NOTE (non-printing)

LIDDELL

GLENCORE

EPBC Approval 2013/6908
Annual Report 2022

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1. Introduction

1.1 Background

Liddell Coal Operations (LCO) is an established open-cut mine located at Ravensworth, approximately 25 kilometres north-west of Singleton in the Upper Hunter Valley of New South Wales. LCO is operated and managed by Liddell Coal Operations Pty Limited, a wholly owned subsidiary of Glencore Coal Pty Limited (Glencore), on behalf of a joint venture between Glencore (67.5%) and Mitsui Matsushima Australia (32.5%).

Mining operations at Liddell Coal have been continuous since the 1950s. Operations prior to the 1950s were intermittent, with underground operations commencing in 1923 and open cut operations in 1946. Current open cut operations access the coal reserves previously not mined by the underground operations. The current open cut mining operation has been in operation since 1990. Figure 1-1 shows LCO's referral areas under EPBC 2013/6908.

On 24th December 2014, LCO was granted EPBC Approval 2013/6908 for a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 to expand the existing Liddell open cut coal mine operations in the Hunter Valley region in New South Wales, under the following Controlling Provisions:

- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 and 20A)
- Water resources/trigger (sections 24D and 24 E)

Mining activities commenced within the approval area on the 19 May 2015.

Figure 1-1 LCO EPBC 2013/6908 Referral Areas

1.2 Scope

Condition 19 of EPBC Approval 2013/6908 requires an annual compliance report to be published on the LCO website addressing:

- compliance with each of the conditions of the Approval; and
- details of implementation of the management plans required by the Approval.

This annual compliance report covers the period 19 May 2021 to 18 May 2022 for Condition 19 of EPBC Approval 2013/6908.

2. Statement of Compliance

Table 1 reproduces the "risk levels" from the ***Independent Audit Guideline. Post-approval requirements for State significant developments (Audit Guidelines)*** (DP&E, 2015) which were attributed to the non-compliances identified during the audit period.

Table 2 below outlines:

- The conditions of EPBC Approval 2013/6908
- A summary of actions completed during the reporting period with a respect to each condition
- The corresponding compliance status with reference to ***Table 1***.

Non-compliances identified in ***Table 2*** are ranked in accordance with the ***Audit Guidelines.***

Table 2-1 - Risk Levels for Non Compliances

Risk Level	Colour Code	Description
High		Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium		Non-compliance with: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low		Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Administrative non-compliance		Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

Table 2-2 - EPBC 2013/6908 Compliance Status

Condition	Actions During Reporting Period	Status
1. The footprint of the action must be no more than 185 ha and must be kept within the areas marked as "Referral Areas" in Figure 1.2 (Annexure C). The approval holder must not clear more than 121 ha of native woodland.	Pre-strip clearing in the referral area was completed in January 2020. During the reporting period (19 May 2021 to 18 May 2022) LCO did not conduct any further clearing in the referral area. Since commencement of the action LCO has cleared 145.5ha of land within the referral area; of which 107.78ha consisted of native woodland including regenerating woodland.	Compliant
2. To protect threatened species, the approval holder must prepare and submit a Biodiversity Management Plan to the Minister for approval prior to commencement of the action. This Plan must contain detail of the following mitigation measures: a. Fencing and access control; b. Weed control; c. Feral animal control; d. Bushfire management; e. Habitat enhancement measures; f. Tree feeling procedure; g. Indirect impact mitigation measures; and h. Adaptive management.	The Biodiversity Management Plan (BMP) was submitted to the Department of Environment (DoE) on 26 March 2015. The BMP was deemed to meet the requirements of the condition and was approved on 14 May 2015. During the reporting period, a revised BMP was submitted on 4 June 2021 in accordance with Condition 22. LCO considers that implementation of the revised plan is not likely to cause new or increased impact. Operations have continued to be implemented as per the Biodiversity Management Plan detailed in **Section 3.1**.	Compliant

3. The approval holder must not commence the action until the Biodiversity Management required under Condition 2 has been approved by the Minister. The approved Plan must be implemented. Note: if more convenient for the approval holder, the requirements of this plan may be met through revision and submission for approval by the Minister of the existing Landscape Management Plan that provides: a. a copy of the management plan, marked up to show the revisions, in both hard copy and electronic copy; and b. A clear summary of all the revisions that have been made to the management plan, and the reasons for these revisions	The BMP was approved on 14 May 2015. The action was commenced on 19 May 2015. Implementation of the BMP commenced after approval and a summary of activities completed to date is provided in **Section 3.1**.	Compliant
4. The Biodiversity Management Plan required under condition 2, must include the following information, which must be specific, measurable, realistic and time-bound in relation to each measure listed in condition 2: a. environmental objectives; b. performance criteria; c. methodology; d. duration and frequency of actions to be implemented; e. monitoring and reporting of the effectiveness of the measures; f. corrective actions; g. criteria for triggering corrective actions, should performance criteria not be met; and h. responsibility for implementation.	The BMP submitted was deemed to meet the requirements of this condition and was approved on 14 May 2015. During the reporting period, a revised BMP was submitted on 4 June 2021 in accordance with Condition 22. LCO considers that implementation of the revised plan is not likely to cause new or increased impact.	Compliant
5. To protect threatened species and water resources, the approval holder must progressively rehabilitate the areas marked as "Referral Areas" in Figure 1.2 (Annexure C) to achieve a self-sustaining landform consisting of Central Hunter Grey Box-Ironbark Woodland and two mine voids. The Central Hunter Grey Box-Ironbark Woodland must be established progressively, in accordance with the Rehabilitation and	LCO undertook rehabilitation in accordance with the Rehabilitation Environmental Management Plan (RMP/MOP) as approved under the NSW Approval. A revised copy of the RMP/MOP was forwarded to the Department on 29th July 2021. Further detail is provided in **Section 3.1.3.**	Compliant

Environmental Management Plan required by Condition 39 of Schedule 3 of the NSW Approval, once the Plan is approved by the NSW Government. The approved Plan must be provided to the Department.		
6. In order to compensate for residual significant impacts on threatened species, the approval holder must protect the offset areas through a legal instrument under relevant conservation legislation prior to 30 June 2019 or another date agreed to in writing by the Minister. The legal instrument must: a. be registered on title of the Offset areas; b. provide for the protection and ongoing conservation management of the Offset areas in perpetuity; c. prevent any future development activities or clearing of native vegetation on the Offset areas; and d. require the approval of a State Planning or Environment Minister to be changed or revoked.	Offsets lands specified under this approval are owned by LCO and are managed in accordance with the Biodiversity Offset Management Plan (BOMP). On the 2nd July 2019 the Minister agreed in writing to extend the required date until 30th November 2019. There are four Conservation Agreements registered on title for the offset areas: • VC00505 Mitchell Hills South Conservation Area (08/08/2019) • VC0525 Mountain Block Conservation Area (01/10/2019) • VC00506 Bowmans Creek Riparian Corridor (01/10/2019) • VC00516 Bowmans Creek Riparian Corridor East (06/08/2019	Compliant
7. The approval holder must provide the Department with details of the offset areas, including offset attributes, shapefiles, textual descriptions and maps to clearly define the location and boundaries of the offset area, to be submitted to the Department prior to commencement of the action.	The required data was submitted on 4 May 2015. The action commenced on the 19 May 2015. An application to vary the boundary of the Bowmans Creek Riparian Corridor was submitted to the Department on 13 April 2017 along with a revised BOMP. This variation was approved along with the BOMP on 4 December 2017. Implementation of the Conservation Agreements to satisfy Condition 6 above required detailed survey of the offset	Compliant

	areas. Consequently LCO submitted revised attribute data to the Department on 24 December 2018.	
8. To ensure management of the offset areas, the approval holder must submit an Offset Management Plan to the Minister for approval prior to 31 May 2015 to provide for the conservation and management in perpetuity of the offset areas. The Plan must include: a. a detailed methodology, frequency, timing and duration of all Offset area management measures proposed. The management measures must include: i. weed and pest control; ii. fencing; iii. ecological monitoring; and iv. assisted regeneration. b. key milestones, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the Plan; c. a detailed methodology, timing goals and corrective actions for revegetation of: i. the Bowmans Creek Riparian Corridor, in accordance with Figure 8.3 (Annexure D) ii. the Mountain Block Offset Site, in accordance with Figure 8.4 (Annexure E); and iii. exotic grassland and derived grassland areas of the Mitchells Hills South Offset Area, as depicted in Figure 3.1 of the letter from David Foster to the Department dated 29 October 2014 (Annexure F), with native woodland or forest communities that occur on the site.	The Biodiversity Offset Management Plan (BOMP) was submitted on 29 May 2015. The BOMP was deemed to meet the requirements of the condition and was approved on 5 January 2016. During the reporting period a revised BOMP submitted on 4 June 2021 in accordance with Condition 22. LCO considers that implementation of the revised plan is not likely to cause new or increased impact.	Compliant

