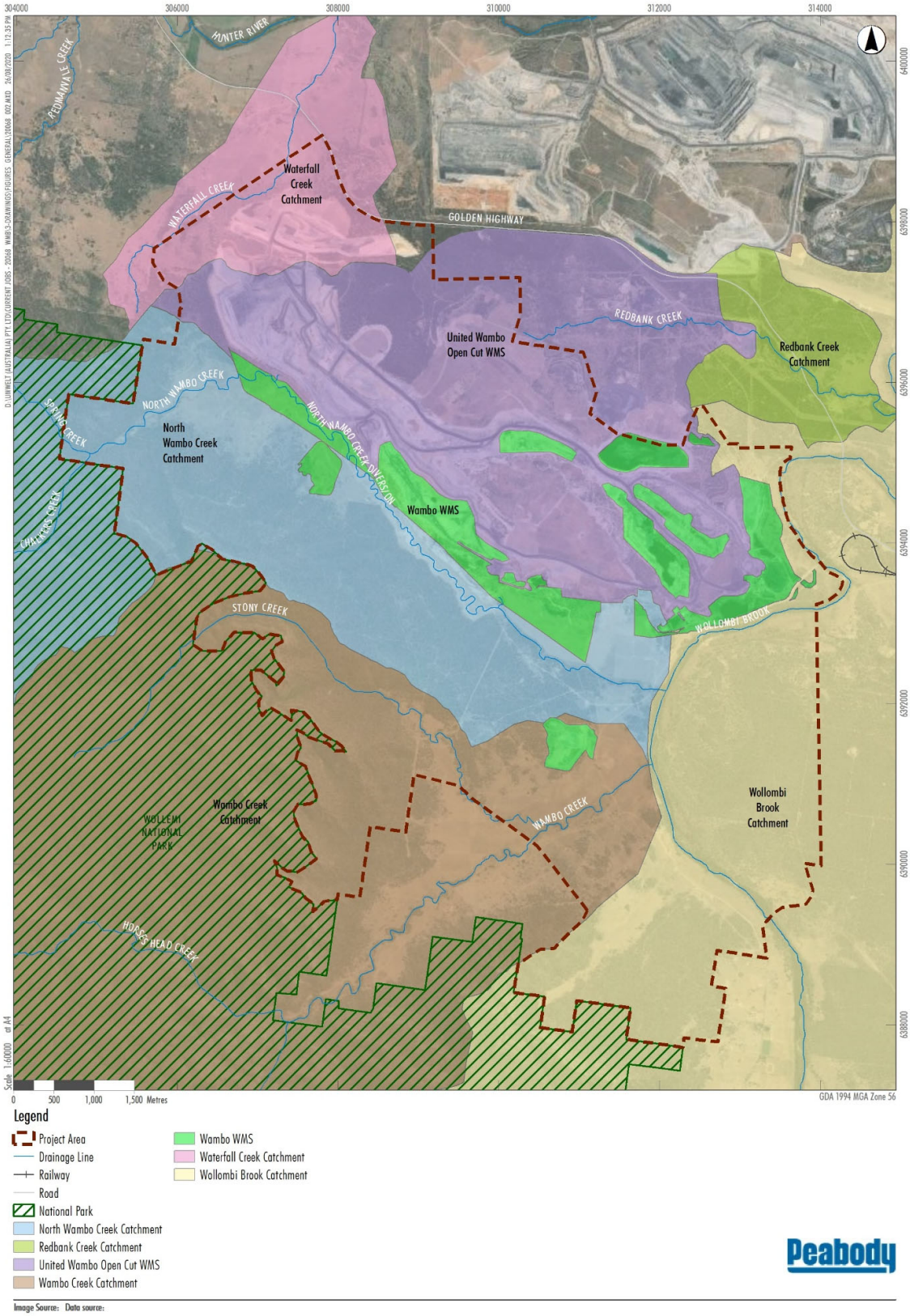


Figure 4: Project Area Catchment Context

North Wambo Creek, which also has its headwaters in the Wollemi escarpment, drains the central parts of the mining lease. A section of North Wambo Creek has been diverted to avoid the Wambo open cut (**Figure 4**). The North Wambo Creek Diversion was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007b).

The rail line also crosses numerous small ephemeral creek systems including Longford Creek and Doctors Creek, which discharge into the Hunter River.

Table 7 provides the catchment areas of the creeks within WCPL's Mining Lease Boundaries and in the vicinity of the WCPL rail line and Wambo rail loop.

Table 7: Catchment Areas of Local Creeks*

Creek	Catchment Area (km^2)
North Wambo Creek	48.5
South Wambo Creek	43.2
Stony Creek	11.2
Redbank Creek	12.3
Waterfall Creek	5.5
Longford Creek	0.89[1]
Doctors Creek	1.58[1]

* Source: Gilbert and Associates (2003) and Mackie Environmental Research (MER) (2002).

Note to **Table 7**:
1. Mining operations from the Warkworth Mine will reduce the catchment size of these systems. The figure provided is the estimated catchment size.

3.2 Water Supply for Surface Water Users

Surface and alluvial water take within the unregulated watercourses surrounding the Project Area (i.e. Wollombi Brook catchment and Waterfall Creek catchment) is regulated under the Water Management Act 2000 (WM Act). Water take from the Hunter River is also regulated under the WM Act.

Water is extracted from both Wollombi Brook and the Hunter River by United and Wambo. Extraction of water from the Hunter River is managed under the Water Sharing Plan (WSP) for the Hunter Regulated River Water Source (2004).

There are no known licensed non-mining water users on waterways directly downstream of the Project Area along Wollombi Brook, its tributaries (Wambo Creek, North Wambo Creek and Redbank Creek) or Waterfall Creek. There are licensed water users downstream of the Project Area on the Hunter River which is a regulated river with extraction managed by WaterNSW and the Natural Resource Access Regulator (NRAR). Water is also extracted downstream of the Project Area from the Hunter River for stock and domestic purposes. All extractions from the downstream watercourses are managed under the *Water Management Act 2000*, the Water Management (General) Regulation and relevant WSPs.

3.3 Surface Water Monitoring Network

Surface water monitoring data has been collected at Wambo since 2003. Monitoring locations have been established along a number of watercourses to monitor both water quality and flow. The sites are comprised Wambo only, combined Wambo and United Wambo monitoring sites and Wambo United Open Cut sites. Monitoring locations are summarised in **Table 8**. Monitoring of mine water storages has also been undertaken for management purposes. Monitoring locations are shown on **Figure 5**. The surface water monitoring program is also summarised in the ***WMProg***.

Table 8: Surface Water Monitoring Locations

Site ID	Easting	Northing	Site Description
Wambo and United Wambo Combined Monitoring sites - Surface Water Quality			
SW40	311910	6391093	Wollombi Brook - Upstream
SW03	312509	6392866	Wollombi Brook - Pumps
SW02	314376	6395037	Wollombi Brook - Warkworth
SW04	306887	6396024	North Wambo Creek - Upstream
SW32a	309905	6393191	North Wambo Creek - Midstream
SW05	311927	6392157	North Wambo Creek - Downstream
SW39	307194	6398519	Waterfall Creek
SW52	312677	6395220	C11 Void
SW31	313276	6393987	CHPP Dams
SW14	312179	6392939	Wambo MIA Box Cut Dam
SW38	311750	6394190	Homestead Pit
Wambo only Monitoring sites - Surface Water Quality			
SW01	314429	6385707	Wollombi Brook, upstream of Wambo Coal Operations
SW06	309056	6389550	South Wambo Creek upstream of Wambo Coal former operations
SW07	311263	6390718	South Wambo Creek downstream of Wambo Coal former operations and junction with Stony Creek
SW08	308536	6392133	Stony Creek
SW15	313133	6393073	Eagles Nest (Process Water Dam) (EPA ID No. 4)
SW27a	309431	6393558	North Wambo Creek (middle of diversion)
SW41	307257	6398952	Waterfall Creek Downstream
USFM1	305250	6395200	Upper reaches of North Wambo Creek
SW53[1]	311904	6391464.	South Wambo Dam – (EPL 529, ID No.19)
STP001	312057	6393219	Monitoring of water quality from the sewage treatment plant discharge (EPL 529, ID No. 18)
Stream Flow and Volume			
FM1A	307013	6396135	North Wambo Creek – confluence (relocated December 2017)
FM2	308181	6395028	North Wambo Creek – middle of diversion
FM3	309114	6393813	North Wambo Creek – Middle-Lower
FM4	311890	6392288	North Wambo Creek - downstream near confluence of Wollombi Brook
FM9	308666	6389176	South Wambo Creek - upstream of confluence of Stony Creek (relocated September 2018)
FM10[2]	314228	6395064	Wollombi Brook - downstream from Wambo Coal at Warkworth
FM11[2]	314360	6385900	Wollombi Brook - upstream from Wambo Coal at the Bulga Village
FM12	307607	6392828	Stony Creek Upstream (installed December 2015, relocated September 2018 approximately 50m downstream of original location)
FM13	309530	6391043	Stony Creek Downstream (installed December 2015, relocated September 2018 approximately 50m downstream of original location)
FM14	307730	6392246	Stony Creek Tributary (installed December 2015)
FM15	311680	6391089	South Wambo Creek (installed December 2016)
FM16	311259	6390666	South Wambo Creek (installed December 2016)
US FM1	305261	6395212	North Wambo Creek – upstream (installed December 2017)
SW15	313133	6393073	Eagles Nest Process Water Dam (EPA ID No. 4)
SW53[1]	311904	6391464.	South Wambo Dam – (EPL 529, ID No.19)

Notes to **Table 8**:

1. Subject to recommissioning of South Wambo Dam, proposed 2021
2. Data sourced from DPIE Water Gauging Stations on Wollombi Brook at Bulga [GS21004] and Warkworth [GS210028]

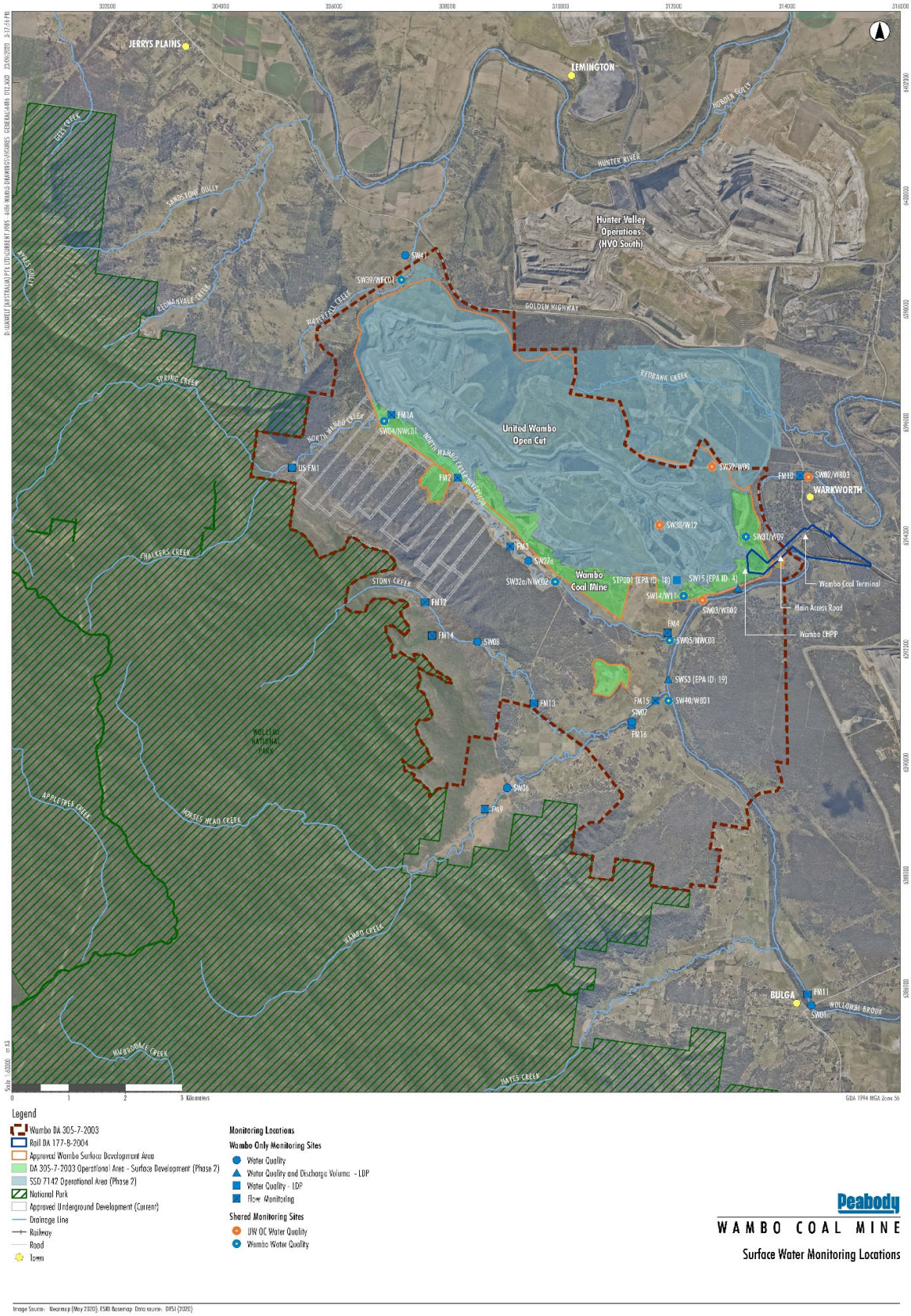


Figure 5: Wambo Surface Water Monitoring Locations

3.3.1 Historical Flow Monitoring Locations

From January 2004 until June 2007 WCPL monitored stream flow at four locations on South Wambo Creek (sites V1 and V2) and Stony Creeks (sites V7 and V8). Automatic data loggers recorded flow at hourly intervals. No flows were observed at sites V1, V2 and V7 between January 2004 and June 2007. The single flow record for site V8 is provided in **Section 3.4.2** (**Table 11**).

Three V-notch weirs, established by United Collieries (United), have recorded flow along North Wambo Creek since mid-2002. A summary of flow records from United weir sites 1 and 2, for the period June 2002 to October 2003, is provided in **Section 3.4.2** (**Table 11**).

Flow monitoring at Weir 3 has generally shown North Wambo Creek to be dry, except following significant rainfall. The highest flow recorded at Weir 3 was 0.1 L/sec in late May 2002 (Geoterra, 2005).

3.4 Review of Baseline Data

3.4.1 Surface Water Quality

A summary of surface water quality monitoring results for July 2003 to December 2019 is presented in **Table 9**.

Table 9: Surface Water Quality Ranges – Local Watercourses

Sites	Sampling Period	pH			EC (uS/cm)			TDS (mg/L)			TSS (mg/L)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
SW01 - Wollombi Brook Up	Jul 03 – Jul 20	6.5	8.8	7.6	160	1969	747	60	1157	406	1	128	10
SW02 - Wollombi Brook Down	Jul 03 – Jul 20	6.3	9.0	7.6	148	5,290	1179	25	3,238	684	1	308	15
SW03 - Wollombi Brook Pump Out	Jul 03 – Jul 20	6.3	9.1	7.6	106	6280	1319	3	2,924	681	1	1,630	43
SW04 - North Wambo Creek Up	Jul 03 – Jul 20	6.8	8.7	7.7	256	563	351	157	2,712	855	5	154	41
SW05 - North Wambo Creek Down	Jul 03 – Jul 20	6.6	9.5	7.7	111	4,770	1,828	135	2,162	996	1	1110	41
SW06 - South Wambo Creek	Jul 03 – Jul 20	6.3	9.1	7.3	119	970	500	28	440	264	1	286	20
SW07 - South Wambo/Stony Creeks	Jul 03 – Jul 20	6.4	9.1	7.5	159	1118	594	145	720	334	1	331	25
SW08 - Stony Creek	Jul 03 – Jul 20	6.2	8.4	7.1	186	479	344	58	276	186	1	61	6
SW15 – Eagles Nest Dam	Jan 18 – Dec 19	7.6	9.3	8.9	2,750	9,210	6,768	ND	ND	ND	20	5,800	336
SW27a - North Wambo Creek Middle Lower	Jul 03 – Jul 20	7.0	9.0	7.9	52	3,360	890	48	4,900	957	1	5440	472
SW32a - North Wambo Creek Pump	Jul 03 – Jul 20	7.2	9.20	8.0	199	6,970	794	153	4,400	779	1	4,190	451
SW39 - Waterfall Creek	Jul 03 – Jul 20	6.6	9.3	7.6	92	1,268	337	82	2,220	514	8	2,600	391
SW40 - Wollombi Brook Upstream of South Wambo Creek	Jul 03 – Jul 20	6.4	8.8	7.6	36	2940	718	18	1090	354	1	179	17
USFM1 - North Wambo Creek upstream Flow Station 1	Jun 19 –Jul 20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes to **Table 9**

* ND – no data available

3.4.2 Stream Flow

WCPL operate eleven continuous flow gauging stations, which are located along North Wambo Creek (five stations), Stony Creek (two stations) and South Wambo Creek (three stations plus another station located on a major tributary). The ephemeral nature of these creeks has resulted in extended no-flow periods. These gauging stations replaced the previous V-notch weir flow measurement points, which were destroyed during the June 2007 flood event.

Additionally, surface water flow monitoring data for Wollombi Brook is sourced from DPIE Water operated flow gauging stations, located at Warkworth (FM10) and Bulga (FM11). A summary of the stream flow data is provided in **Table 10**.

Table 10: Stream Flow Monitoring Data Summary

Site	Location	Period of Record	Flow Days*	Max (M/L Day)	Mean per Flow Day (ML/Day)	% Results with no Data Available
US FM1	North Wambo Creek (Upper)	Dec 2017 – 31/01/2018	No flow events were recorded since installation in December 2017			
		1/02/2018 to 31/12/2019	0	NA	NA	NA
FM1A (old FM1)	North Wambo Creek	21/10/2008 to 1/12/2009	31	264.81	0.77	NA
		2/12/2009 to 30/06/2012	No flow data available			
		1/07/2012 to 30/06/2013	NA	1.296	0.086	16.7%
		1/07/2013 to 31/01/2014	NA	NA	NA	85.7%
		1/02/2014 to 19/08/2014	No flow data available			
		1/02/2015 to 31/01/2016	38	210	21.8	Negligible
		1/02/2016 to 31/01/2017	0	0	0	Negligible
		1/02/2017 to 31/01/2018	0	NA	NA	NA
		1/02/2018 to 31/12/2019	0	NA	NA	NA
FM2	Mid way along the old North Wambo Creek Diversion	12/04/2009 to 1/12/2009	6.5	0.05	NA	NA
		2/12/2009 to 30/06/2012	No flow data available			
		1/07/2012 to 30/06/2013	9	0.39	<0.09	66.7%
		1/07/2013 to 31/01/2014	NA	18.1	0.69	0.0%
		1/02/2014 to 19/08/2014	42	22.59	1.57	Negligible
		1/02/2015 to 31/01/2016	128	160	7.3	Negligible
		1/02/2016 to 31/01/2017	82	12	1.4	Negligible
		1/02/2017 to 31/01/2018	6	20.6	1.53	Negligible
		1/02/2018 to 31/01/2019	8	2.46	1.12	NA
		1/02/2019 to 31/12/2019	3	11.3	4.76	NA

Site	Location	Period of Record	Flow Days*	Max (M/L Day)	Mean per Flow Day (ML/Day)	% Results with no Data Available
FM3	Midway along the new diversion of North Wambo Creek	1/02/2015 to 31/01/2016	29	140	5.2	Negligible
		1/02/2016 to 31/01/2017	5	3.7	0.3	Negligible
		1/02/2017 to 31/01/2018	6	52.3	2.6	Negligible
		1/02/2018 to 31/01/2019	11	6.77	2.75	NA
		1/02/2019 to 31/12/2019	5	8.07	3.09	NA
FM4	North Wambo Creek (Upstream of the confluence of North Wambo Creek and Wollombi Brook)	21/10/2008 to 1/12/2009	391	237.14	1.36	NA
		2/12/2009 to 30/06/2012	No flow data available			
		1/07/2012 to 30/06/2013	21	200.8	86.8	58.3%
		1/07/2013 to 31/01/2014	0	0	0	14.3%
		1/02/2014 to 19/08/2014	6	291.28	59.07	Negligible
		1/02/2015 to 31/01/2016	16	14,300[#]	1,817.2[#]	Negligible
		1/02/2016 to 31/01/2017	0	0	0	Negligible
		1/02/2017 to 31/01/2018	2	56	18.65	Negligible
		1/02/2018 to 31/12/2019	0	NA	NA	NA
Brossi (old FM9)	South Wambo Creek (upstream of confluence of Stony Creek)	Sept 2018 – 31/12/2019	0	NA	NA	NA
FM12	Stony Creek upstream	1/02/2015 to 31/01/2016	40	210	7.0	Negligible
		1/02/2016 to 31/01/2017	31	0.39	0.09	Negligible
		1/02/2017 to 31/01/20/18	15.7	2.75	0.59	Negligible
		1/02/2018 to 31/12/2019	0	NA	NA	NA
FM13	Stony Creek downstream	1/02/2015 to 31/01/2016	26	180	28	Negligible
		1/02/2016 to 31/01/2017	46	26	4.4	Negligible
		1/02/2017 to 31/01/2018	0	NA	NA	NA
		1/02/2018 to 31/12/2019	0	NA	NA	NA
FM14	Major tributary to Stoney Creek	1/02/2015 to 31/01/2016	33	33	1.5	Negligible
		1/02/2016 to 31/01/2017	10	0.38	0.03	Negligible
		1/02/2017 to 31/01/2018	0	NA	NA	NA
		1/02/2018 to 31/01/2019	8	145	33.44	NA
		1/02/2019 to 31/12/2019	2	146	128	NA

Site	Location	Period of Record	Flow Days*	Max (M/L Day)	Mean per Flow Day (ML/Day)	% Results with no Data Available
FM15 (old FM5)	South Wambo Creek	1/02/2017 to 31/01/2018	0	NA	NA	NA
		1/02/2018 to 31/12/2019	0	NA	NA	NA
FM16 (old FM6)	South Wambo Creek	1/02/2017 to 31/01/2018	0	NA	NA	NA
		1/02/2018 to 31/12/2019	0	NA	NA	NA

Notes to **Table 10:**

NA – Parameter not available in data summary records.

No flow data available – Flow data not available due to damage to station or unreliable sensor responses.

- A flow event at FM4 in April 2015 was influenced by backwater flooding from Wollombi Brook.

The flow monitoring data at FM10 and FM11 (DPIE Water operated stations), shows that Wollombi Brook is perennial and has a persistent baseflow which maintains flows between rainfall events. In comparison site drainages are ephemeral and typically only flow in response to intense rainfall events. Flow monitoring data has been used to characterise the flow regime of the monitored watercourses.

Figure 6 shows the flow duration curves for Wollombi Brook at the DPIE Water gauging stations at Warkworth and Bulga (GS 210004 and GS 210028) which have been derived from flow recorded between 2003 and 2014. It is apparent that the distribution of flows in Wollombi Brook upstream and downstream of Wambo has generally been similar but with an increased frequency of low flows at the downstream station.

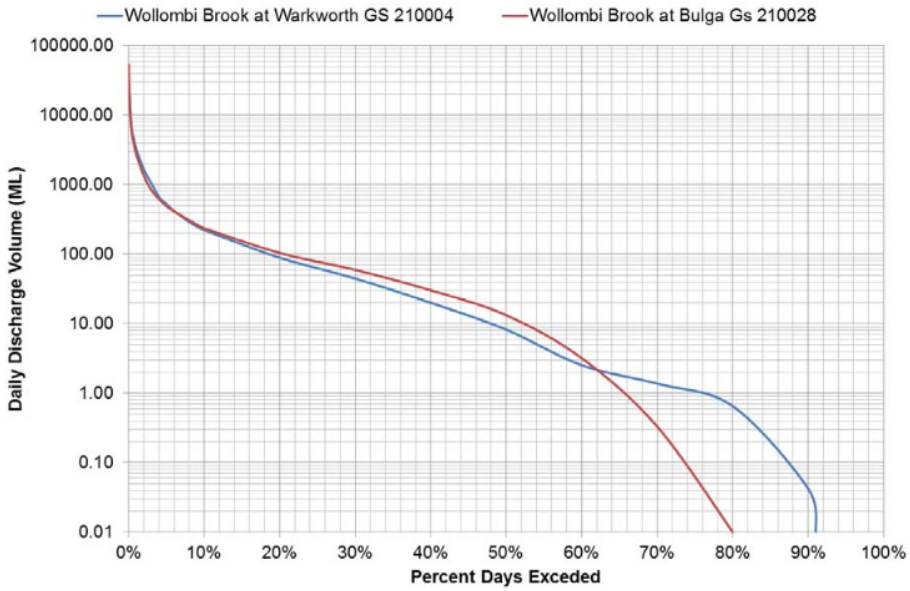


Figure 6: Flow Duration Curves Wollombi Brook Upstream and Downstream of the Mine

The available flow monitoring data for *North Wambo Creek* show that these creeks are all ephemeral and typically only flow in response to intense rainfall. This can be seen in **Figure 7** and **Figure 8**, which show monitored (non-zero) daily flow data and concurrent daily rainfall measured at the Wambo climate station.

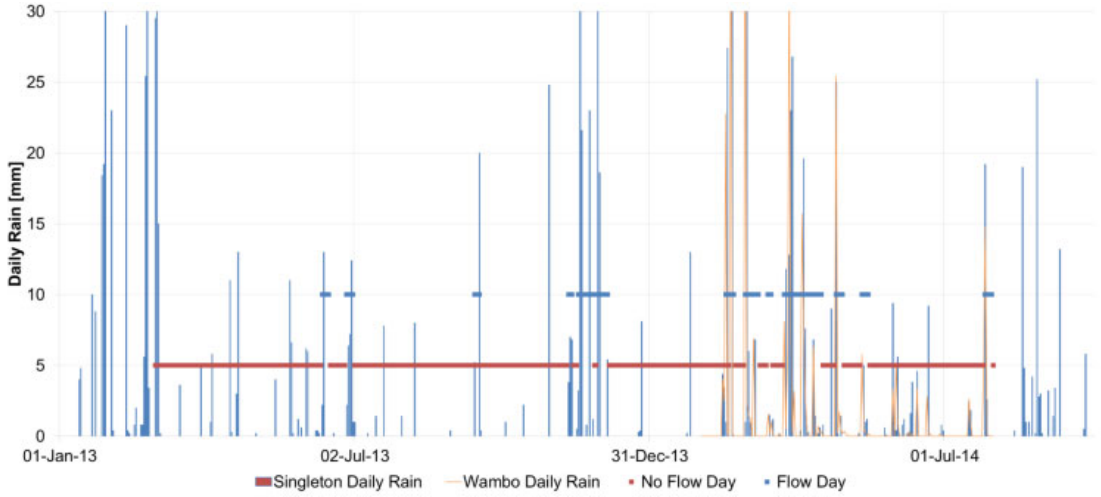


Figure 7: Recorded Daily Rainfall and Flow/No Flow Days – North Wambo Creek at FM2

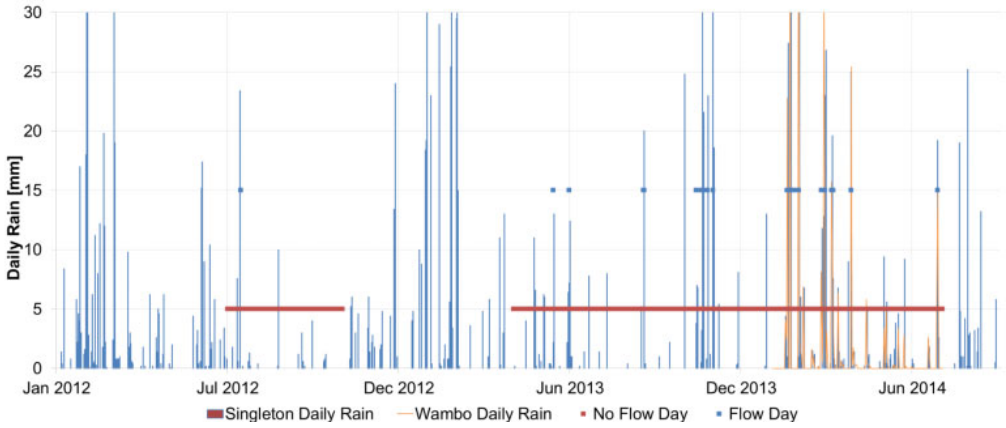


Figure 8: Recorded Daily Rainfall and Flow/No Flow Days – North Wambo Creek at FM4

Historical data for monitoring Site V8 and the two United sites (Weir 1 and Weir 2) is provided in **Table 11.**

Table 11: Stream Flow Summary for Historical Monitoring Sites

Site	Period of Record	Flow Days	Max (L/s Day)	Minimum (L/s)	Mean (L/s)
V8 – Stoney Creek	29 Jun 2005 - 10 Aug 2005	43	216.1	0.0	17.7
Weir 1 – North Wambo Creek	14 Jun 2002 – 1 Oct 2003	NA	9.3	0.0	1.5
Weir 2 - North Wambo Creek	14 Jun 2002 – 1 Oct 2003	NA	120.0	0.0	0.9

3.4.3 Riparian Vegetation Health and Channel Stability

A baseline Riparian Vegetation and Bed Bank Stability Monitoring Program commenced in October 2006 to monitor for potential subsidence impacts on the Wambo Creek and North Wambo Creek. A program to monitor riparian vegetation corridors along North Wambo, South Wambo and Stony Creeks has also been implemented. Details of both programs are presented in the Wambo ***Biodiversity Management Plan*** (***BMP***) and ***NWCD MP*** (for North Wambo Creek only) (refer **Appendix D**).

3.4.4 Geomorphic Assessment of North Wambo Creek

In 2017 WCPL commissioned Alluvium Consulting Australia to undertake a pre-subsidence (baseline) survey, energy profile analysis and geomorphic context statement on North Wambo Creek (the North Wambo Creek Baseline Report) (Alluvium, 2018). The study was completed in February 2018, on a natural section of North Wambo Creek, directly above future Longwalls 23, 24 and 25 (South Bates Extension Mine) and upstream of this area.

The reaches of North Wambo Creek and its upstream tributaries of Spring and Chalkers Creek were categorised in accordance with the River Styles Framework. The extent of North Wambo Creek is shown in **Figure 9**. Energy conditions in each of the reaches were assessed to inform the broader assessment and likely future trajectory of the geomorphic character, behaviour and condition of the waterway. The results of the hydraulic model are presented in **Table 12**.

A copy of the North Wambo Creek Baseline Report was provided to DPIE Water in April 2018.

Table 12: North Wambo Creek – Baseline Assessment Hydraulic Model Results*

Parameter	Units	ARI	Diversion criteria*	Reach average hydraulic parameters								
				Chalkers Creek	Spring Creek	Reach 1	Reach 2	Reach 3	Diversion Stage 2	Diversion Stage 3	Downstream
Shear Stress	N/m^2	2 year	<40	85.3	84.9	75.2	35.0	30.4	29.6	50.4	37.5
		50 year	<80	127.9	113.7	104.7	72.9	40.6	43.8	68.0	68.4
Stream Power	N/m.s	2 year	35-60	213.4	208.3	179.0	58.4	49.3	57.6	106.7	74.8
		50 year	80-150	437.8	364.1	326.9	192.0	87.0	107.2	173.9	195.7
Velocity	m/s	2 year	no vegetation <1.0 with vegetation<1.5	2.5	2.5	2.3	1.4	1.3	1.2	1.9	1.1
		50 year	<2.5	3.4	3.1	3.0	2.3	1.7	1.8	2.3	1.7

* Source: Alluvium, 2015

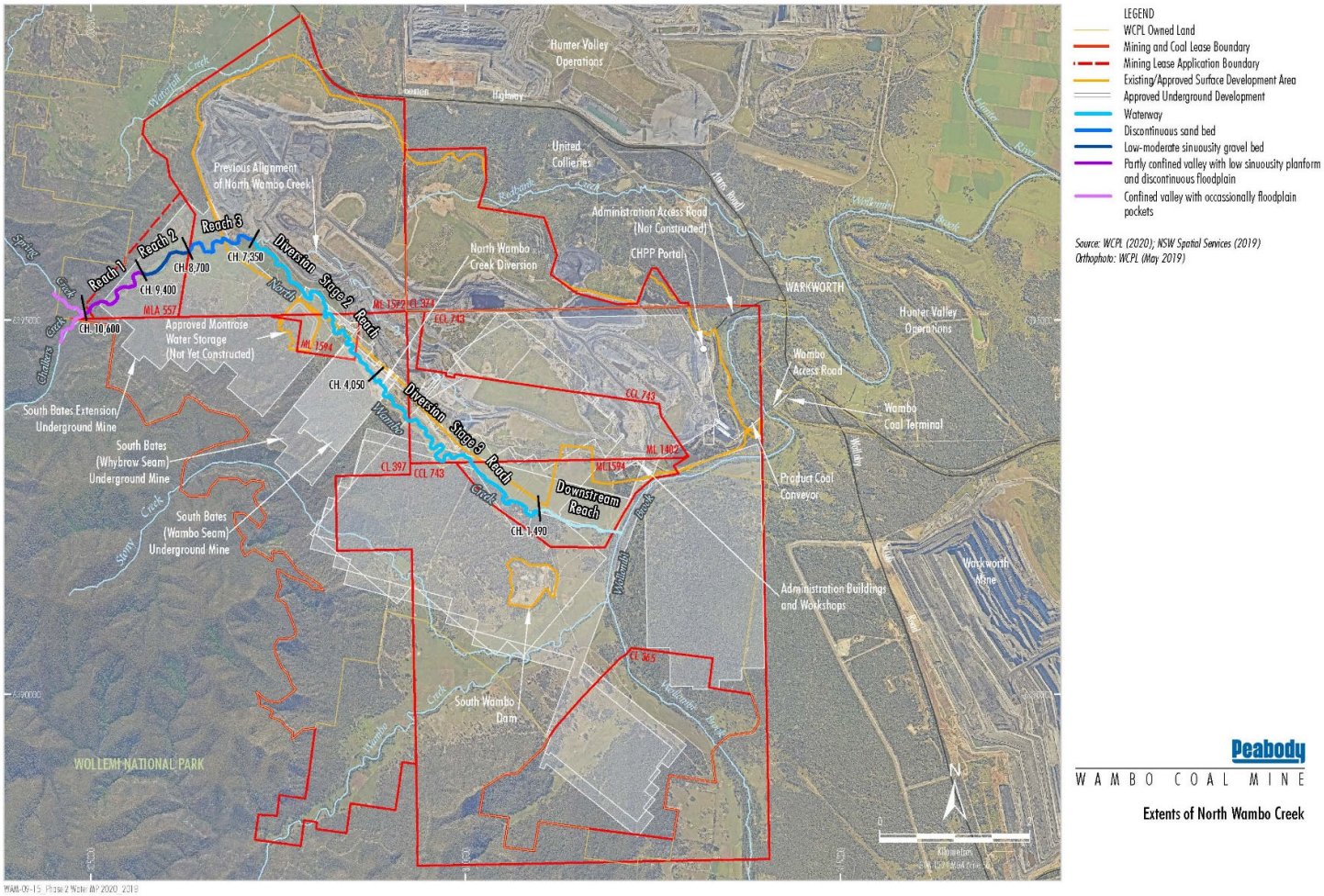


Figure 9: Extents of North Wambo Creek

3.5 Site Water Balance

A water balance model was initially developed for the Wambo water management system as part of the Wambo Development Project EIS studies in 2003 (June 2003). The model simulated inflows, outflows, transfers and changes in storage of water on site on a daily basis, under variable climatic conditions. This initial model adopted a number of simplifications including lumped consideration of site storages and other hydrological processes as well as a simple linear relationship to simulate runoff and seepage from rainfall on the various catchments and mine landforms.

A detailed water balance assessment was completed for the United Wambo Open Cut Project by Hydro Engineering and Consulting Pty Ltd (HEC) and forms an appendix to the Surface Water Assessment (Umwelt 2016a). Given the integrated nature of the United Wambo and Wambo water management systems, the water balance assessment included consideration of water use and make in the Wambo and United pits as well as the Wambo underground, CHPP and train loading facility.

The current GoldSim water balance model was developed by Jacobs in 2019 and updated in 2020 as part of a Peabody mine water governance initiative. Further details can be found in the ***SWB.***

Condition B66, Schedule 2 of DA305-7-2003 requires annual preparation of an updated site water balance. The site water and salt balance will be recalculated on an annual basis and reported in the Annual Review (**Section 9.2.1**).

3.5.1 Salt Balance

The sources of saline water at Wambo are:

- Surface water runoff – in addition to the salt released by weathering of the saline material, salt also accumulates by deposition from rainfall in soil. The salt on the surface of the soil or material is dissolved by rainfall and enters the WMS dissolved in runoff;
- Groundwater inflows into underground mine workings;
- water imported from other mines;
- water imported from the Hunter River and Wollombi Brook; and
- direct rainfall onto water storages.

Median salinity can be expected to increase over time and stabilise at approximately 3800mg/L throughout the operational forecast. An improvement in reported water quality is likely as catchments ae rehabilitated. Further detail on the salt balance can be found in the ***SWB***.

Monitoring will continue to be undertaken for water salinity (EC) in accordance with the surface water monitoring program detailed in **Section 6.0** and included in the ***WMProg*.** Data from this monitoring program may be used to inform future salt balances for the site. The salt balance will be reviewed annually as part of the site water balance and reported in the Annual Review (**Section 9.2.1**).

4.0 Impact Assessment and Performance Criteria

Surface water impact assessment and performance criteria have been established for the following possible project related impacts:

- Reduction in flow due to catchment excision and loss of baseflow; and
- Degradation of surface water quality.

Performance criteria for riparian vegetation health is included in the Wambo ***BMP***. Performance criteria/triggers for geomorphological response to flood events has been developed for the NWCD. This criteria in included in the ***NWCD MP***.

Data from Wambo's surface water monitoring program will be compared against the established criteria. Details of the monitoring program are included in **Section 6.0**. Reporting requirements for this SWMP are detailed in **Section 9.2.**

A review of the data against the criteria will determine if the surface water impact investigation procedure or Trigger Action Response Plans (TARPs) in **Section 7.0** should be initiated. **Section 7.0** provides a protocol for the investigation, notification, and mitigation of identified exceedances of these assessment criteria.

4.1 Surface Water Impact Assessment Criteria

4.1.1 Discharge Criteria

Mine water at Wambo is discharged through the EPL 529 licensed discharge point, located at Eagles Nest Dam (water quality monitoring site SW15) (**Figure 5**). Water quality discharge limits are drawn from EPL 529 and the HRSTS, as presented in **Table 13.**

Table 13: Discharge Limits and Requirements

Conditions		Source
Discharge Limits	No more than 250 ML/day will be discharged from the licensed discharge point/s.	Condition B55 of DA305-7-2003 & Condition L2.4 and L3.1 of EPL 529
	Discharges from any licensed discharge point must comply with the following limits: • 6.5 ≥ pH ≤ 9.5; and • Non-Filterable Residues (NFR)* ≤ 120 mg/L.	
Discharge Requirements	Notification from Water NSW of discharge opportunity must be received.	HRSTS Guidelines
	Flow of water in Wollombi Brook at the Water NSW Bulga Gauging Station (FM11) needs to be more than 500 ML/day.	
	pH will to be measured continuously throughout the discharge with an inline instrument.	
	Conductivity (EC) will be measured continuously in µS/cm throughout the discharge with a calibrated instrument designed to measure between 0 and 10,000 µS/cm.	
	TSS will be measured once a day during discharge. A representative sample will be collected every day and sent to the lab for analysis.	

**Equivalent to TSS*

4.1.2 Stream Flow

Wollombi Brook is perennial and the impact assessment criterion for Wollombi Brook has been set to zero flow at the Warkworth gauging station.

Flow impact assessment criteria for the local mine site ephemeral creeks are based on the unexpected absence of flow in climatic situations when flows would be expected. The impact assessment criteria would be met if there was no flow recorded at the flow monitoring site either on the day or the day after the recorded rainfall was equal to or greater than the nominated amount. The resulting runoff generating rainfall values are given in **Table 14**.

Table 14: Surface Water Flow Impact Assessment Condition

Watercourse and flow monitoring site	Daily rainfall when flow commenced on 80% of recorded occasions
Stony Creek – FM13	20 mm
South Wambo Creek – FM5	20 mm
North Wambo Creek – FM1	100 mm[1]

Notes to Table 14 -

1. Streamflow measurements in North Wambo Creek daily rainfall data from stations adjacent to the catchment have been analysed and indicate a total continuous rainfall depth of approximately 100mm (can occur over more than one day) is required to generate surface flow in North Wambo Creek upstream of the diversion

4.1.3 Surface Water Quality

The impact assessment criteria for surface water quality are summarised in **Table 15**. Where actual site specific water quality monitoring data is available (**Section 3.3.1**) the criteria have been set based on the 20th and 80th percentile for the available dataset. Where insufficient data is available, WCPL has adopted the applicable ANZECC default guidelines values for slightly to moderately disturbed ecosystems or the NSW Water Quality Objectives for the Hunter River.

The high variability in TSS concentrations poses some difficulty in the selection of appropriate assessment criteria. Given the correlation between TSS and flow, separate impact assessment criteria have been set for 'low' and 'high' flow conditions. In this context the term low flow covers recessionary flows and flows generated by small to moderate flow events up to a 1 in 1 year average recurrence interval. The term high flow covers the rising stage of flow events and medium to large flow events e.g. 1 in 20 year average recurrence interval and larger.

Table 15: Surface Water Quality Impact Criteria

Sampling Site	Parameter	Lower Limit	Upper Limit
SW02 – Wollombi Brook	pH	7.4	8.1
	EC (µS/cm)	599	1947
	TSS (mg/L)	17 (low flow) – 308 (high flow)[1]	
SW05 – North Wambo Creek	pH	7.3	8.0
	EC (µS/cm)	1155	2350
	TSS (mg/L)	53 (low flow) – 1,110 (high flow)[1]	
SW07 – Wambo Creek	pH	7.4	7.9
	EC (µS/cm)	360	724
	TSS (mg/L)	29 (low flow) – 331 (high flow)[1]	
SW08 – Stony Creek[5]	pH	6.8	7.4
	EC (µS/cm)	288	416
	TSS (mg/L)	5 (low flow) – 15 (high flow)[1]	
SW39 Waterfall Creek	pH	7.3	7.9
	EC (µS/cm)	159	429
	TSS (mg/L)	582 (low flow) – 1,922 (high flow)[1]	

Notes to Table 15:

[1] An exceedance occurs when water quality results exceed the Trigger Value after three consecutive sampling events or the surface flow impact assessment criteria are exceeded (refer to **Section 7.3.1.2** for TARP).

4.2 Surface Water Performance Criteria

Condition B62 of DA305-7-2003 (Modification 16) and Condition B9 of 177-8-2004 (Modification 3) require WCPL to comply with general water management performance measures (refer **Sections 2.2** and **2.3**). Performance indicators relevant to surface water are outlined in **Table 16**.

Table 16: Surface Water Performance Criteria

Aspect	Performance Measures	Performance Indicator/Trigger	Response
Downstream surface water quality	Negligible change in surface water quality (compared to predicted impacts)	• Surface water quality monitored is outside of the adopted trigger values (refer **Table 15**) for at least one parameter for more than two monitoring rounds.	TARP – Surface water quality (**Section 7.3.1.2**)
Channel stability	No increase in areas of instability within watercourses	• Channel stability monitoring indicates one or more areas of decreasing stability in watercourses.	TARP – NWCD Performance (**Section 7.3.1.5**)
Downstream flooding impacts	Negligible change in downstream flood access (compared to predicted impacts)	• No change to flood inundation of downstream properties in major flood events.	Unforeseen Events Protocol (**Section 7.3.4**)
Stream and riparian health	Riparian Health	• No evidence of significant weed growth or death of vegetation	Unforeseen Events Protocol (**Section 7.3.4**)
	Condition of channel	• No evidence of significant rill erosion, undercutting or slumping	TARP – NWCD Performance (**Section 7.3.1.5**)
	Deposition of sediment and debris	• No evidence of significant accumulation or deposition, large blockages in channel	Unforeseen Events Protocol (**Section 7.3.4**)
	General conditions	• No evidence of significant hazards presented to the public, poor aesthetics or feral animals, or geomorphic instability	Unforeseen Events Protocol (**Section 7.3.4**)
Surface Water User Supplies	Negligible impact to downstream surface water users (compared to predicted impacts)	• Mining extents / disturbance areas lie within approved boundaries. • Surface water take associated with baseflow impacts is licensed. • No complaints from downstream water users regarding loss of surface water (quality and/or quantity).	TARP – Surface Water Flows (**Section 7.3.1.1**)
Post-mining water pollution from rehabilitated areas of the site	Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation	• Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and/or baseline data and does not pose a threat to downstream water quality. • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff	Rehabilitation TARP (refer ***MOP/RMP***)

4.2.1 Channel Stability

Geomorphological triggers and success criteria were developed in 2007 as part of the detailed design of the North Wambo Creek Diversion (NWCD) (Gilbert and Associates, 2007). These triggers and criteria relate to the performance of the NWCD in flood conditions. This criteria is included in the ***NWCD MP***. Channel stability performance criteria has not been established for other watercourses.

4.2.2 Riparian Vegetation Health

Monitoring of riparian vegetation health is undertaken in accordance with the ***BMP***. Performance criteria for riparian health is addressed in the ***BMP.***

4.2.3 Water Supply for Other Water Users

The surface water assessment for the United Wambo Open Cut Coal Mine project found that the project is likely to have minor to negligible impacts on water users relative to the current approved impacts immediately downstream of the mine (Umwelt 2016a). As such, triggers have not been established for specific water users however surface water flows and quality monitoring is undertaken in a number of watercourses, including in Wambo Creek, in accordance with **Section 6.0** and the ***WMProg.*** Triggers have been established for these creeks (**Section 4.1**) and TARPs developed to respond to surface water impacts should they occur (**Section 7.3**).

4.2.4 Post Mining Water Pollution from Rehabilitated Land

WCPL will monitor surface water impacts from operations during the life of the mine. Water runoff from rehabilitated land will be managed as part of the site water management system until such time as the rehabilitated land meets the rehabilitation closure criteria and is approved for relinquishment, as detailed in the ***MOP/RMP***.

4.2.5 Performance Indicators

The performance indicators in **Table 17** will be used to assess the performance of the Mine against the predicted impacts.

Table 17: Performance Indicators

Performance Indicator	Number
Number of complaints received relating to surface water	Nil
Number of non-compliances relating to surface water	Nil
Number of exceedances of surface water impact assessment criteria[1]	Nil
Number of reportable environmental incidents relating to surface water	Nil

Note:

1. An exceedance occurs when water quality results exceed the Trigger Values in **Section 4.1** after three consecutive sampling events (refer to **Section 7.0** for TARP)

WCPL will report on progress against these performance indicators in the Annual Review (**Section 9.2.1**). In the event that a complaint is received relating to surface water, it will be handled in accordance with the complaints management protocol (**Section 8.0**). Contingency plans for unpredicted surface water impacts are discussed in **Section 7.0**.

5.0 Surface Water Management Measures

Surface water management measures are implemented and monitored to ensure compliance with relevant statutory requirements. Management measures include, but are not limited to:

- Site water management system;
- Sewage Treatment Plant operation and maintenance;
- Chemical and Hydrocarbon Storage;
- Erosion and sediment control;
- Site Water Balance (and salt balance);
- Surface water monitoring program; and
- Decommissioning of redundant water management structures.

Specific management measures have also been developed for the Locomotive Provisioning Facility, adjacent to the Wambo rail loop (refer **Section 5.8**).

5.1 Site Water Management System

The site water management strategy for Wambo is based on the containment and re-use of mine water and on the control of sediment that may be potentially carried with runoff from disturbed areas such as the waste rock emplacements. The water management system (WMS) controls waters generated from development and operational areas while diverting upstream water around such areas. It includes both permanent structures that will continue to operate post-closure and temporary structures that will only be required until the completion of rehabilitation works. The WMS includes:

- Up-catchment diversion structures;
- Water storage dams;
- Sediment dams;
- Water transfer infrastructure (i.e. pumps and pipelines);
- Licenced Discharge Points; and
- The North Wambo Creek Diversion.

The WMS operates predominately as a closed, self-contained system. The water balance of the system fluctuates with climatic conditions and as the extent of the mining operations evolves over time.

An extensive reticulation system has been developed to transfer water between open cuts, underground operations and mine water storages, to source water from Wollombi Brook and the Hunter River, to facilitate controlled releases to Wollombi Brook (in accordance with EPL 529 and the Hunter River Salinity Trading Scheme) and to provide/accept water to the adjacent United Collieries operation.

A schematic of the site water management system is provided in **Figure 10. Figure 10** shows current storages and linkages and proposed storages. Not all storages and linkages may be present at any given point in time and the table on the left of **Figure 10** shows indicative start and end dates for applicable storages (for modelling purposes only). The water management system will be constructed and modified as and when required so as to support the required infrastructure and mine development. The water balance model (**Section 5.7**) has been developed based on **Figure 10**.

Runoff from rehabilitated and establishing revegetated mine areas is directed to sediment retention storages. These are either allowed to drain to local drainages or, depending upon the water quality, are directed to mine water storages.

A table showing the water control structures onsite is included in the ***ESCP***. The ***ESCP*** also contains a detailed description of the various classes of water onsite i.e. worked (or mine) water, surface (or dirty) water and diverted (or clean) water.

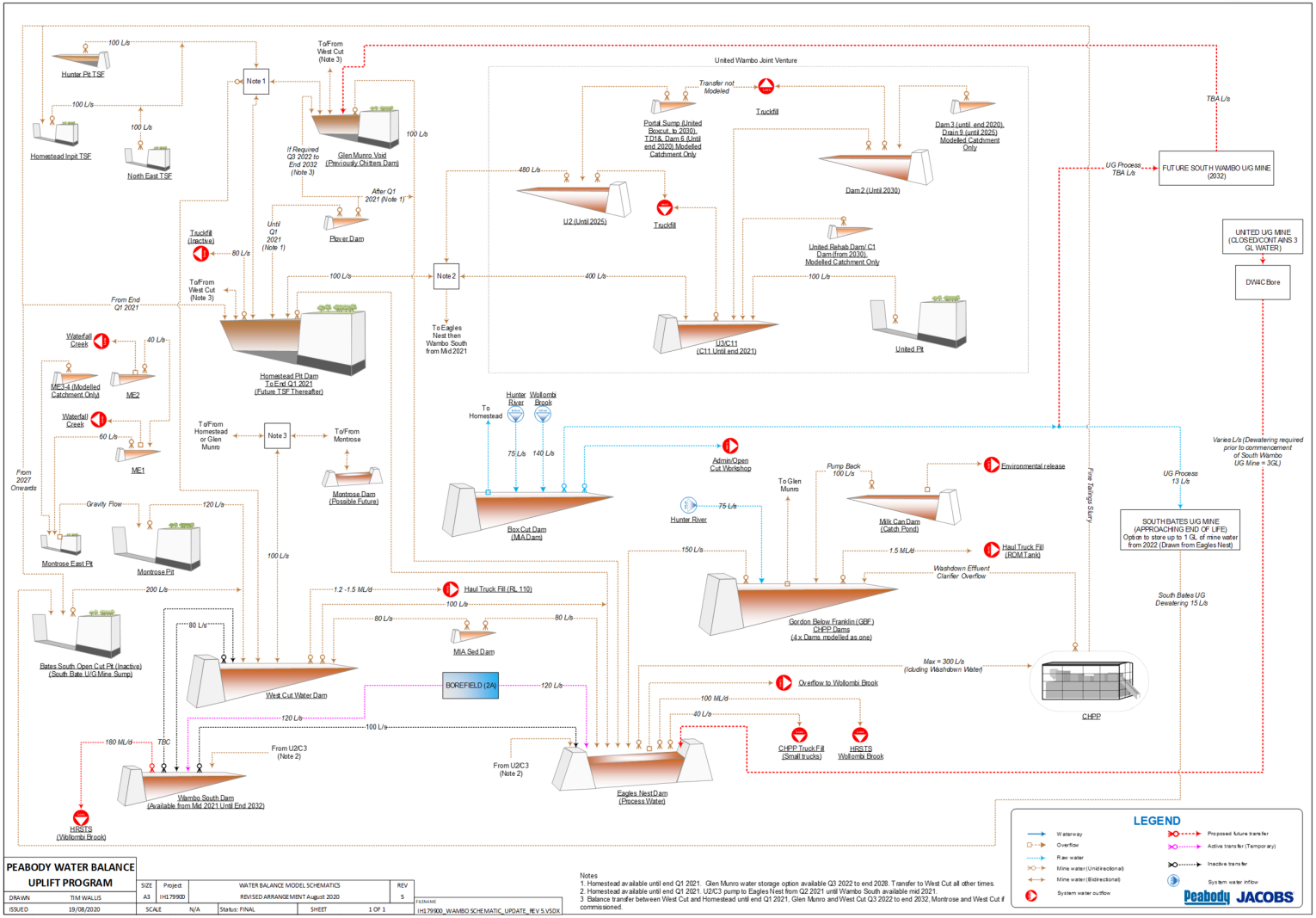


Figure 10: Water Management System (Jacobs, 2020)

5.1.1 Detailed Plans, Design Objectives and Performance Criteria

Detailed plans, design objectives and performance criteria have been developed for the North Wambo Creek Diversion. Further detail is provided in the ***NWCD MP,*** provided in Appendix A.

Sediment control structures are constructed in accordance with the guidelines presented in the Blue Book and design guidelines summarised in the ***ESCP***.

Performance criteria have not been established for other water management infrastructure, with the exception of drainage networks in rehabilitated areas. These drainage networks are designed and constructed in accordance with the ***MOP/RMP*** and ***ESCP*** and performance is measured against completion criteria detailed in the ***MOP/RMP***.

Further detail on the design, construction and maintenance of water management structures such as clean water diversions and sediment dams is included in the ***ESCP***.

In accordance with Condition B62 of DA305-7-2003, all new water management infrastructure will be designed and constructed in consideration of the performance measures detailed in Table 8 of DA305-7-2003 (as modified) (refer **Table 2** in **Section 2.2**).

5.2 Water Supply and Water Sharing

WCPL is required to ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of the development to match its available water supply. WCPL sources most of its water from rainfall runoff and dewatering of the underground mine.

WCPL may receive water from, and transfer water to, neighbouring mines including Hunter Valley Operations, Mount Thorley Warkworth and United Wambo open cut coal mine.

Water inflows and outflows, including any water shared, are reported annually as part of the site water balance (**Section 5.7**) and Annual Review (**Section 9.2.1**).

5.3 Prescribed Dams and Tailings

WCPL currently has three prescribed dams onsite:

- Wambo Hunter Pit Tails Dam;
- South Wambo Dam (currently decommissioned);
- North East Tailings Dam.

These dams were constructed prior to the approval of Modification 16 of DA305-7-2003, therefore the performance measures in Table 8 of DA305-7-2003 do not apply.

Hunter Pit Tails Dam and North East Tailings Dam are operated and maintained in accordance with an Operations and Maintenance Manual (OMM). A Dam Safety Emergency Plan (DSEP) has also been developed for both the Hunter Pit and North East Tailings Dams. If/when South Wambo Dam is recommissioned, an OMM and DSEP will be developed and implemented in line with the requirements of the *Dams Safety Act 2015*. Inspections include routine inspections, intermediate inspections (annually) and comprehensive inspections every 5 years.

WCPL must notify the NSW Dam Safety Committee when mining near prescribed dams. WCPL must also confirm the draining of the Wambo South Dam prior to commencement of secondary workings underneath.

Tailings deposition will cease at the Homestead Main Pit tailings storage facility (TSF) in late 2020. It is proposed that the South Bates Sump will be utilised in the future as a TSF.

5.4 Sewage Treatment Plant Operation and Maintenance

WCPL operates and maintains an onsite sewage treatment plant (STP) to process waste from the mine infrastructure area. The STP is operated and maintained in accordance with manufacturers operating procedures and relevant conditions of EPL 529 (**Appendix C).**

WCPL has prepared a STP maintenance program in accordance with Condition O2.6 of EPL 529. This program includes quarterly service and maintenance conducted by a suitably qualified and experienced wastewater technician. The technician performs a full inspection of the STP and provides a written report including:

- Details of any maintenance undertaken;
- Results of any tests performed; and
- Details of actions required or recommended.

A copy of the quarterly maintenance reports and annual certification that the STP is operating within its capacity is submitted annually to the EPA with the EPL Annual Return (**Section 9.2.2**).

Effluent from the STP is discharged to land at WCPL's approved effluent irrigation area, in accordance with EPL conditions. Monitoring of the STP licensed discharge point (EPL ID No. 18, 42 and 52) is described in **Section 6.0.**

5.5 Chemical and Hydrocarbon Storage

Chemical and hydrocarbon products are stored in bunded areas onsite, in accordance with the relevant Australian Standard. In the event that a chemical or hydrocarbon spill occurs, or a bund requires emptying, WCPL will arrange for removal of contaminated material from site using a licensed waste contractor. Pollution incidents will be managed in accordance with the Wambo ***Pollution Incident Response Management Plan*** (***PIRMP***).

5.6 Erosion and Sediment Control

WCPL is required to install and maintain erosion and sediment controls in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004)* and *2E Mines and Quarries (DECC, 2008).*

An Erosion and Sediment Control Plan (***ESCP***) has been developed and forms part of the Wambo Water Management Plan. Further detail on the management of erosion and sediment control is included in the ESCP. Monitoring of erosion and sediment controls is discussed in the ***ESCP*** and **Section 6.1.5** of this SWMP.

5.7 Annual Site Water Balance and Salt Balance

A site water and salt balance will be completed each year as part of the Annual Review (**Section 9.2.2**). The site water and salt balance incorporates and assesses all of the data collated from the surface water and groundwater monitoring programs including surface water inflows, outflows and storage volumes.

5.8 Management of the Locomotive Provisioning Facility

The 2012 modification to the Wambo Rail Spur Consent (DA 177-8-2004) allowed for the construction of a Locomotive Provisioning Facility adjacent to the WCPL rail loop (Wells Environmental Services, 2011). The facility includes storage and handling facilities for

100,000L diesel, 2,000L oil, sand and water. Due to the environmental risk associated with storage of hydrocarbons, the following management measures will be implemented during the operation of the facility to minimise the potential for contamination of land, or water in Wollombi Brook.

5.8.1 Hydrocarbon Storage and Handling

The diesel storage tank is a double skinned self bunded diesel storage tank with a capacity of approximately 100,000L (Transtank T108E) with an extended pumping bay. The tank has a capacity of 108,000L and a safe fill of 95,000L. The oil tank is integrated into the double bunded storage structure.

The refilling facility incorporates several spill prevention features including a security card to activate the pump, a refill nozzle that must be connected to the fuel tank to flow, an operator dead man switch and a cut-off valve in the event of a ruptured pipe. The refuelling hose connects to the locomotive fuel tank using a Banlaw nozzle eliminating accidental spills. Oil is pumped via a low pressure pipeline into the locomotives via two retractable hose and trigger nozzles. These retractable hose reels are located above spill containment grates adjacent to the rail track.

5.8.2 Facility Site

The hydrocarbon storage and handling facility has been designed, is managed and maintained in accordance with *AS 1940-2004 The storage and handling of flammable and combustible liquids* and other associated standards. Spill containment kits are kept within a lockable onsite storage container.

All pumps and external equipment are locked, and a two metre high chain wire perimeter fence with lockable gate has been installed around the outside of the facility to deter unauthorised access, theft and vandalism.

Drip and spill control grates located at the two refill points and a bunded concrete area for tanker refilling are connected to a SPEL Puraceptor™ oily water management system.

5.8.3 Water Treatment System

The SPEL Puraceptor™ oily water management system is a full retention separator that treats flows from the three refill areas and is sized to contain more than the anticipated maximum oil and diesel spillage enabling it to be fully operational at all times. The system has a working capacity (the volume of water held before treated water discharges from the outflow) of 2050L with a treatment rate of up to 4L/s, and a spill capacity of a further 1,000L. With the small catchment area for the system (approximately 30m^2), the system is capable of treating the equivalent of over 2,000mm of rainfall per hour.

The unit has an alarm signal that notifies management (via SMS) in the event of a spillage that is in excess of 10% of the spill capacity (i.e. 100L) or when progressive spillage reaches this capacity. No visible oil and grease is permitted to leave the site. Visible oil and grease in water is considered equivalent to a criterion of 10mg/L. Treated water from the system has levels of 5mg/L or less.

5.8.4 Management Procedures

All personnel involved in the use of hydrocarbons on the site are trained in the appropriate use of facility and emergency response measures. Regular inspections, servicing and maintenance of the station, in addition to visual inspections by locomotive drivers during refuelling, are undertaken.

Absorbent spill control matting located between the tracks in the refuel area (absorbs approximately 12L/m^2) will be replaced every 18 months or as required.

5.9 Decommissioning of Water Management Structures

It is anticipated that the post-mining area would consist of safe and stable landform features, revegetated to a mixture of woodland and pasture areas, consistent with the ***MOP/RMP***.

Water management structures and sediment control structures would either be retained as wetland habitat/water features or decommissioned and rehabilitated. The design, capacity and final location of these post mining water management structures will be refined and detailed in revised water management plans as the mine progresses towards mine closure. Some access roads may be retained post-mining to enable access for bushfire response and other land management activities.

If the Locomotive Provisioning Facility is retained until the end of Mine Life, the structures associated with the facility will be decommissioned simultaneously with the adjacent rail load out infrastructure. If decommissioning is required before the removal of the rail load out then all above-ground infrastructure will be removed, a contamination assessment completed, and the site rehabilitated to the match the landuse in the immediate surrounding area.

5.10 Inspections

Inspections of water management infrastructure, such as dams, sumps and sediment control structures, are undertaken in accordance with the Wambo Coal *Water Asset Management Plan*. Inspections enable WCPL to monitor the effectiveness of management measures implemented in **Section 5.10** of this SWMP and also the ***ESCP***.

Inspections of the NWCD are also undertaken in accordance with the Extraction Plan monitoring schedule and include visual inspections for evidence of surface cracking and/or ponding.

5.11 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this SWMP, consent conditions, and other relevant approvals, licenses, and guidelines.

Audit requirements are detailed in the ***EMS***.

6.0 Surface Water Monitoring Program

The surface water monitoring program is designed to monitor surface water quality and levels to detect potential impacts on surrounding catchment users and to ensure that relevant legislative and policy requirements are met. Monitoring locations, parameters, frequency and methodology of monitoring are outlined in this section.

Data collected will:

- Be used in the continued development of surface water investigation triggers (**Section 4.1**); and
- Provide input to annual reviews of surface water monitoring data (**Section 9.2.1**) and the site water balance and salt balance (**Section 5.7**).

A general description of the surface water monitoring program for Wambo is included in this section. The surface water monitoring locations, parameters, frequency and methodology of monitoring for the Wambo Underground Mine (and United Wambo Open Cut Mine) are outlined in the combined ***WMProg***.

6.1 Monitoring Network, Parameters and Frequency

Ongoing surface water monitoring requirements at Wambo are as follows:

- Monitoring of water quality including Wollombi Brook, North Wambo, South Wambo, and Stony Creeks (**Section 6.1.1**);
- Monitoring of mine water quality in mine water storage dams and sediment ponds (if applicable) (**Section 6.1.2**);
- Monitoring of flow in the North Wambo Creek, Stony Creek and South Wambo Creek (**Section 6.1.3**);
- Monitoring of water quality to assess the effectiveness of erosion and sediment control measures (**Section 6.1.5**);
- Monitoring of riparian vegetation and creek bed stability (**Section 6.1.6**);
- Monitoring discharge flows through the North Wambo Creek diversion; (**Section 6.1.7**);
- Monitoring of subsidence impacts on the North Wambo Creek diversion (**Section 6.1.8).**
- Monitoring of licenced discharges under EPL 529 and the HRSTS (**Section 6.1.9**);
- Monitoring of inflows into the underground and open cut workings (**Section 6.1.10**);
- Monitoring of water quality of sediment dams with potential for offsite discharge; and
- Monitoring of water supply for other water users (**Section 6.1.11**).

Water quality trigger values have been developed for a number of creeks and waterways. The results of monitoring of these creeks and waterways will be compared against the triggers in **Section 4.1**. Results of monitoring at the licenced discharge point will be compared against the criteria detailed in EPL 529 (**Section 4.1.1**). All required reporting will be undertaken in accordance with **Section 9.2**.

Mine water monitoring is undertaken for operational management purposes only. This data is not reported publicly.

6.1.1 Surface Water Quality

Sampling is undertaken at sites including Wollombi Brook, North Wambo, South Wambo, and Stony Creeks. Surface water quality monitoring is undertaken on a monthly basis and/or following a significant rainfall event (20 mm within 24 hours, midnight to midnight), with a new rainfall event considered to have commenced if there has not been a rainfall event in the previous 48 hours. Sampling is only undertaken during flow periods to ensure that increased solute concentration (caused by evaporation) does not cause incorrect sample results.

Water quality monitoring sites are generally located upstream and downstream of WCPL's operations, to distinguish mining impacts from natural water quality fluctuations. Redbank Creek is not monitored by WCPL, as downstream creek flow is used by United Collieries for operational purposes. Monitoring in Waterfall Creek (SW39) commenced in July 2007 to enable the collection of sufficient baseline data prior to the commencement of any potential mining within that catchment.

In response to comments from the IESC (July 2017), WCPL increased the sampling schedule to include monthly monitoring of metals and ions at six surface water monitoring locations (as outlined in **Table 8** (refer **Section 3.2**). The locations were chosen as representative sites surrounding WCPL operations, including upstream and downstream locations. The additional monitoring will be conducted until December 2020 to collect baseline data.

6.1.2 Mine Water Quality and Storage Levels

A number of mine water storage dams and pits are sampled monthly for water pH and EC. Data from this monitoring is used for operational purposes and is reported internally as required.

A number of key mine water storage dams are also monitored for water storage level. This data is used in the development of the annual Site Water Balance and Salt Balance (**Section 5.7**).

6.1.3 Surface Water Flows

WCPL monitors flow in the North Wambo Creek, Stony Creek and South Wambo Creek using continuous flow monitoring stations. Surface water flow monitoring data for Wollombi Brook is sourced from DPIE Water operated flow gauging stations, located at Warkworth (FM10) and Bulga (FM11).

The ephemeral nature of these creeks often results in extended no-flow periods. Available data from this monitoring is reported in the Annual Review (**Section 9.2.1**).

6.1.4 Sediment Dams

A number of sediment dams are monitored for pH, EC and TSS on a monthly basis. The surface water assessment for the United Wambo project found that the low risk of metal/metalloid contamination is considered to not warrant specific monitoring of these substances as part of the routine monitoring program for sediment dam water however any significant change in pH will trigger further analysis of metal/metalloid concentrations in runoff water (Umwelt, 2016a).

If a monitoring result indicates that there has been a significant change in pH (i.e. >1 pH unit) in a sediment dam with the potential to discharge, WCPL will take a follow up sample to confirm the result. If this second result shows a significant change in pH then WCPL will arrange for the sample to be analysed for metals/metalloids. Further monitoring may be undertaken depending on the results of this analysis.

6.1.5 Erosion and Sediment Control

As well as collecting background water quality data and identifying potential mining impacts, surface water quality monitoring sites are strategically located so as to enable the effectiveness of erosion and sediment control measures (implemented in accordance with the ***ESCP***) to be assessed. Inspection, maintenance and management of erosion and sediment control structures is undertaken in accordance with the requirements of the ***ESCP***, including:

- Inspections of sediment dams during construction at a frequency proportional to the level of risk.
- Inspections of sediment dams to verify dam walls, drainage channels, etc have been successfully stabilised by revegetation methods.
- Inspections of sediment control structures and sediment dams following runoff generating rainfall to determine whether dewatering and/or desilting is required to restore design settling zone capacity.

6.1.6 Riparian Vegetation and Creek Bed Stability

Localised bed and bank instability is a natural phenomenon in alluvial creeks, which contributes to the dynamic geomorphology of fluvial systems. Creek beds are also susceptible to subsidence induced erosion, due to the variable depth of subsidence associated with underground longwall mining.

The Baseline Riparian Vegetation and Bed Bank Stability Monitoring Program commenced in October 2006 to monitor for potential subsidence impacts. The program aims to distinguish natural erosion from mine subsidence associated instability, through pre-mining and post-mining survey of North Wambo Creek, South Wambo Creek and Stony Creeks.

A program to monitor riparian vegetation corridors along North Wambo, South Wambo and Stony Creeks has also been implemented. Details of both programs are presented in the ***BMP*** and ***NWCD MP*** (refer **Appendix D**).

6.1.7 Monitoring of Discharge Flows in the North Wambo Creek Diversion

Monitoring and reporting of discharge flows in the North Wambo Creek Diversion (NWCD) will be undertaken in accordance with DPIE Water requirements. These requirements include the:

- Calculation of bankfull discharge flow capacities and velocities for the first discharge event following NWCD completion, and thereafter as directed by DPIE Water;
- Assessment of diversion stability performance, compared with selected stable reaches of North Wambo Creek and other control catchments, as approved by DPIE Water; and
- Reporting of NWCD monitoring data in the Annual Review (**Section 9.2.1**).

6.1.8 Diversion and Subsidence Monitoring Program

Operational Monitoring

An operational monitoring program for the NWCD commenced in 2017. Monitoring data collected in 2017 forms the baseline for future monitoring.

The program provides an assessment of the condition and condition trajectory of North Wambo Creek and the NWCD above the underground mining areas and adjacent upstream and downstream reaches. The outcomes of the monitoring program will inform recommendations

to manage any identified issues with the condition of the NWCD, in particular management issues that may affect downstream receiving waters or WCPL infrastructure.

The operational monitoring requirements are summarised in **Table 18**. Monitoring locations are shown on **Figure 11**.

The results of the operational monitoring program and the geomorphic condition of the NWCD will be reviewed annually. This review will include an assessment of the efficacy of subsidence management or rehabilitation works and maintenance requirements.

Construction/Rehabilitation Monitoring

Monitoring will be undertaken during and immediately after construction of mitigation or rehabilitation works along the NWCD to confirm that works have been undertaken to specification and/or meet design intent.

The following records will be maintained following the implementation of mitigation or rehabilitation works:

- Descriptions of the design activities completed.
- Photographs of the works taken during construction and immediately after the work is finished. Where possible photographs should be taken from fixed photo points, with details such as date, time and weather conditions noted.
- Aerial photography within 12 months after works are completed to accurately display the extent of change and provide a baseline reference for changes that may occur in the future.

Relinquishment Monitoring

If the operational monitoring program indicates the operation of the NWCD is operating in dynamic equilibrium at or before mine closure, a relinquishment monitoring program would be developed.

With the implementation of planned remediation works, it is anticipated this will not be required as the diversion should have been operating for a minimum of 10 years and had flow events of sufficient frequency and magnitude to test the performance of the diversion and its response to subsidence.

Table 18: Diversion and Subsidence Monitoring Program – Operational Monitoring

Component	Locations	Parameters	Frequency
• Index of Diversion Condition (IDC)	• Upstream reach (U1 – U4, UB - UF). • NWCD Stage 2 (Div1 – Div5). • NWCD Stage 3 (Div 6 – Div11). • Above completed North Wambo Underground (WS1 – WS6). • Downstream reach (D1 – D2).	• Geomorphic Index[1] – based on width of high flow channel, active channel and low flow channel, bank condition, piping of banks, bed condition, spoil piles, recovery and in-stream structures. • Riparian Index[1] – based on width of riparian zone, structural intactness, regeneration and longitudinal continuity. • Six photos at each monitoring point: • Upstream, cross-stream, downstream and away from stream – with the monitoring peg in the lower centre of the frame (where possible). • In-channel bed upstream and downstream – from the centre of the creek bed (or as near as possible).	• Annually[2]
• Landscape Function Analysis (LFA)	• NWCD Stage 2 (17R, 19 R, 21R, 23R). • NWCD Stage 3 (28R, 27R, 26R, 25R).	• Landscape Organisation Index (LOI) (as outlined in the Biodiversity Management Plan). • Soil Surface Assessment (as outlined in the Biodiversity Management Plan).	• Annually
• Riparian Vegetation	• Same as IDC monitoring points.	• Vegetation structure and extent.	• Annually[2]
	• North Wambo Creek (8A, 9A, 10A, 11A, 12A, 13A, 14A, 15A).	• Rapid Appraisal of Riparian Condition (RARC) index (as outlined in the Biodiversity Management Plan).	• Annually
• Aerial Photography	• Full reach of NWCD and North Wambo Creek downstream.	• Changes to channel form compared to previous aerial photographs.	• Annually[2]

Component	Locations	Parameters	Frequency
• Long and Cross-Section Surveys (Bed and Bank Stability Monitoring).	• Extracted from LiDAR or aerial photogrammetry survey data captured over NWCD and North Wambo Creek downstream.	• Changes to channel form compared to previous surveys.	• Annually[2]
• Surface Water Quality Data	• As per **WMProg**		
• Flow Event Data	• As per **WMProg**		

Notes to **Table 18:**
1. Based on ID&A Pty Ltd (2001).
2. Frequency may be reduced following the completion of subsidence from the South Bates Underground Mine.

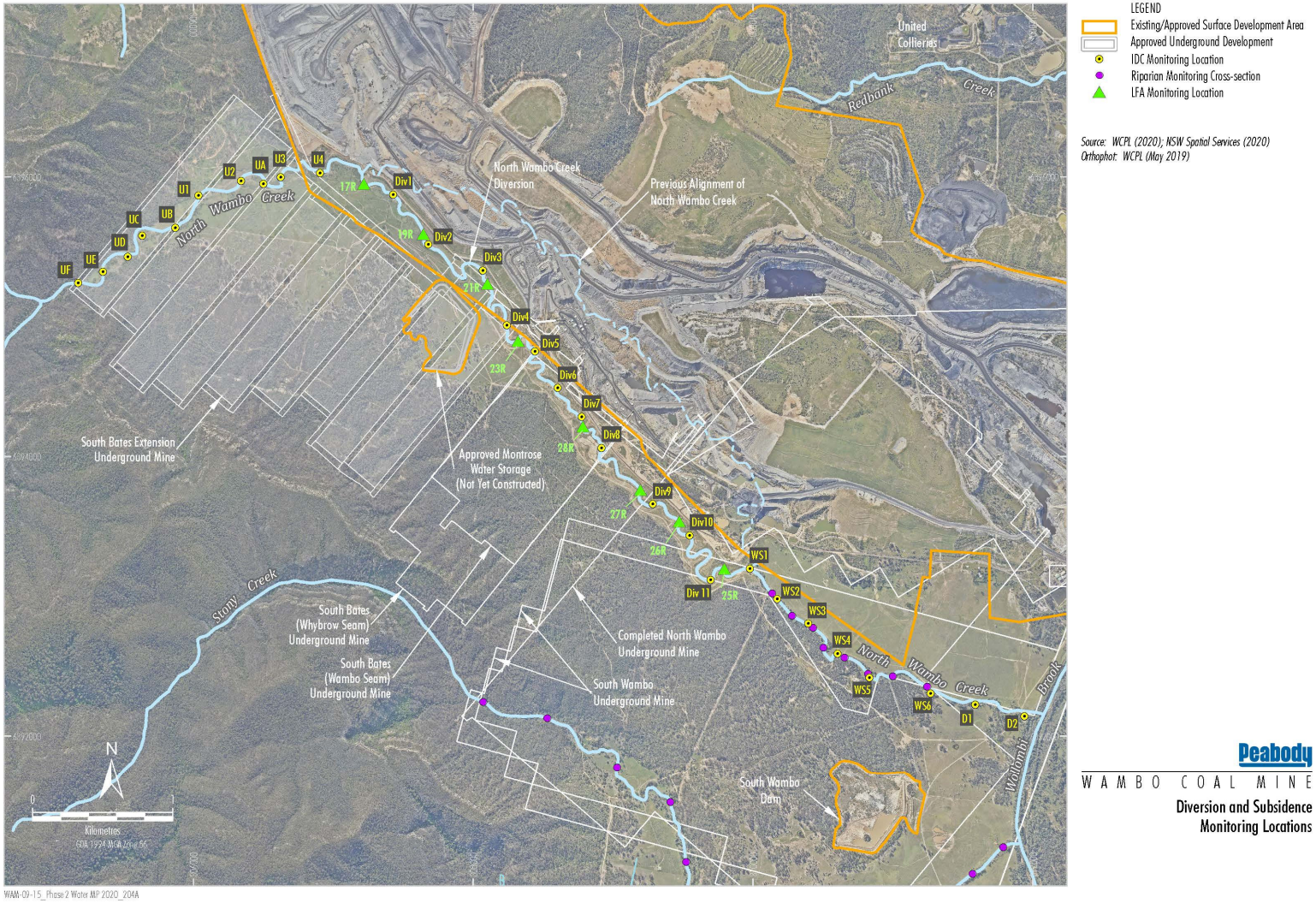


Figure 11: Diversion and Subsidence Monitoring Locations

6.1.9 Monitoring of Licensed Discharges under EPL 529 and the HRSTS

Wambo are required to monitor water quality and volume for licensed discharges at monitoring location SW15 (EPL ID No. 4) and SW53 (EPL ID No. 19) in accordance with the licensed discharge limits and requirements detailed in **Table 13** and relevant monitoring conditions of EPL 529 and the HRSTS (refer **Appendix C**). These monitoring requirements include:

- Ensuring continuous operation and maintenance of communication equipment which makes the conductivity and flow measurements taken at EPL ID No. 4 (SW15) available to the "Service provider" within one hour of those measurements being taken and makes them available in the format specified in the *"Hunter River Salinity Trading Scheme Discharge Point Site Equipment"* (DLWC, 2002);
- Ensuring that all monitoring data is within a margin of error of 5% for conductivity measurements and 10% for discharge flow measurement and
- Marking monitoring point EPL ID No. 4 (SW15) with a sign which clearly indicates the name of the licensee, whether the monitoring point is up or down stream of the discharge point and that it is a monitoring point for the HRSTS.

6.1.10 Monitoring of Flows into Underground and Open Cut Mines

The water quality of inflows to the underground workings are measured indirectly through monthly water quality monitoring of mine water storages (refer ***WMProg***). This is the most practical method to routinely sample for water quality.

An unexpected increase in water make or change in water quality of mine water storages would be investigated in consultation with United Wambo. If warranted, direct measurement of water quality at the source of inflow may be conducted.

Monitoring of flows into the open cut workings is undertaken by United Wambo in accordance with the United Wambo Water Management Plan.

Data from this monitoring is used for operational purposes and is reported internally as required. Data from this monitoring is also incorporated into the ***SWB***.

6.1.11 Monitoring of Water Supply for Other Water Users

As the project is likely to have minor to negligible impacts on water users relative to the current approved impacts immediately downstream of the mine (Umwelt 2016a), no specific monitoring is proposed for other water users in addition to the monitoring program for surface water flows and quality monitoring detailed in **Sections 6.1.1 and 6.1.3** of this SWMP.

6.1.12 Water Balance Monitoring

As part of the site water balance monitoring, water imported to site, water used onsite and water discharged from site will be monitored in accordance with *Water Reporting Requirements for Mines* (NOW undated).

6.2 Sampling Methodology

Surface water quality sampling and analysis is conducted in accordance with *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales (DEC, 2004); Australian Standard/New Zealand Standard (AS/NZS) 5667:1998 Parts 1, 4 and 6*; and the requirements of the HRSTS.

6.3 Data Management Procedures

Validated data from the monitoring program will be entered into a digital database by an Environmental Advisor. This renders the data in a form suitable for analysis.

WCPL will record the following details for all surface water monitoring samples:

- The date(s) and times on which the sample was taken;
- The point at which the sample was taken; and
- The name of the person who collected the sample.

In the event of a suspected anomalous result, WCPL will conduct a re-test as soon as is practicable to do so.

6.4 Data Review and Investigation

Upon receipt of monitoring results, the following review processes will be undertaken:

- Data will be compared to the impact assessment criteria where applicable (**Section 4.0**).
- If result(s) do not meet impact assessment criteria a response procedure will be initiated in accordance with **Section 7.0**.

WCPL will undertake an annual review of monitoring data and compare the results to the surface water impact assessment criteria detailed in **Section 4.0**. Results of the review will be included in the Annual Review (**Section 9.2.1**).

When monitoring results exceed the impact assessment criteria or the annual review identifies surface water impacts, an investigation appropriate for the situation will be launched to determine the cause. The investigation will include comparison of monitoring results, meteorological patterns, mining activities and changes to land use. Further details outlining these response procedures are outlined in **Section 7.0**.

7.0 Surface Water Response Plan

7.1 Adaptive Management

Potential surface water impacts are detailed in the *Wambo Development Project Environmental Impact Statement* (EIS) (Wambo Coal, 2003), *The North Wambo Underground Mine Modification Environmental Assessment* (Resource Strategies, 2012) and the *United-Wambo Project Environmental Assessment* (Umwelt, 2016).

The Wambo Water Management Plan, of which this SWMP forms a part, has been developed to manage and monitor water related risks associated with the Wambo Coal Mine, to minimise the risk of exceedances of the criteria and/or performance measures detailed in the relevant development consents and licences. If an exceedance of these criteria and/or performance measures occurs, WCPL will, at the earliest opportunity:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to DPIE describing those options and any preferred remediation measures or other course of action; and
- Implement remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary.

7.2 Incident Definition

An incident is defined in DA305-7-2003 as:

An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance.

Incident reporting will be undertaken in accordance with **Section 9.2.4.**

7.3 Impacts on Surface Water

Surface water is monitored at over 20 locations across Wambo, including flow monitoring and water quality. Monitoring of mine water storage dams is also undertaken on a monthly basis. WCPL has developed a number of triggers for water quality and flow (refer **Section 4.0**). Licensed discharges from site must also meet the Discharge Criteria specified in EPL 529 (refer **Table 13**).

As detailed in Wambo's 2003 EIS, the potential surface water impacts include:

- Connective cracking between North Wambo Creek and the underground workings;
- Reduction in water quality due to increased sedimentation and potential EC impacts; and
- Reduction of contributing catchments to North Wambo Creek, Waterfall Creek and Redbank Creek due to open cut mining.

Connective cracking was identified in the EIS as the highest risk to surface water flows. However, there has been no evidence of connecting cracking following the subsiding of North Wambo Creek by Longwall panels 1 and 2. In 2008, prior to Longwall 1, a specific *North Wambo Creek Subsidence Response Strategy* (NWCSRS) was prepared in consultation with the Resource Regulator, EPA and DPIE.

If routine monitoring identifies evidence of potential surface water impacts, an investigation will be undertaken as soon as possible. The investigation will include a detailed review of relevant monitoring data trends and climatic information along with operational activities, to determine if the impact on surface water is a result of Wambo's activities.

If the investigation identifies actual surface water impacts and attributes those impacts to Wambo's activities, WCPL will implement the adaptive management process in **Section 7.0**. Appropriate remediation measures will be developed and implemented in consultation with relevant government agencies and affected landowners, as required.

The outcomes of this process will be reported in the Annual Review (**Section 9.2.1**). If an incident is deemed to have occurred (**Section 7.2**) WCPL will notify and report to DPIE and any other relevant government departments in accordance with **Section 9.2.4.**

7.3.1 Trigger Action Response Plans

WCPL has developed a number of TARPs for impacts on surface water. These TARPs were developed and included in the ***SGWRP.*** As the ***SGWRP*** is no longer required under the modified DA305-7-2003 (Modification 16), WCPL has incorporated the relevant surface water TARPs into this SWMP. TARPs were developed in consultation with DPIE Water. Evidence of this consultation is included in **Appendix A**.

7.3.1.1 Impacts on Surface Water Flows

WCPL has developed a TARP that must be implemented in the event that:

- After rainfall exceeding 20mm in 24hr, visual observations during flow events within either South Wambo Creek or Stony Creek, identifies a potential variance in flow rates between upstream and downstream flow monitoring stations; or
- After rainfall exceeding 100mm in 24hr, visual observations during flow events within North Wambo Creek, identifies a potential variance in flow rates between upstream and downstream flow monitoring stations; or
- The initial calculated theoretical flow rates identifies a potential loss of flow between upstream and downstream flow monitoring stations within either North Wambo Creek, South Wambo Creek or Stony Creek.

This TARP is summarised in **Table 19.**

Table 19: TARP for Impacts on Surface Water Flows

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•After rainfall exceeding 20mm in 24hr, visual observations during flow events within either South Wambo Creek or Stony Creek, identifies a potential variance in flow rates between upstream and downstream flow monitoring stations; or •After rainfall exceeding 100mm[1], visual observations during flow events within North Wambo Creek, identifies a potential variance in flow rates between upstream and downstream flow monitoring stations	•The initial calculated theoretical flow rates identifies a potential loss of flow between upstream and downstream flow monitoring stations within either North Wambo Creek, South Wambo Creek or Stony Creek.

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Action	•Confirm actual flow event by observing creek flows at upstream and downstream locations. •Download flow monitoring data from flow monitoring stations at the completion of the flow event. •Check flow monitoring equipment for functionality; •Review recent climatic conditions and rainfall data recorded from meteorological station. •Calculate theoretical flow rates from flow monitoring stations to compare upstream and downstream flow rates. •If the initial calculation of the theoretical flow rates identifies a potential loss of flow when comparing the upstream and downstream flow rates, then go to Level 2 Response.	•Maintain surface flow monitoring to identify if creek flow rates have returned to statistical trends. •Undertake preliminary investigation as soon as possible, including: -Engaging a suitable qualified hydrologist to confirm if a loss of the calculated theoretical flow rates between upstream and downstream flow monitoring stations has occurred; -Review location of rainfall event/s that may have contributed to creek flow variability within the creek catchment; -Check flow monitoring equipment for functionality; -Review pumping volumes from the South Bates Underground Extension Mine to examine pumping trends; and -Provide pumping volumes from underground workings to groundwater specialists for review.
Plan		•If confirmation of a flow loss which is greater than modelled has occurred, Wambo will notify the relevant government agencies and in consultation develop appropriate measures to mitigate the loss of surface water flows in the surface water streams (e.g. stream remediation techniques) as soon as possible. •Review and update the WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

Notes to **Table 19**

1 As outlined in Table 14

7.3.1.2 Impacts on Surface Water Quality

WCPL has developed a TARP that must be implemented in the event that:

- Surface water monitoring of Wollombi Brook, North Wambo Creek, South Wambo Creek, Stoney Creek or Waterfall Creek for pH, EC and TSS, identifies water quality results exceeding the Trigger Value, as identified in **Table 14**, after two consecutive sampling events.