9. The approved Offset Management Plan required under Condition 8 must be implemented.	Monitoring activities associated with the BOMP commenced in Spring/Summer 2015 while the plan was under assessment. Implementation of the BOMP has continued since this time, including the incorporation of changes made by a revision of this plan approved on 4 December 2017 and minor revisions submitted under condition 22 in: • November 2018 • September 2019; • February 2020; and • June 2021. LCO considers that implementation of the revised plan is not likely to cause new or increased impact. A summary of activities completed to date is provided in **Section 4.1**.	Compliant
10. To compensate for residual significant impacts on the Spotted-tailed Quoll, the approval holder must provide an Indirect Offset Plan to the Minister for approval, prior to 30 June 2015. This Plan must specify how it will allocate $243 000 over a period of not more than five years for recovery actions for the Spotted-tailed Quoll, as identified in either the Draft National Recovery Plan for the Spotted-tailed Quoll- Dasyurus maculatus (K. Long and J. Nelson 2008) or in the NSW Office of Environment and Heritage's Saving Our Species Project Species Action Statement. The Plan must include: a. a detailed description of the actions funding, including location and timing of activities; b. demonstration of how the funded activities are additional to any offset requirements of any existing approval conditions and additional to existing practise or other requirements; c. an explanation of how the activities described in the Plan will contribute to conservation of the Spotted-tailed Quoll;	The Indirect Offset Plan (IOP) was originally approved on 5 May 2016. A revised IOP was submitted to the Department on 30 March 2017. The revised IOP details amended projects Task 2 Surveying/Monitoring STQ Populations and Task 3 Assess Habitat Use by Female STQ. This IOP was deemed to meet the requirements of Condition 10 and approved 5 September 2017. Further revisions were submitted on 17 December 2020, and subsequently approved under Condition 10 on 26 May 2021.	Compliant

d. provisions to ensure appropriate management of funds and that auditable financial records are kept and maintained; e. provision for publication of findings: i. of a standard that would be acceptable for publication in an internationally recognised peer-reviewed scientific journal; and ii. together with methodologies and results, on the internet within twelve months of the collection of results and in a form that may be accessed by the public.		
11. The approved Indirect Offset Plan must be implemented.	During the reporting period works under the approved plan were completed and an Indirect Offset Plan Outcomes Report was published on the Liddell website on 30 June 2022 in accordance with Condition 10 (e) and notified to the Department on 1 July 2022. Further details are provided in **Section 4.2.**	Compliant
12. To protect water resources and threatened species, the approval holder must submit a Water Management Plan (WMP) for approval by the Minister prior to commencement of the action which provides for the avoidance and mitigation of impacts to water resources and threatened species. The plan must include the following: a. Management action, mitigation measures and practices designed to limit impacts of the proposal on surface and ground water resources. Management actions, mitigation measures and practices prescribed by the plan must be clear, measurable, auditable and time bound; b. Surface and groundwater monitoring program, that must be implemented for the life of the action, to monitor the success of the management actions in the WMP, define measurable targets of management actions and performance indicators, and provide	The Water Management Plan (WMP) was submitted to the Department of Environment (DoE) on 26 March 2015. The WMP was deemed to meet the requirements of the condition and was approved on 14 May 2015. The action commenced on 19 May 2015. A revised WMP was approved on 26 July 2017, primarily amending the groundwater monitoring triggers and associated response plan. During the reporting period, the WMP was revised and submitted in accordance with Condition 22 on 12 July 2021. LCO considers that implementation of the revised plan is not likely to cause new or increased impact.	Compliant

an adaptive management framework for the duration of the action's impact on water resources. This program must include: i. surface water quality, including pH, electrical conductivity, total suspended solids and total dissolved solids, in Bayswater Creek and Bowmans Creek each month, at each of the sites specified in Figure 9.11 of the Preliminary Documentation; ii. groundwater quality at least every two months and groundwater pressures and levels at least monthly at each location depicted in figure 2-13 of the Groundwater Impact Assessment (Annexure A) and; iii. documentation of the reference value against which the 2 meter drawdown trigger for the Bowmans Creek alluvium will be assessed and a justification of this reference value. c. Clear objectives and performance indicators, timeframes for the completion of all actions outlined in the Plan as well as corrective actions for circumstances where a management action, mitigation measure or practice fails to meet its prescribed objective or performance indicator.		
13. The approved Water Management Plan must be implemented.	Implementation of the WMP commenced after approval and a summary of activities completed to date is provided in **Section 5**.	Compliant
14. The approval holder must only discharge water into the Hunter River or its tributaries in accordance with the Hunter River Salinity Trading Scheme.	During the reporting period, LCO discharged water into a Hunter River tributary under the provisions of the Hunter River Salinity Trading Scheme in: • November 2021; • December 2021; • January 2022; • March 2022;	Compliant

	• April 2022. Further information is provided in **Section 5.1.3**.	
15. If monitoring of surface water quality identifies an exceedance of the Trigger Values for surface water, the approval holder must: a. keep a written record of the exceedance; b. report the exceedance to the Department within 5 business days of the monitored exceedance if the exceedance has the potential to result in environmental harm; c. unless agreed otherwise by the Department in writing, complete an investigation into the potential for environmental harm for any exceedance described in condition 15b. and provide a written report to the Department within 30 calendar days of receiving the result, including: i. a description of the investigations carried out; ii. a statement of the cause and extent of the exceedance; iii. an assessment of the potential for environmental harm; iv. actions taken to prevent environmental harm, if required; and v. actions taken to prevent exceedance from re-occurring in the future.	The surface water quality monitoring Investigation Trigger Action Response Plan (ITARP) was instigated during the reporting period. Further information is provided in **Section 5**.	Compliant
16. If groundwater monitoring identifies groundwater drawdown in the alluvium of Bowmans Creek of more than 2 metres, the approval holder must: a. report this to the Department within 5 business days of the monitored exceedance; b. unless agreed otherwise by the Department in writing, complete an investigation into the potential for environmental harm and provide a written report to the Department within 30 calendar days of receiving the result, including:	The Bowmans Creek groundwater drawdown ITARP was not triggered during the reporting period. Further information is provided in **Section 5**.	Compliant

i. a description of the investigations carried out; ii. a statement of the cause and extent of the drawdown; iii. actions taken to prevent environmental harm; and iv. actions taken to prevent exceedance from re-occurring in the future.		
17. Within 21 calendar days after the commencement of the action, the approval holder must advise the Department in writing of the actual date of commencement.	The action was commenced on the 19th May 2015 and correspondence with communication regarding the notification of commencement was sent to the Department Post Approvals (reference LCO 15/039).	Compliant
18. The approval holder must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the Indirect Offset Plan (described in condition 10), Water Management Plan (described in condition 12) and Biodiversity Management Plan (described in condition 2) required by this approval, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	LCO maintains accurate records in accordance with Condition 18.	Compliant
19. Within three months of every 12 month anniversary of the commencement of the action, the approval holder must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published.	The EPBC Approval 2013/6908 12-month anniversary of commencing the action is 19 May. The 2021 Annual report was published on the LCO public website on 17 August 2021. Notification was provided to the Department on 17 August 2021.	Compliant

20. Potential or actual contraventions of the conditions of the approval must be reported to the Department in writing within 2 business days of the approval holder becoming aware of the actual or potential contravention. All contraventions must be included in the compliance reports.	There were no contraventions of EPBC Approval 2013/6908 identified during the reporting period.	Compliant
21. Upon the direction of the Minister, the approval holder must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	Not triggered during the reporting period.	Compliant
22. The approval holder may choose to revise a management plan approved by the Minister under conditions 2, 8 and 12 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the revised plan would not be likely to have a new or increased impact. If the approval holder makes this choice they must: i. notify the Department in writing that the approved plan has been revised and provide the Department with an electronic copy of the revised plan; ii. implement the revised plan from the date that plan is submitted to the Department; and iii. for the life of this approval, maintain a record of the reasons the approval holder considers that taking the action in accordance with the revised plan would not be likely to have a new or increased impact.	During the reporting period LCO made revisions to the following management plans and submitted the revised plans to the department in accordance with Condition 22: • Biodiversity Management Plan – submitted 4 June 2021; • Biodiversity Offset Management Plan – submitted 4 June 2021; and • Water Management Plan – submitted 12 July 2021.	Compliant
22A. The approval holder may revoke their choice under condition 22 at any time by notice to the Department. If the approval holder revokes the choice to implement a revised plan, without approval under section	Not triggered during the reporting period.	Compliant

143A of the Act, the plan approved by the Minister must be implemented.		
22B. If the Minister gives a notice to the approval holder that the Minister is satisfied that the taking of the action in accordance with the revised plan would be likely to have a new or increased impact, then: i. Condition 22 does not apply, or ceases to apply, in relation to the revised plan; and ii. The approval holder must implement the plan approved by the Minister. To avoid any doubt, this condition does not affect any operation of conditions 22 and 22A in the period before the day the notice is given. At the time of giving the notice the Minister may also notify that for a specified period of time that condition 22 does not apply for one or more specified plans required under this approval.	Not triggered during the reporting period.	Compliant
22C. Conditions 22, 22A and 22B are not intended to limit the operation of section 143A of the EPBC Act which allows the approval holder to submit a revised plan to the Minister for approval.	Not triggered during the reporting period.	Compliant
23. Revoked.	Not applicable.	NA
24. If, at any time after seven years from the date of this approval, the approval holder has not substantially commenced the action, then the approval holder must not substantially commence the action without the written agreement of the Minister. Note: The date stated in condition 24 relates to the date of the approval decision (24 December 2014).	Not triggered. Action commenced on 19 May 2015.	Compliant
25. Unless otherwise agreed to in writing by the Minister, the approval holder must publish all management plans referred to in these conditions of approval on its website. Each management plan must be	During the reporting period all management plans referred to in these conditions were published on the Liddell Coal Website within one month of being approved.	Compliant

published on the website within 1 month of being approved and remain published for the life of the approval.	Revised plan sent on this date & published on the website: • Indirect Offset Plan – 17 December 2020; • Biodiversity Management Plan – 4 June 2021; • Biodiversity Offset Management Plan – 4 June 2021; and • Water Management Plan – 12 July 2021	

3. Avoidance & Mitigation of Impacts

3.1 Biodiversity

The objectives of the Biodiversity Management Plan (BMP) are to provide direction for the short to long term management and enhancement of the biodiversity values of the BMP Area, as well as to provide a detailed description of the measures to be implemented to achieve this over the next three years. The BMP area is defined as all land within Mining Lease 1597 boundary excluding any biodiversity offset areas.

Since the BMP was initially approved in August 2015, LCO is reporting compliance with Year 6/7 performance criteria during this reporting period. **Table 3-1** summarises the performance criteria set for Year 6 of operation of the BMP; and actions completed to date.

Table 3-1 - Biodiversity Management Plan Implementation Summary

Action/Item	Performance Indicator	Compliance	Performance Comment
Year 6 2021			
Fencing, Signage and Access Control			
Minimum twice-yearly inspections of fences and signage to identify any works required. Fencing and signage of relevant parts of BMP area should be as per Section 4.1	Inspections undertaken nominally in March and September. Damaged critical fences to be repaired within 1 week (temporary if needed), final repairs and non-critical repairs to be completed in 1 month	Compliant	Inspections completed. Signage installed and maintained as required
Access Track Maintenance			
Minimum twice a year BMP Area inspections to identify track conditions, any works required and any unnecessary tracks to be remediated	Inspections undertaken nominally in March and September. Action and repair track damage or remediation where applicable.	Compliant	Inspections completed.
Topsoil Management			
Areas containing weeds that may pose a threat to rehabilitation are targeted using appropriate weed control methods prior to topsoil stripping. Methods may include, foliar spraying, basal bark spaying, cut and paint, slashing and other mechanical methods as deemed appropriate.	Pre-stripping weed control of topsoil is completed, as needed.	Compliant. Weed control is completed prior to topsoil stripping (where required) to minimise future potential impact to	Weeds are managed in line with Weed Action Plan. Preclearance survey identifies any weed infestations requiring further management.

Action/Item	Performance Indicator	Compliance	Performance Comment
		rehabilitation success.	
Pathogen Management			
If reasonable potential for pathogens is identified in the BMP Area, appropriate pathogen monitoring and management protocols are developed and implemented.	If reasonable potential is identified, pathogens are considered in design and implementation of monitoring works. If identified (or potential identified), management actions for specific pathogens are developed and implemented.	Compliant	No signs likely to be associated with Phytophthora, myrtle rust or chytrid fungus observed during 2021 BMP monitoring.
Seed Collection			
Where suitable remnant vegetation is available, implementation of seed collection and handling program for use in revegetation/rehabilitation works.	Pre-clearing surveys identify potential seed sources. Seeds are collected, stored and handled according to appropriate program. Collected seed resources are used in revegetation/rehabilitation works.	Compliant.	Seed resources being collected and substituted in seed mix for rehabilitation as key species are available.
Vegetation Clearing			
Detailed pre-clearing procedure is to be implemented when clearing of woody native vegetation (including shrub, groundcover and isolated trees in grasslands).	Pre-clearing process is to be implemented as part of Ground Disturbance Permit process. Outcomes of pre-clearing process are recorded and recommendations are implemented.	Compliant.	LCO implements pre-clearing as part of Ground Disturbance Permit process with outcomes recorded and recommendations implemented.

Action/Item	Performance Indicator	Compliance	Performance Comment
Detailed tree-felling process is to be implemented when clearing areas of woody native vegetation (including shrub, groundcover and isolated trees in grasslands).	Tree felling process is to be implemented as part of the Ground Disturbance Permit process. Outcomes of tree-felling process are recorded and recommendations are implemented.	Compliant.	LCO implements tree-felling as part of Ground Disturbance Permit process, with outcomes recorded and recommendations implemented.
Translocation Works			
Translocation of tiger orchids or other threatened flora species (if encountered during pre-clearing process) to biodiversity offset areas.	Tiger orchids identified during pre-clearing process are salvaged during the tree felling process and are translocated into biodiversity offset areas. Any translocated individuals are subject to regular monitoring and maintenance works, if required. Reporting of translocation works and monitoring works is maintained.	Compliant.	One tiger orchid was relocated to the Mountain Block BOA and has been subject to regular monitoring and maintenance. Translocation is thus far deemed successful.
Remnant Vegetation and Habitat Management			
Remnant vegetation is to be protected from accidental impact.	Areas to be disturbed will be clearly defined in the field to prevent accidental impact to remnant vegetation.	Compliant	Remnant monitoring sites are in areas of undisturbed vegetation which are fenced to prevent unauthorised access. No accidental damage or removal of remnant vegetation was evident during BMP inspections. Fence line inspections are undertaken biannually in accordance with commitments of the BMP.

Action/Item	Performance Indicator	Compliance	Performance Comment
Remnant vegetation is protected from disturbance.	Remnant vegetation will be fenced or sign-posted as necessary to protect from disturbance. Annual inspections are completed to assess condition of fences and signs, areas of erosion concern, weeds or feral animals requiring control. Management works will be conducted, as necessary.	Compliant	Remnant monitoring sites are in areas of undisturbed vegetation which are fenced to prevent unauthorised access. No accidental damage or removal of remnant vegetation was evident. Annual monitoring included assessment of areas of erosion concern and introduced species. Fence line inspections are undertaken biannually in accordance with commitments of the BMP.
Annual inspections undertaken by suitably qualified personnel to assess the extent of natural regeneration occurring.	Annual inspection undertaken by suitably qualified personnel to assess extent of natural regeneration occurring. Appropriate action is undertaken if regeneration is deemed as being inadequate.	Compliant	Annual monitoring included assessing degree of regeneration of native trees. Native regeneration was identified and considered adequate at R02, W01 and W02.
Weed Control			
Complete weed inspections of BMP area every two months to document diversity and abundance of noxious weed records. This will then inform ongoing control actions (as needed), including timing, frequency, target species and methods to be used.	Inspections completed every two months, followed by implementation of required control methods, as required.	Compliant	Inspections being completed as required with appropriate weed priorities actioned.
Weed inspections of remnant and rehabilitation areas	Annual inspections are undertaken of remnant vegetation to identify areas of weed infestation.	Compliant.	Inspections being completed as required with appropriate weed priorities actioned. Annual Weed Action Plan completed and implemented. Annual monitoring undertaken and management recommendations to be actioned.

Action/Item	Performance Indicator	Compliance	Performance Comment
	Weed management actions of infestations are undertaken in accordance with current or other best practice approaches.		Previously identified weeds being targeted and noted as being effective during monitoring and inspections.
Feral Animal Control			
Complete feral animal inspections of BMP area every two months to document sighting and abundance records. This will then inform ongoing control actions (as needed), including timing, frequency, target species and methods to be used.	Inspections completed every two months, followed by implementation of required control methods.	Complete	Inspections for feral fauna are completed every two months.
Develop and implement an effective annual pest animal action plan.	Develop and implement pest animal action plan. Stable or downward trend in population size recorded.	Compliant	Annual Pest Action Plan developed and implemented for 2021. Pest numbers appeared to be stable and low.
Develop a vertebrate pest control register to document when and where each control method is implemented.	Update and maintain vertebrate pest control register.	Compliant	Vertebrate pest control register maintained and updated throughout 2021.
Blue-billed Duck Management			
Complete habitat enhancement, maintenance and monitoring works (as required) for the blue-billed duck	Ongoing enhancement and management works within Dam 3 and two Triangle Dams. Monitoring works as required.	Compliant	Habitat values for Dam 1 and Triangle dams assessed during 2021 monitoring. It was identified that this dam provides moderate habitat value Seeding of the dams with aquatic species was completed in April 2021.
Habitat Enhancement			

Action/Item	Performance Indicator	Compliance	Performance Comment
Salvage of habitat features (particularly for the spotted-tailed quoll) such as hollow-bearing trees, logs, stumps, large rocks and boulders.	Suitable habitat features identified during the pre-clearing process are salvaged. Salvaged features are either re-instated into areas with low levels of habitat features or stockpiled appropriately for later use. Timber or boulder piles will be constructed in riparian areas and areas of regeneration, revegetation and/or rehabilitation (as appropriate) to provide potential quoll denning habitat.	Compliant	Habitat material is identified during the pre-clearance process and salvaged where possible to reinstate into BMP areas.
Nest boxes are providing habitat value for native fauna.	Biodiversity offset areas, areas of remnant vegetation and suitably established rehabilitated vegetation (not in disturbance areas) will be supplemented with nest boxes as required.	Compliant	Remnant vegetation and suitably established rehabilitation areas have been supplemented with nest boxes. Annual monitoring in accordance with "Year A" conducted in 2021.
Salvaged–reinstated hollows	An indicative sample of salvaged and re-instated hollows are subject to annual monitoring in conjunction with nest boxes.	Compliant	Habitat features suitable for salvage are stockpiled or directly placed into rehabilitation and offset areas. Ongoing habitat augmentation works will continue as per recommendation from monitoring events.
Timing of nest box installation	Removed hollows will be replaced (with nest boxes) within six months of each discrete clearing event.	Compliant	Hollows and logs removed during clearing works have been placed in offset and rehabilitation areas.
Foraging specific plant resources	Rehabilitation and revegetation plantings undertaken include bulloak (Allocasuarina luehmannii), swamp oak (Casuarina glauca), broom bitter pea (Daviesia genistifolia), sickle wattle (Acacia falcata), hickory wattle (Acacia implexa) and cooba (Acacia salicina)	Compliant	Continue to undertake plantings that provide foraging resources, as per species listed in BMP and RMP.