This TARP is summarised in **Table 20.**

Table 20: TARP for Impacts on Surface Water Quality

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Surface water monitoring of Wollombi Brook, North Wambo Creek, South Wambo Creek, Stoney Creek or Waterfall Creek for pH, EC and TSS, identifies water quality results exceeding the Trigger Value, as identified in **Table 14**, after two consecutive sampling events.	•Surface water monitoring of Wollombi Brook, North Wambo Creek, South Wambo Creek, Stoney Creek or Waterfall Creek for pH, EC and TSS, identifies water quality results exceeding the Trigger Value, as identified in **Table 14**, after three consecutive sampling events.
Action	•Increase monitoring of surface water site(s) to fortnightly to identify if water quality results are trending back to long term averages as identified in **Table 14**.	•Maintain monitoring of surface water sites to identify if water quality results are trending back to long term averages as identified in **Table 14**. •Undertake preliminary investigation as soon as possible, including:

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
	•If any water quality exceeds the Trigger Value (three consecutive samples), then go to Level 2 Response.	-Determine contributing factors including meteorological conditions, if an incident has potentially occurred, review location of operational activities etc. -Where appropriate, engage a suitable qualified aquatic ecologist or similar to investigate the aquatic environment; -Increase monitoring frequency where relevant; and -Develop corrective/preventative actions based on the outcomes of the investigation and/or additional monitoring.
Plan		•If confirmation of a results above confirms impacts to water quality have occurred as a direct result from Wambo's operations, WCPL will notify the relevant government agencies and in consultation develop appropriate remedial measures as soon as possible. •Review and update the WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

7.3.1.3 Breach of EPL 529 Limits

WCPL has developed a TARP that must be implemented in the event that:

- Monitoring at the Licenced Discharge Point (LDP) confirms pH, EC, TSS or discharge volumes are approaching or have exceeded discharge limits as identified in **Table 13**; and/or
- There is potential evidence of an unauthorised discharge or an uunauthorised discharge event has occurred; or
- Wambo has failed to monitor at the LDP as identified in the SWMP and EPL 529.

This TARP is summarised in **Table 21.**

Table 21: TARP for Breach of EPL 529 Limits

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Monitoring at Licence Discharge Point (LDP) confirms pH, EC, TSS or discharge volumes are approaching discharge limits as identified in **Table 13**; and/or •Potential evidence of an unauthorised discharge	•A Level 2 Response has been triggered if: -Exceedance of EPL 529 pollution concentration limits; -Unauthorised discharge event has occurred; -Exceedance of EPL 529 discharge volume limit; or -Failure to monitor at LDP as identified in EPL 529.
Action	•Maintain monitoring at LDP to confirm pH, EC, TSS remain within discharge limits. •Prepare to cease discharging: -If water quality values for pH, EC and TSS continue to trend towards an exceedence of their respective discharge water quality criteria; and -If daily discharge volumes continue to trend towards an exceedence of the daily discharge water volume criteria. •If there is an exceedence of the pH, EC, TSS criteria and/or discharge	•If monitoring at Licence Discharge Point (LDP) confirms any of the Level 2 Responses have been triggered, WCPL will: -Cease discharge immediately; -Initiate ***PIRMP***; -Initiate an investigation to determine contributing factors including meteorological conditions, if an incident has potentially occurred, review location of operational activities, equipment failure etc; -Provide report within seven days to the EPA and DPIE and other relevant government agencies; -Increase monitoring frequency where relevant;

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
	volume limit then go to Level 2 Response. •If there is evidence of an unauthorised discharge go to Level 2 Response.	-Develop corrective/preventative actions based on the outcomes of the investigation and/or additional monitoring; and -Undertake additional monitoring (stream health monitoring, etc.) if necessary.
Plan		•Implement appropriate contingency and remedial measures, including follow-up monitoring, auditing and advice from relevant government agencies. •Communicate results of investigation and subsequent contingency and remedial measures to relevant government agencies. •Review and update the WMP and SWMP and resubmit to DPIE within 3 months, or as otherwise agreed.

7.3.1.4 Impacts on North Wambo Creek Alluvium

WCPL has developed a TARP that must be implemented in the event that:

- Groundwater monitoring of standing water levels in the proposed replacement bores within the North Wambo Creek alluvium, identifies standing water trigger levels, beyond predicted modelled impacts; and/or
- Monitoring of aquatic ecosystems in accordance with the Biodiversity Management Plan identifies a potential or actual decline in aquatic health, beyond natural fluctuations; and/or
- Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the Biodiversity Management Plan identifies a potential or actual decline in creek stability, beyond natural fluctuations; and/or

This TARP is summarised in **Table 22.** This TARP is also supported by the TARP in the ***GWMP*** related to water licensing.

Table 22: TARP for Impacts on North Wambo Creek Alluvium

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Groundwater monitoring of standing water levels the proposed replacement bores within the North Wambo Creek alluvium, identifies a groundwater level below the minimum observed groundwater level during the first 12 months of monitoring; and/or •Monitoring of aquatic ecosystems in accordance with the ***BMP*** identifies a potential decline in aquatic health, beyond natural fluctuations; and/or •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a potential decline in creek stability, beyond natural fluctuations.	•Groundwater monitoring of standing water levels in the proposed replacement bores within the North Wambo Creek alluvium, identifies more than two consecutive groundwater levels below the minimum observed groundwater level during the first 12 months of monitoring; and/or •Monitoring of aquatic ecosystems in accordance with the ***BMP*** identifies a decline in aquatic health in consecutive monitoring events, beyond natural fluctuations; and/or •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a decline in creek stability in consecutive monitoring events, beyond natural fluctuations.
Action	•Maintain monitoring of bores within the North Wambo Creek alluvium, for	•Maintain monitoring of GW08.2, GW09.2, GW16 and GW17 within the North Wambo Creek alluvium, for standing

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
	standing water levels, to identify if decreasing trends have stabilised and bores display signs of increasing trends. •Review recent rainfall data to identify potential correlation between decreasing water level trends and extended dry periods. •Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •If standing water levels exceed standing water trigger values (consecutively) as provided in the ***GWMP***, then go to Level 2 Response. •If consecutive LFA and aquatic ecosystems monitoring events show continued decline trends and are displaying no signs of improving trends, then go to Level 2 Response.	water levels to identify if decreasing trends have stabilised and bores display signs of increasing trends. •Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •If decreasing standing water level trends are maintained and/or LFA and aquatic ecosystems are in decline and/or a significant increase of alluvium flows into the open cut has been identified, WCPL will undertake preliminary investigation, including: -Engage groundwater specialist to review relevant groundwater monitoring results in conjunction with site activities being undertaken at the time, baseline groundwater monitoring results, groundwater results at nearby locations, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken in the contributing hydrogeological regime; -Review the site water balance and groundwater model; -Engage ecologist to review LFA and aquatic monitoring results in conjunction with site activities being undertaken at the time, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken. -Develop corrective/preventative actions based on the outcomes of the investigation.
Plan		•If investigation confirms impacts to alluvium are greater than modelled, WCPL will notify the relevant government agencies and in consultation develop appropriate remedial measures. •Develop corrective/preventative actions based on the outcomes of the investigation for example: -Secure additional water licences to account for the estimated future inflows (if applicable). •Review and update the SWMP[1] and resubmit to DPIE within 3 months, or as otherwise agreed.

Notes to **Table 22:**
1. GWMP and United Wambo Water Management Plans may also require review/revision and resubmission to DPIE.

7.3.1.5 North Wambo Creek Diversion Performance Criteria

WCPL manages the North Wambo Creek Diversion in accordance with the ***NWCD MP***. Management controls have been designed and implemented to minimise erosion and the potential for sediment generation and loss from the system however there is still a risk that erosion and sediment deposition may impact on North Wambo Creek water quality. Management controls are discussed in detail in the ***ESCP*** and the ***NWCD MP***.

WCPL has developed a TARP that must be implemented in the event that:

- Surface water monitoring of North Wambo Creek, for pH, EC and TSS, identifies water quality results exceeding the Trigger Value, as identified in **Table 15** after two consecutive sampling events; and/or
- Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a potential decline in creek stability, beyond natural fluctuations.

This TARP is summarised in **Table 23.**

Table 23: TARP for North Wambo Creek Diversion Performance

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Surface water monitoring of North Wambo Creek, for pH, EC and TSS, identifies water quality results exceeding the Trigger Value, as identified in **Table 15** after two consecutive sampling events; and/or •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a potential decline in creek stability, beyond natural fluctuations.	•Surface water monitoring of North Wambo Creek for pH, EC and TSS, identifies water quality result exceeding the Trigger Value, after three consecutive sampling events. •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with ***BMP*** identifies a decline in creek stability in consecutive monitoring events, beyond natural fluctuations.
Action	•Review recent rainfall data to identify potential correlation between decreasing water level trends and extended dry periods. •Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •Maintain monitoring of surface water sites to identify if water quality results are trending back to long term averages as identified in **Table 9**. •If consecutive LFA and aquatic ecosystems monitoring events show continued decline trends and displaying no signs of improving trends, then go to Level 2 Response. •If any water quality exceeds the 80th Percentile Trigger Value (three consecutive periods), then go to Level 2 Response.	•Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •Wambo will undertake preliminary investigation as soon as possible, including: -As above for Surface Water Quality -An investigation and engage ecologist specialist to review LFA monitoring results in conjunction with site activities being undertaken at the time, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken.
Plan		•If confirmation of a results and investigations from above confirms impacts, Wambo will notify the relevant government agencies and in consultation develop appropriate remedial measures if required. •Review and update the WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

7.3.2 Compensatory Water Supply

WCPL is required to provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with DPIE Water, and to the satisfaction of the Planning Secretary.

Compensatory water supply arrangements will be negotiated in consultation with the affected landowner(s) and DPIE Water as required, in accordance with Conditions B56 – B59 of DA305-7-2003.

7.3.3 Impacts on Groundwater Dependent Ecosystems or Riparian Vegetation

An aquatic ecosystems monitoring program has been developed to detect any potential changes in aquatic biology in accordance with the ***BMP*** within North Wambo Creek, Wambo Creek and Stony Creek and the North Wambo Creek Diversion.

Annual channel stability surveys are also undertaken to monitor the quantity and quality of riparian vegetation along North Wambo Creek and North Wambo Creek Diversion to determine the need for any maintenance and/or contingency measures (refer **Section 6.1.6**). This program and the development of stream health triggers (for water quality, stability and alluvium) are discussed in the ***NWCD MP*** and the ***BMP***.

In the event that deterioration is identified in groundwater dependent ecosystems during stream health monitoring or annual channel stability surveys, the processes outlined above will be implemented.

7.3.4 Unforeseen Impacts

In the event that any unforeseen surface water impacts are detected, the following general response procedure will be initiated:

- Check and validate the data/information which indicates an unforeseen impact;
- Notify DPIE, EPA and other relevant agencies immediately after becoming aware of the impact;
- In the event of a suspected anomalous monitoring result, conduct a resample/retest where possible;
- Review the unforeseen impact, including consideration of:
    - Any relevant monitoring data; and
    - Current mine activities and land management practices in the relevant catchment, including other mining activities;
- Commission an investigation by an appropriate specialist into the unforeseen impact;
- Provide a preliminary investigation report to DPIE, EPA and relevant agencies within 7 days of identifying the unforeseen impact;
- Implement appropriate contingency/remedial measures;
- Implement additional monitoring to measure the effectiveness of the mitigation measures, where necessary;
- Communicate results of investigation and subsequent contingency and remedial measures to government agencies as required; and
- Review and update the WMP and SMWP and resubmit to DPIE.

7.4 Failure to Comply with Other Statutory Requirements

Statutory requirements relating to this SWMP are summarised in **Section 2.0.** These requirements include compliance with DA305-7-2003, DA177-8-2004 and EPL 529.

WCPL monitors compliance with these statutory requirements on an ongoing basis, including during regular reviews and reporting of blast monitoring data and as part of Annual Reviews and compliance audits (e.g. Independent Environmental Audits).

In the event that WCPL identifies a failure to comply with a statutory requirement (other than those relating to unpredicted impacts – refer **Section 7.3**), WCPL will:

- Undertake an investigation into the failure;

- Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and
- Report the non-compliance in accordance with the requirements of the development consents and EPL 529.

8.0 Community Complaint Response

All surface water related community complaints received by WCPL will be recorded within the Community Complaints Register. The Environment and Community (E&C) Manager (or delegate) will investigate the complaint, which will include, where possible, contacting the complainant within 24 hours to discuss the complaint. A review of the effectiveness of the corrective or preventative actions will be conducted within a month of the complaint and the relevant work procedures updated if required.

Preliminary investigations will commence as soon as practicable upon receipt of a complaint to establish if WCPL is responsible. All efforts will be made to determine the likely causes contributing to the complainant's concerns.

WCPL will attempt to address the complainant's concerns such that a mutually acceptable outcome is achieved. If a mutually beneficial outcome cannot be reached, WCPL may refer the matter to the Planning Secretary for resolution.

Details of all community complaints will be included in the Monthly Environmental Monitoring Report. WCPL will retain a copy of the Community Complaints Register for at least four years. The E&C Manager (or delegate) will ensure the latest Community Complaints Register is posted on the WCPL website.

9.0 Review and Reporting

9.1 Review

9.1.1 Environmental Performance

The performance of the surface water monitoring program outlined in the SWMP be reviewed annually as part of the Annual Review (see **Section 9.2.1**).

9.1.2 Management Plan Review

This SWMP will be reviewed, and if necessary revised, with any review of the ***WMP*** (refer Section 9.1 of the ***WMP***).

The SWMP will reflect any changes in environmental requirements, technology, and operational procedures.

The revised SWMP will be re-submitted to the Secretary for approval as required by Condition B66 of DA305-7-2003.

9.2 Reporting

9.2.1 Annual Review

The WCPL E&C Manager will be responsible for reporting any significant findings regarding the implementation of this SWMP in the WCPL Annual Review. The Annual Review report will include details of:

- results from the monitoring network;
- water extracted or discharged from the site, including water taken under each water licence;
- predictions versus actual results and licensing requirements; and
- any additional monitoring sites that may be required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suites should be undertaken.

Further detail on reporting for the Annual Review is included in Section 9.1 of the ***WMP.***

Reporting on the performance of the North Wambo Creek diversion channel will also be included in the Annual Review, in accordance with DPIE Water requirements (**Table 6**).

9.2.2 EPL 529 Annual Return

WCPL will prepare and submit an Annual Return in the approved form comprising a certified Statement of Compliance and a signed Monitoring and Complaints Summary to the EPA at the end of each EPL reporting period.

The Annual Return for the reporting period will be supplied to the EPA by registered post not later than 60 days after the end of each reporting period. WCPL will retain a copy of the Annual Return for a period of at least four years after the Annual Return was due to be supplied to the EPA.

The sewage treatment system maintenance program required by Condition O2.6 of EPL 529 (**Section 5.4**) will be submitted annually to the EPA with the Annual Return.

9.2.3 HRSTS Reporting

WCPL will compile a written report of the activities under the HRSTS for each scheme year i.e. 1 July to 30 June. The written report will be submitted to the EPA' s regional office within 60 days after the end of each scheme year and will be in a form and manner approved by the EPA. The information will be used by the EPA to compile an annual scheme report.

9.2.4 Reporting of Incidents

Reporting of environmental incidents will be undertaken in accordance with Section 9.2.4 of the ***WMP***.

9.2.5 Reporting of Results

A comprehensive summary of the surface water monitoring results will be made publicly available at WCPL's website (refer Section 9.2.7 of the ***WMP***).

10.0 Responsibilities

Table 24 below summarises responsibilities documented in the SWMP. Responsibilities may be delegated as required.

Table 24: SWMP Responsibilities

No	Task	Responsibility	Timing
1	Ensure inspections and surface water monitoring is undertaken in accordance with **Sections 5.10** and **6.0**.	Senior Environmental Advisor	As required
2	Assess surface water monitoring data against relevant criteria listed in **Section 4.0**	Senior Environmental Advisor	As required
3	Review SWMP in accordance with **Section 9.0**.	Senior Environmental Advisor	Annually
4	Undertake internal surface water reporting.	Senior Environmental Advisor	Monthly/Quarterly
5	Notify government departments if an incident occurs in accordance with **Section 9.2.4**	E&C Manager	As required
6	Submit updated SWMP to DPIE.	E&C Manager	As required
7	Surface water related complaints to be responded to in accordance with **Section 8.0**	E&C Manager	As required
8	Annual Review to include surface water monitoring results, complaints, mitigation measures undertaken and a review of the monitoring undertaken	E&C Manager	Annually
9	Regulator review to be undertaken of the SWMP	E&C Manager	As required
10	Prepare investigation reports and implementation of corrective actions in accordance with **Section 7.0**	E&C Manager	As required
11	Prepare and submit EPL Annual Return (including STP maintenance documents and results) in accordance with EPL 529.	E&C Manager	Annually
12	Prepare and submit HRSTS report for scheme year i.e. 1 July to 30 June in accordance with EPL 529.	E&C Manager	Annually (by end August)

11.0 References

- AECOM (2018) Report on Flow Events along North Wambo Creek, South Wambo and Stoney Creeks for the period 1 February 2017 to 31 January 2018
- Alluvium (2018) North Wambo Creek baseline assessment geomorphic context statement by Alluvium Consulting for Wambo Coal Pty Ltd.
- Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra.
- Development Consent (DA305-7-2003)
- Development Consent (DA177-8-2004)
- Geoterra (2005) United Collieries Pty Ltd Surface and Groundwater Monitoring to December 31 2004.
- Gilbert and Associates (2003) Wambo Development Project Surface Water Impact Assessment.
- Hansen Bailey (2018). Independent Environmental Audit Report for Wambo Coal Pty Ltd, September 2018.
- HEC (2016). United Wambo Open Cut Coal Mine Project Surface Water Assessment Water Balance Report, Prepared for Umwelt (Australia) Pty Ltd.
- HLA-Envirosciences Pty Ltd (1999) Effect of Longwall Panel 9 Mining on Surface and Groundwater – Homestead Underground Mine Warkworth NSW.
- ID&A Pty Ltd (2001) Monitoring & Evaluation Program for Bowen Basin River Diversions. Australian Coal Association Research Program (ACARP) Project C9068.
- Mackie Environmental Research (MER) (2002), Extension of Warkworth Coal Mine Assessment of Environmental Impacts Surface & Groundwater Management Studies, on behalf of Warkworth Mining Limited.
- Resource Strategies (2003) Wambo Development Project Aquatic Assessment.
- Umwelt (2016). United Wambo Open Cut Coal Mine Project Environmental Impact Statement
- Umwelt (2016a). United Wambo Open Cut Coal Mine Project Surface Water Assessment, July 2016
- Wambo Environment Protection Licence (529)
- Wambo Development Project Environmental Impact Statement (EIS), July 2003
- WCPL (2008) North Wambo Creek Subsidence Response Strategy
- Wells Environmental Services (2011) Modification of DA 177-8-2004, Environmental Assessment, Locomotive Refuelling Station - Wambo Coal Rail Loop

APPENDIX A: Evidence of Consultation

Peabody

NSW GOVERNMENT | Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Mine
PMB 1
Singleton NSW 2330

20/11/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003-i)
Water Management Plan

I refer to the Wambo Water Management Plan (WMP), submitted in accordance with condition B66 of the approval for the Wambo Coal Mine (DA 305-7-2003-i). I understand that revisions to the WMP are required prior to Phase 2 of operations between the Wambo Coal Mine and United Wambo Joint Venture, which are scheduled to start on 1 December 2020.

I note that the WMP includes the following sub – plans:
- Site Water Balance;
- Salt Balance;
- Erosion and Sediment Control Plan;
- Surface Water Management Plan (including the North Wambo Creek Diversion Management Plan);
- Groundwater Management Plan; and
- Water Monitoring Plan.

The Department notes that the Site Water Balance, Salt Balance and Water Monitoring Program cover both the Wambo Coal Mine and United Wambo Joint Venture operations.

The Department has carefully reviewed the WMP and is satisfied that it adequately addresses the relevant requirements of the approval. Accordingly, the Planning Secretary has approved the WMP (Revision 2, November 2020) for Phase 2 of the operations. Please continue to operate in accordance with the previously approved WMP until Phase 2 commences.

Please also ensure that the approved plan is placed on the project website at the earliest convenience. If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Peabody

NSW GOVERNMENT | Planning, Industry & Environment

Ms Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton, NSW, 2330

02/09/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Endorsement of Water Expert

I refer to your letter dated 13 August 2020, requesting the Planning Secretary's approval of a suitably qualified person to prepare the Water Management Plan, required by condition B66 of the Wambo Coal Mine Development Consent (DA 305-7-2003).

This plan includes several sub-management plans including a Site Water Balance, Surface Water Management Plan, Monitoring Program, Groundwater Management Plan and Erosion and Sediment Control Plan. I also note that it is proposed to combine the Wambo and United Wambo (SSD 7142) Site Water Balance and Monitoring Program under condition A23(d). These joint aspects of the Water Management Plan would be prepared by Chris Bonomini from Umwelt Australia.

I note that previously endorsed experts for Wambo, Ms Claire Stephenson and Dr Noel Merrick from SLR and Mr Rohan Lucas from Alluvium will remain the endorsed experts for groundwater and the North Wambo Creek Diversion.

The Department has reviewed the nomination and information you have provided and is satisfied that all four experts are suitably qualified and experienced. Consequently, I can advise that the Planning Secretary approves the additional appointment of Chris Bonomini to prepare the relevant sections of the Water Management Plan alongside the existing endorsed experts.

If you wish to discuss the matter further, please contact Sarah Clibborn on (02) 82 896 184 or via email at sarah.clibborn@planning.nsw.gov.au.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Peabody

NSW GOVERNMENT | Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton NSW 2330

28/05/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Approval of Experts

I refer to your correspondence of 23 April, requesting the Secretary's approval of suitably qualified persons to prepare the following environmental management plans for the Wambo Coal Mine (DA 305-7-2003):

- Air Quality and Greenhouse Gas Management Plan, required by condition B46; and
- Groundwater Management Plan required by condition B66(v).

The Department has reviewed the nominations and information you have provided and is satisfied that the following experts are suitably qualified and experienced:

- Shane Lakmaker (Jacobs) – Air Quality; and
- Claire Stephenson (SLR Consulting) – Groundwater.

I note that the Department recently approved the following experts to prepare the Wambo Extraction Plan for Longwalls 21 – 22:

- Dr Noel Merrick, (SLR Consulting) – Groundwater;
- Mr Rohan Lucas, (Alluvium) – Surface water;
- Mr Peter Kuskie, (South East Archaeology) – Aboriginal Cultural heritage; and
- Mr Martin Sullivan, (Eco Logical Australia) – Biodiversity.

The Department is satisfied that these experts are also suitably qualified and experienced to assist in the preparation of site environmental management plans in their field of expertise.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely



Matthew Sprott
Director
Resource Assessments (Coal & Quarries)
as nominee of the Secretary

Peabody

NSW GOVERNMENT | Planning, Industry & Environment

Mr Peter Jaeger
Environment and Community Manager
Wambo Coal Pty Limited
PMB 1
Singleton NSW 2330

28/02/2020

Dear Mr Jaeger

Wambo Coal Project (DA 305-7-2003)
Endorsement of Experts

I refer to your letter dated 11 February 2020, requesting the Secretary's approval of suitably qualified persons to prepare the Extraction Plan for Longwalls 21 to 24 for the Wambo Coal Project (DA 305-7-2003).

The Department has reviewed the nominations and information you have provided and is satisfied that these experts are suitably qualified and experienced. Consequently, I can advise that the Secretary approves the appointment of the following experts to prepare the Extraction Plan for Longwalls 21 to 24:

- Mr Joshua Hunt (Resource Strategies) - Extraction Plan preparation;
- Mr James Barbato (Mine Subsidence Engineering Consultants) - Subsidence;
- Mr Rohan Lucas (Alluvium) - Surface Water;
- Dr Noel Merrick (SLR Consulting) - Groundwater;
- Mr Martin Sullivan (Eco Logical Australia) – Biodiversity; and
- Mr Peter Kuskie (South East Archaeology) - Aboriginal cultural heritage.

In relation the upcoming revisions of complex-wide management plans, to align with the commencement of United Wambo Phase 2, it is recommended that the Department's Water Group is consulted on this approach.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
A/Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Summary of Historic Stakeholder Consultation i.e. for WCPL's Surface Water Monitoring Program (versions 8 to 12)

SWMP Version	Consultation
8	• Version 8 provided to DPIE Water, Resource Regulator (formerly DRE), EPA and DPIE as part of an Extraction Plan submission in October 2015. • Comments were received from DPIE in October 2015. • Comments were received from DPIE Water in November 2015.
9	• Version 9 was approved by DPIE in November 2015.
10	• Version 10 was provided to DPIE Water and EPA in December 2016 for consultation. • Version 10 was provided to DPIE Water, Resource Regulator, EPA and DPIE as part of an Extraction Plan submission in January 2017. • Comments were received from DPIE in May 2017 and July 2017. • No comments were received from DPIE Water, Resource Regulator or EPA.
11	• Version 11 was submitted to DPIE for approval as a component of the Extraction Plan for South Bates Underground LW11-16. • DPIE Water provided comments in correspondence dated 17 December 2017. • In providing advice on MOD 17 to DA 305-7-2003, the Independent Expert Scientific Committee (IESC) made comments in correspondence dated 31 July 2017.
12	• Version 12 of the SWMP, which addressed IESC and DPIE comments following MOD17 approval and included a Summary of Commitments, was submitted to DPIE for approval in March 2018, as a component of the Extraction Plan for South Bates Underground Extension LW17-20. • Version 12 was approved on 4 June 2019.

Consultation for this SWMP (For Phase 2 Activities at the Wambo Coal Mine)

Stakeholder	Consultation
DPIE	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided to the DPIE via the DPIE - Major Projects Planning Portal 26 August 2020. Minor comments were received 18 November 2020 and are addressed in Version 2.
EPA	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided to the EPA 26 August 2020 via the DPIE - Major Projects Planning Portal. The EPA provided correspondence dated 4 September 2020 advising that it is not the role of the EPA to review management plans. No further comments received.
DPIE Water	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided to the DPIE Water via the DPIE - Major Projects Planning Portal 26 August 2020. DPIE requested the WMP be sent directly to nrar.servicedesk.@industry.com.au. A copy of the WMP was sent to NRAR 31 August 2020. No comments have been received.

Peabody

NSW EPA

DOC20/707501-2

Wambo Coal Pty Ltd
134 Jerrys Plains Road
WARWORTH NSW 2330

Returned via the Major Projects Portal

4 September 2020

Dear Sir/Madam

Wambo Open Cut Coal Mine Draft Water Management Plan (DA305-7-2003-i-PA-26)

Reference is made to your request on 28 August 2020 via the Department of Planning, Industry and Environment's major projects portal requesting the Environment Protection Authority (EPA) to review and comment on the draft Wambo Coal Mine Water Management Plan (WMP), Doc No. WA-ENV-MNP-509 incorporating Site Water Balance, Wambo erosion and sediment control plan, surface water management plan and groundwater management plan.

The EPA encourages the development of such plans to ensure that licensees have determined how they will meet their statutory obligations and designated environmental objectives.

Being a regulatory authority, the EPA's role is to set environmental management objectives rather than being directly involved in the development of strategies to achieve those objectives. Accordingly, the EPA has not reviewed this management plan.

If you have any questions about this matter, please contact Jenny Lange on 02 4908 6891 or by email to hunter.region@epa.nsw.gov.au

Yours sincerely

JOCK DUNCAN
Acting Unit Head
Regulatory Operations Regional North

Phone 131 555
Phone 02 9995 5555
(from outside NSW)

TTY 133 677, then
ask for 131 155

Locked Bag 5022
PARRAMATTA
NSW 2124

4 Parramatta Square
12 Darcy Street
PARRAMATTA NSW
2150

info@epa.nsw.gov.au
www.epa.nsw.gov.au
ABN 43 692 285 758

APPENDIX B: SWMP Summary of Commitments

Surface Water Management Plan (SWMP) (Version 1) – Summary of Commitments

Note: The list of commitments in this appendix is in addition to those explicitly required by Development Consent or EPL conditions.

SWMP Section	Commitment	Timing
1.3.1	The status of the **NWCD MP** will be reviewed during future SWMP updates.	During future SWMP updates
3.5	The site water balance will be recalculated on an annual basis and reported in the Annual Review.	Annually
3.5.1	Monitoring will continue to be undertaken for water salinity (EC) in accordance with the surface water monitoring program detailed in **Section 6.0** and included in the **WMProg**. Data from this monitoring program may be used to inform future salt balances for the site.	As per **WMProg**
	The salt balance will be reviewed annually as part of the site water balance and reported in the Annual Review.	Annually
4.0	Data from Wambo's surface water monitoring program will be compared against the established criteria. A review of the data against the criteria will determine if the surface water impact investigation procedure or Trigger Action Response Plans (TARPs) in **Section 7.0** should be initiated.	Ongoing
4.1.1	Mine water is discharged through the EPL 529 licensed discharge point, in accordance with the water quality discharge limits and requirements presented in **Table 13.**	Ongoing
4.2.4	WCPL will monitor surface water impacts from operations during the life of the mine. Water runoff from rehabilitated land will be managed as part of the site water management system.	Ongoing
4.2.5	WCPL will report against the following performance indicators in the Annual Review : • Number of complaints relating to surface water; • Number of non-compliances relating to surface water; • Number of exceedances of surface water impact assessment criteria; • Number of reportable environmental incidents relating to surface water.	Annually
	In the event that a complaint is received relating to surface water, it will be handled in accordance with the complaint's management protocol (**Section 8.0**).	As required
5.2	Water inflows and outflows, including any water shared, are reported annually as part of the Site Water Balance and Annual Review.	Annually
5.3	If/when South Wambo Dam is recommissioned, an OMM and DSEP will be developed and implemented in line with the requirements of the *Dams Safety Act 2015.*	If/when required
	WCPL will notify the NSW Dam Safety Committee when mining near prescribed dams.	Prior to mining near prescribed dams
	WCPL will confirm the draining of the Wambo South Dam prior to commencement of secondary workings underneath.	Prior to undermining
5.4	A copy of the quarterly maintenance reports and annual certification that the STP is operating within its capacity is submitted annually to the EPA with the EPL Annual Return.	Annually
5.5	Chemical and hydrocarbon products are stored in bunded areas onsite, in accordance with the relevant Australian Standard.	Ongoing

SWMP Section	Commitment	Timing
	In the event that a chemical and hydrocarbon spill occurs, or a bund requires emptying, WCPL will arrange for removal of contaminated material from site using a licensed waste contractor.	As required
	Pollution incidents will be managed in accordance with the **PIRMP**.	As required
5.7	A Site Water Balance will be completed each year as part of the Annual Review. A Salt Balance will also be prepared annually and reported in the Annual Review.	Annually
5.8	Implement management measures to address the risk of hydrocarbon storage at the Locomotive Provisioning Facility.	As required
5.8.4	All personnel involved in the use of hydrocarbons on the site are trained in the appropriate use of facility and emergency response measures.	Ongoing
	Complete monthly inspections, servicing and maintenance of the locomotive station along with visual inspections completed by locomotive drivers during refueling.	Monthly
	Replace absorbent spill control matting located between the tracks in the refuel area approximately every 18 months or as required.	As Required
5.9	The design, capacity and final location of these post mining water management structures will be refined and detailed in revised water management plans as the mine progresses towards mine closure.	Towards mine closure
5.10	Inspections of water management infrastructure, such as dams, sumps and sediment control structures, are undertaken in accordance with the Sediment Control Structure Checklist in the **ESCP**.	As per **ESCP**
	Inspections of the NWCD are also undertaken in accordance with the Extraction Plan monitoring schedule and include visual inspections for evidence of surface cracking and/or ponding.	As per Extraction Plan monitoring schedule
5.11	Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this SWMP, consent conditions, and other relevant approvals, licenses, and guidelines. Audit requirements are detailed in the **EMS**.	As per **EMS**
6.0	Data collected will: • Be used in the continued development of surface water investigation triggers; and • Provide input to annual reviews of surface water monitoring data and the site water balance and salt balance.	As required
6.1	Surface water monitoring will be conducted as outlined in **Section 6.0** and the **WMProg**.	Ongoing
	Monitoring results from creeks and waterways will be compared against the triggers in **Section 4.0.**	Ongoing
	The results of monitoring at the licenced discharge point will be compared against the EPL 529 criteria.	Following discharge
	Mine water monitoring is for operational purposes only and is not reported publicly.	Ongoing
	Data from the surface water monitoring is reported in the Annual Review.	Annually
6.1.1	Surface water quality monitoring will be conducted during flow periods, monthly and following more than 20 mm of rainfall in 24 hours.	As required
6.1.2	A number of mine water storage dams and pits are sampled monthly for water pH and EC. Data from this monitoring is used for operational purposes and is reported internally as required.	Monthly

SWMP Section	Commitment	Timing
	A number of key mine water storage dams are also monitored for water storage level. This data is used in the development of the annual Site Water and Salt Balance.	Ongoing
6.1.3	Flow monitoring on the Wambo Creek and North Wambo Creek, and Wollombi Brook (by DPIE Water) will continue to be undertaken on a continuous basis. The flow monitoring will be undertaken by Wambo, although this data will be shared with United.	Ongoing
6.1.4	A number of sediment dams are monitored for pH, EC and TSS on a monthly basis.	Monthly
	Any significant change in pH (in sediment dams) will trigger further analysis of metal/metalloid concentrations in runoff water.	As required
	If a monitoring result indicates that there has been a significant change in pH (i.e. >1 pH unit) in a sediment dam with the potential to discharge, WCPL will take a follow up sample to confirm the result. If this second result shows a significant change in pH then WCPL will arrange for the sample to be analysed for metals/metalloids. Further monitoring may be undertaken depending on the results of this analysis.	As required
6.1.5	Inspections of erosion and sediment control structures will be completed as outlined in the **ESCP**.	As required
6.1.6	Monitoring of riparian vegetation corridors and bed bank stability along North Wambo, South Wambo and Stony Creeks will be completed as outlined in the **BMP**.	Annually or as required
6.1.7	Monitoring and reporting of discharge flows in the North Wambo Creek Diversion (NWCD) will be completed in accordance with DPIE Water requirements and reported in the Annual Review.	Annually
6.1.8	The Diversion and Subsidence Monitoring Program (**Table 18**) will commence from 2017, the outcomes of which will inform recommendations to manage any identified issues with the condition of the NWCD.	As required
	Results of the operational monitoring program and the geomorphic condition of the NWCD will be reviewed annually.	Annually
	During implementation or mitigation rehabilitation works, records will be maintained including: • Description of activities; • Photographs (preferably from fixed photo points); and • Aerial photography within 12 months after works are completed.	Ongoing
6.1.10	WCPL will investigate any unexpected increase in water make or change in water quality of mine water storages and if warranted, commence direct measurement of water quality at the source of inflow.	As required
6.1.12	Water imported to site, water used onsite and water discharged from site will be monitored in accordance with *Water Reporting Requirements for Mines* (NOW undated).	Ongoing
6.3	Validated data from the monitoring program will be entered into a digital database by an Environmental Advisor.	Ongoing
6.4	Monitoring results will be compared to impact assessment criteria and if they do not meet the criteria, a response procedure will be initiated.	Ongoing
7.2	Incident reporting will be undertaken in accordance with **Section 8.6**.	As required
7.3	WCPL will respond to identified surface water impacts in accordance with the procedures and TARPs and processes described in **Section 7.3.**	As required

SWMP Section	Commitment	Timing
7.4	In the event that WCPL identifies a failure to comply with a statutory requirement, WCPL will: • Undertake an investigation into the failure; • Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and • Report the non-compliance in accordance with the requirements of the development consents and EPL 529.	As required
8.0	Surface water related community complaints will be recorded within the Community Complaints Register.	As required
8.0	Surface water related community complaints will be reported in the Monthly Environmental Monitoring Report.	Monthly
9.1.1	Review Wambo's performance against management measures outlined in the SWMP as part of the Annual Review	Annually
9.1.2	Review and, if necessary, revise the SWMP with any review of the **WMP**. Resubmit to DPIE as required.	As required
9.2.1	Report any significant findings regarding the implementation of this SWMP in the WCPL Annual Review.	Annually
	Report details of any incidents or non-compliances relating to surface water in the WCPL Annual Review.	Annually
	Reporting on the performance of the North Wambo Creek diversion channel in the Annual Review, in accordance with DPIE Water requirements (**Table 6**).	Annually
9.2.4	Report incidents as per the **WMP.**	As required

APPENDIX C: EPL Conditions relevant to this SWMP

<table>
<tr><th>EPL 529 Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>P1.3</td><td>The following points referred to in the table are identified in this licence for the purposes of monitoring and/or the setting of limits for discharges or pollutants to water from the point.
<table>
<tr><th>EPA ID No</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Location Description</th></tr>
<tr><td>4</td><td>Discharge of saline water under the Hunter River Salinity Trading Scheme (HRSTS)
Discharge quality
Volume monitoring</td><td>Discharge of saline water under the Hunter River Salinity Trading Scheme (HRSTS)
Discharge quality
Volume monitoring</td><td>HRSTS Outlet from Eagles Nest Dam at co-ordinates 313132 6393073 (Easting Northing) labelled as EPA4 on plan titled “Wambo Mine Environment Protection Licence 529 Plan of Premises – Monitoring Sites” DWG 2160-2 dated 3/3/2017 APE Ref DOC17/147944</td></tr>
<tr><td>9</td><td>Surface Water Monitoring</td><td></td><td>Surface water quality must be measured at locations representative of impacts likely to be experienced outside the premises as a result of the operation of the mine</td></tr>
<tr><td>18</td><td>Discharge quality monitoring</td><td>Discharge quality monitoring</td><td>STP Discharge monitoring point at coordinates 312057 6393219 (Easting and Northing) defined as STPD1 on plan titled “Wambo Mine Environment Protection Licence 529 Plan of Premises – Monitoring Sites” DWG 2160-2 dated 3/3/2017 APE Ref DOC17/147944</td></tr>
</table></td><td>Section 6.0 and WMProg</td></tr>
<tr><td>L1.1</td><td>Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.</td><td>Noted</td></tr>
<tr><td>L2.1</td><td>For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.</td><td>Noted</td></tr>
<tr><td>L2.2</td><td>Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.</td><td>Noted</td></tr>
<tr><td>L2.3</td><td>To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.</td><td>Noted</td></tr>
</table>

<table>
<tr><th>EPL 529 Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>L2.4</td><td>Water and/or Land Concentration Limits
<table>
<tr><th>Pollutant</th><th>Units of Measure</th><th>50 percentile concentration limit</th><th>90 percentile concentration limit</th><th>3DGM percentile concentration limit</th><th>100 percentile concentration limit</th></tr>
<tr><td>pH</td><td>pH</td><td></td><td></td><td></td><td>6.5-9.5</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams per litre</td><td></td><td></td><td></td><td>120</td></tr>
</table></td><td>Section 4.1</td></tr>
<tr><td>L3.1</td><td>For each discharge point or utilisation area specified below (by a point number), the volume/mass of:
a) Liquids discharged to water; or
b) Solids or liquids applied to the area
Must not exceed the volume/mass limit specified for that discharge point or area.
<table>
<tr><th>Point</th><th>Unit of Measure</th><th>Volume/Mass limit</th></tr>
<tr><td>4</td><td>Megalitres per day</td><td>250</td></tr>
</table></td><td>Section 4.1</td></tr>
<tr><td>O2.2</td><td>The licensee is responsible for the correct operation of the sewage treatment system on their premises.</td><td rowspan="9">Section 5.4</td></tr>
<tr><td>O2.3</td><td>Correct operation involves regular supervision and system maintenance. The licensee must be aware of the system management requirements and must ensure that the necessary service contracts are in place.</td></tr>
<tr><td>O2.4</td><td>The sewage treatment system must be serviced by a suitably qualified and experienced wastewater technician at least once in each quarterly period and a minimum of four times per year.</td></tr>
<tr><td>O2.5</td><td>The licensee must record each inspection an any actions required or recommended by the technician including all results of tests performed on the sewage treatment system by the technician as required in Condition O2.4.</td></tr>
<tr><td>O2.6</td><td>The licensee must prepare a sewage treatment system maintenance program. The program must include:
a) Certification from the system provider that the sewage treatment system is operating within its capacity;
b) Date, time and results of all routine maintenance procedures undertaken to the sewage treatment system; and
c) Provide written records of each quarterly inspection.</td></tr>
<tr><td>O4.1</td><td>Effluent application must not occur in a manner that causes ponding or surface runoff.</td></tr>
<tr><td>O4.2</td><td>Spray from the effluent application must not drift beyond the boundary of the effluent discharge utilisation area.</td></tr>
<tr><td>O4.3</td><td>The quantity of effluent/solids applied to the utilisation area must not exceed the capacity of the area to effectively utilise the effluent/solids.
For the purpose of this condition, ‘effectively utilise’ include the use of the effluent/solids for pasture or crop production, as well as the ability of the soil to absorb the nutrient, salt, hydraulic load and organic material.</td></tr>
</table>

<table>
<tr><th>EPL 529 Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>O4.4</td><td>The licensee must ensure that the effluent discharge utilisation area perimeter is fenced and signposted “Effluent Re-Use Area Keep Out” and controlled in a manner to ensure the exclusion of persons from that area.</td><td></td></tr>
<tr><td>M1.1</td><td>The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.</td><td rowspan="3">Section 6.3</td></tr>
<tr><td>M1.2</td><td>All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.</td></tr>
<tr><td>M1.3</td><td>The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.</td></tr>
<tr><td>M2.1</td><td>For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:</td><td rowspan="2">Section 6.0 and WMProg</td></tr>
<tr><td>M2.3</td><td>Water and/ or Land Monitoring Requirements
POINT 4
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Continuous during discharge</td><td>A probe designed to measure the range 0 to 10,000 uS/cm</td></tr>
<tr><td>pH</td><td>pH</td><td>Continuous during discharge</td><td>In line instrumentation</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Daily during any discharge</td><td>Grab sample</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>EPL 529 Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td></td><td>
POINT 9
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Conductivity</td><td>microsiemens per centimetre</td><td>Every 2 months</td><td>Grab sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Every 2 months</td><td>Grab sample</td></tr>
<tr><td>Total suspended solids</td><td>milligrams per litre</td><td>Every 2 months</td><td>Grab sample</td></tr>
</table>
POINT 18
<table>
<tr><th>Pollutant</th><th>Units of measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Faecal Coliforms</td><td>colony forming units per 100 millilitres</td><td>Quarterly during discharge</td><td>Grab sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Quarterly during discharge</td><td>Grab sample</td></tr>
</table>
</td><td></td></tr>
<tr><td>M3.2</td><td>Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.</td><td>Noted</td></tr>
<tr><td>M5.1</td><td>Recording of pollution complaints
The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.</td><td>Section 8.0</td></tr>
<tr><td>M5.2</td><td>The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.</td><td>Noted</td></tr>
<tr><td>M5.3</td><td>The record of a complaint must be kept for at least 4 years after the complaint was made.</td><td>Section 8.0</td></tr>
</table>

<table>
<tr><th>EPL 529 Condition</th><th>Requirements</th><th>Section</th></tr>
<tr><td>M5.4</td><td>The record must be produced to any authorised officer of the EPA who asks to see them.</td><td>Noted</td></tr>
<tr><td>M6.1</td><td>Telephone Complaints Line
The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.</td><td>Section 8.0</td></tr>
<tr><td>M6.2</td><td>The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.</td><td>Section 8.0</td></tr>
<tr><td>M7.1</td><td>Requirement to monitor volume or mass
For each discharge point or utilisation area specified below, the licensee must monitor:
a) the volume of liquids discharged to water or applied to the area;
b) the mass of solids applied to the area;
c) the mass of pollutants emitted to the air;
at the frequency and using the method and units of measure, specified below.
POINT 4
<table><tr><th>Frequency</th><th>Unit of Measure</th><th>Sampling Method</th></tr><tr><td>Continuous</td><td>megalitres per day</td><td>In line instrumentation</td></tr></table></td><td>Section 6.0 and WMProg</td></tr>
<tr><td>M9.1</td><td>HRSTS Monitoring
The licensee must continuously operate and maintain communication equipment which makes the conductivity and flow measurements, taken at Point 4 available to the ""Service provider"" within one hour of those measurements being taken and makes them available in the format specified in the ""Hunter River Salinity Trading Scheme Discharge Point Site Equipment"" as published by the Department of Land and Water Conservation on 7 May 2002.</td><td rowspan="3">Section 6.1.9</td></tr>
<tr><td>M9.2</td><td>The licensee must ensure that all monitoring data is within a margin of error of 5% for conductivity measurements and 10% for discharge flow measurement.</td></tr>
<tr><td>M9.3</td><td>The licensee must mark monitoring point(s) number 4, with a sign which clearly indicates the name of the licensee, whether the monitoring point is up or down stream of the discharge point(s) and that it is a monitoring point for the Hunter River Salinity Trading Scheme.</td></tr>
<tr><td>R1.1</td><td>Annual return documents
The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
1. a Statement of Compliance;
2. a Monitoring and Complaints Summary;
3. a Statement of Compliance - Licence Conditions;
4. a Statement of Compliance - Load Based Fee;</td><td>Section 9.2.2</td></tr>
</table>

EPL 529 Condition	Requirements	Section
	5. a Statement of Compliance - Requirement to Prepare Pollution Incident Response Management Plan; 6. a Statement of Compliance - Requirement to Publish Pollution Monitoring Data; and 7. a Statement of Compliance - Environmental Management Systems and Practices. At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.	
R1.2	An Annual Return must be prepared in respect of each reporting period, except as provided below.	
R1.5	The Annual Return for the reporting period must be supplied to the EPA via eConnect EPA or by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').	
R1.6	The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.	
R1.7	Within the Annual Return, the Statements of Compliance must be certified and the Monitoring and Complaints Summary must be signed by: a) the licence holder; or b) by a person approved in writing by the EPA to sign on behalf of the licence holder.	
R2.1	**Notification of environmental harm** Notifications must be made by telephoning the Environment Line service on 131 555.	**Section 9.2.4**
R2.2	The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred. Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.	**Section 9.2.4**
R3.1	**Written Report** Where an authorised officer of the EPA suspects on reasonable grounds that: a) where this licence applies to premises, an event has occurred at the premises; or b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence, and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.	**Section 9.2.4**
R3.2	The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.	**Noted**
R3.3	The request may require a report which includes any or all of the following information: a) the cause, time and duration of the event; b) the type, volume and concentration of every pollutant discharged as a result of the event; c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort; e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;	**Section 9.2.4**

EPL 529 Condition	Requirements	Section
	f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and g) any other relevant matters.	
R3.4	The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.	**Noted**
R4.1	HRSTS Reporting The licensee must compile a written report of the activities under the Scheme for each scheme year. The scheme year shall run from 1 July to 30 June each year. The written report must be submitted to the EPA' s regional office within 60 days after the end of each scheme year and be in a form and manner approved by the EPA. The information will be used by the EPA to compile an annual scheme report."	**Section 9.2.3**
R4.3	The sewage treatment system maintenance program required by Condition O2.6 must be submitted annually to the EPA with the Annual Return.	**Section 9.2.2**
R4.4	The licensee must retain a copy of each report required by Condition O2.5 for 3 years from the date each report is made.	**Noted**

APPENDIX D: North Wambo Creek Diversion Management Plan

WAMBO COAL
NORTH WAMBO CREEK DIVERSION MANAGEMENT PLAN

Document No. WA-ENV-MNP-509.6
July 2020

Document Control

Document No.	WA-ENV-MNP-509.6
Title	North Wambo Creek Diversion Management Plan
General Description	Management Plan for the North Wambo Creek Diversion
Document Owner	Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked	Signature
0	Sept 2007	Original Plan – developed for the construction of the North Wambo Creek diversion	WCPL		
1	April 2019	New plan for the ongoing management of the North Wambo Creek diversion	WCPL	ND	
2	July 2020	Incorporating feedback from Stakeholder consultation, DA305-7-2003 MOD 16 changes and updated remediation schedule	WCPL	ND	

CONTENTS

1.0 COMMITMENT AND POLICY 5

1.1 BACKGROUND 5
1.2 OBJECTIVES AND SCOPE OF THIS PLAN 6
1.3 NWCD BACKGROUND INFORMATION 6
1.4 REQUIREMENTS OF THIS PLAN 7
1.5 STAKEHOLDER CONSULTATION 8

2.0 PLANNING 10

2.1 ENVIRONMENT BASELINE 10
2.2 PREDICTED IMPACTS FROM UNDERGROUND MINING 18
2.3 BASEFLOW SEPARATION 18

3.0 IMPLEMENTATION 22

3.1 CONSTRUCTION OF THE NORTH WAMBO CREEK DIVERSION 22
3.2 REHABILITATION OBJECTIVES 23
3.3 REVEGETATION STRATEGY 23
3.4 MAINTENANCE AND REHABILITATION (2019 – 2024) 24
3.5 INTERCEPTED GROUNDWATER 33

4.0 MEASUREMENT AND EVALUATION 34

4.1 PERFORMANCE AND COMPLETION CRITERIA 34
4.2 MONITORING PROGRAM 36
4.3 TRIGGER ACTION RESPONSE PLANS 42
4.4 NON-COMPLIANCES WITH STATUTORY REQUIREMENTS 44
4.5 COMPLAINTS 44

5.0 REVIEW AND IMPROVEMENT 45

5.1 REPORTING 45
5.2 PLAN REVIEW 45

6.0 ACCOUNTABILITIES 46

7.0 ACRONYMS 47

8.0 REFERENCES 48

8.1 LEGISLATION 48
8.2 APPROVALS, MODIFICATION APPLICATIONS AND ASSESSMENTS 48
8.3 MANAGEMENT PLANS, PROGRAMS AND STRATEGIES 48
8.4 REPORTS 49
8.5 OTHER 50

Tables

Table 1: DA305-7-2003 Requirements for the NWCD 7
Table 2: Independent Audit Findings relevant to the NWCD 8
Table 3: Baseline Stream Flow in North Wambo Creek 13
Table 4: Flow monitoring stations on the North Wambo Creek 13
Table 5: Baseline Water Quality in North Wambo Creek (WCPL, 2003) 14
Table 6: Water Quality Results for North Wambo Creek 14
Table 7: LFA Results – Landscape Organisation Index 16
Table 8: LFA Results – Stability Index 16
Table 9: LFA Results – Infiltration 16
Table 10: LFA Results – Nutrient Index 17
Table 11. Summary of Streamflow Events in North Wambo Creek 19
Table 12: Five Year NWCD Rehabilitation and Maintenance Plan 26
Table 13: Geomorphological Response to Flood Events – Triggers and Success Criteria 34
Table 14: Performance Criteria for the North Wambo Creek Diversion 35
Table 15: Colour system devised to highlight the performance of each LFA site 35
Table 16: LFA targets for the NWCD 36
Table 17: Diversion Monitoring Program 37
Table 18: TARP for North Wambo Creek Diversion Performance – Surface Water* 42
Table 19: TARP for North Wambo Creek Diversion Performance – Biodiversity* 43
Table 20: Subsidence TARP for the North Wambo Creek Diversion 44
Table 21: Accountabilities 46
Table 22: Acronyms 47

Figures

Figure 1: North Wambo Creek Diversion Location 5
Figure 2: Wambo Water Management Plan Structure* 5
Figure 3: Location of Alluvium in Lower Reaches of Creeks 12
Figure 4: North Wambo Creek Surface Flow Monitoring Locations and Reduction in Catchment Area post Stage 3 Diversion. 19
Figure 5: Rainfall versus Stream Flow 20
Figure 6: North Wambo Creek - FM1 - Rainfall API versus Stream Stage Relationship 21
Figure 7: NWCD 2020-2021 Remediation Works 31
Figure 8: NWCD Instability Locations (as of 2019) 32
Figure 9: Diversion Surface Water Quality and Stream Flow Monitoring Program 40
Figure 10: Diversion and Subsidence Monitoring Program – Operational Monitoring 41

LIST OF APPENDICES

Appendix A NWCD Correspondence
Appendix B NWCD MP Commitments
Appendix C Detailed Rehabilitation Plan
Appendix D NWCD Revegetation Management Plan
Appendix E North Wambo Creek Subsidence Response Strategy

1.0 Commitment and Policy

1.1 Background

This North Wambo Creek Diversion Management Plan (this Plan) has been developed for management of the North Wambo Creek Diversion (NWCD) (**Figure 1**). The NWCD is the responsibility of Wambo Coal Pty Ltd (WCPL).

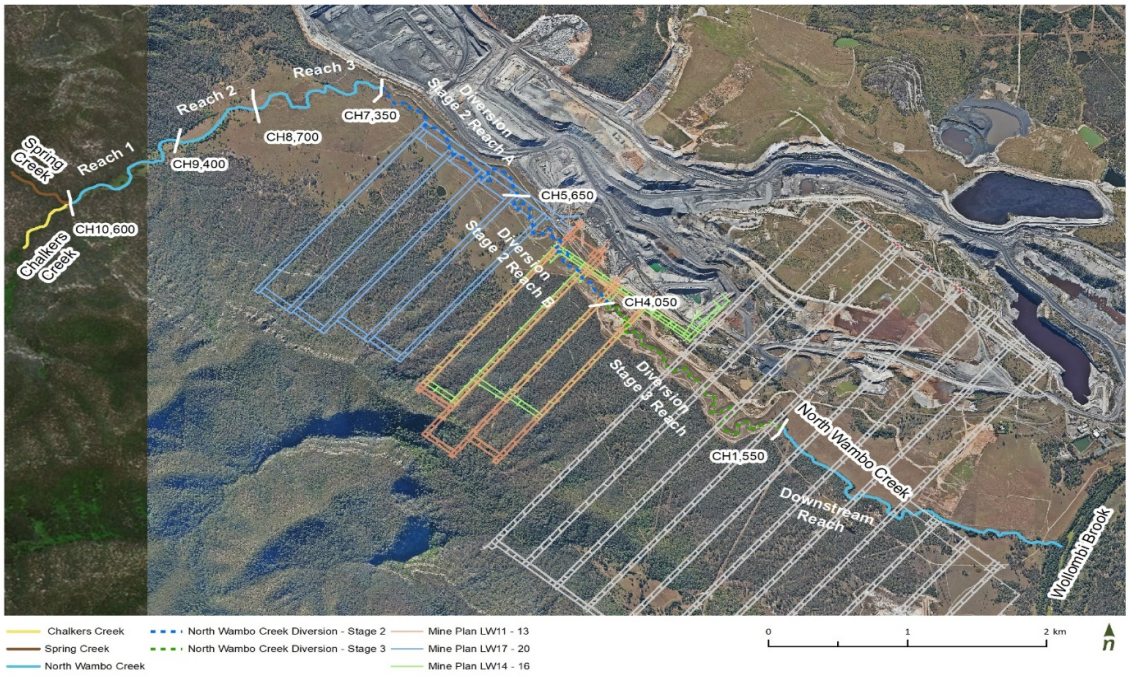


Figure 1: North Wambo Creek Diversion Location

This Plan is part of a set of documents that together form the ***Water Management Plan*** (WMP) for Wambo Coal Mine (Wambo) (refer to **Figure 2**). The WMP is one of a series of Environmental Management Plans that together form the Environmental Management System for Wambo.

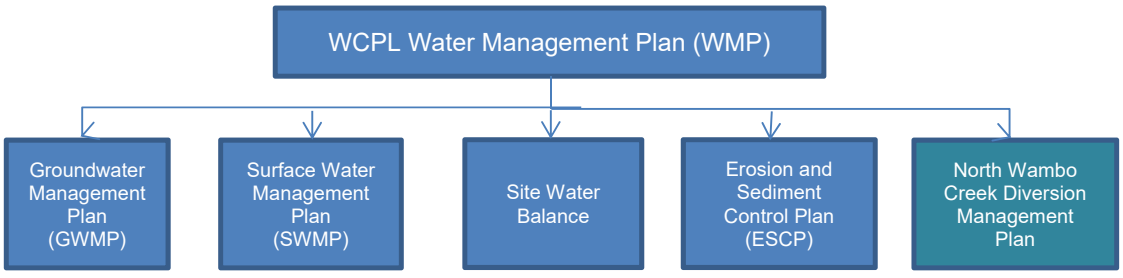


Figure 2: Wambo Water Management Plan Structure*

*This Plan also refers to the WCPL ***Surface and Groundwater Response Plan*** (SGWRP), which was required under Schedule 4 Condition 35 of DA305-7-2003 (Mod 17). As the SGWRP is no longer required under DA305-7-2003 (Mod 16, approved on 29 August 2019), relevant information from the SGWRP, including Trigger Action Response Plans for the NWCD, has been incorporated into this version of the Plan.

Other Wambo documents relevant to this Plan are the WCPL ***Biodiversity Management Plan*** (BMP), WCPL ***Environmental Management Strategy*** (EMS) and WCPL ***Mining Operations Plan*** (MOP).

Operations at Wambo currently consist of underground and open cut mining operations, as described in DA305-7-2003 (Mod 16) (Phase 1). Under Phase 2 operations, due to commence in late 2020, underground mining will continue at Wambo however the Wambo open cut will be managed by the adjacent United Wambo Open Cut Project. The responsibility for ongoing monitoring and management of the North Wambo Creek Diversion (NWCD) will remain with WCPL.

Mining operations at Wambo (during both Phase 1 and 2) include the integrated use of the Wambo coal handling and preparation plant, coal stockpiles and rail load-out facility.

1.2 Objectives and Scope of this Plan

The objectives of this Plan are to satisfy regulatory requirements and commitments for the rehabilitation and ongoing management of the North Wambo Creek Diversion (NWCD) (**Figure 1**). This plan has been developed to address the requirements of the Development Consent (DA305-7-2003).

This Plan replaces the original NWCD Plan, which was developed in 2007 for the construction of the NWCD. The original NWCD Plan was approved on 14 April 2008 by the then NSW Department of Planning (DoP), now the NSW Department of Planning Industry and Environment (DPIE).

It is noted that the most recent modification of the Development Consent (Modification 16, approved 29 August 2019) no longer requires a specific management plan for the NWCD.

This Plan does not address groundwater monitoring or management within the North Wambo Creek Diversion area. Groundwater monitoring and management for the Wambo mine site is addressed in the WCPL GWMP.

1.3 NWCD Background Information

The objective of the NWCD was to divert flows in the North Wambo Creek around the western limit of the open cut operations. The NWCD, as described in the *Wambo Development Project Environmental Impact Statement* (Project EIS) (WCPL, 2003) was originally planned to be constructed in two stages. These stages in included:

- Stage 1 – Permanent diversion from the most Northern upper reaches of the creek to immediately upstream of the Wollemi Underground

- Stage 2 – Extension of the Stage 1 Diversion to connect to the existing North Wambo Creek channel downstream of the Wollemi Underground Mine Boxcut.

In 2006 DA305-7-2003 was modified to allow for the construction of a temporary creek diversion of the North Wambo creek in the North Western area (Mod 5). This temporary diversion became Stage 1, with the permanent Stage 1 and 2 diversions becoming Stages 2 and 3 respectively (Resource Strategies, 2006).

1.4 Requirements of this Plan

1.4.1 Statutory Requirements

1.4.1.1 Development Consent

Wambo received development consent for Development Application DA305-7-2003 in accordance with the *Environmental Planning & Assessment Act 1979* (EP&A Act) from DP&EDPIE on 4 February 2004.

Two modifications to DA 305-7-2003 have been approved to allow for the staged construction of the NWCD (Mod 5 in 2006 and Mod 6 in 2007). Copies of the modification applications, environmental assessment reports and determinations are available on the Wambo website (https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports).

DA305-7-2003 has been modified ten nine times since Mod 6 was approved in 2007, with the most recent being Mod 16 which was approved in August 2019. Conditions within DA305-7-2003 (as modified) relevant to the NWCD are summarised in **Table 1**.

Table 1: DA305-7-2003 Requirements for the NWCD

Schedule	Condition	DA 305-7-2003 (MOD16, August 2019)	Where addressed in this Plan
2	B66	(a) Include a: … **Surface Water Management Plan** that includes:	
		• detailed plans, design objectives and performance criteria for water infrastructure including: ○ any approved creek diversions or restoration works associated with the development;	**Sections 3.1, 3.2, and 3.4**

1.4.1.2 Additional Regulator Requirements

On 14 April 2008, the NWCD Plan was approved by the DPIE (formerly the DoP).

On 1 July 2013 DPIE approved open cut mining of the original creek line, in accordance with specific conditions of DA305-7-2003, subject to the implementation of the approved Remediation and Monitoring Program for Stage 3 of the NWCD (refer **Section 3.4**). In addition to the Development Consent requirements, regulatory authorities have provided additional requirements to be addressed within this plan. These additional requirements and where they have been addressed in this document are detailed in **Appendix A**.

1.4.1.3 Independent Environmental Audits

Further to the Development Consent requirements, Independent Environmental Audits undertaken in 2014 and 2017 have also identified actions required to be undertaken for the NWCD. **Table 2** summarises the findings from these audits and shows where they are addressed in this Plan. In regard to the 2017 IEA finding regarding the development of a stand-alone management plan for the NWCD, this revision of the Plan has sought to include information from other WCPL management plans to address this requirement.

Table 2: Independent Audit Findings relevant to the NWCD

Audit	Description	Where addressed in this Plan
2014 IEA	North Wambo Creek Diversion Plan not yet revised to include the required section on mechanism for the return of intercepted groundwater (Schedule 4, Condition 31(c)).[1]	**Section 3.5**
2017 IEA	The current diversion management and monitoring objectives are contained in several documents. It is recommended these are consolidated into a single management plan for the diversion. It is noted that Wambo is committed to the preparation and implementation of a new Diversion and Rehabilitation Plan.	**This Plan**
	The diversion management program should be implemented to improve the operation of the diversion.	**Sections 3.0** and **4.0**
	Ongoing management is required in order to ensure that soil erosion is minimised and ground cover is given adequate opportunity to become established.	**Sections 3.4** and **4.0**
	Rehabilitation of subsided areas of the diversion is required in accordance with an Extraction Plan (or Subsidence Management Plan), including repairing surface subsidence cracks and undertaking subsidence remediation where necessary in areas where the diversion has been subsided.	**Sections 3.0** and **4.0**

1. It is noted that this requirement is no longer included in DA305-7-2003 (Mod 16).

1.4.1.4 Environment Protection Licence

Condition L1.1 of Environment Protection Licence (EPL) 529 requires compliance with Section 120 of the *Protection of the Environment Operations Act 1997*, which prohibits pollution of waters. Management measures outlined in **Section 3.0** of this Plan have been developed to manage the water quality from the site. The EPL is administered by the NSW Environment Protection Authority (EPA).

1.4.2 Commitments

All commitments outlined within this Plan are detailed in **Appendix B**. Management commitments requiring actioning will be entered into Wambo's compliance management system and actioned. Records of documentation associated with the management commitments will also be maintained by Wambo.

1.5 Stakeholder Consultation

Consultation has been undertaken during a number of phases of the NWCD, from the original environmental assessment for the Project EIS (WCPL, 2003) to the ongoing management and remediation of the NWCD. Consultation continues to be undertaken with key stakeholders as part of WCPL's site reporting and auditing commitments, including for the Annual Review and Independent Environmental Audit (IEA).

The original NWCD Plan was developed in consultation with a range of stakeholders including:

- Government agencies - Department of Planning, Infrastructure and Environment (DPIE), Regional NSW Department of Mining, Exploration and Geoscience (MEG) Resources Regulator (RR), Environment Protection Authority (EPA), Department of Industries Fisheries and DPIE Water Group - Natural Resources Access Regulator (NRAR)
- Specialist consultants - Gilbert and Associates Pty Ltd (Design Report), Alan Watson and Associates Pty Ltd (Design), HLA-Envirosciences (Rehabilitation Plan), Hansen Bailey (SWMP)
- WCPL mine personnel – planners, engineers, managers, safety and environmental staff

A copy of this revised Plan was provided to DPIE, RR, EPA, NSW Fisheries and DPIE Water Group - NRAR for consultation on 20 April 2019. A copy of the regulator comments and how the comments have been addressed is included in **Appendix A** of this Plan.

2.0 Planning

2.1 Environment Baseline

2.1.1 Landforms and Watercourses

Wambo is located in the Upper Hunter Valley where the landform is characterised by gently sloping floodplains of the Hunter River and its tributaries and the undulating foothills, ridges and escarpments of the Mount Royal Range and Great Dividing Range (Heritage Computing, 2012). Elevations in the vicinity of Wambo range from approximately 60 metres (m) Australian Height Datum (AHD) at Wollombi Brook to approximately 650 m AHD at Mount Wambo within the Wollemi National Park to the west of Wambo.

Watercourses in the vicinity of Wambo Mine include Wollombi Brook, North Wambo Creek, (South) Wambo Creek, Stony Creek, Longford Creek and Doctors Creek. These creeks are tributaries of the Hunter River. The locations of these watercourses are shown in **Figure 3** (**Section 2.1.4**).

North Wambo Creek, which has its headwaters in the Wollemi escarpment, drains the central parts of the mining lease and has a catchment area of 48.5 km^2 (Gilbert and Associates, 2003). A section of North Wambo Creek has been diverted to avoid the Wambo open cut (**Figure 1**). The North Wambo Creek Diversion was constructed in accordance with the approved North Wambo Creek Diversion Plan (WCPL, 2007).

2.1.2 Soils and Rural Land Use Capability

A soils, rural land capability and agricultural suitability assessment was conducted for the Project EIS and utilised information from previous soil surveys, the Department of Land and Water Conservation and NSW Agriculture mapping, aerial photography and field surveys.

Major soil types identified include alluvial soils along major drainage lines, siliceous sands to the east of Wollombi Brook, yellow podzolics and yellow solodic intergrades adjacent to the alluvials on lower slopes and undulating plains, soloths on moderately elevated slopes and lithosols along the eastern boundary of the Wollemi National Park.

A rural land capability assessment was conducted in accordance with the standard NSW eight class system (Cunningham et al., undated) which assesses biophysical soil properties and categorises land according to limitations such as erosion hazard, climate and slope.
Seven of the eight classes were identified in the vicinity of the mine.

Further detail on soils and rural land use capability is included in the WCPL BMP.

2.1.3 Climate and Rainfall

The area experiences a dry temperate to sub-tropical climate with hot humid summers and cool drier winters. The annual average rainfall is approximately 650 mm. Further information on rainfall, including a Cumulative Rainfall Departure curve for the area, is included in the WCPL GWMP.

2.1.4 Geology

Wambo is located in the Hunter Coalfield, which occupies the north-eastern portion of the Sydney Basin. The site is underlain by the Permian Singleton Coal Measures as well as Quaternary alluvial sediments along watercourses. This is underlain by the Permian Maitland Group which consists of siltstone, sandstone and conglomerate.

Approximate boundaries of quaternary alluvial sediments in the vicinity of Wambo are shown in **Figure 3** and have been derived from the Hunter Coalfields Regional Geology 1:100,000 map (NSW Department of Mineral Resources, Edition 2 1993).

A transient electromagnetic survey (Groundwater Imaging, 2012) was carried out to investigate the extent and thickness of alluvium along the lower reaches of (South) Wambo and North Wambo Creek. The extent of alluvial sediments determined from that study is also presented on **Figure 3.**

Further information on the geology of the area is included in the WCPL GWMP.

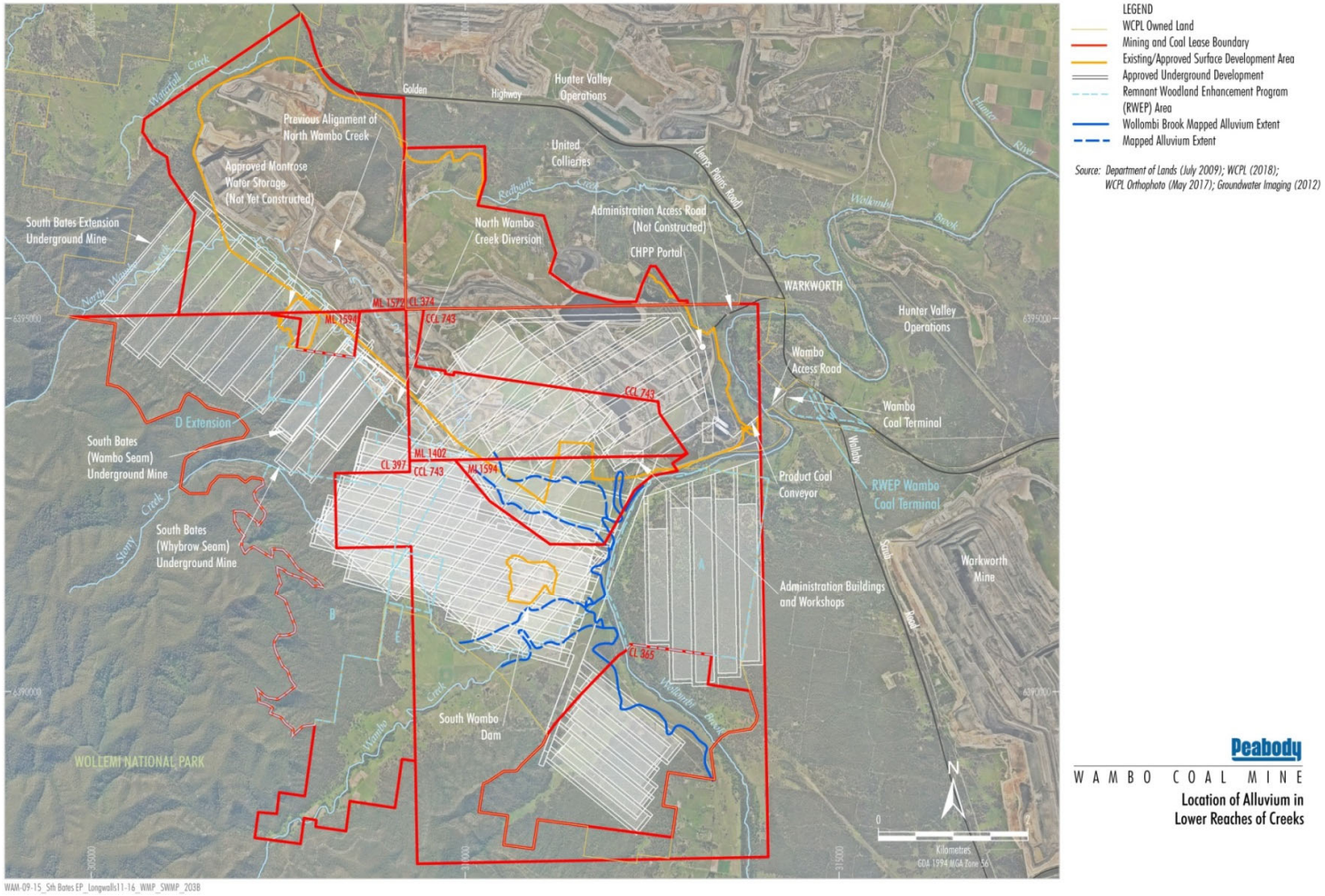


Figure 3: Location of Alluvium in Lower Reaches of Creeks

2.1.5 Stream Flow

North Wambo Creek is an intermittent stream which ceases to flow in extended dry periods.

Three V-notch weirs were established by United Collieries (United) in 2001/2002 to record flow along North Wambo Creek. A summary of flow records from United weir sites 1 and 2, for the period 14 June 2002 to 1 October 2003, is included in the WCPL SWMP and reproduced in **Table 3.**

Table 3: Baseline Stream Flow in North Wambo Creek

Site	Flow Days	Max (L/s Day)	Min (L/s)	Mean (L/s)
Weir 1	NA	9.3	0.0	1.5
Weir 2	NA	120.0	0.0	0.9

Flow monitoring data collected at Weir 3 for the period December 2001 to December 2004 generally showed the creek to be dry, except following significant rainfall. The highest flow recorded at Weir 3 during the data period was 0.1 L/sec in late May 2002 (Geoterra, 2005).

In addition to the baseline data collected in the North Wambo Creek during 2001-2003, WCPL has also established a number of flow monitoring stations along the North Wambo Creek, including within the NWCD to monitor stream flow. Five flow monitoring stations were established in the North Wambo Creek between 2008 and 2017. Flow monitoring locations are shown on **Figure 9** (in **Section 4.2**). The maximum flow recorded at these five stations during the period of record is provided in **Table 4**.

Table 4: Flow monitoring stations on the North Wambo Creek

Site	Location	Period of Record^	Max flow recorded (ML/Day)
US FM1	North Wambo Creek (Upper)	Dec 2017 – present	282
FM1	North Wambo Creek	Oct 2008 – present	264.81
FM2	Mid way along the North Wambo Creek diversion	Apr 2009 – present	160
FM3	Mid way along the new diversion of the North Wambo Creek	Feb 2015 – present	140
FM4	North Wambo Creek (Upstream of the confluence of North Wambo Creek and Wollombi Brook)	Oct 2008 – present	14,300*

^ *The period of record may not be a continuous period of record – there may be periods where no flow data was captured (refer to SWMP for further detail on data capture percentages).*

* *A flow event at FM4 in April 2015 was influenced by backwater flooding from Wollombi Brook. The next largest flow day during the period of record was 291.28 ML (between 1 Feb 2014 and 19 Aug 2014).*

Further information on historical flow monitoring and the monitoring data from these stations is included in the WCPL SWMP.

2.1.6 Water Quality

WCPL has been monitoring water quality, including pH, electrical conductivity (EC), total suspended solids (TSS) and total dissolved solids (TDS), in the North Wambo Creek since 1994 (WCPL, 2003). Baseline water quality of North Wambo Creek is described in the Project EIS (WCPL, 2003) and reproduced in **Table 5**.

Monitoring sites SW04 and SW05 are shown on **Figure 9** (in **Section 4.2**). Sites SW26 and SW27 were located within the original North Wambo Creek, which has since been mined through. Further information on the baseline monitoring program is included in the Surface Water Assessment for the Project EIS (Gilbert and Associates, 2003).

Table 5: Baseline Water Quality in North Wambo Creek (WCPL, 2003)

	SW04 – Upstream	SW05 - Downstream	SW26	SW27
Sampling Period	July 1996 – Sept 2002	Jan 1994 – Sept 2002	June – Sept 2002	June - Sept 2002
pH				
min	7.1	6.6	6.4	7.0
max	8.0	8.9	7.2	8.4
mean	7.6	7.7	6.9	7.9
EC (µS/cm)				
min	291	240	639	970
max	410	4,650	687	1,056
mean	351	1,839	663	1,027
TDS (mg/L)				
min	184	114	360	524
max	236	4,460	366	582
mean	210	1,135	362	548
TSS (mg/L)				
min	NR	1	1	1
max	NR	71	8	2
mean	NR	6	4	2

* NR = no results available

WCPL has continued to monitor water quality at sites SW04 and SW05 since 2003. New water quality monitoring sites were established in the North Wambo Creek in 2012, to monitor water quality within the NWCD. These sites include SW27a, in the middle lower section of North Wambo Creek, and SW32a at the North Wambo Creek pump site (refer **Figure 9** in **Section 4.2**). Water quality data collected since 2003 is included in **Table 6.**

Table 6: Water Quality Results for North Wambo Creek

	SW04 – North Wambo Creek Up	SW05 – North Wambo Creek Down	SW27a – North Wambo Creek Middle Lower	SW32a – North Wambo Creek Pump
No of samples	4	137	46	39
Sampling period	July 2003 – Jan 2018	July 2003 – Jan 2018	2012 – Jan 2018	2012 – Jan 2018
pH				
min	7.3	6.94	7.00	7.30
max	8.71	8.96	9.00	9.20
mean	8.03	7.66	7.93	8.05
EC (µS/cm)				
min	256	111	52	199
max	563	3,200	3,360	6,970
mean	362	1,698	927	861
TDS (mg/L)				
min	157	135	184	153
max	2,712	3,642	4,900	4,400
mean	855	1,021	954	779
TSS (mg/L)				
min	5	1	1	1
max	154	1,110	5,440	4,190
mean	47	52	477	435

The data in the above table has been used to develop performance criteria for water quality in the North Wambo Creek. This performance criteria is included in **Section 4.1.2.** A Trigger Action Response Plan (TARP) has also been developed for implementation if monitoring data indicates that the water quality performance criteria have not been met. This TARP is included in **Section 4.3.**

2.1.7 Biodiversity

Baseline biodiversity surveys were undertaken for the Project EIS (WCPL, 2003). Further surveys have been undertaken as part of subsequent mine modifications, including the South Wambo, South Bates and South Bates Extension Underground Mines. The findings of these surveys are included in the WCPL BMP with a summary of the information included below.

The results of annual biodiversity monitoring undertaken along the NWCD (refer **Section 4.2**) are compared against baseline surveys.

2.1.7.1 Flora

Flora surveys of the Mine site were undertaken in 2003 by Orchid Research as part of the Project EIS (WCPL, 2003). Follow up surveys were completed as part of the South Wambo Underground, South Bates Underground and South Bates Extension Underground (FloraSearch, 2015, 2016 and 2017).

A total of 17 vegetation communities have been identified in the Wambo Mine study area, including a number of threatened Endangered Ecological Communities. A number of threatened flora species and populations have also been recorded (or have potential to occur) onsite including *Acacia pendula* (FloraSearch, 2015).

Further detail on the results of these surveys is included in the WCPL BMP.

2.1.7.2 Fauna

Avifauna, mammals, reptiles and amphibians were surveyed at the Mine by Mount King Ecological Surveys and Greg Richards and Associates in 2003 as part of the Project EIS (WCPL, 2003).

The fauna surveys recorded a relatively large number of woodland birds and birds associated with waterbodies. Threatened fauna species recorded in the vicinity of WCPL include amphibians (3), reptiles (2), birds (41) and mammals (20). Eleven pest fauna species were also recorded in the Project EIS surveys (WCPL, 2003).

2.1.7.3 Aquatic Ecosystems

Aquatic macroinvertebrate, fish and water quality sampling was conducted for the Project EIS (WCPL, 2003).

The sampling found North Wambo Creek to represent minimal fish habitat with two native and one introduced fish species recorded from North Wambo Creek during the sampling (WCPL, 2003).

2.1.8 Landscape Function Analysis

Landscape Function Analysis (LFA) is a monitoring procedure developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Tongway and Hingley, 2004). It provides a rapid, reliable and easily applied method for assessing and monitoring landscape restoration or rehabilitation. It uses simple indicators that assess how well a landscape works as a system.

LFA monitoring plots were established in riparian rehabilitation areas along the North Wambo Creek in 2008. Additional plots were added in 2015 in the North Wambo Creek Diversion and Wambo Creek. LFA Monitoring locations are shown on **Figure 10** (in **Section 4.2**).

Plots are monitored on an annual basis in accordance with the methodology and monitoring program described in the WCPL BMP. Baseline LFA results for the NWCD and Wambo Creek (for reference) are provided in **Table 7** to **Table 10**. Monitoring results from the last nine years of monitoring for the NWCD and Wambo Creek have also been included in these tables.

Table 7: LFA Results – Landscape Organisation Index

Site	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NWCD										
17R	-	1	1	1	0.86	0.92	0.97	0.93	0.96	0.92
19R	0.25	1	1	1	1	1	0.69	0.71	0.75	0.71
21R	0.18	1	0.81	1	0.86	1.07	0.54	0.66	0.76	0.87
23R	-	0.6	0.63	0.85	0.84	0.84	0.7	0.41	0.44	0.34
25R*	-	-	-	-	-	-	-	0.45	0.59	0.74
26R*	-	-	-	-	-	-	-	0.55	0.67	0.72
27R*	-	-	-	-	-	-	-	0.35	0.35	0.29
28R*	-	-	-	-	-	-	-	0.43	0.55	0.41
Average	**0.22**	**0.90**	**0.86**	**0.96**	**0.89**	**0.96**	**0.73**	**0.56**	**0.63**	**0.63**
Wambo Creek										
14R*	-	-	-	-	-	-	-	0.67	-	0.99

* New riparian monitoring site added in 2015
- No data available

Table 8: LFA Results – Stability Index

Site	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NWCD										
17R	-	79	70	71.3	56.1	74.5	64	60.1	65.1	62.2
19R	53	71	61	65.6	57	54.3	55.1	53.8	55.9	64.6
21R	56	75	62	65.4	58.6	65.8	53.4	56.5	60.3	60.5
23R	53	52	48	52.6	44.9	45.9	50	51.4	56.8	44.1
25R*	-	-	-	-	-	-	-	52.1	56.9	58.6
26R*	-	-	-	-	-	-	-	54.2	59	61.1
27R*	-	-	-	-	-	-	-	52.1	58.1	46.7
28R*	-	-	-	-	-	-	-	45.9	51.9	52.2
Average	**54**	**69.25**	**60.25**	**63.725**	**54.15**	**60.125**	**55.625**	**53.26**	**58**	**56.25**
Wambo Creek										
14R*	-	-	-	-	-	-	-	52.3	-	53.9

* New riparian monitoring site added in 2015
- No data available

Table 9: LFA Results – Infiltration

Site	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NWCD										
17R	-	37	36	41.2	27.7	38.4	38.4	37.6	36.3	38.6
19R	27	42	33	30.7	25.1	19.6	23.1	27.7	32.6	30
21R	33	47	23	33.2	30	28.4	24.2	33.7	34.8	35
23R	30	27	26	29	18.4	23.3	25.7	30.1	27.4	28.6
25R*	-	-	-	-	-	-	-	23.9	29.9	31.9
26R*	-	-	-	-	-	-	-	28.1	30.2	27.9
27R*	-	-	-	-	-	-	-	22.9	24.8	33.5
28R*	-	-	-	-	-	-	-	26.1	25.5	38.2
Average	**30.00**	**38.25**	**29.50**	**33.53**	**25.30**	**27.43**	**27.85**	**28.76**	**30.18**	**32.96**
Wambo Creek										
14R*	-	-	-	-	-	-	-	45.0	-	40.3

* New riparian monitoring site added in 2015
- No data available

Table 10: LFA Results – Nutrient Index

Site	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NWCD										
17R	-	39	30	40.1	28.2	34.6	30.2	28.3	26.8	33.3
19R	15	38	30	30.8	25.1	15.2	18.4	20	21.9	26.7
21R	17	44	21	30.5	29.7	26.1	19.5	24.6	25	31.1
23R	14	18	19	24.5	15.4	15.6	17.4	17.2	14.6	19.5
25R*	-	-	-	-	-	-	-	16.2	20	26.2
26R*	-	-	-	-	-	-	-	18.5	24.7	25.6
27R*	-	-	-	-	-	-	-	13.9	15.2	19.6
28R*	-	-	-	-	-	-	-	16	19.2	26.4
Average	**11.5**	**27.8**	**20**	**25.18**	**19.68**	**18.3**	**17.1**	**19.34**	**20.93**	**26.05**
Wambo Creek										
14R*	-	-	-	-	-	-	-	29.6	-	29.5

* New riparian monitoring site added in 2015
- No data available

The data in the tables above has been used to develop target scores for LFA for the NWCD. These target scores are included in **Section 4.1.3.** A TARP has also been developed for implementation if monitoring data indicates that there is less than 5% annual improvement or a decline in the LFA target score (from the previous monitoring round). This TARP is included in **Section 4.3.**

2.1.9 Geomorphology

2.1.9.1 2006 Geomorphic Assessment

The form and status of North Wambo Creek was assessed by Gilbert and Associates during a detailed site reconnaissance and mapping programme which was conducted in March 2006 and by supplementary observations in February 2007. The assessment resulted in the production of a series of strip maps showing the main geomorphological features and a suite of photographs which provided further visual record of the creek. The reconnaissance was conducted from a point approximately 800 m upstream of the proposed diversion inlet to the confluence of North Wambo Creek with Wollombi Brook. A summary of the geomorphological conditions of North Wambo Creek in the reach that would be replaced by the diversion was provided in the *North Wambo Creek Diversion Design Report* (Gilbert and Associates, 2007).

Geomorphological triggers and success criteria were developed as part of the detailed design of the NWCD. These triggers and success criteria are described in **Section 4.1.1.** A review of these triggers and success criteria will be undertaken by WCPL in 2020/2021.

2.1.9.2 2018 Geomorphic Context Statement

In accordance with Schedule 4, Condition 33A of DA 305-7-2003 (Modification 17), WCPL commissioned Alluvium Consulting Australia (Alluvium) to undertake a pre-subsidence (baseline) survey, energy profile analysis and geomorphic context statement on North Wambo Creek (the North Wambo Creek Baseline Report). The study was completed in February 2018, on a natural section of North Wambo Creek, directly above future Longwalls 23, 24 and 25 (South Bates Extension Mine) and upstream of this area.

The reaches of North Wambo Creek and its upstream tributaries of Spring and Chalkers Creek were categorised in accordance with the River Styles Framework. Energy conditions in each of the reaches were assessed to inform the broader assessment and likely future trajectory of the geomorphic character, behaviour and condition of the waterway. The results of this assessment will be considered during the review of performance criteria for the NWCD and development of future Extraction Plans for the South Bates Underground Extension Mine. A

copy of the North Wambo Creek Baseline Report (Alluvium, 2018) was provided to DPIE Water Group - NRAR and DPIE on 10 April and 1 May 2018 respectively.

2.2 Predicted Impacts from Underground Mining

The Project EIS included predictions relating to underground mining subsidence for the North Wambo Creek. These predictions included the creation of a subsidence-induced basin in the lower sections of the North Wambo Creek (WCPL, 2003). It was expected that this basin would form a wetland over time, acting as a trap for many of the sediments moving through the diversion with beneficial effects in terms of water quality entering Wollombi Brook.

Predicted subsidence impacts on surface water, including the NWCD, have been assessed as part of the environmental assessments for the South Wambo, South Bates and South Bates Extension Underground Mines. The extraction plans developed for longwall extraction in these mines detail the predicted impacts and proposed management and mitigation measures to be implemented.

Approximately 980 metres (m) of the NWCD has been undermined by Longwalls (LW) 11 to 13 and LW 14 to 16 at the South Bates Underground Mine. An additional 30 m will be undermined by LW 17 in the South Bates Underground Extension Mine. Subsidence impacts on the NWCD as a result of the extraction of LW 17 are expected to be similar to those observed in the adjacent South Bates Underground Mine. The potential environmental consequences to the NWCD described in the South Bates Extension Modification EA (WCPL, 2017) include:

- potential for minor increased ponding above LW 17;
- potential for surface cracking above LW 17 (similar to that observed above LW 11) and minor cracking along the section of the Diversion not located directly above the longwalls;
- potential for increased scour (and associated suspended solids) prior to the implementation of scour protection works; and
- potential for increased leakage from the Diversion prior to crack remediation works.