Action/Item	Performance Indicator	Compliance	Performance Comment
Grazing Management			
Stock rotation	Cattle are grazed within improved pasture areas within mine rehabilitation >3years where practical Stocked will be managed to allow pasture recovery and maintain pasture availability and sufficient groundcover.	Compliant	LCO coordinate cattle grazing and rotate stock between paddocks with input from local agronomist.
Bushfire Management			
Bushfire Management Plan will be implemented	Implementation of requirements of updated Bushfire Management Plan.	Compliant	Bushfire Management Plan updated in 2021. No signs of bushfire impacting biodiversity values.
Ecological Monitoring			
Undertake floristic, fauna, LFA, waterbird, nest box, stygofauna and instream/riparian monitoring program throughout LCO	Monitoring program completed and reported.	Compliant	Monitoring completed in 2021 indicates remnant sites have remained relatively stable since commencing monitoring; however, rehabilitation is still young and will not be likely to provide comparable floristic and faunal diversity to reference vegetation for a number of years.
Undertake annual inspections of LCO rehabilitation areas as per the MOP	Annual inspections completed	Compliant	Annual inspections of LCO rehabilitation areas completed and included in Section 3.1.2.
Native fauna presence in rehabilitation/regeneration areas	Fauna monitoring completed.	Compliant	2021 fauna monitoring completed and indicates native fauna is present in rehabilitated vegetation. Introduced fauna are also present and should be subject to ongoing control to reduce impact on native vegetation and faunal assemblages. Increased structural and vegetation diversity in rehabilitation areas will increase native fauna diversity in these areas with

Action/Item	Performance Indicator	Compliance	Performance Comment
			time. Maintain current pest control programs. Ongoing placement of habitat features such as log and rock piles as well as small retention dams and vegetated corridors in rehabilitation areas will also increase the niche availability for native fauna colonisation. Report available at ***Monitoring documents (glencore.com.au).***

3.1.1 Biodiversity Monitoring

During the reporting period, LCO undertook biodiversity monitoring in accordance with the BMP to assess progress/performance against the BMP criteria and Rehabilitation Management Plan (RMP/MOP) performance criteria. This section details the results from rehabilitation and biodiversity monitoring within the BMP area.

The key findings of the 2021 biodiversity monitoring program were as follows:

- The vegetation structure, vegetation health and habitat features of remnant monitoring sites have all remained in a very similar state to that at the commencement of monitoring. Rehabilitation site WR01 conversely, has undergone significant growth of canopy vegetation from 20cm height to approximately 10 m in height.

- Rehabilitation site WR01 is floristically similar to remnant vegetation (native and introduced composition). However, remains distinct to benchmark in terms of floristic structure. Although closer in terms of structure to remnant vegetation, it still requires improvement of most parameters.

- Remnant vegetation at woodland sites W01 and W03 are generally in a good condition. However, some potentially problematic weed species are present in these areas and should be controlled.

- A decrease in native floristic diversity at W02 and R02 since 2019.

- An increase in native floristic diversity at WR01 and W01.

- An increase in native species diversity at remnant site W03 interestingly also correlates with a decrease in total native cover and an increase in exotic cover. Care should be taken to monitor and control any increase in weed cover as necessary.

- Weed infestation of scarlet pimpernel (*Lysimachia arvensis*) at rehabilitation site WR01 is problematic.

- Riparian remnant site R02 is dominated by introduced species which are out competing natives, and given their prevalence over an extended period of time; these are unlikely to recover to former levels without intervention.

- Bird diversity has increased at all sites since the previous monitoring in 2019. Amphibian diversity has also increased since 2019 at all sites except for W02. These results likely reflect the breaking of the drought and a replenishment of resources in the area.

- There has not been a notable increase in the extent of feral species presence, however foxes (*Vulpes vulpes*) were recorded at all remnant sites and a feral cat (*Felis catus*) was recorded in the rehabilitation. Continued management of predators will increase the value of all areas for the spotted-tailed quoll (*Dasyurus maculatus*).

- Rehabilitated vegetation at WR01 is in a moderate condition (species diversity and plant health). However, could be assisted in becoming more compatible with reference vegetation by:

    - reducing weed levels/ maintaining weed management efforts and focus and

- increasing diversity of native flora species in the groundcover.

- Stygofauna diversity at ALV2, ALV3, ALV4, ALV7 and ALV9 were low, however this was consistent with most previous recent monitoring events.

- No signs consistent with myrtle rust, *Phytophthora* or Chytrid fungus were identified.

As per the BMP, LCO will prepare an Annual Ecological Monitoring Report (AEMR), which will document the monitoring methods and results from the winter monitoring period through to the autumn monitoring period. The intent of this report will be to provide a comparison of the data collected with previous monitoring event and to provide (where necessary) ongoing management recommendations and ameliorative methods to ensure the biodiversity within the BMP area is subject to a positive feedback loop. The full report summarising the method and results of the 2021 Annual Ecological Monitoring Program is available on the LCO website.

3.1.2 Rehabilitation Program

Rehabilitation activities during the reporting period were completed generally in accordance with the approved Mining Operations Plan (MOP). LCO achieved the 2021 rehabilitation targets as specified in the ***2021-2023 MOP*** during the reporting period, with 19ha of rehabilitation during 2021 compared to a target of 17ha.

The LCO ***2021-2023 MOP*** target for rehabilitation in 2022 is 45 ha.

LCO will continue to implement the MOP/RMP and BMP to progressively rehabilitate the operation.

3.1.2.1 Rehabilitation Monitoring Summary

LCO conducts a detailed rehabilitation monitoring program as detailed in the MOP. Due to the age of the operation, LCO has established rehabilitation areas which are distinctly different reflecting the evolving rehabilitation objectives and practices. Each area has unique challenges for progressing towards the final land uses of pasture and woodland which are being managed by LCO. Further detail is provided in the below from the 2021 Rehabilitation Monitoring Reports.

The overall condition of rehabilitation at LCO is moderate and trending towards the target. Most areas have a good ground coverage which is preventing substantial erosion. In the woodland vegetation, ground coverage is generally provided by non-target species and vegetation has not been established for long enough to provide substantial soil organic matter (leaf litter).

Pasture areas are typically of good height and density for grazing, which has been employed in a number of rehab areas in the reporting period. LCO continue to manage exotic species throughout the rehabilitation.

Pasture Rehabilitation

The two broad pasture rehabilitation types have been established across the LCO site being the pre-2013 pasture areas that are dominated by Rhodes grass (*Chloris gayana*) and the post-2013 pasture areas that are dominated by a higher diversity of species including kikuyu (*Cenchrus clandestinus*) and lucerne (*Medicago sativa*).

The older pasture areas have a higher overall biomass but contain a lower diversity of species and generally consist of lower quality pasture species. Paddocks consisting of this pasture type that have been managed through the site grazing program by grazing and over sowing have a much-improved pasture composition and structure. This has been demonstrated as an effective management process for older pastures.

The newly established pasture areas are establishing well, and older areas established using the new pasture mix may be suitable for light grazing. These pastures should be managed to maintain and increase the diversity of high-quality pasture species, increase cover and biomass and to limit the establishment of lower quality species such as Rhode's grass. Across all pasture areas, a low level of soil carbon was identified is a factor that will potentially limit the productivity and sustainability of pastures. Managing pastures to increase soil carbon will be a critical step in maintaining pastures that are consisted with the completion criteria with minimal inputs.

Pasture areas are generally trending towards completion criteria across the site.

Woodland Rehabilitation

Woodland rehabilitation areas are more variable and each of the woodland rehabilitation blocks face unique challenges. Most areas, however, contain suitable species in at least two vegetative layers.

Augmentation works undertaken in 2020-2021 are not yet of a sufficient age to assess but showed signs of early establishment of seedlings and good survival of planted species.

A major threat to woodland rehabilitation area observed has been the establishment of weed species. Dominance of weed species, particularly invasive perennial grasses, kikuyu (*Cenchrus* clandestinus) and galenia (*Galenia pubescens*) continues to be a major threat to the establishment of target vegetation in Woodland rehabilitation areas.