Management and mitigation measures have been developed to address the predicted subsidence impacts on the NWCD. These measures are described in detail in the relevant extraction plans and are summarised in the ***North Wambo Creek Subsidence Response Strategy (NWCSRS)***. A copy of the NWCSRS is included in this Plan (**Appendix E**).

2.3 Baseflow separation

An assessment of surface water baseflow separation has been undertaken for stream flow gauges in North Wambo Creek. This work was completed in 2019 and early 2020 to address comments made by DPIE Water and the Natural Resources Access Regulator (NRAR) on this Plan (Version 1).

North Wambo Creek is an ephemeral stream and only flows after significant rainfall events. Its headwaters are located in the Wollemi escarpment which include sandstone escarpments that have very high infiltration losses to the aquifer. The creek drains the central parts of the Wambo Coal mining lease. Extension of the Wambo Open-Cut Mine required a diversion of the creek.

As the open cut mine extended towards the diversion, the pit encroached on the alluvial aquifer. Recent and historic subsidence has contributed to reduced surface flows occurring in the creek.

A number of reports and data files were provided to Alluvium for this assessment. This included annual flow monitoring reports and this Plan. In addition, surface flow monitoring data was provided in spreadsheets for flow stations along the North Wambo Creek and within the diversion. Five flow monitoring stations were established between 2008 and 2017 (refer **Table 4**). The location of each flow monitoring location is shown in **Figure 4**.

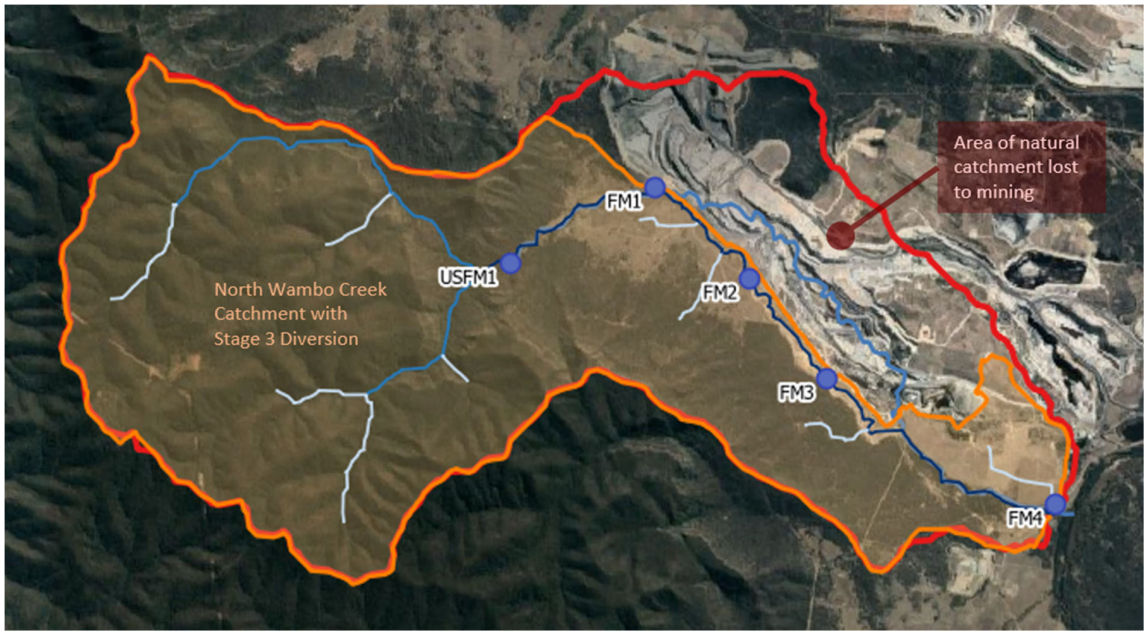


Figure 4: North Wambo Creek Surface Flow Monitoring Locations and Reduction in Catchment Area post Stage 3 Diversion.

The flow data for the period spanning 2012 to 2020 was inspected for suitable flow events. The majority of records have either no flow due to dry conditions or very low flow (less than 0.1 m^3/s) which is too small for meaningful analysis. There are also gaps in the record due to instrumentation issues. Five flow events (presented in **Table 11**) were selected for baseflow analysis because they have larger peak flows with relatively smooth hydrographs and represent the best available data.

Table 11. Summary of Streamflow Events in North Wambo Creek

Event No	Date	NWC Diversion	Peak flow (m^3/s) FM1	Peak flow (m^3/s) FM4	Cumulative vol. FM1 (m3)	Cumulative rainfall (mm)	Flow index (m^3/mm)	FM1 Baseflow drawdown (days)
1	Feb-09	Stage 2	1.3	1.9	678,606	212	3,198	5 to 6
2	Apr-09	Stage 2	3.0	2.9	943,649	124	7,641	10 to 15
3	Apr-15	Stage 3	2.3	- *	323,721	170	1,913	5 to 6
4	Jan-16	Stage 3	2.4	10.4	493,324	240	2,055	5 to 6
5	Feb-20	Stage 3	0.7	1.8	21,007	180	117	2 to 3

* Note:FM4 removed due to influence of flood ingress from Wollombi Brook

A key observation in **Table 11** is that the flow index in Event 5 is considerably lower than the other events. This event came at the end of a hot and very dry summer season. The dryness of the catchment and deficit of groundwater likely resulted in far greater rainfall losses in this event with a corresponding short surface flow.

A comparison of rainfall and surface streamflow data was undertaken to analyse the North Wambo Creek system response to storm events to identify a minimum threshold of rainfall that is required prior to the onset of surface flow (**Figure 5**). Such a relationship will assist with providing performance measures and the performance of the groundwater model.

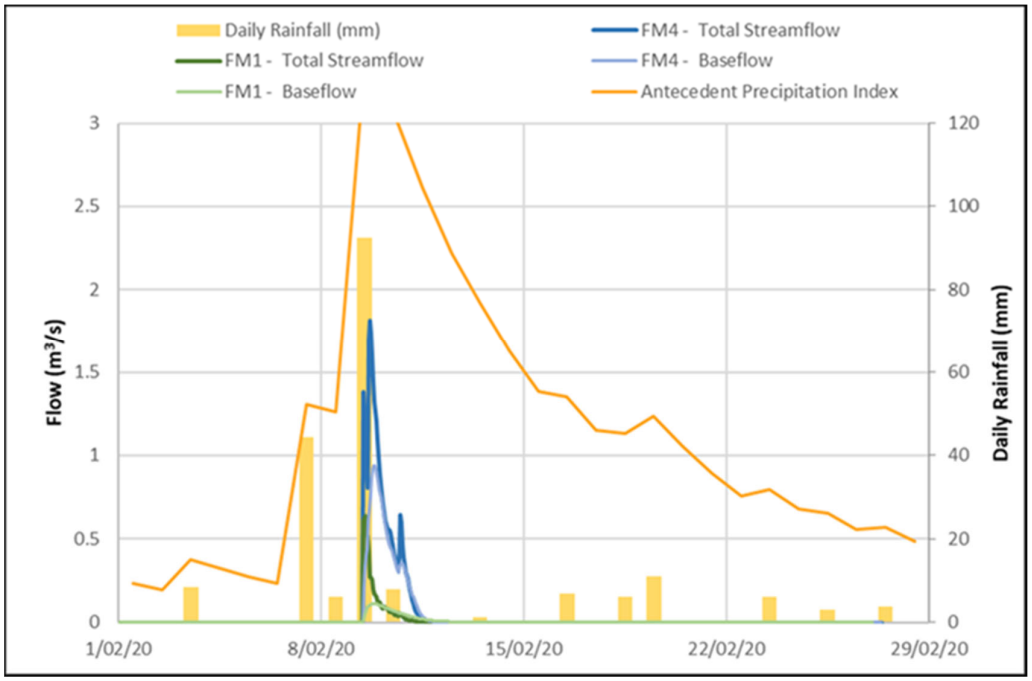


Figure 5: Rainfall versus Stream Flow

The adopted approach uses Antecedent Precipitation Index (API) to provide a combined measure of catchment wetness and the total rainfall from the storm event being assessed. A plot of the Stage-API relationship for streamflow station FM1 is presented in **Figure 6.** The points that relate to the onset of streamflow indicate that a minimum API value of 100 mm is required before flow is registered at the gauge. The orange points represent events that most likely resulted in flow, but the data is unreliable. Some of the flow events include successive peaks following additional rainfall and these have also been emphasized.

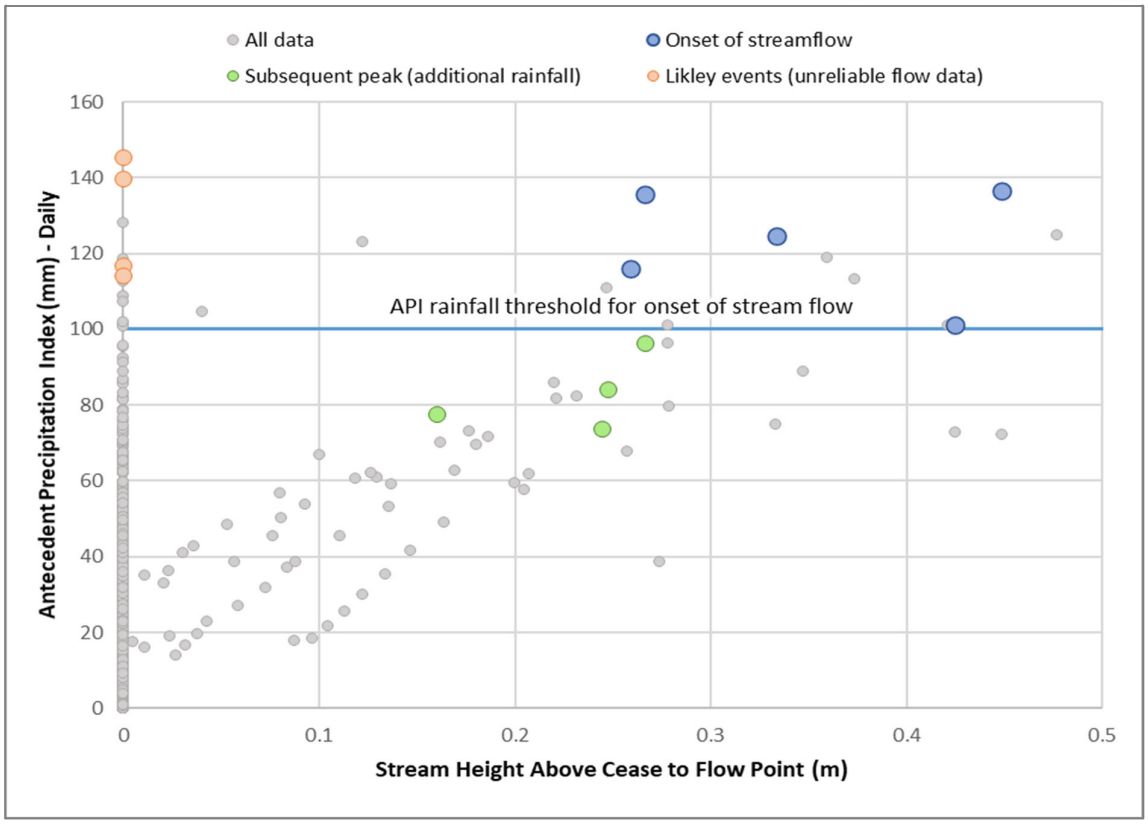


Figure 6: North Wambo Creek - FM1 - Rainfall API versus Stream Stage Relationship

In summary, five flow events have been analysed in an attempt to understand the change in catchment runoff and baseflow in North Wambo Creek pre and post development. This is a small number of events to understand the typical catchment response to rainfall. Ideally a greater number of events would be considered including different times of year (seasonal changes) as the response would change within and between years.

Further information in response to Regulator comments and recommendations is included in **Appendix A**.

3.0 Implementation

3.1 Construction of the North Wambo Creek Diversion

Construction of the NWCD was undertaken in a staged approach with construction design works undertaken and approved by DPIE prior to the construction of the diversion in 2007.

The objective of the NWCD was to divert flows in the North Wambo Creek around the western limit of the open cut operations. The diversion was to be constructed in two stages:

- Stage 1: Initially the upstream portion of the Diversion would be constructed generally along the alignment shown in the Project EIS and would connect to the existing North Wambo Creek channel upstream of the Wollemi Underground Mine Boxcut; and

- Stage 2: This stage would comprise an extension of the Stage 1 Diversion in a south-easterly direction to connect to the existing North Wambo Creek channel downstream of the Wollemi Underground Mine Boxcut.

Further detail on the staged approach to the NWCD construction is included in the Statement of Environmental Effects for the Wambo Coal Mine Modification (Mod 5) (WCPL, 2006). A further modification application was submitted in 2006 to allow for the construction of a temporary creek diversion on a 2km section of the North Wambo Creek to allow for the construction of the permanent Diversion (Mod 6). Mod 6 was approved on 25 January 2007.

This resulted in a three stage construction program (refer **Section 3.1**).

3.1.1 Diversion Design

Gilbert and Associates Pty Ltd, in conjunction with Allan Watson Associates Pty Ltd, were commissioned by WCPL to design the NWCD. The design process involved geotechnical site investigations; a geomorphological assessment of the North Wambo Creek, detailed survey of the proposed inlet and outlet areas of the diversion; hydrological and hydraulic modelling and a pit inflow risk assessment study. The design was documented in the North Wambo Creek Diversion Design Report (Gilbert and Associates, 2007), which was appended to the original NWCD Plan.

Geomorphological success criteria and triggers were developed by Gilbert and Associates Pty Ltd and included in the North Wambo Creek Diversion Design Report (Gilbert and Associates, 2007). The intention was that these criteria would be used as a regulatory tool to assess performance relative to the design intention of the NWCD and as a set of levels at which corrective actions would be initiated. The success criteria and action triggers proposed in the North Wambo Creek Diversion Design Report are included in **Section 4.1.**

The NWCD design was developed in consultation with relevant stakeholders and was approved by the NSW Department of Planning in 2008, as part of the original NWCD Plan.

3.1.2 Construction Program

A construction program was developed for the NWCD in accordance with Schedule 4, Condition 31 of DA305-7-2003 (Mod 6). The program described how the work would be staged and progressively integrated with the mining operations and the mine waste emplacement drainage system. The program was appended to the original NWCD Plan.

The NWCD construction program involved the construction of a flood levee and creek bed which starts at the north-western limit of the Wambo open cut operations and re-joins the North Wambo Creek downstream of the Wollemi Box Cut.

3.2 Rehabilitation Objectives

The Wambo MOP defines the rehabilitation domain and objectives for the NWCD.

The rehabilitation objectives for the NWCD include:

- Pasture species established consistent with revegetation strategy.
- Tree species established along creek line consistent with riparian zone.
- Creek diversion stable and will not present a greater safety hazard than surrounding land.
- Creek diversion able to shed water safely without causing excessive erosion, jeopardising landform integrity or increasing pollution of downstream watercourses.
- All watercourses subject to subsidence impacts shall be hydraulically and geomorphologically stable, with riparian vegetation established that is the same or better than prior to commencement of mining.

The rehabilitation objectives have been utilised to inform the performance and completion criteria included in **Section 4.1.**

3.3 Revegetation Strategy

The MOP includes a revegetation strategy for the Wambo Mine site. The objectives of the strategy are to increase the amount of native vegetation, particularly in those landscapes that have been extensively cleared. The rehabilitation program will aim to increase the continuity of vegetation in the region through the establishment of woodland corridors, linking the rehabilitation areas with existing remnant vegetation and Wollemi National Park.

Historically, the revegetation strategy for the NWCD sought a net increase in the quantity of riparian vegetation and included the planting of native species such as River Oak (*Casuarina cunninghamiana*) and Rough-barked Apple (*Angophora floribunda*) on creek banks.

Revegetation required for the implementation of the 5 Year Rehabilitation and Maintenance Plan, detailed in **Section 3.4.1**, will be consistent with the *North Wambo Creek Diversion Revegetation Management Plan*) (**Appendix D**). The plan states, following soil analysis and investigation that it would be '.. *more appropriate to establish a woodland vegetation type on the majority of the creek diversion site'.* This conclusion is reinforced by the 2019 analysis of flows in the North Wambo Creek system, which concluded around 100 mm of rainfall is required before flow is registered in the NWCD (refer to **Section 2.3**).

Some areas of the diversion remain suitable for the establishment of riparian vegetation, particularly where the creek profile will slow water flow and therefore increase the availability of moisture. These areas will be identified once the final landform is constructed and will be rehabilitated with a species mix which includes both riparian and woodland species.

A net increase in riparian vegetation is no longer considered achievable.

3.4 Maintenance and Rehabilitation (2019 – 2024)

The following sections detail the monitoring and rehabilitation works which are required to be undertaken at the NWCD during the period 2019 – 2024. Maintenance and rehabilitation works for the NWCD have previously been included in the 2013 Remediation and Monitoring Program, which was developed by WCPL following a significant storm event in 2013. The 2013 Remediation and Monitoring Program has been incorporated, where relevant, into the 5 Year Rehabilitation and Maintenance Plan and will be superseded by this document (refer to **Section 3.4.1**).

3.4.1 Five Year NWCD Rehabilitation and Maintenance Plan

In 2018 Alluvium were engaged by WCPL to develop a Five Year Rehabilitation and Maintenance Plan for the NWCD for the period 2019 -2024 (5YR RMP) to address ongoing issues relating to bank stability, erosion and revegetation. The 5YR RMP was updated in April 2019 to include a Detailed Rehabilitation Plan with recommended management actions and rehabilitation works for identified issues. A copy of the Detailed Rehabilitation Plan has been included in **Appendix C**.

The works undertaken by Alluvium included an assessment of existing batter chutes, a review of areas of channel and bank instability and a review of areas on site which required ripping, soil amelioration and revegetation works. Alluvium also assessed the requirement for additional batter chutes in the LW15/16 area. The focus of the rehabilitation plan is the area of the NWCD downstream of LW16 as underground mining and related subsidence has not yet occurred in the area upstream of LW16.

Recommended rehabilitation works, as detailed in the Detailed Rehabilitation Plan developed by Alluvium (**Appendix C**), include:

- Re-forming overland flow entry management, both bunds and batter chutes in the downstream portion of the NWCD and the portion over LWs 11-16.
- Ripping, soil amelioration and revegetation establishment on upper surfaces, upper batters and the inset floodplain (as identified by the blue shading in **Figure 7**).
- Bank stability management in areas identified in the extraction plans for LWs 11-16 and LWs 17-20 (as identified by the red shading in **Figure 8**).

The overall objective of the 5YR RMP is to achieve the performance and completion criteria detailed in **Section 4.1.** The 5YR RMP is summarised in **Table 12** and described further in **Section 3.4.1.1.** The locations of all proposed site works and instability are shown on **Figure 7** and **Figure 8.**

All works will be undertaken in accordance with the Detailed Rehabilitation Plan (**Appendix C**), which will be revised as required. Additional monitoring and inspections will be undertaken in accordance with site-specific Erosion and Sediment Control Plans or Surface Disturbance Permit requirements for on-ground works. Ongoing monitoring will continue to be undertaken in accordance with **Section 4.2.** Performance will be reviewed annually against the performance criteria in **Section 4.1** and the 5YR RMP, with results reported in the Annual Review.

The five year rehabilitation strategy has been developed as a staged approach to enable WCPL to:

- Finalise consultation with regulatory authorities in regard to this Plan;
- Enable the revision of the performance and completion criteria (refer to **Section 4.1**) for the NWCD, based on ACARP studies undertaken and the proposed works to be undertaken; and
- Commence planning including detailed design, development of a works program and associated tender documentation for works described in this Plan.

The Five Year Rehabilitation and Maintenance Plan in **Table 12** has been developed as a high level program which aligns with the recommendations in the North Wambo Creek Detailed Rehabilitation Plan (refer to **Appendix C**). The works to be undertaken each year will be confirmed in the Wambo Annual Review (refer to **Section 5.1.1**).

Table 12: Five Year NWCD Rehabilitation and Maintenance Plan

Task[1]	Task Description	2019	2020	2021	2022-2023
	New batter chute construction		New chutes 8, 9, 11 and 12	New chute 10[2]	Scope of works to be undertaken in Years 2022 – 2023 will be confirmed within the Wambo Annual Review. The scope of works to be undertaken in these years will be determined following of review of this plan based on monitoring results collected annually, and a review of the performance of the newly constructed batter chutes and the completed batter chute repairs. This work will likely include: • Areas upstream of LW15/16 area (where subsidence is complete)
	Existing batter chute repairs		None proposed	3 and 7	
	In-stream Stability Works[6]	-	Two tier bed control, log deflectors, bench reconfiguration	-	
	Stabilisation works		LW15/16 area	Instability areas - sites 01 and 05, including reprofilng of benches	
	Road Realignment works	-	-	Between batter chutes 7 and 9	
Revegetation works	Native grass seed collection across lease area	Complete	Spring	Spring[3]	
	Native pasture trial		Seeding	Review[3]	
	Development of Revegetation Strategy		Refer to **Section 3.3**		
	Soil testing and weed control in preparation for ripping, soil amelioration and revegetation works	Approx. 2.5ha - LW14 area complete	As required	-	
	Ripping, soil amelioration and revegetation works	-	Approx. 2.5ha - LW14 area	Batter areas within LW15/16 and new construction works (chutes 10, 7 and 3), instability area 01 and LW15/16 area and road realignment	

Task[1]	Task Description	2019	2020	2021	2022-2023		
Further assessment	Stabilisation - further assessment of areas of instability		Sites 01 and 05 – assessment	Sites 01 and 05 – include results in 2021revised Plan			
Monitoring, Maintenance and Review	Annual Diversion and Subsidence Monitoring	Complete	As per **Table 17**[4]	As per **Table 17**	As per **Table 17**	As per **Table 17**	As per **Table 17**
	Monthly monitoring and maintenance		Following areas revegetated in 2020[5]	Following areas revegetated in 2020 and 2021[5]	-	-	-
	Development of work program for following year – to be included in Annual Review		By 30 December	By 30 December	By 30 December	By 30 December	By 30 December
	NWCD Management Plan review/revision if required		-	By 30 June	By 30 June	By 30 June	By 30 June
	Performance criteria			Refine criteria	Include revised criteria in 2022 revised Plan -	-	-
	Undertake review of works completed to date with stakeholders.		-	As part of Annual Review	As part of Annual Review	As part of Annual Review	As part of Annual Review

1. Refer to **Figure 7** and **Figure 8** for location of proposed works and instability areas.
2. Construction of Chute 10 will only commence following a full review of the 2020 works program, as part of the Annual Review.
3. Native grass seed collection will only continue past 2021 if the 2020 native grass trial is successful. This trial will be reviewed as part of the Annual Review process.
4. Monitoring of areas of instability at Sites 02, 03, 04, 06, 08 and 09 will be included in the annual monitoring program in 2020.
5. Monthly inspections and maintenance as required until vegetation established. Review as part of 2021 NWCD Management Plan revision.
6. Repairs required following a significant flow event early 2020.

3.4.1.1 Overview of works to be undertaken

The proposed works in **Table 12** include chute construction and repair, channel stability works and revegetation works. These works are also detailed further in **Appendix C** which includes priorities for the completion of the works. A range of works will be undertaken each year and these works include:

- Review of this plan to confirm there are no changes required to the plan;
- Review of the works undertaken in the previous year to confirm whether there are any amendments or improvements which can be made to chute design or repairs;
- Monitoring required to be undertaken as detailed in **Section 4.2**; and
- Reporting of works undertaken during the year as detailed in **Section 5.1.**

The works detailed below are the works as recommended in **Appendix C**. WCPL have provided a conceptual scope of works to be undertaken in 2019 and 2020, with the scope of works to be undertaken in 2021 – 2023 to be confirmed in subsequent reviews of this plan.

Construction and Earthworks – Chute Construction and Repairs

The methods for the earthworks repairs and the design information for the chute construction and repair works are conceptually included in **Appendix C**.

The schedule for the completion of the construction and repair of chutes within the NWCD has been recommended by Alluvium based on the review undertaken by Alluvium in 2019. Batter chute design specifications are included in **Appendix C**.

The proposed program for the batter chute construction and repairs prioritised the construction of new chutes 10, 11 and 12 with remaining chute 9 to be constructed the following year following a review of the performance of the chutes constructed. The location of these new chutes is shown on **Figure 7.** Due to restrictions associated with the construction of an overhead powerline, which interfered with the construction of the batter chutes, construction of the batter chutes were re-prioritised in 2019, resulting in the construction of chute 10 being delayed until 2021. Batter chutes 8, 9, 11 and 12 were constructed in 2020. The location of batter chute 10 will likely be relocated from its proposed location, now that subsidence impacts have been fully assessed.

As detailed in **Appendix C**, there are a number of other batter chutes proposed to be constructed. The plan detailed in **Table 12** has committed to the construction of the initial 5 batter chutes with the remaining batter chutes to be constructed following the development of a scope of works in 2021.

Batter chute repairs are proposed to commence in 2021. Batter chute repairs will be undertaken in accordance with the recommendations in the Detailed Rehabilitation Plan (**Appendix C**) and further assessments made in 2020.

Stabilisation Works

There are areas of instability noted in **Appendix C** which will not be repaired as part of the program to construct new chutes and repair existing chutes.

Works to be undertaken in these areas include battering of eroded banks, application of topsoil and revegetation. Stabilisation works to be undertaken will initially focus on works within LW 15 and LW 16, as these areas have been subsided and are not expected to be further

impacted. Stabilisation works within LW panels 17 – 19 will not commence until mining has finished in these areas. The schedule for these works will be detailed in future revisions of this plan.

There are two locations (Sites 1 and 5 on **Figure 8**) which have been identified by Alluvium as areas of instability which require further assessment to identify appropriate management actions. This assessment will commence in 2020.

Ripping, Soil Amelioration and Revegetation

There are areas of the NWCD that require ripping and revegetation. These areas are located in the LW14 area and are shown on **Figure 7**. Works required to be undertaken include soil testing, weed management, soil amelioration, ripping and revegetation. The NWCD Revegetation Management Plan (Cumberland Plains Seeds), was developed during 2019.

Revegetation Trial

WCPL will also undertake a native grass trial in areas of the NWCD during the MOP period, as part of the 5YR RMP. This trial will be undertaken in consultation with Wambo's environmental consultants, with the results to be included in the Annual Review.

3.4.1.2 Program Summary for 2019

In 2019 the objective was to establish the management framework and stakeholder consultation program for the ongoing management of the NWCD over the next five years. The construction of new batter chutes were delayed until 2020 (refer to **Appendix C**).

Works undertaken in 2019 are detailed in **Table 12** and included:

- Consultation with relevant stakeholders for this revised plan;
- Development of a Revegetation Strategy for NWCD to identify proposed planting program for Years 2019 – 2023;
- Diversion and subsidence monitoring;
- Collection of native grass species for revegetation works proposed to be undertaken in LW 14 including the planting of approximately 2.5 hectares; and
- Batter chute construction planning works including the development of tender documentation and contract scopes.

3.4.1.3 Program Summary for 2020

The works to be undertaken in 2020 are detailed below. Standard annual tasks detailed in **Section 3.4.1.1** will be undertaken in addition to the following:

- Construction of batter chute 8, 9; 11 and 12;
- Commencement of further assessment for Sites 1 and 5 (areas of instability);
- On ground civil works to be completed for selected new batter chutes;
- Implementation of the Revegetation Strategy; and
- Review of further assessment of stabilisation works for Sites 1 and 5. The 2020 Annual Review will detail proposed works for these locations based on the outcomes of the investigation undertaken in 2020.

3.4.1.4 Program Summary for 2021-2023

The scope of works to be undertaken during 2021 – 2023 will be refined in subsequent revisions of this plan. As detailed in the above sections, in the initial years of 2020 and 2021 chute construction and batters works will be undertaken and this, in combination with the annual monitoring required to be completed, will be utilised for the development of the 2022 – 2023 program.

3.4.1.5 Implementation

In 2019, Soil Conservation Services (SCS) were engaged to design and construct the remediation works, whilst respecting and referring to the modelling, research and action plans for the NWCD conducted by Alluvium in the following reports:

- Design Report: North Wambo Creek Detailed Rehabilitation Plan (April 2019);
- Technical Specification – Diversion Stabilisation Works: NWCD Detailed Action Plan Detailed Design (April 2019);
- Report: North Wambo Creek Diversion Operations Monitoring 2018 (December 2018);
- Report: North Wambo Creek – Baseline assessment geomorphic context statement (February 2018);
- Report: Surface Water Technical Report for South Bates Underground Mine (Longwalls 11 – 16) Wambo Coal Mine (December 2016); and
- Report: North Wambo Creek diversion – review of condition and performance (November 2015).

SCS are progressing on schedule with the 2020 program of work, as outlined in **Table 12**.

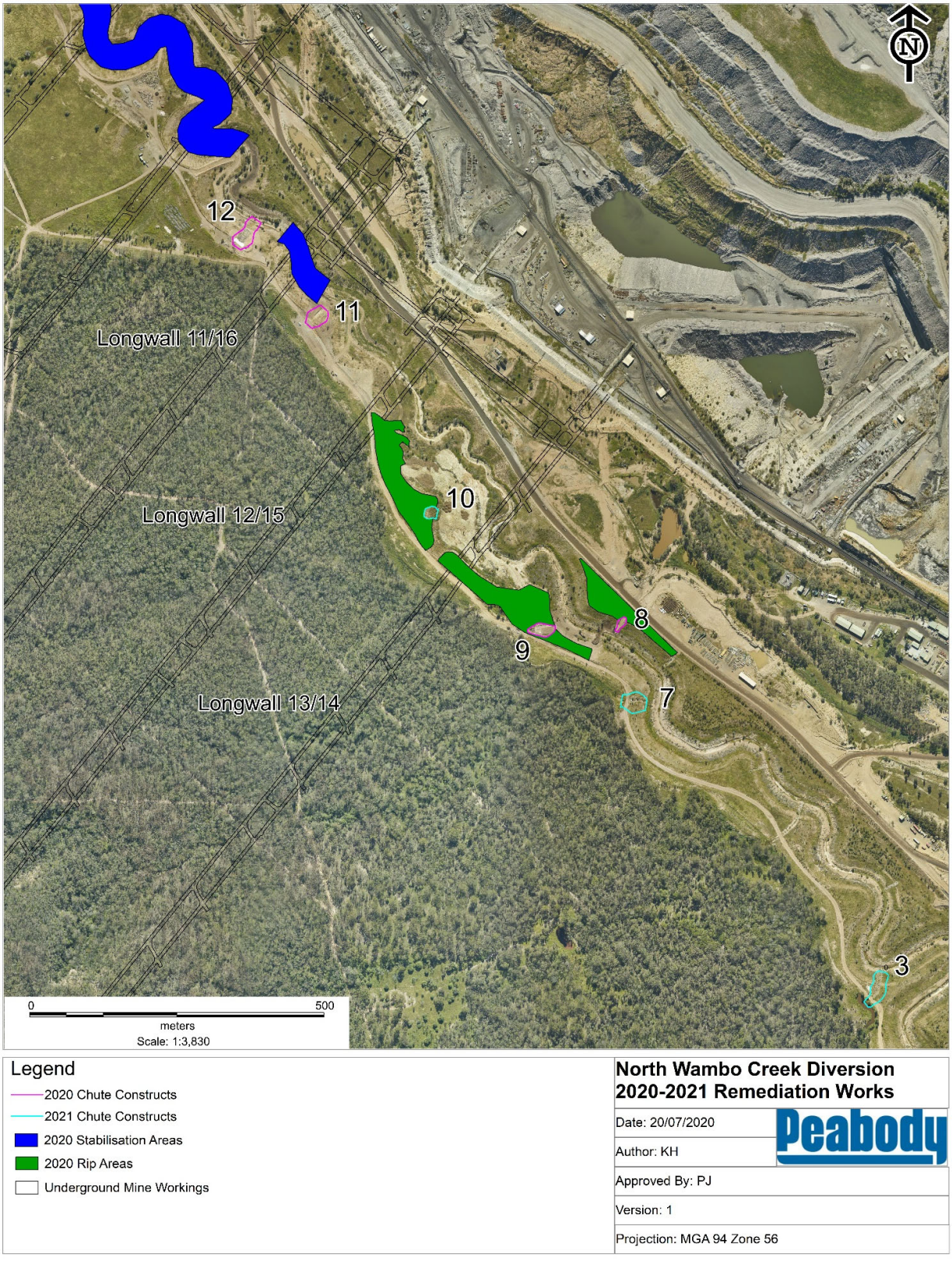
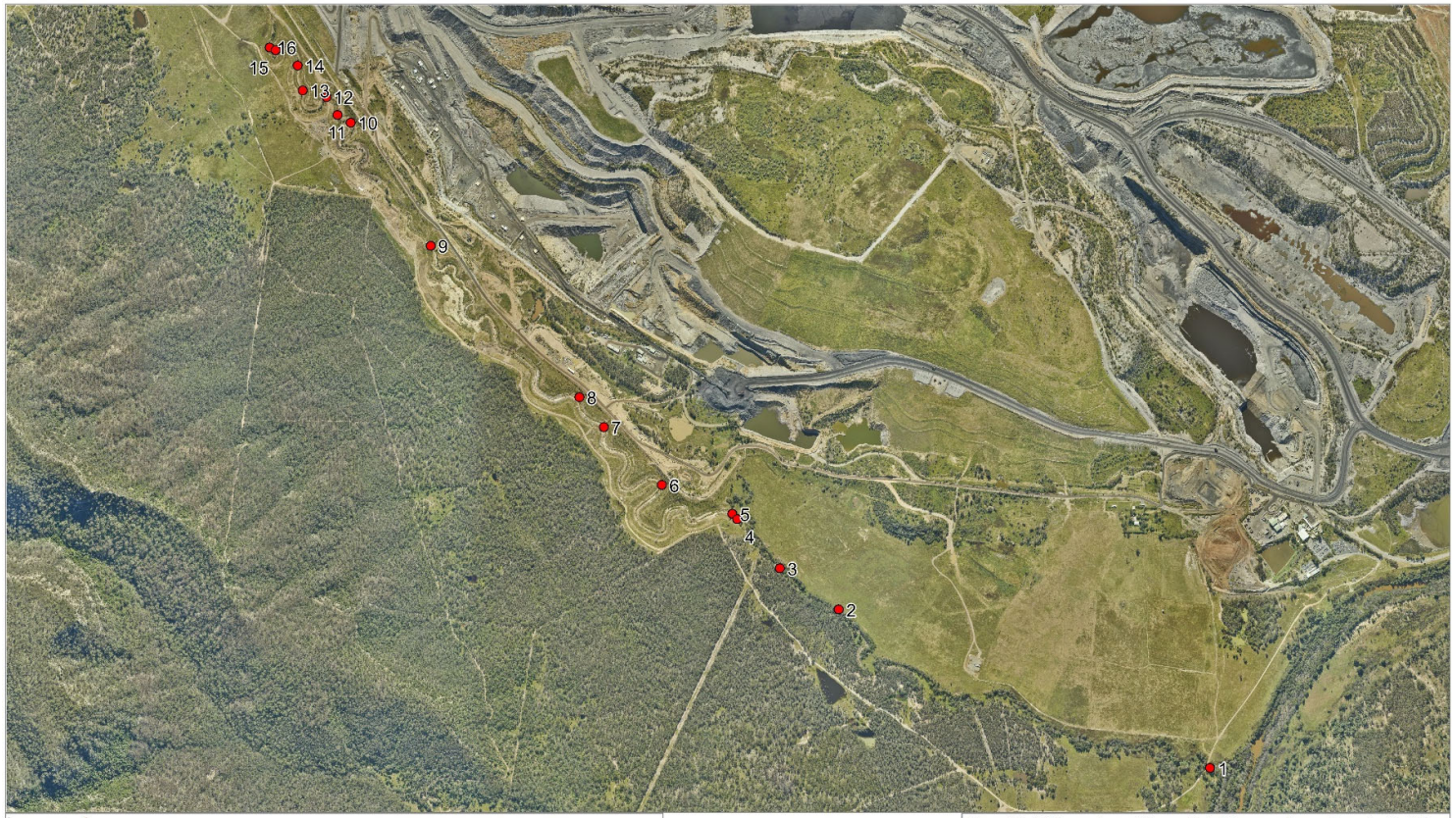


Figure 7: NWCD 2020-2021 Remediation Works



Legend

- Location of instabilities

Peabody	**North Wambo Creek Diversion Instability Locations (as of 2019)**
	Date: 20/07/2020
Version: 1	Author: KH
Projection: MGA 94 Zone 56	Approved By: PJ

Figure 8: NWCD Instability Locations (as of 2019)

3.5 Intercepted Groundwater

Previous versions of the Development Consent required WCPL to return intercepted ground water from the NWCD to the alluvial aquifer downstream of the open cut. This requirement was removed from the Development Consent in Modification 16 (August 2019).

Since December 2017, three (3) separate investigative drilling programs have been undertaken in the North Wambo Creek alluvium, upstream of the North Wambo Creek Diversion, resulting in 33 investigative holes drilled. Thirteen of these have been converted in to alluvial (11) and weathered Permian (2) monitoring bores. Continuous groundwater level loggers have been installed at two (2) sites to capture rapid changes in groundwater level within the North Wambo Creek alluvium associated with intense weather events and periods of flow in North Wambo Creek. Further detail on the monitoring program for these bores is included in the WCPL GWMP.

Following regulator comments received on the NWCD MP (Version 1), the HydroSimulations (2018) groundwater model was updated to include greater temporal variability to better capture groundwater conditions along North Wambo Creek. The alluvium and shallow weathered rock are noted to be less broadly saturated following the construction of the NWCD and interception of alluvial material by the Montrose Open cut. The report notes that '*The existing groundwater monitoring network has a good spatial spread, with bores monitoring the alluvium and the weathered sandstone'.*

It is anticipated that further backfilling of the Montrose open cut mine, already undertaken across the alluvial aquifer intercept, will consolidate over time, reducing hydraulic conductivity. WCPL will continue to account for intercepted groundwater in the annual water balance which is reported in the Annual Review.

4.0 Measurement and Evaluation

The performance and completion criteria within the following sections include the criteria from existing WCPL management plans and monitoring programs. Performance and completion criteria included in **Section 4.1** will be reviewed by WCPL in 2020/2021.

4.1 Performance and Completion Criteria

Preliminary performance completion criteria and indicators have been developed for the NWCD (Domain 7) for all rehabilitation phases except relinquishment. These criteria and performance indicators are detailed in the MOP and have not been included in this Plan.

Specific performance indicators and completion criteria have been developed for the NWCD for geomorphology, surface water (quality and flow) and LFA. Further information on the development of these performance indicators and completion criteria is provided in the WCPL SWMP and WCPL BMP.

4.1.1 Geomorphological Triggers and Success Criteria

Geomorphological triggers and success criteria were developed as part of the detailed design of the NWCD (Gilbert and Associates, 2007). These triggers and criteria relate to the performance of the NWCD in flood conditions (refer to **Table 13**). As noted in **Section 2.1.9.1,** the geomorphological triggers will be reviewed in 2020/2021.

Table 13: Geomorphological Response to Flood Events – Triggers and Success Criteria

Flood Event	Attribute	Success Criteria*	Trigger
Extreme i.e. >100 year ARI	Bank erosion, siltation of over bank and in-channel deposition and bed scour features	Frequency and magnitude of attribute are not more than: • 100% greater than the average of the same attributes in the control reaches or • 50% greater than the greatest as measured in any of the control reaches	Severe erosion of bed and banks or over bank scour which would likely lead to an ongoing threat to the integrity of the diversion and the pit bund
Major i.e. 20-100 year ARI	Bank erosion, siltation of over bank and in-channel deposition and bed scour features	Frequency and magnitude of attribute are not more than: • 100% greater than the average of the same attributes in the control reaches or • 50% greater than the greatest as measured in any of the control reaches	Bank slips, undermining or over bank scour would likely lead to ongoing instability in either the diversion or the pit bund
Medium i.e. 5-20 year ARI	Bank erosion, siltation of over bank and in-channel deposition and bed scour features	Frequency and magnitude of attribute are not more than: • 100% greater than the average of the same attributes in the control reaches or • 50% greater than the greatest as measured in any of the control reaches	Severe erosion of bed and banks or over bank scour which would likely lead to ongoing degradation of the diversion or the pit bund
Small to medium i.e. <5 year ARI peak discharge but sufficient to cause	Bank erosion, siltation of over bank and in-	Frequency and magnitude of attribute are not more than:	Erosion of bed and banks or over bank scour which would likely lead to

Flood Event	Attribute	Success Criteria*	Trigger
measureable responses/changes in either the diversion or the control reaches.	channel deposition and bed scour features	• 50% greater than the average of the same attributes in the control reaches or • 25% greater than the greatest as measured in any of the control reaches	accelerated erosion or instability of the diversion and the pit bund

* Determined as a result of a survey

4.1.2 Surface Water Triggers and Success Criteria

The performance and completion criteria for the diversion are outlined in **Table 14.** Further discussion on the triggers/criteria and specific Trigger Action Response Plans (TARPs) is included in the WCPL SWMP. TARPs relevant to the diversion are included in **Section 4.3.**

Table 14: Performance Criteria for the North Wambo Creek Diversion

Parameter	Trigger/Criteria	Comment	Relevant Management Plan
Water Quality			
pH	Lower limit: 7.3 Upper Limit: 7.9	The TARP for these triggers is included in **Section 4.3**.	SWMP
EC	Lower limit: 1,155 µS/cm Upper Limit: 2,246 µS/cm		
TSS	Low Flow: 53 mg/L High Flow: 1,110 mg/L		
Stream Flow			
Flow	Flow recorded following 100mm* of rainfall	There are currently no TARPS established for stream flow, specific to the NWCD.**	SWMP

*revised as outlined in **Section 2.3**

** Performance and completion criteria are to be developed with a better informed understanding of the likely surface hydrologic regime of the diversion with monitoring data collected over the next 5-10 years.

4.1.3 LFA Target Scores

Target scores were developed to provide quantitative measures that can be used to compare rehabilitation areas with reference sites throughout the course of the monitoring program (**Section 4.2**). These scores were developed using the data in **Section 2.1.8** as well as data from nearby sites within relatively undisturbed riparian habitat.

A colour system (**Table 15**) has been devised to highlight the performance of LFA sites against the target scores in **Table 16**. The colour system is applied to the average score from monitoring of LFA sites within the NWCD rehabilitation area.

Table 15: Colour system devised to highlight the performance of each LFA site

Performance Rating			
Green	**Yellow**	**Orange**	**Red**
Area is generally meeting or exceeding target values and values do not show trend of decline over time – where monitoring sites are meeting targets and values are relatively consistent, reduce monitoring to infrequent LFA when changes in landscape or	Area generally falls below target values but within 75% of targets or appears to be on a trajectory of improvement without the need for management intervention – further monitoring required	Area generally falls between 75% and 50% of target values or shows little sign of improvement over several monitoring events – further monitoring and possibly management actions required	Area falls below 50% of target and is unlikely to improve without management actions or shows trend of decline which is unlikely to improve without management actions

Performance Rating			
Green	Yellow	Orange	Red
management practices occur i.e. fire or grazing)			

The ongoing use of LFA will be result-based, with achievement of a self-sustaining stable landform no longer requiring further monitoring. Incremental improvement toward target scores is anticipated in each successive monitoring season. Failure to progress towards completion criteria for three consecutive years will trigger further investigation, in accordance with the WCPL BMP.

Table 16: LFA targets for the NWCD

	Landscape Organisation Index	Stability Index	Infiltration	Nutrient Index
Target Score	>84	>62	>41	>37
2017 average score*	0.63	56.25	32.96	26.05

* refer **Section 2.1.8**

If there is less than 5% annual improvement or a decline in the LFA target score (from the previous monitoring round) then this will trigger a response in accordance with the WCPL BMP (refer to TARP in **Section 4.3.2** of this Plan).

4.2 Monitoring Program

The diversion monitoring program is designed to regularly monitor and inspect the water quality, ecology, hydrology and geomorphic integrity to ensure identification of any issues and efficient remediation can be actioned where required. The diversion monitoring program is summarised in **Table 17.** Monitoring locations are shown on **Figure 9** and **Figure 10.** Further detail on the monitoring programs is provided in the relevant management plans.

Monitoring data is compared to the performance criteria detailed in **Section 4.1**. If any unsatisfactory performance is identified, the actions and follow up required will be recorded as part of the monitoring observations and as described in the Trigger Action Response Plans (**Section 4.3**).

Reporting on the performance of the diversion and the diversion monitoring program is undertaken as part of the Annual Review process (**Section 5.1.1**). The process for reporting environmental incidents is described in **Section 5.1.2.**

Table 17: Diversion Monitoring Program

Component	Site	Parameter	Frequency	Purpose	Relevant Management Plan
Water Quality and Stream Flow					
Water Quality	SW05	pH, EC, TSS	Monthly/ Rainfall Event	Monitoring water quality of North Wambo Creek downstream of Wambo Coal Operations	SWMP
	SW27a			Monitoring water quality at North Wambo Creek (middle of diversion)	
	SW32a			Monitoring water quality at North Wambo Creek Pump	
	SW04	pH, EC, TSS, metals and ions (including sulfates)	Monthly/ Rainfall Event	Monitoring water quality of North Wambo Creek upstream of North Wambo Creek Diversion, including monitoring for metals and ions (including sulfates) until March 2020 for baseline data	
	US FM1			Monitoring water quality of upper reaches of North Wambo Creek, including monitoring for metals and ions (including sulfates) until March 2020 for baseline data	
Stream Flow	FM1	Flow	Continuous	Monitoring of flow in North Wambo Creek – confluence	SWMP
	FM2			Monitoring of flow in North Wambo Creek – middle of diversion	
	FM3			Monitoring of flow in North Wambo Creek	
	FM4			Monitoring of flow in North Wambo Creek - downstream near confluence of Wollombi Brook	
	US FM1			North Wambo Creek - upstream	
Diversion and Subsidence Monitoring Program – Operational Monitoring					
Index of Diversion Condition	Upstream reach (U1-U4), NWCD Stage 2 (Div1-Div5), NWCD Stage 3 (Div 6 – Div11), Above completed North Wambo Underground (WS1-WS6) and Downstream reach (D1-D2)	Geomorphic Index and Riparian Index Photo recording	Annually*	IDC provides a rapid assessment of the diversion and adjoining reaches of interest along the watercourse and is designed to flag potential management issues rather than provide a detailed scientific assessment of the waterway. The assessment uses current aerial photos, LIDAR data, mine plans and flow monitoring data.	Extraction Plan for LWs 11-16 (Subsidence Monitoring Program) SWMP
Landscape Function	NWCD Stage 2 (17R, 19R, 21R, 23R)	Landscape Organisation Index and Soil	Annually (Autumn or Spring)	Monitoring of established LFA transects in areas of revegetation along the diversion and a corresponding reference site on Wambo Creek.	BMP SWMP

Component	Site	Parameter	Frequency	Purpose	Relevant Management Plan
Analysis (LFA)	NWCD Stage 3 (25R, 26R, 27R & 28R) and W14R (Wambo Creek reference site)	Surface Assessment			
Riparian Vegetation	Same as IDC monitoring sites	Vegetation structure and extent	Annually *		BMP SWMP
	8A, 9A, 10A, 11A, 12A, 13A, 14A, 15A	Rapid Appraisal of Riparian Condition (RARC) Index	Annually	Monitoring of riparian vegetation in the North Wambo Creek Diversion, using the RARC index, as well as a visual assessment of the impact of erosion and subsidence (as part of an ongoing photographic record).	BMP
Aerial Photography	Full reach of NWCD and North Wambo Creek downstream	Changes to channel form compared to previous aerial photographs.	Annually *		SWMP
Long And Cross-Section Surveys - Creek Bed and Bank Stability	Various cross sections	Changes to channel form compared to previous surveys.	Annually	Locations extracted from LiDAR or aerial photogrammetry survey data captured over NWCD and North Wambo Creek downstream. Monitoring of bed and bank stability by surveying consultants to measure areas if significant erosion and identify changes related to creek bed condition and water flow.	SWMP
Annual Subsidence Inspection	Areas impacted by subsidence	Subsidence Inspection	Annually	Inspection to identify any surface disturbance, assess the level of disturbance to native vegetation and assess any changes in the diversion due to subsidence.	BMP
Daily Subsidence Inspection	Areas impacted by subsidence	Surface cracks and ponding	Daily during undermining	Daily inspections when extraction is occurring directly beneath North Wambo Creek Diversion.	Extraction Plan for LWs 11-16 and LWs17-20
Other					
Freshwater Macro-invertebrate	1D, 12D	Freshwater Macro-invertebrate Study	Every 5 years (2021, 2026 etc)	Monitoring of freshwater macroinvertebrates in the North Wambo Creek Diversion, including assessment of SIGNAL A values. Water quality data to (EC, pH and temperature) to be sourced from scheduled surface water monitoring.	BMP

Component	Site	Parameter	Frequency	Purpose	Relevant Management Plan
Weeds	Stage 3	Weeds	In accordance with Annual Weed Treatment Plan	Weed management of NWCD Stage 3 will be monitored by a weed inspection regime and will be included in the Wambo Annual Weed Treatment Plan	BMP
Discharge Flows	Entire diversion	Bankfull discharge flow capacity and velocity	Annually (as part of Annual Review)	Calculation of Bankfull discharge flow capacities and velocities in the diversion.	SWMP
Diversion Stability^	Entire diversion^	Diversion stability		Assessment of diversion stability performance, compared with selected stable reaches of North Wambo Creek and other control catchments, as approved by DPI Water	
Diversion Construction and Rehabilitation Monitoring	Areas impacted by construction or rehabilitation works	General environment	As required during and immediately after construction of mitigation or rehabilitation works along the NWCD	Monitoring to confirm that works have been undertaken to specification and/or meet design intent.	SWMP

*Frequency may be reduced following the completion of subsidence from the South Bates Underground Mine.
^ new monitoring sites added in 2019 in response to the identification of areas of instability, as detailed in the Detailed Rehabilitation Plan for the NWCD (**Appendix C**). Monitoring locations include Sites 02, 03, 04, 06, 08 and 09 (refer **Figure 7**).

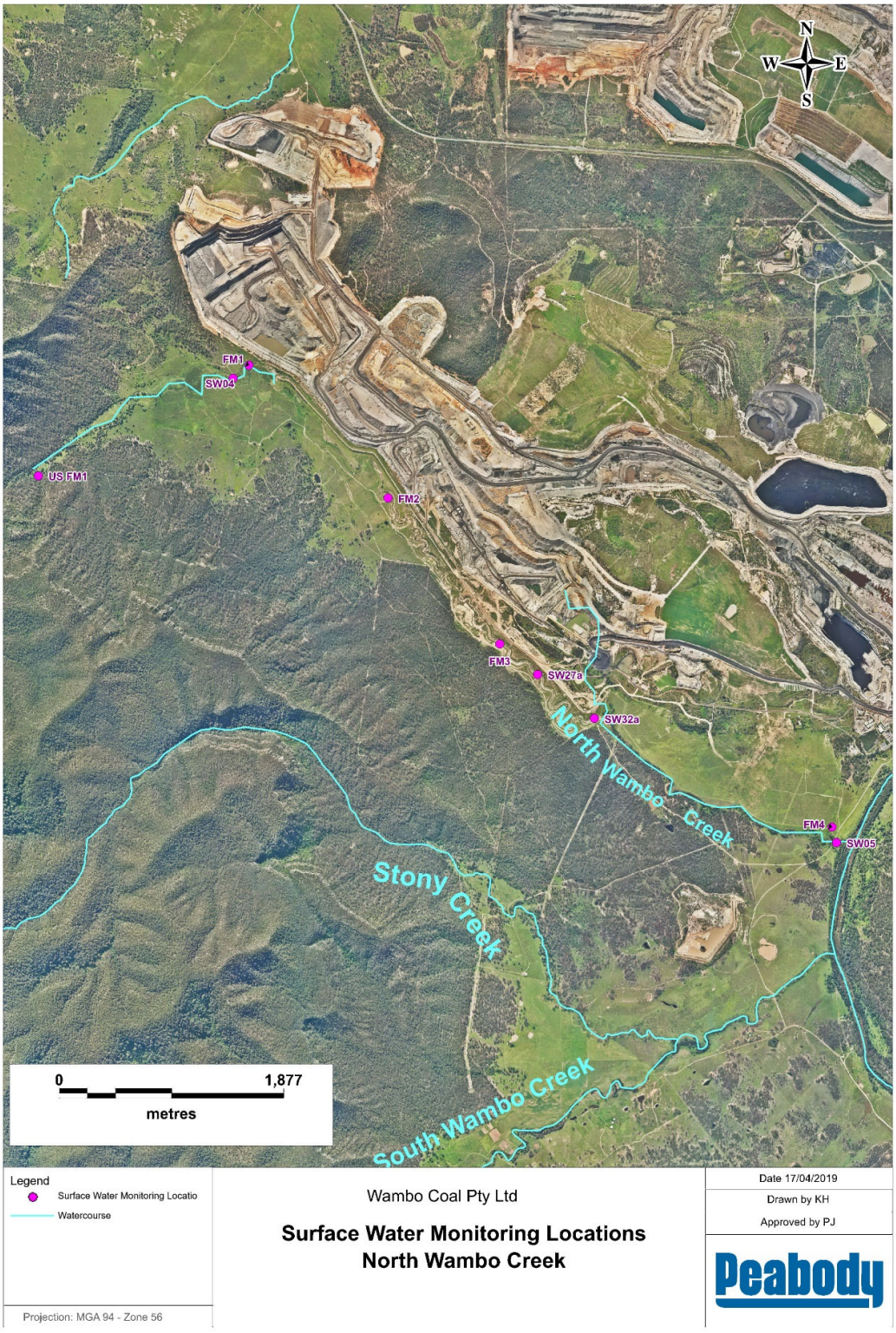


Figure 9: Diversion Surface Water Quality and Stream Flow Monitoring Program

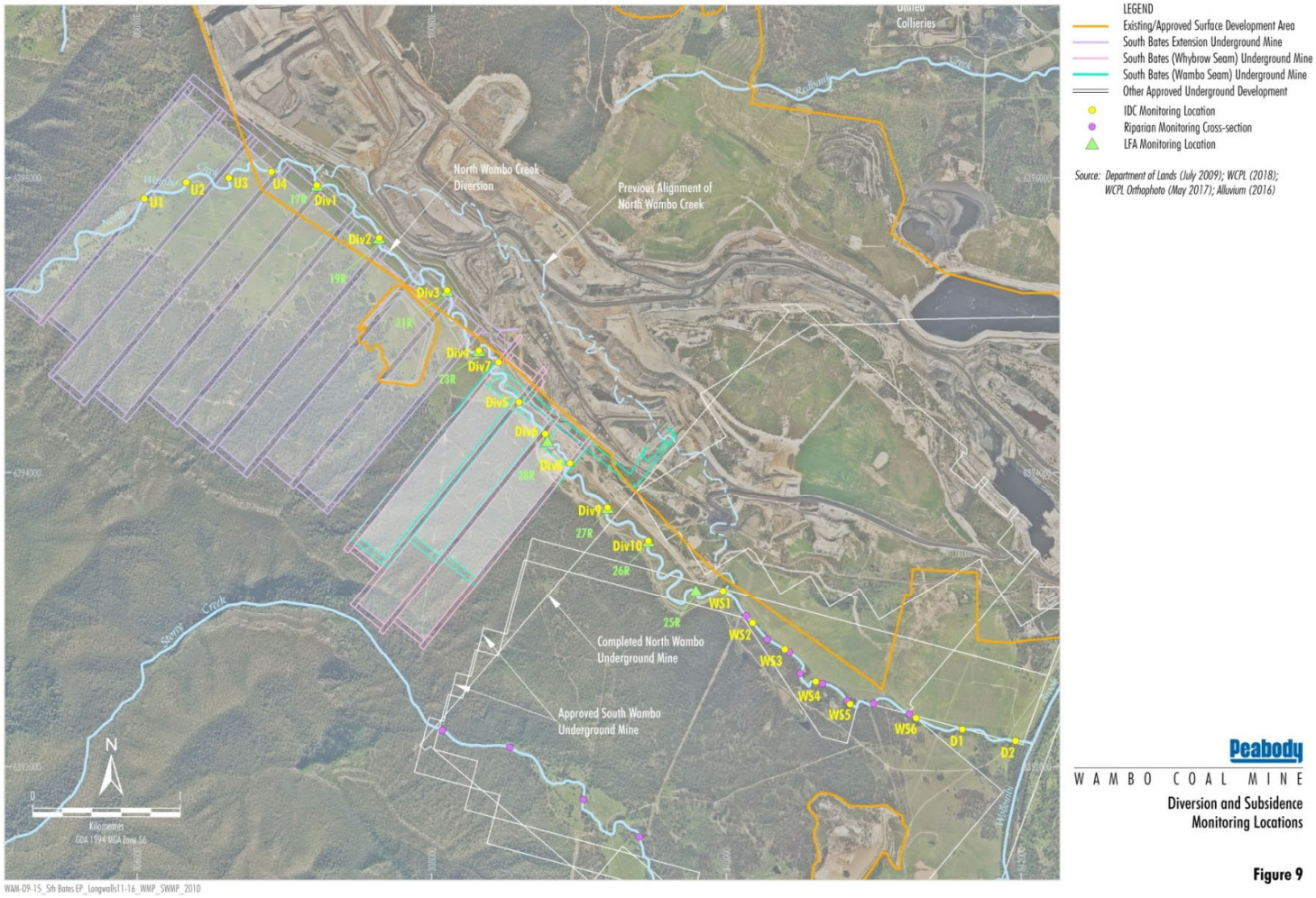


Figure 10: Diversion and Subsidence Monitoring Program – Operational Monitoring

4.3 Trigger Action Response Plans

A range of TARPS have been developed for the NWCD. These TARPS have been developed and included within existing WCPL Management Plans and strategies, with the TARPS being included in the following sections.

TARPS have been developed for key aspects of the performance of the NWCD and include TARPs for surface water, subsidence and LFA. These TARPs will continue to be refined as further monitoring data is obtained and following receipt of regulatory agency comments and DPE approval of this Plan.

The TARPS include preliminary reviews of trending data after two consecutive events are observed, with investigations required to be undertaken by WCPL if three consecutive events are observed. Two consecutive events require the initiation of the Level 1 response with three consecutive events requiring instigation of the Level 2 response.

TARP's for the management of subsidence are included in the respective Extraction Plans.

Additional TARPs will be developed to address geomorphic factors as well as specific TARPs for the civil works as detailed in **Section 3.4.**

4.3.1 Surface Water TARP

The TARP in **Table 18** will be implemented in the event that surface water monitoring of North Wambo Creek, for pH, EC and TSS, identifies water quality results exceeding the 80th Percentile Trigger Value, as identified in the WCPL SWMP, after two consecutive sampling events.

Table 18: TARP for North Wambo Creek Diversion Performance – Surface Water*

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Surface water monitoring of North Wambo Creek, for pH, EC and TSS, identifies water quality results exceeding the 80th Percentile Trigger Value, as identified in the SWMP, after two consecutive sampling events; and/or	•Surface water monitoring of North Wambo Creek for pH, EC and TSS, identifies water quality result exceeding the 80th Percentile Trigger Value, after three consecutive sampling events.
Action	•Review recent rainfall data to identify potential correlation between decreasing water level trends and extended dry periods. •Maintain monitoring of surface water sites to identify if water quality results are trending back to long term averages as identified in the SWMP. •If any water quality exceeds the 80th Percentile Trigger Value (three consecutive periods), then go to Level 2 Response.	•Continue surface water monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •Wambo will undertake preliminary investigation as soon as possible, including: - Undertaking an investigation to review surface water monitoring results in conjunction with site activities being undertaken at the time, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken. •If confirmation of a results and investigations from above confirms impacts, Wambo will notify the relevant government agencies and in consultation develop appropriate remedial measures if required.
Plan	Data obtained from monitoring to be utilised as part of ongoing refinement of criteria.	•Review and update the WCPL WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

* This TARP is consistent with the "*TARP for North Wambo Creek Diversion Performance*" in the WCPL SGWRP (Version 12).

4.3.2 LFA Monitoring TARP

The TARP in **Table 19** will be implemented in the event that LFA monitoring of riparian areas identifies a potential decline in creek stability, beyond natural fluctuations.

Table 19: TARP for North Wambo Creek Diversion Performance – Biodiversity*

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Monitoring of LFA of riparian areas identifies a potential decline in creek stability, beyond natural fluctuations – refer to **Section 4.1.3**.	•Monitoring of LFA of riparian areas^ identifies a decline in creek stability in consecutive monitoring events, beyond natural fluctuations.
Action	•Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •If consecutive LFA and aquatic ecosystems monitoring events show continued decline trends and displaying no signs of improving trends, then go to Level 2 Response.	•Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •Wambo will undertake preliminary investigation as soon as possible, including: - Undertaking an investigation to review monitoring results in conjunction with site activities being undertaken at the time, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken. •If confirmation of a results and investigations from above confirms impacts, Wambo will notify the relevant government agencies and in consultation develop appropriate remedial measures if required.
Plan	Data obtained from monitoring to be utilised as part of ongoing refinement of criteria.	•Review and update the WCPL BMP and resubmit to DPIE within 3 months, or as otherwise agreed.

*This TARP is consistent with the TARP in the WCPL BMP and the "TARP for North Wambo Creek Diversion Performance" in the WCPL SGWRP (Version 12).
^ Monitoring undertaken in accordance with the WCPL BMP.

4.3.3 Subsidence TARP

WCPL has developed a TARP to manage subsidence impacts on surface and groundwater as a result of underground mining. This TARP is detailed within the ***North Wambo Creek Diversion Subsidence Response Strategy – SBU and SBU Extension Mine*** which forms part of approved Extraction Plan. A copy of this strategy is included in **Appendix E.**

Triggers and actions specifically related to the NWCD are summarised in **Table 20** below.

Table 20: Subsidence TARP for the North Wambo Creek Diversion

Condition	Normal	Level 1	Level 2
	Normal conditions	Management Measures	Restoration/Contingency Phase
Trigger	• No visible cracks along North Wambo Creek Diversion.	• Cracks observed along North Wambo Creek Diversion.	• Functionality of North Wambo Creek Diversion materially affected.
Action	• Conduct monitoring, consistent with **Table 17** of this plan, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan). • Assess the environmental consequences of the subsidence in accordance with Section 1.2 of the NWCSRS (**Appendix E**). • Assess the need for management measures in accordance with Section 2.2 of the NWCSRS (**Appendix E**).	• Implement management measures, as required, in accordance with Section 2.2 of the NWCSRS (**Appendix E**). • Continue monitoring, consistent with **Table 17** of this plan, the GWMP, SWMP, and the Subsidence Monitoring Program (Appendix H of the Extraction Plan).	• Develop and implement an action plan for additional measures*, including consideration of: ○ additional scour protection, crack remediation and/or stabilisation; and/or ○ isolation sealing of the diversion cutting, for example through injection grouting or installation of low permeability material.
Frequency	• Monitoring as per **Table 17** of this plan, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan). • Assessment of consequences and need for management measures, as required (dependent on monitoring results)	• As required, in accordance with Section 2.2 of the NWCSRS (**Appendix E**).	• As required, in accordance with Section 2.2 of the NWCSRS (**Appendix E**).
Position of Decision Maker	• Environment and Community Manager.	• Environment and Community Manager.	• General Manager.

*Implementation of additional management measures will be undertaken in consultation with the RR and DPI Water.

4.4 Non-compliances with Statutory Requirements

Non-compliances with the performance criteria detailed in **Section 4.1** will be managed in accordance with the relevant TARP (**Section 4.3**). Environmental incidents that cause or have the potential to cause harm to the environment will be reported in accordance with **Section 5.1.2.** Any other non-compliances with statutory requirements will be investigated and the results of this investigation will be reported in the Annual Review.

4.5 Complaints

Any complaints received regarding the diversion will be handled in accordance with the complaints management procedure detailed in the Wambo EMS.

5.0 Review and Improvement

5.1 Reporting

5.1.1 Annual Review

Wambo will review the performance of the diversion on an annual basis and report on any significant findings in the Annual Review. The Annual Review will be provided to DPIE and will be available on the Wambo website.

The Annual Review will detail the works which have been undertaken during the report period and will also provide an update against the actions as detailed in **Section 3.4** whilst also detailing the actions to be undertaken for the following 12 months. The action plan, as shown in **Section 3.4.1**, will be included in further detail for each year within the Annual Review.

5.1.2 Reportable Environmental Incidents

In accordance with the Pollution Incident Response Management Plan (PIRMP), WCPL must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of *Part 5.7* of the *POEO Act.* This will be undertaken as required by the WCPL E&C Manager in accordance with WCPL's PIRMP.

5.2 Plan Review

WCPL will review, and if necessary, revise the NWCD Plan (in accordance with Condition D6 of DA 305-7-2003) within three months of:

- The submission of an Annual Review;
- The submission of an incident report;
- The submission of an independent environmental audit; or
- Any modification to the development consent (excluding Mod 16).

The Plan will also be reviewed:

- Prior to new underground mining areas being developed,
- Following continual exceedance of trigger values; or
- If there is a relevant change in technology, practice or legislation.

The revised Plan will be re-submitted to the Secretary for approval as required.

6.0 Accountabilities

Table 21 summarises accountabilities associated with this Plan.

Table 21: Accountabilities

No	Task	Accountability	Timing
1	Provide adequate resources for the implementation of this Plan.	General Manager	As required
2	Implement this Plan	Environment and Community Manager	As required
3	Ensure monitoring, inspections and visual assessments after high rainfall events are undertaken	Environment and Community Manager	As required

7.0 Acronyms

Table 22 lists the acronyms used throughout this Plan.

Table 22: Acronyms

Acronym	Description
AHD	Australian Height Datum
ARI	Average Recurrence Interval
BMP	WCPL Biodiversity Management Plan
CLWD	Crown Lands and Water Division within Department of Primary Industry
DA	Development Approval
DPI - Water	NSW Department of Industry – Water (Formerly DWE)
DoP	NSW Department of Planning
DPIE	NSW Department of Planning, Industry and Environment (formerly DoP)
DPIE Water Group	NSW Department of Planning, Industry and Environment – Water (DPIE Water and the Natural Resources Access Regulator)
DPI	NSW Department of Primary Industries
DWE	NSW Department of Water and Energy
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning & Assessment Act 1979
EPL	Environment Protection Licence
GWMP	WCPL Groundwater Management Plan
IEA	Independent Environmental Audit
LFA	Landscape Function Analysis
LW	Longwall
MOP	Mining Operations Plan
NWCD	North Wambo Creek Diversion
NWCSRS	North Wambo Creek Subsidence Response Strategy
NWU	North Wambo Underground
PIRMP	WCPL Pollution Incident Response Management Plan
RARC	Rapid Appraisal of Riparian Condition
RMP	Remediation and Monitoring Program
RR	Resources Regulator - DPIE (formerly DPI)
SBU	South Bates Underground
SGWRP	WCPL Surface and Groundwater Response Plan
SWMP	WCPL Surface Water Management Plan
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WCPL	Wambo Coal Pty Ltd
WMP	WCPL Water Management Plan

8.0 References

8.1 Legislation

- Environmental Planning and Assessment Act 1979
- Protection of the Environment Operations Act 1997

8.2 Approvals, Modification Applications and Assessments

- Development Consent (DA305-7-2003)
- Wambo Development Project Environmental Impact Statement, volumes 1-5, dated July 2003, prepared by Resource Strategies Pty Ltd (Project EIS)
- Wambo Development Project – Modification of DA 305-7-2003-I; dated 27 July 2006 (Mod 5)
- Wambo Development Project – Modification of DA 305-7-2003-I; dated 21 September 2006 (Mod 6)
- Wambo Coal Mine Modification Statement of Environmental Effects; dated September 2006 (Mod 6)
- Modification application DA 305-7-2003 MOD 16 and accompanying documents titled *United Wambo open cut coal mine Project Environmental Impact Statement*, prepared by Umwelt (Australia) Pty Limited, dated August 2016, submitted with the application for consent for the development for SSD-7142 dated August 2016 including the Applicant's response to submissions, the Applicant's response to the Independent Planning Commission's review and the additional information responses provided by the Applicant in support of the application dated 20 September 2017, 6 November 2017, 5 December 2017, 11 October 2018, 17 October 2018, 12 April 2019, 14 April 2019 and 27 May 2019
- Modification application DA 305-7-2003 MOD 17 and accompanying documents titled *South Bates Extension Modification Environmental Assessment*, dated March 2017, and associated Response to Submissions (Parts A and B) dated June and September 2017 (Mod 17)
- Environment Protection Licence (EPL) 529

8.3 Management Plans, Programs and Strategies

- WCPL Biodiversity Management Plan (WA-ENV-MNP-506)
- WCPL Environmental Management Strategy (WA-ENV-MNP-501)
- WCPL Water Management Plan
- WCPL Groundwater Management Plan (WA-ENV-MNP-509.1)
- WCPL Surface Water Management Plan (WA-ENV-MNP-509.2)
- WCPL Site Water Balance (WA-ENV-MNP-509.5)
- WCPL Erosion and Sediment Control Plan (WA-ENV-MNP-509.3)
- WCPL Surface and Groundwater Response Plan (WA-ENV-MNP-509.4)

- WCPL Mining Operations Plan (MOP)
- WCPL, undated. Diversion Construction Program
- WCPL, 2007. North Wambo Creek Diversion (NWCD) Plan
- WCPL, 2008. North Wambo Creek Subsidence Response Strategy
- WCPL, 2013. North Wambo Creek Diversion Stage 3 Remediation and Monitoring Program, 28 June 2013
- WCPL, 2015. North Wambo Creek Diversion Inspection and Action Plan (July 2015)

8.4 Reports

- AECOM, 2018. Report on Flow Events along North Wambo Creek, South Wambo and Stoney Creeks for the period 1 February 2017 to 31 January 2018
- Alluvium, 2018. North Wambo Creek baseline assessment geomorphic context statement by Alluvium Consulting for Wambo Coal Pty Ltd, February 2018
- Cumberland Plains Seeds, 2019 NWCD Revegetation Management Plan. Report prepared for Soil Conservation Service.
- Cunningham et al., undated. Systems used to classify rural lands in New South Wales
- FloraSearch, 2015. South Bates (Wambo Seam) Underground Mine Modification Environmental Assessment – Flora Assessment. Report prepared for Wambo Coal Pty Limited.
- FloraSearch, 2016. South Wambo Underground Mine Modification – Flora Assessment. Prepared for Wambo Coal Pty Ltd. March 2016.
- FloraSearch, 2017. South Bates Extension Modification – Flora Assessment. Prepared for Wambo Coal Pty Ltd. January 2017.
- Geoterra, 2005. United Collieries Pty Ltd Surface and Groundwater Monitoring to December 31 2004.
- Gilbert and Associates, 2003. Wambo Development Project Surface Water Impact Assessment.
- Gilbert and Associates Pty Ltd, 2007. North Wambo Creek Diversion Design Report prepared for Wambo Coal Pty Ltd, Sep-07, Report ref: J0207-7-rgd.doc.
- Groundwater Imaging, 2012. A Transient Electromagnetic Investigation of the Extent of the Wollombi Brook Alluvium at the Wambo Coal Mine Site
- Hansen Bailey, 2018a. Wambo Coal Mine and Rail Loop Independent Environmental Audit Report, prepared by Hansen Bailey September 2018 for Wambo Coal Mine Pty Ltd.
- Hansen Bailey, 2018b. Wambo Coal Mine Independent Environmental Audit Additional Information
- Heritage Computing, 2012. North Wambo Underground Mine Modification Environmental Assessment: Appendix B Groundwater Assessment.

- HLA-Envirosciences Pty Ltd, 2007. North Wambo Creek Diversion Rehabilitation Plan, 5 September 2007 Resource Strategies, 2006. Wambo Coal Mine Modification Statement of Environmental Effects, Wambo Coal Pty Ltd, September 2006
- Soil Conservation Service 2019. North Wambo Creek Diversion Condition Assessment and Remediation Proposal Stage 1 Works 2020
- Soil Conservation Service 2019.North Wambo Creek Diversion Condition Assessment and Remediation Proposal Stage 2 Works 2021
- SLR North Wambo Creek Groundwater Modelling Report (draft) 2020. Prepared for Wambo Coal

8.5 Other

- NSW Department of Mineral Resources, 1993. Hunter Coalfield Regional Geology 1:100,000 map, Edition 2
- Tongway, D.J. and Hingley, N.L 2004. Landscape Function Analysis, Procedures for monitoring and assessing landscapes

APPENDIX A
CORRESPONDENCE

Regulator Comments received on Update to NWCD MP V1 (2019)

Regulator	Comment/Recommendation	WCPL Response
DPIE Water Group (Natural Resources Access Regulator) 4 July 2019	Recommendation 1 The Management Plan should be updated to address the performance criteria to demonstrate effective conformance to conditions 31(b), 31(c), 31(e), 31(f), 31(g), 35(b), 35(g) of the development consent.	These conditions relate to the previous version of DA305-7-2003. Modification 16, approved 29 August 2019, no longer contains this requirement. Conditions relevant to DA305-7-2003 (Modification 16) and where the conditions are addressed in this document are shown in **Table 1** (**Section 1.4.1**).
	Recommendation 2 The Management Plan as per Schedule 4 Condition 31(c) should be updated to provide prescriptive detail articulating the process for measuring stream flow and alluvial aquifer losses associated with the stream diversion against nominated alluvial and/or stream flow performance measures positioned downstream of the open cut.	A detailed analysis of hydrology based on historic gauging information in association with more in depth groundwater analysis has developed further relationships between the two and provided direction for monitoring and analysis into the future with data from an expanded monitoring program. The flow event in February 2020 was the first event with adequate data (refer **Section 2.3**).
	Recommendation 3 The Plan infers the hardrock base of the creek will sufficiently self seal subsidence-related hydraulic fracturing thereby limiting stream losses. A staged contingency plan is required to account for water losses in the event that the performance measures listed under Schedule 4 Condition 31 are not achieved within an acceptable timeframe.	Accounting for water losses upstream of the diversion by addressing Recommendation 2 has provided a much improved understanding of what flow can be expected to enter the diversion. Losses to subsidence related cracks in the diversion can be framed in that context. Flow events, with associated sediment transport are known at many longwall mining operations to reduce the hydraulic conductivity of subsidence cracks in bedrock (as is present in the base of the diversion) to a similar order of magnitude of natural fractures in the bedrock.
	Recommendation 4 Provide additional information clarifying changes in hydrologic behaviour in North Wambo Creek through the diversion cutting. This must analyse any alteration in hydrographs from upstream to downstream of the diversion cutting. This must be delivered within three months of approval of the remediation plans to the North Wambo Creek Diversion Plan.	Addressed through the analysis for Recommendation 2 (refer **Section 2.3**)
	Explanatory Comment 1 <u>Hydrogeology</u> Schedule 4 Condition 31(c) states: "The Plan must include the detailed design of the system that would return intercepted ground water to the alluvial aquifer downstream of the open cut." Review of the Wambo Coal Annual Reports and Water Management Plan identifies that the existing alluvial monitoring bores downstream of the NWCD have gone dry or in other cases presented declining trends prior to being destroyed. Loss of recharge to the alluvial aquifer was evident. These bores were subsequently removed from Wambo Coal's Trigger Action and Response Plan (TARP) without activation of any restoration works.	This condition relates to the previous version of DA305-7-2003. Modification 16, approved 29 August 2019, no longer contains this condition. Conditions relevant to DA305-7-2003 (Modification 16) are shown in **Table 1** (**Section 1.4.1**).

Regulator	Comment/Recommendation	WCPL Response
	Further detail is required to demonstrate how the proposed drilling program within an already impacted aquifer leads to returning intercepted groundwater, particularly if nominated reference TARP bores are to be removed once an impact is evident. As currently presented in the report, the proposed drilling work and monitoring does not appear sufficient to fulfil the conditional requirement and further detail is required prior to approval.	
	Explanatory Comment 2 <u>Ecohydrology</u> The diversion channel performance is not considered successful. Ongoing intervention is required to maintain the channel with similar bed widths and batter toe levels. The report does not provide sediment transport information. No revegetation seems to have occurred downstream of Point 10 of Figure 4 of the North Wambo Creek Diversion Management Plan. Where vegetation is present, it is widely scattered, and covers less than 10% of bank length in any reach. Vegetation species have not been listed in s 3.3 (Revegetation Strategy) of the Diversion Management Plan, though two species – Casuarina cunninghamia and Angophora floribunda – are identified for the strategy. Appropriate density and reach proportion of established vegetation along the diversion channel is required to achieve the stability outcome identified in the North Wambo Creek Diversion Management Plan. Condition 35(b) and 35(f) of Schedule 4 of the consolidated development consent requires Wambo Coal Mine to design and implement measures to mitigate reduction in surface flows and throughflows reporting to the final gauge site on North Wambo Creek above its junction with Wollombi Brook. The mitigation measures do not address these conditions. No information is presented to identify any impact caused by reduction in baseflows, pooling or saturation thickness in the associated alluvium.	Rehabilitation actions in the form of soil improvement, overland flow erosion management and revegetation are being incrementally implemented from downstream to upstream in the diversion over a number of years, having commenced in 2016 following initial review of performance by Alluvium in 2015 (refer to **Table 12** (**Section 3.4.1**)).
DPIE - Resources Regulator	4.1 Performance and Completion Criteria should include success criteria for performance of revegetation works (for example, species diversity, species establishment). Moreover, section 4.3 Trigger Action Response Plans should be updated to include trigger levels for vegetation reestablishment	Performance and completion criteria are to be developed with a better informed understanding of the likely surface hydrologic regime of the diversion with monitoring data collected over the next 5-10 years. Trigger levels for vegetation re-establishment will be established and included in future revisions to this plan.

Previous regulator comments and where they have been addressed

Date	Regulator	Requirements	Where addressed in this Plan
14 April 2008	DPIE (formerly DoP)	1. The SWMP must be updated to include at least two additional surface monitoring sites within the area of the North Wambo Creek Diversion footprint to replace those to be discontinued in the old North Wambo Creek footprint i.e. SW27 & SW32 have been replaced by SW41, SW47 and SW48. 2. The company must comply with the requirements of the Department of Water and Energy (DWE) and the Department of Primary Industries (DPI) as outlined in the attached letters to the company ….	**Section 4.2** (see also SWMP)
31 March 2008	RR (formerly DPI)	DPI requires additional matters to be addressed in the Rehabilitation Plan: • Assessment of weeds and a weed control/eradication program. • Use of large woody debris for habitat creation and stability design of diversion banks and bed. • Implementation of supplementary control protocols for mining activities within the diversion area, vehicle and equipment access, signage of stockpiles, revegetation areas, monitoring and transect areas.	Addressed in original NWCD Plan **Section 3.4** includes management strategies and actions for ongoing maintenance and rehabilitation of the NWCD
		DPI also required: • Improved specification of success criteria and a systematic review during the Stage 1 works program. • Supplementary specifications on project management and a gant chart showing activities for Stage 1 and 2 works. • As-executed reports and survey drawings to be provided as an annexure to the MOP.	**Section 4.1** includes revised criteria N/A to this Plan N/A to this Plan
14 April 2008	DPI-Water (formerly DWE)	DWE grants approval to the detailed design plans for the constructed diversion channel, subject to the following; • Monitoring of discharge flows, and calculation of bankfull discharge capacities and velocities along the channel shall occur at the first discharge event along the diversion channel, and then thereafter as directed by the DWE; • Comparative performance with agreed reaches upstream and downstream of the diversion shall occur, together with agreed stable reaches of control catchments, as approved by DWE; • Reporting on performance of the diversion channel shall occur annually (in AEMR).	**Section 4.2** **Section 4.2** **Section 5.1.1**
1 July 2013	DPIE	NWCD Stage 3 Remediation and Monitoring Program The Director-General has approved open cut mining through the original creek line as described in Condition 28 Schedule 3 with the following conditions: • The Program, as provided to the Department on the 28th June 2013, is implemented in full; • The Program is to be implemented on a continual basis, 5 days a week and weather depending, until completed.	**Section 3.4**

NWCD Plan approval – 14 April 2008

NSW GOVERNMENT
Department of Planning

Contact: Rohan Tayler
Phone: 02 9228 6465
Fax: 02 9228 6466
Email: rohan.tayler@planning.nsw.gov.au
Our ref: S02/02197
Your ref:

Ms Sarah Bailey
Environment and Community Manager
Wambo Coal Pty Limited
PMB 1
SINGLETON NSW 2330

Dear Ms Bailey,

Re: North Wambo Creek Diversion Plan

The Department has completed its review of the North Wambo Creek Diversion Plan in consultation with other relevant agencies, and I wish to advise you that it is generally satisfied that the plan fulfils the requirements of conditions 30 and 31 of Schedule 4 to the Wambo development consent (DA 305-7-2003). Consequently, the Director-General has approved the North Wambo Creek Diversion Plan, subject to the following conditions:

- the Surface Water Monitoring Program must be updated to include at least two additional surface monitoring sites within the area of the North Wambo Creek Diversion footprint to replace those to be discontinued in the old North Wambo Creek footprint (SW27 and SW32); and
- the company must comply with the requirements of the Department of Water and Energy and the Department of Primary Industries as outlined in the attached letters to the company.

It would be appreciated if you would forward the Department a copy of the final diversion plan once the conditions listed above have been addressed. Please also note that progress on the construction and monitoring of the creek diversion must be reported in the mine's Annual Environmental Management Report.

If you wish to discuss these matters further please contact Rohan Tayler on 9228 6465.

Yours sincerely

DKitto 14/4/08

David Kitto
A/Executive Director
Major Project Assessment
as Delegate for the Director-General

Department of Planning, 23-33 Bridge Street (GPO Box 39), Sydney, NSW 2001
Website www.planning.nsw.gov.au

NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Now incorporating Department of Mineral Resources
ABN 51 73 412 4190-003

31 March 2008

File Ref: L93/0257

General Manager
Wambo Mine
PMB 1
SINGLETON NSW 2330

ATTENTION: Sarah Bailey – Environmental Specialist

Dear Sir,

NORTH WAMBO CREEK DIVERSION

I conducted an annual environmental review at Wambo on 11 November 2007. The purpose of the inspection was to review compliance with environmental requirements of relevant approval instruments including the Mining Lease, Mining Operation Plan (MOP) and Annual Environmental Management Report (AEMR).

At the mine meeting I provided review discussion and comment on various component plans of the Site Water Management Plan pursuant to consultation requirements of Condition 30 of DA 305-7-2003 (as modified);

- Site water balance
- SWMP
- ESCP
- SGWRP

These documents were generally satisfactory requiring generally additional notification in protocols for events and TARPs to DPI, and for the ESCP further information on vegetation cover procedures (seeding, hydro mulching, jute meshing and armouring) and for check validation within the Surface Disturbance Procedure. I understand the plans have been amended accordingly.

At the meeting I requested and Wambo provided status reports on the design for the North Wambo Creek Diversion for DPI review and comment;

1) North Wambo Creek Diversion Rehabilitation Plan, by HLA-Envirosciences, September 2007,
2) North Wambo Creek Diversion Design Report, by Gilbert and Associates, September 2007,
3) North Wambo Creek Opencut Diversion Channel General Specification, Alan Watson Associates, September 2007.

These documents have been reviewed and the following comments are provided according to the terms of Wambo's development consent (DA 305-7-2003 as modified) consultation requirements.

Mineral Resources - Environmental Sustainability Branch
PO Box 51
SINGLETON, NSW 2330 Australia

North Wambo Creek Diversion Plan Conditions 26 to 28, and 30 to 31:

DPI requires additional matters to be addressed in the Rehabilitation Plan 1) above;

- Section 3.1 - Site Preparation to include assessment of weeds and a weed control / eradication program by approved spraying and/or grubbing. This is to enhance germination of the revegetation works.
- Section 3.2 - Large woody debris is to be used for habitat creation and for stability design of diversion banks and bed. Wambo is to use large trunks and bowls of trees prestripped in the open cut operations for this purpose and assign management procedures for the evaluation, select handling, stockpiling and placement of large prestrip vegetation for the diversion works.
- Section 3.5 – Ecological performance's visual monitoring program should be supplemented by Wambo control protocols for any mining purpose activity within the diversion area; vehicle and equipment access, signage of material stockpile areas, revegetation areas, monitoring and transect areas.

The demonstration (referred to in Condition 28, and in Condition 31 e, f, g) of successful operation of the diversion prior to Stage 2 works will subsequently require improved specification of hydrological, ecological, geomorphic and water quality success criteria than is currently documented in 1) and 2) above. DPI recommends that Wambo facilitates a systematic review, in consultation inspections with DPI and DWE officers, during the Stage 1 works program.

It is assumed that the diversion plan comprises the combination of the reports 1) to 3) above. It is apparent however that these reports need integration through systematic project management. DPI subsequently will require supplementary specification by Wambo of;

- the diversion project's management (allocation of responsibilities, roles and contacts for technical / quality control supervision, integration with Wambo mine management),
- a gant chart of the diversion project's Stage 1 and Stage 2 activity (integrating; earthwork operations, rehabilitation and revegetation operations, inspection and monitoring program, agency consultation timelines).

DPI will require the as-executed report and survey drawings of the North Wambo Creek diversion (referred to in Condition 27) Stages 1 and 2 to be provided as an annexure to Wambo's MOP documentation.

The DPI concludes that the reports provided to date by Wambo are adequate to address consultation requirements for the design phase, however according to these review comments above further documentation and consultation with key agencies will be required during the operations and monitoring phases of the diversion project.

For clarification or further information please contact me at the DPI Maitland Office on (02)49316705.