Ongoing works including continued augmentation of mid and ground layer vegetation with species selected from target vegetation communities and weed control works will be required to continue progressing woodland rehabilitation areas towards closure criteria.

Ongoing improvements have been made to the methodology for establishing new rehabilitation. Woodland rehabilitation areas established since 2018 have included increased diversity within the seed mix and the installation of habitat features such as stag trees and water retention features. Other ongoing improvements include seeding of water retention features with aquatic species and increased weed control in establishing rehabilitation areas. These works are likely to improve; the representativeness of rehabilitation areas to the target vegetation communities, the overall habitat value of the rehabilitation to local fauna species, and the biodiversity value of the area if assessed under the Biobanking Assessment Methodology (BAM).

While continued works are required, particularly in woodland rehabilitation blocks, the commitment to adaptive management at Liddell Coal should be commended.

3.1.3 Tailings Emplacement Rehabilitation Strategy

Rehabilitation execution works were undertaken on Antiene Tailings Storage Facility (TSF) in line with site Tailings Rehabilitation Strategy. LCO has utilised suitable materials from surrounding overburden emplacements to construct a 1.5m cap across the tailings surface as shown in Figure 8-1 above. The capping surface has been designed to be free draining to the adjacent Dam 4. Fluvial rehabilitation design has been implemented for the surrounding slopes where material has been borrowed for capping. During the reporting period approximately 90% of the initial 0.5m capping layer and 80% of total 1.5m cap has been constructed. Rehabilitation activities at Antiene has also included reshaping of the Dam 4 void adjacent to the TSF to final landform.

Planning and design is also in progress for Reservoir South and West TSF, with rehabilitation and capping to schedule to commence July 2022.

3.1.4 Detailed Mine Closure Planning

Current Life of Mine Planning indicates that LCO coal extraction will cease in Q3 2023 and the site transition into 'mine closure' with the continued rehabilitation of the site. Rehabilitation activities for the remaining mine life is detailed in the ***LCO Mining Operations Plan*** (Rehabilitation Management Plan).

Detailed Mine Closure Planning (DMCP) refers to the planning of rehabilitation activities outstanding once coal extraction has been completed (e.g. decommission and rehabilitation of CHPP areas) to achieve the rehabilitation objectives. Further, consideration of the socio-economic impacts and particular stakeholder consultation is also provided for. LCO aims to have proactive approach to mine closure planning and progressive implementation of decommissioning and rehabilitation works concurrently with mining to provide for efficient delivery of the required rehabilitated landform.

Glencore Coal Assets Australia Mine Closure Planning Protocol provides for a framework for clear, well planned and executable process that will provide for a sustainable post-mining land use and ultimately allow mining tenements to be relinquished. The ***Mine Closure Planning Protocol*** meets the requirements of ***Integrated Mine Closure: Good Practice Guide (ICMM 2019)*** which is considered as international best practice for mine closure planning. As LCO approaches closure, mine closure planning is ongoing to ensure that an executable plan can be readily implemented when required to rehabilitate the site.

LCO engaged with a number of stakeholders throughout the reporting period including, but not limited to, the Department of Planning Industry & Environment, Resources Regulator, Department of Natural Resources Access Regulator and local councils. A summary of mine closure planning themes during 2021 included:

- Review of risks to rehabilitation and development of treatment plans
- Refinement of the final surface landform and rehabilitation completion criteria
- Tailings rehabilitation strategy
- Groundwater regime investigation and water balance for final landform and voids
- Final landform surface water management and creek stream health
- Borehole and underground mining
- Rail pillar stability assessment
- Socio-economic impact assessment
- Provision review

To date, LCO progressed mine closure preparedness as summarised in the following:

- An Initial Closure Broad Brush Risk Assessment with risks individually assigned to a closure domain or where deemed appropriate, applied to the whole site.
- Legal and Other Obligations Register with consideration of the State/Commonwealth legislation, guidelines, standards, permits, agreements and planning requirements that are applicable to the site that require consideration when preparing the DMCP
- A Constrains and Opportunities analysis commensurate to the risks and opportunities relating to closure of the site.
- A Mine Closure Stakeholder Engagement Strategy has been prepared to ensure that all relevant internal and external stakeholders who have an interest or role in the preparation of the DMCP

are consulted at the appropriate times throughout the process. It is intended that this be a "live" document that will be revised and updated at regular milestones.

- A Knowledge Base Report to define the Environmental and Socio-Economic Baseline and to provide for a systematic 'gap analysis' of information required to prepare the detailed mine closure plan. Outcomes of this gap analysis were then used to further detail the Closure Risk Assessment and scope the technical studies required.
- Technical studies and assessments to address knowledge gaps identified above to minimise risks identified in the Closure Risk Assessment. During 2021 the following key study areas were addressed:
  - Final landform water management detailed designs
  - Hydrogeological assessments focusing on confirmation of predicted drawdown in the Bowmans CK alluvium and tailings emplacement seepage
  - Final voids water balance assessment and optimisation
  - Landform erosion management
  - Demolition, waste and mineral waste management
  - Archaeological artefact management
  - Social Impact Assessment
  - Biodiversity and rehabilitation completion criteria
  - Tailings Emplacement Rehabilitation
  - Geotechnical assessments.

During 2022, LCO will continue to develop the DMCP by:

- Conduct additional assessment of risks to rehabilitation following completion of technical studies during Q1 2022.
- Implementation of treatments plans following risk review.
- Continuing progressive rehabilitation as mining activities complete in areas including tailings emplacements.
- Ongoing schedule briefing session with the NSW Resources Regulator updating progress and timing.
- Development of a detailed internal rehabilitation scope of works.
- Progress preparation of a Rehabilitation Management Plan to detail activities occurring post mining.

4. Offsetting of Residual Impacts

4.1 Biodiversity Offsets

The Biodiversity Offset Management Plan (BOMP) guides ongoing management of the LCO biodiversity offset areas, to maintain and enhance biodiversity values, particularly those relating to threatened species and threatened ecological communities (TECs) within the LCO biodiversity offset areas.

The objectives of the BOMP are to provide direction for the short to long-term management and enhancement of the biodiversity values of the LCO biodiversity offset areas. It provides a description of the measures implemented to achieve the objectives over the next three years.

Although the EPBC reporting period begins in May 2021, annual objectives detailed in the BOMP are measured from the approved date of the BOMP i.e. Year 7 commences August 2021.

The completion of and performance against each of these indicators is summarised in ***Table 4-1*** below, based on the outcomes of ecological monitoring and inspections across LCO for each year.

Table 4-1 - Year 6/7 Biodiversity Offset Management Plan Implementation Summary

Relevant Offset Area	Action	2020 Performance Indicator (Year 6/7)	Compliance	Performance Comment
Pathogen Management				
All BOAs	If reasonable potential for pathogens is identified in the BOAs, appropriate pathogen monitoring and management protocols are developed and implemented.	If reasonable potential is identified, pathogens are considered in design and implementation of monitoring works. If identified (or potential identified), management actions for specific pathogens are developed and implemented.	Compliant	No signs likely to be associated with Phytophthora, myrtle rust or chytrid fungus observed in any of the BOAs.
Fencing and Signage				
All BOAs	Repair boundary fences, restricting unauthorised access to property and controlling livestock movements	All boundary fences in place and gates are secured.	Compliant	Boundary fences and gates appeared secure during monitoring event. Fences are additionally monitored during BOMP inspections completed by LCO.
All biodiversity offset areas	Any new fencing does not have barbed wire on upper strands and as little barbed wire generally as possible. The bottom strand will be plain wire and elevated to allow	New fences are installed without barbed wire on upper strands and an elevated plain wire bottom strand.	Not applicable	No new fences installed.

	faunal passage (while maintaining cattle exclusion).			
All BOAs	Inspections of fences every two months to identify condition.	Inspections every two months. Damaged critical fences to be repaired within one week (temporary if needed), final repairs and non-critical repairs to be completed in one month.	Compliant	Fence inspections undertaken every two months in accordance with commitments of the BOMP.
All BOAs	Information signage for the spotted-tailed quoll.	Informational signage (for the spotted-tailed quoll) is maintained.	Compliant	Signage is installed and in good condition.
Cultural Heritage				
Bowmans Creek Riparian Corridor	Detailed rehabilitation planning for the Bowmans Creek Riparian Corridor managing outcomes of cultural heritage assessment.	Implement plan as required.	Compliant	Planning and due diligence surveys completed where required.
All biodiversity offset areas	Implement protocols for identification of potential cultural heritage issues, including how to avoid or mitigate impacts.	Implement protocol.	Compliant	Implemented as per the approved ACHMP.
Grazing Management				
All BOAs	All stock to be removed from BOAs	No stock grazing unless required based on monitoring results.	Compliant	No evidence of cattle grazing was evident during 2021 in any BOA.