Yours faithfully,

Greg Summerhayes
Principal Environmental Officer
Environmental Sustainability Division

Cc. Colin Phillips, DOP and Fergus Hancock, DWE

Mineral Resources - Environmental Sustainability Branch
PO Box 51
SINGLETON, NSW 2330 Australia

NSW Government

DEPARTMENT OF WATER AND ENERGY

Contact: Fergus Hancock
Phone: (02) 4904 2532
Fax: (02) 4904 2503
Email: Fergus.Hancock@dnr.nsw.gov.au

File: Detail_design_approval_151107.doc

Jeff Hanlon
Environmental Manager
Wambo Coal Mines
PMB 1
Singleton NSW 2330

15 November 2007

Dear Mr Hanlon

Subject: Detailed design approval – North Wambo Creek diversion 20SL61690

The Department of Water and Energy (DWE) has completed its assessment of the detailed design plans with regard to the approved diversion of North Wambo Creek by Peabody Wambo Coal. DWE confirms the discussion held on 15 November 2007, which included:

- Confirmation that the 1:2 year storm event modelled discharge approximates bankfull discharge, which was raised as a concern in DWE's previous correspondence
- Explanation of the post-construction armouring of high energy zones in the channel
- Protection/armouring of inlet and outlet works to the existing North Wambo Creek channel
- Armouring or other protective measures to be incorporated into high energy zones of the constructed channel
- Performance measures to be incorporated into the monitoring programme

DWE grants approval to the detailed design plans for the constructed diversion channel, subject to the following:

- Long profile gradients and channel cross sections shall be constructed in accordance with design plans submitted to DWE
- Armouring protection works shall be incorporated into the inlet and outlet of the channel, at design sizes sufficient to resist scour and dislodgement under design discharge conditions
- Survey plans shall be submitted for the as-executed survey, including identification of sites requiring rock or other protection to bed and banks of the diversion channel
- Stage 2 works shall include additional armouring or other protective works, with revegetation, to prevent scour or erosion damaging the channel
- Revegetation, using suitable native species as approved by DWE, shall commence on completion of the construction of the channel

Major Projects, Mine Assessments and Planning Branch Level 3 26 Honeysuckle Drive Newcastle PO Box 2213 Dangar 2309
Telephone (02) 4904 2500 Facsimile (02) 4904 2503 Website naturalresources.nsw.gov.au

- Monitoring of discharge flows, and calculation of bankfull discharge capacities and velocities along the channel shall occur at each discharge event along the channel for the first five years of the diversion, and then thereafter as directed by DWE
- Comparative performance with agreed reaches upstream and downstream of the diversion shall occur, together with agreed stable reaches of control catchments, as approved by DWE
- Reporting on performance of the diversion channel shall occur annually, and after each discharge event, as agreed by DWE
- The finalised diversion channel shall be incorporated into the final landform plan for the Wambo mine site, as agreed between the Department of Primary Industries and DWE
- The as-executed report shall include channel bankfull capacity and hydraulic radius figures, and explanation for the size and grade of material used to stabilise the diversion channel prior to vegetation establishment
- Ongoing reporting of the stability of the diversion channel, and vegetation establishment, shall occur to DWE

DWE requires these measures to be incorporated into the diversion management plan required under conditions 11 and 12 of licence 20SL61690.

Should you require any clarification of the above, please contact Fergus Hancock on the above number.

Yours sincerely

Hemantha DeSilva
Senior Licensing Officer

Approval to mine through original creek line – 1 July 2013

Contact: Scott Brooks
Phone: 6575 3401
Fax: 6575 3415
Email: scott.brooks@planning.nsw.gov.au
Our ref:

Peter Baker
General Manager
Wambo Coal Pty Limited
PMB 1
SINGLETON NSW 2330

28 June 2013

Dear Peter

Wambo Coal Mine (DA 305-7-2003)
North Wambo Creek Diversion Stage 3

On 5 February 2013 the Division of Resources and Energy and our Department held a joint Annual Environmental Management Review (AEMR) inspection. As a part of this we inspected the recently completed North Wambo Creek Diversion (NWCD)

At the inspection, concern was raised over the condition of the recently completed Stage 3 NWCD.

Following this inspection there has been numerous correspondence between Wambo Coal and our Department. Further there has been considerable rehabilitation work undertaken on the NWCD Stage 3.

On the 28th June the final version of the Remediation and Monitoring Program (Program) was submitted to the Department. This Program has been reviewed by Neil McElhinney from DRE and Chris Gipple from Fluvial Systems. Both parties advised they were satisfied by the Program and Neil advised we could approve Condition 28 of the Wambo Consent.

Condition 28 Schedule 4 requires:

28. Prior to destroying the original creek line by open cut mining, the Applicant shall demonstrate that the relevant stage of the North Wambo Creek Diversion is operating successfully from a hydrological and biological point of view to the satisfaction of DRE and the Director-General.
Note: This condition does not apply to the temporary North Wambo Creek Bypass.

As stated above, DRE have advised they are satisfied with the current condition of the NWCD stage 3 providing the Program is implemented in full.

I advise that the Director General has approved open cut mining through the original creek line as described in Condition 28 Schedule 3 with the following conditions:

1. The Program, as provided to the Department on the 28th June 2013, is implemented in full;
2. The Program is to be implemented on a continual basis, 5 days a week and weather depending, until completed.

Singleton Office: P.O. Box 3145, Suite 14, Level 1, 1 Civic Avenue Singleton NSW 2330
Website: www.planning.nsw.gov.au

Please note that the Department's approval of the open cut mining operations through the original creek line of North Wambo Creek is dependent upon the implementation of the Remediation and Monitoring Program. Should any adverse consequence arise which may compromise the integrity of the project approval, the Department may consider regulatory action under the provisions of the *Environmental Planning and Assessment At 1979.*

Should you need to discuss the above, please contact me on 6575 3401 or email to scott.brooks@planning.nsw.gov.au.

Yours sincerely

Scott Brooks
Team Leader Compliance, Singleton
As Nominee of the Director General
1 - 7 - 2013

APPENDIX B
NWCD MP COMMITMENTS

Document	Section	Commitment	Timing
NWCD plan	Original 2008	Approved in 2008, subject to additional monitoring and reporting requirements. North Wambo Creek Diversion Plan is found within the Site Water Management Plan Appendix B - NWCD Rehabilitation Plan requires: - A tree/grass/sedge mix is to be dispersed over the banks and base of the low flow channel as defined in Table 1 - Following soil preparation the Floodplain domain above the Low Flow Channel and tributary channels are to be direct seeded. Seeding is to occur via a broadcast spinner, or by hand were the spinner is not suitable. Harrowing is required directly after seed dispersal. Species breakdown is as per Table 2. - 50mm tube stock is to be selectively planted in order to assist in the stability of areas at risk to erosion during high flow events. - Species chosen should be designed to provide strata composition of 60% overstorey; 20% middle storey and 20% understorey. - Planting densities should be no less than 400 stems per hectare. - Ten transects will be established along the length of the creek diversion, each transect will be clearly marked and GPS data collected. - Visual monitoring will take place at each of the ten transects - A weighted field sheet is to be used during the survey to assess the ecological performance and stability of the revegetated areas, and include; • Vegetation Species and Site Sustainability • Assessment of Undesirable Characteristics • Landform and Geophysical Processes • Available Habitat - Visual Monitoring and LFA Monitoring will be conducted on and annual bases in Spring. Appendix C – NWCD Construction Program - A highwall bund will be built to the east of the diversion. - The diversion will be monitored in the same way as all other rehabilitated areas of the mine. As with other rehabilitation on site, monitoring will identify success of the work or areas which may require remediation work. - Until the mine sites rehabilitation has been proved successful and has been approved by the relevant authority, all runoff from those surfaces will be captured and added to the site water system, not NWCD.	Incorporated into the Mining Operations (MOP)
MOP	2.2.3.6	In 2018, Wambo Coal, in consultation with the NSW Soil Conservation Service will prepare and commence implementation of a detailed 5 Year NCWD Rehabilitation and Maintenance Plan. The Plan will be developed in consultation with DRG. Rehabilitation maintenance works will be undertaken annually throughout the MOP term, including: - Weed management (particular focus on Galenia puescens) to control this noxious weed; - Repair areas of erosion; - Re-seeding with selected native pasture and tree species;	2019-2020

Document	Section	Commitment	Timing
		- Revegetation trials with native grass species in selective areas of the diversion to assist in controlling weeds; and - Collection of native grass seeds within pasture areas on adjacent WCPL owned pasture lands.	
2017 IEA		North Wambo Creek Diversion Plan not yet revised to include the required section on mechanism for the return of intercepted groundwater (previous Audit non-compliance)	No longer required by Development Consent
	6.7.3	The current diversion management and monitoring objectives, strategies and commitments are contained in several documents. Consolidated commitments into a single management plan	Complete in draft – this Plan
	Table 9	Rehabilitation of subsided areas is required in accordance with an Extraction Plan, including repairing surface subsidence cracks and undertaking subsidence remediation where necessary in areas where the diversion has been subsided.	Ongoing (as detailed in Appendix C)
	Appendix F Independent Environmental Audit Additional Information (Ross Edwards) Section 3.1.2	<u>Downstream of longwall panel LW16</u> (i.e. currently subsided areas): - The reconstruction of all batter chutes in order to manage runoff draining over the diversion banks address rill and gully erosion issues; - Reconfiguration of the overbank bunding and drainage arrangement in order to prevent ponding at the top of the diversion banks and associated tunnel erosion; - The application of on-contour ripping (per 2015 diversion review recommendations) to all appropriate locations in Stage 3 diversion reach; and - Regrading of the existing drain to repair incision in the mid Stage 3 diversion reach. <u>Upstream of longwall panel LW16</u> (i.e. including planned subsidence areas): - Actions to address existing erosion of diversion banks above and upstream of longwall panel LW 16 pillar, and any potential increase in erosion due to subsidence in these areas. Actions may include stabilisation above longwall panels LW 11 and LW12 and the area upstream of longwall panel LW 11. - Actions to address alluvial baseflow to the open cut mining area. - Subsidence crack management and monitoring in the diversion. - New batter chutes to be designed and installed above longwall panels LW11 to LW16 including both banks of the diversion above longwall panel LW13; - Regrading of the existing drain to repair incision in the upper Stage 3 diversion reach; and - A review of stream flow estimates and monitoring data for North Wambo Creek to refine the modelling predictions. These modelling predictions are used to as a diversion management tool.	Ongoing (as detailed in Appendix C)
		North Wambo Creek Diversion Rehabilitation and Maintenance Plan be developed in 2018 in consultation with key stakeholders. The proposed scope of the plan includes consideration of the current diversion performance indicators and completion criteria, development of alternative performance indicators and completion criteria if necessary and detailed scheduling of diversion stabilisation and rehabilitation	2019

<table>
<tr><th>Document</th><th>Section</th><th>Commitment</th><th>Timing</th></tr>
<tr><td></td><td></td><td>works over a five year horizon. The proposed scope of the North Wambo Creek Diversion Rehabilitation and Maintenance Plan is currently limited to the reaches of the diversion and North Wambo Creek located downstream of longwall panel LW16. The proposed plan is to be implemented from 2018 onwards and reviewed in 2020.</td><td></td></tr>
<tr><td></td><td></td><td><table>
<tr><th>Action</th><th>Timing</th></tr>
<tr><td>Liaise with technical specialists and stakeholders to establish the scope specific erosion repair works to be undertaken in early 2019 as an interim management measure until the Diversion and Rehabilitation Plan is finalised. The following specific erosion repair works will be considered:
• The reconstruction of all batter chutes in order to manage runoff draining over the diversion banks address rill and gully erosion issues;
• Reconfiguration of the overbank bunding and drainage arrangement in order to prevent ponding at the top of the diversion banks and associated tunnel erosion;
• The application of on-contour ripping (per 2015 diversion review recommendations) to all appropriate locations in Stage 3 diversion reach; and
• Regrading of the existing drain to repair incision in the mid Stage 3 diversion reach.
These measures should be included in the updated North Wambo Creek Management Plan.</td><td>End 2018</td></tr>
<tr><td>Undertake diversion inspections and implement rehabilitation maintenance works described in the MOP (refer to above in MOP commitments)</td><td>End 2018</td></tr>
<tr><td>Update the North Wambo Creek Management Plan. (refer to listed detail in Table on Page 10, IEA Appendix attached)</td><td>Complete, this document</td></tr>
<tr><td>Implement the updated North Wambo Creek Management Plan</td><td>Ongoing</td></tr>
</table></td><td>2019-2020</td></tr>
<tr><td>NWCD Management Plan (version 1) 2019</td><td>3.3</td><td>Identify areas suitable for establishment of riparian vegetation once the final landform is constructed and revegetate remaining areas with a species mix which includes both riparian and woodland species.</td><td>Ongoing</td></tr>
<tr><td></td><td>3.3</td><td>Revegetation required for the implementation of the 5 Year Rehabilitation and Maintenance Plan, detailed in Section 3.4.1, will be consistent with the Revegetation Strategy contained in the MOP and the North Wambo Creek Diversion Revegetation Management Plan (Cumberland Plains Seeds, 2019)</td><td>Ongoing</td></tr>
<tr><td></td><td>3.4.1</td><td>All works will be undertaken in accordance with the Detailed Rehabilitation Plan (Appendix C), which will be revised as required. Ongoing monitoring will continue to be undertaken in accordance with Section 4.2.</td><td>Ongoing</td></tr>
</table>

Document	Section	Commitment	Timing
		Additional monitoring and inspections will be undertaken in accordance with site-specific Erosion and Sediment Control Plans or Surface Disturbance Permit requirements for on-ground works.	As required
		Performance will be reviewed annually against the performance criteria in **Section 4.1** and the 5YR RMP, with results reported in the Annual Review.	Annually
	3.4.1.1	The proposed works in **Table 12** include chute construction and repair, channel stability works and revegetation works. These works are also detailed further in Appendix C.	2019-2020
		A range of works will be undertaken each year including: - Review of this plan to confirm there are no changes required to the plan; - Review of the works undertaken in the previous year to confirm whether there are any amendments or improvements which can be made to chute design or repairs; - Monitoring required to be undertaken as detailed in **Section 4.2**; and - Reporting of works undertaken during the year as detailed in **Section 5.1**.	Annually
		Sites 1 and 5 (on **Figure 7**) have been identified as areas of instability which require further assessment to identify appropriate management actions. This assessment will commence in 2019.	2019
	3.4.1.2	Establish the management framework and stakeholder consultation program (in 2019) for the ongoing management of the NWCD over the next five years.	2019
		Works to be undertaken as detailed in **Table 12**) - .	2020-2021 and beyond
	4.2	Monitoring data will be compared to the performance criteria detailed in **Section 4.1**. Unsatisfactory performance and follow up required will be recorded as part of the monitoring observations and as described in the Trigger Action Response Plans (**Section 4.3**)	As required
		Diversion monitoring will be undertaken as summarised in **Table 17**	As required
	4.3	The North Wambo Creek Diversion Performance TARP implemented in the event that: - Surface water monitoring of North Wambo Creek, for pH, EC and TSS, identifies water quality results exceeding the 80th Percentile Trigger Value, as identified in the SWMP after two consecutive sampling events; or - Monitoring of Landscape Function Analysis (LFA) of riparian areas in accordance with the Biodiversity Management Plan (2019) identifies a potential decline in creek stability, beyond natural fluctuations (**Section 4.3.2**); or - Subsidence impacts are observed which exceed the performance criteria (**Section 4.3.3**). - Two consecutive events require the initiation of the Level 1 response with three consecutive events requiring instigation of the Level 2 response.	
	4.4	Environmental incidents that cause or have the potential to cause harm to the environment will be reported in accordance with **Section 5.1.2**.	As required

APPENDIX C
DETAILED REHABILITATION PLAN

alluvium

DESIGN REPORT:

North Wambo Creek Detailed Rehabilitation Plan

April 2019

Document history

Revision:

Revision no.	01
Author/s	Jacob Dearlove Rohan Lucas Jason Carter
Checked	Rohan Lucas
Approved	Rohan Lucas

Distribution:

Revision no.	01
Issue date	18 April 2019
Issued to	Nicole Dobbins

Description: Original issue

Citation: Alluvium (2019) North Wambo Creek Detailed Rehabilitation Plan. A report for Wambo Coal Pty Limited.

Ref: \\all-sbs\departments\Work\2019\0219016_North_Wambo_Creek_Detailed_Action_Plan\10_Project\1_Deliverables\0219016_North Wambo Creek Detailed Rehabilitation Plan v1.0.docx

Contents

1 Introduction 3

1.1 Background 3

1.2 Areas of interest 3

2 Overland flow entry management 5

2.1 Batter Chute Assessment 7

2.2 Batter chute design 14

3 Channel stability works 16

3.1 Identified Areas of instability and proposed works 16

4 Ripping, soil amelioration and revegetation works 22

4.1 Areas requiring works 22

4.2 Proposed rehabilitation methods 22

Weed management 22

Ripping 23

Soil amelioration 23

5 References 24

Attachment A Design Drawings 25

Attachment B Technical Specifications 27

Figures

Figure 1. Extents of proposed North Wambo Creek detailed design works 4

Figure 2. Location of existing batter chutes along both the downstream portion of NWCD and the portion over LW11-LW16 5

Figure 3. Location of new and reconfigured batter chutes along both the downstream portion of NWCD and the portion over LW11-LW16 6

Figure 4. NWCD overland flow path mapping using CatchSim 7

Figure 5. Identified bank instabilities and recommended areas of stabilisation works 16

Figure 6. Areas requiring ripping and soil amelioration works. 22

Tables

Table 1. Existing batter chute assessment 8

Table 2. Design parameters and criteria adopted for detail design batter chutes 14

Table 3. Predicted flows for flow paths over South Bates Extension post subsidence 14

Table 4. Batter Chute specifications 15

Table 5. Areas of Instabilities and recommended management actions 17

Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
WCPL	Wambo Coal Pty Limited

1 Introduction

1.1 Background

Alluvium Consulting Australia (Alluvium) has been commissioned by Wambo Coal Pty Limited (WCPL) to develop a Detailed Action Plan (suitable for construction) following from previous work in providing responses to NSW DPE's requests following an independent environmental audit on the following:

1. An assessment of geomorphic function of the North Wambo Creek Diversion (NWCD) compared to an undisturbed reference reach section of North Wambo Creek; and
2. An action plan to include stabilisation and rehabilitation works for NWCD.

The work completed prior to this detailed action plan includes the delivery of the report "North Wambo Creek diversion – rehabilitation action plan" (Alluvium October 2018, updated April 2019), which provides a concept level diversion design and rehabilitation action plan. WCPL now wish to undertake on ground works, which requires that the concept design prepared previously be progressed to a detailed level, suitable for issuing for construction. This report details that design.

The "North Wambo Creek diversion – rehabilitation action plan" (Alluvium October 2018, updated April 2019), has also been updated to include a 5 year action plan.

1.2 Areas of interest

North Wambo Creek forms at the confluence of its two tributaries, Spring Creek and Chalkers Creek upstream of current mining (underground and open cut) operations at the base of slope of steep sandstone escarpment country. Further downstream in what was a broader valley with alluvial valley fill, North Wambo Creek has been subject to diversion around the open cut operations by construction of a new channel in several stages through footslope areas to the west of the original valley alignment. This diversion makes up approximately 5.8km of the remaining 7.3km before its confluence with Wollombi Brook.

The areas of interest for this Detailed Rehabilitation Plan are (see Figure 1):

- Re-forming overland flow entry management, both bunds and batter chutes in both the downstream portion of NWCD and the portion over LW11-LW16.
- Ripping, soil amelioration and vegetation establishment on upper surfaces, upper batters and the inset floodplain. In some areas this may require ripping of the sandstone. Temporary fencing may also be considered for plant establishment given the high grazing pressure from kangaroos.
    - Previous seeding campaigns with various species have been identified, monitoring of these areas will inform any further revegetation effort.
- Bank stability management in areas identified in the extraction plan for LW11-16 and LW17-20.

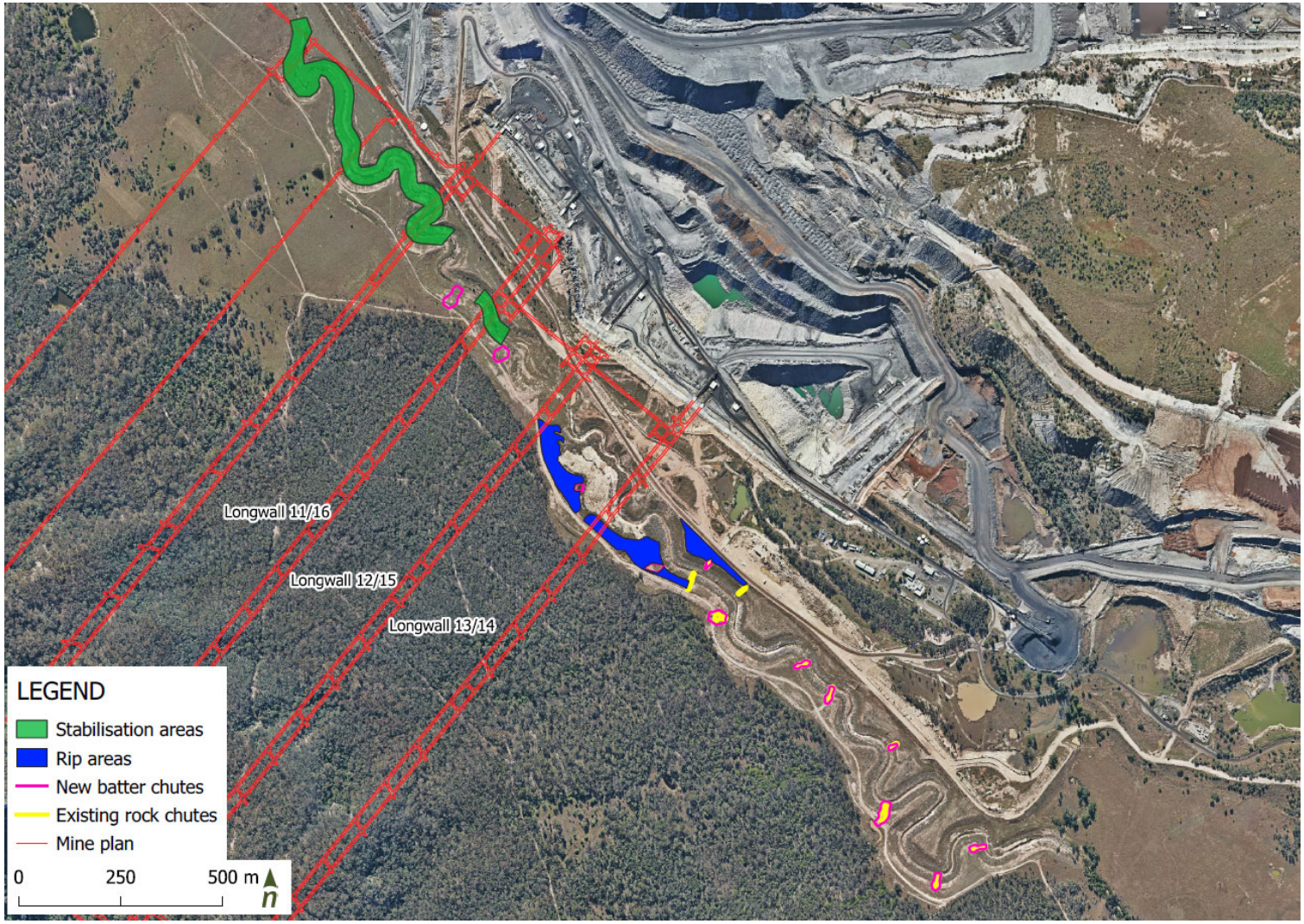


Figure 1. Extents of proposed North Wambo Creek detailed design works

2 Overland flow entry management

The NWCD channel alignment intercepts a number of minor tributaries and overland flow catchments originating in the hillslopes to the west of the diversion. There are also some small catchments on the eastern side (mining side) of the diversion channel requiring management.

To manage this surface water runoff a series of rock lined batter chutes with associated bunds at top of bank, aimed at intercepting and conveying surface water flows to the base of the diversion channel, have been constructed previously (refer Figure 2). In total there are eleven batter chutes along the NWCD. Monitoring of the diversion has revealed that these rock lined batter chutes have not performed to their design intent and have been damaged or bypassed by nearby pipe/tunnel erosion.

As part of the NWCD detailed action plan these batter chutes will be reconstructed with appropriate materials for the dispersive sub soils and moved to locations appropriate to the topography.

In addition to the repair/reconstructing of these existing batter chutes three new batter chutes will be constructed to manage the altered overland flow entry created by subsidence over LW11-LW16. Minor ancillary earthworks to ensure these chutes capture and convey all flow from the panels into the diversion without creating further rill/pipe/tunnel/gully erosion on the diversion batters will also be required. It should be noted that the batter drains have been designed to a detailed level, however fine detail regarding the reshaping of the area adjacent to the batter drains and diversion banks to ensure flows enter at the batter drain crests has been deferred to the construction stage. The new/reconfigured chute locations are shown in Figure 3.

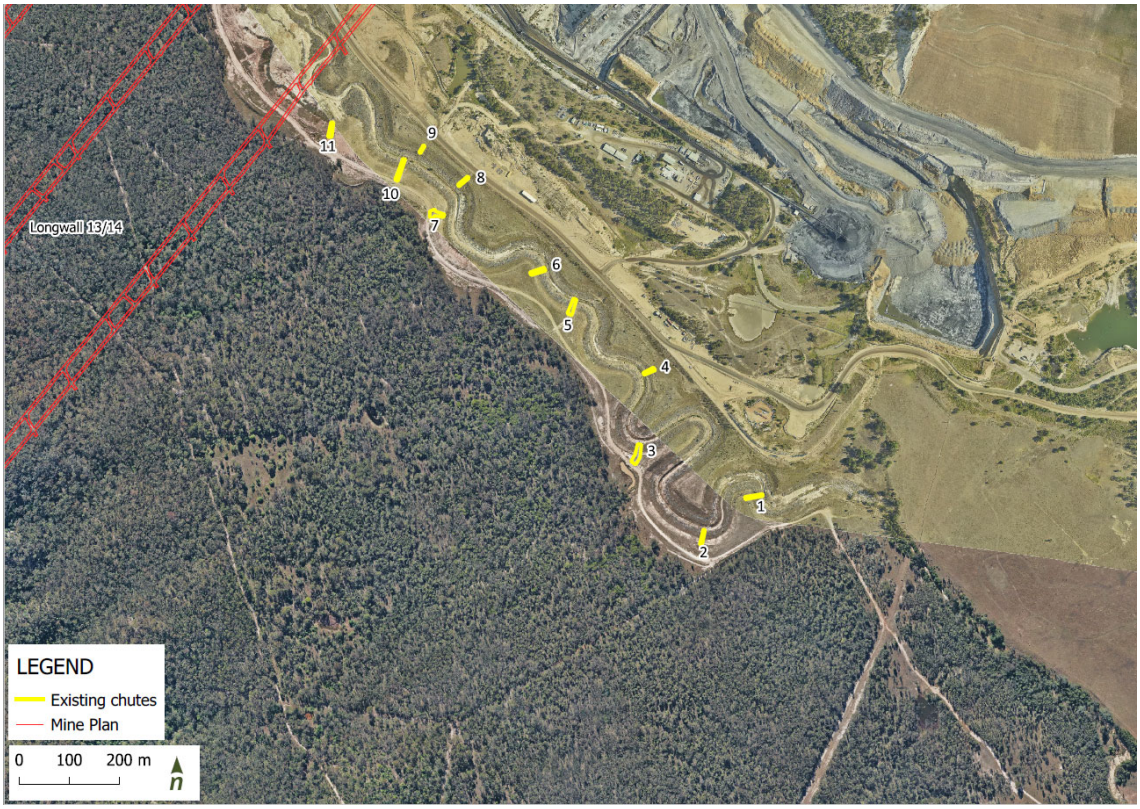


Figure 2. Location of existing batter chutes along both the downstream portion of NWCD and the portion over LW11-LW16

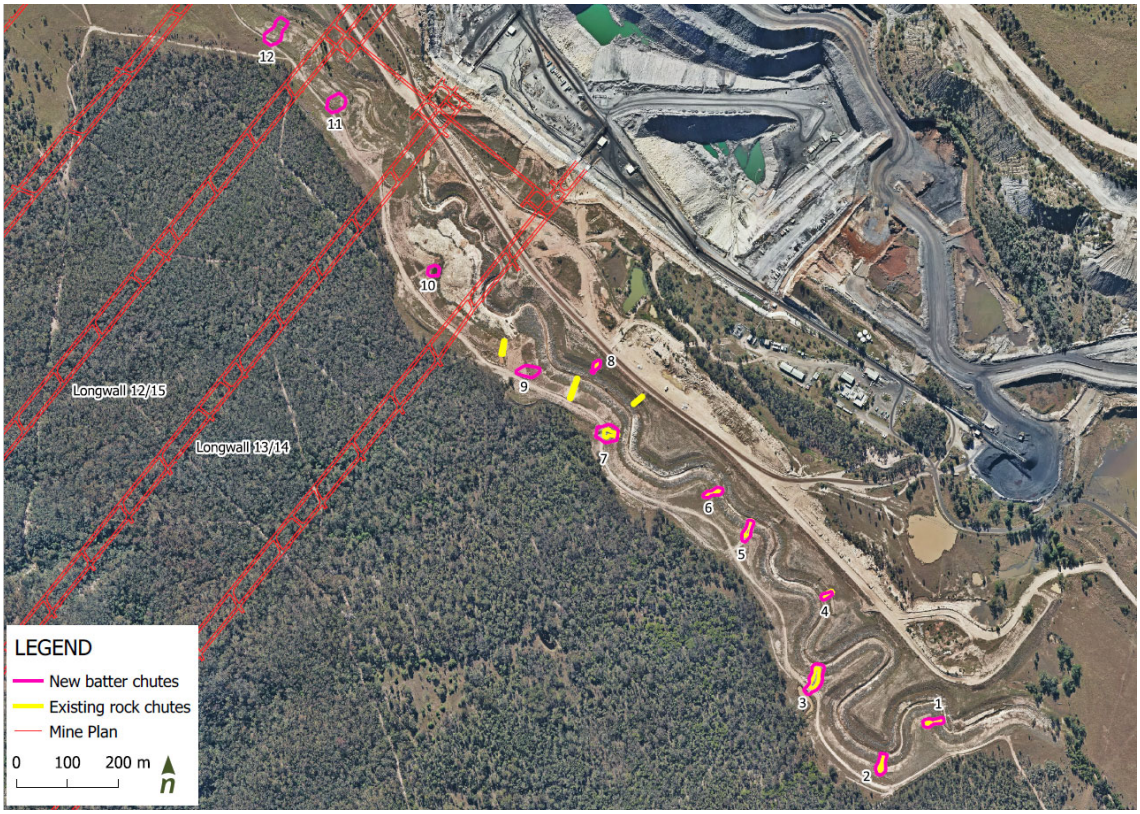


Figure 3. Location of new and reconfigured batter chutes along both the downstream portion of NWCD and the portion over LW11-LW16

2.1 Batter Chute Assessment

Assessment of the existing batter chutes has been completed using a combination of onsite inspection of the chutes and flow path mapping using the latest (post LW11-LW16 subsidence) survey data. As part of the assessment, the current issues, threats and risks of each batter chute has been identified as well as a summary of the management action and an order of priority for construction. New chutes are the highest priority then the repair of existing chutes based on area of catchment and those with the largest catchments to be treated first. Management actions are described in detail in section 2.2.

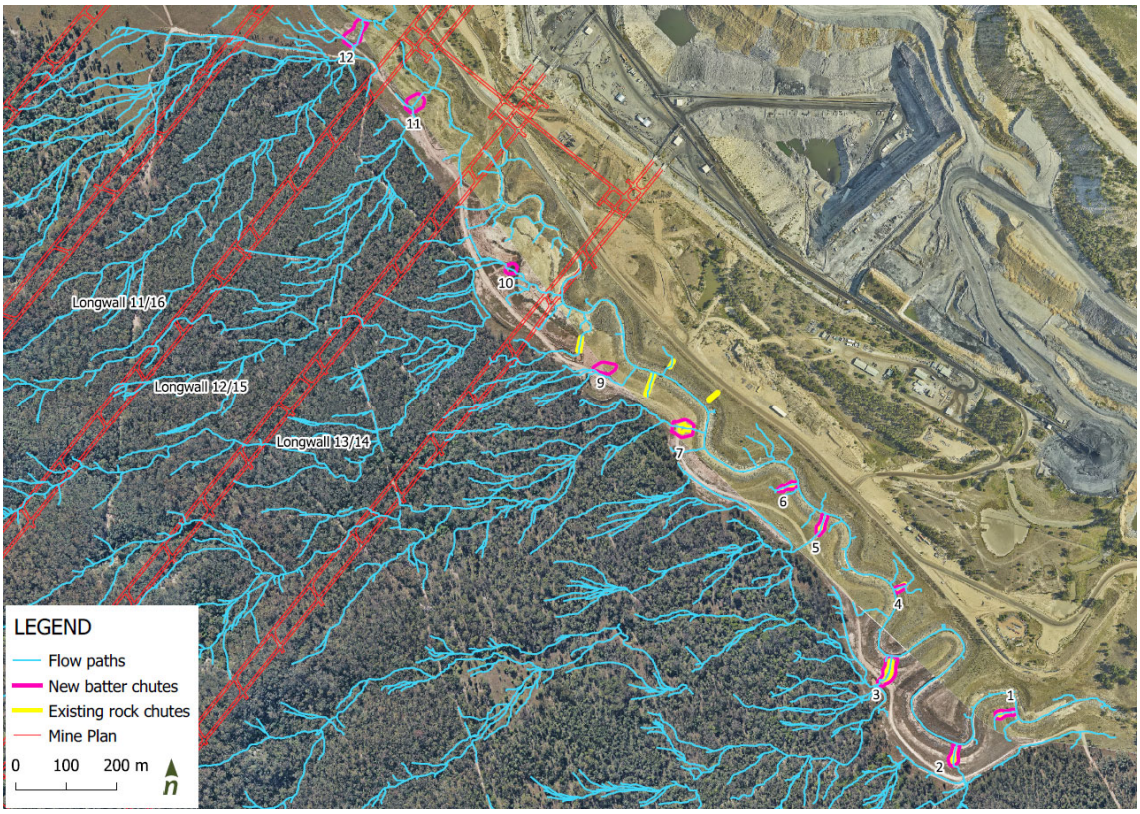


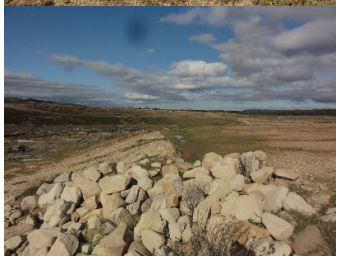
Figure 4. NWCD overland flow path mapping using CatchSim

Table 1. Batter chute assessment and priority order

Priority order and catchment area	Batter chute ID	Photo	Issue/threat/risk	Management Action
1 (50ha)	12	New chute - no photo	New chute to address change in flow path due to subsidence.	Construct new chute.
2 (43ha)	11		Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion. Road along top of bank with drain alongside causes ponding along top of bank – causing tunnelling.	Catchment area contributing chute has decreased due to subsidence – possibility to direct flows from this catchment into nearby chute.

3 (36ha)	10	 	Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion. Road along top of bank with drain alongside causes ponding along top of bank – causing tunnelling. Catchsim flow path modelling shows that flowpaths have changed due to subsidence – rock chute in incorrect place.	Replace batter chute with properly designed new chute. Include granular filter layer. Use correctly graded rock mix. Extend rock beaching upstream to pond – acts as rock armoured spillway. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank. Realign road and fill over existing road so that top of bank ties in with nearby raised bund of eastern side of existing road. Realign chute according to new flow paths.
4 (5ha)	9	New chute - no photo	New chute to address change in flow path due to subsidence.	Construct new chute.

5 (106ha)	3		Rock chute effectively acts as spillway from small pond. Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion.	Reconstruct batter chute with: • granular filter layer instead of geofabric • correctly graded rock mix. Extend rock beaching upstream to pond – acts as rock armoured spillway. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank.
6 (50ha)	7		Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion.	Reconstruct batter chute with: • Lower crest • granular filter layer instead of geofabric • correctly graded rock mix. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank.

7 (11ha)	2	 	Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and rounded rock mix used. Geotextile layer under rock causing preferential piping plane under rock. Ponding upstream of crest – tunnelling risk.	Reconstruct batter chute with: • Lower crest • granular filter layer instead of geofabric • correctly graded rock mix. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank.
8 (8.3ha)	5	   	Risk of erosion upstream of chute due to lack of vegetation. Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion.	Revegetation/rock beaching upstream of chute. Replace batter chute with properly designed new chute. Reconstruct batter chute with: • Lower crest • granular filter layer instead of geofabric • correctly graded rock mix. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of

				bank.
9 (5.4ha)	6	   	Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion.	Reconstruct batter chute with: • Lower crest • granular filter layer instead of geofabric • correctly graded rock mix. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank.
10 (1ha)	1	 	Undermining of chute due to incorrect construction/materials. Rock chute sits proud of surrounding surface, preventing flows entering chute. Poorly graded and shaped rock mix used. Geotextile layer under rock causing piping plane failure. Ponding along top of bank causing Tunnel erosion.	Reconstruct batter chute with: • Lower crest • granular filter layer instead of geofabric • correctly graded rock mix. Reconfigure area upstream of chute to direct flows down bund whilst preventing water from ponding within 10m of top of bank.

		  		
11 (1ha)	4	No Photos		
12 (1ha)	8	 		No works required – Catchsim flow mapping indicates chute redundant.

2.2 Batter chute design

The location for the batter chutes has been selected based on the updated flow path mapping and site visits. Batter chutes have been designed with the aid of the CHUTE software package. The parameters required for input to CHUTE for the design of the chutes are summarised below (Table 2).

Table 2. Design parameters and criteria adopted for detail design batter chutes

Parameter	Units	Adopted criteria
Rock angle of repose	degrees	42
Specific Gravity of rock		2.65
Factor of Safety		1.2

Streamflow estimates for each of the upstream contributing catchments for each chute were obtained using the Regional Flood Frequency Estimation Model (RFFEM). The RFFEM is a method developed by Dr Ataur Rahman and Dr Khaled Haddad from Western Sydney University for the draft 4th edition of Australian Rainfall and Runoff and is suitable for use in small, rural catchments. The flow estimates are summarised in Table 3.

Table 3. Predicted flows for flow paths over South Bates Extension post subsidence

Batter Chute	Catchment area (ha)	5% AEP/20year ARI (m3/s)
1	1	0.74
2	11	3.32
3	106.4	12.5
4	1	0.74
5	8.3	2.86
6	5.4	2.06
7	50	8.82
8	1	0.74
9	5	1.83
10	36	6.86
11	43	7.86
12	50	8.82

The following dimensions and quantity estimates have been determined for each of the Batter chutes (Table 4**Error! Reference source not found.**). Note that some chutes comprise of two chutes in order to match the existing diversion bank profile which includes an upper batter, bench and lower batter.

Table 4. Batter Chute specifications

Parameter	Chute 1		Chute 2		Chute 3	Chute 4	Chute 5		Chute 6	Chute 7	Chute 8	Chute 9	Chute 10	Chute 11	Chute 12
	upper	lower	upper	lower			upper	lower							
Chute length (m)	15	8	20	5	48	21	20	6	31	37	26	44	17	35	43
Chute Drop (m)	3.0	1.5	4.0	1.0	4	2.5	3.5	1	5	7	5.2	8.5	3.3	7	8.5
Chute Width (m)	6	6	8	8	10	4	6	6	4	15	4	4	12	14	15
Apron Length (m)	17	1	15	2	2	2.5	16	2	9.5	2	1.5	2	4.5	4	13.5
Apron Rise (m)	-1	0	-0.5	0	0	0	-1	0	0	0	0.5	0	0	0	0
Rock size, D50 (mm)	300	300	400	400	450	450	400	400	400	450	300	450	450	450	450

The full design details are shown in the associated drawings and technical specifications in Attachments A and B.

3 Channel stability works

3.1 Identified Areas of instability and proposed works

Identified areas of bank instabilities that aren't included as part of batter chute works or ripping and soil amelioration along with proposed works are shown in Figure 5 and Table 5.

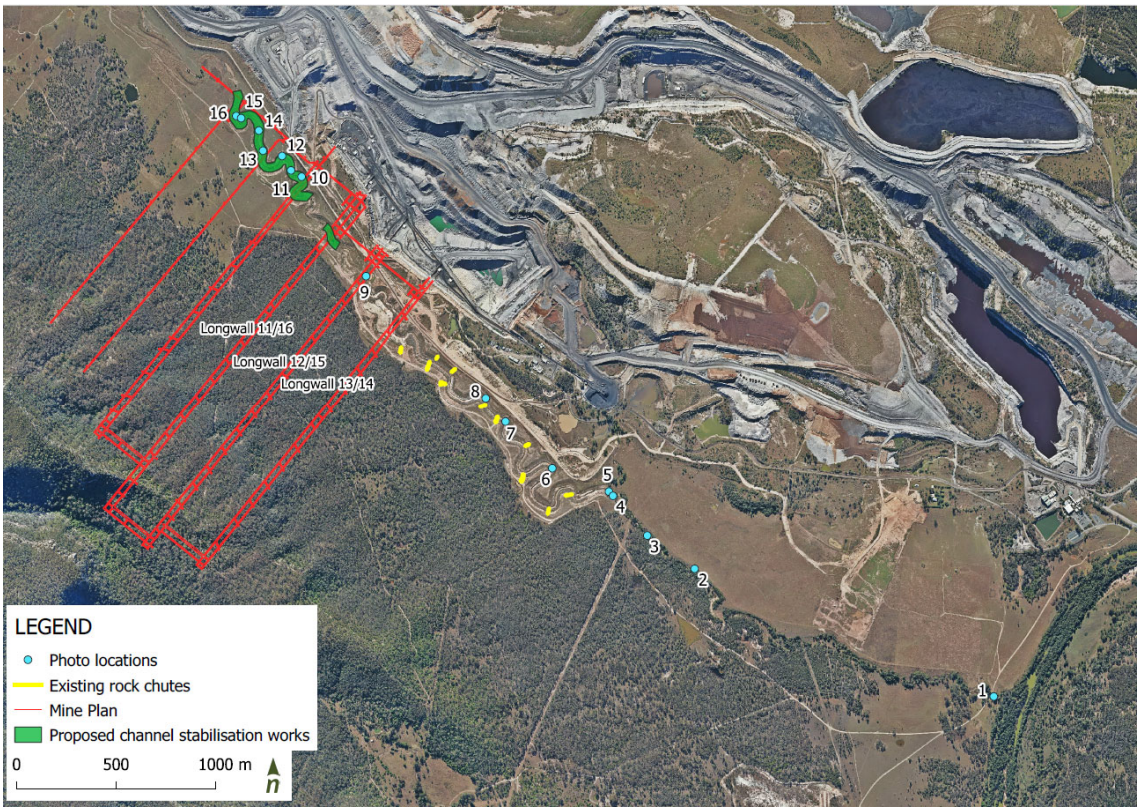


Figure 5. Identified bank instabilities and recommended areas of stabilisation works

Table 5. Areas of Instabilities and recommended management actions

Site ID	Stage	Description	Photo	Issue/threat/risk	Management Action
01	Downstream Reach	Incision in downstream reach.		Loss of crossing, major sediment slug release by incision, unravelling of rock chute at downstream end of diversion.	Further assessment required.
02	Downstream Reach	Incision in downstream reach.		Loss of sediment.	Bedrock controls will prevent further migration. Ongoing monitoring recommended – Annual inspections and survey of head cut to measure any significant changes.
03	Downstream Reach	Incision in downstream reach.		Loss of sediment.	Bedrock controls will prevent further migration. Ongoing monitoring recommended – Annual inspections and survey of head cut to measure any significant changes.

04	Diversion - Stage 3	Rock chute tie in to downstream.	 	Durability of sandstone, long term increase in grade and erosive potential in downstream end of diversion, partial mitigation due to the downstream extent of diversion being largely in situ sandstone.	Include in ongoing monitoring program - Annual inspections to monitor any significant changes in stability.
05	Diversion - Stage 3	Rock chute.		Instabilities, undermining due to poor rock grading and poor embedment (no granular filter layer/sitting on bedrock).	Further assessment required however chute may need to be replaced (graded rock, filter layer, key in).
06	Diversion - Stage 3	Rock beaching works on outside bend of diversion channel.		durability of sandstone, long-term stability of rock beaching, undermining.	Include in ongoing monitoring program - Annual inspections to monitor any significant changes in stability.

07	Diversion - Stage 3	Erosion along toe.		Further channel erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
08	Diversion - Stage 3	Gullying along bench caused from flows down possible batter chute.		Migration of head cut, loss of sediment.	Include in ongoing monitoring program – Annual inspections and survey of head cut to measure any significant changes. Possible rock beaching required depending on underlying geology.
09	Diversion - Stage 3	Incision down to bedrock. Head cut migrating upstream.		Risk head cut will continue migrating upstream.	Include in ongoing monitoring program – Annual inspections and survey of head cut to measure any significant changes. Progression of head cut limited by hard underlying geology (sandstone).

					
10	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
11	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
12	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.

13	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
14	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
15	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.
16	Diversion - Stage 2	Erosion along toe.		Risk of further bank erosion and loss of sediment.	Batter eroded banks back at 1V:4H from the toe, apply topsoil and revegetate.

4 Ripping, soil amelioration and revegetation works

4.1 Areas requiring works

The new areas to be ripped and treated are shown in Figure 6 below. Based on advice from Wambo Mine staff, areas downstream of this have already been subject to ripping and seeding. Success of those works will be evaluated over time and further maintenance recommended if required.

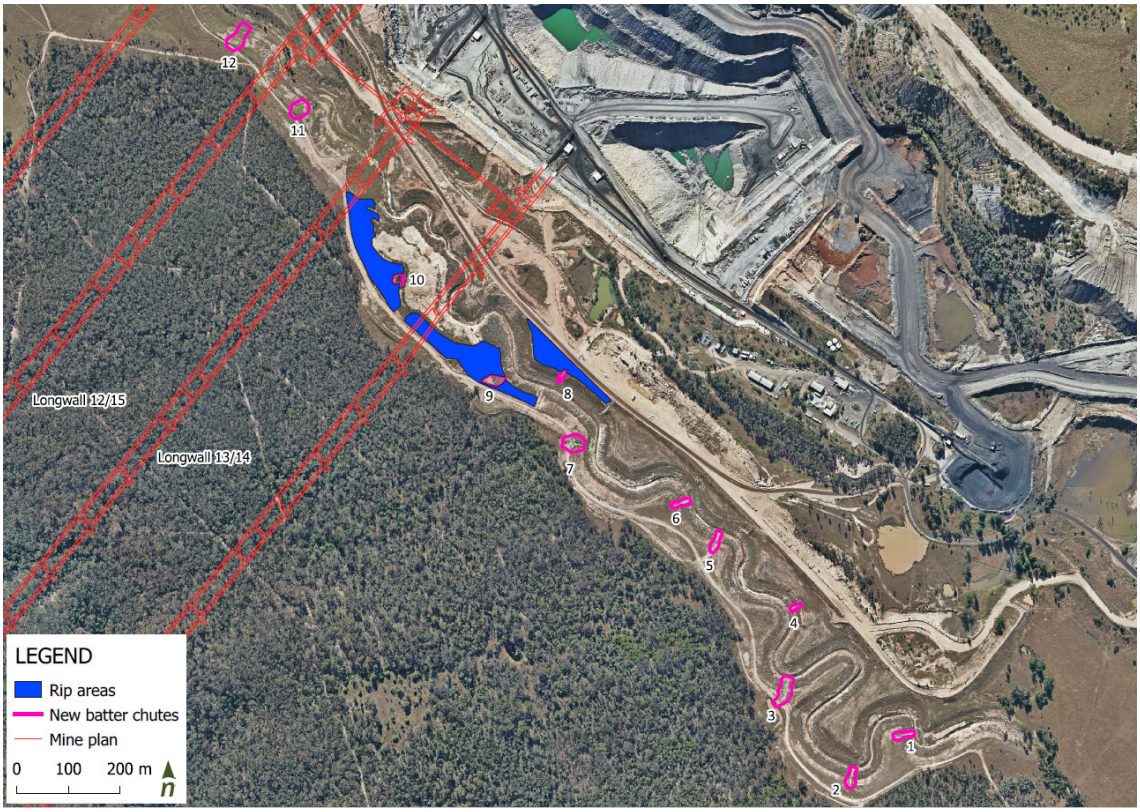


Figure 6. Areas requiring ripping and soil amelioration works.

4.2 Proposed rehabilitation methods

It should be noted that this document does not include a revegetation plan, which will need to be completed separately, it does however provide details on site preparation for revegetation efforts.

Good site preparation is essential for successful revegetation. Appropriate measures will minimise seedling losses, encourage healthy plant growth and minimise maintenance requirements. Conversely, poor preparation usually results in high rates of seedling loss and increased maintenance requirements.

Weed management

Weed management prior to revegetation reduces competition for nutrients, water and light. A weed-free environment helps new seedlings develop a vigorous root system that can access nutrients and soil moisture. This is most critical during their initial development and establishment. Ideally, weed control is undertaken a year or more in advance, though this is risky in erodible soils. To minimise the risk of exposed soils a surface mulch may be used to reduce the loss of soil moisture through evaporation and reduces runoff.

Non-chemical methods rely on smothering and usually require pinning in place to avoid disturbance from wind or water flow. Chemical herbicides may be the most effective method but should be used carefully near waterways and will likely need follow up applications to deplete the weed seedbank in the soil. For large areas

strip spraying may be used to avoid exposing the entire area. Prolonged use of chemicals can lead to resistance and should be used sparingly.

Ripping

Ripping of soils makes planting easier and increases aeration and water infiltration, which improves root development by enabling deeper penetration and faster growth. On slopes, ripping should be done along the contour, though on flatter ground cross ripping on a grid layout should be used to prevent root development in one direction along a rip line. Soil should generally be ripped to a depth of at least 300 mm.

Sodic soils, which are anticipated at the site, are more prone to structural degradation and should receive minimal cultivation. The aim is to preserve soil organic matter in the surface soil and leave the more sodic subsoil at depth.

Soil amelioration

Experience from previous rehabilitation works at sites with similar characteristics indicate that amelioration will likely need to address low Phosphorus (P) and high sodicity. The likely treatments are anticipated to be application of a high-P fertiliser and gypsum to address sodicity. These treatments will also improve soil structure and reduce erosion risk. For sodic soils, beneficial techniques involve high application rates of gypsum before tillage or concentrating gypsum into rip lines and is most effective at sowing time.

Soil testing will be undertaken during rehabilitation works once the site has been disturbed. Treatments and application rates will be determined prior to revegetation works.

5 References

Alluvium (2018). North Wambo Creek diversion – rehabilitation action plan by Alluvium Consulting Australia Pty Ltd for Wambo Coal Pty Ltd.

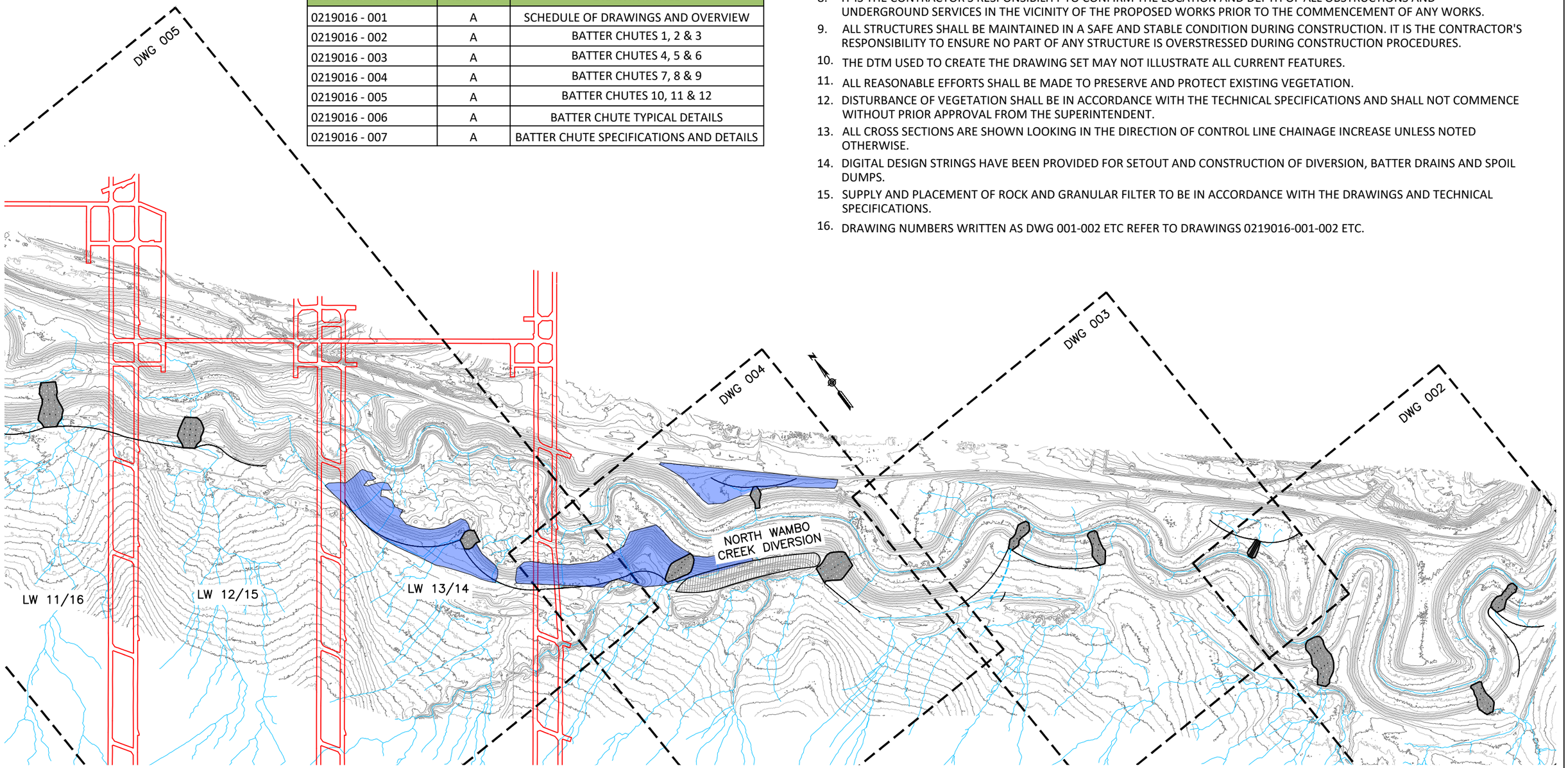
Attachment A
Design Drawings

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN

SCHEDULE OF DRAWINGS		
DRAWING NUMBER	**REVISION**	**DRAWING TITLE**
0219016 - 001	A	SCHEDULE OF DRAWINGS AND OVERVIEW
0219016 - 002	A	BATTER CHUTES 1, 2 & 3
0219016 - 003	A	BATTER CHUTES 4, 5 & 6
0219016 - 004	A	BATTER CHUTES 7, 8 & 9
0219016 - 005	A	BATTER CHUTES 10, 11 & 12
0219016 - 006	A	BATTER CHUTE TYPICAL DETAILS
0219016 - 007	A	BATTER CHUTE SPECIFICATIONS AND DETAILS

GENERAL NOTES

1. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS. ANY DISCREPANCY SHALL BE REFERRED TO THE SUPERINTENDENT FOR DECISION BEFORE PROCEEDING WITH THE WORK.
2. ALL WORKMANSHIP AND MATERIALS SHALL COMPLY WITH THE DRAWINGS AND TECHNICAL SPECIFICATIONS AND RELEVANT AUSTRALIAN STANDARDS.
3. CONTOURS SHOWN ARE AT 0.5m INTERVALS.
4. ALL LEVELS PROVIDED ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
5. ALL CO-ORDINATES PROVIDED ARE IN METRES TO DATUM GDA94 AND PROJECTION AMG ZONE 56.
6. ALL DESIGN OFFSETS AND CHAINAGES PROVIDED ARE IN METRES UNLESS NOTED OTHERWISE.
7. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORKS.
8. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONFIRM THE LOCATION AND DEPTH OF ALL OBSTRUCTIONS AND UNDERGROUND SERVICES IN THE VICINITY OF THE PROPOSED WORKS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
9. ALL STRUCTURES SHALL BE MAINTAINED IN A SAFE AND STABLE CONDITION DURING CONSTRUCTION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE NO PART OF ANY STRUCTURE IS OVERSTRESSED DURING CONSTRUCTION PROCEDURES.
10. THE DTM USED TO CREATE THE DRAWING SET MAY NOT ILLUSTRATE ALL CURRENT FEATURES.
11. ALL REASONABLE EFFORTS SHALL BE MADE TO PRESERVE AND PROTECT EXISTING VEGETATION.
12. DISTURBANCE OF VEGETATION SHALL BE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS AND SHALL NOT COMMENCE WITHOUT PRIOR APPROVAL FROM THE SUPERINTENDENT.
13. ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE DIRECTION OF CONTROL LINE CHAINAGE INCREASE UNLESS NOTED OTHERWISE.
14. DIGITAL DESIGN STRINGS HAVE BEEN PROVIDED FOR SETOUT AND CONSTRUCTION OF DIVERSION, BATTER DRAINS AND SPOIL DUMPS.
15. SUPPLY AND PLACEMENT OF ROCK AND GRANULAR FILTER TO BE IN ACCORDANCE WITH THE DRAWINGS AND TECHNICAL SPECIFICATIONS.
16. DRAWING NUMBERS WRITTEN AS DWG 001-002 ETC REFER TO DRAWINGS 0219016-001-002 ETC.



REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

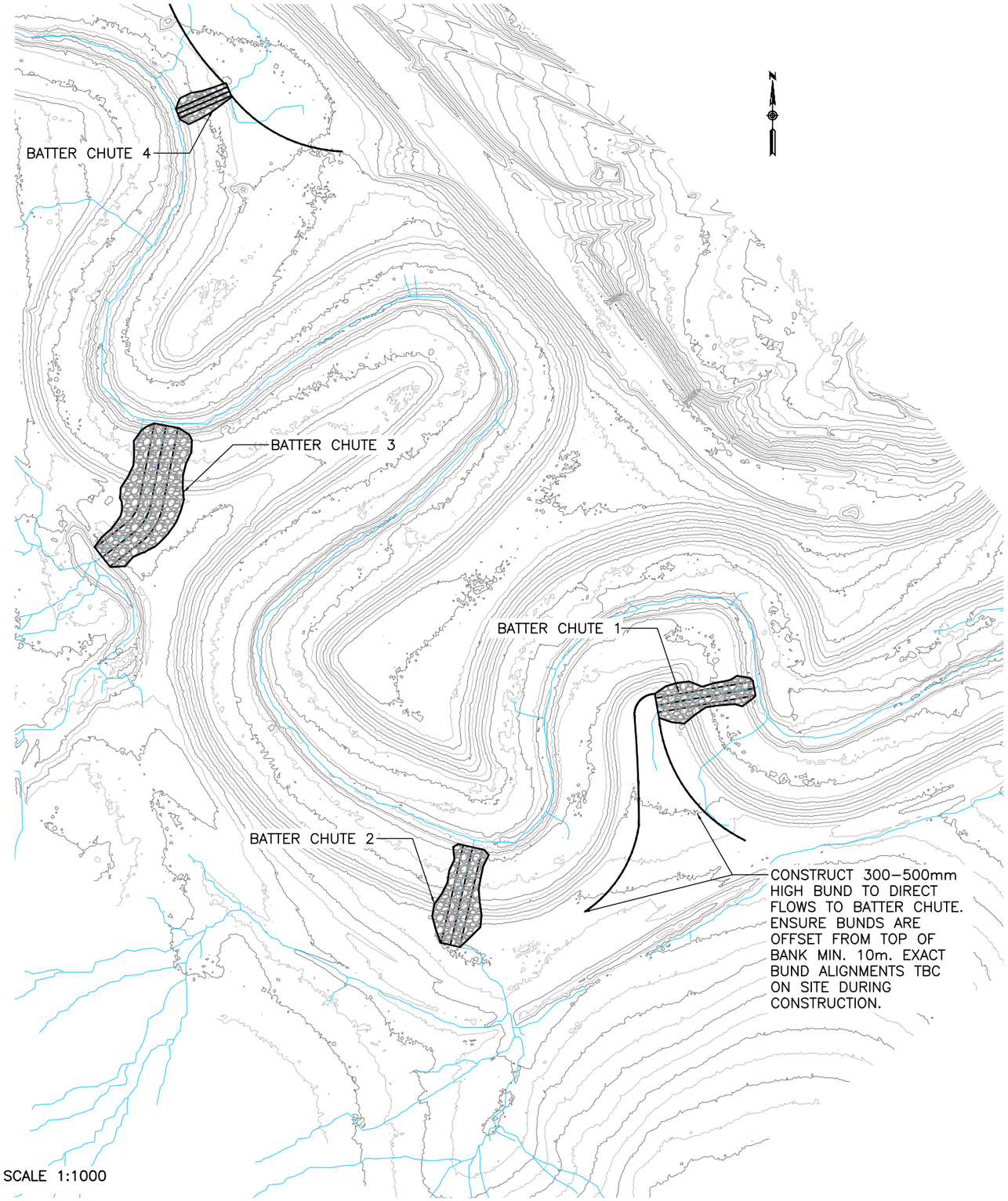
LEGEND
- LONGWALL PANEL
- NEW/REPAIRED ROCK BATTER CHUTE
- FLOW DIVERSION BUND
- EXISTING FLOW PATH
- AREAS TO BE RIPPED

Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
SCHEDULE OF DRAWINGS AND OVERVIEW

REVISION:	SHEET No.:	ORIGINAL SIZE: A1	SCALE:
A	001	DATUM: m AHD (MGA z56)	



SCALE 1:1000

-20% -5.88% -18.75% 0%

Datum R.L.71

DESIGN SURFACE	78.00	77.00	76.00	75.00	74.71	74.41	74.12	73.44	72.50
EXISTING SURFACE	78.00	78.04	77.01	75.46	75.18	74.83	74.77	74.59	72.77
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00

BATTER CHUTE 1

-19.58% -3.33% -20% 0%

Datum R.L.73

DESIGN SURFACE	79.92	78.94	77.96	76.98	76.00	75.83	75.67	75.50	74.50
EXISTING SURFACE	79.94	79.92	79.13	78.13	76.75	76.46	76.41	76.32	75.05
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00

BATTER CHUTE 2

-3.57% -8.33% 0%

Datum R.L.75

DESIGN SURFACE	81.00	80.82	80.64	80.42	80.00	79.58	79.17	78.75	78.33	77.92	77.50	77.08	76.67
EXISTING SURFACE	81.00	81.59	81.40	80.89	80.59	80.12	79.98	79.60	79.26	79.03	78.54	78.23	77.37
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

BATTER CHUTE 3

LONGITUDINAL SCALE
HORIZONTAL SCALE:1:250
VERTICAL SCALE:1:500

REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

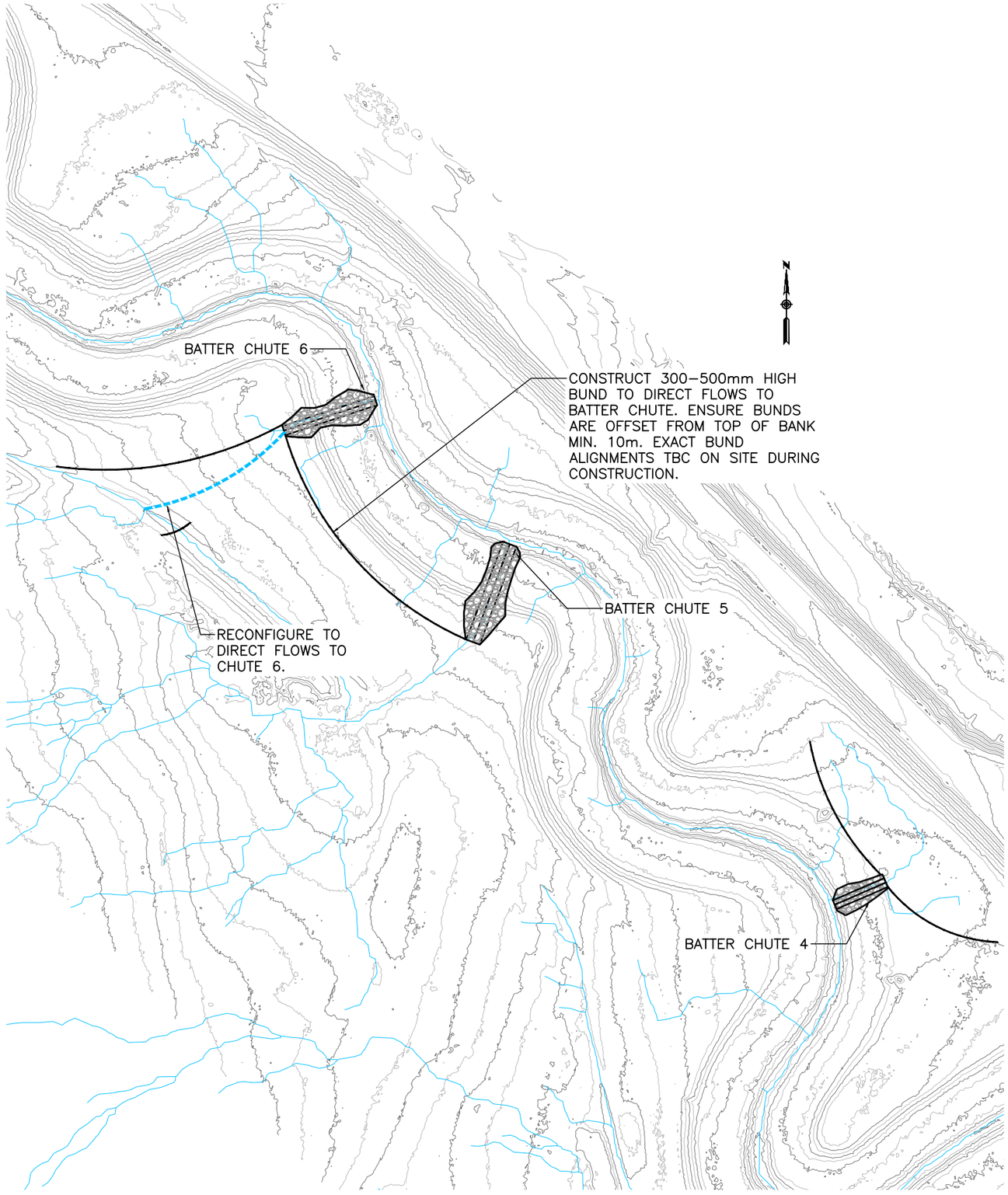
Peabody ENERGY

alluvium
Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTES 1, 2 & 3

REVISION:	SHEET No.:	ORIGINAL SIZE: A1	SCALE:
A	002	DATUM: m AHD (MGA z56)	



-11.9% 0%

Datum R.L.76

DESIGN SURFACE	80.50	79.90	79.31	78.71	78.12
EXISTING SURFACE	80.50	80.44	80.14	79.87	79.34
CHAINAGE	0.00	5.00	10.00	15.00	20.00

BATTER CHUTE 4

-17.05% -6.25% -16.67% 0%

Datum R.L.78

DESIGN SURFACE	85.41	84.56	83.71	82.85	82.00	81.69	81.38	81.06	80.33
EXISTING SURFACE	85.41	85.18	85.01	84.17	82.73	82.56	81.91	81.93	81.43
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00

BATTER CHUTE 5

-16.13% 0%

Datum R.L.79

DESIGN SURFACE	85.50	84.69	83.89	83.08	82.27	81.47	80.66	80.50	80.50
EXISTING SURFACE	85.50	85.43	84.77	83.60	83.00	82.63	82.36	81.59	80.59
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00

BATTER CHUTE 6

LONGITUDINAL SCALE
HORIZONTAL SCALE:1:250
VERTICAL SCALE:1:500

REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

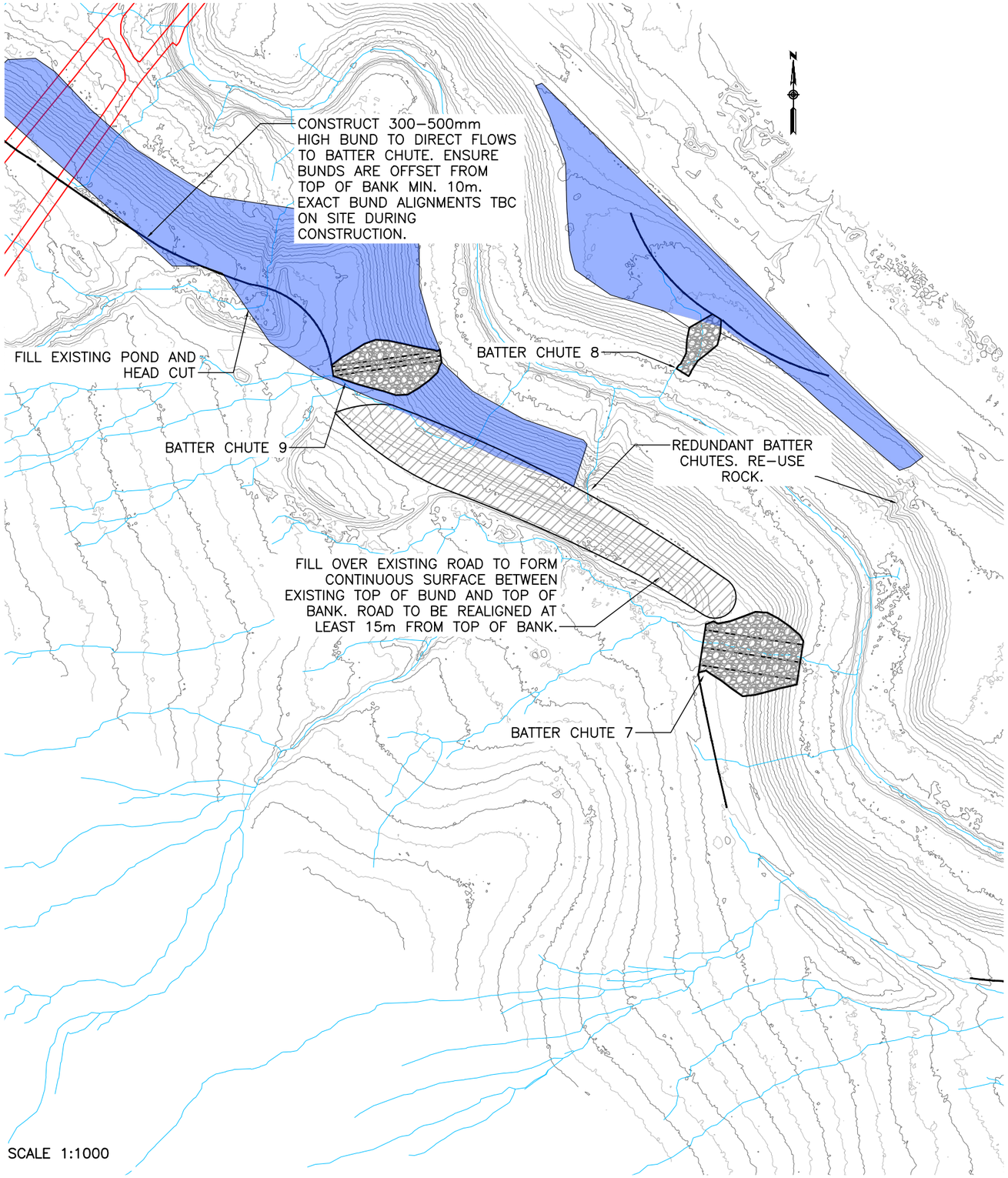
Peabody ENERGY

alluvium
Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

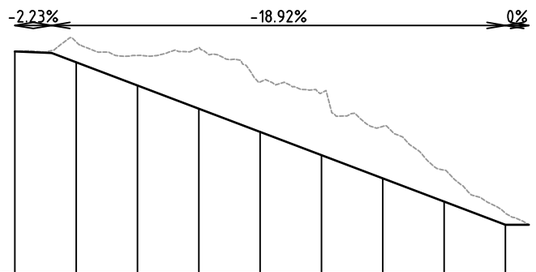
DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTES 4, 5 & 6

REVISION:	SHEET No.:	ORIGINAL SIZE:	SCALE:
A	003	A1	
		DATUM: m AHD (MGA z56)	



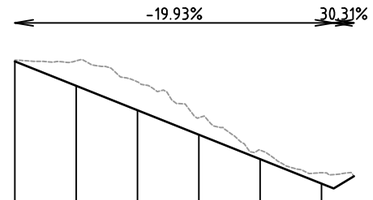
SCALE 1:1000



Datum R.L.83

DESIGN SURFACE	92.07	91.62	90.68	89.73	88.78	87.84	86.89	85.95	85.00
EXISTING SURFACE	92.07	92.46	91.90	92.21	90.82	90.37	89.01	87.23	85.48
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00

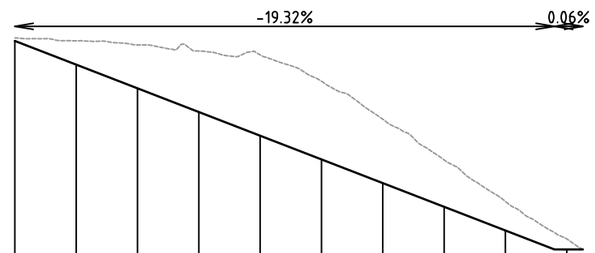
BATTER CHUTE 7



Datum R.L.83

DESIGN SURFACE	90.18	89.19	88.19	87.19	86.20	85.20
EXISTING SURFACE	90.23	90.20	89.34	87.88	86.56	85.64
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00

BATTER CHUTE 8



Datum R.L.85

DESIGN SURFACE	95.50	94.53	93.57	92.60	91.64	90.67	89.70	88.74	87.77	87.00
EXISTING SURFACE	95.62	95.50	95.34	95.09	94.93	93.85	92.31	90.65	88.96	87.43
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00

BATTER CHUTE 9

LONGITUDINAL SCALE
HORIZONTAL SCALE:1:250
VERTICAL SCALE:1:500

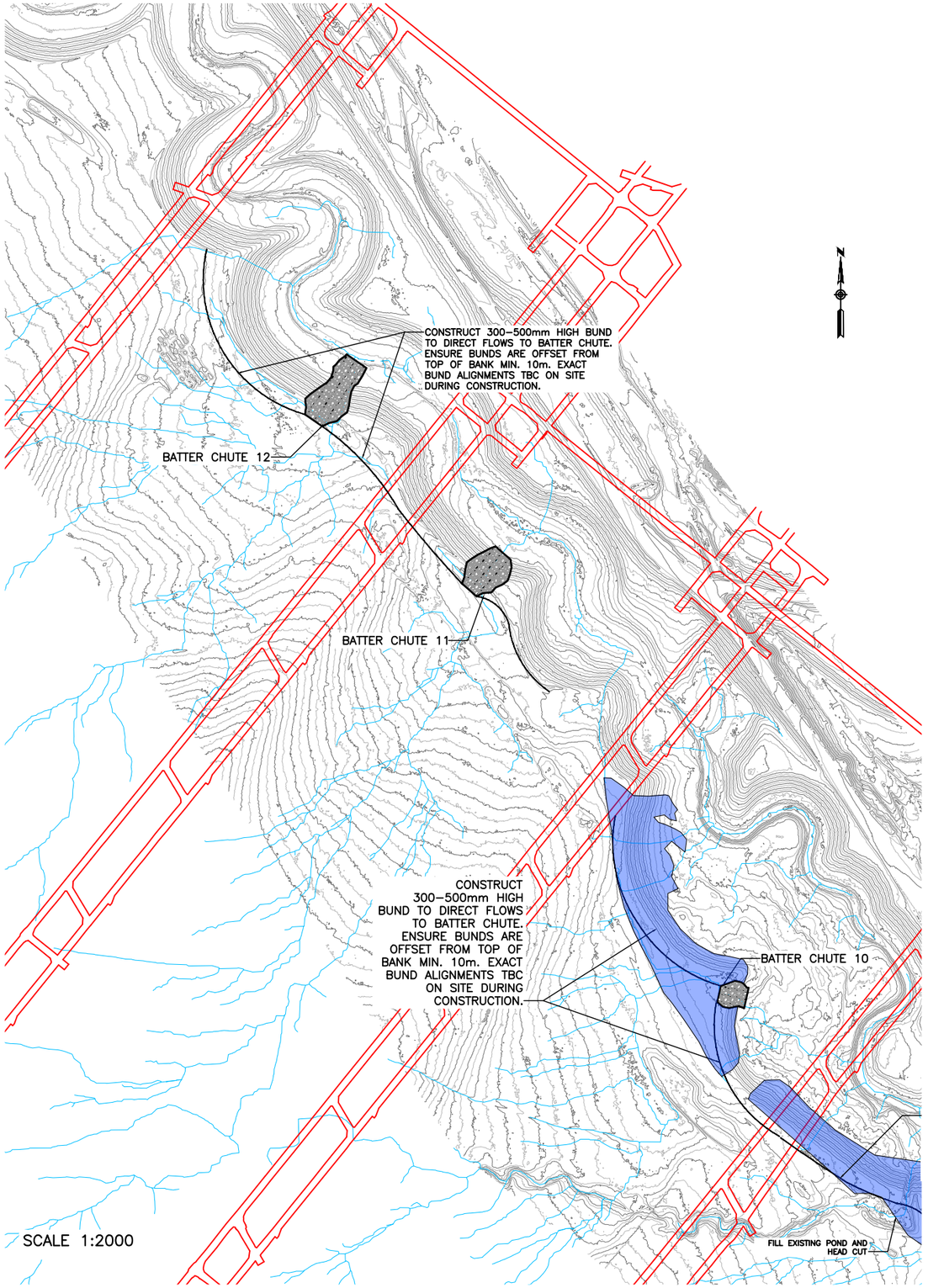
REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

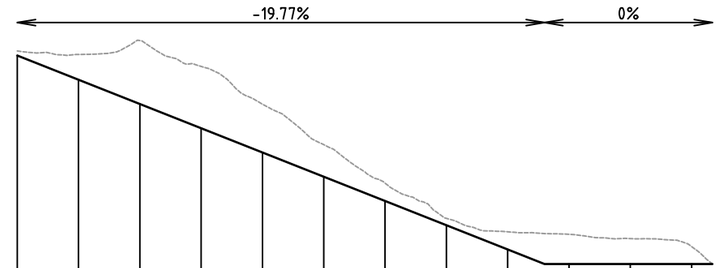
Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTES 7, 8 & 9

REVISION:	SHEET No.:	ORIGINAL SIZE:	SCALE:
A	004	A1	
		DATUM: m AHD (MGA z56)	

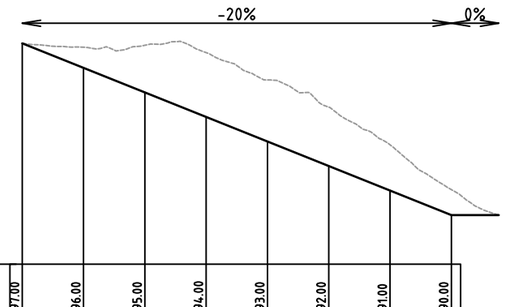




Datum R.L.88

DESIGN SURFACE	98.00	97.01	96.02	95.03	94.05	93.06	92.07	91.08	90.09	89.50	89.50	89.50
EXISTING SURFACE	98.18	98.04	98.61	97.55	96.01	94.37	92.80	91.36	90.81	90.71	90.53	90.21
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00

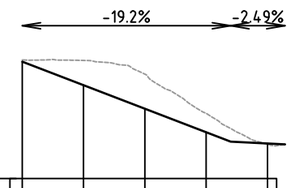
BATTER CHUTE 12



Datum R.L.88

DESIGN SURFACE	97.00	96.00	95.00	94.00	93.00	92.00	91.00	90.00
EXISTING SURFACE	97.00	96.84	96.92	96.62	95.51	94.40	92.86	91.04
CHAINAGE	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00

BATTER CHUTE 11



Datum R.L.92

DESIGN SURFACE	96.76	95.80	94.84	93.88	93.43
EXISTING SURFACE	96.83	96.81	96.25	94.66	93.39
CHAINAGE	0.00	5.00	10.00	15.00	20.00

BATTER CHUTE 10

LONGITUDINAL SCALE
HORIZONTAL SCALE:1:250
VERTICAL SCALE:1:500

REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

Peabody ENERGY

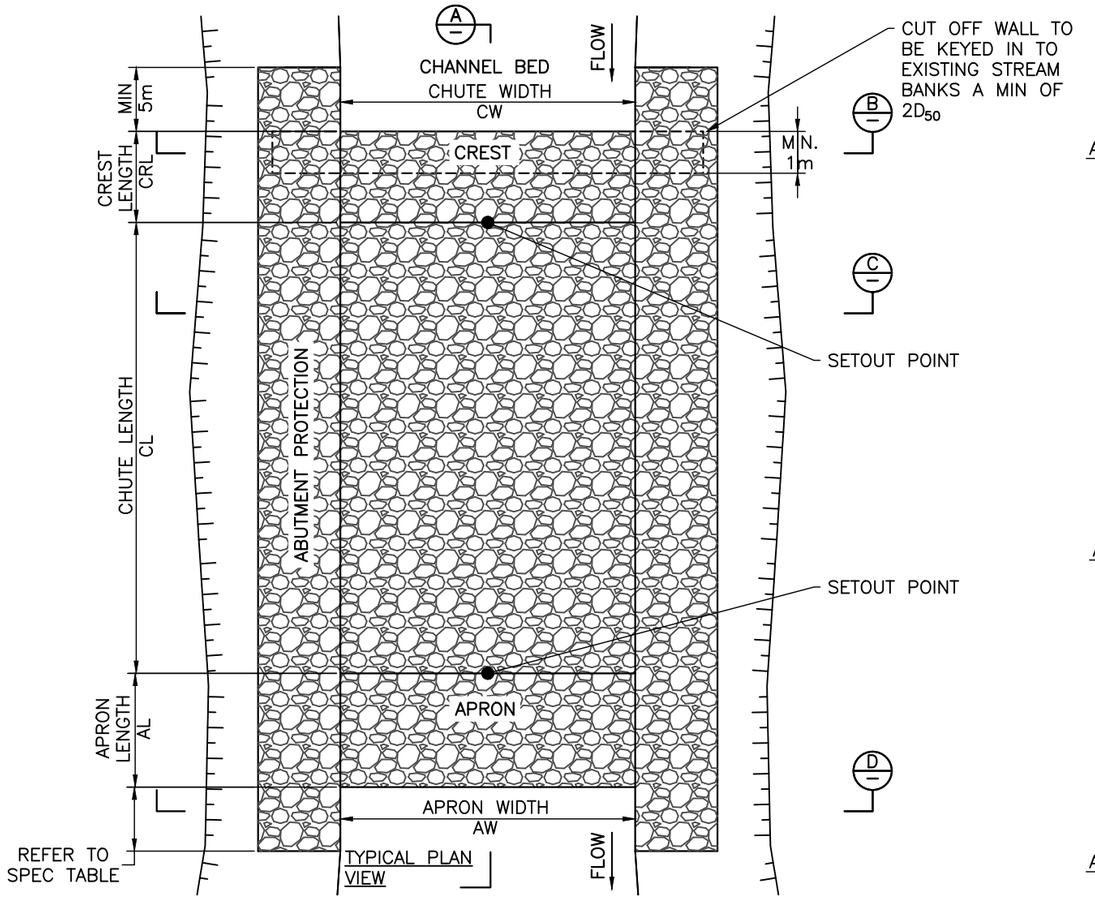
alluvium

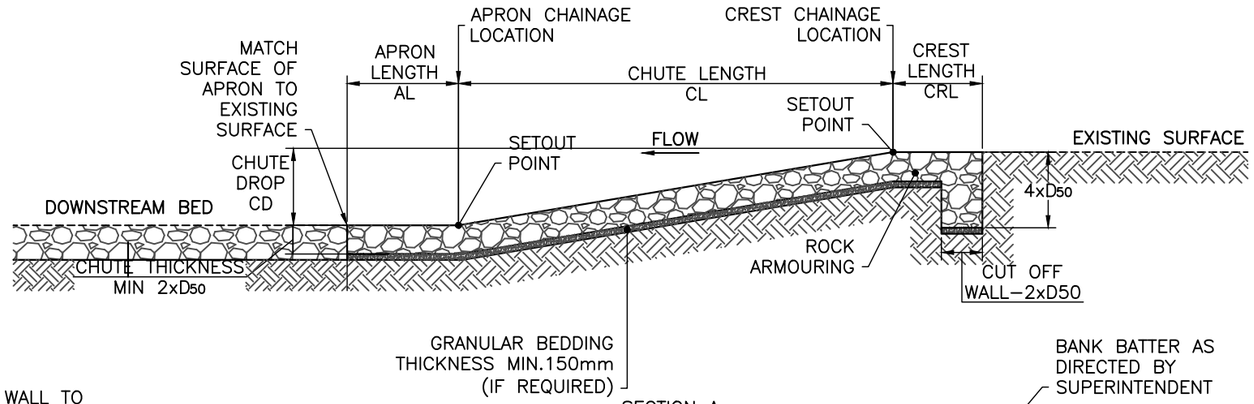
Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

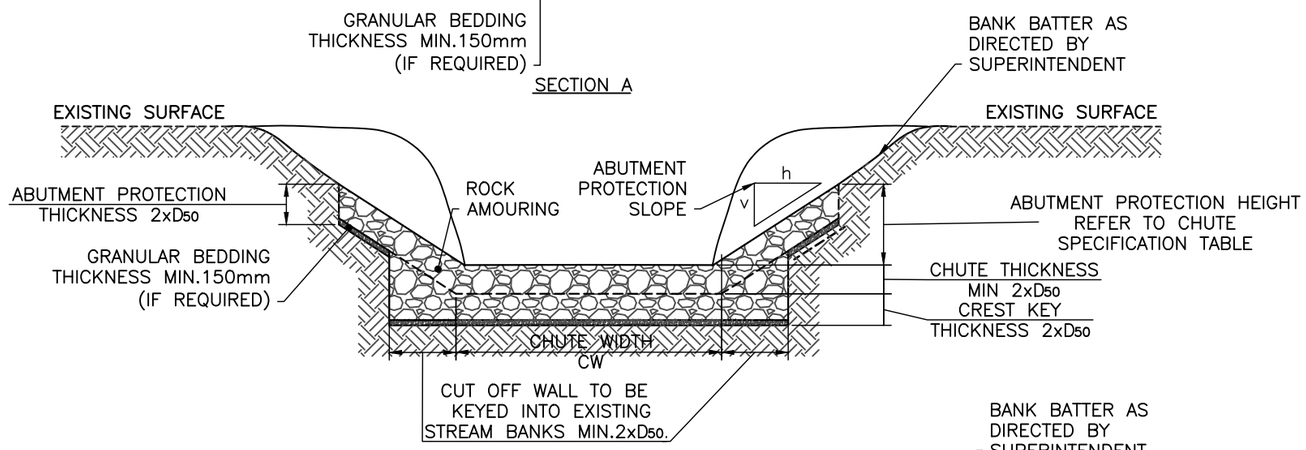
WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTES 10, 11 & 12

REVISION:	SHEET No.:	ORIGINAL SIZE: A1	SCALE:
A	005	DATUM: m AHD (MGA z56)	

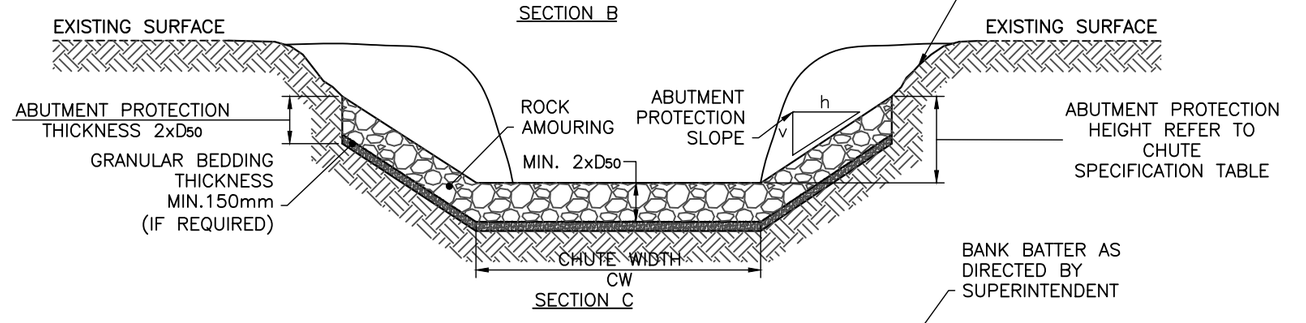




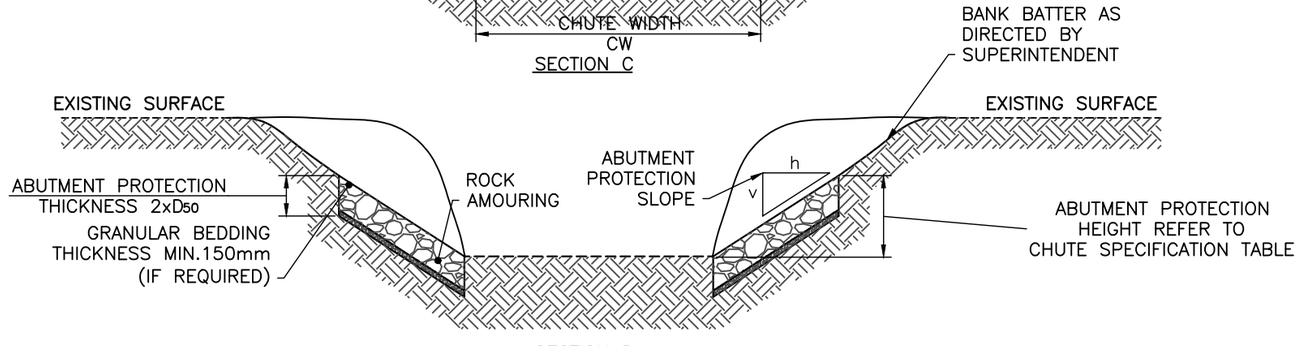
SECTION A



SECTION B



SECTION C



SECTION D

REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

Peabody ENERGY

alluvium
Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTE TYPICAL DETAILS

REVISION:	SHEET No.:	ORIGINAL SIZE: A1	SCALE:
A	006	DATUM: m AHD (MGA z56)	

BATTER CHUTE SPECIFICATION TABLE

BATTER CHUTE ELEMENT	SYMBOL	UNITS	BATTER CHUTE 1		BATTER CHUTE 2		BATTER CHUTE 3	BATTER CHUTE 4	BATTER CHUTE 5		BATTER CHUTE 6	BATTER CHUTE 7	BATTER CHUTE 8	BATTER CHUTE 9	BATTER CHUTE 10	BATTER CHUTE 11	BATTER CHUTE 12
			UPPER	LOWER	UPPER	LOWER			UPPER	LOWER							
CHUTE LENGTH	CL	m	15	8	20	5	48	21	20	6	31	37	26	44	17	35	43
CHUTE DROP	CD	m	3.0	1.5	4.0	1.0	4	2.5	3.5	1	5	7	5.2	8.5	3.3	7	8.5
CHUTE WIDTH	CW	m	6	6	8	8	10	4	6	6	4	15	4	4	12	14	15
CREST LENGTH	CRL	m	0	0	0	0	14	0	0	0	0	3	0	0	0	0	0
CREST RL	-	m	78.0	74.0	80.0	75.5	81 (u/s) 80.5 (d/s)	80.5	85.5	81	85.5	92	90.2	95.5	97	97	98
CREST HEIGHT ABOVE BED	-	m	0.0	0.0	0.0	N/A	0	0	0	0	0	0	0	0	0	0	0
APRON LENGTH	AL	m	17	1	15	2	2	2.5	16	2	9.5	2	1.5	2	4.5	4	13.5
APRON RL (END OF CHUTE/START OF APRON)	-	m	75.0	72.5	76.0	74.5	76.5	78	82	80	80.5	85	85	87	93.5	90	89.5
APRON RISE	-	m	-1	0	-0.5	0	0	0	-1	0	0	0	0.5	0	0	0	0
APRON RL (END OF APRON)	-	m	74.0	72.5	75.5	74.5	76.5	78	81	80	80.5	85	85.5	87	93.5	90	89.5
CREST SETOUT COORDINATES		EASTING	309763.5	309795.0	309677.6	309685.4	309543.8	309586.0	309412.3	309425.0	309332.9	309126.9	309130.2	308967.1	308794.3	308600.7	308480.2
		NORTHING	6393164.5	6393170.0	6393064.9	6393099.0	6393234.8	6393420.0	6393520.9	6393554.6	6393609.6	6393734.2	6393874.7	6393851.7	6394051.1	6394363.9	6394495.2
APRON SETOUT COORDINATES		EASTING	309778.3	309802.9	309682.0	309686.5	309558.9	309566.0	309419.4	309427.1	309362.4	309163.4	309116.4	309010.7	308810.9	308623.8	308504.8
		NORTHING	6393167.1	6393171.4	6393084.4	6393103.9	6393279.0	6393412.0	6393539.6	6393560.2	6393619.2	6393728.7	6393852.6	6393858.0	6394047.5	6394390.2	6394530.6
VOLUME OF CUT	-	m^3	585		915		2158	281	758		547	2487	268	1337	573	1982	2409
SIZE OF ROCK	D50	mm	300		400		450	450	400		400	450	300	450	450	450	450
ABUTMENT PROTECTION HEIGHT	-	m	1		1		1	1	1		1	1	1	1	1	1	1
ABUTMENT PROTECTION SLOPE	-	m/m	1V:3H		1V:3H		1V:3H	1V:3H	1V:3H		1V:3H	1V:3H	1V:3H	1V:3H	1V:3H	1V:3H	1V:3H
QUANTITY OF ROCK REQUIRED	-	m^3	225		375		758	151	323		232	687	118	297	293	602	924
	-	tonnes	360		600		1210	240	520		370	1100	190	470	470	960	1480
GRANULAR FILTER LAYER (150mm LAYER)	-	m^3	77		99		204	33	85		68	185	38	120	61	154	207

REV	DESCRIPTION	APP'D	DATE
A	PRELIMINARY ISSUE	RL	04.04.19

Peabody ENERGY

alluvium

Alluvium Consulting Australia Pty. Ltd.
ABN 76 151 119 792
412 Flinders Street
Townsville QLD 4810
T (07) 3257 1628
www.alluvium.com.au

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	PROJECT No:
JD	JD	RL	RL	0219016

WAMBO COAL
NORTH WAMBO CREEK DIVERSION
DETAILED ACTION PLAN
BATTER CHUTE SPECIFICATIONS AND SETOUT

REVISION:	SHEET No.:	ORIGINAL SIZE: A1	SCALE:
A	007	DATUM: m AHD (MGA z56)	

Attachment B
Technical Specifications

TECHNICAL SPECIFICATION – DIVERSION STABILISATION WORKS

NWCD Detailed Action Plan Detailed Design

April 2019

Document history

Revision:

Revision no.	01
Author/s	Jacob Dearlove Rohan Lucas
Checked	Rohan Lucas
Approved	Rohan Lucas (RPEQ)

Distribution:

Revision no.	01
Issue date	04/04/2019
Issued to	Nicole Dobbins
Description:	Original issue

Ref:
V:\Work\2019\0219016_North_Wambo_Creek_Detailed_Action_Plan\10_Project\1_Deliverables\0219016_R01_Technical_Specification.docx

Contents

1 Introduction 1

1.1 Site of works 1

1.2 Timing of works 1

1.3 Scope of works 1
General 2
Formation of batter chutes 2
Ripping, soil amelioration and vegetation establishment 2
Site reinstatement 2

1.4 Standards 2

1.5 Project drawings 2

1.6 Sequence of works 3

1.7 Hold points and inspection requirements 3

1.8 Survey 5

1.9 Storage of materials 6

1.10 Protection of the environment 6

1.11 Fencing 7

1.12 Safety 7

1.13 Permit to disturb 7

1.14 Utilities 7

1.15 Definitions and interpretations 7

2 Codes and standards 9

3 Control of water and sediment 9

4 Site preparation 10

4.1 Set out of works 10
Set out – for clearing and grubbing of vegetation, removal of existing rock beaching and stripping of topsoil 10
Set out – for excavation (all components) 10

4.2 Clearing and grubbing of vegetation 10
Extent of clearing 10
Clearing 11
Disposal of cleared vegetation 11

4.3 Stripping and stockpiling of topsoil and rock beaching 11

5 Earthworks 11

5.1 General 11

5.2 Tolerances 11

5.3 Excavation 12

5.4 Materials 12
Fill materials 12
Earth fill materials 13

5.5 Excavation methods 14

5.6 Removal of unsuitable material 14

5.7 Spoil dumps 14

5.8 Stockpiles 14
5.9 Blasting 15
6 Filling 15
6.1 General 15
6.2 Approval by Superintendent 15
6.3 Placement of fill 16
6.4 Moisture Conditioning 16
6.5 Compaction and Moisture Content Criteria 16
6.6 Fill testing 16
6.7 Superintendent's progressive approval of constructed work 16
6.8 Compaction plant 17
6.9 Drainage and dewatering 17
6.10 Topsoil surfacing 17
Other areas 17
7 Material requirements 17
8 Supply and placement of rock 18
8.1 General 18
8.2 Rock Material Requirements 18
8.3 Rock Size and Thickness 18
8.4 Granular filter 19
8.5 Placement of Rock Beaching 19
Stream Bank Preparation 19
Rock Placement 20
9 Soil amelioration 20
10 Reinstatement of works sites and disturbed areas 20

Tables

Table 1-1. Schedule of Project Drawings 3
Table 1-2. Schedule of hold points 4
Table 1-3. Superintendent approval required 5
Table 5-1. Earth fill material requirements 13
Table 8-1. Rock Durability Requirements 18
Table 8-2. Size Specification for Rock 19

1 Introduction

This technical specification sets out the technical details of the proposed Works to be undertaken for the North Wambo Creek Diversion (NWCD) Detailed Action Plan project. It deals specifically with the works associated with:

- Overland flow management which involves the construction/repair of rock lined batter chutes and associated flow management earthen bunds.
- Bank stability works in identified areas.

This specification details the standards, quality and dimensions to which the works are to be implemented. This specification is to be read in conjunction with the Project Drawings listed in Table 1-1 and the schedule of quantities in *NWCD Detailed Action Plan – Schedule of Quantities* report.

The contractor must keep a copy of the relevant specifications and Project Drawings on site at all times. Where a conflict occurs between the conditions of the Contract, Specifications and Project Drawings the order of precedence shall be as follows:

1. Conditions of Contract
2. Project Specifications (this document)
3. General Specifications
4. Project Drawings, and
5. Standard Drawings

1.1 Site of works

The site of works is located at Wambo Coal Mine, approximately 17 km West of Singleton in New South Wales, Australia. Wambo Coal Mine is owned and operated by Wambo Coal Pty Limited (WCPL).

1.2 Timing of works

Works should be undertaken during the dry season to minimise the risk of rain interruptions and potential erosion on freshly cut surfaces, where possible. Should construction take place during the wet season, controls should be put in place to minimise potential damage to people, equipment and the environment.

1.3 Scope of works

The scope of works is for overland flow management and bank stability works along NWCD in both the downstream portion of NWCD and the portion over LW11-LW16.

The Contractor shall supply all labour, plant, and material required to complete all earthworks and excavations shown on the Project Drawings and/or specified in the contract documents. The Work includes all clearing, carting, excavation, preparation, placement, pumping, drainage, restoration and all associated work in accordance with the Contract Documents and as may be directed by the Superintendent. All Work shall be carried out in accordance with this Specification. This document does not include revegetation works, a detailed design for revegetation will be required.

Several tasks will be required as part of the works:

- Excavation and formation of the Batter Chutes;
- Formation of the overland flow directing bunds;

The works comprise a number of tasks that should be undertaken in stages and approved prior to commencement of the next stage. The scope of work includes the following general items.

General

- Mobilisation and demobilisation;
- Compliance with all mine regulations and the requirements of the Superintendent;
- Liaison and cooperation with the Superintendent;
- Survey and setting out all construction features and the extents of the Site;
- Construct all temporary access and haulage routes and re-construct all existing access as directed;
- Surface preparation including vegetation removal, topsoil stripping, removal of existing rock beaching and removal of unsuitable surface material;
- Stockpile topsoil and rock beaching in approved areas as directed;
- Excavation of the batter chutes;
- Placement of rock beaching for batter chutes;
- Stockpiling of selected materials (including rock beaching) for re-use;
- Carting to spoil materials not required for re-use;
- Topsoiling and ripping or scarifying of channel banks and restoration of disturbed areas including topsoiling.

Formation of batter chutes

Formation of the batter chutes involves the removal of existing rock lined batter chutes and excavation for placement of granular filter layer and newly graded rock mix. Minor ancillary earthworks to ensure these chutes capture and convey all flow from the panels into the diversion without creating further rill/pipe/tunnel/gully erosion on the diversion batters will also be required. It should be noted that the batter drains have been designed to a detailed level, however fine detail regarding the reshaping of the area adjacent to the batter drains and diversion banks to ensure flows enter at the batter drain crests has been deferred to the construction stage as per the scope of works.

Written approval from the Superintendent shall be obtained prior to any modification of the design.

Ripping, soil amelioration and vegetation establishment

These works will be specified in a separate document.

Site reinstatement

All waste and surplus material resulting from the works shall be disposed of or re-used as approved by the Superintendent. Disturbed areas shall be rehabilitated to the satisfaction of the Superintendent prior to leaving the site.

1.4 Standards

All works are to be carried out in accordance with current industry best practice and must comply with current, relevant standards or codes of the Standards Association of Australia.

1.5 Project drawings

The Project Drawings relevant to this project are listed in Table 1-1.

Table 1-1. Schedule of Project Drawings

DRAWING NUMBER	DRAWING TITLE
0219016_001	SCHEDULE OF DRAWINGS AND OVERVIEW
0219016_002	BATTER CHUTES 1, 2 & 3
0219016_003	BATTER CHUTES 4, 5 & 6
0219016_004	BATTER CHUTES 7, 8 & 9
0219016_005	BATTER CHUTES 10, 11 & 12
0219016_006	BATTER CHUTE TYPICAL DETAILS
0219016_007	BATTER CHUTE SPECIFICATIONS AND DETAILS

1.6 Sequence of works

The Contractor shall structure the sequence of works to minimise the need for stockpiling and excess handling of material. The staging of works for all features shall be conducted in conjunction with each other and shall cover:

- Site set out of major construction features;
- Construct all temporary access and haulage routes and re-construct all existing access as directed;
- Removal of vegetation, stripping of topsoil and removal of rock beaching and carting to stockpile or spoil;
- Formation of rock chutes and bank stabilisation works;
- Formation of flow directing bunds;
- Formation of (stockpile sites) and local fill areas;

The Contractor is to submit to the Superintendent a construction program allowing progress to be tracked against the sequence above. The Contractor may submit an alternative sequence for approval from the Superintendent.

A revegetation program is required, however is not included in this specification.

1.7 Hold points and inspection requirements

Hold points are identified in this Specification by the words **'HOLD POINT'** and are summarized in Table 1-2. Works shall not proceed beyond hold points until expressly released in writing by the Superintendent.

The Contractor shall give not less than 48 hours' notice for hold points so that the Superintendent can review the submission or witness the Work process or test being undertaken and/or to undertake necessary inspections. The Contractor shall make adequate allowance in the construction program for the Superintendents' review of hold points.

Hold points may also arise from non-conformances, and the Superintendent may nominate additional hold points to be observed during construction activities.

The review by the Superintendent of a hold point does not relieve the Contractor of responsibility for satisfactory execution or performance of the work.

Table 1-2. Schedule of hold points

Hold Point #	Process held	Details	Inspection by	Release of Hold Point
1	Commencement of clearing vegetation (if required)	Set out of works – pegged limits of proposed clearing with pegs at maximum 50m intervals along the limit of clearing.	Survey & site engineer	Approval by Superintendent, verification that any features to be protected are adequately marked or protected, followed by hold point release form. Contractor signed acceptance of approved Permit to Disturb.
2	Chute excavation for review of excavation requirements in certain geologic units.	Prior to excavation.	Designer/ Site engineer	Approval by Superintendent confirmed by hold point release form.
3	Foundation preparation prior to commencement of fill placement, granular filter placement or rock placement.	Foundation surface is to be prepared in accordance with this Specification. Surface preparation varies according to material and location.	Designer/Site engineer	Approval by Superintendent confirmed by hold point release form.
4	Preparation of suitable materials prior to placement (fill, granular filter, rock beaching).	Fill materials are to be prepared in accordance with this Specification.	Designer/Site engineer	Approval by Superintendent based on inspection and field and laboratory test results. Followed by hold point release form.
5	Placement of granular filter prior to placement of rock.	Granular filter to be formed into place in accordance with this Specification where called for on the Project Drawings.	Designer/Site engineer	Approval by Superintendent confirmed by hold point release form.
6	Progressive quality assurance testing during fill/rock placement.	The test results for each stage of testing must be submitted to the Superintendent.	NA	Approval by Superintendent based on field and laboratory test results.
7	Revegetation works/ demobilisation.	Finished surface of all components.	Designer/ Site engineer	Approval by Superintendent confirmed by hold point release form.

In addition to the identified hold points, the Superintendent may inspect the Works at any time and/or at nominated milestones as in Table 1-3.

Table 1-3. Superintendent approval required

Clearing of vegetation
Surface preparation (vegetation removal, topsoil stripping and removal of unsuitable surface material) prior to excavation or filling
Stockpiling and re-use or disposal of cleared vegetation, waste and various materials
Foundation preparation – removal of unsuitable materials
Fill materials – control by testing
Supply of rock and granular filter material prior to placement
Prior to blasting (if required)
Prior to any modification of the design
Formation of all components prior to placement of topsoil (where required)
Rehabilitation of disturbed areas outside of the designed works

1.8 Survey

The Contractor is responsible for undertaking all survey and maintaining all survey marks in their correct position. The survey requirements apply to the setting-out of the Work, conformance with the design and measurement for payment. Survey required is the extent of survey necessary to confirm that the Work conforms to the details and requirements shown on the Project Drawings and the requirements of the Specification in regard to line, length, thickness, level, position, dimension and performance.

The position, level and dimension of elements of completed Work shall be measured and recorded relative to the map grid and height datum used at Wambo Coal Mine.

Required Survey Locations
The minimum survey requirements for the Work include but are not limited to:

- Base of excavation levels;
- Excavation design lines;
- Limits of Work;
- Progressive fill levels;
- Final fill levels;
- Quality Control / Quality Assurance testing locations (Easting, Northing, Reduced Level); and,
- Survey of Work as executed.

Differential Global Positioning Systems (DGPS)
The use of DGPS is acceptable for both set out and control of construction plant, provided that verification survey and periodic testing of DGPS equipment is carried out to confirm the accuracy and reliability of the systems adopted.

For verification testing, bench marks established by conventional survey techniques, located with respect to the local Map Grid and level datum shall be measured for co-ordinate and level on an ‘as required basis’. The results of such checking will be recorded in writing and forwarded to the Superintendent for confirmation that the set out of the Work is in agreement with the tolerances provided in this Specification.

1.9 Storage of materials

The Contractor must store materials, equipment and excavated material in accordance with the requirements of the mine, local municipal council, owner or other relevant authority and this specification.

1.10 Protection of the environment

The Contractor must take all necessary precautions to ensure that the environment is protected at all times.

Soil conservation

All proper precautions shall be taken by the Contractor to prevent the erosion of soil by wind or water from land used or occupied by the Contractor and to prevent the deposition of soil in waterways beyond the extent of works, during and after execution of work under the Contract.

Existing vegetation and established ground surfaces shall not be disturbed unless necessary for the purpose of construction of the Works and in the accordance with the Permit to Disturb (PTD).

If in the opinion of the Superintendent the Contractor's operations cause erosion hazards, the Contractor shall undertake soil conservation measures in these areas when directed by the Superintendent. Soil conservation measures shall include, but are not limited to, stabilisation of embankment slopes and the construction of cut-off drains.

Fire precautions

The Contractor shall provide, operate and maintain adequate firefighting equipment for the protection of the Works and its Construction Plant and take all necessary measures to prevent fire during the execution of work under the Contract. All reasonable measures shall be undertaken by the Contractor to protect vegetation from fire, in and adjacent the area of works arising from the Contractor's operations.

The Contractor shall comply with the requirements of the relevant Fire Authority Act and Regulations made there under, and ensure that all persons on the Site observe these requirements.

The Contractor shall take notice, and implement appropriate strategies, of any announcements by the Country Fire Authority (or equivalent), particularly the notification of days of Total Fire Ban.

Control of surface water runoff

All necessary measures, including design, supply, installation, maintenance and operation of drainage systems, shall be implemented by the Contractor to manage surface water from the works area reporting to the environment beyond the works area consistent with the mines Environmental Authority.

Preservation of flora and fauna

The Contractor shall not destroy, remove or clear trees and vegetation without the prior written permission of the Superintendent.

All necessary measures shall be taken by the Contractor to prevent its employees and subcontractors from hunting, disturbing, capturing or destroying animals and birds or their breeding places within the site and all neighbouring areas and along the accesses to the site.

The Contractor must not damage, clear or cut back vegetation more than is necessary to enable construction of the Works. Construction of the Works shall be undertaken in a manner that minimises disturbance to existing vegetation.

Flora debris

Whenever clearing is required under the Contract selected trees, stumps, roots and brush shall be stockpiled for use in rehabilitation of the diversion. Burning of material will not be permitted unless otherwise approved in writing by the Superintendent.

1.11 Fencing

The Contractor shall arrange for and erect any necessary fencing around the Works to maintain a safe environment, and where necessary, to keep livestock from the construction Site.

1.12 Safety

The Contractor shall comply with all safety requirements of Wambo Coal Mine and comply with all relevant safety standards required by Statutory Authorities having jurisdiction over all or part of the works.

1.13 Permit to disturb

An approved Permit to disturb from the Superintendent is required for any excavation. The Contractor shall request such permits from the Superintendent, in writing, not less than five (5) working days before commencing any excavation. The request shall detail the location and the size of the area to be excavated and the planned commencement and completion date. The planned excavation shall not be commenced until the Superintendent's written approval has been obtained.

1.14 Utilities

The Superintendent will work with the Contractor to establish the location and extent of any buried utilities. The Contractor shall immediately cease work and inform the Superintendent when unknown utilities are encountered, or if utilities are not located as indicated in the excavation permit. The Contractor shall record the position and elevation by survey of all existing, re-routed and abandoned service lines encountered in the Work.

Damage caused by Contractor negligence shall be satisfactorily repaired at no cost to the Superintendent.

Superintendent-approved isolation/lock-out procedures (energy isolation) shall be used around live systems, and must be coordinated with the Superintendent.

1.15 Definitions and interpretations

The following definitions and interpretations shall apply to this Technical Specification:

- The Project means the total construction contemplated of which the Work may be the whole or part.
- The Work means the total construction and related services required by the Contract Documents.
- Superintendent means Wambo Coal Mine's appointed representative in charge of the Work and duly authorized to act on Wambo Coal Mine's behalf.
- Owner's Representative means a person, group of persons or corporate entity designated by the Principal who is authorized to represent the interests and make decisions on behalf of the Principal for the Work.
- Words importing the singular shall include the plural and vice versa and words importing the masculine gender shall include the feminine and words importing persons shall include bodies corporate.
- Plant means, as distinguished from Work, anything and everything, except persons, used by the Contractor in the performance of the Work.
- Site means the place where the work is being performed and the immediate vicinity thereof.
- Where the words shown, indicated, detailed, specified, or words of a similar import are used, such words shall refer to the Specifications and/or Project Drawings unless expressly stated otherwise.

- Drawing, means all drawings, plans, sketches and maps issued with the Specifications or subsequently as provided for in the Contract and includes any drawings submitted by the Contractor if signed as approved by the Superintendent.
- Project drawing means those drawings listed in section 1.5 of this specification.
- Where the words directed, permitted, approved, accepted, required, satisfactory, rejected or words of similar import are used such words shall refer to the direction, permission, approval, acceptance, requirements, satisfaction or rejection in writing by the Superintendent unless expressly stated otherwise.
- Environmental Management System (EMS) means the Superintendent's environmental standards and procedures for management, reporting, and compliance with applicable environmental regulations.
- Embankment means earthen plug, earthen levee and/or earthen embankment.
- Inspection by Survey for hold points means the contractor shall survey the work item[s] being considered for compliance with the design and submit to the Superintendent for approval.
- Inspection by Site Engineer for hold points means an engineer appointed by the Superintendent.
- Inspection by Designer means a person appointed by the company who designed the project.
- Inspection by Geotechnical engineer means the certifying geotechnical engineer appointed by the Superintendent.

2 Codes and standards

Unless otherwise approved or specified, the workmanship, equipment and materials shall comply with the latest revision (including the latest addenda prior to the date of submission of the bid) of this Specification and the relevant Australian Standards together with the requirements of Statutory Authorities having jurisdiction over all or part of the works. Where conflict exists between different applicable codes, standards or regulations the higher requirement shall apply. No deviation from the provisions of the relevant standard is permitted without first obtaining approval in writing from the Superintendent.

3 Control of water and sediment

All works shall comply with the site Sediment and Erosion Control Plan and Environmental Authority where there is potential risk to discharge sediment off mine lease and/or into a waterway beyond the extent of works. Slopes, crowns and drains shall be provided and maintained by the Contractor on all excavations and fills to ensure satisfactory drainage at all times. Culverts, catch drains, ditches, sumps, silt traps, sediment basins, settling areas and other facilities shall be provided by the Contractor and maintained to control the stormwater runoff on, over and from the site, to control erosion, and to prevent damage to, or fouling of work in progress or completed.

Sediment settling structures and other debris collecting structure shall be cleaned out by the Contractor as directed by the Superintendent.

All necessary pumping equipment for controlling runoff and ponding during storms and dewatering the surfaces surrounding excavations and in foundations shall be provided, by the Contractor, on site in working order at all times.

Repairs by the Contractor to damage caused by stormwater runoff form part of the requirements of this specification.

4 Site preparation

Site preparation is the responsibility of the Contractor and must be completed and approved by the Superintendent prior to Works being undertaken.

4.1 Set out of works

Works shall be set out in accordance with the Project Drawings, digital design strings and these specifications and shall be approved by the Superintendent prior to Works being undertaken.

Existing levels including any variations from those shown on the Project Drawings and digital design strings shall be verified with the Superintendent prior to commencement of work.

The position and level of Works including the placement of benchmarks, controls and offset pegs; the set out of embankment toes and alignment of structures and limits of Work shall be established by the Contractor and approved by the Superintendent prior to the commencement of Works. Line and level pegs shall be positioned as required to ensure accuracy and control of the earthworks undertaken. The Contractor is responsible for maintaining, offsetting and placing additional pegs and must ensure offset pegs are adequately protected.

The Superintendent may request details of offset and construction pegs, in writing, and may periodically check construction levels and set out at any time during construction.

Set out – for clearing and grubbing of vegetation, removal of existing rock beaching and stripping of topsoil
The set out of any section of work shall be pegged by the Contractor not less than 48 hours prior to commencement of clearing. Pegs at maximum 50 m intervals shall be established along the limits of the proposed clearing. The Contractor shall notify the Superintendent when the proposed clearing limits have been pegged and are ready for approval by the Superintendent.

HOLD POINT 1 – The Superintendent will inspect and approve the set out and any required permits before any clearing can commence.

Set out – for excavation (all components)
The set out of any section of excavation shall be pegged by the Contractor not less than 48 hours prior to commencement of excavation. Pegs at intervals as required to ensure accuracy and control of the excavation and maximum 50 m intervals shall be established along the construction control lines, embankment toes and batter tops and limits of the proposed excavation. The Contractor shall notify the Superintendent when the proposed excavation limits have been pegged and are ready for approval by the Superintendent.

HOLD POINT 2 – The Superintendent will inspect and approve the set out of any required excavation and issue an approved permit to dig before any excavation can commence.

4.2 Clearing and grubbing of vegetation

Removal of vegetation shall be undertaken in accordance with any permit conditions and in a manner that will avoid damage to other vegetation or property outside the area to be cleared.

Approval for clearing of vegetation shall also be obtained from the Superintendent and/or relevant authorities (if required) and copies of all related permits provided to the Superintendent for approval prior to any vegetation removal.

Extent of clearing
The areas where any works are to commence shall be cleared and grubbed to a minimum width of 3m margin outside the area of works, or as specified by the Superintendent.

The extent of clearing shall be restricted to the minimum required to undertake the works safely and without negatively impacting on the works and adjacent areas. The area to be cleared shall be agreed upon by all relevant parties prior to clearing going ahead. Clearing outside the approved areas shall not be permitted without the Superintendents prior written approval.

Clearing
Clearing of vegetation shall be undertaken by suitably qualified persons in accordance with permit conditions, and in a manner that satisfies safety requirements of the mine site.

Disposal of cleared vegetation
Disposal of cleared vegetation shall be in accordance with relevant conditions of vegetation clearing approvals and mine site regulations. Cleared vegetation can be re-used as part of rehabilitation works for the diversions in the form of mulch, strategically placed logs and general habitat and organic matter provision in accordance with the revegetation plan.

4.3 Stripping and stockpiling of topsoil and rock beaching

Topsoil shall be stripped from all work areas and stockpiled in accordance with this specification. All work areas shall be stripped of topsoil to a nominal depth of 300 mm or otherwise as directed by the Superintendent to ensure no significant visible organic matter is retained and to ensure no mixing of topsoil with the subsoil occurs. The part of the stripped material that contains significant visible organic matter shall be stockpiled separately for potential re-use as topsoil surfacing.

Stripped topsoil shall be stockpiled clear of the earthworks and all other Works areas as directed and approved by the Superintendent for later reuse. Topsoil stockpiles shall be positioned and shaped in such a way to minimise erosion. Adequate drainage shall be provided to minimise sediment mobilisation. The height of topsoil stockpiles shall not exceed 3.0 metres unless approved in writing by the Superintendent.

If the topsoil is to be stored for longer than 3 months it is recommended the stockpiles are grass seeded.

Rock beaching shall be removed and stockpiled for re-use in rock lined batter chute construction if suitably graded.

5 Earthworks

Earthworks shall not be undertaken by the Contractor until the Superintendent has approved site preparation.

HOLD POINT 2 – The Superintendent will inspect and approve the set out and any required permits before any excavation can commence.

5.1 General

Earthworks shall be formed to the lines and levels specified in this technical specification and on the Project Drawings and digital design strings. Written approval from the Superintendent must be received by the Contractor prior to implementation of any proposed modifications to the design presented on the Project Drawings, digital design strings or detailed in this specification. All earthworks shall be finished to be free draining surfaces and left rough, unless specified otherwise.

5.2 Tolerances

Earthworks, including excavation and the placement of select fill and topsoil, shall conform to the dimensions and grades shown on the Project Drawings, digital design strings and detailed in this specification.

Longitudinal gradients of batter drains shall not differ by more than 10 % from the design grade.

Construction that varies from the above tolerances must be approved, in writing, by the Superintendent.

5.3 Excavation

Excavation shall consist of removal and satisfactory disposal (or stockpiling) of all materials from within the limits of the excavation Works. Excavation shall be undertaken to shape the area to the design surface, forming the desired slopes, widths and elevations as shown on the Project Drawings and digital design strings with allowance for the placement of materials including, but not limited to, rock and granular filter material. The Superintendent may direct the re-use of materials and the appropriate stockpiling of them. Excess cut material shall be disposed at the nearest suitable site identified and approved by the Superintendent.

Unsuitable material including, but not limited to, roots, decaying vegetation and unstable soils shall be removed from the excavation at the direction of the Superintendent. Where removal of such material extends beyond the design surface the design surface shall be reinstated with a suitable material (including moisture conditioning and compaction where necessary) to the satisfaction of the Superintendent.

Excavation shall be undertaken in a manner that minimises disturbance to material outside the limits of the batters.

HOLD POINT 2 – The Superintendent will inspect and approve the set out of any required excavation and issue an approved permit to disturb before any excavation can commence.

5.4 Materials

Material to be excavated is suggested to be classified as rippable or non-rippable.

Common excavation

Common excavation refers to all materials including vegetal material, peat and organic soil, clay, silt, sand and gravel, boulders and loose rock smaller than 1,000 mm average diameter or weathered rock that is classified as rippable.

Common materials shall be excavated from the Work area to the approved depths and limits. Unsuitable materials encountered in the excavations that exist prior to construction or develop during construction shall be excavated, hauled to the designated disposal areas and replaced with approved fill meeting the minimum Specification.

Materials segregation

Materials encountered as part of the Works, including materials uncovered during vegetation clearing, topsoil stripping and excavation, and imported materials, shall be separated as follows:

- Selected timber may be retained, under direction of the Superintendent, for possible re-use in providing general habitat features within the Works area including in stream channels where appropriate;
- Topsoil is to be stripped from all Works areas and stockpiled for future use in covering disturbed surfaces such as, channel banks, placed fill, rock beaching and batter drains;
- Selected material that meets the requirements of this Specification may be used for embankment construction or replacement of unsuitable material where approved by the Superintendent;
- Rock uncovered as part of the Works should be stockpiled and re-used as rock fill, beaching, rock/rubble, rock-soil mix or any other use approved by the Superintendent; and
- Materials imported from outside the Works area should be stockpiled in separate piles to materials encountered on site, unless directed otherwise by the Superintendent.

Fill materials

The Superintendent shall make available materials from nominated borrow areas. The Superintendent makes no representation as to the suitability or otherwise of the materials in the borrow areas for use within the Work. Selection and processing of materials from the borrow areas to meet the requirements of the

Specification is the responsibility of the Contractor. Borrow materials should be sourced from the diversion excavation material.

Unsuitable fill materials

The following fill materials shall not be used in the Work:

- Organic soil (topsoil) and vegetal materials;
- Silts, or materials that have the deleterious engineering properties of silt;
- Metal, timber; plastic, organic clays and silts, fly ash, and the like;
- Building waste or other such material;
- Material deemed deleterious by the Superintendent;
- Material which is too wet or too dry to achieve the required level of compaction;
- Materials which have been contaminated with fuels or other pollutants;
- Materials that for any other reason do not meet the minimum Specification.

Soil meeting the minimum requirements for fill but unsuitable for immediate use due to high moisture content may be temporarily stockpiled and dried for later use.

Earth fill materials

All earth fill suitable for the general fill areas shall comply with the requirements of this specification. The Contractor shall confirm to their satisfaction prior to bidding that sufficient materials are available. Material requirements are provided in Table 5-1.

Table 5-1. Earth fill material requirements

Property	Criteria
Soil description	Clay and/or sandy clay/clayey sand
Maximum Size[1]	25 mm
% Passing 75 µm Sieve[1]	>20
Plasticity index[2]	7-40%
Liquid Limit[3]	25-45%
Emerson Class	N/A
Pinhole dispersion (PD)	N/A
Exchangeable sodium percentage (ESP)	N/A

1 Procedure AS1289.3.6.1 – 2009
2 Procedure AS1289.3.3.1 – 2009
3 Procedure AS1289.3.1.1 – 2009

5.5 Excavation methods

The Contractor shall conform to the following general guidelines for all excavation activities:

- Develop excavation methods, techniques, and procedures with consideration for safety, environmental hazards and the nature of materials to be excavated.
- Take precautions to preserve in an undisturbed condition all materials outside the excavation lines. All slips of insecure masses of materials outside the limits of excavations and specified cut batters shall be removed and reinstated by the Contractor in a manner approved by the Superintendent.
- Avoid excavation beyond the excavation lines shown on the Project Drawings and any permit to disturb unless otherwise approved by the Superintendent.
- Dispose of all excavated material in the areas designated and approved by the Superintendent. Under no circumstance shall water, soil, rock, or deemed contaminated material be discharged, ponded, or stockpiled outside of the Site or approved areas.
- The construction of temporary roads, ramps, or fills to allow equipment access to certain areas could be required. Such requirements shall be identified by the Contractor and submitted to the Superintendent for approval before starting the excavation. The Contractor shall be responsible for construction, deconstruction, and safe disposal in approved areas of all temporary structures.

5.6 Removal of unsuitable material

Soft, wet or unstable areas of material that extend below design levels, which exist or develop during construction, shall be excavated and replaced with approved materials in layers not exceeding 200 mm loose thickness, moisture conditioned as required and compacted as directed in writing by the Superintendent.

5.7 Spoil dumps

Excess excavated material not required for construction of the works shall be dumped to form permanent spoil dumps in locations approved by the Superintendent. The spoil dumps shall be designed and constructed in accordance with Wambo Coals Mine's standards.

5.8 Stockpiles

Where necessary, the Contractor shall stockpile various materials for future use including materials recovered during clearing and excavation. Different materials shall be stockpiled separately and materials excavated from different areas of the site shall not be mixed unless required to meet specification. Materials to be stockpiled include sand and gravels, topsoil, clay, silt, identified imported fill, rock and imported rock, in designated areas approved by the Superintendent.

Stockpiles must be kept clear of hazard areas and shall be located out of the way of Works and away from watercourses or any associated drainage lines at sites approved by the Superintendent.

Areas designated for stockpiling of materials shall be determined as part of the construction sequence to be approved by the Superintendent prior to commencement of Works.

Stockpiles shall be formed such that they minimise erosion of material during any rainfall events in the construction period. Prior to stockpiling material, designated areas shall be cleared of vegetation as per Section 4 of this specification.

Prior to stockpiling clay material, the designated area shall be stripped down to a lower level, approved by the Superintendent, to minimise contamination during subsequent excavation of stockpiles.

Stockpiles of topsoil shall be no more than 3.0 m in height. If topsoil is to be stored for longer than 3 months, the stockpiles are suggested to be grass seeded.

5.9 Blasting

If blasting is required all necessary permits applicable under the mine and statutory regulations must be obtained and copies provided to the Superintendent prior to any blasting being undertaken. The Contractor must comply with the conditions of the blasting permit/s and the following Acts and Standards:

- Mining and Quarrying Safety and Health Regulation 2001
- Explosives Act 1999
- Explosives Regulation 2003
- AS 2187.0 -1998 Explosives - Storage, transport and use
- AS 2187.1-1998: Explosives – Storage and use; Part 1: Storage
- AS 2187.1-1998/Amdt 1-2000: Explosives – Storage and use; Part 1: Storage
- AS 2187.2 - 2006: Explosives – Storage and use; Part 2: Use of explosives
- AEISG Code of Practice - Precursors for Explosives 1999. (Australian Explosives Industry Safety Group)
- Australian Explosive Code (AEC) – Australian Code for the transport of explosives by Road and Rail, 2nd Ed Mar 2000
- Australian Dangerous Goods Code (ADG)
- Dangerous Goods Safety Management Act 2001
- Dangerous Goods Safety Management Regulation 2001
- AS 4326-2008: The storage and handling of oxidizing agents
- Security Sensitive Ammonium Nitrate Guidance Notes
- All applicable regulations of the municipality in which the blasting operations are being carried out, regarding the use of explosives, and
- Any other statutory regulations that may apply.

This list is not comprehensive and does not override any Ensham Mine standard operating procedures regarding the use of explosives. The Contractor is liable for any accident, injury or damage resulting from the use of explosives.

6 Filling

Where shown on the Project Drawings, fill material shall be placed, moisture conditioned and compacted, as required, in accordance with the following specifications.

6.1 General

Fill shall not be placed in any area until clearing; excavation and surface preparation have been carried out and approved in writing by the Superintendent.

6.2 Approval by Superintendent

No fill material shall be placed in any section of the Work until the material beneath that section has been suitably prepared and has been approved by the Superintendent.

HOLD POINT 3 - The Superintendent will provide written approval of the prepared founding surfaces before filling can commence.

6.3 Placement of fill

Earth fill shall be placed in continuous approximately horizontal layers for the full width of the filled area and having a thickness not greater than 300 mm loose (before compaction), except as otherwise approved by the Superintendent. Each layer placed shall be scarified in an approved manner to provide a satisfactory bonding surface with the overlying layer.

The Contractor shall for all materials mark the proposed layer thicknesses at intervals of not less than 50m for each material being placed. The method of marking shall be in the form of clearly visible marks such as pegs-and-flags or spray paint markings indicating the proposed layer thickness. The Contractor is responsible for constructing to Specification within the lines and levels indicated in the Project Drawings.

6.4 Moisture Conditioning

The Contractor is to pump or transport water for use in moisture conditioning of soil. The Contractor is to supply all equipment necessary for pumping and transport of water to moisture condition soils. The Superintendent will nominate a suitable source of water, located within the mine lease boundaries.

The moisture conditioning of the embankment fill materials must be done as a separate phase prior to placing the fill; moisture conditioning after placement shall be rejected.

Moisture conditioning of excavated materials shall be carried out in the borrow pits or in an approved area purpose-built for this purpose.

6.5 Compaction and Moisture Content Criteria

Each layer of material shall be compacted with a 12 tonne (minimum) pad foot roller until the field density, as determined by the Superintendent, meets the following criteria:

- 95% of the Maximum Dry Density obtained from the standard compaction test method carried out in accordance with AS 1289 5.4.1-1993.
- A moisture content between -2% to +2% of Standard Optimum Moisture Content (OMC) as determined in accordance with AS 1289 5.7.1-1993.

The material in each layer shall have uniform moisture content throughout within the specified range. The compacted fill shall be consistently dense and moist throughout and free from lenses, pockets, laminations, streaks, continuous planes of weakness, large open voids and areas of varying moisture content or density.

6.6 Fill testing

Testing of earth fill shall be carried out by the Contractor at a frequency detailed below and in accordance with the relevant Australian Standards:

- In-situ density: not less than one test for every 2,000 m^3 placed and for each layer placed;
- Moisture content: not less than one test for every 2,000 m^3 placed and for each layer placed;

The testing must be completed in accordance with the relevant Australian Standards. All test data must be recorded and stored as part of the construction quality assurance.

6.7 Superintendent's progressive approval of constructed work

The suitability of each section of the constructed works for placing further embankment materials thereon and for all other materials for use in the embankment construction shall be progressively determined by the Contractor and approved by the Superintendent.

The Contractor will report all tests including failed tests to the Superintendent. No materials shall be placed on the constructed works prior to the Superintendent's written notification of approval of that section of the Work.

The Superintendent will approve material placement as construction continues (**HOLD POINT A5**).

6.8 Compaction plant

The Contractor shall provide and operate appropriate equipment to compact materials to the specified compaction standards. All equipment will need to meet Ensham Mine requirements for site compliance.

6.9 Drainage and dewatering

Where excavation and filling is specified on the Project Drawings, the Contractor shall be responsible for the effective removal and conveyance of all water and sludge from such areas in such a manner as not to cause any nuisance or injury to property or persons.

Earthworks shall be kept clear of water at all times, either through provision of pumped or gravity drainage systems.

The Contractor shall at all times during the progress of the work, construct and maintain such temporary drains, pumps and other equipment necessary to protect the Works. The Contractor must control discharges to watercourses or drains so that they comply with mine and/or DEHP requirements.

No ponding of surface water is permitted within 15m of the top of diversion batters due to the risk of tunnel erosion in dispersive soils.

No concentration of overland flow or minor tributary inlet is allowed that will create rills/gullies in diversion batters during or after works.

6.10 Topsoil surfacing

Following topsoil placement of approximately 300mm, the finished surface shall be ripped to a minimum depth of 600 mm where substrate allows, approximate the grade and shape of the design surface, be free draining and left rough. The 300mm topsoil thickness may be made of a blend of topsoil and rubble of erosion resistant materials won from excavation such as laterite/indurated Tertiary sediments.

No topsoil surfacing is required on the upper batter if it is steepened to 1V:1H where erosion resistant indurated sediments are encountered in the upper profile.

Other areas

All other areas disturbed by the construction activities but not specifically designated for topsoiling on the Project Drawings or in this specification shall be graded to form a uniform slope and covered with topsoil to a minimum thickness of 150 mm, ripped to a minimum depth of 300 mm and left rough with no concentration of overland flow entry or ponding within 15m of top of diversion batter.

7 Material requirements

The Contractor shall provide the Superintendent with a certified test report showing that the material requirements meet the details outlined in this specification.

HOLD POINT 4 – Materials to be approved by Superintendent based on inspection and field and laboratory test results prior to placement.

Fill material requirements to be determined by the Superintendent if filling is required.

8 Supply and placement of rock

8.1 General

The supply, delivery and placement of rock shall be in accordance with this specification and the Project Drawings.

8.2 Rock Material Requirements

Rock used for beaching or in chutes shall be hard, durable, angular in shape, and free from cracks, overburden, shale and organic matter. Thin, slab-type stones, rounded stones and flaking rock shall not be used. Rock should not be adversely affected by repeated wetting and drying and shall have a crushing strength of not less than 25 MPa.

The 50-percentile size has been specified and is defined as the 'D_{50}', meaning that 50% of the rock blend must pass through a sieve of that nominated size. The size specification is shown in Table 8-2. The grading is given to ensure that a well graded rock mix is obtained so that the rock will interlock and have low void spaces that will seal with time. Poor grading is to be avoided as it will increase the potential for structure failure. Hence the rock mix should not be single sized, but be a well graded mixture that will ensure that all interstices between large rocks are able to be filled with rock of progressively smaller size. This has the combined effect of:

- Ensuring that no significant voids occur in the rock blanket through which the underlying materials can be washed out.
- Creating an interlocking mass of rock in which no individual rock is free to move by itself.
- Creating a shielding effect on the surface of the rock, avoiding high drag forces which occur when individual rocks excessively protrude into the flow (hence oversized rocks are not permitted).

Rock used for beaching or in chutes shall meet the durability requirement listed in Table 8-1 when tested in accordance with the specified procedures. The Contractor shall furnish the Superintendent with a certified test report showing that the rock meets these requirements. Service records of the proposed material may also be considered by the Superintendent, in determining the acceptability of the rock.

Table 8-1. Rock Durability Requirements

Test	Requirement
Relative Density (density of dry solid rock relative to water)	Minimum of 2.5
Abrasion (Abrasive Grading A) Los Angeles Abrasion Test. (AS 1141.23)	Less than 40% loss of weight after 500 revs.

8.3 Rock Size and Thickness

The size of rock to be used for riprap or beaching shall have a D_{50} as specified on the Project Drawings. Classifications and gradations for the rock are shown in Table 4 2. The maximum stone size shall not be larger than the thickness of the designed rock layer. Neither breadth nor thickness of a single stone shall be less than one-third its length.

The rock shall be a well-graded mixture designed to ensure that all interstices between larger rocks are filled with rock of progressively smaller size. Notwithstanding the grading given in Table 8-2, the grading of the rock shall be such as to produce a blanket of interlocking rock that is devoid of significant voids and that will provide bed and bank soils with a shielding surface able to withstand high stream flows.

Table 8-2. Size Specification for Rock

Equivalent "sieve" size	Percentage (by weight) finer
2 times D_{50}	100%
D_{50}	50%
0.3 x D_{50}	10%

Note: D_{50} = median particle size. (50% of the mass shall consist of stones with an equivalent spherical diameter* equal to or larger than this dimension). *The diameter of a sphere with an equivalent volume to the individual rock.

8.4 Granular filter

A granular filter layer shall be of the nominal size indicated on the Project Drawings. Durability and other requirements shall satisfy the requirements of this specification as it relates to D_{50} graded material.

A 150mm thick granular filter layer of crushed rock shall be placed at all rock to soil interfaces. The granular filter layer shall generally be placed and compacted by machine bucket to provide an even surface.

HOLD POINT 5 – The Superintendent will inspect and approve the placement of granular filter prior to the placement of rock.

8.5 Placement of Rock Beaching

Where indicated on the drawings or directed by the Designer, the Contractor shall protect sections of stream bank with riprap or rock beaching placed in accordance with the requirements of this specification and associated drawings.

The Contractor shall use methods for handling and placement of rock that will avoid segregation of the rock size fractions.

Rock shall be carefully placed by bucket from a loader or excavator from no greater than 1.0 m above the material onto which it is to be placed. Placement of rock shall be such as to produce a blanket of interlocking rock that has no significant voids.

Voids in the blanket of rock which, in the opinion of the Superintendent, place the structural integrity of the chute at risk shall be reworked to the satisfaction of the Superintendent.

No rock shall be placed until the preparation of the site has been approved by the superintendent. Where a granular filter or geotextile is used no rock shall be placed until placement and formation of the material has been approved by the superintendent.

Stream Bank Preparation

Where stream bank protection is required by the drawings, the Contractor shall excavate or fill such that the finished surface including rock beaching matches the lines and levels shown on the drawings.

All earthworks shall be carried out in a manner that minimises the mobilisation of potential erosion products.

To achieve the required natural channel effect, the Contractor shall vary the bank slopes between the general limits shown on the Drawings.

Rock beaching on the bank is to be installed in manageable sections, wherein the rock is placed on the bank on the same day that the excavation is undertaken. At the completion of each day's work all toe excavations must be backfilled with rock beaching.

Rock Placement

The Contractor shall not place any rock until the Superintendent approves the excavations.

The rock shall be placed on the embankment to the thickness and grade shown on the drawings. The finished surface shall be evenly sloped, conforming to the contour required (the maximum angle of repose being 42 degrees). Where the drawings stipulate that variations in surface profile of the riprap are required (for the purpose of providing variable habitat conditions), the Contractor shall modify the placement process so that larger pieces of rock are placed with a portion protruding above the general riprap profile, as well as providing for some undulation in the surface profile.

The rock riprap shall be placed in a manner that will produce a well graded, interlocking mass of riprap with a minimum amount of voids.

A granular filter layer, as specified in the Project Drawings and in Section 4.2, shall be placed on the prepared sub grade.

The Contractor shall use methods for handling and placement of the rock that will avoid segregation of the rock size fractions. Rock shall be carefully placed by the bucket from a loader or excavator. Rock placing by dumping directly from a dump truck will not be permitted.

Voids in the blanket of rock that expose the subgrade shall be packed with smaller rock by suitable methods such that, in the opinion of the Superintendent, this method can produce a shielding surface of interlocking rock and the structural integrity of the rock blanket is not at risk. If, in the opinion of the Superintendent, the extent of voids in the blanket of rock is such that the structural integrity of the rock blanket is at risk, the Superintendent shall direct that that section of rockwork be reworked.

At the toe of embankments the Contractor shall key all rockwork closely so as to improve the stability of the toe against erosion as detailed in the accompanying construction drawing set.

HOLD POINT 6 – The Superintendent will inspect and approve the quality and placement of rock.

9 Soil amelioration

Specified in separate document.

10 Reinstatement of works sites and disturbed areas

The Contractor is responsible for reinstatement of the Works site and all other areas disturbed as a result of the works including access tracks.

Reinstatement may include grading or filling of areas to match adjacent undisturbed surface levels.

All such areas shall be topsoiled, ripped and revegetated in accordance with the quantities and detail design plan, this specification and approved by the superintendent. No overland flow will be concentrated over diversion batters and no areas of ponding will be left within 15m of top of diversion batters.

Where the contractor uses existing access tracks these shall be maintained throughout the Works and, at the end of the Works, be reinstated to a minimum condition that is similar to that prior to the start of Works.

HOLD POINT 7 – The Superintendent will inspect and approve the finished surface of all reinstated sites and issue a hold point release form before demobilisation can commence.

APPENDIX D
NWCD REVEGETATION MANAGEMENT PLAN

North Wambo Creek Diversion

Revegetation Management Plan

Prepared by **Cumberland Plain Seeds**
for Wambo Coal mine and Soil Conservation Service
August 2019

Authors: John Moen & Tim Berryman



Contents

Introduction..... 3

Target vegetation..... 3

Direct seeding – species selection..... 5

Seed collecting..... 6

Direct seeding methods..... 6

Mechanical broadcasting/ Hand broadcasting.....7

Hydromulching/Hydroseeding in steep or inaccessible areas 9

Placing and seeding of erosion controls.....10

Planting procedure.....11

Site monitoring and performance criteria.....12

Visual monitoring.....12

Landscape Function Analysis monitoring.....12

Floristic monitoring.....12

Trigger Action Response Plans.....14

Appendix 1. Revegetation species list.....15

Appendix 2. References.....17



Early establishment of diverse grassy woodland at Mount Thorley Mine, NSW.

Introduction

This document has been prepared in conjunction with Soil Conservation Service's North Wambo Creek Diversion Stability Assessment and Remediation Proposal. Cumberland Plain Seeds has been commissioned by Soil Conservation Service (SCS) to develop a plan for revegetation works of a section of the North Wambo Creek Diversion (NWCD). The revegetation will take place after reshaping and remediation of the Trial Section of the NWCD.

This plan proposes a method for establishing native vegetation on the site which resembles the local native plant communities close by. Performance criteria and a monitoring protocol are also included to aid in assessing the revegetation works and identifying potential problems.

Target vegetation

The North Wambo Creek diversion was initially intended to be revegetated using riparian species native to the local area. However, much of the constructed creek line has become unsuitable for riparian vegetation establishment due to changes in soil type and water flow. It would therefore be more appropriate to establish a woodland vegetation type on the majority of the creek diversion site. Some areas of the creek may remain suitable for the establishment of riparian vegetation, particularly where the creek profile will slow water flow and therefore increase the availability of moisture.

These areas will be identified once the final landform is constructed and based on data provided in hydrological reports. Revegetation in areas identified as potential habitat for riparian species should be done with a species mix which includes both riparian and woodland species. Riparian plants included in the revegetation species list are hardy species which should be able to establish in areas with limited water availability.

If riparian species prove successful in these areas they will provide important islands of riparian vegetation. These islands may in time expand as the hydrology and soil characteristics of the creek line change. A detailed revegetation species list is included in Appendix 1.

The majority of the site should be sown using a variety of direct seeding methods. Although seed costs are much higher, this method of revegetation has several advantages over tube stock planting:

- Plants growing from seed in situ develop a robust root system before devoting resources to vegetative growth, resulting in a hardier plant which can better withstand heat and drought early in the establishment phase.
- Plants grow in the niche best suited to them – seed only germinates when it encounters the right combination of soil type, depth, temperature and moisture.
- It is much easier to establish plants at high density – 10-20 plants/m2 (Trees, shrubs and herbs) is quite achievable.
- Installation and maintenance watering requirements are much lower, although irrigation is useful to assist establishment
- Labour costs for sowing are significantly lower than for planting.

Planting of tube stock in selected areas may also be appropriate. Tube stock can be useful in areas where higher water flows or steep slopes decrease soil stability and therefore the potential for seed to germinate. Tube stock may also be useful in increasing understorey species diversity once a canopy and shrub layer have been established. Planted tube stock must be given enough water to ensure survival.

Establishing native vegetation on this site presents many challenges. The soil conditions at the site are currently unknown and it is difficult to predict the behaviour of the exposed dispersive subsoil and the ability of native species to establish in such a medium. Soil amelioration will improve the quality and chance of success.

Exotic species currently present on the site pose a second challenge. Competition from exotic species, particularly perennial grasses and Galenia pubescens will potentially provide significant competition to native species.

Thirdly the prevailing climatic conditions were particularly difficult in the 3 years preceding 2019. For example 2018 rainfall totals for NSW were 40% below average, Autumn 2019 rainfall was 32% below average and Summer 2019 rainfall was 48% below average (BOM 2019).

These challenges will make it particularly important to focus on the following:

- good soil analysis and amelioration
- appropriate species selection and sourcing high quality seed
- ground preparation
- weed control both before and after sowing
- monitoring and adaptive management (see performance criteria for further details)

North Wambo Creek Diversion revegetation concept plan



Woodland
Salt tolerant vegetation
Riparian Vegetation

DigitalGlobe | Esri, HERE, Garmin

Note: This map is a concept plan only, drawn after a brief site inspection. Detailed mapping of the revegetation site will be done following re-shaping and soil amelioration.

Direct seeding – species selection

The focus of this seed mix should be on primary and secondary colonising species which can establish in harsh conditions. The conditions prevailing on the rehabilitation areas will be ones of high light, heat, relatively low moisture and potentially intense competition. The soil type does not conform to those normally supporting local vegetation communities (e.g. absence of an A horizon, exposed subsoil and bedrock).

Initial soil test results show that there are several potential problems with the soil on site. Soils vary but salinity and sodicity along with high pH appear to be the key problems. The addition of organic material in the form of mulches and composts should help both stabilise the soil, decrease pH and provide a better growing medium for natives. Salinity will be difficult to combat in the short term and the focus in areas affected by salinity should be to sow salt-tolerant species. Further soil testing may be warranted to assist in mapping soil type and matching species best suited to each situation.

Native seed require a stable niche with good soil contact and appropriate sowing depth in order to germinate. They need sufficient moisture to germinate and a gap relatively free from competition. They may also require particular soil conditions - pH, salinity, availability of certain nutrients – to establish on a given site. However, once germinated these species are usually able to cope well with heat and drought and compete effectively with many exotic plants.

Species selected for direct seeding, listed in Appendix 1, are based on their success rates in similar rehabilitation situations. Consideration is also given to the local availability of seed in direct-seeding quantities.

Once native vegetation is re-established on the site it will have characteristics of several vegetation communities identified in the Wambo Coal Mine Biodiversity Management Plan, in particular River Red Gum/ River Oak riparian woodland wetland in the Hunter Valley and Narrow-leaved Ironbark–Grey Box – spotted gum shrub grass open forest of the central and lower hunter. It is important to note that in the early stages of any rehabilitation program the young vegetation will not closely resemble that of a target vegetation community. Any vegetation assemblage colonising a bare site will be quite different in assemblage from any analogue reference site.



Native seedling establishment, Hungerford Creek NSW

Some additional species not listed in the Biodiversity Management Plan have been added to the list for direct seeding. They are all species which occur in local plant communities and may be sourced in quantities suitable for direct seeding. Most of the site will be sown with a woodland mix, and, as outlined above, riparian species will be targeted towards areas with higher water retention. Once initial vegetation is established the biodiversity can be further increased with shade tolerant species either through direct seeding or planting of tube stock.

Seed collecting

All of the plants on the revegetation seed list grow in the local area and can be harvested in varying quantities. However, each species has a different flowering and fruit ripening time and so seed collection must be the first priority if there is to be enough seed available for direct seeding. Seed will be harvested as much as possible from the Wambo Mine Conservation lands and grazing properties adjoining the creek diversion site. If more seed is required it will be harvested from the Hunter Valley area, prioritising the Wollombi Brook catchment in order to select the plant genetics best suited to the site and local conditions. If sowing is to commence in summer-autumn of 2020 then seed collection activities should start no later than September 2019 to allow sufficient time to collect as many target species as possible. This is because each species has a different flowering and seed-ripening time and often the window between seed ripening and dropping from the plant can be quite short.

It may not be possible to collect all the species on the revegetation list but as many species as possible from each of the types of vegetation should be sourced. Final seed mixes should meet or exceed diversity values as compared to target vegetation benchmark values.



Native seed blended for broadcasting

Direct seeding methods

Various methods exist for sowing native seed – e.g. broadcasting, drilling, hydroseeding. Given the size and topography of the site a combination of broadcasting and hydroseeding are considered the most appropriate. The majority of the site can be sown using broadcasting techniques but in some steep areas prone to erosion hydroseeding could be used, particularly in conjunction with hydromulch applications. These methods may be required due to lack of access for conventional seedbed preparation and the need for added stability in these zones.



Aerator preparing ground for sowing, Jerry's Plains NSW

Mechanical broadcasting/ Hand broadcasting

Seed broadcasting can be done over large areas using tractors and appropriate agricultural implements e.g. spreader, air seeder, seed blower. Small inaccessible areas can be sown by hand to good effect.

For any given area the following procedure should be followed to maximise success:

- **Soil analysis** and interpretation of results
- **Soil amelioration** according to the interpretation of soil test results and need to be matched to the requirements of the native species selected, otherwise amelioration may be counterproductive.
  - Soil ameliorants may include, amongst others, gypsum, compost, mulch or microbial inoculants
- **Cultivation**
  - Deep ripping or chisel ploughing may be required to break up compacted soil (depending on depth).
  - Cultivation will usually be required to properly incorporate soil ameliorants
  - Cultivation should be conducted in such a way as to protect the soil from erosion – i.e. rip along contours, avoid leaving wheel tracks, reduce preferential water flow channels at all times.
  - Aerators are particularly useful for providing a pattern of small pockets which limits preferential flow channels and should be used to leave such a pattern post sowing.
- **Weed Control**
  - Weed control should be timed to provide bare ground for the sowing date. Perennial weeds may require multiple spray events for effective control.
- **Final seedbed preparation**
  - A suitable seedbed will have niches available for seed to fall and be covered by soil
  - Preferential flow channels must be avoided to maintain a stable surface so that seed is not washed away during rain events
  - Soil condition should be friable so that good seed-soil contact can be made

> **Species mix selection and blending**
  - Seed mixes should be blended according to the requirements of each area. High bank mixes should be different to those used on the bank toe or in areas of potential ponding. Consideration should also be given to changes in soil chemistry and texture. The site should be mapped prior to sowing based on soil type, topography and predicted waterflows and seed blends developed for each area.

> **Sowing**
  - Seed should be sown when conditions are likely to be most favourable for germination – i.e. when soil temperatures are high and rainfall is predicted. In the Hunter Valley the best time for sowing is usually February-April in anticipation of late summer storm events.

> **Maintenance**
  - Maintenance activities should focus on competition from perennial weeds which have the highest competitive impact on native seedlings. These weeds are likely to include Chloris gayana – Rhodes Grass, Panicum maximum var. trichoglume – Green Panic, Eragrostis curvula¬– African Lovegrass, Cynodon dactylon – Couch Grass and Galenia pubescens – Galenia.
  - Annual weeds present in the soil seedbank usually emerge on freshly sown sites although they are of lower concern and should only be controlled if present in very high density and are competing too strongly with emerging natives. In many cases annual weeds provide benefits to the native plants such as protection from sun and wind, nutrient cycling and increasing soil organic matter.
  - Timely repair of any emerging erosion issues will also be important.



Ground prepared for sowing, Camden Lakeside Golf Course NSW

Hydromulching/Hydroseeding in steep or inaccessible areas

Application of seed using a hydroseeding machine either with or without mulch, soil ameliorants or soil stabilisation polymers can be useful in steep or otherwise unstable sites. The site preparation using this technique is just as important as in broadcasting. Hydromulches may provide a growth medium for native species on slopes where it is impossible to fully prepare a seed bed. However, we cannot rely solely on the mulch as a growing medium and attention must be paid to the underlying soil surface. It may be necessary to increase surface roughness and therefore niches for seed germination. Creating furrows or pockets using hand tools or machinery can significantly increase water harvesting and soil stability and therefore the success of revegetation efforts.

The same steps as above are required. See previous section for more detail as required:

> **Soil analysis** and interpretation of results

> **Soil amelioration** according to the interpretation of soil test results
- Soil ameliorants may include, amongst others, gypsum, lime, compost, mulch or microbial inoculants

> **Cultivation**
- Cultivation in areas to be hydroseeded may not be possible to the same extent because of steep slopes or inaccessible areas. Efforts should be made, however, to shape the slope topography so as to increase surface roughness and reduce soil crusting.

> **Weed Control**
- Weed control should be timed to provide bare ground for the sowing date. Perennial weeds may require multiple spray events for effective control.

> **Final seedbed preparation**
- A suitable seedbed will have niches available for seed to fall and be covered by soil
- Preferential flow channels must be avoided to maintain a stable surface so that seed is not washed away during rain events

> **Species mix selection and blending**
- Many native species are suitable for use in a hydroseeding application. The process for species selection is the same as for broadcasting.

> **Sowing**
- Seed should be sown when conditions are likely to be most favourable for germination – i.e. when soil temperatures are high and rainfall is predicted. In the Hunter Valley the best time for sowing is usually February-April in anticipation of late summer storm events.
- Seed can be sown (hydroseeded) directly onto the soil surface and then hydro mulch and other products can be applied in a second pass, or seed can be blended with mulch and applied in a single pass. Both techniques should be trialled in areas which have been identified for hydromulch application.



Natives germinated among exotic annuals

> Maintenance

- Maintenance activities should focus on competition from perennial weeds which have the highest competitive impact on native seedlings. These weeds are likely to include Chloris gayana – Rhodes Grass, Panicum maximum var. trichoglume – Green Panic, Eragrostis curvula¬– African Lovegrass, Cenchrus clandestinus – Kikuyu, Cynodon dactylon – Couch Grass and Galenia pubescens – Galenia.

- Annual weeds present in the soil seedbank usually emerge on freshly sown sites but they are of lower concern and should only be controlled if present in very high density and are competing too strongly with emerging natives. In many cases annual weeds provide benefits to the native plants such as protection from sun and wind, nutrient cycling and increasing soil organic matter.
- Timely repair of any emerging erosion issues will also be important.

Placing and seeding of erosion controls

Examples of possible sites (subject to assessment post re-shaping and hydrological assessment.

Treatment	Example locations (as per. Soil Conservation Service mapping locations)
Woodland	26
Riparian	22
Hydro-mulching/ Hydro-seeding	25, 29, 30
Salt tolerant vegetation	16
Timber and coir logs	31

Materials such as timber, coir logs, coarse mulch and jute mesh can be used to help control soil erosion and will enhance a revegetation project when increased soil stability is required. They also increase variety in a landscape, trapping moisture and other resources to provide niches for seed germination and protection for young plants. To exploit this seed can be targeted to these areas, either using a hydroseeder or hand broadcasting method. Jute matting or other geotextile fabrics are less useful in direct seeding projects because the dense weave of the mat prevents germination and emergence of seedlings. These fabrics can be used in areas to be planted with tube stock.

> **Timber and coir logs need to be pinned in place on steeper slopes.**
  - seed should be sown on the upslope side where moisture, soil and other resources will be trapped

> **Jute mesh needs to be securely pinned in place.**
  - Seed should be sown before placing the jute mesh to ensure good seed-soil contact. The seedlings can emerge through the holes in the open weave of the mesh.
  - If seed is sown over jute mesh then a top dressing of soil may be necessary to provide seed soil contact.

> **Coarse mulch will protect bare soil from rain**-splash and sheet erosion (on shallow slopes). It will increase soil organic matter and microbial activity and provide small niches for seed placement and germination. Mulch should not be spread thickly on sites to be direct seeded because it will prevent seed-soil contact and the mulch itself will not provide a suitable growing medium.

Planting procedure

> **Identify areas best suited** to use of tube stock. These areas will most likely have the following characteristics
  - Sites subject to high flow events where soil stability may be compromised
  - With relatively high water harvesting potential
  - Accessible for maintenance watering

> **Tube stock** may also be useful in introducing small numbers of high-value species designed to increase overall species diversity when insufficient seed is available for direct seeding. E.g. threatened species.

> **Soil analysis and interpretation of results**

> **Soil amelioration** according to the interpretation of soil test results
  - Soil ameliorants may include, amongst others, gypsum, compost, mulch or microbial inoculants. Fertiliser may also be useful.

> **Site preparation**
  - Deep ripping and/or surface cultivation may be necessary to reduce compaction and assist plant roots in quickly colonising the soil profile.

> **Planting**
  - Planting should be timed to avoid the hottest part of the summer and to allow plants to settle in before there is a risk of severe frost.
  - Plants should be thoroughly watered before planting to ensure a saturated root ball.
  - care should be taken to dig appropriately sized planting holes and to avoid damaging root balls.
  - Fertiliser or plant tonic such as seaweed extract can help plants recover from planting shock
  - Tree guards and mulch can help with water retention and protect young plants from predation

> **Initial watering**
  - Water plants in immediately after planting to thoroughly saturate the surrounding soil and collapse any air gaps.

> **Maintenance watering**
  - Water as required according to the climatic conditions and to take advantage of rainfall.

Site monitoring and performance criteria

Works planned for 2019 may be monitored and assessed against the following criteria, which are based on those found in the Wambo Mine Biodiversity Management Plan (BMP). Because of the trial nature of these works there may be a need to amend these criteria based on field observations and analysis of monitoring data following the works.

Visual monitoring

Wandering transects should be conducted across the whole site in accordance with visual monitoring specified in the BMP. Observations should include:

- General site condition
- Presence of threatening weeds
- Rate of native establishment
- Soil surface condition and erosion
- Evidence of plant nutrition or toxicity problems
- Evidence of feral animals
- Disturbance from land management and other activities

Landscape Function Analysis monitoring

Landscape Function Analysis (LFA) should be used as specified in the Wambo Mine Biodiversity Management Plan. LFA transects should be established at several locations along the creek diversion. LFA indices of Landscape Organisation (LOI), Stability (SI), Soil Infiltration (INFI) and Nutrient Cycling (NI) should be tracked over time and against reference site scores. All indices should increase over time until they meet or exceed the reference site scores.
Target scores as defined in the Wambo Mine BMP are as follows:

LOI	SI	INFI	NI
> 0.84	> 62	> 41	> 37

These target scores should be verified against data collected from reference sites at the same time as revegetation site monitoring. This will assist in interpreting results and accounting for variations in scores due to climatic factors and differences in field observation.

Floristic monitoring

Monitoring should be conducted at several locations along the creek diversion. Several monitoring locations will be necessary to correctly characterise the vegetation performance.

Wambo BMP specified Vegetation Assessment method is BioMetric (OEH 2016). This method was developed for assessing established vegetation and it is difficult to assess the characteristics of early-stage rehab using only this methodology. So that potential problems and early success in vegetation establishment can be identified it would be useful to include a series of 1x1m quadrats along the monitoring transects specified in the BMP in addition to the BioMetric sampling.

In the early stages the focus should be on maintaining a high level of ground cover, both as live plants and litter. Perennial plant cover will provide the best protection for soil but in the early stages at least, and potentially for many years post sowing the low productivity at this site may mean that perennial vegetation cover will be limited. Increased soil and landscape stability could be achieved using coarse woody debris and other litter to protect against erosion, increase infiltration and provide habitat for micro and macro-organisms.
The following table outlines performance measures as tracked against benchmark value targets. Benchmark values (targets) are based on combination of Benchmark Values for River Red Gum/ River Oak riparian woodland wetland in the Hunter Valley and Narrow-leaved Ironbark– Grey Box – spotted gum shrub grass open forest of the central and lower hunter.

In addition to using the Benchmark values an additional measure should be added for the first 2-3 years post sowing: Plants/m2 as measured by sampling 1x1m quadrats along a transect. This measurement will better quantify the native ground cover in the early stages of rehabilitation (i.e. when plants will be very small and will not contribute much to the %cover scores, even when numerous) and will assist in identifying potential issues with native plant recruitment.

Exotic plant cover should be measured both for total EPC and for total threatening weed cover (Rhodes Grass, Galenia, Green panic, Kikuyu, Couch, African Lovegrass).
Floristic performance measures vs target ecological community benchmark values.

Floristic performance measures vs target ecological community benchmark values			
Measure	Benchmark ranges	Recommended (years 1-2) Following years should show further improvement towards benchmark values.	Recommended 5-25 years all measures tracking towards benchmark values. Native ground cover scores should be maintained at 30-60%, assuming shrub and canopy layer values are tracking well.
NPS	Native plant species richness	38-41	
NOS – Native Overstorey Cover	10-50%	0-5%	
NMS – Native - Cover	10-50%	5%	
NGCG – Native Ground Cover - Grass	30-60%	20-40%	
NGCS – Native Ground Cover - shrub	5-10%	5-20%	
NGCO – Native Ground cover - Other	20-40%	10-20%	
EPC – Exotic plant cover	<10% 1.	<30%	
OR – Proportion of overstorey spp. regenerating	1	N/A	
HBT – Hollow bearing trees (in quadrat)	0.1-1	N/A	
FL – Fallen logs (length in quadrat)	10-35	N/A	
Additional measures			
Native plants / m2	N/A	15-20 2.	5-10
EPC for threatening weeds	<5%	<20%	<5%

1. Exotic annuals will often increase the EPC score at times but this is usually a temporary problem. The focus of this measure should be on exotic perennial weeds.
2. This measure is not expected to increase after the first 2 years as individual plants should increase in size. Further it will probably decline over time as mature plants won't be supported at this density in a dry climate.





Native grasses and herbs established. Camden Lakeside Golf Course

Trigger Action Response Plans

The trigger action response plan listed in the Wambo Mine BMP is quite appropriate for setting the trigger levels for this project. Please refer to the BMP for further details. There are some minor changes that are recommended.

In the BioMetric Assessment section (Section 5.1 of the BMP) actions are triggered when some of the floristic attributes are above the target ranges. For example a Native Ground Cover – Grasses (NCGC) score above 150% of the target range requires action. In the first 2-5 years of vegetation establishment a NCGC of 150% of the target (Benchmark 30-60% cover) would be a good result, provided that grasses were not excluding tree and shrub species. The same would be the case for the other ground cover scores. Colonising grasses and saltbushes often dominate in newly rehabilitated land, and as long as trees, shrubs and herbs have also managed to germinate, these species will tend to decline in cover over time.

Tree and shrub cover at too high a density is more of a problem, as dense woody vegetation tends to exclude ground cover species in rehab situations due to light interception and competition for moisture. This can lead to a loss of grassy woodland cover and diversity and bare soil patches which are then prone to erosion. In such cases it may be necessary to thin the vegetation to maintain a suitable ground cover.

Any management actions identified by the Trigger Action Response Plan process should be based on careful assessment of the data gathered in the monitoring program.

Appendix 1. Revegetation species list

Trees			Available in CPS seedbank
Angophora	floribunda	riparian	
Casuarina	glauca	riparian	
Casuarina	cunninghamiana	riparian	Yes
Corymbia	maculata	woodland	
Eucalyptus	tereticornis	riparian/ woodland	Yes
Eucalyptus	dawsonii	woodland	
Eucalyptus	moluccana	woodland	Yes
Eucalyptus	crebra	woodland	Yes
Eucalyptus	melliodora	woodland	Yes
Eucalyptus	fibrosa	woodland	
Shrubs/small trees			
Acacia	decora	woodland	Yes
Acacia	decurrens	woodland	
Acacia	falcata	woodland	Yes
Acacia	filicifolia	woodland	
Acacia	implexa	woodland	Yes
Acacia	leiocalyx	woodland	
Acacia	salicina	woodland	
Acacia	amblygona	woodland	
Acacia	cultriformis	woodland	
Allocasuarina	littoralis	woodland	
Allocasuarina	leuhmanii	woodland	
Bursaria	spinosa	woodland	Yes
Cassinia	quinquefaria	woodland	
Indigofera	australis	woodland	Yes
Melaleuca	decora	riparian / woodland	
Melaleuca	linariifolia	riparian	Yes
Notolaea	microcarpa	woodland	Yes
Grasses			
Aristida	ramosa	woodland	Yes
Austrodanthonia	spp.	woodland	Yes
Austrostipa	ramosissisma	riparian / woodland	
Austrostipa	scabra	woodland	Yes
Grasses			

Bothriochloa	decipiens	woodland	Yes
Capillipedium	spicigerum	riparian / woodland	
Chloris	truncata	woodland	Yes
Chloris	ventricosa	woodland	Yes
Cymbopogon	refractus	woodland	Yes
Dichanthium	sericeum	woodland	Yes
Digitaria	divaricatissima	woodland	Yes
Digitaria	brownii	woodland	Yes
Microlaena	stipoides	riparian / woodland	Yes
Paspalidium	brevifolium	woodland	Yes
Poa	sieberiana	riparian / woodland	Yes
Themeda	triandra	woodland	Yes
Sedges			
Carex	apressa	riparian	Yes
Cyperus	exaltatus	riparian	Yes
Gahnia	aspera	riparian/ woodland	Yes
Juncus	usitatus	riparian	Yes
Juncus	subsecundus	riparian	
Juncus	subglaucus	riparian	
Juncus	prismatocarpus	riparian	
Lomandra	longifolia	riparian	Yes
Herbs/ Saltbushes			
Atriplex	semibaccata	woodland	Yes
Calotis	lappulacea	woodland	Yes
Calotis	cuneifolia	woodland	
Einadia	trigonos	woodland	
Einadia	hastata	woodland	Yes
Einadia	polygonoides	woodland	
Enchylaena	tomentosa	woodland	
Glycine	tabacina	woodland	
Glycine	clandestina	woodland	
Hardenbergia	violacea	woodland	Yes
Persicarea	decipiens	riparian	Yes
Vittadinia	cuneata	woodland	
Vittadinia	sulcata	woodland	

Appendix 2. References

Wambo Coal Mine Biodiversity Management Plan, 2018, Peabody Energy
Surface Water Technical Report for South Bates Undergound Mine Extraction Plan (Longwalls 11 to 16) 2016, Alluvium.

www.bom.gov.au/ 2019 Bureau of Meteorology.

http://plantnet.rbgsyd.nsw.gov.au/ 2019, NSW Herbarium

https://avh.ala.org.au/occurrences/search, 2019, Australasian Virtual Herbarium

10. Appendix B – Soil Tests

Department of Primary Industries

Biosecurity Laboratory Operations
Environmental Laboratory
1243 Bruxner Highway, WOLLONGBAR NSW 2477
Phone: 02 6626 1103 Email: wollongbar.csu@dpi.nsw.gov.au

Report No. **WN190709**

Taresa Hateley
Soil Conservation Service
709 Gundy Road
SCONE NSW 2337

Soil Analysis Report

4 sample(s) of soil received on 18/07/19. Tested as per the following methods.
Testing commenced 18/07/19

Method	Method Description
S202	Soil Electrical Conductivity
S201	Soil pH in 1:5 water or 1:5 $CaCl_2$ suspension
S262	Colwell, Bicarbonate Extractable Phosphorus in soil by FIA
S273	Gillman & Sumpter Exchangeable Cations

** Where shown, indicates NATA accreditation does not cover the performance of this service.

Results relate only to the items tested.
Notes: As requested, testing for physical anlalysis will be performed by SESL.

- When required, samples air dried at 40ºC as per Soil Chemical Methods - Australasia (Rayment and Lyons 2011).
- Results are expressed on an air-dry weight basis unless otherwise stated.
- Physical soil testing results are calculated on 105ºC dry weight.
- This report should not be reproduced except in full.
- Samples will be retained for one calendar month from the date of the final report. Samples will then be discarded.
- Clients wishing to recover their samples must contact the laboratory within this period. This laboratory will return residual samples at client expense.

Date of issue 31/07/19

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025 – Testing
Accreditation No. 14173

ASPAC

Approved for Release by: Craig Hunt
Craig Hunt
Technical Officer

Laboratory No. **Client's ID**	**Units**	**Limit of Reporting**	**1** **SS.1 0-20**	**2** **SS.1 20-60**	**3** **SS.2 0-60**	**4** **SS.3 0-30**
Miscellaneous Analysis						
Electrical Conductivity	dS/m	0.0010	0.056	0.26	0.74	0.36
pH (Water)	pH units	0.04	6.3	7.5	8.3	8.9
pH ($CaCl_2$)	pH units	0.04	5.4	6.6	7.0	8.0
Colwell Phosphorus	mg/kg	2.0	6.2	6.2	7.5	9.1
Exchangeable Cations						
Aluminium	cmol(+)/kg	0.10	<0.1	<0.1	<0.1	<0.1
Calcium	cmol(+)/kg	0.030	5.6	3.3	1.6	1.1
Potassium	cmol(+)/kg	0.010	0.62	0.82	0.70	0.56
Magnesium	cmol(+)/kg	0.0070	2.3	4.7	4.4	3.5
Sodium	cmol(+)/kg	0.030	0.39	2.4	5.1	1.6
CEC (effective)	cmol(+)/kg	0.20	8.9	11	12	6.7
Calcium/ Magnesium			2.5	0.70	0.37	0.31
Percent Aluminium Saturation	% of ECEC		N/A	N/A	N/A	N/A
Exchangeable Calcium	% of ECEC		63	29	14	16
Exchangeable Potassium	% of ECEC		6.9	7.3	5.9	8.4
Exchangeable Magnesium	% of ECEC		26	42	37	51
Exchangeable Sodium Percentage	% of ECEC		4.4	22	43	24

Clay Content Assessment

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120

Mailing Address: PO Box 357
Pennant Hills NSW 1715

Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Client Name: **NSW Department of Primary Industries (NSW DPI)**
Client Contact: **Amanda Musgrave**
Client Order N°:
Address: **1243 Bruxner Highway Wollongbar NSW 2477**

Project Name: **WN190709**
SESL Quote N°: **Q10056**
Sample Name: **WN190709-1**
Description: **Soil**
Test Type: **Texture_SESL, EAT, PSA_SC, Disp_PER, USCS_SESL**

Batch N°	Sample N°	Sample Name	Description	Clay Content (%)
53734	1	WN190709-1	Soil	5.34
53734	2	WN190709-2	Soil	21.01
53734	3	WN190709-3	Soil	13.83

SUMMARY AND RECOMMENDATIONS

Analysed by SESL Australia Pty Ltd, NATA # 15633
Recommendations by SESL Australia not requested.

Consultant: Michelle Murphy

Authorised Signatory: Michelle Murphy

Report Status:
Final

Date Report Generated
7/08/2019

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Method Reference: SESL In house, PM0001

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Batch N°: 53734 **Sample N°: 1** **Date Instructions Received: 31/7/19** **Report Status: Final**

Client Name: **NSW Department of Primary Industries (NSW DPI)**
Client Contact: **Amanda Musgrave**
Client Order N°:
Address: **1243 Bruxner Highway**
Wollongbar NSW 2477

Project Name: **WN190709**
SESL Quote N°: **Q10056**
Sample Name: **WN190709-1**
Description: **Soil**
Test Type: **Texture_SESL, EAT, PSA_SC, Disp_PER, USCS_SESL**

Analysis	Unit	Result
Texture	--	Sandy loam
Emerson Aggregate Class (EAT)	--	Class 8
Clay Dispersion	%	SW - Well graded clean sands (<5% fines), gravelly sands, little or no fines.
USCS	--	5.56

Analysed by SESL Australia Pty Ltd, NATA # 15633
Recommendations by SESL Australia not requested.

Consultant: Michelle Murphy

Authorised Signatory: Michelle Murphy

Date Report Generated
7/08/2019

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Batch N°: 53734 **Sample N°: 2** **Date Instructions Received: 31/7/19** **Report Status: Final**

Client Name: **NSW Department of Primary Industries (NSW DPI)**
Client Contact: **Amanda Musgrave**
Client Order N°:
Address: **1243 Bruxner Highway**
Wollongbar NSW 2477

Project Name: **WN190709**
SESL Quote N°: **Q10056**
Sample Name: **WN190709-2**
Description: **Soil**
Test Type: **Texture_SESL, EAT, PSA_SC, Disp_PER, USCS_SESL**

Analysis	Unit	Result
Texture	--	Sandy loam
Emerson Aggregate Class (EAT)	--	Class 5
Clay Dispersion	%	SC - Sands with fines, (>12%); clayey sands, sand-clay mixtures.
USCS	--	59.9

Consultant: Murphy
Michelle Murphy

Authorised Signatory: Murphy
Michelle Murphy

Date Report Generated
7/08/2019

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Batch N°: 53734 **Sample N°: 3** **Date Instructions Received: 31/7/19** **Report Status: Final**

Client Name: **NSW Department of Primary Industries (NSW DPI)**
Client Contact: **Amanda Musgrave**
Client Order N°:
Address: **1243 Bruxner Highway**
Wollongbar NSW 2477

Project Name: **WN190709**
SESL Quote N°: **Q10056**
Sample Name: **WN190709-3**
Description: **Soil**
Test Type: **Texture_SESL, EAT, PSA_SC, Disp_PER, USCS_SESL**

Analysis	Unit	Result
Texture	--	Sandy loam
Emerson Aggregate Class (EAT)	--	Class 5
Clay Dispersion	%	SC - Sands with fines, (>12%); clayey sands, sand-clay mixtures.
USCS	--	44.3

Consultant: Murphy
Michelle Murphy

Authorised Signatory: Murphy
Michelle Murphy

Date Report Generated
7/08/2019

SESL AUSTRALIA
Environment & Soil Sciences

Multiple Analysis Profile

Sample Drop Off: 16 Chilvers Road
Thornleigh NSW 2120
Tel: 1300 30 40 80
Fax: 1300 64 46 89

Mailing Address: PO Box 357
Pennant Hills NSW 1715
Em: info@sesl.com.au
Web: www.sesl.com.au

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

Batch N°: 53734 **Sample N°: 4** **Date Instructions Received: 31/7/19** **Report Status: Final**

Client Name: **NSW Department of Primary Industries (NSW DPI)**
Client Contact: **Amanda Musgrave**
Client Order N°:
Address: **1243 Bruxner Highway Wollongbar NSW 2477**

Project Name: **WN190709**
SESL Quote N°: **Q10056**
Sample Name: **WN190709-4**
Description: **Soil**
Test Type: **Texture_SESL, EAT**

Analysis	Unit	Result
Texture	--	Sandy loam
Emerson Aggregate Class (EAT)	--	Class 5

Consultant: Michelle Murphy

Authorised Signatory: Michelle Murphy

Date Report Generated 7/08/2019

APPENDIX E
NORTH WAMBO CREEK SUBSIDENCE STRATEGY

WAMBO COAL
NORTH WAMBO CREEK DIVERSION SUBSIDENCE RESPONSE STRATEGY – SBU AND SBU EXTENSION MINE

Document No. WA-ENV-MNP-509.7
March 2018

Document Control

Document No.	WA-ENV-MNP-509.7
Title	North Wambo Creek Diversion Subsidence Response Strategy – SBU Mine
General Description	Responses to potential subsidence impacts on North Wambo Creek Diversion
Document Owner	Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked	Signature
1	May 2016	Updated for SBU LW11-LW13	WCPL	SP	
2	July 2017	Revised to address DPE comments and incorporate LW14-16	WCPL		
3	March 2018	Revised following MOD17 approval for SBUEx (Longwalls 17-25)	WCPL		

CONTENTS

1.0 INTRODUCTION....4

1.1 BACKGROUND....4

1.2 OVERVIEW OF PREDICTED IMPACTS - NORTH WAMBO CREEK DIVERSION..5

1.3 PURPOSE....5

1.4 SCOPE....6

2.0 MANAGEMENT STRATEGIES....10

2.1 MONITORING....10

2.2 MANAGEMENT RESPONSES....11

2.3 NWCD TRIGGER ACTION RESPONSE PLAN....12

3.0 MONITORING AND REPORTING....14

3.1 MONITORING....14

3.2 REPORTING....14

4.0 AUDIT/REVIEW....14

5.0 RESPONSIBILITIES....14

6.0 REFERENCES....15

Tables

Table 1 Monitoring Program for NWCD....10

Table 2 Management Response Strategies for NWCD....11

Table 3 NWCD Trigger Action Response Plan....13

Table 4: NWCSRS Responsibilities....15

Figures

Figure 1: Wambo Coal Regional Location....7

Figure 2 – Location of SBU LW11 to LW16 and SBUE LW17 to LW25....8

Figure 3 – Location of SBU LW11 to LW16, LW17 to 20 and NWCD....9

LIST OF ATTACHMENTS

Attachment A *Water Management Plan – South Bates (Whybrow Seam) Underground Mine Longwalls 11-16*

1.0 Introduction

1.1 Background

The Wambo Coal Mine (the Mine) is situated approximately 15 kilometres west of Singleton, near the village of Warkworth, New South Wales (**Figure 1**). The Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

The South Bates (Whybrow Seam) Underground Mine is a component of the approved Wambo Coal Mine. The South Bates (Whybrow Seam) Underground Mine commenced in February 2016 and involves extraction of coal by longwall mining methods from the Whybrow Seam within Coal Lease (CL) 397 and Mining Lease (ML) 1594 (**Figure 2**).