All BOAs	Minimum bi-monthly inspections to determine presence of rogue stock and assess condition of fences.	To be completed bi-monthly.	Compliant	Cattle inspections undertaken bi-monthly in accordance with commitments of the BOMP.
All BOAs	Remove reported rogue stock and repair damaged fences.	Action and remove reported rogue stock and repair damaged fences.	Compliant	No rogue stock removed.
Track Maintenance				
All BOAs	New access tracks (only where necessary) are subject to due diligence assessments.	Complete due diligence assessments for new access tracks to minimise impact on biodiversity, where possible.	Not applicable	To be assessed on an ongoing basis. No new tracks installed.
All BOAs	Minimum twice yearly (nominally in March and September) inspections to identify track conditions.	Inspections undertaken nominally in March and September. Action and repair track damage.	Compliant	Access track inspections undertaken bi-annually in accordance with commitments of the BOMP.
All BOAs	Rehabilitation of unnecessary access tracks.	Tracks no longer required will be rehabilitated.	Not applicable	All tracks present are considered necessary.
Pest Management				
All biodiversity offset areas	Complete feral animal inspections of BOAs every two months to document sighting and abundance records. This will then inform ongoing control actions (as needed), including timing,	Inspections completed every two months, followed by implementation of required control methods, as required.	Compliant	Feral animal inspections undertaken every two months in accordance with commitments of the BOMP.

	frequency, target species and methods to be used.			Feral cats, foxes and dogs were identified in low numbers in Bowmans Creek Riparian Corridor and subsequently continue to be key species for management in 2022.
All BOAs	Develop and implement an annual pest animal action plan.	Develop and implement pest animal action plan. Stable or downward trend in population size recorded.	Compliant	Annual pest action plan developed and implemented during 2021.
All BOAs	Particular action is paid to managing foxes, feral cats and feral dogs in order to protect the spotted-tailed quoll population in this area.	Implementation of favoured fox, feral cat and feral dog control measures.	Compliant	Feral fauna identified in low numbers and not appear to be significantly increasing in abundance. Feral dogs, foxes and cats were observed throughout the year and during monitoring. Control activities undertaken included two 1080 dog/fox baiting rounds, one soft jaw trapping event and one shooting control event Further implementation of control measures to occur during 2022 as per annual action plan.
All biodiversity offset areas	Presence of pest animals	As evidenced by monitoring, pest animal presence in revegetation/ rehabilitation areas does not pose a risk to establishment of vegetation.	Compliant	Feral rabbit, hare, and house mouse were identified in all BOAs. Further control measures for these species to be implemented during 2022 as per annual action plan.

All BOAs	Develop a vertebrate pest control register to document when and where each control method is implemented.	Update and maintain vertebrate pest control register.	Compliant	Existing vertebrate pest control register implemented.
Weed Management				
All BOAs	Complete weed inspections every two months to document diversity and abundance of noxious weed records.	Inspections completed every two months, followed by implementation of required control methods, as required.	Compliant	Inspections completed in accordance with the BOMP. Weeds identified in all BOAs. Evidence of spraying and wick wiping that appeared successful.
Natural Regeneration				
Mountain Block and Mitchell Hills South	Mapping of areas naturally regenerating and subject to revegetation works to track if natural/assisted regeneration is on track to meet final hectare goals.	Revised in ongoing monitoring works, as needed.	Compliant	Regenerating areas appear to be progressing. Mapping to be completed in future after additional growth to capture recent plantings.
Mountain Block and Mitchell Hills South	Management of regeneration progress is responsive to monitoring outcomes.	Monitoring of regeneration areas.	Compliant	Monitoring of regeneration progress occurred in 2021 and appear to be progressing.
Assisted Regeneration				

Mountain Block and Mitchell Hills South	Review need for assisted regeneration where outcomes of natural regeneration is deemed lacking.	Assess progress/outcomes of natural regeneration and assess and implement assisted regeneration measures as required.	Compliant	Natural regeneration was identified in BOAs. Undertake supplementary plantings in areas of poor revegetation success (as identified in monitoring report).
Rehabilitation				
Mountain Block	Modification 7 Area transferred back under BOMP management	-	Compliant	Rehabilitation completed in 2020. Transferred back under BOMP management in 2022, initial establishment monitoring ongoing (Year 2).
Bowmans Creek Riparian Corridor Mountain Block Offset Area	Develop detailed performance criteria for all management zone types.		Not applicable	2021 monitoring results reviewed and no changes to performance criteria for 2022.
Bowmans Creek Riparian Corridor Mountain Block Offset Area	Implement rehabilitation / revegetation program.	Implementation of plan.	Compliant	Additional plantings (tubestock and seed) occurred in Bowmans Creek Riparian Corridor and Mitchell Hills South. Continue to feed in results of monitoring of supplementary planting into ongoing vegetation establishment and maintenance program.

Bowmans Creek Riparian Corridor	Positive feedback loop from monitoring results.	Feedback from monitoring is incorporated into ongoing review and improvement of plan.	Compliant	To be updated in response to these works.
Habitat Augmentation				
Bowmans Creek Riparian Corridor	Salvage of habitat features (particularly for the spotted-tailed quoll) such as hollow-bearing trees, logs, stumps, large rocks and boulders.	Suitable habitat features identified during the pre-clearing process are salvaged. Salvaged features are either re-instated into areas with low levels of habitat features or stockpiled appropriately for later use. Timber or boulder piles will be constructed in riparian areas and areas of regeneration, revegetation and/or rehabilitation (as appropriate) to provide potential quoll den habitat.	Compliant	No clearing occurred in 2021 and therefore no salvaged habitat trees added in the offsets. Nest boxes and boulder piles previously installed in Bowmans Creek Riparian Corridor and Mountain Block.
Bowmans Creek Riparian Corridor	Nest boxes are providing habitat value for native fauna.	Established nest boxes are subject to regular monitoring.	Compliant	Nest box installation completed and monitoring program implemented. Signs of presence and actual occupation of nest boxes is occurring.

All biodiversity offset areas	Habitat and hollow augmentation will occur in Mountain Block and Mitchell Hills South offset areas if monitoring identifies a dearth of key habitat features such as log piles or boulder piles.	Habitat augmentation, if required.	Compliant	No further needs identified to that reported previously.
Translocation				
All BOAs	Translocation of tiger orchids or other threatened flora species (if identified in pre-clearing process) to BOAs. Methods to be adopted are detailed within the BMP.	Tiger orchids are salvaged and translocated according to the process in the BMP as needed.	Compliant	No translocations conducted during reporting. Monitoring of Orchid translocated in 2018 continues and translocation successful to date.
Creek and Drainage Line Protection				
Bowmans Creek Riparian Corridor	Fencing / protection of LCO controlled side of riparian corridor.	Riparian corridor will be fenced from human and livestock access.	Compliant	Offsets remain fenced and stock excluded.
Bowmans Creek Riparian Corridor	Rehabilitation works to address stabilisation and erosion issues, as necessary.	Implementation, as needed.	Compliant	Nil required during reporting period.
Seed Collection				
All BOAs	Where suitable remnant vegetation is available, implementation of seed collection and handling program for	Pre-clearing surveys identify potential seed sources.	Compliant	Seed collection occurred in 2021 in Mountain Block BOA.

	use in revegetation/rehabilitation works.	Seeds are collected, stored and handled according to appropriate program. Collected seed resources are used in revegetation/rehabilitation works.		
Erosion Sedimentation and Salinity				
Mountain Block	Control of erosion in southern paddocks	Continue hydromulching of remainder of eroded areas if trials are successful.	Compliant	2019 trial area monitored. No additional substantial erosion although limited seed strike.
Mountain Block	Monitor completed erosion works and action repairs if required.	Monitor completed erosion works and action repairs if required.	Compliant	2019 trial area monitored. No additional substantial erosion although limited seed strike.
Bushfire Management				
All BOAs	Bushfire Management Plan implementation	The current Bushfire Management Plan will be updated to address the approved modification. Implementation of requirements of updated Bushfire Management Plan.	Compliant	Bushfire Management Plan implemented.
Monitoring				

All BOAs	Undertake floristic, fauna, LFA and nest box monitoring program	Monitoring program completed and reported	Compliant	Monitoring program completed. Summary of monitoring provided in ***Section 4.1.1***
All BOAs	Undertake annual inspections of LCO rehabilitation and active regeneration areas	Annual inspections completed	Compliant	Monitoring program completed. Summary of monitoring provided in ***Section 4.4.1***
All BOAs	Native fauna presence in rehabilitation/regeneration areas	Fauna monitoring completed	Compliant	Monitoring program completed. Summary of monitoring provided in ***Section 4.1.1***

4.1.1 Biodiversity Offset Monitoring Program

In general, the remanent vegetation of Mitchell Hills South has the highest habitat values of the biodiversity offset areas, with high hollow densities, rock on rock habitat, moderate log presence, abundant shrubs, low introduced species although they key lacking habitat is permanent water. Bowmans Creek Riparian Corridor requires the greatest amount of ongoing active management, particularly for high introduced groundcover species, to improve recruitment of canopy species and increase of habitat features such as logs and boulders. Quality habitat was also noted in Mountain Block, however much of the vegetation within the offset is regrowth and has not yet developed hollows or other habitat complexity (such as logs). Permanent water resources in this BOA are also limited. Although remnant vegetation at the BOAs was in good/moderate condition and the general coverage of weed species was low (monitoring sites had invasive species present that require active management to prevent reduction in ecological value over time.

Although not necessarily within monitoring plots and subsequently may not be reflected within quantitative monitoring results, LCO has been undertaking extensive management actions within the Mountain Block, Mitchell Hills South and Bowmans Creek Riparian Corridor since 2017.