The potential environmental impacts of the existing Wambo Coal Mine (including the approved South Bates [Whybrow Seam] Underground Mine) were assessed in the Wambo Development Project Environmental Impact Statement (the Wambo Development Project EIS) (WCPL, 2003). Development Consent DA 305-7-2003 for the Wambo Coal Mine was granted on 4 February 2004 by the then NSW Minister for Urban Affairs and Planning under Part 4 of the *NSW Environmental Planning and Assessment Act, 1979*.

An application to modify the Development Consent (DA 305-7-2003 MOD 15) was lodged in July 2015 to allow an extension to the South Bates Underground Mine to include three additional longwalls (Longwalls 14 to 16) in the Wambo Seam and was approved on 10 November 2015. The application was accompanied by the South Bates (Wambo Seam) Underground Mine Modification Environmental Assessment (WCPL, 2015).

Underground mining at North Wambo Underground Mine commenced in 2005 was completed in early 2016 with the completion of Longwall 8b. Underground mining operations moved to South Bates (Whybrow Seam) Underground Mine with the commencement of Longwalls 11 to 16 (approved as part of the Development Consent DA 305-7-2003).

The SBU Mine has an Extraction Plan for LW11 to LW16 (the Extraction Plan) that outlines the proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences from the secondary extraction of Longwalls 11 to 16 at the South Bates Underground Mine in the Whybrow and Wambo Seams.

In December 2017, the DP&E granted approval for Wambo Coal Mine to conduct secondary extraction of nine additional longwall panels (LW17 to LW25) in the Whybrow Seam of the South Bates Underground Extension (SBUE) area (DA 305-7-2003 MOD 17). An Extraction Plan is currently being prepared for longwall panels 17 to 20. The Extraction Plan will outline proposed management, mitigation, monitoring and reporting of potential subsidence impacts and environmental consequences.

1.2 Overview of Predicted Impacts - North Wambo Creek Diversion

Potential environmental consequences to the North Wambo Creek Diversion (NWCD)[1] above the Longwalls 11 to 16 from the Extraction Plan, include:

- In-channel ponding up to 1.4 metres (m) deep and up to 250 m long;
- Potential for increased scour (and associated suspended solids) prior to the implementation of scour protection works; and
- Potential for increased leakage from the North Wambo Creek Diversion prior to crack remediation works.

HydroSimulations (2015) estimates that increased leakage from the North Wambo Creek Diversion to the underground workings could be in the order of approximately 12.5 megalitres per day (ML/day) prior to remediation during periods of flow. Advisian notes that flows in excess of 10 ML/day can be expected on approximately 22 days per year, comprising events of 2 to 3 days duration.

An additional 120 m of the NWCD will be directly undermined by the SBUE area longwalls. Subsidence from mining is predicted to impact a small section of the NWCD in the north-eastern corner of Longwall 17 (refer to Figure 2), where a shallow pool estimated to be 0.1 m deep and 25 m long is predicted to form. Pools are an existing feature of the NWCD and therefore the small pool that is predicted to form as a result of mining of Longwall 17 is proposed to be retained and would possibly contribute to the local ecology of the area in the future. The adjoining floodplain near the upstream edge of the pool is the area most vulnerable to scour. Cracking of the surface soil and underlying rock is predicted (Advisian, 2016). Subsidence impacts are predicted to be similar to those observed at the adjacent Longwalls 11 to 16 (Resource Strategies, 2017).

Management and remediation measures to mitigate the risk of scour and leakage associated with Longwalls 11 to 16 are outlined in **Section 2**. Additional measures are currently being developed for the Extraction Plan for Longwalls 17 to 20. Following approval of this document, relevant measures will be included in the next revision the North Wambo Creek Subsidence Response Strategy (NWCSRS).

1.3 Purpose

The purpose of this revised NWCSRS is to provide monitoring and management response strategies as a result of subsidence impacts on the NWCD (**Figure 3**) from the subsequent underground mining operations at SBU for LW11 to LW16 and SBUE area LW17-20.

[1] North Wambo Creek has now been completely diverted around the active Bates South Open Cut Pit. The creek diversion is located adjacent to the finishing (i.e. north-eastern) ends of the proposed South Bates (Wambo Seam) Underground Mine Longwalls 14 to 16 (WMLW14 to WMLW16) and is partially located above the three longwalls in the Whybrow Seam, now referred to as WYLW11 to WYLW13 at the South Bates (Whybrow Seam) Underground Mine.

1.4 Scope

The NWCSRS applies to all WCPL employees, contractors and sub-contractors, undertaking activities within the vicinity of North Wambo Creek Diversion, within WCPL's mining authorisations and approved mining areas. The North Wambo Creek Diversion is located adjacent to the proposed LW11 to LW16 and LW17 to LW20 as shown in **Figure 3**.

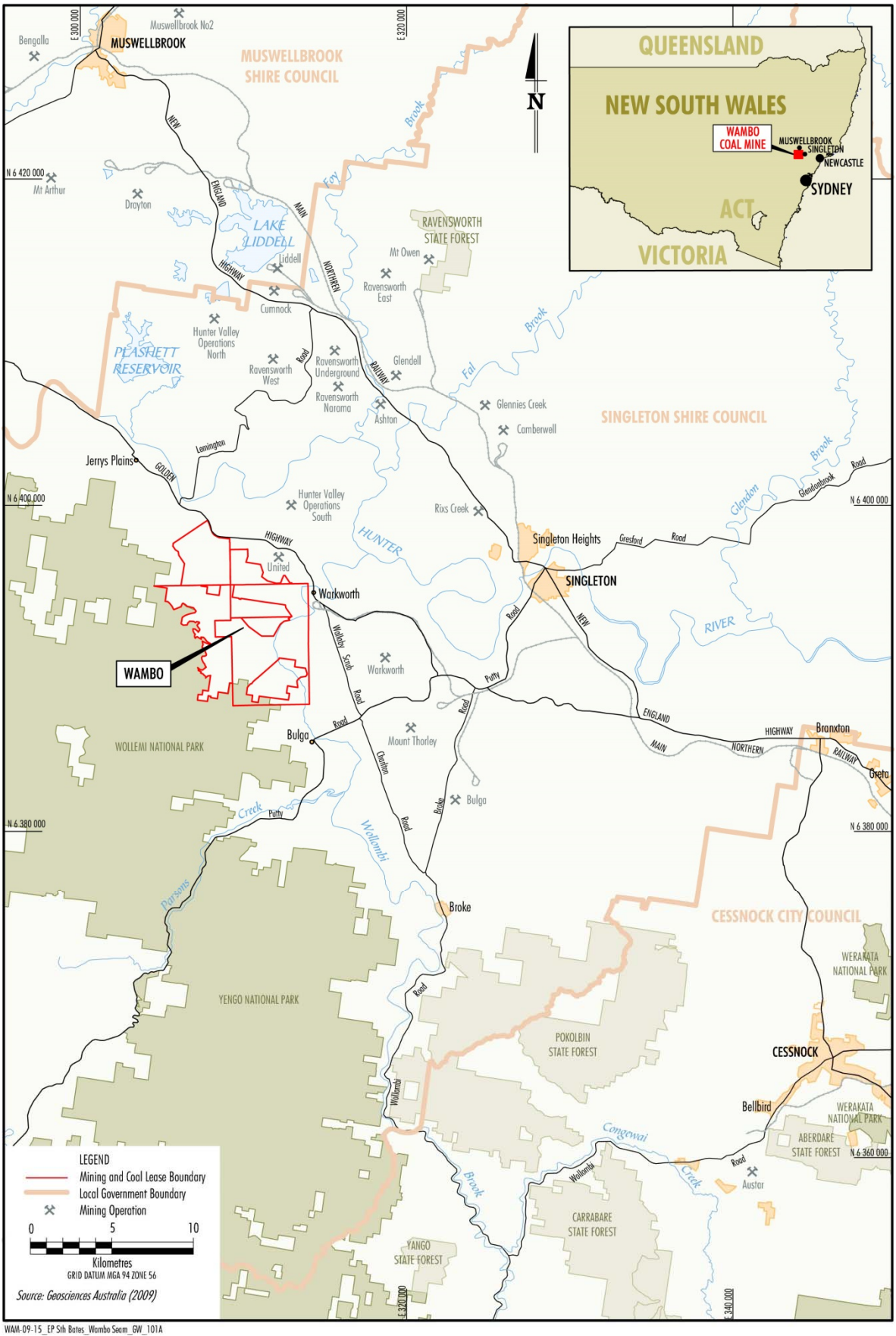


Figure 1: Wambo Coal Regional Location

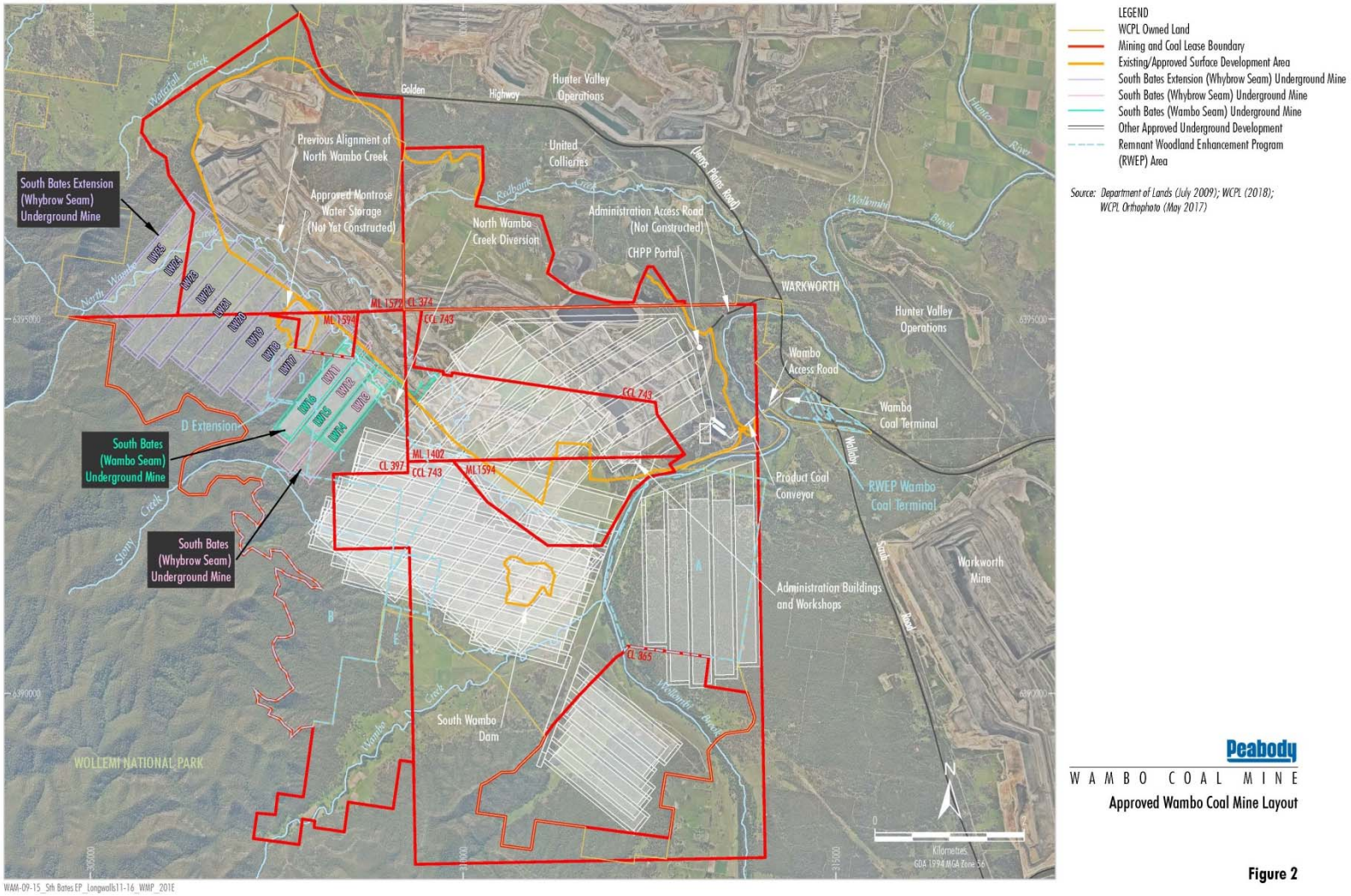


Figure 2 – Location of SBU LW11 to LW16 and SBUE LW17 to LW25

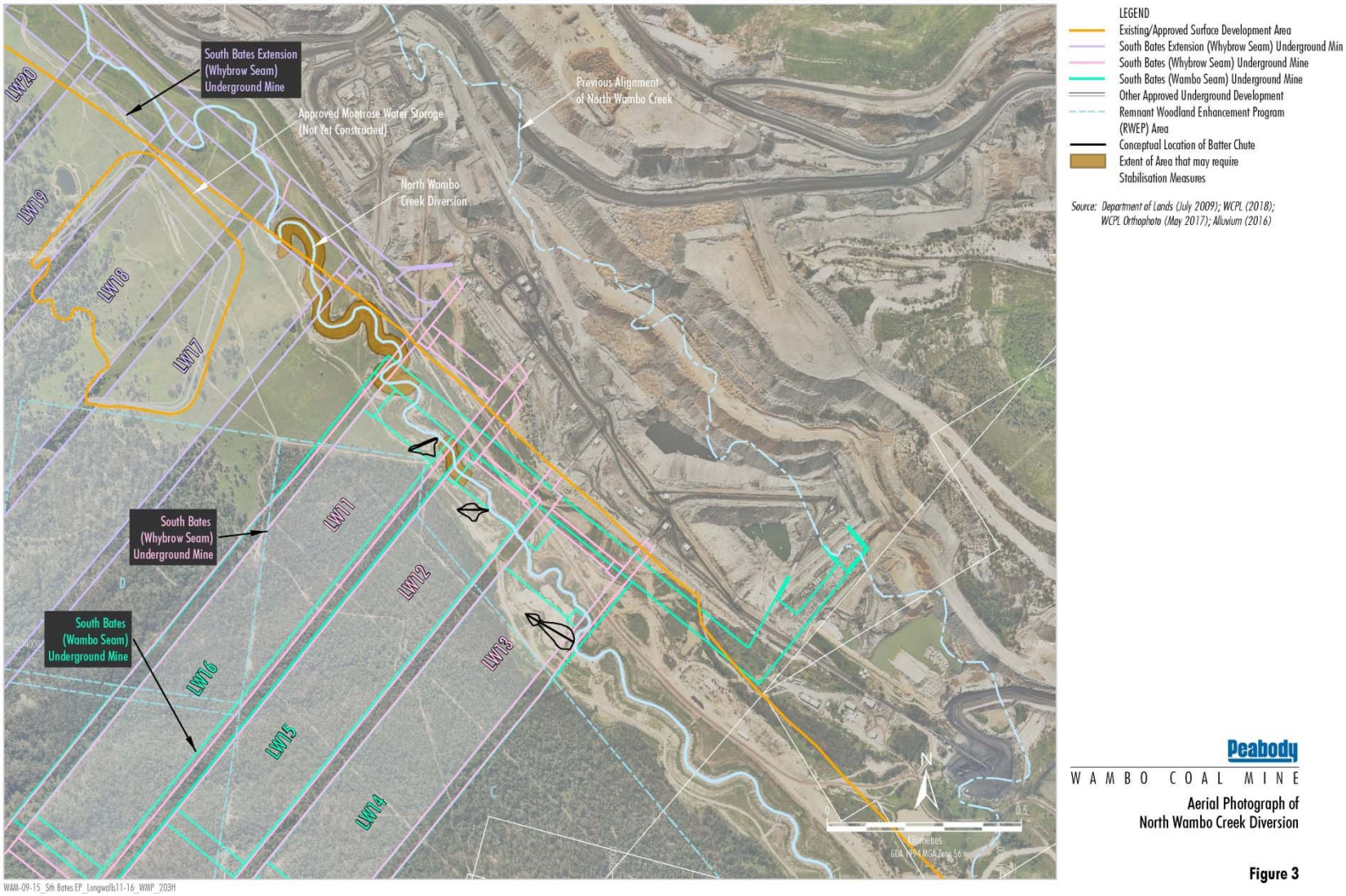


Figure 3 – Location of SBU LW11 to LW16, SBUE LW17 to LW20 and NWCD

2.0 Management Strategies

2.1 Monitoring

The monitoring strategies to identify the proposed impacts within the NWCD as described in **Section 1** (from the Extraction) are detailed and summarised in **Table 1**.

Table 1 Monitoring Program for NWCD

Monitoring Component	Parameter	Timing/Frequency	Responsibility
Pre-Mining			
Bed and bank stability monitoring of North Wambo Creek Diversion and Stony Creek.	In accordance with the SWMP.	In accordance with the SWMP.	Environment and Community Manager
Monitoring of surface water quality and flow monitoring sites (SW04, SW27a, SW08, FM2, FM3).	In accordance with the SWMP.	In accordance with the SWMP.	Environment and Community Manager
Monitoring of groundwater sites (GW21, N2, N3).	In accordance with the GWMP.	In accordance with the GWMP.	Environment and Community Manager
During Mining			
Longwalls 11 to 16 and LW17 to LW25 subsidence monitoring lines as described in the Subsidence Monitoring Program.	Monitoring parameters include: • subsidence; • tilt; • tensile strain; • compressive strain; and • absolute horizontal translation.	Monitoring during secondary extraction of Longwalls 11 to 16 and LW17, in accordance with the Subsidence Monitoring Program.	Mine Surveyor
Diversion and subsidence monitoring program.	As outlined in the SWMP.	In accordance with the SWMP.	Environment and Community Manager
Visual inspection of the North Wambo Creek Diversion.	Surface cracks. Surface ponding.	Daily inspections when extraction is occurring directly beneath North Wambo Creek Diversion.	Environment and Community Manager
Visual inspection of drainage line flow paths.	Evidence of erosion or channelisation.	Following a rainfall event of greater than 40 mm in 24 hours.[1]	Environment and Community Manager
Bed and bank stability monitoring of Stony Creek.	In accordance with the SWMP.	In accordance with the SWMP.	Environment and Community Manager
Monitoring of surface water quality and flow monitoring sites (SW04, SW27a, SW08, FM2, FM3).	In accordance with the SWMP.	In accordance with the SWMP.	Environment and Community Manager
Monitoring of groundwater sites (GW21, N2, N3).	In accordance with the GWMP.	In accordance with the GWMP.	Environment and Community Manager
Inflows to underground workings.	Dewatering volumes and underground water levels in accordance with the GWMP.	Recorded on a daily basis during pumping.	Environment and Community Manager

2.2 Management Responses

The management response strategies to address the proposed impacts within the NWCD as described in **Section 1** (from the Extraction Plan) are detailed and summarised in **Table 2**.

Table 2 Management Response Strategies for NWCD

Management Measure	Timing/Frequency	Responsibility
Pre-Mining		
Stockpile sufficient materials and make equipment and necessary resources available for: • sealing any surface cracks (particularly in areas that are predicted to be ponded); and • installation of scour protection works.	Prior to commencement of secondary extraction of Longwalls 11 to 16 and 17 to 25.	Environment and Community Manager
Management Measure	Timing/Frequency	Responsibility
During Mining		
Remediation of all visible surface cracks in the North Wambo Creek Diversion low flow channel as soon as practicable. Cracks would be infilled with alluvial/colluvial material that may be blended with bentonite to achieve a level of seal consistent with the surrounding host material.	As soon as practicable following observation (nominally within two weeks).	Environment and Community Manager
Remediation of surface cracks[1] in areas outside the North Wambo Creek Diversion low flow channel where practicable using conventional earthmoving equipment (e.g. a backhoe) including: • infilling of surface cracks with soil or other suitable materials; or • locally re-grading and re-compacting the surface.	When required during secondary extraction of Longwalls 11 to 16 and 17 to 25.	Environment and Community Manager
Review of areas that may be vulnerable to scour along the North Wambo Creek Diversion (as shown on Figure 3) and installation of appropriate scour protection (e.g. vegetation planting, placement of woody debris, localised rock armouring).	The timing for installation of scour protection is currently being reviewed in consultation with external consultant.	Environment and Community Manager
Construction of new batter chutes to manage concentrated overland flow entry to the North Wambo Creek Diversion (see conceptual locations on Figure 3).	The timing for construction is currently being reviewed in consultation with external consultant.	Environment and Community Manager
Stabilisation of any areas of surface cracking or erosion using erosion protection measures (e.g. vegetation planting).	When required during secondary extraction of Longwalls 11 to 16 and 17 to 25.	Environment and Community Manager
Review of remediation measures and implementation of additional measures if required, in accordance with the TARP (Attachment 1).	Ongoing during mining.	Environment and Community Manager

Table 2 Management Response Strategies for NWCD (cont..)

Post-Mining		
Review of remediation measures and implementation of additional measures if required, in accordance with the TARP (**Attachment 1**).	Following completion of secondary extraction of Longwalls 11 to 16 and 17 to 25.	Environment and Community Manager
Post-subsidence assessment of impacts to Stony Creek and drainage lines and implementation of any minor remedial works.	Following completion of secondary extraction of Longwalls 11 to 16 and 17 to 25.	Environment and Community Manager

Notes: [1]

- Minor cracks that develop are not expected to require remediation as geomorphic processes will result in natural filling of these cracks over time;
- Remediate surface cracks as required by the MOP i.e.:
  - No subsidence surface cracks remaining that present a risk to the environment, safety and the final land use objectives; and/or
  - Remediation of surface cracks >50 mm.
- Remediation of surface cracks, where practicable using conventional earthmoving equipment (e.g. a backhoe) including:
  - Infilling of surface cracks with soil or other suitable materials; and
  - Locally re-grading and re-compacting the surface.
- Ensure sufficient stockpiles of suitable material (i.e. sandy-silt and/or alluvium material that has been confirmed by soil specialist) have been either placed or identified within the vicinity of the NCWD prior to longwall within the NWCD;
- Ensure equipment and necessary resources available for remediation prior to longwall within the NWCD;
- Whilst the methods of remediation would not be expected to change, infilling the larger surface cracking with cohesive materials and by regrading and re-compacting the surface soils; and
- WCPL will consider the addition of bentonite to the alluvial material used in crack remediation in the low flow channel (i.e. where the bedrock is exposed) based on geotechnical advice. The addition of bentonite could be beneficial due to its ultra fine particle size, expansive and sealing properties and could assist with the natural process of capturing fines. If required, a percentage of bentonite will be blended with the alluvial material where required to supplement its fines content to achieve a level of seal consistent with the surrounding host material.

2.3 NWCD Trigger Action Response Plan

A trigger action response plan (TARP) (**Table 3**) from the Extraction Plan has been developed if additional remediation measures and responses are required. **NOTE:** This TARP must be read in conjunction with the approved *Water Management Plan – South Bates (Whybrow Seam) Underground Mine Longwalls 11-16* (**Appendix 1**). Table 3 will be reviewed following the approval of the Extraction Plan for LW17 to LW20.

Table 3 NWCD Trigger Action Response Plan

Condition	Normal	Level 1	Level 2
	Normal Conditions	**Management Measures**	**Restoration/Contingency Phase**
Trigger	• No visible cracks along North Wambo Creek Diversion. • Dewatering volumes and underground water levels at normal conditions and not significantly influenced by climatic conditions. • Predicted impacts on other surface water and groundwater as described in **Section 3**.	• Cracks observed along North Wambo Creek Diversion. • Dewatering volumes and underground water levels are elevated and responding significantly to climatic conditions. • Impacts requiring remediation observed on Stony Creek or other ephemeral drainage lines/overland flow paths. • Groundwater or surface water impacts greater than expected.	• Functionality of North Wambo Creek Diversion materially affected. • Dewatering volumes and underground water levels continue to respond significantly to climatic conditions following remediation. • The Wollombi Brook performance measure has been exceeded, or is likely to be exceeded.
Action	• Conduct monitoring, consistent with **Tables 4 and 7**, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan). • Assess the environmental consequences of the subsidence in accordance with **Section 6** and the SGWRP. • Assess the need for management measures in accordance with **Section 5** and the SGWRP.	• Implement management measures, as required, in accordance with **Section 5** and the SGWRP.[1] • Continue monitoring, consistent with **Tables 4 and 7**, the GWMP, SWMP and the Subsidence Monitoring Program (Appendix H of the Extraction Plan).	• Implement Contingency Plan described in **Section 7**. • Develop action plan for additional measures, including consideration of: - additional scour protection, crack remediation and/or stabilisation; and/or - isolation sealing of the diversion cutting, for example through injection grouting or installation of low permeability material.
Frequency	• Frequency consistent with **Table 5**, the GWMP, SWMP and SGWRP.	• As required, in accordance with **Section 6** and the SGWRP.	• As required, in accordance with **Section 7**.
Position of Decision Making	• Environment and Community Manager.	• Environment and Community Manager.	• General Manager. • Implementation of additional management measures will be undertaken in consultation with DRG and CLWD.

1 With regard to the specific circumstances of the subsidence impact [e.g. the location, nature and extent of the impact] and the assessment of environmental consequences, in accordance with **Sections 5 and 6** and the SGWRP.

Note: GWMP refers to the Wambo Coal Groundwater Monitoring Program.
SWMP refers to the Wambo Coal Surface Water Monitoring Program.
SGWRP refers to the Wambo Coal Surface Water Groundwater Response Plan.
DRG refers to the NSW Department of Environment and Planning - Division of Resources and Geoscience.
CLWD - refers to the Water division in the Department of Primary Industries, Crown Lands and Water

3.0 Monitoring and Reporting

3.1 Monitoring

Detailed longitudinal geomorphological surveys should be conducted along creek reaches affected by subsidence. The surveys should include a photographic record with location co-ordinates, with any areas of potential instability noted. Monitoring (as outlined in **Table 1**) should be undertaken:

- Prior to subsidence;
- During subsidence;
- Post subsidence; and
- Following the completion of any restoration or remediation works.

3.2 Reporting

All reporting requirements will be in accordance with Section 4.2 of the Extraction Plan. The reporting requirements include:

- Incident Reporting;
- Subsidence Management Status Report;
- Six Monthly Report; and
- Annual Review.

The Annual Review (AR) will include:

- Summary of subsidence effects monitoring and a comparison to predicted subsidence effects; and
- Summary of all environmental and subsidence monitoring results and a comparison of actual impacts with predicted subsidence impacts and the subsidence impact performance measures.

4.0 Audit/Review

The NWCSRS will be reviewed by the Environmental and Community Manager:

- On an annual basis;
- When there are changes to consent or licence conditions relating to aspects of this NWCSRS;
- In response to an Independent Environmental Audit conducted in accordance with Consent Condition 7, Schedule 6 of DA 305-7-2003;
- Following an incident at SBU in relation to water; or
- In response to a relevant change in technology or legislation.

5.0 Responsibilities

Table 4 below summarises responsibilities documented in the NWCSRS. Responsibilities may be delegated as required.

Table 4: NWCSRS Responsibilities

No	Task	Responsibility	Timing
1	Subsidence monitoring as identified in **Section 2** of this Strategy.	Environmental and Community Advisor	As required
2	Implementation of mitigation strategies and monitoring measures in accordance with this Strategy and in consultation with relevant agencies.	Environment and Community Manager and Underground Manager	As required
3	Ensure that all process and procedures under this Strategy and all other relevant management plans in relation to this Strategy are followed.	Environment and Community Manager	As required
4	Ensure that all relevant personnel have reviewed the Strategy and any amendments.	Environment and Community Manager	As required
5	Ensure Strategy is implemented across all relevant personnel.	Environment and Community Manager	As required

6.0 References

- *Gilbert & Associates (2003) Wambo Development Project – Surface Water Assessment.*
- *Resource Strategies (January 2017) Extraction Plan – South Bates (Whybrow Seam) Underground Mine Longwalls 11 to 16;*
- *Resource Strategies (March 2017)* Environmental Assessment for the Modification of DA305-7-2002 (MOD17) Extension of the Approved South Bates Mine
- *SP Solutions (2006) Review of North Wambo Underground SMP Proposed Controls - North Wambo Creek.*
- *SCT Operations Pty Ltd (2015) Assessment of Inflow Potential Associated with Mining Under the North Wambo Creek Diversion.*
- *WCPL (2006) Wambo Coal Mine Modification Statement of Environmental Effects.*
- *WCPL (2015) South Bates (Wambo Seam) Underground Mine Modification Environmental Impact Statement.*
- *Water Management Plan – South Bates (Underground Mine Longwalls 11-16)*

ATTACHMENT 4

WAMBO COAL PTY LIMITED
GROUNDWATER MANAGEMENT PLAN

WAMBO
GROUNDWATER MANAGEMENT PLAN

Document No. WA-ENV-MNP-509.1
November 2020

Document Control

Document No.	WA-ENV-MNP-509.1
Title	Wambo Groundwater Management Plan
General Description	Groundwater Management at Wambo Coal Mine
Document Owner	WCPL Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked	Signature
1	August 2020	New Groundwater Management Plan (Version 1) for Wambo Mine, following approval of DA305-7-2003 (Modification 16) & DA177-8-2004 (Modification 3). Replaces the Wambo Groundwater Monitoring Program (Version 12).	WCPL	CB	
2	November 2020	Revised to address minor comments from DPIE	WCPL	-	

CONTENTS

1.0 INTRODUCTION 1

1.1 PURPOSE AND OBJECTIVES 1
1.2 SCOPE 1
1.3 RELATIONSHIP TO OTHER MANAGEMENT PLANS 2
1.4 PREPARATION OF THE GWMP 3
1.5 STAKEHOLDER CONSULTATION 3
1.6 STATEMENT OF COMMITMENTS 4

2.0 STATUTORY REQUIREMENTS 5

2.1 LEGISLATION, POLICIES, GUIDELINES AND STANDARDS 5
2.2 DA305-7-2003 CONDITIONS OF CONSENT 5
2.3 INDEPENDENT ENVIRONMENTAL AUDIT RECOMMENDATIONS 8
2.4 GROUNDWATER LICENCE CONDITIONS 10
2.5 MINING TENEMENT AND EXPLORATION LICENCE CONDITIONS 11

3.0 EXISTING ENVIRONMENT AND BASELINE DATA 13

3.1 EXISTING ENVIRONMENT 13
3.2 GROUNDWATER RECEPTORS 15
3.3 GROUNDWATER MONITORING NETWORK 22
3.4 REVIEW OF BASELINE DATA 33
3.5 SITE WATER BALANCE 37
3.6 HYDROGEOLOGICAL MODEL 37

4.0 GROUNDWATER TRIGGERS AND PERFORMANCE CRITERIA 40

4.1 TRIGGER VALUES FOR GROUNDWATER LEVELS 40
4.2 TRIGGER VALUES FOR GROUNDWATER QUALITY 42
4.3 GROUNDWATER PERFORMANCE CRITERIA 43
4.4 PERFORMANCE INDICATORS FOR EXTRACTION PLANS 43

5.0 GROUNDWATER MANAGEMENT MEASURES 45

5.1 GROUNDWATER MANAGEMENT SYSTEM 45
5.2 ANNUAL SITE WATER BALANCE AND SALT BALANCE 45
5.3 HYDROGEOLOGICAL MODEL VALIDATION 46
5.4 DECOMMISSIONING OF BORES 46
5.5 EXPLORATION DRILL HOLES 46
5.6 TRAINING 46
5.7 AUDITING 46

6.0 GROUNDWATER MONITORING PROGRAM 47

6.1 MONITORING NETWORK, PARAMETERS AND FREQUENCY 47

6.2 MONITORING METHODOLOGY 49

6.3 DATA MANAGEMENT PROCEDURES 50

6.4 DATA REVIEW AND INVESTIGATION 50

7.0 GROUNDWATER RESPONSE PLAN 52

7.1 ADAPTIVE MANAGEMENT 52

7.2 INCIDENT DEFINITION 52

7.3 IMPACTS ON GROUNDWATER 52

7.4 FAILURE TO COMPLY WITH OTHER STATUTORY REQUIREMENTS 57

8.0 COMMUNITY COMPLAINT RESPONSE 58

9.0 REVIEW AND REPORTING 59

9.1 REVIEW 59

9.2 REPORTING 59

10.0 RESPONSIBILITIES 60

11.0 REFERENCES 61

APPENDIX A: EVIDENCE OF CONSULTATION 63

APPENDIX B: SUMMARY OF COMMITMENTS 70

Tables

Table 1: DA305-7-2003 Requirements for this GWMP 5
Table 2: DA305-7-2003 Groundwater Management Performance Measures 7
Table 3: 2017 IEA Recommendations relevant to this GWMP 8
Table 4: WCPL Groundwater Entitlement and Licences 10
Table 5: Mining Tenement & Exploration Licence Conditions relevant to this GWMP 11
Table 6: Results of NSW Bore Database Search (at 2020) 16
Table 7: Groundwater Monitoring Bore Details 24
Table 8: HARTT Analysis Results for Shallow Monitoring Bores 33
Table 9: Bore Groundwater Level and Quantity (baseline data to April 2015) 36
Table 10: Stratigraphy of the Wambo Area 38
Table 11 Shallow Bores Water Level Trigger Values 40
Table 12Bores no longer assessed against groundwater level trigger 41
Table 13: Shallow Bores Water Quality Trigger Values 42
Table 14: Groundwater Management Performance Indicators 43
Table 15: NWU Performance Indicators 43
Table 16: SBU Performance Indicators 44
Table 17: TARP for Impacts on Private Bores 53
Table 18: TARP for Impacts on North Wambo Creek Alluvium 54
Table 19: TARP for Wollombi Brook and Wambo Creek Alluvium 55
Table 20: GWMP Responsibilities 60

Figures

Figure 1: Approved Wambo Coal Mine – Phase 2 1
Figure 2: Wambo Water Management Plan 2
Figure 3: Location of Alluvium in Lower Reaches of Creeks 14
Figure 4: NSW Bore Database Search Results (at 2020) 20
Figure 5: Wambo Groundwater Monitoring Bore Locations 32

1.0 Introduction

1.1 Purpose and Objectives

This Groundwater Management Plan (GWMP) has been developed by Wambo Coal Pty Ltd (WCPL) to address the relevant requirements of WCPL's development consent DA305-7-2003, as relevant to Phase 2 mining operations at the Wambo Coal Mine (Wambo). This GWMP also addresses the requirements of Condition 12 of Exploration Licence EL7211 for the preparation of a Groundwater Monitoring and Modelling Plan (GWMMP).

The key objectives of groundwater management at Wambo are to:

- satisfy regulatory requirements, including meeting required performance criteria;
- ensure there are negligible impacts to adjacent groundwater users (both consumptive users and the environment);
- ensure the underlying and adjacent groundwater resources are not degraded;
- reuse mine impacted water within the WMS to reduce reliance on raw/clean water; and
- minimise adverse effects on downstream waterways (including hydraulic and water quality impacts).

The GWMP has also been prepared in accordance with Condition D5 of DA305-7-2003 (Management Plan Requirements). There are no conditions specific to groundwater management in DA177-8-2004 or WCPL's Environment Protection Licence (EPL) 529.

1.2 Scope

This GWMP applies to all Phase 2 operational activities at the Wambo Coal Mine, including underground mining operations, CHPP and train loading operations (**Figure 1**). It does not apply to open cut mining operations associated with the United Wambo Open Cut Project.

This GWMP applies to all WCPL employees and contractors working for, or on behalf of WCPL within the project approval boundary (**Figure 1**).

This GWMP covers all groundwater management activities undertaken within Wambo's mining authorisations and approved mining areas as well as regional groundwater bores. This GWMP has been prepared to manage groundwater impacts from Wambo on local groundwater systems.

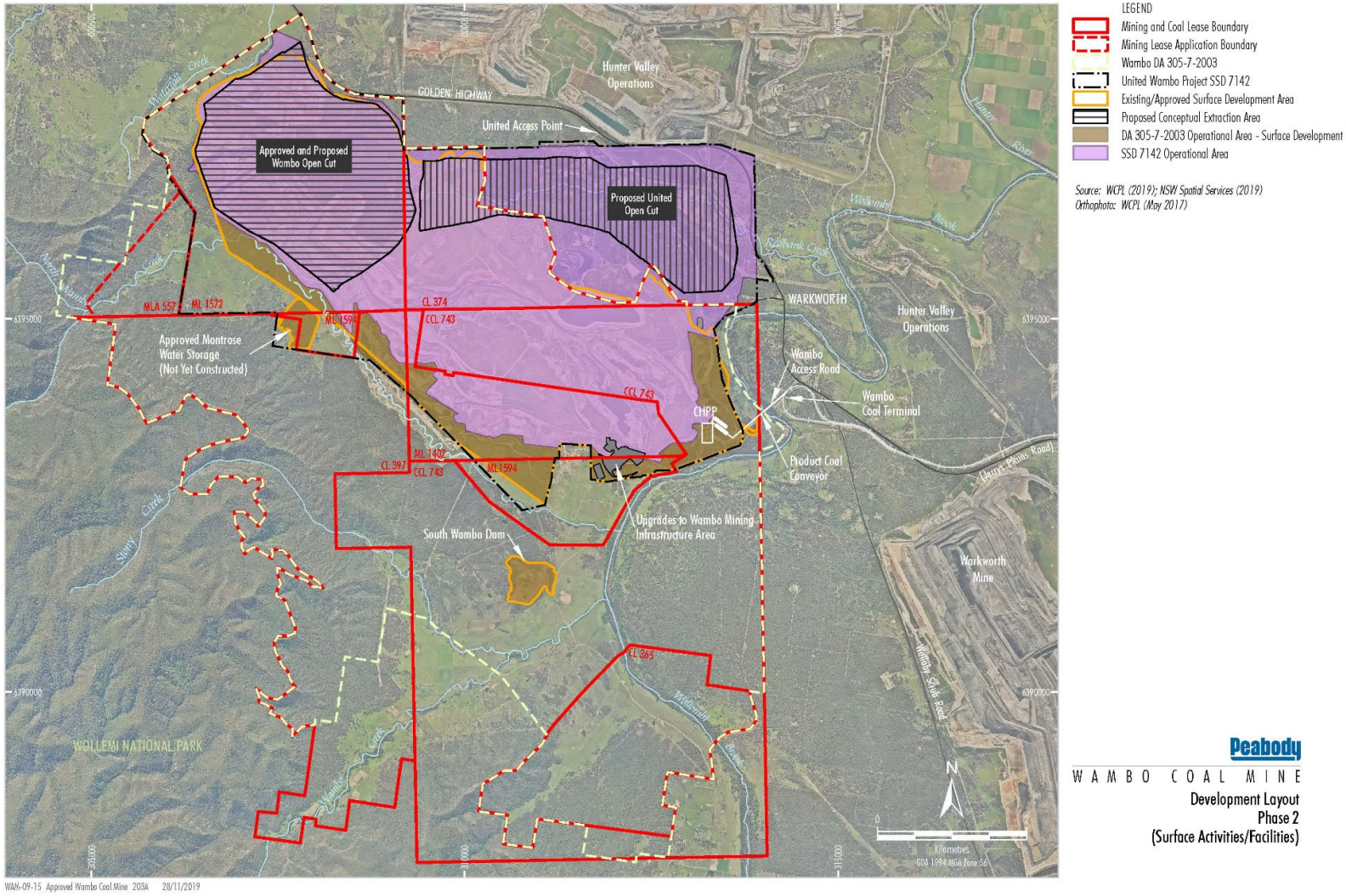


Figure 1: Approved Wambo Coal Mine – Phase 2

1.3 Relationship to Other Management Plans

This GWMP is part of a set of documents that together form the WCPL Water Management Plan (WMP) for the Wambo Coal Mine (**Figure 2**). The WMP is one of a series of Environmental Management Plans that together forms part of the WCPL Environmental Management System.

As part of Phase 2 operations, WCPL has combined the surface and ground water monitoring programs at Wambo with the United Wambo Open Cut surface and ground water monitoring programs. This combined monitoring program is now contained within the new ***United Wambo Open Cut and Wambo Water Monitoring Program (WMProg)*** (WA-ENV-MNP-509.8). A brief description of WCPL's groundwater monitoring program is included in **Section 6.0** of this GWMP however the monitoring program itself is now included in the ***WMProg.***

As part of the United Wambo Open Cut project Environmental Assessment (Umwelt 2016), WCPL's site water balance (and salt balance) was expanded to include the United Wambo Open Cut project. The ***United Wambo Open Cut and Wambo Site Water and Salt Balance*** (***SWSB***) (WA-ENV-MNP-509.4) is now a shared document, managed by WCPL. The ***SWSB*** will be updated annually using monitoring data from the ***WMProg.***

This GWMP should be read in conjunction with the other components of the Water Management Plan, particularly the overarching Wambo ***Water Management Plan*** (WA-ENV-MNP-509), ***WMProg*** (WA-ENV-MNP-509.8) and the Wambo ***Environmental Management Strategy*** (***EMS***) (WA-ENV-MNP-501).

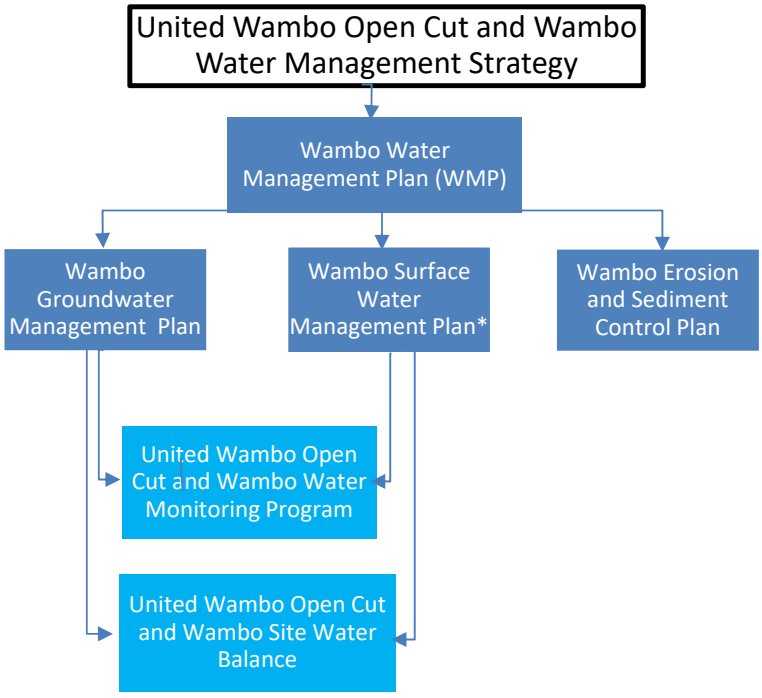


Figure 2: Wambo Water Management Plan

Notes to **Figure 2:**

Shared Document with United Wambo Open Cut Operations (refer Table 2 **of *WMP***)

Wambo Document (refer Table 2 **of *WMP***)

* SWMP incorporates the ***North Wambo Creek Diversion Management Plan*** (***NWCD MP***) – refer **Section 1.3.1**

1.3.1 Obsolete Plans

Prior to Modification 16 of DA305-7-2003, WCPL was required to prepare a ***Surface and Groundwater Response Plan*** (***SGWRP***) for the Wambo Coal Mine. The ***SGWRP*** detailed WCPL's response to observed impacts on surface and ground water as a result of WCPL's operations. Following approval of Modification 16, the Groundwater Response Plan has now been incorporated into this GWMP (refer **Section 7.0**). The Surface Water Response Plan has been incorporated into the ***SWMP***.

1.3.2 Relationship to EL7211 Groundwater Monitoring and Modelling Plan

Condition 12 of EL7211 requires WCPL to develop a Groundwater Monitoring and Modelling Plan (GWMMP) for exploration activities in EL7211. In 2016 WCPL developed a GWMMP to satisfy this condition and submitted it to DPIE Water on 16 January 2017 for review and comment. Feedback was received on 18 January 2017 and this feedback was addressed in the revised GWMMP (Version 2).

Condition B66(v) of DA305-7-2003 requires WCPL to develop a GWMP that is consistent with *Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities* (DPI Water, 2014) (refer **Table 1** in **Section 2.2**).

For simplicity and to avoid duplication of management plans, the GWMMP for EL7211 has been incorporated into this GWMP. **Table 5** (**Section 2.5**) shows where the requirements of Condition 12 (of EL7211) are addressed in this GWMP.

1.4 Preparation of the GWMP

In recognition of the requirements of Condition B66(a) of DA305-7-2003, this GWMP prepared by WCPL has been reviewed by a suitably experienced and qualified person, Ms Claire Stephenson from SLR Consulting (refer **Section 1.5.2** regarding NSW Department of Planning, Industry and Environment (DPIE) endorsement of Ms Stephenson).

1.5 Stakeholder Consultation

1.5.1 History of Consultation

There is a long history of consultation with various stakeholders regarding WCPL's Water Management Plan. Over the years WCPL has undertaken extensive consultation with government agencies, the Wambo Community Consultative Committee (CCC) and affected landholders in relation to management plan updates, including for various extraction plans.

Prior to the approval of DA305-7-2003 Modification 16 (in August 2019), this consultation was undertaken for WCPL's Groundwater Monitoring Program. The last update to the WCPL Groundwater Monitoring Program (version 12) was undertaken in consultation with DPIE, as part of the Extraction Plan for South Bates Underground Extension LW17-20. This update addressed comments from the DPIE and Independent Expert Scientific Committee (IESC) and built on consultation undertaken on previous versions of the document.

A summary of historic consultation, including how comments from DPIE Water, the IESC and DPIE have been addressed in previous versions of the GWMP, is provided in **Appendix A.**

1.5.2 Consultation for this GWMP

Dr Noel Merrick (SLR Consulting) was approved by DPIE on 28 February 2020 as the suitably qualified groundwater expert for the preparation of the South Bates Underground Extension (SBUE) Extraction Plan for Longwalls 21-24. In April 2020, WCPL wrote to DPIE and requested

Ms Claire Stephenson from SLR also be endorsed as a suitably qualified experienced expert. DPIE provided endorsement for Ms Stephenson 29 May 2020 (refer to correspondence in **Appendix A**).

As required by Condition B66 (b) of DA305-7-2003, WCPL must prepare this GWMP in consultation with DPIE Water and the EPA, to the satisfaction of the Planning Secretary. This GWMP (including all appendices) was provided to DPIE Water and EPA on 26 August 2020 for review and comment. Correspondence was received from the EPA 4 September 2020 to advise that the EPA does not provide comments on management plans. No comments were received from DPIE Water.

Version 2 of the GWMP was approved 20 November 2020. Correspondence in relation to consultation is attached as **Appendix A**.

1.5.3 Consultation for the Groundwater Dependent Ecosystem Study

On 5 February 2020 WCPL received correspondence from DPIE advising that they were satisfied with WCPL's Groundwater Dependent Ecosystem (GDE) Study, required by Condition B64 of DA305-7-2003.

Correspondence in relation to the GDE Study is attached as **Appendix A**.

1.6 Statement of Commitments

A Summary of Commitments for this GWMP is included in **Appendix B**.

2.0 Statutory Requirements

This GWMP has been prepared to fulfil all statutory requirements relating to groundwater management at the Wambo Coal Mine, including:

- Relevant legislation, policies, guidelines and standards;
- DA305-7-2003 Conditions of Consent (CoC);
- Recommendations from the 2017 Independent Environmental Audit (Hansen Bailey, 2018);
- Groundwater licence conditions; and
- Mining Tenement and Exploration Licence Conditions.

There are no conditions specific to groundwater management in WCPL's EPL 529 or DA177-8-2004.

There are no commitments in the *United Wambo Open Cut Project Environmental Impact Assessment* (Umwelt, 2016) relevant to this GWMP, however there are commitments relating to groundwater management and monitoring for the United Wambo Open Cut project that are addressed as part of the shared ***WMProg*** and ***SWSB***. Further information on these commitments and how they have been addressed is contained in the United Wambo Groundwater Management Plan.

2.1 Legislation, Policies, Guidelines and Standards

The legislation relevant to this GWMP is described in Section 2.1 of the ***WMP.***

The policies, guidelines and standards relevant to this GWMP are described in Section 2.2 of the ***WMP.***

This plan has been prepared to be consistent with *Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities* (DPIE Water 2014).

2.2 DA305-7-2003 Conditions of Consent

WCPL received development consent (DA305-7-2003) in accordance with the *Environmental Planning & Assessment Act 1979* (EP&A Act) from DPIE, formerly NSW Department of Planning and Environment (DP&E), on 4 February 2004. The most recent modification to DA305-7-2003 was granted by the Independent Planning Commission of NSW on 29 August 2019 (Modification 16).

DA305-7-2003 requirements related to the development of this GWMP are summarised in **Table 1.** Groundwater management performance measures, as specified in Condition B62 of DA305-7-2003, are listed in **Table 2.**

Table 1: DA305-7-2003 Requirements for this GWMP

Condition	Condition Details	GWMP Section
B66	(v) Groundwater Management Plan, which is consistent with *Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities* (DPI Water, 2014) and includes:	**Entire document**
	• detailed baseline data of groundwater levels, yield quality for	**Section 3.4**

Condition	Condition Details	GWMP Section
	groundwater resources and groundwater dependent ecosystems potentially impacted by the development, including groundwater supply for other water users;	
	• a detailed description of the groundwater management system;	**Section 5.1**
	• groundwater performance criteria, including trigger levels for identifying and investigating any potentially adverse groundwater impacts associated with the development, on: o regional and local aquifers (alluvial and hardrock);	**Section 4.0**
	o groundwater supply for other water users such as privately-owned licensed groundwater bores; and	
	o groundwater dependent ecosystems;	
	• a program to monitor and evaluate: o compliance with the relevant performance measures listed in Table 8, and the performance criteria established above, including monitoring of regional groundwater levels and quality during the life of the development and at least 10 years post-mining;	**Sections 6.0 and 9.2**
	o water loss/seepage from water storages into the groundwater system (particularly from South Wambo Dam and Montrose East Dam);	
	o groundwater inflows, outflows and storage volumes to inform the Site Water Balance;	
	o any hydraulic connectivity between the alluvial and hardrock aquifers;	
	o impacts on groundwater dependent ecosystems;	
	o impacts on groundwater supply for other water users; and	
	o the effectiveness of the groundwater management systems;	
	• reporting procedures for the results of the monitoring program;	**Section 9.2**
	• a plan to respond to any exceedances of the groundwater performance criteria, and repair, mitigate, compensate and/or offset any adverse groundwater impacts of the development; and	**Section 7.0**
	• a program to periodically validate the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and	**Sections 5.3 and 9.1.2**
D5	**Management Plan Requirements** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include where relevant:	**Section 2.1**
	(a) summary of relevant background or baseline data;	**Section 2.4**
	(b) details of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions);	**Section 2.0**
	• any relevant limits or performance measures and criteria;	**Table 2 and Section 4.0**
	• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or	**Section 4.0**

Condition	Condition Details	GWMP Section
	any management measures;	
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	**Section 2.0**
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Sections 5.0 and 6.0**
	(e) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures set out pursuant to paragraph (d);	**Monitoring – Section 6.0 Reporting - Section 9.0**
	(f) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 7.0**
	(g) a program to investigate and implement ways to improve the environmental performance of the development over time;	**Section 9.0**
	(h) a protocol for managing and reporting any: • incident, non-compliance or exceedance of any impact assessment criterion and performance criterion;	**Managing – Section 7.0 Reporting – Section 9.0**
	• complaint; or	**Section 8.0**
	• failure to comply with other statutory requirements; and	**Section 7.4**
	(i) a protocol for periodic review of the plan.	**Section 9.1.3**

Table 2: DA305-7-2003 Groundwater Management Performance Measures

Feature	Performance Measure[1]	GWMP Section
Water management – general[2]	• Maintain separation between clean, dirty and mine water • Minimise the use of clean and potable water • Maximise water recycling, reuse and sharing opportunities • Minimise the use of make-up water from external sources • Design, install, operate and maintain water management infrastructure in a proper and efficient manner	**Section 5.1 See also SWMP, GWMP & ESCP**
Alluvial aquifers (including Wollombi Brook alluvium and excluding North Wambo Creek alluvium)	• Negligible impacts beyond those predicted in the document/s listed in condition A2(c), including: • negligible change in groundwater levels; • negligible change in groundwater quality; and • negligible impact to other groundwater users	**Sections 3.2.2 and 5.0 - 7.0**
Aquatic, riparian and groundwater dependent ecosystems	• Negligible environmental consequences beyond those predicted in the document/s listed in condition A2(c) • Maintain or improve baseline channel stability • Develop site-specific in-stream water quality	**Sections 3.2.3 and 5.0 - 7.0 (See also WMP & SWMP)**

Feature	Performance Measure[1]	GWMP Section
	objectives in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000) and *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006)	

Note:

1. The performance measures in **Table 2** do not apply to water management structures constructed prior to the approval of Modification 16 (to DA305-7-2003).

WCPL is also required to undertake a Groundwater Dependent Ecosystem Study in accordance with Condition B64 of DA305-7-2003. Further detail on this study is included in **Section 3.2.3.1.**

Other conditions relating to general water management are addressed in the ***WMP.***

2.3 Independent Environmental Audit Recommendations

In 2017 Hansen Bailey conducted an Independent Environmental Audit of the Mine, in accordance with the requirements of Condition D11 of DA305-7-2003 and DA177-8-2004 (Hansen Bailey, 2018). Recommendations from the audit report relating to this GWMP, and where they are addressed, are included in **Table 3.**

Table 3: 2017 IEA Recommendations relevant to this GWMP

DA305-7-2003 Reference	Recommendation[1]	WCPL Response[2]	Timing	Section
Schedule 4, Condition 30	The GWMP should be updated with the suggestions provided by NSW government subsequent to approval of the GWMP in November 2015 and resubmitted. Updates should include: • A more contemporary reference to groundwater sampling techniques;	Complete, changes made in V12 of the GWMP, approved by DP&E 17 September 2018.	Complete	**Section 6.2**
	• Amendment of the text relating to purging of groundwater bores to be consistent with the latest guidelines;			**Section 6.2**
	• Outline the methods of water quality data upload from the laboratory;			**Section 6.3**
	• The bore labels in Figure 7 need to be clear for all bores; and			**Figure 5**
	• General update of text relating to historical or proposed activities.			**Various**
Schedule 4, Condition 34	Update GWMP to include Montrose Dam prior to its construction.	Current Mining Operation Plan refers to construction likely in 2023.	Prior to 2023 construction	**Section 6.1.4**
Schedule 4, Condition 34	Consideration should be made to directly monitor the quality of groundwater seepage reporting to the underground and open-cut workings.	Addressed in 2018 Annual Review of Groundwater prepared by HydroSimulations	Ongoing	**Sections 6.1.2 and 6.1.2 (see also United Wambo Water**

DA305-7-2003 Reference	Recommendation[1]	WCPL Response[2]	Timing	Section
		for the WCPL Annual Review Samples will be taken at active underground areas, to complement the extensive groundwater monitoring network.		**Management Plan)**
NA	AGE made the following recommendations for future groundwater modelling and assessments (see Appendix F): • Future groundwater modelling updates/reports need a clear description of the interactions/connectivity of the open cut and underground area and how this is represented in the modelling; • Future groundwater modelling updates/reports should comment on the interaction/connectivity of the open cut and underground areas and whether it is visible in the observational data; and	Recommendations have been emailed to HydroSimulations. Groundwater model will be rerun for the Extraction Plan for Longwalls 21 and beyond (approx 2020)[3].	Ongoing	**See notes to Table 3[3]**
	Future annual groundwater monitoring reviews should comment on the interaction/connectivity of the open cut and underground area and on the degree of match of the predicted versus observed water levels. The predictions, actual and licensing requirements should be included in a tabular format in each Annual Review.			**Section 9.2.1**
NA	The status of the single groundwater licence under the *Water Management Act* 2000 should be regularly followed up with DPI-Water	Six WCPL groundwater licences have been consolidated – WAL39738, 39803, 41528, 39375, 41520, 41494. New WAL yet to be issued by NSW Land Registry Services[4]	Complete	**Table 4**

Notes to **Table 3:**
1. As per Table 9 of the 2017 IEA Report (Hansen Bailey, 2018).
2. As per WCPL Responses to Recommendations made in the 2017 Independent Environmental Audit – Version 2 (dated 29 April 2019).
3. Recommendations relating to monitoring of groundwater inflows and seepage were considered by HydroSimulations in their annual review of WCPL's groundwater monitoring data for the 2018 Annual Review (HydroSimulations, 2019). A comparison of measured and predicted inflow volumes (to underground and open cut workings) will be undertaken annually and reported in the Annual Review (**Section 9.2.1**). Recommendations relating to future groundwater modelling and assessments will be considered as part of the groundwater model rerun for the Extraction Plan for Longwalls 21 and beyond.
4. New WAL (WAL42373) issued on 20 December 2018 (included in **Table 4** of this GWMP).

2.4 Groundwater Licence Conditions

Table 4 includes a list of groundwater entitlements held by WCPL. Surface water entitlements are outlined in the ***SWMP***.

WCPL currently holds one alluvial aquifer licence (WAL 23897, Licence 20AL211371, 70 shares) within the Lower Wollombi Brook water source of the Hunter Unregulated and Alluvial Water Sources Sharing Plan (WSP).

WCPL holds 1,647 ML of entitlements under the North Coast Fractured and Porous Rock Groundwater Sources WSP for the Sydney Basin – North Coast water source. United holds a further 300 ML of entitlements (refer United Wambo Groundwater Management Plan).

WCPL will report performance against relevant groundwater licence conditions in the Annual Review (refer **Section 9.2.1**).

Table 4: WCPL Groundwater Entitlement and Licences

Licence Number	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry date
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 23897[1,2]	Well No. 2	Perpetuity	70 unit shares	Aquifer	20AL211371	20WA211372	31/7/2022
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source)							
WAL42373[1,3]	Dewatering	Perpetuity	1549 unit shares	Aquifer	20AL219997	20MW065010	-
WAL41532[1,2]	Dewatering	Perpetuity	98 unit shares	Aquifer	20AL218994	20MW065010	-
20BL168997	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL168998	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL168999	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL169000	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL170638	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL172237	Monitoring Bore (GW14, GW18, GW21)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172238	Monitoring Bore (GW12)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172240	Monitoring Bore (GW15)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172242	Monitoring Bore (GW16, GW17)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172244	Monitoring Bore (GW20)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172255	Monitoring Bore (GW22)	Perpetuity	Groundwater monitoring	NA		-	-

Licence Number	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry date
20BL172256	Monitoring Bore (GW13)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172257	Monitoring Bore (GW19)	Perpetuity	Groundwater monitoring	NA		-	-
20BL172332	Piezometer	Perpetuity	Groundwater monitoring	NA		-	-
20BL173032	Monitoring		Groundwater monitoring	NA			-
20BL173290	Monitoring Bore	Perpetuity	Groundwater monitoring	NA		-	-
20BL173291	Monitoring Bore	Perpetuity	Groundwater monitoring	NA		-	-
20BL173292	Monitoring Bore	Perpetuity	Groundwater monitoring	NA		-	-
20BL173293	Monitoring Bore	Perpetuity	Groundwater monitoring	NA		-	-
20BL173946	Monitoring	Perpetuity		NA			
20BL173999	Monitoring Bore	Perpetuity	Groundwater monitoring	NA		-	-
20BL009818	Bore	Perpetuity	Stock	NA		-	-
20BL009819	Bore	Perpetuity	Stock	NA		-	-
20BL009820	Bore	Perpetuity	Stock	NA		-	-
20BL009821	Bore	Perpetuity	Stock	NA		-	-
20BL143779	Bore	Perpetuity	Stock/Domestic	NA		-	-

Notes to **Table 4:**

1. WAL = water access licence, ML/year = megalitres per year.
2. Former licence number: For WAL 23897 = 20BL167737, WAL41532 = 20BL172156
3. 6 x WALs consolidated on 20/12/18

2.5 Mining Tenement and Exploration Licence Conditions

Mining tenement and exploration licence conditions relevant to groundwater management and where they are addressed in this GWMP are summarised in **Table 5**.

Table 5: Mining Tenement & Exploration Licence Conditions relevant to this GWMP

Tenement/ Licence	Condition No.	Condition Description	GWMP Section
EL7211	12	**Groundwater Monitoring and Modelling Plan** Prior to conducting prospecting operations involving the construction and use of boreholes, the licence holder must: a) Prepare a Groundwater Monitoring and Modelling Plan in consultation with the NSW Office of Water;	**Section 1.5**
		b) Ensure the Groundwater Monitoring and Modelling Plan: i. describes methods for identifying aquifers, their depths, behaviour, containing layers and connectivity with surrounding aquifers or surface water systems;	**Section 3.1.1 and Section 6.0**
		ii. describes methods for collection of data relevant to the type, quantity and quality of water contained within aquifer systems likely to be encountered during prospecting operations;	**Section 6.0 and WMProg**
		iii. provides for the future development of a conceptual model of regional groundwater behaviour;	**Section 3.6**

Tenement/ Licence	Condition No.	Condition Description	GWMP Section
		iv. provides for the future development of a calibrated computer model of regional groundwater behaviour, to enable the impacts of any proposed mining operations to be assessed;	**Section 9.1.2**
		v. describes how records of all data collected will be maintained;	**Section 6.3**
		vi. describes the staging process for implementation of the plan; and	**Section 1.2**
		vii. is prepared in accordance with any additional requirements prescribed by the Secretary.	**Section 2.0**
		c) The Groundwater Monitoring and Modelling Plan must address the requirements identified in b)i) and b)vii) in a level of detail commensurate with the scale, timing and potential impact of the proposed operations;	**Noted (see above sections)**
		d) have the Groundwater Monitoring and Modelling Plan approved by the Minister; and	**Noted[1]**
		e) Implement and comply with the approved Groundwater Monitoring and Modelling Plan.	**Noted[2]**
EL7211	26	**Drilling** The licence holder must: a) Construct, maintain and decommission all boreholes and petroleum wells in accordance with standards equivalent to or exceeding the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2012), as amended or replaced from time to time. Where this condition is inconsistent with other conditions set out in this exploration licence, those conditions prevail to the extent of that inconsistency. b) Ensure that the construction, operation, maintenance and decommissioning of boreholes does not cause or enhance: i. hydraulic connection between aquifers; ii. contamination or cross-contamination of aquifers; iii. the escape of natural or noxious gases; iv. the uncontrolled surface discharge of ground waters; v. collapse of the surrounding surface; or vi. hazards to persons, stock and wildlife.	**Sections 5.1.3 and 5.4**
		e) Contain all drill cutting, fluids and groundwater returned to the surface as part of the drilling process in above-ground tanks or in-ground sumps pending recirculation or disposal. In-ground sumps must be lined with an impermeable barrier where there is a potential risk of contamination from drill cuttings or fluids;	**Section 5.1.3**
ML1594, ML1572 & CL374	15	**Exploratory Drilling** c) all drill holes are permanently sealed with cement plugs to prevent surface discharge of any groundwaters;	**Section 5.5**
		e) if any drill hole meets an artesian or sub-artesian flow it is effectively sealed to prevent contamination of aquifers.	
CCL743 & ML1402	17	**Exploratory Drilling** b) iii) all drill holes are permanently sealed with cement plugs to prevent surface discharge of any groundwaters;	**Section 5.5**
		b) v) if any drill hole meets an artesian or sub-artesian flow it is effectively sealed to prevent contamination of aquifers.	

Notes to **Table 5**:

1. The approved GWMP will be published on WCPL's website.
2. Groundwater management performance will be reported on in the Annual Review.

3.0 Existing Environment and Baseline Data

3.1 Existing Environment

The existing environment is described in detail in the EIS (Umwelt 2016) and summarised (with respect to water) in Section 3.1 of the ***WMP***. This includes information on:

- Rainfall;
- Geological setting; and
- Topography and vegetation.

3.1.1 Hydrogeology

The hydrogeological regime of the Wambo area and surrounds comprises two main systems (HydroSimulations, 2014):

- Quaternary alluvial aquifer system of channel fill deposits associated with Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek.
- Underlying Permian strata consisting of:
    - hydrogeologically "tight" and hence very low yielding to essentially dry sandstone and lesser siltstone;
    - low to moderately permeable coal seams, which are the prime water-bearing strata within the Permian measures; and
- Triassic Narrabeen Group described as:
    - Unconformably overlying the Permian coal measures and comprising lithic to quartzose sandstone, conglomerate, mudstone and siltstone. The Narrabeen Group is not present in the mine disturbance footprint but does form the ridges and high plateau within Wollemi National Park.

3.1.1.1 Quaternary Alluvium

The alluvium in the vicinity of the GWMP area forms an unconfined shallow aquifer. The alluvium within the Wambo area is generally less than 15 m thick (Heritage Computing, 2012). Previous studies indicate that the alluvium of Wambo Creek is 4 to 7 m deep and is discontinuous, probably due to bedrock highs (HLA-Envirosciences, 1999). The alluvium of North Wambo Creek near its confluence with Wollombi Brook was found to vary between 7 and 19 m (GHD, 2007). The extent of alluvium interpreted from the TEM study is typically of a narrower alluvial body along both the lower reaches of (South) Wambo Creek and North Wambo Creek than is mapped in the publicly available mapping (HydroSimulations, 2014) (refer **Figure 3**).

A section of North Wambo Creek has been diverted to skirt the Wambo Open Cut. Groundwater conditions within the North Wambo Creek alluvium have been locally altered by historical and existing mining operations, including removal of alluvium with progression of open cut mining (Montrose Pit).

Based on a review of groundwater quality and the results of the search of the NSW Bore Database (**Section 3.2.1**) the typical yield of the alluvial aquifer is likely to be less than 5 litres per second (L/s) and the salinity varies from low to very high. Based on this information the environmental value of the alluvial groundwater is considered to be 'primary industry' (specifically stock watering) and potentially irrigation.

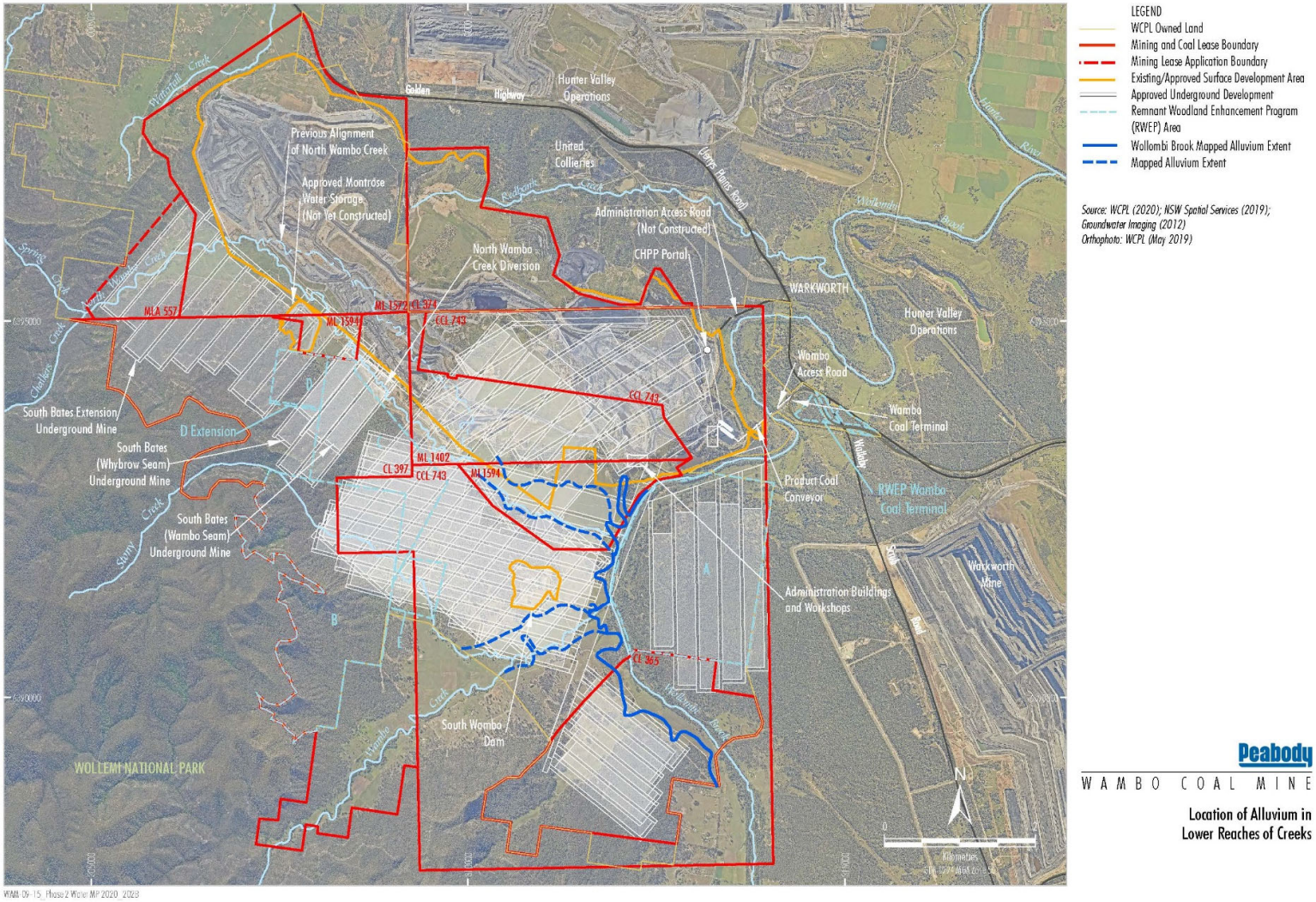


Figure 3: Location of Alluvium in Lower Reaches of Creeks

3.1.1.2 Permian Groundwater Sources

The fractured and porous groundwater sources within the Permian strata consist of both the coal seams and the interburden layers. The Permian strata includes the Wittingham Coal Measures intersected at site, and the overlying Newcastle Coal Measures. The coal measures are also weathered at surface.

Groundwater flow in the coal measures is influenced by the local geomorphology and structural geology, with unconfined conditions where the coal measures occur at outcrop, becoming confined as they dip towards the south-west. Pre-mining regional groundwater flow is generally towards the north-east. The regolith is variably saturated and shows unsaturated groundwater conditions. Previous and ongoing open cut and underground mining within the Wambo area and adjoining mining operations has resulted in a regional zone of depressurisation within the Permian coal measures (HydroSimulations, 2020).

The permeability of the fresh Permian coal measures is generally low and decreases with depth. This is due to tightening of joints between rock units as depth increases. The coal seams generally have higher permeability than the interburden layers. Overall, the Permian groundwater sources are low yielding and brackish to saline. The weathered coal measures (regolith) show variable permeability dependent on the insitu material (i.e. siltstone, sandstone, conglomerate). Water quality within the regolith is variable dependent on recharge sources, including rainfall recharge and upward seepage from underlying fresh Permian coal measures.

3.2 Groundwater Receptors

3.2.1 NSW Bore Database Search

Registered bores within a 4 km radius of Wambo and the United Wambo Open Cut based on a search of the NSW Bore Database (in 2020) and bore census findings reported by HydroSimulations (2014) and AGE (2016).

The search identified 122 bores, 23 of which are noted as abandoned and destroyed. T majority of the existing bores (41) are registered as monitoring/test bores and located within WCPL tenement boundaries (namely ML 1402, CL 743 and ML 1594). There were 15 bores identified as mining/dewatering/exploration bores and 16 bores were of unknown use. The remainder are registered for irrigation, domestic and/or stock use (27).

Bore details (including bore use and current status) are outlined in **Table 6** for all registered bores, excluding monitoring bores and bores that have been abandoned and destroyed. The approximate bore locations are shown in **Figure 4.**

Table 6: Results of NSW Bore Database Search (at 2020)

Figure 4 Ref	Bore No.	Licence No.	Location		Ground elevation	SWL (mbgl)	EC	Yield (L/s)	Bore depth (mbGL)	Aquifer	Status	Bore Use	Comment
			mE	mN									
1	10010974	316585	6394626	-	67.89	-	-	-	-	Alluvium	Unknown/ AD	Unknown	HVO land – Lemington South
2	10011156	306219	6400469	-	66.03	-	-	-	-	Alluvium	Unknown	Unknown	Access restrictions, bore not assessed.
3	GW005327	314683	6394498	20BL009540	59.92	6.1*	Excellent	0.13*	10.4	Alluvium	EX	Stock	Located in township of Warkworth.
4	GW017462	315339	6391460	20BL008224	-	-	-	-	0	-	-	Farming	-
5	GW017644	306708	6399431	-	75.3	-	salty*	-	11.6*	Weathered Permian	EX	Irrigation	Located on Wambo owned land
6	GW017646	306937	6399774	-	72.7	-	3,001-7,000*	-	11*	Alluvium	Unknown	Unknown	Located on Wambo owned land
7	GW017647	307326	6399905	-	72	-	7,001-10,000*	-	9.1*	Weathered Permian	EX	Unknown	Located on Wambo owned land
8	GW017648	307397	6400276	-	70.3	-	3,001-7,000*	25.26*	12.8*	Alluvium	Unknown	Irrigation	Located on Wambo owned land
9	GW017798	307290	6399042	-	86.6	-	1,001-3,000*	-	12.2*	Weathered Permian	EX	Unknown	Located on Wambo owned land
10	GW017799	306598	6398412	-	108.7	-	Salty*	-	12.2*	Weathered Permian	EX	Unknown	Located on Wambo owned land
11	GW017800	304413	6398000	-	133.2	-	-	-	27.4*	Triassic Narrabeen	Unknown	Unknown	Access restrictions, bore not assessed.
12	GW017801	304320	6397443	-	149	-	-	-	42.7*	Triassic Narrabeen	EX	Stock	Access restrictions, bore not assessed.
13	GW018045	302941	6398556	-	0	-	-	-	27.4*	Coal (Newcastle Coal Measures)	EX	Unknown	Access restrictions, bore not assessed.
14	GW018046	303013	6398866	-	0	-	-	-	18.3*	Coal (Newcastle Coal Measures)	Unknown	Unknown	Access restrictions, bore not assessed.
15	GW018047	302620	6398920	-	145.31	-	-	-	36.3	Newcastle CM	PRP	Unknown	-
16	GW022685	309088	6401184	-	75	10.67	1022	Continuous use	14.6	Alluvium	EX	Stock	Concrete well with pump infrastructure in place. Continuously used for stock and

Figure 4 Ref	Bore No.	Licence No.	Location		Ground elevation	SWL (mbgl)	EC	Yield (L/s)	Bore depth (mbGL)	Aquifer	Status	Bore Use	Comment
			mE	mN									
													domestic supply. Water quality sample taken.
17	GW027120	309501	6401185	-	77	10.75	822	25.26*	13.4	Alluvium	AU	Irrigation	Concrete well at surface with metal lid. Currently disused.
18	GW030731	316680	6397640	-	63	13.33	2460	No Pump	17.02	Alluvium	AU	-	Steel bore with marker post, disused. Water quality sample taken.
19	GW037184	309685	6393911	-	0	-	-	-	21*	Sandstone (overburden)	-	Exploration	Located on Wambo owned land
20	GW037734	309553	6401502	-	83	11.36	1022	15.16*	13.4	Alluvium	AU	Irrigation	Concrete well structure in paddock. No pump infrastructure present, appears disused.
21	GW037998	311589	6392530	-	62.38	-	-	-	10.9*	Alluvium	-	Irrigation	Located on Wambo owned land
22	GW037999	311482	6392713	-	64.01	-	-	-	13.7*	Shale	-	Irrigation	Located on Wambo owned land
23	GW038000	311457	6392620	-	63.59	-	-	-	9.4*	Shale	-	Irrigation	Located on Wambo owned land
24	GW038579	309738	6393882	-	0	-	-	-	20.9*	Weathered Permian	-	Exploration	Located on Wambo owned land
25	GW042364	316824	6397645	-	63	12.77	1077	-	13.3	Alluvium	AU	Unknown	Steel bore with marker post, was used for irrigation but hasn't been used for some time.
26	GW043225	303653	6398949	-	116	12.1	-	-	22.5*	Sandstone	EX	Irrigation	Private bore, 150 mm diameter PVC bore, equipped with Kenrahn LCS2DE pump. Pump currently not working, but normally used regularly for stock, and used to fill dams in dry weather.
27	GW043673	311486	6392467	-	63.11	-	-	-	9.4*	Shale	-	Exploration	Located on Wambo owned land
28	GW043674	311303	6392525	-	64.6	-	-	-	8.2*	Alluvium	-	Exploration	Located on Wambo owned land
29	GW043675	311433	6392527	-	63.73	-	-	-	8.5*	Alluvium	-	Exploration	Located on Wambo owned land
30	GW043676	311480	6392805	-	64.24	-	-	-	10.6*	Shale	-	Exploration	Located on Wambo owned land
31	GW053123	309631	6402062	-	78	12.55	993	-	13.1	Alluvium	AU	Irrigation	Concrete well structure, disused.
32	GW053173	309101	640317	-	76	13.38	967	10.1*	14.8	Alluvium	AU	Irrigation and stock	Concrete well with old pump infrastructure present, but appears disused.

Figure 4 Ref	Bore No.	Licence No.	Location		Ground elevation	SWL (mbgl)	EC	Yield (L/s)	Bore depth (mbGL)	Aquifer	Status	Bore Use	Comment
			mE	mN									
33	GW053292	317670	6398097	-	53.3	-	-	-	10*	Alluvium	EX	Irrigation	Bore not visited, located on east side of Hunter River.
34	GW060326	314104	6393348	-	-	6.7	-	-	9.8		-	Mining	-
35	GW060327	314181	6393442	-	-	6.7	0-500	-	9.8	-	-	Mining	-
36	GW060328	314205	6393534	-	-	7	-	-	10	-	-	Mining	-
37	GW060329	311904	6392474	-	-	-	-	-	6.4	-	-	Mining	-
38	GW060330	311727	6392163	-	-	3.8	0-500	-	6.2	-	-	Mining	-
39	GW060750	314310	6394923	20BL132130	59	-	-	-	24.4*	Weathered Permian	Unknown	Domestic	Bore not visited, located in township of Warkworth.
40	GW060780	305961	6399379	-	104.1	18.62	1552	No Pump	25.5	Weathered Permian	AU	Stock and domestic	Steep bore within vegetation. Uncapped and appears disused (no pump infrastructure present).
41	GW064382	303908	6394477	-	414.4	-	-	-	60*	Sandstone	-	HUSE	Access restrictions, bore not assessed.
42	GW065014	305777	6400368	-	85	-	-	-	14.5*	Weathered Permian	Unknown	Irrigation	Located on Wambo owned land
43	GW065117	311154	6390735	-	-	-	-	-	6	-	-	Irrigation	-
44	GW066606	311207	6390674	-	-	-	-	-	2.5	-	-	Domestic	-
45	GW078055	310105	6390490	-	-	-	1660	3-5 L/s	198.5		-	Test	-
46	GW078477	304007	6398988	-	109.8	11.05	3630*	-	102.5*	Sandstone	EX	Domestic	Private bore, bore in use with water license 20BL167575. 150 mm diameter PVC casing. Grundfos pump installed to 29 m depth, used approximately every 3 months and yields 3 L/s.
47	GW078574	309174	6390605	20BL167170	-	-	-	-	12	-	-	Farming	-
48	GW078575	309505	6389687	20BL167171	-	-	-	-	12	-	-	Farming	-
49	GW078576	309764	6389784	20BL167172	-	-	-	-	7	Gravel, Shale Grey Siltstone, Sandstone Conglomerate	-	Farming	-
50	GW078577	309969	6389973	20WA208559	-	-	-	-	10		-	Domestic	-
51	GW079060	314596	6394852	-	-	-	-	-	14.6		-	Unknown	-
52	GW080502	308897	6390160	20BL168017	-	105	-	-	250	Coarse Sand	-	Mining	-
53	GW080519	313622	6394161	20BL168885	57.98	7.42*	6490*	-	10.5*	Alluvium	-	Unknown	Located on Wambo owned land

Figure 4 Ref	Bore No.	Licence No.	Location		Ground elevation	SWL (mbgl)	EC	Yield (L/s)	Bore depth (mbGL)	Aquifer	Status	Bore Use	Comment
			mE	mN									
54	GW080951	314619	6394878	-	55	-	-	-	3.14*	Alluvium	Unknown	-	Bore not visited, located in township of Warkworth.
55	GW080952	314643	6394904	-	54	-	-	-	1.59*	Alluvium (sandy clay)	EX	-	Bore not visited, located in township of Warkworth.
56	GW200361	311833	6392209	20BL170638	60.97	3.12	-	-	-	Alluvium	-	Test	Located on Wambo owned land
57	GW200624	310166	6392650	20BL168939	-	6	-	-	260		-	Dewatering	-
58	GW200625	310901	6393375	20BL168940	-	-	-	-	270		-	Mining	-
59	GW200942	312325	6395750	20BL167947	-	32	-	-	37		-	Test	-
60	GW200943	312332	6395760	20BL167947	-	27	-	-	30		-	Test	-
61	GW203459	311820	6392560	-	0	-	-	-	55	Jerrys Plains SG	EX	Dewatering	-
62	Unregistered bore (near GW029155)	305430	6401656	-	76	8.2	-	-	9.8	Alluvium	EX	Stock	Private bore, well at least 50 years old, 1 m concrete well, casing 0.6 m above surface. Windmill in place and pumps at rate of 2.4 L/minute. Used for stock water supply year round.

Note: Coordinates are in MGA94, Zone 56
EX – existing bore
* - value derived from Pineena
AU – abandoned but in usable condition
AD – abandoned and destroyed

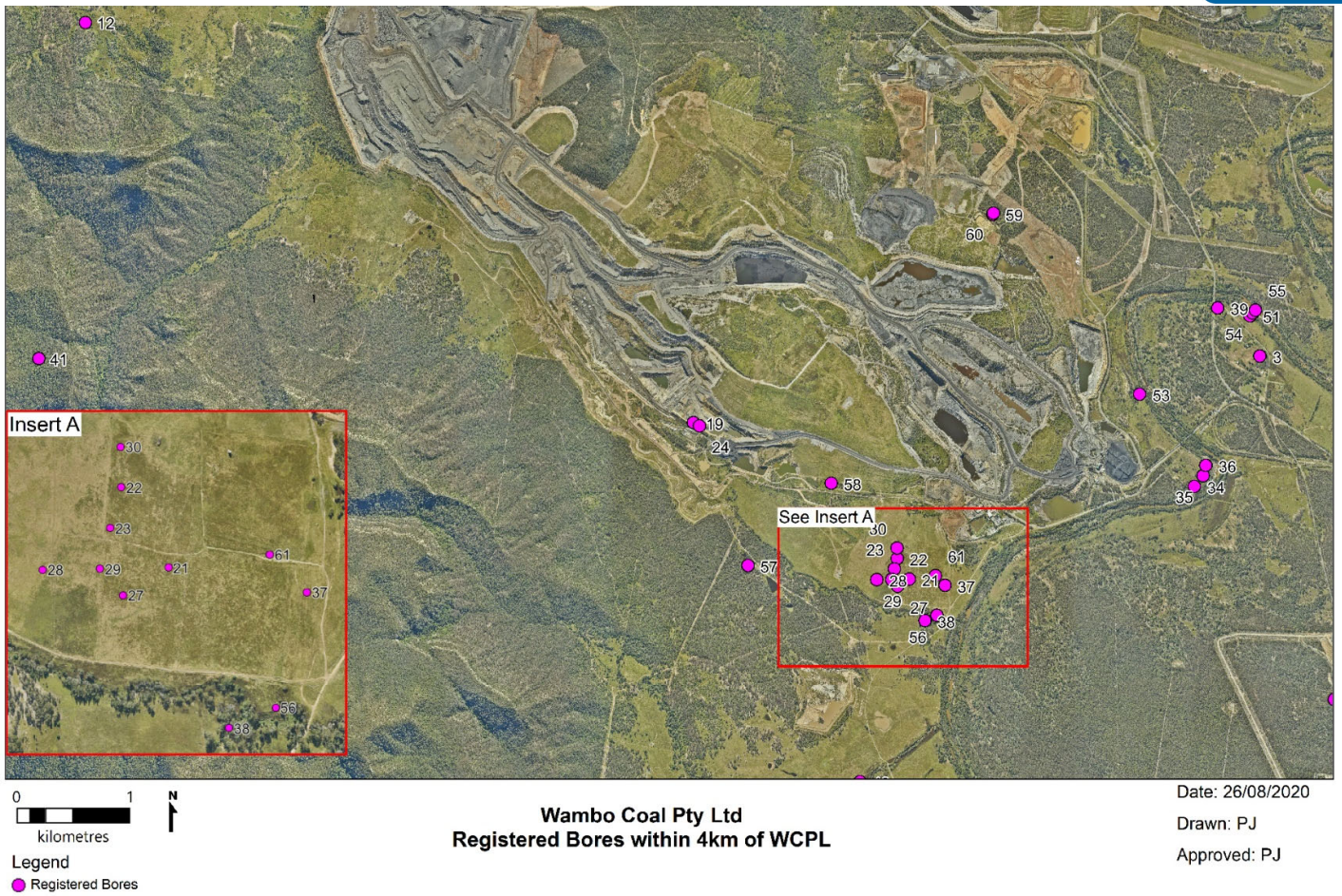


Figure 4: NSW Bore Database Search Results (at 2020)

3.2.2 Predicted Impacts on Groundwater Users

HydroSimulations (2016a) and previous groundwater assessments for Wambo predict that some privately-owned bores may experience more than 2 m cumulative drawdown as a result of the already approved operations at Wambo. These drawdowns are due to the cumulative effects of all mining in the Wambo district. In addition, it was predicted that there would be no additional privately-owned registered groundwater users affected as a result of Modification 12 or Modification 17.

Limited information is available on three privately owned bores in the vicinity of Wambo (**Figure 4**). Depending on the extraction depth and nature of bores, these bores may experience more than 2 m cumulative drawdown as a result of the approved Wambo operations.

3.2.3 Groundwater Dependent Ecosystems

The potential vegetation GDEs within the vicinity of Wambo have been mapped by BoM in the Groundwater Dependant Ecosystem Atlas. They include ecosystems that rely on the surface presence of groundwater and ecosystems that rely on the subsurface presence of groundwater.

Ecosystems that potentially rely on the presence of groundwater include various vegetation types, namely:

- Grey Box-Red Gum-Grey Ironbark.
- White Box-Ironbark-Red Gum.
- Hunter Roughbarked Apple-Red Gum.
- Roughbarked Apple-Forest Oak.
- Grey Gum - Grey Myrtle.
- Yellow Bloodwood-Stringybark.
- Yellow Bloodwood-Narrowleaved Apple.
- Blackbutt-Sydney Peppermint-Smoothbarked Apple.
- Grey Gum-Scribbly Gum.
- Grey Gum-Stringybark-Apple.
- Turpentine-Oak-Myrtle.

The Wollombi Brook and the Hunter River were also identified in the search of the Groundwater Dependant Ecosystem Atlas as being habitats for GDEs. It is considered that all or parts of the listed communities are potentially GDEs. The mapped locations of potential GDEs generally correspond with the surrounding watercourses, the neighbouring national park or the Remnant Woodlands Enhancement Program (RWEP) areas.

3.2.3.1 GDE Study for the South Bates Extension Area

Further investigations into the likely level of groundwater dependence were undertaken in 2019 by Hunter Eco Pty Ltd for the *South Bates Extension Underground - Groundwater Dependent Ecosystems Vegetative Assessment (Hunter Eco, 2019)*.

Two likely Groundwater Dependent Ecosystem communities were identified, being *Melaleuca decora* low forest and River Oak riparian grassy tall woodland. The River Oak community is restricted to the alignment of the North Wambo Creek channel, and rather than be dependent

on a permanent aquifer water source, River Oak are a facultative user of groundwater able to sustain themselves through lengthy dry periods. *Melaleuca decora* low forest appears to not have been impacted upon by earlier underground mining.

Key conclusions of the assessment were as follows:

- The riparian vegetation along North Wambo Creek does not meet the definition of a threatened ecological community under the *Biodiversity Conservation Act 2016*;
- The quality of the riparian community was moderate to poor primarily as a consequence of historic clearing and ongoing grazing;
- At the time of the study the alluvium in the vicinity of the North Wambo Creek riparian vegetation was unsaturated, but further monitoring identified periods of saturation following peak rainfall events (i.e. February-June 2020);
- South Bates Extension is unlikely to reduce the long-term ability for the River Oak vegetation community to temporarily access groundwater; and
- There is unlikely to be a long-term detrimental effect on the River Oak along North Wambo Creek.

A copy of the GDE Study was provided to DPIE on 11 April 2019 and was approved by DPIE on 5 February 2020 (refer to **Appendix A**). Monitoring of the GDE commenced in 2019 as a component of the Annual Flora and Fauna Monitoring Program (refer Wambo ***Biodiversity Management Plan (BMP)***). Groundwater monitoring bore GW36a and GW36b was installed in close proximity to the River Oak GDE in June 2020, monitoring groundwater level in the North Wambo Creek alluvium and underlying weathered Permian strata.

3.3 Groundwater Monitoring Network

Groundwater monitoring data has been collected at Wambo since 1994. The groundwater monitoring network currently consists primarily of standpipe monitoring bores installed in the alluvial groundwater sources and the Permian groundwater sources. The bores are generally monitored bi-monthly for groundwater levels and quality (pH and electrical conductivity [EC]), although there are some bores in key locations that contain a water level logger to continuously monitor groundwater levels.

Wambo has also been monitoring standing water levels and quality in a number of private bores since 2005.as well as a number of bores that are part of the United Colliery monitoring network.

At present there are 21 sites in the Wambo only groundwater monitoring network, supplemented by another 34 sites combined with United Wambo Open Cut. Vibrating wire piezometers (VWPs) have been installed to monitor water levels in the Permian measures at 12 Wambo sites and two United sites. These piezometers are downloaded on a quarterly basis. Further information is provided in the ***WMProg***.

Recent additions to the groundwater monitoring network have focused on increasing data availability for groundwater systems and key receptors near to current and future areas of active Wambo mining operations. These mine areas include South Bates Extension Underground Mine, open cut mining in the West Montrose pit, the approved South Wambo Underground Mine, as well as additional monitoring near mine water storage locations.

Since December 2017, 3 separate investigative drilling programs have been undertaken in the North Wambo Creek alluvium, upstream of the North Wambo Creek Diversion, providing

baseline data and an increased understanding of the groundwater conditions within the North Wambo Creek alluvium that will be undermined by South Bates Extension Underground Mine longwalls. These studies completed 33 investigative drill holes, of which, 13 have been converted in to alluvial (11) and weathered Permian (2) monitoring bores (refer to GW23 to GW35). A paired monitoring site has also been installed at GW36 (In-stream 4), near to the River Oak vegetation community identified as a likely GDE, to target both alluvial and weathered Permian strata. Continuous groundwater level loggers have recently been installed at two (2) sites to capture changes in groundwater level within the North Wambo Creek alluvium associated with intense weather events and periods of flow in North Wambo Creek. The new holes complement the historically monitored GW16 and GW17. VWP P317 was established in January 2018 and augmented with United monitoring bore UG139 to monitor depressurisation above South Bates Extension.

In late 2017, early 2018 and early 2020, additional monitoring locations (P316, P316a,b,c and P319) were established adjacent to South Wambo Dam to supplement shallow piezometers P114 and P116 (as requested by DPIE Water). VWPs were installed at P316 and P319 within regolith, overburden and the target seams of Homestead (Whybrow Seam) and North Wambo Underground (Wambo Seam) mining operations. These VWPs enable monitoring of recovery within and above the strata targeted by mining below South Wambo Dam and Wambo Creek alluvium. P316a,b,c was installed as a nested standpipe monitoring location, targeting the same strata as the upper three (3) sensors of P316, enabling validation of the VWP outputs and ongoing collection of water quality samples.

VWPs P320, P321, P327, P328 P329, P330, P408 and UG166A have been constructed to monitor the effects of the open cut to the north-west. With P329, P330 and P408 having a standpipe monitoring bore constructed within the Hunter River alluvium adjacent to the VWPs.

VWPs P318 and P325 are included in the program to establish baseline groundwater conditions to the south prior to the commencement of South Wambo Underground. The P325 VWP is accompanied by a standpipe monitoring bore constructed within the Wollombi Brook alluvium.

Details of the groundwater bores at Wambo are summarised in **Table 7** and locations are shown in **Figure 5**.

Table 7: Groundwater Monitoring Bore Details

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
GW02	Combined	Wambo	Well	EX	309109	6389680	82.5	11.2			Upper South Wambo Creek Alluvium
GW08.2	Combined	Wambo	MB	EX	311869	6392326		3	2.0	3	North Wambo Creek Alluvium
GW09.2	Combined	Wambo	MB	EX	311743	6392326		7.4	4.5	7.4	North Wambo Creek Alluvium
GW10.2	Combined	Wambo	MB	EX	311872	6392264		3	2	3	
GW10.2a	Combined	Wambo	MB	EX	311872	6392264		25	22	25	
GW11	Combined	Wambo	Well	EX	309228	6389699	76.335	9.6			Upper South Wambo Creek Alluvium
GW13	Combined	United Wambo	MB	EX	313810	6388990	61.839	15	6.0	15.0	Regolith
GW15	Combined	Wambo	MB	EX	313164	6392807	61.895	17.4	13.8	17.4	Wollombi Bk alluvium
GW16	Combined	Wambo	MB	EX	306641	6396034	112.445	12.15	6.2	12.2	Alluvium, Regolith
GW17	Combined	Wambo	MB	EX	306895	6396048	110.685	14	11.0	14.0	Regolith
GW21	Combined	Wambo	MB	EX	308647	6393378	121.824	36	24.0	36.0	Whybrow Coal Interburden
GW22	Combined	Wambo	MB	EX	311335	6389535	88.403	54	42.0	54.0	Whybrow Coal Interburden
GW23	Combined	Wambo	MB	EX	305791	6395668	118.8	13.2	11.7	13.2	North Wambo Creek – Consolidated Bedrock
GW25	Combined	Wambo	MB	EX	305299	6395288	129.4	13.2	11.7	13.2	North Wambo Creek – Consolidated Bedrock

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
P1	Combined	United Wambo	MB	EX	312199	6395840	86.0	37	31.0	37.0	Interburden - Blakefield - unnamed C
P2	Combined	United Wambo	MB	EX	312403	6395552	85		24	30	Interburden - Blakefield Seam
P106 (repair/ replace)	Combined	Wambo	MB	Blocked	311518	6391084	61.07	11	5.0	11.0	Alluvium
P109 (replacement)	Combined	Wambo	MB	Proposed	311215	6390768	62.44				Alluvium
P109 (replacement)	Combined	Wambo	MB	Proposed	311215	6390768	62.44				Permian
P11	Combined	United Wambo	MB	EX	312728	6395462	71.8	31	19.0	28.0	Interburden Blakefield - unnamed D
P316(a,b,c)	Combined	Wambo	MB	EX	311255	6391087		7	4.0	7.0	North Wambo Creek alluvium
								13	10.0	13.0	Weathered Permian
								26	23.0	26.0	Permian
P16	Combined	Wambo	MB	EX	313480	6394655	57.48	11.5	5.0	10.5	West Wollombi Brook Colluvium
P20	Combined	Wambo	MB	EX	313639	6394166	57.4	10.6	6.0	9.2	West Wollombi Brook Colluvium
P28	Combined	United Wambo	MB	EX	311396	6392632	63.1	-	-	-	Whybrow Coal Overburden
P29	Combined	United Wambo	MB	EX	311820	6392560	60.8	-	-	-	Whybrow Coal Overburden
P202	Combined	Wambo	MB	EX	311854	6391262	60.265	20	14.0	20.0	Overburden Whybrow
P301	Combined	Wambo	MB	EX	309360	6391466	88.18	20.4		20.4	Alluvium, shallow overburden
P315	Combined	Wambo	MB	EX	309084	6391856	94.74	9.5		9.5	Stoney Creek Alluvium/Regolith

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
P317	Combined	Wambo	VWP	Unknown	307115	6394439	155.41	248.5	35		Regolith
									100		Overburden
									174		Whybrow Seam
									213		Wambo Rider Seam
									248.5		Wambo Seam
P318	Combined	Wambo	VWP	Unknown	312599	6388922	71.05	357	11		Regolith
									150.79		Whybrow Seam
									205.25		Wambo Seam
									314.25		Woodlands HIll
									357		Arrowfield Seam
P319	Combined	Wambo	VWP	Unknown	311125	6391412	64.4	265.3	11		Regolith
									74.9		Whybrow Seam
									161.3		Wambo Seam
									265.3		Interburden Sandstone
P320	Combined	Wambo	VWP	Unknown	307573	6398890	85.86	344	92		Warkwort
									191		Vaux
									217.5		Baywater
									263		Pike Gully
									305		Lower Arties
									344		Middle Barrett
P321	Combined	Wambo	VWP	Unknown	307573	6398890	110.39	187.8	31.8		Arrowfield
									72.1		Warkworth
									161.15		Vaux
									187.82		Bayswater
UG139	Combined	United Wambo	VWP	EX	306665.45	6395172.7	128.9	402.0	263.0		Unnamed D
									281.0		Unnamed E
									319.0		interburden Glen Munro - Unnamed E
									329.0		Glen Munro

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
									375.0		interburden Arrowfield - Glen Munro
									382.0		Arrowfield
									402.0		interburden Warkworth - Bowfield
UG166A	Combined	United Wambo	VWP	EX	306488.43	6398076	141.5	260.0	130.0		Unnamed D
									153.0		Unnamed E
									183.0		Blakefield
									200.0		Glen Munro
									238.0		Arrowfield
									254.0		Bowfield
									260.0		Bowfield
BH1	Wambo Only	Wambo	MB	EX	313265	6394804	59.09	9.3	2.1	8.1	Tertiary Alluvium
BH1G	Wambo Only	Wambo	Dewatering	EX	310104	6391551		-			Whybrow Seam
BH2	Wambo Only	Wambo	Dewatering	EX	308867	6390147		-			Whybrow Seam
BH2A	Wambo Only	Wambo	Dewatering	EX	308868	6390096		-			Whybrow Seam
BH3	Wambo Only	Wambo	MB	EX	313399	6394644	54.39	65.4 -	55.4	61.4	Woodlands Hill Seam
BH4C	Wambo Only	Wambo	Dewatering	EX	309323	6391080		-			Whybrow Seam
BH4D	Wambo Only	Wambo	Dewatering	EX	??	??		-			Whybrow Seam, Wambo Seam
GW27	Wambo Only	Wambo	MB	EX	305736	6395614	117.4	2.6	1.1	2.6	North Wambo Creek - Alluvium
GW28	Wambo Only	Wambo	MB	EX	306008	6395769	115.0	5.9	2.9	5.9	North Wambo Creek - Alluvium

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
GW30	Wambo Only	Wambo	MB	EX	305867	6395617	121.8	7.1	4.1	7.1	North Wambo Creek - Alluvium
GW31	Wambo Only	Wambo	MB	EX	306073.82	6395772.1	114.968	8.5	5.5	8.5	North Wambo Creek - Alluvium
GW32	Wambo Only	Wambo	MB	EX	305863.81	6395583.2	122.12	10.0	7.0	10.0	North Wambo Creek - Alluvium
GW33	Wambo Only	Wambo	MB	EX	306393	6395828	115.05	7.0	4.0	7.0	North Wambo Creek - Alluvium
GW34	Wambo Only	Wambo	MB	EX	306592	6395946	110	7.0	4.0	7.0	North Wambo Creek - Alluvium
GW35	Wambo Only	Wambo	MB	EX	307356	6395779	104.23	4.0	2.5	4.0	North Wambo Creek - Alluvium
GW36 (Site 20)	Wambo Only	Wambo	MB	EX	306988	6396012	107.28	9	6	9	North Wambo Creek - Alluvium
N2	Wambo Only	Wambo	VWP	EX	308663	6393376	122.53	204	40		Permian Overburden
									70		Permian Overburden
									100		Permian Overburden
									140		Whybrow Seam
									172.5		Interburden
									204		Wambo Seam
N3	Wambo Only	Wambo	VWP	EX	308314	6394575	104.97	-190	30		Permian Overburden
									55		Permian Overburden
									75		Permian Overburden
									108.5		Whybrow Seam
									142		Interburden
									190		Wambo Seam

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
N5	Wambo Only	Wambo	VWP	EX	306755	6395963	110.78	133	30		Permian Overburden
									73		Whybrow Seam
									89.5		Interburden
									133		Wambo Seam
P316	Wambo Only	Wambo	VWP	EX	311252	6391128	60.39	71	10		Alluvium
									25		Regolith
									50.63		Regolith Overburden
									71		Whybrow Seam
P322	Wambo Only	Wambo	VWP	EX	312572	6395026	110.13	128	65		Regolith
									65		Whynot Seam
									128		Interburden (between Whynot & Woodlands Hill)
P323	Wambo Only	Wambo	VWP	EX	309797	6393428	76.65	85.5	23		Overburden siltstone
									33		Whybrow Seam
									85.5		Wambo Seam
P323	Wambo Only	Wambo	VWP	EX	309799	6393431	76.64	273.5	224.5		Woodlands Hill Seam,
									273.5		Arrowfield Seam
P324	Wambo Only	Wambo	VWP	EX	310471	6391983	74.44	304.5	11.5		Regolith
									95.75		–Whybrow Seam
									157		Wambo Seam
									269.75		Woodlands Hill Seam
									304.5		Interburden
P325	Wambo Only	Wambo	VWP	EX	311806	6390306	65.2	336.5	10.5		Regolith
									32.5		Permian Overburden
									82		Whybrow Seam
									159.5		Wambo Seam

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
									203		Whynot Seam
									251.5		Woodlands Hill Seam
									336.5		Arrowfield Seam
P325a	Wambo Only	Wambo	MB	EX	312062	6390137	65.2	8	5.0	8.0	Wambo Creek Alluvium
P326	Wambo Only	Wambo	VWP	EX	310087	6392874	75.48	332.5	43		Overburden–
									113.5		Wambo Seam
									234		Woodlands Hill Seam
									294.5		Arrowfield Seam
P327	Wambo Only	Wambo	VWP	EX	302941	6399995	141.25	332.5	65.25		Overburden
									228.25		Whybrow Seam
									301.05		Wambo Seam
									332.45		Whynot Seam
P328	Wambo Only	Wambo	VWP	EX	303160.33	6398869.64	131.89	338	43		Overburden
									275		Whybrow Seam
									350		Wambo Seam
									388		Whynot Seam
P329	Wambo Only	Wambo	VWP	EX	307454	6400351	72.42	150.5	67.6		Vaux Seam 1
									87.4		Vaux Seam 2/3
									117.5		Bayswater Seam
									150.5		Pikes Gully Seam
P329a	Wambo Only	Wambo	MB	EX	307456	6400352	72.42	16	10.0	16.0	Hunter River Alluvium
P330	Wambo Only	Wambo	VWP		306533	6400050	73.62	201.5	67		Vaux Seam 1
									137.25		Bayswater Seam
									201.5		Pike Gully Seam
P330a	Wambo Only	Wambo	MB	EX	306533	6400052	73.63	13	10.0	13.0	Hunter River Alluvium
Wambo-03	Wambo Only	Wambo	Dewatering	EX	311699	6392752		-			Wambo Seam

Lookup ID	Monitoring Program	Responsible for Monitoring	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbGL)	Screen/ Sensor from (mbGL)	Screen to (mbGL)	Lithology
Wambore South	Wambo Only	Wambo	Dewatering	EX	311812	6392555		-			Wambo Seam

Note: Coordinates in MGA94Z56
EX – Existing Monitoring Bore

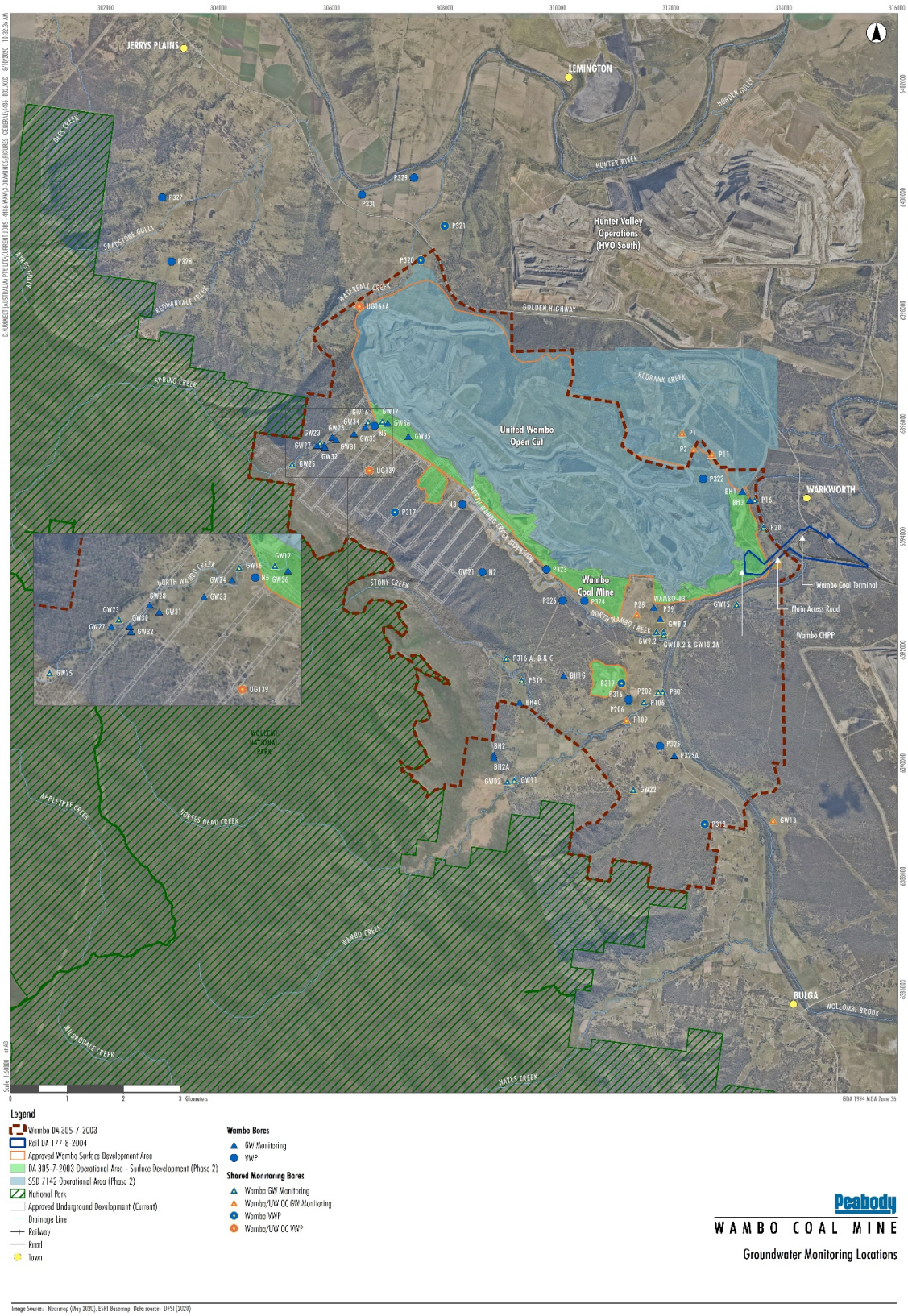


Figure 5: Wambo Groundwater Monitoring Bore Locations

3.4 Review of Baseline Data

3.4.1 Alluvial/Shallow Water Sources

Most groundwater levels at Wambo have been recorded manually. As the limit of reading of the measuring tape is about 10 mm, groundwater monitoring is unlikely to detect changes in groundwater level of less than 10 mm at a particular bore from one manual monitoring round to the next.

For the baseline period, a HARTT (Hydrograph Analysis: Rainfall and Time Trends) analysis was undertaken for each alluvial and regolith dataset and three shallow interburden bores (up to June 2014) to establish the relationship between groundwater levels and rainfall and to detect underlying trends in groundwater level that are independent of rainfall (GHD 2014). The HARTT statistical output for each alluvial hydrograph is given in **Table 8**. It should be noted that this analysis did not include review of the bore construction and geology. Recent review identified several bores intersect weathered Permian coal measures (regolith) that influences the results.

Table 8: HARTT Analysis Results for Shallow Monitoring Bores

Bore	R^2	Rainfall Coeff. *a* (m/mm)	P rain	Time Coeff. *b* (m/month)	P time	*c* (m)
ALLUVIUM/ REGOLITH						
P106	0.400	0.006	0.000	-0.005	0.365	54.751
P109	0.587	0.003	0.000	-0.002	0.446	58.690
P114	0.734	0.003	0.000	-0.004	0.005	57.173
P116	0.541	0.000	0.483	0.015	0.000	52.859
P315	0.313	0.005	0.002	-0.003	0.671	89.304
GW02	0.411	0.005	0.000	-0.012	0.000	79.447
GW08	0.643	0.000	0.273	-0.015	0.000	56.869
GW09	0.811	0.000	0.241	-0.024	0.000	64.339
GW11	0.601	0.003	0.000	0.005	0.111	75.982
GW12	0.765	0.010	0.004	-0.169	0.000	82.760
GW13	0.354	0.012	0.002	-0.113	0.010	65.201
GW15	0.360	0.002	0.006	-0.005	0.307	51.836
GW16	0.701	0.011	0.000	-0.064	0.000	108.256
GW17	0.660	0.011	0.000	-0.050	0.001	102.559
GW18	0.988	0.020	0.014	-0.581	0.006	78.010
P16	0.367	0.001	0.000	-0.008	0.000	53.445
P20	0.388	0.002	0.000	-0.017	0.000	55.512
PERMIAN						
P202	0.254	0.001	0.273	0.010	0.001	52.021
P203#	0.802	0.003	0.001	0.031	0.000	40.476
P301	0.149	0.000	0.950	-0.015	0.013	77.220

Also known as P206

The R^2 value (coefficient of determination) of the HARTT regression line gives a measure of the quality of fit of the non-linear regression line to the observed hydrograph. This value was greater than 50% for 12 of the 22 alluvial and regolith hydrographs analysed, indicating that over half of the hydrographs can be reasonably modelled by the HARTT variables (CRD and linear time trends) alone. A lower R^2 value indicates that the bore is situated at a location where the hydrograph cannot be adequately modelled by the HARTT variables and that other factors are affecting groundwater levels.

The p-value for the rainfall variable *a* is less than 0.05 for 17 of 22 bores, indicating that there is a significant relationship between groundwater level and CRD at most alluvial and regolith monitoring locations. The rainfall coefficient suggests that alluvial groundwater levels generally respond by 1 – 10 mm per mm of CRD (or atypical rainfall).

The p-value for the time variable *b* is less than 0.05 for the datasets of 17 of the 22 alluvial and regolith bores at Wambo, indicating statistically significant linear time trends (independent of rainfall) in groundwater levels at these locations. Where the p-value is greater than 0.05, time trends are statistically insignificant, and the time coefficient *b* cannot be relied upon to describe historical trends or predict future groundwater levels.

Of the 17 bores displaying statistically significant time trends, only three indicated an increasing trend. As shown in **Figure 5** these three bores (P116, P202 and P203) are all located near the confluence of Wambo Creek and Wollombi Brook. Bores P202 and P203 are screened within the Whybrow Seam interburden. It is considered that recovering water levels within the underlying previously mined Homestead workings and/or seepage from the South Wambo Dam may be attributable to these increasing trends.

At the time of the GHD (2014) analysis, the decreasing trends in groundwater levels at a number of the alluvial bores were considered possibly attributable to mining related activities. Subsequent analysis of contemporary data undertaken as part of Annual Reviews (HydroSimulations, 2019a; SLR, 2020b) found that mining activities were affecting shallow groundwater levels at monitoring locations such as GW16, GW17, GW08, GW09 and P114, but that other declines are likely attributable to a period of average and below average rainfall conditions from late 2012 to 2014.

The decreasing trends in groundwater levels within North Wambo Creek alluvium and underlying regolith at bores GW16 and GW17 were considered most likely attributable to the open cut operations at Wambo, while decreasing trends in lower North Wambo Creek alluvium and regolith at GW08 and GW09 were considered attributable to upstream impacts as well as underlying secondary extraction within the United Colliery mine and dewatering operations in the Whybrow Seam above the North Wambo Underground Mine.

Minor decreasing downward trends in groundwater at bores P16, P20 and GW13 within colluvium and regolith were considered less likely to be attributable to mining operations. The HARTT regression for these bores has a lower R^2 value which suggests that other recharge or discharge mechanisms may be affecting these locations.

Dewatering of the old Homestead Underground Mine via dewatering bores 2 and 2A may have been responsible for the slight decreasing trend in groundwater levels within Wambo Creek alluvium at GW02. It was noted, however, that there was no statistically significant trend at adjacent bore GW11.

Time series plots of groundwater pH and EC reported at alluvial monitoring bores at Wambo were presented in GHD (2014). Based on a visual assessment of the time series plots, EC appeared to be following a falling trend at most monitoring locations from 2007 to 2014. This may be attributable to increased rainfall from 2007.

Between February 2011 and June 2014 at monitoring bore P114, EC increased from below 1,000 microSiemens per centimetre (µS/cm) to almost 7,000 µS/cm. The bore is constructed within shallow alluvium and fine-grained sandstone and is located to the east of South Wambo Dam water storage which receives mine water from the open cut and underground mining operations. As the average EC in the dam was 7,350 µS/cm between July 2011 and October 2013 (Worley Parsons 2014), it was posited that the increase in EC at P114 might be due to

seepage from this water storage. Further review determined that seepage to the alluvium was unlikely based on available data (refer to **Section 6.4.2**). The variation in EC over the same time period at neighbouring bore P116 indicated a much smaller increase in EC that is within the range reported prior to construction of the dam, while EC at alluvial bore P106 and Whybrow Seam interburden bore P206 had been steady over the same time period.

At Whybrow Seam overburden bore P202, groundwater EC increased from 3,490 µS/cm in October 2011 to 6,610 µS/cm in June 2014. However, similar increases in EC are observed in 1999/ 2000 and 2007/08 prior to the construction and storage of mine water in South Wambo Dam.

Monitoring bores P114 and P116 have been removed from the monitoring network as they are constructed across both alluvial and Permian strata, inconsistent with the *Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012)*. P114 and P116 have been replaced by the nested standpipe monitoring location P316, which has an alluvial, weathered rock and overburden standpipe and is located between South Wambo Dam and Wambo Creek.

3.4.2 Permian Groundwater Sources

According to Ferdowsian *et al.* (2001), the HARTT method is generally limited to the analysis of relatively shallow groundwater from unconfined aquifers, and so does not provide information for deeper lithologies. For Permian hydrographs, qualitative comparison of groundwater hydrographs with the CRD curve is sufficient to allow inference of dependence on weather or the effects of mining.

3.4.3 Groundwater Attribute Statistics

A statistical summary of baseline (to April 2015) groundwater levels and quality is shown in **Table 9**, including the maximum, minimum, median and 10th and 90th percentiles. This table includes the bores screened within both alluvium and underlying Permian interburden.

EC has a wide range at alluvial sites, from about 300 to about 12,000 µS/cm with an overall median of about 700 µS/cm. By contrast, the median at Permian sites is about 5,000 µS/cm (excluding outlier GW12). Since 2007, EC at Permian sites has been very stable with little variation.

pH is consistently between 6 and 8 at the majority of alluvial monitoring locations, with an overall median of 7.1. At Permian sites, pH is reasonably constant with minimum and maximum recorded values ranging between 5.8 and 8.6 at all locations with an overall median of 7.3.

The overall median depths to groundwater are about 7 m at alluvial sites and about 13 m at Permian sites. The range of variation (from 10th to 90th percentiles) varies from 0.6 to 4.7 m at alluvial sites, and from 1.8 to 5.5 m at Permian sites.

Table 9: Bore Groundwater Level and Quantity (baseline data to April 2015)

Bore	pH					Conductivity (µS/cm)					Depth to Groundwater (mBTOC[1])				
	Min	Max	Median	10th	90th	Min	Max	Median	10th	90th	Min	Max	Median	10th	90th
ALLUVIUM/															
P106	6.2	8.6	6.9	6.7	7.9	391	1072	593	454	941	4.7	15.1	9.3	6.6	10.7
GW02	6.3	8.4	7.0	6.7	7.4	439	908	588	481	715	4.7	9.5	6.8	5.8	8.5
GW11	6.6	8.2	7.1	6.8	7.5	372	691	529	433	592	3.7	7.6	4.8	4.0	6.5
GW15	6.3	7.5	6.9	6.7	7.2	521	879	627	599	730	10.0	11.4	10.9	10.4	11.1
ALLUVIUM and REGOLITH/REGOLITH/ COLLUVIUM															
P109	6.2	8.7	6.8	6.5	7.6	431	1164	616	525	694	4.3	9.0	6.1	4.6	6.7
P114	6.3	8.7	7.1	6.5	7.8	509	7180	611	550	6141	5.2	8.1	6.7	5.4	7.6
P116	6.1	8.0	7.1	6.6	7.5	454	6570	1710	673	5972	4.2	8.3	6.3	4.8	7.3
P315	3.7	7.7	6.4	6.0	7.4	257	758	405	298	552	3.8	9.4	7.6	4.4	9.1
GW08	5.7	8.4	7.1	6.8	7.7	1371	2248	1864	1749	1972	2.8	5.9	3.4	3.0	5.1
GW09	6.5	8.8	7.7	7.2	8.4	287	1937	1140	420	1800	2.5	7.1	3.7	3.0	6.3
GW13	6.8	7.3	7.0	6.9	7.1	575	4820	3630	3240	4370	4.8	12.9	5.1	4.8	5.4
GW16	7.1	8.1	7.5	7.3	7.8	294	889	666	454	823	4.3	9.7	7.2	4.9	8.9
GW17	6.9	7.6	7.1	7.0	7.3	4610	5480	5160	4812	5304	6.9	11.8	10.9	8.3	11.5
P16	5.1	8.1	7.4	7.0	7.7	6700	12100	9545	7697	10832	6.3	8.2	7.4	7.1	7.8
P20	5.5	8.1	7.3	7.0	7.6	6500	12390	9515	8504	10625	5.4	8.1	7.8	7.1	8.2
PERMIAN															
P202	6.4	7.9	7.3	6.7	7.7	2650	10520	4687	3552	8172	3.3	8.7	8.8	7.8	9.6
P206	6.8	8.6	7.6	7.3	8.1	213	2672	2410	2160	2630	12.9	22.8	18.8	16.1	21.6
P301	5.8	7.6	6.6	6.1	7.2	461	9270	6430	2420	9199	7.2	19.9	13.2	11.1	15.5
GW12	6.6	6.9	6.8	6.6	6.8	19400	22300	21350	19670	22210	9.8	12.9	10.8	9.9	12.9

1. mBTOC = metres below top of casing

3.5 Site Water Balance

A Site Water Balance was developed as part of the United *Wambo Open Cut Coal Mine Project Environmental Assessment* (Umwelt, 2016). Further detail on the Site Water Balance is included in the *United Wambo Open Cut Coal Mine Project Surface Water Assessment* (Umwelt, 2016a) and the ***United Wambo Site Water Balance.***

Inflows to the water balance included groundwater flows from the open cuts and underground. The average groundwater flow was predicted to be 256 ML/year from the open cuts and 505 ML/year from the underground.

The Site Water Balance will be recalculated on an annual basis and reported in the Annual Review (**Section 9.2.1**).

3.5.1 Intercepted Alluvial Groundwater

Since December 2017, three (3) separate investigative drilling programs have been undertaken in the North Wambo Creek alluvium, upstream of the North Wambo Creek Diversion, resulting in 33 investigative holes drilled. Thirteen of these have been converted in to alluvial (11) and weathered Permian (2) monitoring bores. Continuous groundwater level loggers have been installed at two (2) sites to capture rapid changes in groundwater level within the North Wambo Creek alluvium associated with intense weather events and periods of flow in North Wambo Creek.

In 2019, the Wambo groundwater model was updated to include greater temporal variability to better capture groundwater conditions along North Wambo Creek. This was further refined in the South Bates Extension LW21-24 Extraction Plan modelling undertaken by SLR (2020). The modelling noted that the alluvium and shallow weathered rock are less broadly saturated following the construction of the NWCD and interception of alluvial material by the Montrose Open cut. An integrated groundwater model will be completed by SLR in Q4 2020, to incorporate the Wambo Underground and United Wambo Open Cut mines.

Intercepted groundwater will continue to be accounted for in the Wambo Underground and United Wambo Open Cut annual site water balance, which is reported in the Annual Review.

3.6 Hydrogeological Model

Several groundwater models have been constructed within the Wambo area to simulate the stresses on the groundwater environment from mining activities i.e. Wambo, Mt Thorley Warkworth and Hunter Valley Operations (HVO) models. The most recent modelling prepared for WCPL is based on the HydroSimulations (2016a) model that was developed as part of the groundwater assessment for the South Bates Underground Mine Modification (MOD 12) application (HydroSimulations, 2016a) and was subsequently used for the South Bates Extension Modification (Modification 17 in July 2017) (HydroSimulations 2017).

The model extends 19 km from west to east and 16 km from south to north, covering an area of approximately 300 km^2. Sixteen model layers represent the stratigraphic section of the Wambo area, as indicated in **Table 10** (HydroSimulations, 2016a).

The model domain has been designed to be large enough to prevent boundary influence on internal model drawdown/depressurisation associated with mining at Wambo. The model extends beyond the subcrop trace of the deepest coal seam that is likely to be mined in the future. The model domain and boundaries have been selected to incorporate any potential receptors (i.e. surface water bodies) that could be adversely affected by mining.

Numerical modelling was undertaken to inform the Groundwater Assessments detailed above and to quantify the likelihood and magnitude of potential impacts. On each occasion the Groundwater Assessment was peer reviewed by Kalf and Associates (Dr Frans Kalf) who concluded that the hydrogeological description, conceptualisation, model design, simulations and reporting had been conducted in a professional manner.

More recently groundwater modelling has been undertaken to inform the Wambo GDE Study (HydroSimulations, 2019) and the South Bates Extension Extraction Plan for Longwalls 21-24 (SLR, 2020). The hydrogeological model predicts the lateral zone of impact of depressurisation of aquifers due to current and future mining activity. In addition, the hydrogeological model predicts groundwater inflows into the underground workings over the life of the mine.

Periodic re-calibration of the model will be undertaken based on observed piezometric heads and groundwater inflow data. This periodic review and recalibration of the groundwater model is being undertaken by SLR for completion in Q4 2020.

Table 10: Stratigraphy of the Wambo Area

Supergroup	Group	Subgroup	Formation	Seam
Singleton Supergroup	Narabeen Group	Widden Brook Conglomerate		
	Newcastle Coal Measures[1]	Glen Gallic Subgroup	Greigs Creek Coal Redmanvale Creek Formation Dights Creek Coal	
		Doyle's Creek Subgroup	Waterfall Gully Formation Pinegrove Formation	
		Horseshoe Creek Subgroup	Lucernia Coal Strathmore Formation Alcheringa Coal Clifford Formation	
		Apple Tree Flat Subgroup	Charlton Formation Abbey Green Coal	
		Watts Sandstone		
	Wittingham Coal Measures	Denman Formation		
		Jerry's Plains Subgroup	Mount Leonard Formation	Whybrow Seam
			Althorpe Formation	
			Malabar Formation	*Redbank Creek Seam*[2] *Wambo Seam*[2] *Whynot Seam*[2] Blakefield Seam
			Mount Ogilvie Formation	*Glen Munro Seam* *Woodlands Hill Seam*[3]
			Milbrodale Formation	
			Mount Thorley Formation	Arrowfield Seam[2] Bowfield Seam[2] Warkworth Seam[4]
			Fairford Formation	
			Burnamwood Formation	Mount Arthur Seam Piercefield Seam Vaux Seam

Supergroup	Group	Subgroup	Formation	Seam
				Broonie Seam Bayswater Seam
		Archerfield Sandstone		
		Vane Subgroup	Bulga Formation	
			Foybrook Formation	
			Saltwater Creek Formation	

Source: HydroSimulations, 2016a, after DMR, 1993.

Notes to **Table 10:**
1 Previously known as the Wollombi Coal Measures
2 Coal reserves currently approved to be mined at the Wambo Coal Mine
3 Coal reserves to be mined at Wambo Coal Mine as part of MOD12.
4 Coal reserves to be mined by the Wambo Coal Mine where the upper three piles of the Warkworth Seam combine with the two piles of the Bowfield Seam

4.0 Groundwater Triggers and Performance Criteria

Groundwater triggers for both groundwater levels and quality have been developed using statistical analysis of the baseline data (**Section 3.4**) and data acquired to April 2015, and the predicted effects presented in the EIS and subsequent EAs.

The trigger values are not assessment criteria but are used to initiate investigations into the groundwater levels or groundwater quality as reported by the monitoring program. Details of the monitoring program are included in **Section 6.0**. Reporting requirements for this GWMP are detailed in **Section 9.0**.

Triggers will be used to determine if the groundwater impact investigation procedure or Trigger Action Response Plan (TARP) in **Section 7.0** should be initiated. **Section 7.0** provides a protocol for the investigation, notification, and mitigation of identified exceedances of these assessment criteria.

4.1 Trigger Values for Groundwater Levels

4.1.1 Alluvial Monitoring Locations

Statistical analysis of groundwater levels in shallow bores has been undertaken in **Section 3.4.1**. The results of this analysis indicate that shallow groundwater levels are highly responsive to rainfall.

Trigger values have been adopted for shallow bores monitoring key environmental receptors near Wambo Coal mine, such as alluvium associated with Wollombi Brook, North Wambo Creek, Wambo Creek and Stony Creek where predicted impacts are less than 2 metres. The trigger values adopted are equivalent to the 10th and 90th percentiles of recorded depths to groundwater in the historical dataset. Groundwater level trigger values are shown in **Table 11**. In order to avoid false triggering, as a trigger would be initiated 20% of the time due to natural causes, triggers for groundwater level are defined to occur when two consecutive bi-monthly observations (over a 2-month interval) fall outside of the depth to groundwater trigger value range.

Bores P16 and P20 provide suitable indicators near the Chitter Dam. Bores P116, P202 and P203 provide suitable indicators near the South Wambo Water Dam.

Table 11 Shallow Bores Water Level Trigger Values

	Minimum (10th percentile)		Maximum (90th percentile)	
Bore	Depth to Groundwater (mBTOC[5])	Level (m AHD)	Depth to Groundwater (mBTOC[8])	Level (m AHD)
P109[1]	4.6	57.8	6.7	55.7
P202	7.8	52.5	9.6	50.7
P206	16.1	44.1	21.6	38.6
P315[3]	N/A[6]	N/A	N/A	N/A
GW08.2[3]	ND[7]	ND	ND	ND
GW09.2[3]	ND	ND	ND	ND
GW15	10.4	52.0	11.1	51.3
GW16[3]	N/A	N/A	N/A	N/A
GW17[3]	N/A	N/A	N/A	N/A
P16	7.1	50.4	7.8	49.7
P20	7.1	50.3	8.2	49.2

1. P109 to be replaced by paired site that separates alluvial and Permian groundwater sources, trigger levels to be updated following collection of baseline data (2yrs or 18 observations).

2. P315 has dry observations prior to NWU mining activity. Therefore, a specific depth to water trigger is not appropriate to indicate Wambo mining impacts. Data will be reviewed as part of the Annual Review to determine whether there are changes in the relationship between climate and groundwater level that can be attributed to Wambo mining activity.
3. GW08.2, GW09.2 and GW10.2 have been installed within unconsolidated strata near North Wambo Creek to serve as replacement bores to GW08 and GW09. Trigger levels for these bores will be established following the collection of baseline data and based on predicted drawdown from the revised groundwater model to be complete in Q4 2020.
4. GW16 and GW17 are located upstream of the North Wambo Creek Diversion and in close proximity to the approved open cut. There are no groundwater users located in the vicinity of North Wambo Creek upstream of the North Wambo Creek Diversion. Both GW16 and GW17 have also been constructed across both alluvium/ regolith and weathered Permian strata and are not representative of a single groundwater source. Therefore, a trigger level for these two bores is not considered warranted. Monitoring data will be reviewed annually at these bores.
5. mBTOC = metres below top of casing
6. N/A – trigger level not appropriate for assessing Wambo mining impact at this location.
7. ND – insufficient baseline data to develop meaningful trigger level.

Ongoing review of Wambo groundwater monitoring locations has indicated a number of bores that have been previously assessed against groundwater level triggers should be reclassified as Permian monitoring bores, or are no longer appropriate to assess Wambo mining impacts to the local groundwater system. **Table 12** provides justification for the bores no longer assessed using a water level trigger.

Table 12 Bores No Longer Assessed Against Groundwater Level Trigger

Bore	Justification
P106	Bore obstructed and no longer providing meaningful data
P114	Bore screened across both alluvial and Permian strata, inconsistent with *Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012)*. Bore removed from monitoring network and replaced by P316a,b,c
P116	Bore screened across both alluvial and Permian strata, inconsistent with *Minimum Construction Requirements for Water Bores in Australia (NUDLC 2012)*. Bore removed from monitoring network and replaced by P316a,b,c
P202	Not shallow alluvial/ regolith bore – Permian bore with data analysed as in **Section 4.1.2**.
P206	Not shallow alluvial/ regolith bore – Permian bore with data analysed as in **Section 4.1.2**.
P301	Not shallow alluvial/ regolith bore – Permian bore with data analysed as in **Section 4.1.2**.
GW02	Landholder well with pumping equipment installed/ nearby, not appropriate to assess Wambo mining impacts at these locations. Replacement monitoring-only site recommended by SLR.
GW11	Landholder well with pumping equipment installed/ nearby, not appropriate to assess Wambo mining impacts at these locations. Replacement monitoring-only site recommended by SLR.
GW12	Bore constructed within shallow/ weathered Permian strata after the commencement of NWU mining. Length of baseline period not suitable for development of trigger. Bore removed from monitoring network with P315 to provide supplementary data for Stony Ck alluvium
GW13	Bore screened within weathered to fresh Permian strata containing coal seams. Bore also shows impacts associated with the approaching Warkworth Open Cut and is distant from current Wambo mining activity. Data to be analysed as in **Section 4.1.2**.

4.1.2 Permian Monitoring Locations

Given the lack of licensed water supply bores within the coal measures and generally poor water quality (EIS, 2003), no specific management measures are proposed. As Permian groundwater levels are predicted to fall below baseline levels(HydroSimulations, 2016a, SLR, 2020), groundwater trigger levels have not been established.

However, groundwater levels and quality are monitored for review of general groundwater behaviour. Hydrographs within Permian groundwater sources will be reviewed as part of the Annual Review (**Section 9.2.1**)and compared against groundwater model predictions to validate the groundwater model (**Section 5.3**).

Further investigations within these sources are triggered if:

- An adjacent landholder complains about declining groundwater levels in their bore; or

- Higher than predicted inflows are recorded; or
- The groundwater drawdown is greater than predicted.

Groundwater monitoring data from the Permian monitoring bores will be assessed and reviewed as part of the Annual Review (**Section 9.2.1**). Data will also be used to validate the groundwater model (**Section 5.3**).

4.2 Trigger Values for Groundwater Quality

There is considerable variability in groundwater pH and EC in both alluvial and Permian groundwater sources. In addition, the beneficial use category of Permian groundwater and alluvial groundwater along North Wambo Creek and Wambo Creek is limited due to naturally high salinity.

A water quality trigger for EC has been proposed based on the 90th percentile value observed in these bores (refer to statistical summary in **Table 9**). Although ANZECC and ARMCANZ (2018) recommend 80th percentile values as being suitable for trigger values, a trigger would be initiated 20% of the time due to natural causes. Therefore, a less stringent criterion is applicable so that the trigger would be a more meaningful indicator of a possible mining effect. Triggers for EC are to occur when *three* consecutive bi-monthly observations (that is, over a 6-month interval) exceed the specified trigger level (**Table 13**).

As described in **Section 3.4.1**, pH is consistently between 6 and 8 at the majority of alluvial monitoring locations. The 10th and 90th percentile values have been adopted as minimum and maximum exceedance values, where an investigation will not be triggered unless the value is exceeded on three consecutive bi-monthly monitoring events (over a 4-month interval) (**Table 13**).

Bores P16 and P20 provide suitable indicators near the Chitter Dam. Bores P116, P202 and P203 provide suitable indicators near the South Wambo Water Dam.

Table 13: Shallow Bores Water Quality Trigger Values

Bore	Conductivity (µS/cm)	pH	
	Maximum (Three Consecutive Bi-Monthly Exceedances)	Minimum (Two Consecutive Bi-Monthly Exceedances)	Maximum (Two Consecutive Bi-Monthly Exceedances)
P109	695	6.5	7.6
P202	8172	6.7	7.7
P206	2630	7.3	8.1
P301	9200	6.1	7.2
P315	552	6.0	7.4
GW02	715	6.7	7.4
GW11	592	6.8	7.5
GW15	730	6.7	7.2
GW16[2]	NA	NA	NA
GW17[2]	NA	NA	NA
P16	10832	7.0	7.7
P20	10625	7.0	7.6

1. GW16 and GW17 are located upstream of the North Wambo Creek Diversion and in close proximity to the approved open cut. There are no groundwater users located in the vicinity of North Wambo Creek upstream of the North Wambo Creek Diversion. Therefore, a trigger level for water quality in these two bores is not considered warranted. Monitoring data will be reviewed annually at these bores.

4.3 Groundwater Performance Criteria

Condition B62 of DA305-7-2003 (Modification 16) requires WCPL to comply with general water management performance measures. Performance indicators relevant to groundwater are outlined in **Table 14**.

Table 14: Groundwater Management Performance Indicators

Feature	Performance Indicator
Alluvial aquifers (including Wollombi Brook alluvium and excluding the North Wambo Creek alluvium)	The performance indicators will be considered to have been exceeded if the impacts are beyond those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: – A greater than negligible change in groundwater levels; – A greater than negligible change in groundwater quality; and – A greater than negligible impact to other groundwater users
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if the impacts are beyond those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: • Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c) • Channel stability is not maintained or improved

WCPL will report on progress against these performance indicators in the Annual Review (**Section 9.2**). In the event that a complaint is received relating to groundwater, it will be handled in accordance with the complaints management protocol (**Section 8.0**). Contingency plans for unpredicted groundwater impacts are discussed in the Extraction Plan and **Section 7.0.**

4.4 Performance Indicators for Extraction Plans

4.4.1 North Wambo Underground

Specific performance indicators have been developed for the subsidence impact performance measures relating groundwater in Section 3.1.3 of the Extraction Plan for North Wambo Underground Mine Longwalls 8 to 10A (NWU Extraction Plan). For further details of the monitoring conducted to inform the assessment of the extraction of Longwalls 8 to 10A against these performance indicators, refer to Section 3.8 of the NWU Extraction Plan.

The performance indicators outlined in the NWU Extraction Plan specific for groundwater, as outlined in **Table 15,** will be used to assess the performance of the Mine against the predicted impacts. North Wambo Underground operations were completed in December 2015.

Table 15: NWU Performance Indicators

Performance Indicator
The performance indicators will be considered to have been exceeded if Wambo receive complaints from groundwater users
The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergences away from the modelled groundwater.
The performance indicators will be considered to have been exceeded if pumping of water from the North Wambo Underground Mine roadways requires regular pumping at rates higher than normal.
The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria listed in **Table 11**
The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria listed in **Table 13**

4.4.2 South Bates Underground & South Bates Extension Underground

Specific performance indicators have been developed for the subsidence impact performance measures relating to groundwater in Section 3.1.3 of the Extraction Plan for South Bates Underground Mine Longwalls 11 to 16 (SBU Extraction Plan), and Table 12 of the Extraction Plan for South Bates Extension Underground Mine Longwalls 17 to 20 and 21 to 24. For further details of the monitoring conducted to inform the assessment of the extraction of Longwalls 11 to 16 against these performance indicators, refer to Section 3.8 of the SBU Extraction Plan.

The performance indicators outlined in the SBU Extraction Plan specific for groundwater, as outlined in **Table 16**, will be used to assess the performance of the Mine against the predicted impacts.

Table 16: SBU Performance Indicators

Performance Indicator
Wollombi Brook
The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (**Table 11**).
The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (**Table 13**).
The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.

5.0 Groundwater Management Measures

5.1 Groundwater Management System

WCPL's groundwater management system forms part of the United Wambo mining complex Water Management System, and mainly consists of dewatering infrastructure, water supply bores and groundwater monitoring bores (or piezometers). Further detail on the site Water Management System is included in the ***WCPL WMP***.

5.1.1 Dewatering Infrastructure

Dewatering infrastructure generally consists of water pumps and pipelines (including flow meters), which are used to convey groundwater to the surface, where it is then managed as part of the surface water management system. Management of dewatering infrastructure is undertaken in accordance with WCPL's procedures.

Key dewatering infrastructure is monitored by WCPL, with real time alarms to detect potential issues such as pump or pipeline failures. Data from monitoring of dewatering infrastructure will be used in the annual Site Water Balance calculations (**Section 5.2**) and groundwater model validation (**Section 5.3**).

5.1.2 Water Supply Bores

Water supply bores provide for the extraction of groundwater from underlying aquifers in accordance with WCPL's various water licences (**Table 4**). Water volumes extracted from these bores are monitored by WCPL and reported in the Annual Review (**Section 9.2**). Data from monitoring of water supply bores will also be used in the annual Site Water Balance calculations (**Section 5.2**) and groundwater model validation (**Section 5.3**).

5.1.3 Groundwater Monitoring Bores

Groundwater monitoring bores allow WCPL to monitor groundwater levels and quality in underlying aquifers. Further detail on WCPL's current groundwater monitoring network is included in **Section 3.3.** The groundwater monitoring program is described in **Section 6.0**

Data from the groundwater monitoring program is used in the annual Site Water Balance calculations (**Section 5.2**) and groundwater model validation (**Section 5.3**). Groundwater monitoring data is reported in the Annual Review (**Section 9.2.1**). Bi-monthly updates are also provided on WCPL's website.

Where required, new monitoring bores are constructed in accordance with standards equivalent to or exceeding the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2012). All drill cutting, fluids and groundwater returned to the surface as part of the drilling process is contained in above-ground tanks or in-ground sumps pending recirculation or disposal. In-ground sumps are lined with an impermeable barrier where there is a potential risk of contamination from drill cuttings or fluids.

5.2 Annual Site Water Balance and Salt Balance

A Site Water Balance is completed each year as part of the Annual Review (**Section 9.2.1**). The Site Water Balance incorporates and assesses all of the data collated from the surface water and groundwater monitoring programs including inflows, outflows and storage volumes.

A Salt Balance is also prepared annually and reported in the Annual Review (**Section 9.2.1**). Water monitoring data, including EC results, will be used in the calculation of the Salt Balance.

5.3 Hydrogeological Model Validation

Periodic re-calibration of the model (refer **Section 3.6**) will be undertaken based on observed piezometric heads and groundwater inflow data. An independent review of the model will be undertaken every 3 years, in accordance with Condition B66(d)(v) of DA305-7-2003. Revision of the regional groundwater model is being undertaken in the second half of 2020 consistent with this requirement

5.4 Decommissioning of Bores

Decommissioning of monitoring bores will be undertaken in accordance with *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2012). In most cases, this will involve:

- Removal of above ground casing and monuments.
- Injection of a cement bentonite grout from the base of the bore to the surface with a tremie pipe.

5.5 Exploration Drill Holes

In accordance with mining tenement conditions (refer **Table 5**), exploration drill holes not required for monitoring purposes are permanently sealed with cement plugs to prevent surface discharge of any groundwaters. If any drill hole meets an artesian or sub-artesian flow it is effectively sealed to prevent contamination of aquifers.

5.6 Training

Generic training on the aspects of the GWMP will be provided to all employees and contractors through the WCPL Site Induction process.

Regular workforce communication days and toolbox talks allow for discussion of the objectives and requirements of this and any other relevant Plans.

Selected site personnel whose duties directly involve the management of water at Wambo will undertake specific training with respect to site Operational Procedures which incorporate water management measures.

5.7 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this GWMP, consent conditions, and other relevant approvals, licenses, and guidelines.

Audit requirements are detailed in the ***EMS***.

6.0 Groundwater Monitoring Program

The purpose of the groundwater monitoring program is to monitor groundwater quality and levels to detect potential impacts on surrounding groundwater users, assess the performance of the Mine against the performance indicators and to ensure that relevant legislative and policy requirements are met.

Data collected will:

- Enable verification and refinement (where necessary) of the hydrogeological model developed for Wambo (**Section 5.3**);
- Be used in the continued development of groundwater investigation triggers (**Section 4.0**); and
- Provide input to annual reviews of groundwater monitoring data (**Section 9.1.1**).

The monitoring program takes into account the existing site groundwater data, both from WCPL and the neighbouring United Colliery, as well as the historical and current mining operations. Furthermore, it incorporates the recommendations from the annual review of groundwater, included in the Annual Review each year.

A review of the groundwater monitoring program was undertaken following approval of DA305-7-2003 (Modification 16). Changes to the monitoring program include:

- Expansion of the groundwater quality suite for some bores to include key analytes to determine any changes in beneficial groundwater use i.e. livestock drinking water;
- The addition of new bores monitoring pressure, groundwater level and water quality in various seams including alluvials; and
- Removal of decommissioned bores.

A general description of the groundwater monitoring program for Wambo is included in this section. The groundwater monitoring locations, parameters, frequency and methodology of monitoring for the Wambo Underground Mine (and United Wambo Open Cut Mine) are outlined in the combined ***WMProg***.

6.1 Monitoring Network, Parameters and Frequency

Ongoing groundwater monitoring requirements at Wambo are as follows:

- Groundwater monitoring bores to monitor groundwater sources above and in close proximity to mine workings;
- Monitoring of potential groundwater leakage from Wollombi Brook and associated alluvial aquifers;
- Monitoring of groundwater inflows to underground and open cut mining operations; and
- Monitor for potential water loss from the Chitter Dam and Wambo South Water Dam, including potential migration of sub-surface water toward Wollombi Brook.

6.1.1 Groundwater Monitoring Bores

Wambo's groundwater monitoring network consists of purpose-constructed monitoring bores (also referred to as piezometers), water supply bores and vibrating wire piezometers (VWPs). The GWMP includes the monitoring of water levels and water quality.

Particular areas that require monitoring are alluvium associated with Wollombi Brook, Wambo Creek (also known as South Wambo Creek), North Wambo Creek and Stony Creek.

Additional monitoring bores may be required in the future as underground mining progresses. Any additional monitoring locations should target alluvial groundwater and areas where depth of cover above the seam is lowest. Any additional monitoring bores will be installed so that at least two years of monitoring data are collected prior to undermining. All new monitoring bores are constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2012).

Bi-monthly monitoring of groundwater levels, pH and EC will be undertaken at all standpipe bores in the groundwater monitoring program. Comprehensive analysis of major ions will occur at each standpipe bore annually. VWPs, which continuously record groundwater levels, are downloaded quarterly.

6.1.2 Inflows to Underground Workings

Currently there is no dewatering required in underground workings.

Dewatering volumes and underground water levels will be recorded and data will be incorporated into the site water balance on an annual basis to allow calculation of groundwater inflows including loss of groundwater from alluvium and to verify whether WCPL holds sufficient groundwater licence entitlements.

Where the annual assessment for mine inflows to the South Bates Underground Extended Mine exceeds the peak estimate predicted by HydroSimulations (2017) (316 ML/year) by 50% or more (that is more than 474 ML/year), WCPL will:

- Investigate if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities;
- Where there is an increased take from the Lower Wollombi Brook Water Source, investigate any influence on low flow cease-to-pump criteria specified in the HUA WSP;
- Define the Mine inflow volume value triggering this response procedure; and
- Submit a report summarising the assessment to DPIE Water.

WCPL must notify DPIE Water as soon as practicable on becoming aware of any take of water in excess of its licensed entitlement.

The water quality of inflows to the underground workings are measured indirectly through monthly water quality monitoring of mine water storages. This is the most practical method to routinely sample for water quality. An unexpected increase in water make or change in water quality of mine water storages will be investigated by WCPL. If warranted, direct measurement of water quality at the source of inflow may be conducted.

6.1.3 Chitter Dam and South Wambo Water Dam Monitoring Program

In accordance with Condition B66 (v) of DA305-7-2003, WCPL has expanded the GWMP to investigate and monitor potential water loss from the Chitter Dam and South Wambo Water Dam, including potential migration of sub-surface water toward Wollombi Brook.

The Chitter Dam was drained and decommissioned by WCPL in 2016, it has subsequently been mined out as the Glen Munro Boxcut. Investigation was undertaken by SLR (2020c) to

characterise the groundwater regime and potential flow pathways. Recommendations were included for a groundwater monitoring program and collection of additional data to further inform understanding of the current groundwater conditions. The GWMP will be updated to include these changes to the monitoring program if required.

South Wambo Dam has been drained as far as practical since January 2015, prior to undermining by NWU longwalls 9, 10 and 10a, and has subsequently not been used to store mine water. However, to detect potential sub-surface water loss from South Wambo Dam, WCPL will monitor existing groundwater monitoring bores P202, P206, newly installed nested standpipe P316 (a,b,c) and surface water quality of any water stored in the dam. Water quality analysis will include annual analysis of major cations (sodium, potassium, magnesium and calcium) and major anions (chloride, sulphate and alkalinity) in addition to bi-monthly monitoring of pH and EC. Water chemistry and water levels will be analysed to identify evidence of connection between dams and the shallow groundwater systems downgradient.

In September 2018, an investigation was conducted by HydroSimulations titled *Update on Possibility of Mine Water Seepage to Wollombi Brook* (HydroSimulations, 2018). This report utilised key findings from previous assessments (HydroSimulations 2016, 2017a, 2017b), as well as new data and more extensive historical data and concluded "*The leakage of mine water from South Wambo Dam is unlikely to be the cause for the increase in EC from fresh to saline at P114. Instead, it is likely related to the construction and storage of water within the dam, and to natural fluctuations in groundwater levels due to rainfall.*"

South Wambo Dam will only be recommissioned after further geotechnical assessment, structural repairs and following relevant consultation with NSW Dams Safety Committee (DSC) and NSW DPIE Resources Regulator. WCPL met with DPIE Water Group in April 2020 to commence consultation regarding the re-use of the South Wambo Dam.

SLR Consulting Australia is currently undertaking further investigation into the local groundwater conditions, geology and construction design of South Wambo Dam to build on the HydroSimulations (2018) investigation and assess groundwater related risks associated with recommissioning the dam. This work will determine an appropriate monitoring network to detect seepage from the dam, and help develop a series of actions to be undertaken if seepage is detected.

6.1.4 Montrose Dam Monitoring Program

WCPL will develop a program to investigate and monitor potential water loss from the Montrose Dam prior to construction. The GWMP will be updated to include any changes to the monitoring program.

6.1.5 Groundwater Dependent Ecosystems

The GDE Vegetation Assessment Report (referred to in **Section 3.2.3.1**) recommended an additional monitoring bore in the channel of North Wambo Creek, near the River Oak riparian grassy tall woodland. A paired site GW36a & b (refer to **Table 7**) was installed in June 2020, with ground level dataloggers installed at both sites. Monitoring of the areas identified as GDEs are included in the annual flora and fauna monitoring program, which commenced Spring 2019 (refer ***BMP***). The GDE Vegetation Assessment Report recommended monitoring continue for at least five years beyond the completion of mining.

6.2 Monitoring Methodology

The monitoring methodology for the groundwater monitoring program is described in Section 3.3 of the ***WMProg.***

6.3 Data Management Procedures

Data management procedures for the groundwater monitoring program are described in Section 3.4 of the ***WMProg.***

6.4 Data Review and Investigation

Data review and investigation procedures for the groundwater monitoring program are described in Section 3.6 of the ***WMProg.***

Further details outlining the response procedures for exceedance of trigger values are outlined in **Section 7.0**.

6.4.1 Investigation of Levels in GW08 and GW09

An investigation into the declining water levels in bores GW08 and GW09 has been undertaken to further investigate potential impacts on the North Wambo Creek alluvium in the vicinity of these bores and potential licensing implications (HydroSimulations, 2015a). The investigation report was provided to the DPIE and DPIE Water.

The investigation concluded that the drawdown at GW08 and GW09 is due to pumping of water from (dewatering of) the old mine workings. The numerical model, was updated by HydroSimulations in 2015 to assess the South Bates underground operations (HydroSimulations, 2015b), and was not optimised at the location of GW08 and GW09, despite being well-calibrated elsewhere. Since then, HydroSimulations (2016a) updated and recalibrated the numerical model to better replicate shallow groundwater effects in the area around GW08 and GW09 with groundwater modelling associated with the South Bates Extension LW21-24 Extraction Plan (SLR, 2020a), that has built on the HydroSimulations (2016a) model, serving as the current model for compliance and impact assessment purposes.

The status of the two bores has been assessed in recent monitoring reviews such as the 2019 Annual Review (SLR, 2020b) using model results from SLR (2020a).

SLR (2020a) Modelled heads at GW08 show a good match with the overall trends seen in the observed data. The timing of mining related drawdown in both modelled and observed heads, following the extraction of NWU LW5 is well correlated despite simulated heads being lower than observed. At GW08, observed water levels fell below simulated heads in 2013. This relationship continues during the 2019 monitoring period with modelled heads showing a milder response to drawdown than that seen in the observed heads. Despite this, the difference in elevation between modelled and observed heads is quite small, being within 1 m of one another. GW08 was dry from the beginning of 2019, limiting the ability to compare modelled versus observed groundwater levels for the reporting period.

Calibration performance at GW09 in SLR (2020a) is poorer than previously reported in HydroSimulations (2017a). Simulated groundwater levels at GW09 show a response to climatic inputs of a similar magnitude to the observed data but do not show any drawdown associated with NWU LW5 mining. GW09 observations indicate drawdown in the order of 3 m at GW09 prior to going dry in December 2014 in response to NWU mining. It is possible that the interaction between NWU and the overlying historical Homestead Underground Mine has not been sufficiently captured within the SLR (2020) model. The revision of fracture zone parameters and extents associated with longwall extraction is recommended for consideration within future model updates.

HydroSimulations (2015a) recommended replacement bores be established for GW08 and GW09. Bores GW8.2, GW9.2, GW10.2 and 10.2a were installed in early 2020, and will be monitored to supplement the data collected at GW08 and GW09.

6.4.2 Investigation of Water Quality in P114

An investigation into the increased EC in shallow bore P114 has been initiated to further investigate the potential for impacts on this bore as a result of possible leakage from South Wambo Water Dam and potential remediation/mitigation measures.

As described in **Section 6.1.3**, South Wambo Water Dam has been disused following secondary extraction of Longwall 9, Longwall 10 and Longwall 10A at the North Wambo Underground Mine. South Wambo Water Dam has been drained as far as practical since January 2015. Therefore, any possible leakage mechanism that may have impacted bore P114 may no longer be present.

HydroSimulations (2018) assessed the likelihood of leakage of saline mine water from South Wambo Dam to the Wambo Creek alluvium. This assessment found no clear evidence for leakage from South Wambo Dam and also found evidence of P114 being screened across both alluvial and Permian strata. The 2019 Annual Review (SLR,2020) determined the rapid observed decline in groundwater level at P114 is related to the extraction of NWU Longwall 10a, and that observed increases in EC are associated with periods of lower groundwater level most likely related to the interception of saline Permian groundwater below the base of the Wambo Creek Alluvium (refer to **Section 6.1.3**).

Two additional monitoring sites in the vicinity of P114 have been included in the program from 2018 (P316 and P319). These sites are VWPs and will help inform whether groundwater levels are recovering below the Wambo Creek alluvium. Three open standpipes, screened within alluvial, weathered Permian, and Whybrow Seam overburden, were established and added to the monitoring program early 2020 (P316a, P316b and P316c). Data collected in these bores will assist with ongoing investigations into increased salinity within the Wambo Creek alluvium. P114 has been removed from the groundwater monitoring network as its construction is not consistent with *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2012)

It is noted that South Wambo Water Dam can only be recommissioned after secondary extraction has been completed following receipt of relevant approvals from the NSW Dams Safety Committee.

7.0 Groundwater Response Plan

7.1 Adaptive Management

Potential groundwater impacts are detailed in the *Wambo Development Project Environmental Impact Statement (EIS)* (Wambo Coal, 2003), the *North Wambo Underground Mine Modification Environmental Assessment* (Resource Strategies, 2012) and the *United-Wambo Project Environmental Assessment* (Umwelt, 2016).

The WCPL Water Management Plan, of which this GWMP forms a part, has been developed to manage and monitor water-related risks associated with the Wambo Coal Mine, to minimise the risk of exceedances of the criteria and/or performance measures detailed in the relevant development consents and licences. If an exceedance of these criteria and/or performance measures occurs, WCPL will, at the earliest opportunity:

- Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- Consider all reasonable and feasible options for remediation (where relevant) and submit a report to DPIE describing those options and any preferred remediation measures or other course of action; and
- Implement remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary.

7.2 Incident Definition

An incident is defined in DA305-7-2003 as:

An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance.

Incident reporting will be undertaken in accordance with **Section 9.2.2**.

7.3 Impacts on Groundwater

Following the receipt of groundwater monitoring results, a data review will be undertaken. In the event that a trigger level is exceeded, or a complaint is received in relation to loss of groundwater supply, an investigation will be undertaken as soon as possible. The investigation will include a detailed review of monitoring data trends and climatic information along with operational activities and surrounding land uses, to determine if the impact on groundwater is a result of Wambo's activities.

If the investigation identifies actual groundwater impacts and attributes those impacts to Wambo's activities, WCPL will implement the adaptive management process in **Section 7.1**. Appropriate remediation measures will be developed and implemented in consultation with relevant government agencies and affected landowners, as required.

Measures may include:

- Modification to the groundwater monitoring program;
- Review of the water balance modelling for relevant underground / open cut mining activities;
- Review of mine plan and/or methodology; or

- Implementation of mitigation measures, especially where use of groundwater resources are interrupted.

The outcomes of this process will be reported in the Annual Review (**Section 9.2.1**). If an incident is deemed to have occurred (**Section 7.2**), WCPL will notify and report to DPIE and any other relevant government departments in accordance with **Section 9.2.2**.

7.3.1 Trigger Action Response Plans

WCPL has developed a number of TARPs for impacts on groundwater. These TARPs were developed and included in the ***SGWRP***. As the ***SGWRP*** is no longer required under the modified DA305-7-2003 (Modification 16), WCPL has incorporated the relevant groundwater TARPs into this GWMP. TARPs were developed in consultation with DPIE Water. Evidence of this consultation is included in **Appendix A**.

7.3.1.1 Impacts on Private Bores

WCPL has developed a TARP that must be implemented in the event that:

- A complaint is received from a private bore holder in relation to decreasing levels in a private bore; or
- Groundwater monitoring of private bores identifies a decreasing trend approaching 2 metres below the modelled statistical trends.

This TARP is summarised in **Table 17**.

Table 17: TARP for Impacts on Private Bores

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Groundwater monitoring of Private Bores (where access granted) for standing water levels, identifies a decreasing trend approaching 2m below the modelled statistical trends.	•Groundwater monitoring of Private Bores (where access granted) for standing water levels, identifies a decreasing trend greater than 2m below modelled statistical trends for three consecutive sampling events. •WCPL receives a community complaint in relation decreasing water levels in a Private Bore.
Action	•Maintain monitoring of Private Bores to identify if decreasing trends has stabilised and displays signs of increasing trends. •Review recent rainfall data to identify potential correlation between decreasing water level trends and extended dry periods. •If decreasing trends are maintained and eventually exceed 2m below modelled statistical trends then go to Level 2 Response.	•Initiate consultation with the affected Landowner/s of the Private Bore to commence preliminary investigations on receipt of complaint. •Maintain monitoring of Private Bore to identify if decreasing trend has stabilised and displays signs of increasing trend. •Review recent rainfall data to identify potential correlation between decreasing water level trend and extended dry periods. •If decreasing trend is maintained and remains 2m below statistical trends for three consecutive monitoring events, initiate consultation with affected owner of Private Bore. •Undertake preliminary investigation as soon as possible and engage groundwater specialist for a review of relevant groundwater monitoring results in conjunction with site activities being undertaken at the time, baseline groundwater monitoring results, groundwater observations at nearby locations, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken in the contributing hydrogeological regime. Notify DPIE and DPIE Water of contingency response.

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Plan		•If preliminary or subsequent investigations indicate that compensatory water supplies are to be initiated, as a direct result from WCPL's operations, then WCPL will commence consultation with the affected Landowners to establish an agreed suitable compensatory supply of water, until further monitoring can establish these are no longer required. •Review and update the WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

7.3.1.2 Impacts on North Wambo Creek Alluvium

WCPL has developed a TARP that must be implemented in the event that:

- Groundwater monitoring of standing water levels in the proposed replacement bores within the North Wambo Creek alluvium, identifies standing water trigger levels, beyond predicted modelled impacts; and/or
- Monitoring of aquatic ecosystems in accordance with the ***BMP*** identifies a potential or actual decline in aquatic health, beyond natural fluctuations; and/or
- Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a potential or actual decline in creek stability, beyond natural fluctuations.

This TARP is summarised in **Table 18.** This TARP is also supported by the TARP in the ***SWMP***

Table 18: TARP for Impacts on North Wambo Creek Alluvium

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Groundwater monitoring of standing water levels the proposed replacement bores within the North Wambo Creek alluvium, identifies a groundwater level below the minimum observed groundwater level during the first 12 months of monitoring; and/or •Monitoring of aquatic ecosystems in accordance with the ***BMP*** identifies a potential decline in aquatic health, beyond natural fluctuations; and/or •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a potential decline in creek stability, beyond natural fluctuations.	•Groundwater monitoring of standing water levels in the proposed replacement bores within the North Wambo Creek alluvium, identifies more than two consecutive groundwater levels below the minimum observed groundwater level during the first 12 months of monitoring; and/or •Monitoring of aquatic ecosystems in accordance with the ***BMP*** identifies a decline in aquatic health in consecutive monitoring events, beyond natural fluctuations; and/or •Monitoring of Land Function Analysis (LFA) of riparian areas in accordance with the ***BMP*** identifies a decline in creek stability in consecutive monitoring events, beyond natural fluctuations.
Action	•Maintain monitoring of bores within the North Wambo Creek alluvium, for standing water levels, to identify if decreasing trends have stabilised and bores display signs of increasing trends. •Review recent rainfall data to identify potential correlation between	•Maintain monitoring of bores within the North Wambo Creek alluvium, for standing water levels to identify if decreasing trends have stabilised and bores display signs of increasing trends. •Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •If decreasing standing water level trends are maintained and/or LFA and aquatic ecosystems are in decline and/or a

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
	decreasing water level trends and extended dry periods. •Continue annual LFA and aquatic ecosystems monitoring to determine if decline trends have stabilised and displaying signs of improving trends in consecutive monitoring periods. •If standing water levels exceed standing water trigger values (consecutively) as provided in the GWMP, then go to Level 2 Response. •If consecutive LFA and aquatic ecosystems monitoring events show continued decline trends and are displaying no signs of improving trends, then go to Level 2 Response.	significant increase of alluvium flows into the open cut has been identified, WCPL will undertake a preliminary investigation, including: -An investigation and engage groundwater specialist to review relevant groundwater monitoring results in conjunction with site activities being undertaken at the time, baseline groundwater monitoring results, groundwater results at nearby locations, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken in the contributing hydrogeological regime; -Review the site water balance and groundwater model; -An investigation and engage ecologist to review LFA and aquatic monitoring results in conjunction with site activities being undertaken at the time, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken. -Develop corrective/preventative actions based on the outcomes of the investigation.
Plan		•If confirmation of a results above and investigations confirms impacts to alluvium are greater than modelled, WCPL will notify the relevant government agencies and in consultation develop appropriate remedial measures. •Develop corrective/preventative actions based on the outcomes of the investigation for example: -Secure additional water licences to account for the estimated future inflows (if applicable). • Review and update the GWMP[1] and resubmit to DPIE within 3 months, or as otherwise agreed.

Notes to **Table 18:**
1. SWMP and United Wambo Water Management Plans may also require review/revision and resubmission to DPIE.

7.3.1.3 Groundwater Leakage from Wollombi Brook

WCPL has developed a TARP that must be implemented in the event that:

- Groundwater monitoring of standing water levels in bores P106, P109, P114, P116 within the Wambo Creek alluvium and GW13 and GW15 within the Wollombi Creek alluvium, identifies a decreasing trend, beyond natural fluctuations and predicted modelled impacts.

This TARP is summarised in **Table 19.**

Table 19: TARP for Wollombi Brook and Wambo Creek Alluvium

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Trigger	•Groundwater monitoring of standing water levels in bores P106, P109, P114, P116 (within the Wambo Creek alluvium) and GW13 and/or GW15 (within the Wollombi Creek alluvium), identifies a decreasing trend, beyond natural fluctuations and predicted modelled impacts	•Groundwater monitoring of standing water levels in bores P106, P109, P114, P116, GW13 and/or GW15, exceed the standing water trigger values as provided in **Table 11**, beyond natural fluctuations, for more than two consecutive monitoring events.

TARP Code	Level 1 Response Management Measures	Level 2 Response Contingency Phase
Action	•Maintain monitoring of bores within the Wollombi and Wambo Creek alluvium, for standing water levels, to identify if decreasing trends have stabilised and bores display signs of increasing trends. •If standing water levels exceed standing water trigger values as provided in **Table 11**, then go to Level 2 Response.	•Maintain monitoring of P106, P109, P114, P116 within the Wambo Creek alluvium and GW13 and GW15 within the Wollombi Creek alluvium, for standing water levels to identify if decreasing trends have stabilised and bores display signs of increasing trends. •If decreasing standing water level trends are maintained, WCPL will undertake preliminary investigation as soon as possible, including: -An investigation and engage groundwater specialist to review relevant groundwater monitoring results in conjunction with site activities being undertaken at the time, baseline groundwater monitoring results, groundwater observations at nearby locations, the prevailing and preceding meteorological conditions and changes to the landuse/ activities being undertaken in the contributing hydrogeological regime. -Review the site water balance and groundwater model; -Develop corrective/preventative actions based on the outcomes of the investigation.
Plan		•If confirmation of results and investigations from above confirms impacts to alluvium are greater than modelled, WCPL will notify the relevant government agencies and in consultation develop appropriate remedial measures. •Develop corrective/preventative actions based on the outcomes of the investigation for example: -Secure additional water licences to account for the estimated future inflows (if applicable). -Measures to offset the potential groundwater leakages. •Review and update the WMP and resubmit to DPIE within 3 months, or as otherwise agreed.

7.3.2 Compensatory Water Supply

WCPL is required to provide a compensatory water supply to any landowner of privately-owned land whose rightful water supply is adversely and directly impacted (other than an impact that is minor or negligible) as a result of the development, in consultation with DPIE Water, and to the satisfaction of the Planning Secretary.

Compensatory water supply arrangements will be negotiated in consultation with the affected landowner(s) and DPIE Water as required, in accordance with Conditions B56 – B59 of DA305-7-2003.

7.3.3 Impacts on Groundwater Dependent Ecosystems or Riparian Vegetation

An aquatic ecosystem and GDE monitoring program has been developed to detect any potential changes in aquatic biology in accordance with the ***BMP,*** within North Wambo Creek, Wambo Creek, Stoney Creek and the North Wambo Creek Diversion.

Annual channel stability surveys are also undertaken to monitor the quantity and quality of riparian vegetation along North Wambo Creek and North Wambo Creek Diversion to determine the need for any maintenance and/or contingency measures. This program and the development of stream health triggers (for water quality, stability and alluvium) are discussed above and within the ***BMP*** and ***SWMP***.

In the event that deterioration is identified in GDEs during stream health monitoring or annual channel stability surveys, the processes outlined below will be implemented.

7.3.4 Unforeseen Impacts

In the event that any unforeseen surface water or groundwater impacts are detected, the following general response procedure will be initiated:

- Check and validate the data/information which indicates an unforeseen impact;
- Notify DPIE, EPA and other relevant agencies immediately after becoming aware of the impact;
- In the event of a suspected anomalous monitoring result, conduct a resample/retest where possible;
- Review the unforeseen impact, including consideration of:
    - Any relevant monitoring data; and
    - Current mine activities and land management practices in the relevant catchment, including other mining activities;
- Commission an investigation by an appropriate specialist into the unforeseen impact;
- Provide a preliminary investigation report to DPIE, EPA and relevant agencies within 7 days of identifying the unforeseen impact;
- Implement appropriate contingency/remedial measures;
- Implement additional monitoring to measure the effectiveness of the mitigation measures, where necessary;
- Communicate results of investigation and subsequent contingency and remedial measures to government agencies as required; and
- Review and update the WMP and resubmit to DPIE.

7.4 Failure to Comply with Other Statutory Requirements

Statutory requirements relating to this GWMP are summarised in **Section 2.0**. WCPL monitors compliance with these statutory requirements on an ongoing basis, including during regular reviews and reporting of monitoring data and as part of Annual Reviews and compliance audits (e.g. Independent Environmental Audits).

In the event that WCPL identifies a failure to comply with a statutory requirement (other than those relating to unpredicted impacts – refer **Section 7.3.4**), WCPL will:

- Undertake an investigation into the failure;
- Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and
- Report the non-compliance in accordance with the requirements of the development consents.

Reporting of non-compliances will be undertaken in accordance with Section 9.2.5 of the ***WMP***.

8.0 Community Complaint Response

All groundwater related community complaints received by WCPL will be recorded within the Community Complaints Register. The WCPL Environment and Community (E&C) Manager (or delegate) will investigate the complaint, which will include, where possible, contacting the complainant within 24 hours to discuss the complaint. A review of the effectiveness of the corrective or preventative actions will be conducted within a month of the complaint and the relevant work procedures updated if required.

Preliminary investigations will commence as soon as practicable upon receipt of a complaint to establish if WCPL is responsible. All efforts will be made to determine the likely causes contributing to the complainant's concerns.

WCPL will address the complainant's concerns such that a mutually acceptable outcome is achieved. If a mutually beneficial outcome cannot be reached, WCPL may refer the matter to the Planning Secretary for resolution.

Details of all community complaints will be included in the Monthly Environment Monitoring Report. WCPL will retain a copy of the Community Complaints Register for at least four years. The Community Complaints Register is posted on the WCPL website.

9.0 Review and Reporting

9.1 Review

9.1.1 Environmental Performance

The performance of the groundwater monitoring program outlined in the GWMP will be reviewed annually as part of the Annual Review (see **Section 9.2.1**).

9.1.2 Validation of Predictions

Every year the site water balance, surface water take and groundwater model will be validated by comparing predicted results to monitoring results collected over the life of the development. This will be undertaken as part of the Annual Review process (see **Section 9.2.1**).

Every five years the validity of the model predictions will be assessed and if the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for simulation of mining. Further detail on the groundwater model is included in **Section 3.6.**

9.1.3 Management Plan Review

This GWMP will be reviewed, and if necessary revised, with any review of the ***WMP*** (refer Section 9.1 of the ***WMP***).

The GWMP will reflect any changes in environmental requirements, technology, and operational procedures.

The revised GWMP will be re-submitted to the Secretary for approval as required by Condition B66 of DA305-7-2003.

9.2 Reporting

9.2.1 Annual Review

The WCPL E&C Manager will be responsible for reporting any significant findings regarding the implementation of this GWMP in the WCPL Annual Review. The Annual Review report will include details of:

- water level and quality results from the monitoring network;
- water extracted or discharged from the site, including water taken under each water licence;
- predictions, actual and licensing requirements; and
- any additional monitoring sites that may be required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suites should be undertaken.

Further detail on reporting for the Annual Review is included in Section 9.1 of the ***WMP***.

9.2.2 Reporting of Incidents

Reporting of environmental incidents will be undertaken in accordance with Section 9.2.4 of the ***WMP***.

9.2.3 Reporting of Results

A comprehensive summary of the groundwater monitoring results will be made publicly available at WCPL website (refer Section 9.2.7 of the ***WMP***).

10.0 Responsibilities

Table 20 below summarises responsibilities documented in the GWMP. Responsibilities may be delegated as required.

Table 20: GWMP Responsibilities

No	Task	Responsibility	Timing
1	Ensure groundwater monitoring is undertaken in accordance with **Section 6.0** and the ***WMProg***	Environmental Advisor	As required
2	Assess groundwater monitoring data against relevant trigger levels listed in **Section 4.0.**	Environmental Advisor	As required
3	Review GWMP in accordance with **Section 9.1.3**.	Environmental Advisor	Annually
4	Undertake internal bi-monthly groundwater reporting.	Environmental Advisor	Bimonthly
5	Notify government departments if an incident occurs in accordance with **Section 9.2.2**.	E&C Manager	As required
6	Submit updated GWMP to DPIE.	E&C Manager	As required
7	Groundwater related complaints to be responded to in accordance with **Section 8.0**.	E&C Manager	As required
8	Annual Review to include groundwater monitoring results, complaints, mitigation measures undertaken and a review of the monitoring undertaken.	E&C Manager	Annually
9	Regulator review to be undertaken of the GWMP.	E&C Manager	As required
10	Prepare investigation reports and implementation of corrective actions in accordance with **Section 7.0**	E&C Manager	As required

11.0 References

- AGE (2019): Wambo Coal Mine Alluvial Drilling and Monitoring Bore Installation Report - Phase Two
- AGE (2018): Wambo Coal Mine Alluvial Drilling and Monitoring Bore Installation Report - Phase One
- AGE (2016) Report on United Wambo Open-Cut Coal Mine Project Groundwater Impact Assessment, Prepared for Umwelt Australia Pty Ltd, Project No. G1733 July 2016
- Development Consent (DA305-7-2003)
- Development Consent (DA177-8-2004)
- Wambo Development Project Environmental Impact Statement (EIS), July 2003
- Wambo Environment Protection Licence (529)
- Bore licences 20BL173032, 20BL173033, 20BL173034 and 20BL173035
- Bureau of Meteorology (2014) Atlas of Groundwater Dependent Ecosystems.
- Hunter Eco Pty Ltd (2019) South Bates Extension Underground - Groundwater Dependent Ecosystems Vegetative Assessment. Report prepared for Wambo Coal Pty Ltd.
- Glen, R.A. and Beckett, J. (1993) Newcastle Coalfields Regional Geology 1:100,000 map, (Second Edition), NSW Department of Mineral Resources, Sydney.
- Groundwater Imaging Pty Ltd (2012) A Transient Electromagnetic Investigation of the Extent of the Wollombi Brook Alluvium at the Wambo Coal Mine Site.
- Hansen Bailey (2018). Independent Environmental Audit Report for Wambo Coal Pty Ltd, September 2018.
- Heritage Computing (2012) North Wambo Underground Mine Modification Environmental Assessment: Appendix B Groundwater Assessment.
- HLA-Envirosciences Pty Ltd (1999) Effect of Longwall Panel 9 Mining on Surface and Groundwater – Homestead Underground Mine Warkworth NSW.
- HydroSimulations (2014) North Wambo Underground Longwall 10A Modification Groundwater Assessment. Report prepared for Wambo Coal Pty Limited.
- HydroSimulations (2015a) Assessment of Groundwater Trends in GW08 and GW09. Report prepared for Wambo Coal Pty Ltd. Report No. HC2015/39.
- HydroSimulations (2015b) South Bates (Wambo Seam) Underground Mine Modification Groundwater Assessment. Report for Wambo Coal Pty Ltd. Report No. HC2015/026.
- HydroSimulations (2016a) South Wambo Underground Mine Modification Groundwater Assessment. Report for Wambo Coal Pty Ltd Report No..HS2016/01.
- HydroSimulations (2016b) Wambo Annual Review Groundwater Analysis. Report for Wambo Coal Pty Ltd. Report No. HS2016/26
- HydroSimulations (2017) South Bates Underground Extension Modification Groundwater Assessment. Report for Wambo Coal Pty Ltd Report No. HS2016/51.