A summary of management actions completed in 2021 include:

- Active regeneration works in Bowmans Creek Riparian Corridor, including strip seeding approximately 25 ha and tubestock (18,000 plants).
- Supplementary strip seeding of target vegetation in Mountain Block South (12 ha) and Mitchell Hills (1.5ha).
- Weed and pest management throughout all BOAs.
- Seed collection to supplementary seeding resources for regeneration purposes.
- Repair of nest boxes

It is anticipated that floristic and fauna value provided by the BOAs will increase with time as more management actions required by the BOMP are initiated and as tubestock/seed planted begin to grow and provide improved habitat value (canopy coverage and foraging resources).

Key findings of the 2021 biodiversity offset monitoring program were as follows:

- Remnant vegetation is generally in good condition (across the three BOAs) and is showing signs of recovery from previous drought-stress, whereby native diversity has increased from previous drops at all sites except for R02, which is still declining in general. Weed species are encroaching in these areas (particularly site R02 and W08) as a result of drought recovery.

- Fauna diversity has decreased since baseline at all sites except for W04 in Mountain Block. Remnants held higher fauna diversity at Mountain Block and Mitchell Hills South, with Bowmans Creek having higher diversity at a regenerating site. The bird and mammal groups have shown the largest decline however these groups tend to be highly mobile and irruptive to climatic conditions. It is expected that these numbers will recover with continued favourable conditions and the decrease is not attributable to a lack of habitat or management actions.

- Observed levels of threatened species during the 2021 monitoring were low across all sites (remnant and regenerating), except for micro-bats which did not discriminate between low-and high-quality vegetated areas, instead preferring areas in proximity to water resources.

- Levels of feral fauna detection remain low, likely due to management actions as part of the BOMP. These actions may be assisting in the ongoing presence of the spotted-tailed quoll

(Dasyurus maculatus maculatus) in these areas, which will hopefully increase in abundance during subsequent monitoring.

- Substantial nest box installation activities have been undertaken in all BOAs. These nest boxes are currently showing moderate signs of occupation. Ongoing monitoring should see an increase in presence of hollow-dependent species over time.

- Vegetation of Bowmans Creek Riparian Corridor is highly disturbed and requires substantial intervention (remnant and regeneration areas). Active revegetation works have commenced with varying levels of success and will be assisted by infill planting and reduced water stress. These should start to show progress in subsequent monitoring.

- A detailed Revegetation Plan is currently being prepared for the Bowmans Creek and Mountain Block BOAs in order to assess the suitability of target communities and current revegetation practices. The outcomes of this assessment should be adopted in order to improve revegetation outcomes in these areas.

- No signs consistent with myrtle rust, Phytophthora or Chytrid fungus were identified during the 2021 BOMP surveys.

- Management actions currently being undertaken in accordance with the BOMP is appropriate to meet the relevant objectives.

Liddell will continue to action the recommendations of the monitoring report and will continue remediation implementation.

4.2 Indirect Offsets

The State and Commonwealth approvals both require the provision of an indirect offset to augment the agreed land-based biodiversity offsets to address the impacts of the project. The indirect offset was a financial contribution towards recovery actions for the spotted-tailed quoll (*Dasyurus maculatus maculatus*), as part of the:

- Final Draft National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* (Long and Nelson 2008);
- and/or Management actions identified for the spotted-tailed quoll as part of the Office of Environment and Heritage (OEH) Saving Our Species Project Species Action Statement.

An Indirect Offset Plan (IOP) was prepared to satisfy the conditions of the State and Commonwealth approvals relating to this financial contribution. The approved IOP specifies how the $243,000 indirect offset (by way of financial contribution) would be used to support recovery actions for the quoll.

Three recovery projects were identified and implemented under the IOP as follows:

1. Develop software to allow identification of individual quolls from camera trap images.
2. Development of standard camera trapping protocol based on project above. Implement cross tenure monitoring program (Royal National Park, Wollemi National Park and Middle Foy Brook Area) integrating live trapping, camera trapping, population viability and genetic analysis.
3. Trap and track (using telemetry collars or camera trapping) 6 female quolls for 3 years. Assess habitat use by female spotted-tailed quolls.

The IOP was reviewed and reapproved by under ***DA Mod 7*** and ***EPBC 2013/6908*** and details the tasks required to facilitate the implementation of the above requirements.

4.2.1 Management Actions during the reporting period

Project work and funding was carried out over a 5yr period, nominally FY2016/17, FY2017/18, FY2018/19, FY2019/20 and FY2020/21. A 12-month period has followed with assessment of results and findings ready for publication by end June 2022 in line with condition 10 (e).

The ***Indirect Offset Plan Outcomes Report***, was published on the Liddell Coal website on 30 June 2022, documenting the outcomes and contribution to spotted-tailed-quoll conservation realised from funding each project.

A copy of the report can be accessed at *https://www.glencore.com.au/operations-and-projects/coal/current-operations/liddell-coal-operations/reporting-documents* .

Publication of this report and funding completion as discussed below represents completion of the projects committed under the IOP.

4.2.2 Funding Summary

Over the course of five years (2016-2021), LCO has committed a total of $243,000 to research partners Invasive Animals Limited and University New England in acordance with the objectives of the IOP. Table 4-2 summarises the yearly payments.

Payment To	Date	Amount (AU$ excluding GST)	Cumulative commitment ($)
Project 1:			
Invasive Animal Limited	30/06/2016	50,000	50,000
Invasive Animals Limited	16/12/2016	18,000	68,000
Invasive Animals Limited	30/06/2017	12,000	**80,000**
Project 2 and 3:			
University of New England	11/05/2018	61,000	61,000
University of New England	30/06/2019	28,773	89,773
University of New England	30/04/2020	11,050	100,823
University of New England	30/10/2020	25,618	126,441
University of New England	24/9/2021	11,082	137,523

Payment To	Date	Amount (AU$ excluding GST)	Cumulative commitment ($)
University of New England	6/7/2022	26,424	**163,947**
IOP Total Funding			**243,947**

Table 4-2 – IOP Funding summary

5. Water Resources

This section outlines surface water and groundwater monitoring program findings during the reporting period pertaining to the determination of mining related impacts. ***Figure 5-1*** shows the locations of each of the surface and groundwater monitoring sites. The LCO Water Management Plan (WMP) documents the processes and responsibilities of all aspects of the site water management system. There were no changes to the LCO Water Management Plan (WMP) during the reporting period.

5.1 Surface Water

Surface water monitoring is undertaken along the two creek lines adjacent the operation (Bayswater and Bowmans) as well as at onsite water storages. During the reporting period, LCO undertook the approved WMP surface water monitoring program. This monitoring program utilises specific surface water quality monitoring trigger limits which provide for the identification of potential adverse impacts; results from the reporting period are summarised in this Section 5.1.

Bayswater Creek is considered to be a highly disturbed system with respect to ANZECC 2000 with low ecological value and a flow regime which is controlled by discharges from Lake Liddell with the remaining catchment not sufficient to maintain flow within the creek adjacent to LCO. Bowmans Creek is considered to be a moderately disturbed system with respect to ANZECC 2000 with moderate ecological value. Based on long term streamflow monitoring, flow within Bowmans Creek is intermittent adjacent to LCO although consistent flow is recorded further downstream nearer to the Hunter River.

The ephemeral nature of flow within the creeks adjacent to LCO means that stagnant pools of water are sometimes monitored which may have higher/atypical concentrations of the key parameters (pH, Total Suspended Solids (TSS) and Electrical Conductivity (EC) and Total Dissolved Solids (TDS)) than during periods of flow. To reflect the natural ponding and varying quality of both creeks, the WMP sets site specific and flow determinant impact assessment criteria for both creeks. This criterion has been determined based on a statistical analysis of data collected over a 5 year period in accordance with ANZECC (2000) guidelines.

LCO's interpretation and response to monitoring results is detailed in the WMP Section 10 Surface Water and Groundwater Response Plan, which has been implemented during the reporting period to investigate exceedances of determined criteria. It is important to note that before an exceedance is to be considered to have been reached, monitoring will continue for up to two observations beyond the initial exceedance measurement (i.e. a total of three consecutive exceedances of a trigger value). This is to check that the exceedance is repeated, ongoing, and not erroneous. Notwithstanding, a decision is made whether the initial exceedance requires immediate investigation.

The creek trigger levels are presented in ***Table*** 5-1.

Table 5-1 – Water Managemnt Plan trigger values for surface water quality

Location	pH lower limit[4]	pH upper limit		EC	EC	TDS	TDS	TSS	TSS
		90th %tile[1]	Max[2]	90th %tile[1]	Max[2]	90th %tile[1]	Max[2]	90th %tile[1]	Max[2]
Bayswater	6.5	8.3	8.5	5130	7300	3230	5180	50[3]	302
Bowmans Creek	6.5	8.3	8.8	2020	4570	1210	3460	50[3]	97

Notes to table:

Trigger Level when creek is flowing

Trigger Level when no flow in creek

[1] whole creek 90th percentile
[2] maximum recorded value for whole creek
[3] ANZECC criteria for TSS
[4] ANZECC criteria for pH lower limit

5.1.1 Bayswater Creek

Monitoring of the three sites within the creek (upstream, midstream and downstream) was completed monthly during the reporting period in accordance with the WMP.