- HydroSimulations (2018) Update on the Possibility of Mine Water Seepage to Wollombi Brook– Report for Wambo Coal Pty Ltd. Report No. HS2018/10
- HydroSimulations (2019a) Wambo Annual Review Groundwater Analysis – Report for Wambo Coal Pty Ltd. Report No. HS2019/13
- HydroSimulations (2019b) Groundwater Knowledge to inform GDE Study. Report for Wambo Coal Pty Ltd Report No. HS2018/50
- NUDLC (2012) Minimum Construction Requirements for Water Bores in Australia. National Uniform Drillers Licensing Committee, 3rd Edition.
- SLR Consulting (2017) Wambo Drilling Program – North Wambo Creek. Letter report prepared for Wambo Coal Pty Ltd. Ref 630.12300-L01-v0.1.docx
- SLR (2020a) SBE LW21-24 Groundwater Technical Review. Report for Wambo Coal Pty Ltd. Report No.665.10008.R02
- SLR (2020b) Wambo 2018 Annual Review: Groundwater. Report for Wambo Coal Pty Ltd. Report No 665.10008.00006-R01
- SLR (2020c) Glen Munro Seepage Investigation. Report for Wambo Coal Pty Ltd. Report No. 665.10008.00009-L01
- Umwelt (2016) United Wambo Open Cut Coal Mine Project Environmental Impact Statement
- Worley Parsons (2014) OPSIM Water Balance Model Initial Investigations – January 2014.

APPENDIX A: Evidence of Consultation

Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Mine
PMB 1
Singleton NSW 2330

20/11/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003-i)
Water Management Plan

I refer to the Wambo Water Management Plan (WMP), submitted in accordance with condition B66 of the approval for the Wambo Coal Mine (DA 305-7-2003-i). I understand that revisions to the WMP are required prior to Phase 2 of operations between the Wambo Coal Mine and United Wambo Joint Venture, which are scheduled to start on 1 December 2020.

I note that the WMP includes the following sub – plans:
- Site Water Balance;
- Salt Balance;
- Erosion and Sediment Control Plan;
- Surface Water Management Plan (including the North Wambo Creek Diversion Management Plan);
- Groundwater Management Plan; and
- Water Monitoring Plan.

The Department notes that the Site Water Balance, Salt Balance and Water Monitoring Program cover both the Wambo Coal Mine and United Wambo Joint Venture operations.

The Department has carefully reviewed the WMP and is satisfied that it adequately addresses the relevant requirements of the approval. Accordingly, the Planning Secretary has approved the WMP (Revision 2, November 2020) for Phase 2 of the operations. Please continue to operate in accordance with the previously approved WMP until Phase 2 commences.

Please also ensure that the approved plan is placed on the project website at the earliest convenience. If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton NSW 2330

28/05/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Approval of Experts

I refer to your correspondence of 23 April, requesting the Secretary's approval of suitably qualified persons to prepare the following environmental management plans for the Wambo Coal Mine (DA 305-7-2003):

- Air Quality and Greenhouse Gas Management Plan, required by condition B46; and
- Groundwater Management Plan required by condition B66(v).

The Department has reviewed the nominations and information you have provided and is satisfied that the following experts are suitably qualified and experienced:

- Shane Lakmaker (Jacobs) – Air Quality; and
- Claire Stephenson (SLR Consulting) – Groundwater.

I note that the Department recently approved the following experts to prepare the Wambo Extraction Plan for Longwalls 21 – 22:

- Dr Noel Merrick, (SLR Consulting) – Groundwater;
- Mr Rohan Lucas, (Alluvium) – Surface water;
- Mr Peter Kuskie, (South East Archaeology) – Aboriginal Cultural heritage; and
- Mr Martin Sullivan, (Eco Logical Australia) – Biodiversity.

The Department is satisfied that these experts are also suitably qualified and experienced to assist in the preparation of site environmental management plans in their field of expertise.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)
as nominee of the Secretary

Planning, Industry & Environment

Mr Peter Jaeger
Environment and Community Manager
Wambo Coal Pty Limited
PMB 1
Singleton NSW 2330

28/02/2020

Dear Mr Jaeger

Wambo Coal Project (DA 305-7-2003)
Endorsement of Experts

I refer to your letter dated 11 February 2020, requesting the Secretary's approval of suitably qualified persons to prepare the Extraction Plan for Longwalls 21 to 24 for the Wambo Coal Project (DA 305-7-2003).

The Department has reviewed the nominations and information you have provided and is satisfied that these experts are suitably qualified and experienced. Consequently, I can advise that the Secretary approves the appointment of the following experts to prepare the Extraction Plan for Longwalls 21 to 24:

- Mr Joshua Hunt (Resource Strategies) - Extraction Plan preparation;
- Mr James Barbato (Mine Subsidence Engineering Consultants) - Subsidence;
- Mr Rohan Lucas (Alluvium) - Surface Water;
- Dr Noel Merrick (SLR Consulting) - Groundwater;
- Mr Martin Sullivan (Eco Logical Australia) – Biodiversity; and
- Mr Peter Kuskie (South East Archaeology) - Aboriginal cultural heritage.

In relation the upcoming revisions of complex-wide management plans, to align with the commencement of United Wambo Phase 2, it is recommended that the Department's Water Group is consulted on this approach.

If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
A/Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Planning, Industry & Environment

Planning and Assessment
Energy and Resource Assessments
Contact: Melanie Hollis
Phone: 8217 2043
Email: melanie.hollis@planning.nsw.gov.au

Ms Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Pty Ltd
PMB 1
Singleton, NSW 2330

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003)
Groundwater Dependent Ecosystem Study

I refer to your recent correspondence submitting the revised Groundwater Dependent Ecosystem Study (Study), in accordance with condition B64 of Schedule 2 of the Wambo Coal Mine development consent (DA 305-7-2003).

The Department has reviewed the revised Study and considers that it adequately addresses the requirements of DA 305-7-2003. Consequently, the Secretary approves this Study.

If you have any questions in relation to the above matters, please contact Melanie Hollis on 8217 2043.

Yours sincerely,

05/02/2020

Matthew Sprott
Director
Resource Assessments
as nominee of the Secretary

Summary of Historic Stakeholder Consultation i.e. for WCPL's Groundwater Monitoring Program (versions 8 to 12)

GWMP Version	Consultation
8	• Version 8 provided to DPI Water, Resource Regulator (formerly DRE), EPA and DPIE as part of an Extraction Plan submission in October 2015. • Comments were received from DPIE in October 2015. • Comments were received from DPI Water in November 2015.
9	• Version 9 provided to DPI Water, DRE, EPA and DPIE as part of an Extraction Plan submission in October 2015. • Comments received from DPIE in October 2015 and DPI Water in November 2015. • Version 9 was approved by DPIE in November 2015.
10	• Version 10 was provided to DPI Water and EPA in December 2016 for consultation. • Version 10 was provided to DPI Water, Resource Regulator, EPA and DPIE as part of an Extraction Plan submission in January 2017. • Comments were received from DPIE in May 2017 and July 2017. • No comments were received from DPIE Water, Resource Regulator or EPA.
11	• Version 11 was submitted to DPIE for approval as a component of the Extraction Plan for South Bates Underground LW11-16. • DPIE Water provided comments in correspondence dated 17 December 2017. • In providing advice on MOD 17 to DA 305-7-2003, the Independent Expert Scientific Committee (IESC) made comments in correspondence dated 31 July 2017.
12	• Version 12 of the GWMP, which addressed IESC and DPIE comments following MOD17 approval and included a Summary of Commitments, was submitted to DPIE for approval in March 2018, as a component of the Extraction Plan for South Bates Underground Extension LW17-20. • Version 12 was approved on 4 June 2019.

Consultation for this GWMP (for Phase 2 Activities at the Wambo Coal Mine)

Stakeholder	Consultation
DPIE	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided 26 August 2020 via the DPIE - Major Projects Planning Portal. Minor comments received 18 November 2020 which have been addressed in Version 2.
EPA	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided to the EPA 26 August 2020 via the DPIE - Major Projects Planning Portal. The EPA provided correspondence dated 4 September 2020 advising that it is not the role of the EPA to review management plans. No further comments received.
DPIE Water	Copy of draft Version 1, prepared for the commencement of Phase 2 activities at the Wambo Coal Mine provided to the DPIE Water via the DPIE - Major Projects Planning Portal 26 August 2020. DPIE requested the WMP be sent directly to nrar.servicedesk.@industry.com.au. A copy of the WMP was sent to NRAR 31 August 2020. No comments have been received.

DOC20/707501-2

Wambo Coal Pty Ltd
134 Jerrys Plains Road
WARWORTH NSW 2330

Returned via the Major Projects Portal

4 September 2020

Dear Sir/Madam

Wambo Open Cut Coal Mine Draft Water Management Plan (DA305-7-2003-i-PA-26)

Reference is made to your request on 28 August 2020 via the Department of Planning, Industry and Environment's major projects portal requesting the Environment Protection Authority (EPA) to review and comment on the draft Wambo Coal Mine Water Management Plan (WMP), Doc No. WA-ENV-MNP-509 incorporating Site Water Balance, Wambo erosion and sediment control plan, surface water management plan and groundwater management plan.

The EPA encourages the development of such plans to ensure that licensees have determined how they will meet their statutory obligations and designated environmental objectives.

Being a regulatory authority, the EPA's role is to set environmental management objectives rather than being directly involved in the development of strategies to achieve those objectives. Accordingly, the EPA has not reviewed this management plan.

If you have any questions about this matter, please contact Jenny Lange on 02 4908 6891 or by email to hunter.region@epa.nsw.gov.au

Yours sincerely

JOCK DUNCAN
Acting Unit Head
Regulatory Operations Regional North

Phone 131 555
Phone 02 9995 5555
(from outside NSW)

TTY 133 677, then
ask for 131 155

Locked Bag 5022
PARRAMATTA
NSW 2124

4 Parramatta Square
12 Darcy Street
PARRAMATTA NSW
2150

info@epa.nsw.gov.au
www.epa.nsw.gov.au
ABN 43 692 285 758

APPENDIX B: GWMP Summary of Commitments

Groundwater Management Plan (GWMP) Version 1 - Summary of Commitments

Note: The list of commitments in this appendix is in addition to those explicitly required by Development Consent conditions.

GWMP Section	Commitment	Timing
3.5	The site water balance will be recalculated on an annual basis and reported in the Annual Review.	Annually
3.6 and 5.3	Periodic re-calibration of the hydrogeological model, based on observed piezometric heads and groundwater inflow data.	As required
4.0	Triggers will be used to determine if the groundwater impact investigation procedure or Trigger Action Response Plan (TARP) in **Section 7.0** should be initiated.	Ongoing
4.1.1	Establish trigger levels for replacement bores (for GW08 and GW09) based on modelled groundwater levels.	Once sufficient data is available
4.1.1 and 4.2	Review monitoring data annually at bores GW16 and GW17.	Annually
4.1.2	Initiate further investigation of the Permian monitoring bores if: • An adjacent landholder complains about declining groundwater levels in their bore; or • Higher than predicted inflows are recorded; or • The groundwater drawdown is greater than predicted. (Note - specific groundwater trigger values have not been established for the Permian monitoring bores).	As required
	Groundwater monitoring data from the Permian monitoring bores will be assessed and reviewed as part of the Annual Review.	Annually
4.3	Report on progress against the performance indicators in **Table 13** in the Annual Review.	Annually
	In the event that a complaint is received relating to groundwater, it will be handled in accordance with the complaint's management protocol (**Section 8.0**).	As required
4.4	Report on progress against the performance indicators in **Tables 14** and **15** in the Annual Review.	Annually
5.1 and 5.2	Use actual monitoring data in the annual Site Water Balance and groundwater model validation.	As required
5.3	Organise an independent review of the model every 3 years.	3 yearly
5.4	Decommissioning of monitoring bores will be undertaken in accordance with NUDLC (2012) requirements.	As required
5.5	Permanently seal all exploration drill holes not required for monitoring purposes.	As required
5.6	Generic training on the aspects of the GWMP will be provided to all employees and contractors through the WCPL Site Induction process.	Ongoing
	Selected site personnel whose duties directly involve the management of water at Wambo will undertake specific training with respect to site Operational Procedures which incorporate water management measures.	As required
5.7	Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this GWMP, consent conditions, and other relevant approvals, licenses, and guidelines. Audit requirements are detailed in the **EMS**.	As per **EMS**

GWMP Section	Commitment	Timing
6.0	Data collected will: • Enable verification and refinement (where necessary) of the hydrogeological model developed for Wambo (**Section 5.3**); • Be used in the continued development of groundwater investigation triggers (**Section 4.0**); and • Provide input to annual reviews of groundwater monitoring data (**Section 9.1.1**).	As required
6.1.1	Install additional monitoring bores so that at least two years of monitoring data is collected prior to undermining.	2 years prior to mining
	Construct all new monitoring bores in accordance with the Minimum Construction Requirements for Water Bores in Australia (NUDLC, 2012).	As required
	Bi-monthly monitoring of groundwater levels, pH and EC will be undertaken at all standpipe bores in the groundwater monitoring program.	Bi-monthly
	Comprehensive analysis of major ions will occur at each standpipe bore annually.	Annually
	VWPs, which continuously record groundwater levels, are downloaded quarterly.	Quarterly
6.1.2	Dewatering volumes and underground water levels will be recorded.	As required (during pumping)
	Data collected from the underground dewatering volumes will be incorporated into the site water balance on an annual basis	Annually
	Where the annual assessment for mine inflows to the South Bates Underground Mine exceeds the peak estimate predicted by HydroSimulations (2017) (316 ML/year) by 50% or more (that is more than 474 ML/year), WCPL will: • Investigate if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities; • Where there is an increased take from the Lower Wollombi Brook Water Source, investigate any influence on a low flow cease to pump criteria specified in the HUA WSP; • Define the mine inflow volume value triggering this response procedure; and • Submit a report summarising the assessment to DPIE Water.	Annually
	Notify DPIE Water as soon as practicable on becoming aware of any take of water in excess of the licensed entitlement.	As required
	Investigate an unexpected increase in water make or change in water quality of mine water storages.	As required
6.1.3	Monitoring bores P114, P116 and P202 and surface water quality from Wambo South Water Dam will be analysed to detect potential sub-surface water loss. Water quality analysis will include major cations and major anions (annually) in addition to pH and EC (bi-monthly).	Bi-monthly and annually
	South Wambo Dam will only be recommissioned after further geotechnical assessment, structural repairs and following relevant consultation NSW DSC and NSW DPIE Resources Regulator.	If required
6.1.4	Develop a program to investigate and monitor potential water loss from the Montrose Dam prior to construction.	Prior to construction
6.1.5	Install GW36 in the channel of North Wambo Creek, near the River Oak riparian grassy tall woodland, to monitor potential impacts.	2020
7.3	Following the receipt of groundwater monitoring results, a data review will be undertaken.	On receipt of results

GWMP Section	Commitment	Timing
	In the event that a trigger level is exceeded, or a complaint is received in relation to loss of groundwater supply, an investigation will be undertaken as soon as possible. The investigation will include a detailed review of monitoring data trends and climatic information along with operational activities and surrounding land uses, to determine if the impact on groundwater is a result of Wambo's activities.	As required
	If the investigation identifies actual groundwater impacts and attributes those impacts to Wambo's activities, WCPL will implement the adaptive management process in **Section 7.1**. Appropriate remediation measures will be developed and implemented in consultation with relevant government agencies and affected landowners, as required.	As required
	The outcomes of this process will be reported in the Annual Review.	Annually
	WCPL will notify and report to DPIE and any other relevant government departments in accordance with **Section 9.2.2**.	As required
7.3	WCPL will respond to identified groundwater impacts in accordance with the procedures and TARPs and processes described in **Section 7.3**.	As per TARPs
7.4	In the event that WCPL identifies a failure to comply with a statutory requirement, WCPL will: • Undertake an investigation into the failure; • Identify suitable strategies or actions to be implemented to address the failure (and avoid a recurrence of the failure); and • Report the non-compliance in accordance with the requirements of the development consents.	As required
8.0	All groundwater related community complaints will be recorded within the Community Complaints Register.	As received
	The Monthly Environment Monitoring Report will include details of all community complaints.	Monthly
9.1.1	Review Wambo's performance against management measures outlined in the GWMP as part of the Annual Review.	Annually
9.1.2	Every year the site water balance, surface water take and groundwater model will be validated by comparing predicted results to monitoring results collected over the life of the development. This will be undertaken as part of the Annual Review process.	Annually
	Every five years the validity of the model predictions will be assessed and if the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for simulation of mining.	5 yearly
9.1.3	Review and, if necessary, revise the GWMP with any review of the WMP. Resubmit to DPIE as required.	As required
9.2.1	Report any significant findings regarding the implementation of this GWMP in the WCPL Annual Review.	Annually
	Report details of any incidents or non-compliances relating to groundwater in the WCPL Annual Review.	Annually
	Report on water extracted or discharged from the site each year (direct and indirect) in the Annual Review, including water taken under each water licence.	Annually
	Yearly reporting of the water level and quality results from the monitoring network will be included in the Annual Review. An experienced hydrogeologist will review measured water levels and determine when water levels deviate significantly from that predicted by the groundwater model and determine the reason for this deviation. The review will consider the impact of mining, and other factors that could result in declining water levels including climatic conditions, rainfall recharge and pumping from private (and mine owned) bores.	Annually
	The Annual Review will also identify if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suites should be undertaken.	Annually
9.2.2	Report incidents as per the **WMP**.	As required

GWMP Section	Commitment	Timing
9.2.3	Groundwater monitoring results will be made publicly available on the WCPL website.	Monthly

ATTACHMENT 5

UNITED WAMBO AND WAMBO COAL WATER MONITORING PROGRAM

UNITED WAMBO
JOINT VENTURE

GLENCORE

Peabody

UNITED WAMBO OPEN CUT AND WAMBO WATER MONITORING PROGRAM

Document No. WA-ENV-MNP-509.8
November 2020

UNITED WAMBO
JOINT VENTURE
GLENCORE

Peabody

Document Control

Document No.	WA-ENV-MNP-509.8
Title	United Wambo Open Cut and Wambo Water Monitoring Program
General Description	Water monitoring program for the Wambo Coal Mine and United Wambo Open Cut Coal Mine
Document Owner	WCPL Environment & Community Manager

Revisions

Rev No	Date	Description	By	Checked	Signature
1	August 2020	New document detailing the shared water monitoring program for the Wambo Coal Mine and United Wambo Open Cut Coal Mine. Addresses monitoring requirements associated with Wambo's and United Wambo's statutory approvals including development approvals (DA305-7-2003 & SSD7142) and Environment Protection Licences (529 & 3141).	WCPL	CB	
2	November 2020	Revised to address minor comments from DPIE	WCPL	-	

UNITED WAMBO
JOINT VENTURE
GLENCORE

Peabody

CONTENTS

1.0 INTRODUCTION 1

1.1 PURPOSE AND OBJECTIVE 1
1.2 SCOPE 1
1.3 RELATIONSHIP TO OTHER MANAGEMENT PLANS 2
1.4 PREPARATION OF THE WMPROG 3
1.5 STAKEHOLDER CONSULTATION 3

2.0 PLANNING 4

2.1 STATUTORY REQUIREMENTS 4
2.2 BASELINE DATA 4
2.3 TRIGGERS AND PERFORMANCE CRITERIA 4
2.4 CHANGES TO MONITORING INFRASTRUCTURE, PROGRAM OR LOCATION 4

3.0 WATER MONITORING PROGRAM 5

3.1 SURFACE WATER MONITORING PROGRAM 5
3.2 GROUNDWATER MONITORING PROGRAM 5
3.3 MONITORING METHODOLOGY 5
3.4 DATA MANAGEMENT 7
3.5 DATA SHARING 8
3.6 DATA REVIEW AND INVESTIGATION 8

4.0 REVIEW AND REPORTING 9

4.1 REVIEW 9
4.2 REPORTING 9

5.0 RESPONSIBILITIES 10

5.1 WAMBO 10
5.2 UNITED WAMBO 11

6.0 REFERENCES 12

6.1 RELATED DOCUMENTS 12
6.2 REFERENCE INFORMATION 12

APPENDIX A: EVIDENCE OF CONSULTATION 13

APPENDIX B: MONITORING PROGRAM TABLES AND FIGURES 16

UNITED WAMBO
JOINT VENTURE
GLENCORE

Peabody

Tables

Table 1: WMProg Responsibilities - Wambo 10
Table 2: WMProg Responsibilities- United Wambo 11
Table 3: Related Documents 12
Table 4: Reference Information 12

Figures

Figure 1: Approved Mining Operations – Phase 2 1
Figure 2: Wambo and United Wambo Water Management Plans 2

1.0 Introduction

1.1 Purpose and Objective

This Water Monitoring Program (WMProg) has been developed by Wambo Coal Pty Ltd (WCPL) to consolidate the surface and ground water monitoring requirements associated with:

- Wambo Coal Mine (Wambo), operated by WCPL; and
- United Wambo Open Cut Coal Mine (United Wambo), operated by Glencore on behalf of the United Wambo Joint Venture (UWJV).

The objective of this WMProg is to provide a consolidated water monitoring program that satisfies the statutory requirements for water monitoring at Wambo and United Wambo and assist in maintaining consistent monitoring of the integrated water management system and regional groundwater monitoring network for the two sites.

This WMProg is a shared document, which is maintained by WCPL. Any changes to this document will be undertaken in consultation with UWJV. The revised document will be submitted to the Planning Secretary of the NSW Department of Planning, Industry and Environment (DPIE) by WCPL.

1.2 Scope

This WMProg applies to surface and ground water monitoring for all Phase 2 operational activities associated with Wambo and United Wambo, including underground and open cut mining operations, Coal Handling and Preparation Plant (CHPP) and train loading operations (**Figure 1**).

The WMProg also includes monitoring of regional groundwater bores and surface water monitoring sites outside the project approval boundaries.

This WMProg applies to all employees and contractors, engaged by WCPL or UWJV, who are responsible for water monitoring activities.

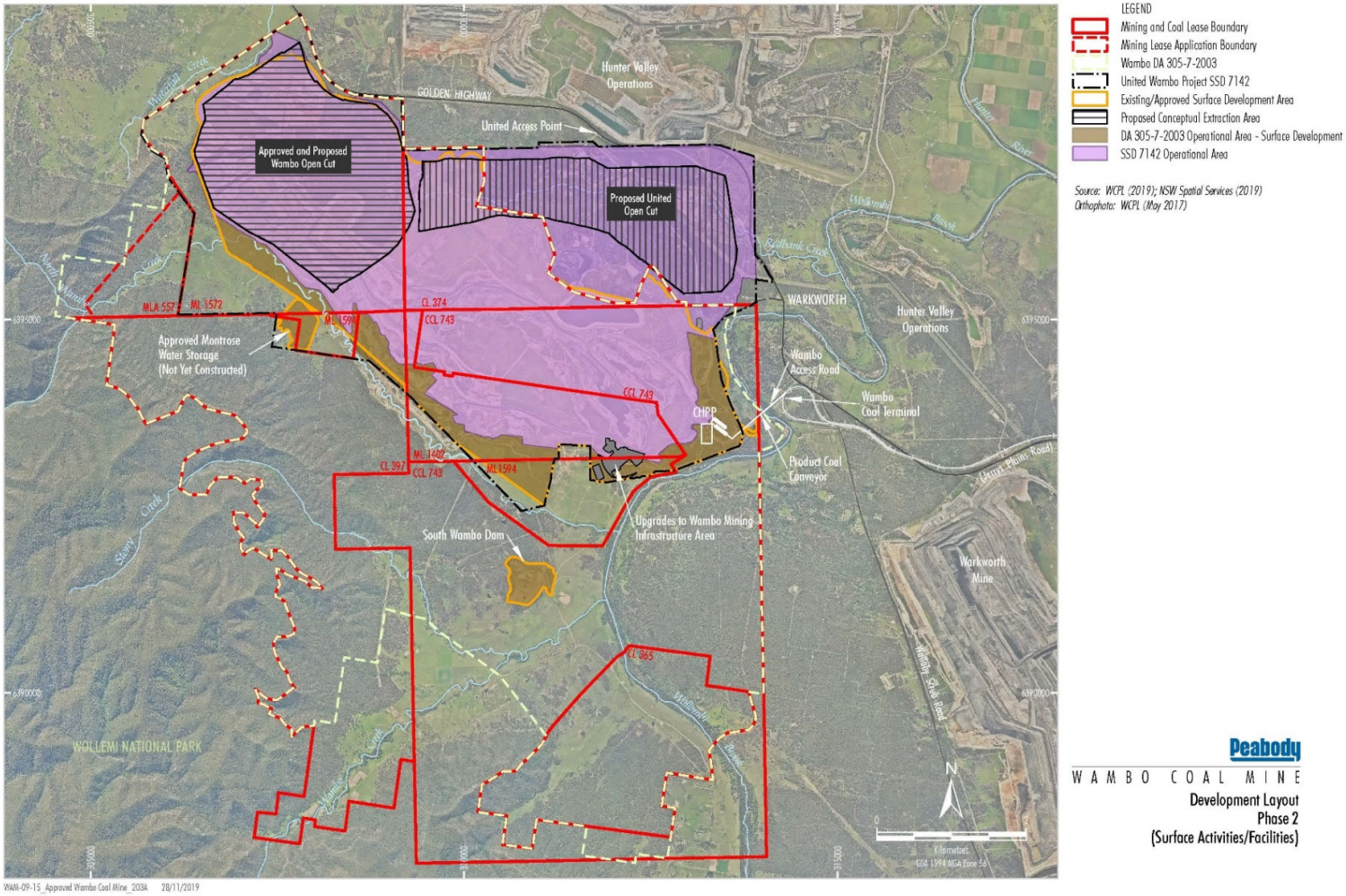


Figure 1: Approved Mining Operations – Phase 2

1.3 Relationship to other Management Plans

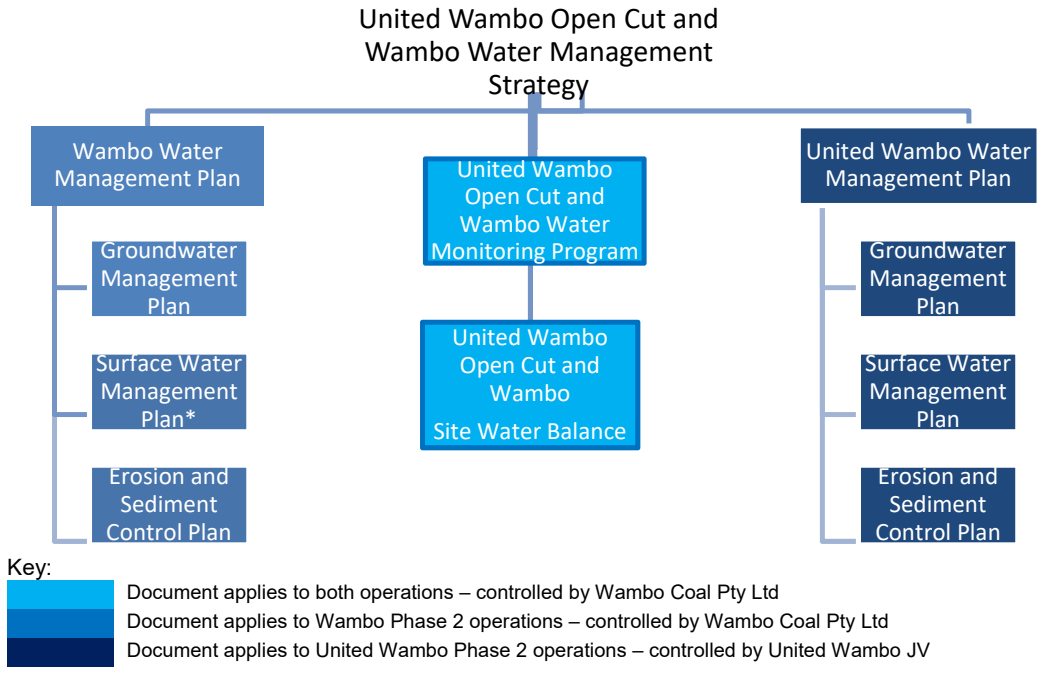
This WMProg is part of a set of documents that together form the Water Management Plans (WMPs) for Wambo and United Wambo (**Figure 2**).

Statutory approvals for both Wambo and United Wambo require the WMP to include proposed monitoring programs to monitor impacts from the respective operations. Monitoring requirements for water are described in the following documents:

- Wambo Surface Water Management Plan (***Wambo SWMP***) (WA-ENV-MNP-509-2);
- Wambo Groundwater Management Plan (***Wambo GWMP***) (WA-ENV-MNP-509-1);
- United Wambo Surface Water Management Plan (***UW SWMP***) (UWOC-1689771511-364); and
- United Wambo Groundwater Management Plan (***UW GWMP***) (UWOC-1689771511-370).

As part of the *United Wambo Open Cut Project Environmental Assessment* (Umwelt 2016), WCPL's site water balance (and salt balance) was expanded to include the United Wambo Open Cut project. The ***United Wambo Open Cut and Wambo Site Water and Salt Balance*** (***SWSB***) (WA-ENV-MNP-509.4) is now a shared document, managed by WCPL. The ***SWSB*** will be updated annually using monitoring data from this WMProg.

This WMProg should be read in conjunction with the other components of the Wambo and United Wambo Water Management Plans, particularly the documents mentioned above.



* Wambo SWMP incorporates the North Wambo Creek Diversion Management Plan

Figure 2: Wambo and United Wambo Water Management Plans

1.4 Preparation of the WMProg

This WMProg has been prepared using information from the existing monitoring programs described in the Wambo and United Wambo SWMPs and GWMPs.

In recognition of the requirements of Condition B66(a) of DA305-7-2003 and Condition B52(a) of SSD7142, this WMProg prepared by WCPL has been reviewed by suitably experienced and qualified persons, i.e. Ms Claire Stephenson from SLR Consulting (Groundwater) and Chris Bonomini from Umwelt Australia Pty Ltd (other components of the water management plans).

Correspondence from DPIE endorsing Ms Stephenson and Mr Bonomini is included in the Wambo and United Wambo water management plans.

1.5 Stakeholder Consultation

1.5.1 Historic Consultation

Consultation has previously been undertaken for the development of the Wambo and United Wambo water management plans as well as for the *United Wambo Open Cut Project Environmental Impact Statement (EIS)* (Umwelt, 2016). This included consultation relating to the water monitoring programs for Wambo and United Wambo.

Details of this consultation are included in the EIS (Umwelt 2016) and in the Wambo and United Wambo SWMPs and GWMPs.

1.5.2 Consultation for this WMProg

Consultation specifically related to the development of this WMProg is described below: e,g,

- Copies of the Water Management Plan and sub-components provided for consultation to DPIE Water and the EPA on Wednesday 26 August 2020.
- EPA provided correspondence 4 September 2020 to advise that the role of the EPA is not to provide advice on management plans; and
- No comments were received from DPIE Water.

The WMProg was approved by DPIE 20 November 2020. Correspondence specifically related to this WMProg is attached as **Appendix A**.

2.0 Planning

2.1 Statutory Requirements

This WMProg has been prepared to fulfil all statutory requirements relating to surface and ground water monitoring at Wambo and United Wambo. These requirements are detailed in the respective water management plans for Wambo and United Wambo.

2.2 Baseline Data

Baseline data relevant to this WMProg is included in the respective water management plans for Wambo and United Wambo. Management triggers for a number of surface and ground water monitoring locations has been established based on a statistical analysis of this data.

2.3 Triggers and Performance Criteria

Management triggers and performance criteria relevant to this WMProg are included in the respective water management plans for Wambo and United Wambo.

Where triggers have been developed for individual monitoring locations, these have been included in the monitoring program (refer **Section 3.0** and **Appendix B**).

2.4 Changes to Monitoring Infrastructure, Program or Location

Changes to the water monitoring infrastructure, program or locations may be required for a number of reasons e.g. equipment failure or blockage, inability to access sites due to safety, sites impacted by mining, additional monitoring site required, changes to monitoring parameters, frequency, addition of or change to triggers etc.

Where a change is required, the party (i.e. Wambo or United Wambo) proposing the change will consult with the other party **prior to** any changes being made.

Details of the proposed change will be provided including:

- The monitoring location affected by the change; and
- The nature of the change e.g. equipment replacement, site removal or relocation due to mining impacts, new monitoring site, changes to existing monitoring parameters or frequency, addition of or change to triggers etc.

If a monitoring site requires relocation or a new monitoring site is required, the following details will also be provided:

- Details relating to new monitoring location e.g. proposed site ID, coordinates (easting, northing), site description, monitoring program, responsibility for monitoring, triggers etc
- Whether any new approvals are required; and
- Access requirements for the new site

Any changes to the water monitoring network will trigger a review of this WMProg (refer **Section 4.1.2**).

3.0 Water Monitoring Program

A general description of the water monitoring program for Wambo and United Wambo is provided in the respective water management plans for Wambo and United Wambo.

The water monitoring locations, parameters, frequency and methodology of monitoring are outlined below and included as tables and figures in **Appendix B**.

The water monitoring program is split into Surface and Ground Water monitoring. These programs are then split into 3 components:

1. Combined monitoring:
2. Wambo Only monitoring; and
3. United Wambo Open Cut Only monitoring.

Monitoring parameters and frequency may differ between the three program components, depending on statutory requirements and commitments made in the respective water management plans (refer to respective water management plans for more detail).

3.1 Surface Water Monitoring Program

The surface water monitoring program is summarised in **Tables A, B and C (Appendix B)** and shown on **Figure A (Appendix B).** The program includes:

- Water quality monitoring in creeks, licensed discharge points (LDPs) and water storage dams and voids;
- Stream flow monitoring in creeks; and
- Discharge monitoring at LDPs.

A number of monitoring locations are monitored for internal management purposes – results from this monitoring are not shared publicly. These sites are identified in the monitoring program tables in **Appendix B**.

3.2 Groundwater Monitoring Program

The groundwater monitoring program is summarised in **Tables D, E and F (Appendix B)** and shown on **Figure B (Appendix B).** The program includes monitoring of water quality and depth to groundwater in bores within the project approval boundaries as well as regional bores.

3.3 Monitoring Methodology

3.3.1 Surface Water

Surface water quality sampling and analysis will be conducted in accordance with *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales (DEC, 2004); Australian Standard/New Zealand Standard (AS/NZS) 5667:1998 Parts 1, 4 and 6*; and the requirements of the Hunter River Salinity Trading Scheme (HRSTS).

Field physio-chemical water quality parameters (at a minimum pH and electrical conductivity) will be measured using calibrated equipment.

Flow monitoring will be undertaken using instream flow monitoring equipment. This equipment will be calibrated and maintained to manufacturer's specifications by qualified, experienced field technicians.

3.3.2 Groundwater

The groundwater monitoring program was developed with consideration of the *Murray-Darling Basin Groundwater Quality. Sampling Guidelines. Technical Report No 3* (Murray-Darling Basin Commission [MDBC, 1997]).

In general, the groundwater monitoring methodology will include the following:

- assessment of groundwater level (manual measurement and datalogger download prior to purging/sampling);
- sampling of groundwater (direct sampling, sampling after purging, or low-flow sampling); and
- implementation of a quality control plan including appropriate chain-of-custody for laboratory analysis and provision of appropriate documentation.

3.3.2.1 Groundwater Level and Purging

The static groundwater level within each groundwater monitoring bore will be measured to the nearest millimetre prior to purging (if required) or sampling, using an electronic groundwater level dip meter (dipper) referenced to a known (and consistent) surveyed point at the top of the bore casing. The groundwater level below top of casing will be corrected to mAHD using the survey data. Recorded groundwater level will be tabulated in both metres below top of casing (mbTOC) and mAHD.

The base of the bore will be measured and recorded to the nearest millimetre periodically by lowering the dipper to the base of the bore until it touches the bottom.

Following water level measurement, the monitoring bore will be purged using an appropriate pump (selected based on the hydraulic characteristics of the bore) and a groundwater sample will be collected. If insitu low-flow sampling techniques are used (e.g. micropurge or hydrosleeve), purging will not be required.

Field physio-chemical water quality parameters (at a minimum pH and electrical conductivity) will be measured using calibrated equipment. Field parameters will also be measured during purging (if applicable).

The groundwater monitoring bore will be sufficiently purged when one of the following criteria is achieved (whichever occurs first):

- three bore volumes of water have been purged;
- the bore is purged until no more water can be removed (considered dry); or
- the water quality parameters have stabilised within 10 per cent over three consecutive recorded measurements.

In cases where a water level datalogger is installed in a monitoring bore, it will be removed from the bore and checked/maintained as necessary before being re-calibrated (if required) and returned to the bore at a known depth below the top of casing.

At the completion of purging (if applicable), groundwater samples will be collected.

3.3.3 Sample Collection

Water samples will be collected following the protocols outlined in the *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC 2000). Samples will be collected in dedicated laboratory-supplied sampling bottles with sufficient volume to satisfy the requirements for all analytes.

The following details will be recorded at the time of sampling for all groundwater monitoring samples:

- the date(s) and time(s) at which the sample was taken;
- the point at which the sample was taken; and
- the name of the person who collected the sample.

The samples will be placed into a chilled ice-chest for transport to the nominated laboratory(s). Where required (i.e. for dissolved metals analysis), the water sample will also be filtered in the field using a dedicated 0.45 micrometre water filter to remove fine suspended particles.

Cross-contamination of samples will be prevented through either dedicated tubing at the pump, dedicated sampling devices, or by decontamination of equipment with phosphate-free detergent and clean water between sampling locations.

3.3.4 Quality Assurance and Documentation

Quality assurance and control protocols during sampling will be undertaken in accordance with ANZECC (2000) to ensure the integrity of the dataset.

Samples will be transported to a NATA-accredited laboratory(s) under appropriate documented chain-of-custody. Laboratory guidelines on holding times for samples will be complied with where practicable.

Laboratory and field results will be checked for accuracy on receipt of all sampling data and laboratory certificates of analyses. Errors or discrepancies will be cross-checked with field and laboratory records and further investigation initiated if required.

In the event of an apparently anomalous result, Wambo or United Wambo (depending on who is responsible for the monitoring site – refer tables in **Appendix B**) will organise a re-test as soon as is practicable to do so.

3.4 Data Management

3.4.1 Wambo

Water monitoring data from monitoring sites managed by WCPL is collated and stored in WCPL's environmental monitoring database. Validated data from the monitoring program will be entered into Wambo's Environmental Monitoring Database in a form suitable for analysis.

3.4.2 United Wambo

Water monitoring data from monitoring sites managed by UWJV is collated and stored in UWJV's environmental monitoring database. Validated data from the monitoring program will

be entered into the GCAA Environmental Monitoring Database (EMD) in a form suitable for analysis.

3.5 Data Sharing

The Water Monitoring program contains monitoring sites for the United Wambo open cut, the Wambo Mine and sites shared for both operations. Where data sharing is required, spreadsheets containing monitoring data will be shared bi-monthly.

3.6 Data Review and Investigation

The monitoring program clearly identifies the triggers applicable to individual monitoring sites and who is responsible for responding when trigger thresholds are exceeded (refer **Tables A-F** in **Appendix B**). Responses to these triggers have been developed and included in the respective water management plans for Wambo and United Wambo.

Upon receipt of monitoring results, the following review processes will be undertaken:

- Data will be compared to the impact assessment criteria where applicable (refer **Section 2.3**).
- If result(s) do not meet impact assessment criteria a response procedure will be initiated in accordance with the respective SWMP or GWMP.

Each operation will undertake an annual review of monitoring data and compare the results to the water impact assessment criteria. Results of the review will be included in the Annual Review (**Section 4.2.1**).

When monitoring results exceed the impact assessment criteria or the Annual Review identifies surface or groundwater impacts, an investigation appropriate for the situation will be initiated to determine the cause. The investigation will include a review of monitoring results, climate data, mining activities and changes to land use. Further details outlining these response procedures are outlined in the respective SWMPs and GWMPs.

4.0 Review and Reporting

4.1 Review

4.1.1 Environmental Performance

The performance of the water monitoring program outlined in this WMProg will be reviewed annually as part of the Annual Review (refer **Section 4.2.1**).

4.1.2 Document Review

This WMProg will be reviewed as part of any review of the Wambo or United Wambo water management plans. Any changes to the WMProg will be undertaken in consultation with United Wambo.

The WMProg will reflect any changes in environmental requirements, technology, and operational procedures.

Where significant changes to the monitoring program are proposed, the appointed expert (as outlined in **Section 1.4**) will be consulted prior to the changes being made. WCPL will also consult with DPIE Water and the NSW EPA prior to submission to the Planning Secretary for approval.

4.2 Reporting

4.2.1 Annual Review

Results of the water monitoring program will be reported annually as part of the Annual Review for Wambo and United Wambo (refer to Wambo and United Wambo water management plans for more detail).

The Annual Review will also include details of any trigger exceedances, in accordance with the requirements of the Wambo and United Wambo water management plans.

4.2.2 Reporting of Results

Internal reporting of results will be undertaken in accordance with the procedures outlined in the Wambo and United Wambo water management plans.

Water monitoring results will be made publicly available via the Wambo and United Wambo websites (refer to Wambo and United Wambo water management plans for more detail).

5.0 Responsibilities

Responsibilities for water management are described in detail in the Wambo and United Wambo water management plans. The sections below summarise the responsibilities relating to this WMProg.

5.1 Wambo

Table 1 summarises responsibilities documented in the WMProg for Wambo personnel. Responsibilities may be delegated as required.

Table 1: WMProg Responsibilities - Wambo

No	Task	Responsibility	Timing
1	Ensure the water monitoring program for Wambo Underground is implemented, as per program included in Appendix B).	WCPL Environment and Community Manager	As per program in **Appendix B**
2	Ensure the water monitoring program for shared bores (that are the responsibility of Wambo) is implemented, as per program included in Appendix B.	WCPL Environment and Community Manager	As per program in **Appendix B**
3	Facilitate access to water monitoring locations on Wambo managed land, for United Wambo personnel and contractors.	WCPL Environment and Community Manager	As required
4	Ensure all personnel undertaking monitoring are inducted, trained and authorised to perform required duties.	WCPL Environment and Community Manager	As required
5	Manage data from the monitoring program in accordance with **Section 3.4**	WCPL Environment and Community Manager	As required
6	Share data from the monitoring program with United Wambo in accordance with **Section 3.5**	WCPL Environment and Community Manager	As required
7	Assess water monitoring data from relevant monitoring sites (that are the responsibility of Wambo) against relevant trigger levels and respond in accordance with protocols and TARPs in the WCPL SWMP and GWMP**.**	WCPL Environment and Community Manager	Monthly
8	Undertake reporting of data in accordance with **Section 4.2.**	WCPL Environment and Community Manager	As required
9	Consult with United Wambo prior to any changes to monitoring infrastructure, monitoring program or location (refer **Section 2.4**).	WCPL Environment and Community Manager	As required
10	Review the WMProg in accordance with **Section 4.1.2** and update as required.	WCPL Environment and Community Manager	Annually and as required
11	Resubmit WMProg to DPIE for approval.	WCPL Environment and Community Manager	As required

5.2 United Wambo

Table 2 summarises responsibilities documented in the WMProg for United Wambo personnel. Responsibilities may be delegated as required.

Table 2: WMProg Responsibilities- United Wambo

No	Task	Responsibility	Timing
1	Ensure the water monitoring program for United Wambo Open Cut is implemented, as per program included in **Appendix B**).	UWJV Environment and Community Manager	As per program in **Appendix B**
2	Ensure the water monitoring program for shared bores (that are the responsibility of United Wambo) is implemented, as per program included in **Appendix B**).	UWJV Environment and Community Manager	As per program in **Appendix B**
3	Facilitate access to water monitoring locations on United Wambo managed land, for Wambo personnel and contractors.	UWJV Environment and Community Manager	As required
4	Ensure all personnel undertaking monitoring are inducted, trained and authorised to perform required duties.	UWJV Environment and Community Manager	As required
5	Manage data from the monitoring program in accordance with **Section 3.4**	UWJV Environment and Community Manager	As required
6	Share data from the monitoring program with Wambo in accordance with **Section 3.5**	UWJV Environment and Community Manager	As required
7	Assess water monitoring data from relevant monitoring sites (that are the responsibility of United Wambo) against relevant trigger levels and respond in accordance with protocols and TARPs in the WCPL SWMP and GWMP**.**	UWJV Environment and Community Manager	Monthly
8	Undertake reporting of data in accordance with **Section 4.2.**	UWJV Environment and Community Manager	As required
9	Consult with Wambo prior to any changes to monitoring infrastructure, monitoring program or location (refer **Section 2.4**).	UWJV Environment and Community Manager	As required
10	Review the WMProg in accordance with **Section 4.1.2** and provide any changes to WCPL[1].	UWJV Environment and Community Manager	Annually and as required

Notes to **Table 2**:
1. The WCPL Environment and Community Manager will be responsible for submitting the revised WMProg to DPIE (refer **Table 1**).

6.0 References

6.1 Related Documents

Related documents, listed in **Table 3** below, are internal or United Wambo documents directly related to or referenced from this document.

Table 3: Related Documents

Number	Title
WA-ENV-MNP-509	Wambo Water Management Plan
WA-ENV-MNP-509.1	Wambo Groundwater Management Plan
WA-ENV-MNP-509.2	Wambo Surface Water Management Plan
WA-ENV-MNP-509.3	Wambo Erosion and Sediment Control Plan
WA-ENV-MNP-509.5	United Wambo Open Cut and Wambo Site Water and Salt Balance
WA-ENV-MNP-509.6	North Wambo Creek Diversion Management Plan
WA-ENV-MNP-509.7	United Wambo Open Cut and Wambo Water Management Strategy
UWOC-1689771511-365	United Wambo Water Management Plan
UWOC-1689771511-370	United Wambo Groundwater Management Plan
UWOC-1689771511-364	United Wambo Surface Water Management Plan
UWOC-1689771511-369	United Wambo Erosion and Sediment Control Plan

6.2 Reference Information

Reference information, listed in **Table 4** below, is information that is directly related to the development of this document or referenced from within this document.

Table 4: Reference Information

Reference	Title
DA 305-7-2003	Wambo Coal Mine Notice of Modification of DA305-7-2003 (Modification 16)
EPL 529	Environment Protect Licence 529 for Wambo Coal Mine
WCPL 2003	Wambo Development Project Environmental Impact Statement (EIS), July 2003
SSD 7142	United Wambo Open Cut Coal Mine Development Consent SSD 7142
EPL 3141	Environment Protection Licence for United Wambo Coal Mine
Umwelt 2016	United Wambo Open Cut Coal Mine Project – Environmental Impact Statement (EIS)
AS/NZS 5667:1998	Australian Standard/New Zealand Standard (AS/NZS) 5667:1998 Parts 1, 4 and 6
DEC, 2004	Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales
MDBC, 1997	Murray-Darling Basin Groundwater Quality. Sampling Guidelines. Technical Report No 3

APPENDIX A: Evidence of Consultation

UNITED WAMBO
JOINT VENTURE
GLENCORE

Peabody

NSW GOVERNMENT | Planning, Industry & Environment

Nicole Dobbins
Senior Environmental Advisor
Wambo Coal Mine
PMB 1
Singleton NSW 2330

20/11/2020

Dear Ms Dobbins

Wambo Coal Mine (DA 305-7-2003-i)
Water Management Plan

I refer to the Wambo Water Management Plan (WMP), submitted in accordance with condition B66 of the approval for the Wambo Coal Mine (DA 305-7-2003-i). I understand that revisions to the WMP are required prior to Phase 2 of operations between the Wambo Coal Mine and United Wambo Joint Venture, which are scheduled to start on 1 December 2020.

I note that the WMP includes the following sub – plans:
- Site Water Balance;
- Salt Balance;
- Erosion and Sediment Control Plan;
- Surface Water Management Plan (including the North Wambo Creek Diversion Management Plan);
- Groundwater Management Plan; and
- Water Monitoring Plan.

The Department notes that the Site Water Balance, Salt Balance and Water Monitoring Program cover both the Wambo Coal Mine and United Wambo Joint Venture operations.

The Department has carefully reviewed the WMP and is satisfied that it adequately addresses the relevant requirements of the approval. Accordingly, the Planning Secretary has approved the WMP (Revision 2, November 2020) for Phase 2 of the operations. Please continue to operate in accordance with the previously approved WMP until Phase 2 commences.

Please also ensure that the approved plan is placed on the project website at the earliest convenience. If you wish to discuss the matter further, please contact Melanie Hollis on 8217 2043.

Yours sincerely

Matthew Sprott
Director
Resource Assessments (Coal & Quarries)

as nominee of the Planning Secretary

Consultation for Water Monitoring Program

Stakeholder	Consultation
DPIE	Copy of draft Version 1, provided 26 August 2020 via the DPIE - Major Projects Planning Portal. Minor comments were received 18 November 2020 and have been addressed in Version 2.
EPA	Copy of draft Version 1, provided to the EPA 26 August 2020 via the DPIE - Major Projects Planning Portal. The EPA provided correspondence dated 4 September 2020 advising that it is not the role of the EPA to review management plans. No further comments received.
DPIE Water	Copy of draft Version 1, provided to the DPIE Water via the DPIE - Major Projects Planning Portal 26 August 2020. DPIE requested the WMP be sent directly to nrar.servicedesk.@industry.com.au. A copy of the WMP was sent to NRAR 31 August 2020. No comments have been received.

APPENDIX B: Monitoring Program Tables and Figures

UNITED WAMBO
JOINT VENTURE
GLENCORE

Peabody

Surface Water Monitoring Program

Table A: Surface Water Monitoring Program- Combined Program

United Site ID	Wambo Site ID	Former United Site ID	Site Description	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Monitoring Program	Responsibility for monitoring	Trigger[1]	Responsibility for trigger response
Water Quality									
WB01	SW40	-	Wollombi Brook - Upstream	311910	6391093	WQ – Monthly[2], full suite annually[3]	Wambo	N/A	N/A
WB02	SW03	SW03	Wollombi Brook - Pumps	312509	6392866		United Wambo	N/A	N/A
WB03	SW02	SW04	Wollombi Brook - Warkworth	314376	6395037		United Wambo	pH: 7.4-8.1 EC: 599-1947 TSS: 17-308 (low flow-high flow)	United Wambo
NWC01	SW04	-	North Wambo Creek - Upstream	306887	6396024		Wambo	N/A	N/A
NWC02	SW32a	-	North Wambo Creek - Midstream	309905	6393191		Wambo	N/A	N/A
NWC03	SW05	SW02	North Wambo Creek - Downstream	311927	6392157		Wambo	pH:7.3-8.0 EC: 1155-2350 TSS: 53-1110 (low flow-high flow)	Wambo
WFC01	SW39	-	Waterfall Creek	307194	6398519		Wambo	pH:7.3-7.9 EC: 159-435 TSS: 582-1922 (low flow-high flow)	Wambo
W08[4]	SW52	C11 Void	C11 Void	312677	6395220		United Wambo	N/A	N/A
W09[4]	SW31	-	CHPP Dams	313276	6393987		Wambo	N/A	N/A
W11[4]	SW14	-	Wambo MIA Box Cut Dam	312179	6392939		Wambo	N/A	N/A
W12[4]	SW38	-	Homestead Pit	311750	6394190		United Wambo	N/A	N/A

Notes to Table A:

1 Units: pH in pH units, EC in µS/cm and TSS in mg/L. All triggers include 10th and 90th percentile limits

2 Monthly WQ suite = pH, EC (µS/cm), TSS (mg/L) & TDS (mg/L) as well as description of flow conditions by observation (i.e. high, medium or low flow; or no flow).

3 Annual WQ suite = Monthly WQ Suite plus:
- Total Metals / Metalloids - Aluminium (Al), Arsenic (As), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Selenium (Se), Zinc (Zn), Mercury (Hg), Lead (Pb), Potassium (K), Silver (Ag), Flouride (Fl), Boron (B), Calcium (Ca), Barium (Ba), Magnesium (Mg), Cadmium (Cd), Sodium (Na);
- Nutrients - total phosphorous (P), Nitrite, Nitrate, Total Kjeldahl Nitrogen (TKN), Total nitrogen (Total N); and Ions - Chloride (Cl), Bicarbonate (CaCO3), Sulphate (SO4).

4. Data from this monitoring point is used for operational purposes and is reported internally as required. This data is not reported publicly.

Table B: Surface Water Monitoring Program- Wambo Only Program

Site ID	Site Description	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Monitoring Program	Responsibility for monitoring	Trigger[1]	Responsibility for trigger response
Water Quality							
SW01	Wollombi Brook, upstream of Wambo Coal Operations	314429	6385707	pH, EC, TSS, metals and ions (including sulfates) - monthly & during rainfall events	Wambo	N/A	N/A
SW06	South Wambo Creek upstream of Wambo Coal former operations	309056	6389550	pH, EC, TSS, metals and ions (including sulfates) - monthly & during rainfall events	Wambo	N/A	N/A
SW07	South Wambo Creek downstream of Wambo Coal former operations and junction with Stony Creek	311263	6390718	pH, EC, TSS - monthly & during rainfall events	Wambo	pH: 7.4-7.9 EC: 360-724 TSS: 29-331 (low flow-high flow)	Wambo
SW08	Stony Creek	308536	6392133	pH, EC, TSS, metals and ions (including sulfates) - monthly & during rainfall events	Wambo	pH: 6.8-7.4 EC: 288-416 TSS: 5-15 (low flow-high flow)	Wambo
SW15	Eagles Nest (Process Water Dam) (EPA ID No. 4)	313133	6393073	pH, EC, TSS, monthly & during discharge events	Wambo	pH: 6.5-9.5 (EPL 529 criteria) TSS: 120 (EPL 529 criteria)	Wambo
SW27a	North Wambo Creek (middle of diversion)	309431	6393558	pH, EC, TSS - monthly & during rainfall events	Wambo	N/A	N/A
SW41	Waterfall Creek Downstream	307257	6398952	pH, EC, TSS - monthly & during rainfall events	Wambo	N/A	N/A
USFM1	Upper reaches of North Wambo Creek	305250	6395200	pH, EC, TSS, metals and ions (including sulfates) - monthly & during rainfall events	Wambo	N/A	N/A
SW53[3]	South Wambo Dam – (EPL 529, ID No.19)	311904	6391464.	pH, EC - continuous during discharge & monthly grab sample	Wambo	N/A	N/A
US FM1	North Wambo Creek - upstream	305257	6395201	pH, EC, TSS - monthly	Wambo	N/A	N/A

Site ID	Site Description	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Monitoring Program	Responsibility for monitoring	Trigger[1]	Responsibility for trigger response
STP001	Monitoring of water quality from the sewage treatment plant discharge (EPL 529, ID No. 18)	312057	6393219	pH, EC, TSS, metals and ions (including sulfates) - monthly & during rainfall events[5]	Wambo	N/A	N/A
Flow & Volume							
FM1A	Monitoring of flow in North Wambo Creek – confluence	307013	6396135	Flow monitoring - continuous	Wambo	N/A	N/A
FM2	Monitoring of flow in North Wambo Creek – middle of diversion	308181	6395028	Flow monitoring - continuous	Wambo	N/A	N/A
FM3	Monitoring of flow in North Wambo Creek – middle of diversion	309114	6393813	Flow monitoring - continuous	Wambo	N/A	N/A
FM4	Monitoring of flow in North Wambo Creek - downstream near confluence of Wollombi Brook	311890	6392288	Flow monitoring - continuous	Wambo	20mm	Wambo
FM9	Monitoring of flow in South Wambo Creek - upstream of confluence of Stony Creek	308666	6389176	Flow monitoring - continuous	Wambo	N/A	N/A
FM10[2]	Monitoring of flow in Wollombi Brook - downstream from Wambo Coal at Warkworth	314228	6395064	Flow monitoring - continuous	Wambo	N/A	N/A
FM11[2]	Monitoring of flow in Wollombi Brook - upstream from Wambo Coal at the Bulga Village	314360	6385900	Flow monitoring - continuous	Wambo	N/A	N/A
FM12	Monitoring of flow in Stony Creek - Upstream	307607	6392828	Flow monitoring - continuous	Wambo	N/A	N/A
FM13	Monitoring of flow in Stony Creek - Downstream	309530	6391043	Flow monitoring - continuous	Wambo	20mm	Wambo
FM14	Monitoring of flow in Stony Creek - Tributary	307730	6392246	Flow monitoring - continuous	Wambo	N/A	N/A

Site ID	Site Description	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Monitoring Program	Responsibility for monitoring	Trigger[1]	Responsibility for trigger response
FM15	Monitoring of flow in South Wambo Creek	311680	6391089	Flow monitoring - continuous	Wambo	20mm	Wambo
FM16	Monitoring of flow in South Wambo Creek	311259	6390666	Flow monitoring - continuous	Wambo	N/A	N/A
US FM1	Monitoring of flow in North Wambo Creek - upstream	305257	6395201	Flow monitoring - continuous	Wambo	N/A	N/A
SW15	Eagles Nest Process Water Dam (EPA ID No. 4)	313133	6393073	Discharge volume - continuous during discharge	Wambo	250ML/day	
SW53[3]	South Wambo Dam – (EPL 529, ID No.19)	311904	6391464.	Discharge volume - continuous during discharge	Wambo	250ML/day	Wambo

Notes to Table B:

1. Units: pH in pH units, EC in µS/cm and TSS in mg/L, 20mm = Daily rainfall when flow commenced on 80% of recorded occasions
2. Gauging Stations on Wollombi Brook at Bulga (FM11) [GS21004] and Warkworth (FM10) [GS210028]
3 Subject to recommissioning

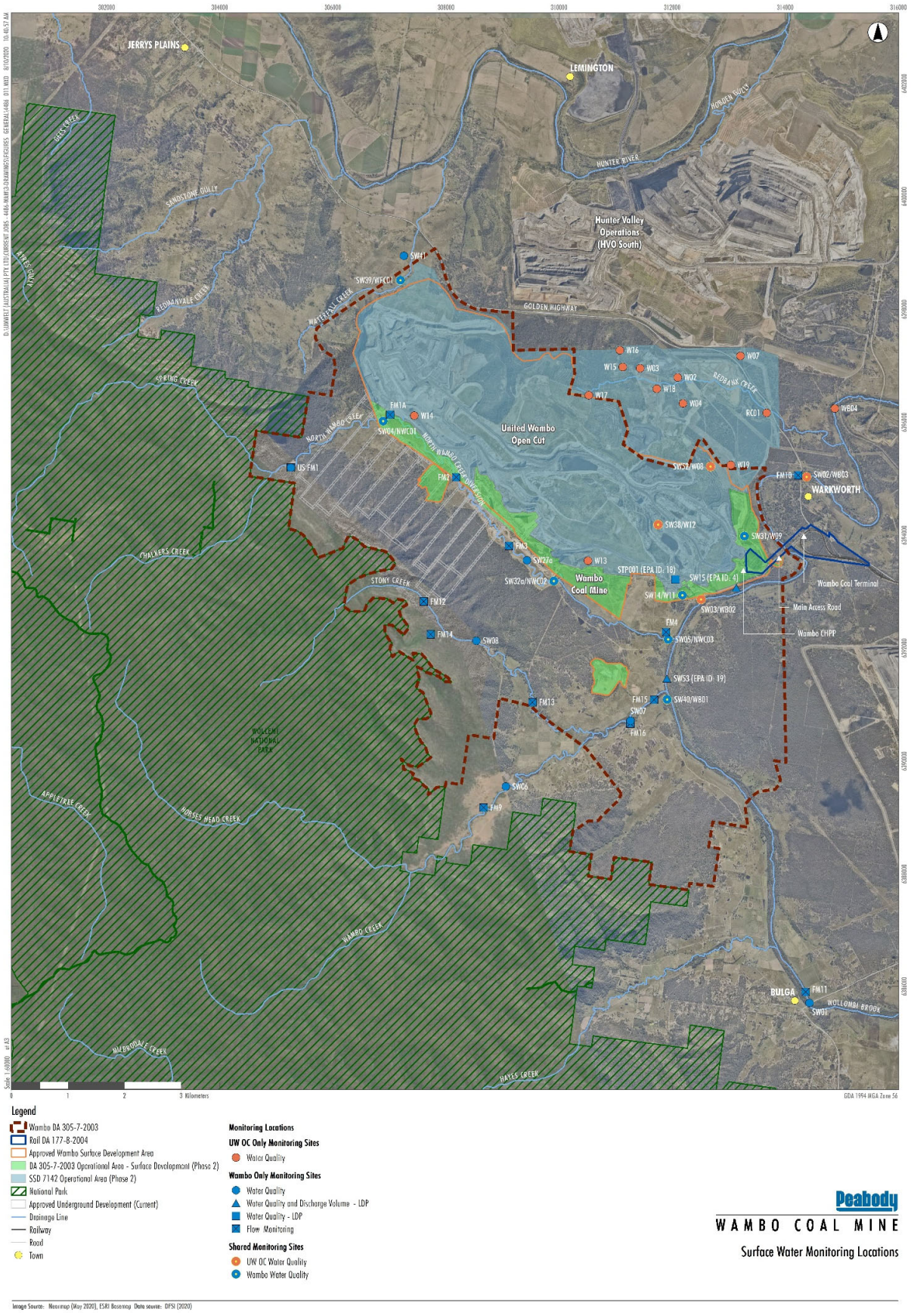
Table C: Surface Water Monitoring Program- United Wambo Open Cut Only Program

Site ID	Former Wambo Site ID	Former United Site ID	Site Description	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Monitoring Program	Responsibility for monitoring	Trigger[1]	Responsibility for trigger response
WB04	-	-	Wollombi Brook - Downstream	314874	6396247	WQ – Monthly[2], full suite annually[3]	United Wambo	N/A	N/A
RC01	-	SW05	Redbank Creek - Downstream	313672	6396168		United Wambo	pH: 7.9-8.3 Max EC: 8482 TSS: 22	United Wambo
W02[4]	-	Dam 2	Dam 2	312097	6396796		United Wambo	N/A	N/A
W03[4]	-	-	United UG Boxcut	311432	6396959		United Wambo	N/A	N/A
W04[4]	-	Dam 3	Dam 3	312191	6396336		United Wambo	pH: 6.5-8 EC: 2200 TSS: 50	United Wambo
W07[4]	-	Dam 14	Dam 14	313207	6397177		United Wambo	N/A	N/A
W13[4]	SW12	-	West Cut Dam	310510	6393550		United Wambo	N/A	N/A
W14[4]	SW54	-	Montrose Pit Inflows	307440	6396120		United Wambo	N/A	N/A
W15[4]	-	Dam 7	Dam 7	311126	6396981		United Wambo	N/A	N/A
W16[4]	-	Dam 15	Dam 15	311075	6397280		United Wambo	N/A	N/A
W17[4]	Wombat Dam	-	Wombat Dam	310526	6396481		United Wambo	N/A	N/A
W18[4]	-	-	U2	311727	6396595		United Wambo	N/A	N/A
W19[4]	-	-	U3	313035	6395248		United Wambo	N/A	N/A

Notes to Table C:

1. Units: pH in pH units, EC in µS/cm and TSS in mg/L
2. Monthly WQ suite = pH, EC (µS/cm), TSS (mg/L) & TDS (mg/L) as well as description of flow conditions by observation (i.e. high, medium or low flow; or no flow).
3. Annual WQ suite = Monthly WQ Suite plus:
   - Total Metals / Metalloids - Aluminium (Al), Arsenic (As), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Selenium (Se), Zinc (Zn), Mercury (Hg), Lead (Pb), Potassium (K), Silver (Ag), Flouride (Fl), Boron (B), Calcium (Ca), Barium (Ba), Magnesium (Mg), Cadmium (Cd), Sodium (Na);
   - Nutrients - total phosphorous (P), Nitrite, Nitrate, Total Kjeldahl Nitrogen (TKN), Total nitrogen (Total N); and
   - Ions - Chloride (Cl), Bicarbonate (CaCO3), Sulphate (SO4).
4. Data from this monitoring point is used for operational purposes and is reported internally as required. This data is not reported publicly.

Surface Water Monitoring Program



Legend

- Wambo DA 305-7-2003
- Rail DA 177-8-2004
- Approved Wambo Surface Development Area
- DA 305-7-2003 Operational Area - Surface Development (Phase 2)
- SSD 7142 Operational Area (Phase 2)
- National Park
- Approved Underground Development (Current)
- Drainage Line
- Railway
- Road
- Town

Monitoring Locations

UW OC Only Monitoring Sites

- Water Quality

Wambo Only Monitoring Sites

- Water Quality
- Water Quality and Discharge Volume - LDP
- Water Quality - LDP
- Flow Monitoring

Shared Monitoring Sites

- UW OC Water Quality
- Wambo Water Quality

Peabody

WAMBO COAL MINE

Surface Water Monitoring Locations

Image Source: Nearmap (May 2020), ESRI Basemap Data source: DPSI (2020)

Groundwater Monitoring Program

Table D: Groundwater Monitoring Program- Combined Program

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
Standpipe Monitoring Bores								
GW02[4]	309109	6389680	South Wambo Creek Alluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: N/A Max EC: 715 pH: 6.7-7.4	Wambo
GW8.2	311869	6392326	North Wambo Creek Alluvium	B	SWL and WQ - 2m – full suite[5]	Wambo	N/A	N/A
GW9.2	311743	6392326	North Wambo Creek Alluvium	B	SWL and WQ - 2m – full suite[5]	Wambo	N/A	N/A
GW10.2 & GW10.2a	311872	6392264	North Wambo Creek Alluvium & Permian	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW11[4]	309228	6389699	South Wambo Creek Alluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: N/A Max EC: 592 pH: 6.8-7.5	Wambo
GW13	313810	6388990	Regolith	A	SWL and WQ - 2m – full suite	United Wambo	N/A	United Wambo
GW15	313164	6392807	Wollombi Brook (east) Alluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: 10.4-11.1 Max EC:730 pH: 6.7-7.2	Wambo
GW16	306641	6396034	North Wambo Creek Alluvium and Regolith	A	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW17[5]	306895	6396048	Regolith	A	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW21	308647	6393378	Whybrow Coal Interburden	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW22	311335	6389535	Whybrow Coal Interburden	A	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW23	305791	6395668	North Wambo Creek – Consolidated Bedrock	B	SWL and WQ - 2m	Wambo	N/A	N/A
GW25	305299	6395288	North Wambo Creek – Consolidated Bedrock	B	SWL and WQ - 2m	Wambo	N/A	N/A
P1	312199	6395840	Interburden- Blakefield Seam	EX	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P2	312403	6395552	Interburden- Blakefield Seam	EX	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P11	312728	6395462	Alluvium	A	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
P16	313480	6394655	Wollombi Brook (west) Colluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: 7.1-7.8 Max EC:10832 pH: 7.0-7.7	Wambo
P20	313639	6394166	Wollombi Brook (west) Colluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: 7.1-8.2 Max EC:10625 pH: 7.0-7.6	Wambo
P28	311396	6392632	Whybrow Coal Overburden	EX	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P29	311820	6392560	Whybrow Coal Overburden	EX	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P106	311518	6391082	Wambo Creek Alluvium	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: 6.6-10.7 Max EC:941 pH: 6.7-7.9	Wambo
P109 (Replacement)	311215	6390766	Wambo Creek Alluvium	A	SWL and WQ - 2m – full suite	United Wambo	Depth to Water: 6.7 Max EC: 695 pH: 6.5-7.6	United Wambo
P109 (Replacement)	311215	6390766	Permian overburden	A	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P206	311777	6391261	Whybrow Interburden	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: N/A Max EC: 2630 pH: 7.3-8.1	Wambo
P316a, b & c	311255	6391087	North Wambo Creek alluvium, Weathered Permian & Permian	B	SWL and WQ – 2m - full suite[4]	Wambo	N/A	N/A
P202	311854	6391262	Whybrow Interburden	A	SWL and WQ - 2m – full suite	Wambo	Depth to Water: N/A Max EC: 8172 pH: 6.7-7.7	Wambo
P301	309360	6391466	Whybrow Interburden	A	SWL and WQ - 2m	Wambo	N/A	N/A
P315	309084	6391856	Stony Creek Alluvium/Regolith	A	SWL and WQ - 2m	Wambo	Depth to Water: N/A Max EC: 552 pH: 6.0-7.4	Wambo

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
Vibrating Wire Piezometers								
P317	307115	6394439	Regolith, Overburden, Whybrow Seam, & Wambo Seam	EX	SWL (continuous, download quarterly) and WQ – full suite	Wambo	N/A	N/A
P318	312599	6388922	Regolith, Whybrow Seam, Wambo Seam & Arrowfield Seam	EX	SWL (continuous, download quarterly) and WQ – full suite	Wambo	N/A	N/A
P319	311125	6391412	Regolith, Whybrow Seam, Wambo Seam & Interburden Sandstone	EX	SWL (continuous, download quarterly) and WQ – full suite	Wambo	N/A	N/A
P320	307573	6398890	Coal Seams - Middle Barrett, Lower Arties, Pikes Gully, Bayswater, Vaux & Warkworth	EX	SWL (continuous, download quarterly) and WQ – full suite	Wambo	N/A	N/A
P321	307999	6399498	Coal Seams – Arrowfield, Warkworth, Vaux & Bayswater	EX	SWL (continuous, download quarterly) and WQ – full suite	Wambo	N/A	N/A
UG139	306665	6395172	Coal seams – Unnamed (D & E), Blakefield , Glen Munro, Arrowfield & Bowfield	EX	SWL and WQ – full suite	United Wambo	N/A	N/A
UG166A	306488	6398075	Coal seams – Unnamed (D & E), Interburden , Glen Munro, Interburden, Arrowfield & Bowfield	EX	SWL and WQ – full suite	United Wambo	N/A	N/A

Notes to Table D:

1. A = bore currently monitored under existing GWMP, with individual trigger level for SWL, pH and EC,

   B = bore currently monitored under existing GWMP, individual trigger to be established once sufficient data has been collected

   EX = existing monitoring bore with baseline data available

   Proposed = bore proposed to be installed and included in the monitoring network

   SWL = Static water level - VWP sensors record daily pressure (converted to SWL) – download results every six months, 2m = monitoring frequency every two months, measuring water level, field pH and EC, full suite = conduct water quality testing annually for revised full water quality suite as follows:

2.
   - physio-chemical indicators – pH, EC, total dissolved solids (TDS);
   - major ions – calcium, fluoride, magnesium, potassium, sodium, chloride, sulphate;
   - total alkalinity as CaCO3, HCO3, CO3; and
   - dissolved and total metals – aluminium, arsenic, barium, boron, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, silver, vanadium, and zinc.

3. Units: Depth to Water (metres below top of casing (MBTOC) – 10th and 90th percentile triggers, pH in pH units, EC in µS/cm – 10th and 90th percentile triggers

4. Private bore

5. Annually from Oct 2020

Table E: Groundwater Monitoring Program- Wambo Only Program

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
Standpipe Monitoring Bores								
BH1	313265	6394804	Alluvium	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
BH1G	310104	6391551	Whybrow Seam		SWL – 2m	Wambo	N/A	N/A
BH2	308867	6390147	Whybrow Seam		SWL (continuous – real time)	Wambo	N/A	N/A
BH2A	308868	6390096	Whybrow Seam		SWL (continuous – real time)	Wambo	N/A	N/A
BH3	313399	6394644	Woodlands Hill Seam	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
BH4C	309323	6391080	Whybrow Seam		SWL (continuous – real time)	Wambo	N/A	N/A
BH4D			Whybrow Seam, Wambo Seam		SWL – 2m	Wambo	N/A	N/A
GW27	305736	6395614	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW28	306008	6395769	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW30	305867	6395617	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite	Wambo	N/A	N/A
GW31	306076	6395720	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW32	305876	6395581	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW33	306393	6395828	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW34	306592	6395946	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW35	307356	6395779	North Wambo Creek - Alluvium	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
GW36	306988	6396012	North Wambo Creek - Unconsolidated sediments	B	SWL and WQ - 2m – full suite[4]	Wambo	N/A	N/A
P325a	312062	6390137	Wambo Creek Alluvium	B	SWL and WQ – 2m - full suite[4]	Wambo	N/A	N/A

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
P329a	307456	6400352	Hunter River Alluvium	B	SWL and WQ – 2m - full suite[4]	Wambo	N/A	N/A
P330a	306533	6400052	Hunter River Alluvium	B	SWL and WQ – 2m - full suite[4]	Wambo	N/A	N/A
Wambo-03	311699	6392752	Wambo Seam	A	SWL (continuous – real time)	Wambo	N/A	N/A
Wambore South	311812	6392555	Wambo Seam	A	SWL – 2m	Wambo	N/A	N/A
Vibrating Wire Piezometers								
N2	308663	6393376	Permian Overburden, Whybrow Seam, Redbank Creek Seam & Wambo Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
N3	308314	6394575	Permian Overburden, Whybrow Seam, Redbank Creek Seam & Wambo Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
N5	306755	6395963	Permian Overburden, Whybrow Seam, Redbank Creek Seam & Wambo Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P316	311252	6391128	Alluvium, Regolith, Regolith Overburden & Whybrow Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P322	312572	6395026	Regolith, Whynot Seam, Interburden (between Whynot & Woodlands Hill)	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P323	309797	6393428	Overburden siltstone, Whybrow Seam, Wambo Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
	309799	6393431	Woodlands Hill Seam, Arrowfield Seam	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P324	310471	6391983	Regolith	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
	310471	6391984	Coal Seams - Whybrow, Wambo & Woodlands Hill and Interburden	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P325	311806	6390306	Siltstone & Coal Seams - Whybrow, Wambo, Whynot, Woodlands Hill & Arrowfield	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P326	310087	6392874	Overburden & Coal Seams – Wambo, Woodlands Hill & Arrowfield	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P327	303000	6400000	Overburden Sandstone & Coal Seams – Whybrow, Wambo & Whynot	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P328	303160	6398870	Overburden, Whybrow, Wambo, Whynot	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P329	307454	6400351	Vaux, Bayswater & Pikes Gully coal seams	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A
P330	306533	6400050	Vaux & Pikes Gully coal seams	EX	SWL (continuous, download quarterly)	Wambo	N/A	N/A

Notes to Table E:

1. A = bore currently monitored under existing GWMP, with individual trigger level for SWL, pH and EC,

   B = bore currently monitored under existing GWMP, individual trigger to be established once sufficient data has been collected

   EX = existing monitoring bore with baseline data available

   Proposed = bore proposed to be installed and included in the monitoring network

2. SWL = Static water level - VWP sensors record daily pressure (converted to SWL) – download results every six months, 2m = monitoring frequency every two months, measuring water level, field pH and EC, full suite = conduct water quality testing annually for revised full water quality suite as follows:
   - physio-chemical indicators – pH, EC, total dissolved solids (TDS);
   - major ions – calcium, fluoride, magnesium, potassium, sodium, chloride, sulphate;
   - total alkalinity as CaCO3, HCO3, CO3; and
   - dissolved and total metals – aluminium, arsenic, barium, boron, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, silver, vanadium, and zinc.
3. Units: Depth to Water (metres below top of casing (MBTOC) – 10th and 90th percentile triggers, pH in pH units, EC in µS/cm – 10th and 90th percentile triggers
4. Annually from Oct 2020

Table F: Groundwater Monitoring Program- United Wambo Open Cut Only Program

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
Standpipe Monitoring Bores								
GW14[4]	312478	6391358	Regolith	B	SWL	United Wambo	N/A	N/A
P12[5]	313644	6394797	Wollombi Brook (east) Alluvium	EX	SWL and WQ - 2m – full suite	United Wambo	Depth to Water: 6.3-7.7 Max EC: 1002 pH: 7.3-7.7	United Wambo
P13	313722	6394412	Wollombi Brook (east) Alluvium	EX	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P401	313660	6395336	Overburden	Proposed	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P402	313660	6395336	Arrowfield Seam	Proposed	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P404	307023	6398634	Overburden	Proposed	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P405	307025	6398634	Arrowfield Seam	Proposed	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P407	312599	6392933	Wollombi Brook (west) Alluvium	Proposed	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
P408a	307282	6399576	Hunter River Alluvium	B	SWL and WQ - 2m – full suite	United Wambo	N/A	N/A
Vibrating Wire Piezometers								
P33	313757	6394659	Unnamed Seams (C, D and E), Blakefield Seam & Arrowfield Seam	EX	SWL	United Wambo	N/A	N/A
P34	313757	6393961	Glen Munro Seam, Blakefield Seam & Bowfield Seam	EX	SWL	United Wambo	N/A	N/A
P35	313611	6395196	Interburden, Blakefiled Seam & Arrowfield Seam	EX	SWL	United Wambo	N/A	N/A
P403	308565	6397958	Overburden & Coal Seams – Arrowfield, Warkworth & Vaux	Proposed	SWL	United Wambo	N/A	N/A
P406	307681	6398872	Overburden	Proposed	SWL	United Wambo	N/A	N/A
P408	307000	6399500	Vaux, Bayswater, Pikes Gully Semas	B	SWL	United Wambo	N/A	N/A

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
UG134	313782	6395767	Interburden & Coal Seams – Warkworth, Mt Arthur, Piercefield & Vaux	EX	SWL	United Wambo	N/A	N/A
UG135	313831	6396748	Interburden & Coal Seams – Warkworth, Mt Arthur, Piercefield & Vaux	EX	SWL	United Wambo	N/A	N/A
UG147	311245	6397207	Interburden & Coal Seams – Glen Munro, Mt Arthur, Piercefield, Vaux & Broonie	EX	SWL	United Wambo	N/A	N/A
UG193	313757	6396090	Coal Seams – Glen Munro, Arrowfield, Bowfield, Warkworth, Piercefield & Broonie	EX	SWL	United Wambo	N/A	N/A
UG194	312436	6397191	Interburden & Coal Seams – Blakefield & Vaux	EX	SWL	United Wambo	N/A	N/A
UG196	312364	6397122	Interburden & Coal Seams – Glen Munro, Arrowfield, Mt Arthur & Broonie	EX	SWL	United Wambo	N/A	N/A
UG220	312522	6397233	Interburden, Overburden & Coal Seams - Arrowfield, Warkworth, Mt Arthur & Vaux	EX	SWL	United Wambo	N/A	N/A
UG224	313860	6396243	Interburden & Coal Seams - Piercefield & Vaux	EX	SWL	United Wambo	N/A	N/A
UG225	313214	6397095	Interburden, Overburden & Coal Seams - Arrowfield, Bowfield, Mt Arthur, Vaux & Warkworth	EX	SWL	United Wambo	N/A	N/A
P33	313757	6394659	Unnamed Seams (C, D and E), Blakefield Seam & Arrowfield Seam	EX	SWL	United Wambo	N/A	N/A
P34	313757	6393961	Glen Munro Seam, Blakefield Seam & Bowfield Seam	EX	SWL	United Wambo	N/A	N/A

Site ID	Easting (MGA94 Zone 56)	Northing (MGA94 Zone 56)	Targeted Unit	Current Status[1]	Monitoring Program[2]	Responsibility for monitoring	Trigger[3]	Responsibility for trigger response
P35	313611	6395196	Interburden, Blakefiled Seam & Arrowfield Seam	EX	SWL	United Wambo	N/A	N/A

Notes to Table F:

1. A = bore currently monitored under existing GWMP, with individual trigger level for SWL, pH and EC,

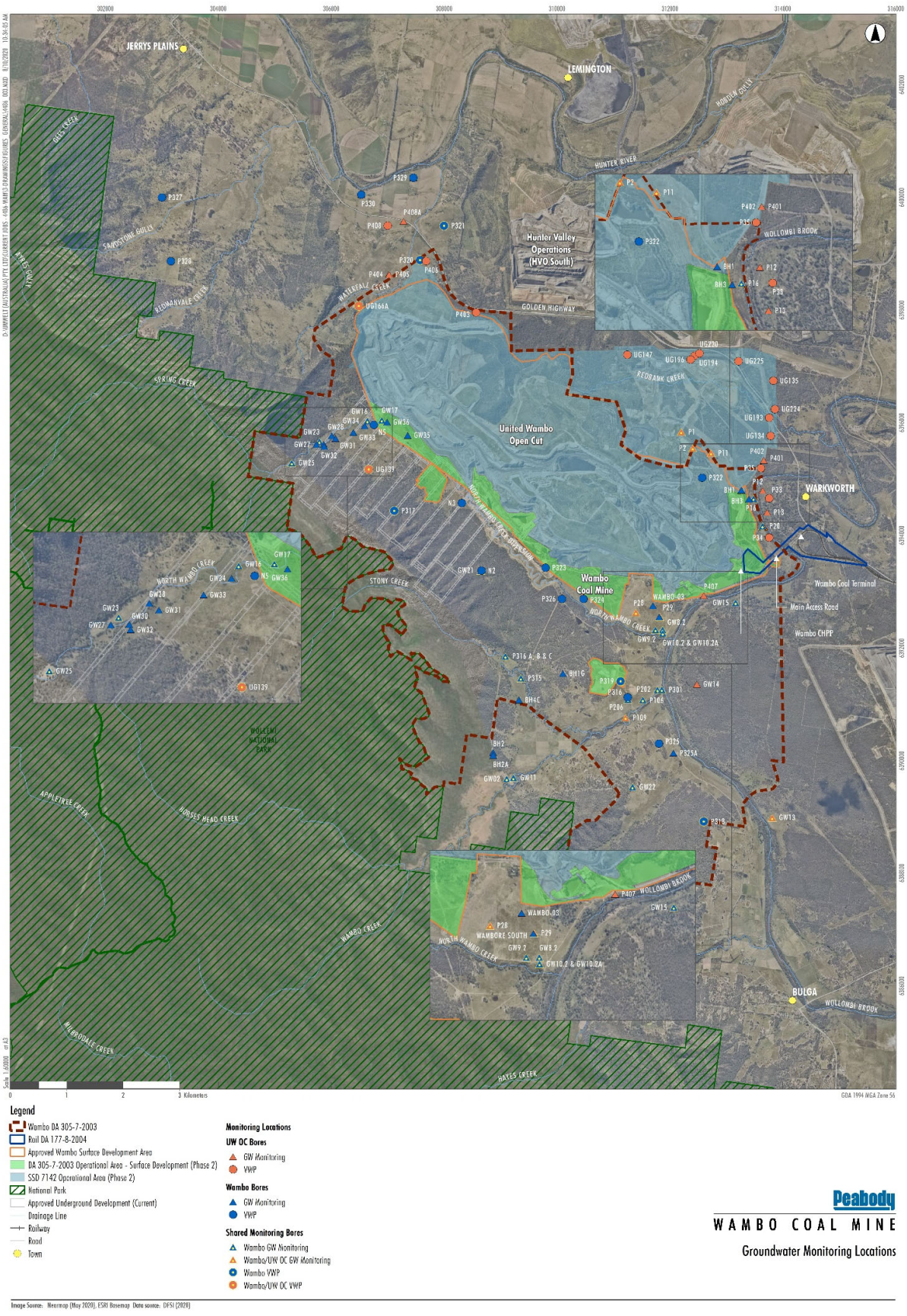
   B = bore currently monitored under existing GWMP, individual trigger to be established once sufficient data has been collected

   EX = existing monitoring bore with baseline data available

   Proposed = bore proposed to be installed and included in the monitoring network

2. SWL = Static water level - VWP sensors record daily pressure (converted to SWL) – download results every six months, 2m = monitoring frequency every two months, measuring water level, field pH and EC, full suite = conduct water quality testing annually for revised full water quality suite as follows:
   - physio-chemical indicators – pH, EC, total dissolved solids (TDS);
   - major ions – calcium, fluoride, magnesium, potassium, sodium, chloride, sulphate;
   - total alkalinity as CaCO3, HCO3, CO3; and
   - dissolved and total metals – aluminium, arsenic, barium, boron, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, strontium, silver, vanadium, and zinc.
3. Units: Depth to Water (metres below top of casing (MBTOC) – 10th and 90th percentile triggers, pH in pH units, EC in µS/cm – 10th and 90th percentile triggers
4. GW14 has been dry since December 2011
5. Water level also recorded with datalogger at this site.

Groundwater Monitoring Program Figure


JERRYS PLAINS
LEMINGTON
HUNTER RIVER
WOLLOMBI BROOK
GOLDEN HIGHWAY
Hunter Valley Operations (HVO South)
United Wambo Open Cut
Wambo Coal Mine
WARKWORTH
Wambo Coal Terminal
Main Access Road
Wambo CHPP
BULGA
REDBANK CREEK
WATERFALL CREEK
SPRING CREEK
STONY CREEK
NORTH WAMBO CREEK
WAMBO CREEK
APPLETREE CREEK
HORSES HEAD CREEK
HAYES CREEK
WOLLEMI NATIONAL PARK
Legend
Wambo DA 305-7-2003
Rail DA 177-8-2004
Approved Wambo Surface Development Area
DA 305-7-2003 Operational Area - Surface Development (Phase 2)
SSD 7142 Operational Area (Phase 2)
National Park
Approved Underground Development (Current)
Drainage Line
Railway
Road
Town
Monitoring Locations
UW OC Bores
GW Monitoring
VWP
Wambo Bores
GW Monitoring
VWP
Shared Monitoring Bores
Wambo GW Monitoring
Wambo/UW OC GW Monitoring
Wambo VWP
Wambo/UW OC VWP
Peabody
WAMBO COAL MINE
Groundwater Monitoring Locations