It should be noted that Bayswater Creek is a highly modified watercourse and regularly experiences periods of low or no flow. The measured pH, Electrical Conductivity (EC) Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) levels were typical of historical results, noting that periods of elevated EC and TDS correspond with Hunter River Salinity Trading Scheme discharge flows discussed in ***Section 5.1.3***.

Table 5-2 below summarises the monitoring program results and identifies that there were a small number of isolated results where applicable trigger limits were exceeded in Bayswater Creek during the reporting period. As per the WMP monitoring program and Trigger Action Response Plan (TARP), exceedances of surface water trigger levels are required to be sustained for three consecutive months to initiate an investigation and therefore were no investigations or notifications to DPE, DAWE or DPE Water required by the surface water TARP during the reporting period.

5.1.2 Bowmans Creek

Monitoring of the eight sites within the creek (upstream BCK1, BCK1A, BCK2, BCK2A, BCK3, BCK4 BCK5 and downstream BCK6) was completed monthly during the reporting period in accordance with the WMP.

It should be noted that historical disturbance (grazing, mining, etc) has modified the catchment of Bowmans Creek significantly; it is ephemeral in nature and often pool or have very low flow leading to potential stagnant conditions which influences water quality. ***Table 5-3*** summarises the monitoring results. No trigger limit exceedances in Bowmans Creek were identified during the reporting period.

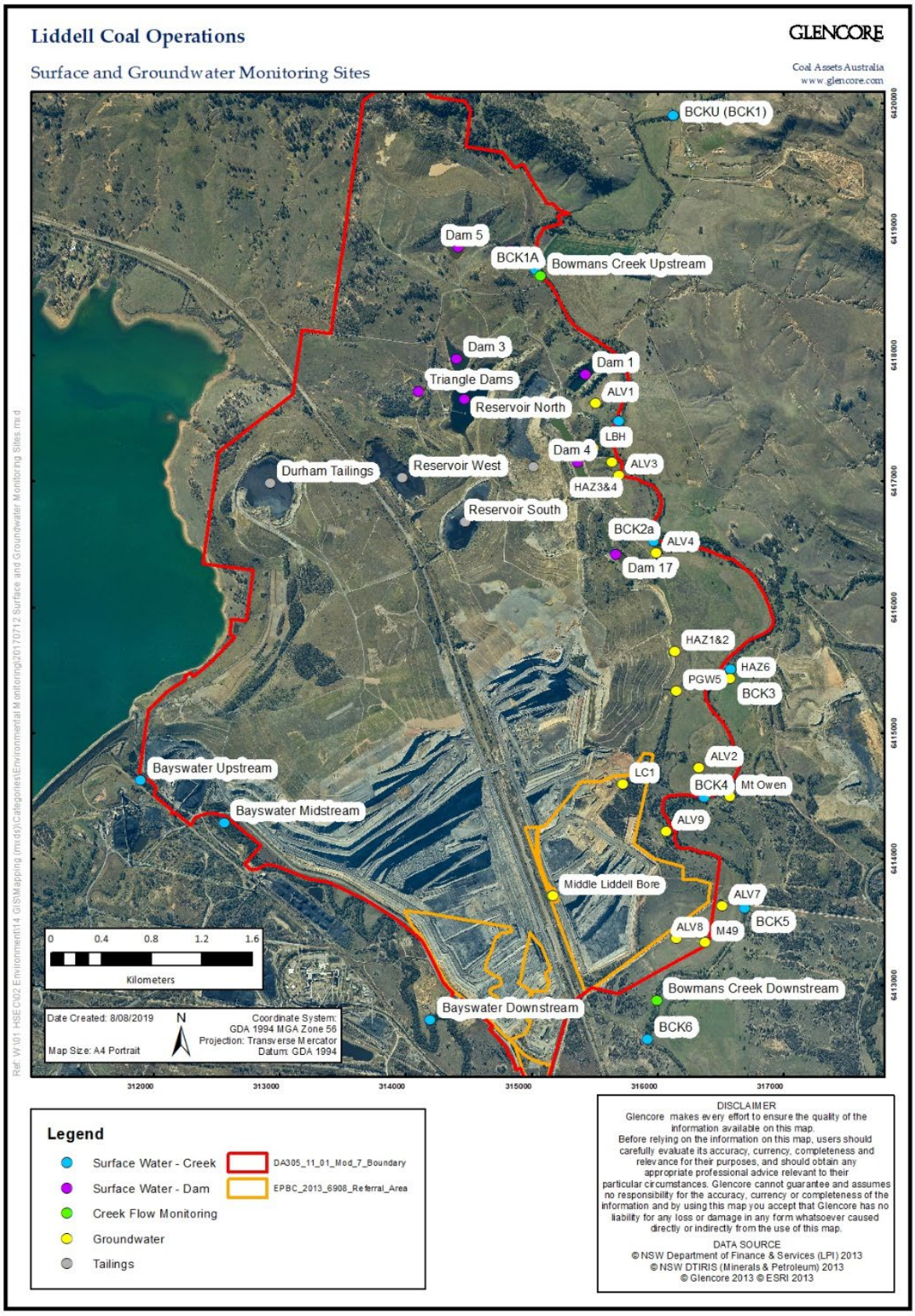

Figure 5-1 - Location of surface and groundwater monitoring sites

Table 5-2 - Bayswater Creek Trigger Limit Summary

Bayswater Creek Water Quality Results															
Month	Bayswater Creek Upstream					Bayswater Creek Midstream					Bayswater Creek Downstream				
	Flow	pH	EC (µS/cm	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm	TDS (mg/L)	TSS (mg/L)
Jun-21	Trickle	7.92	2760	1940	11	Still	7.9	2970	2050	<5	Dry	-	-	-	-
Jul-21	Trickle	7.74	3960	2680	7	Still	8.17	4790	3420	17	Dry	-	-	-	-
Aug-21	Trickle	7.88	5010	3420	8	Still	8.08	6060	4010	5	Dry	-	-	-	-
Sep-21	Trickle	7.95	4610	2970	15	Still	8.05	5920	3860	6	Dry	-	-	-	-
Oct-21	Trickle	7.96	3450	2210	9	Still	7.99	5260	3520	<5	Dry	-	-	-	-
Nov-21	Trickle	7.4	2080	1360	10	Trickle	8.72	5510	3480	10	Trickle	8.49	4970	2760	<5
Dec-21	Slow	7.76	3740	2530	8	Still	8.41	4600	3080	<5	Slow	7.9	4550	2980	6
Jan-22	Slow	7.95	2500	2210	<5	Slow	8.62	5110	3860	<5	Steady	8.15	2950	2510	<5
Feb-22	Trickle	7.91	4810	3250	10	Still	8.32	5700	4180	<5	Dry	-	-	-	-
Mar-22	Slow	8.1	2600	2060	<5	Steady	8.36	3020	2230	<5	Steady	8.42	2920	2200	<5
Apr-22	Trickle	7.75	4190	2450	<5	Slow	8.28	4630	3120	<5	Trickle	7.89	5080	3410	<5
May-22	Trickle	7.84	4390	2870	9	Trickle	8.29	5000	3430	<5	Trickle	7.97	5880	3830	7

Notes to Table:

Denotes an exceedance of the 90%ile trigger limit as applicable for the flow conditions

Denotes an exceedance of the maximum trigger limit as applicable for the flow conditions

\- unable to obtain a sample due to water level being too low to sample

Table 5-3 - Bowmans Creek Monitoring Summary

Bowmans Creek Water Quality Results																				
Month	BCK1 (Upstream)					BCK 1A					BCK2					BCK2A				
	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)
Jun-21	Slow	8.03	724	404	<5	Slow	8.09	765	447	<5	Slow	8.16	764	480	<5	Slow	8.02	787	466	7
Jul-21	Slow	7.96	714	426	<5	Slow	8.07	760	470	<5	Slow	8.02	764	475	<5	Steady	7.98	784	472	<5
Aug-21	Slow	7.94	819	470	<5	Trickle	7.97	914	520	<5	Trickle	7.74	885	484	<5	Trickle	8.03	917	522	6
Sep-21	Slow	7.97	835	461	<5	Slow	8	885	488	7	Slow	7.92	922	514	8	Slow	7.87	926	519	8
Oct-21	Slow	7.81	829	460	<5	Slow	7.92	888	510	<5	Trickle	7.88	894	504	<5	Trickle	7.89	915	514	18
Nov-21	Slow	7.91	622	360	<5	Slow	7.84	637	360	<5	Fast	7.80	240	208	16	Fast	7.62	245	216	23
Dec-21	Slow	7.88	460	322	8	Slow	7.84	475	325	12	Steady	8.04	549	323	<5	Steady	8.01	551	334	<5
Jan-22	Steady	7.99	727	443	8	Steady	8.07	758	448	16	Slow	7.87	723	431	10	Steady	7.86	735	434	14
Feb-22	Slow	7.78	732	628	8	Slow	7.88	808	684	13	Slow	7.88	844	522	14	Slow	7.94	832	520	11
Mar-22	Slow	7.86	627	383	<5	Steady	7.89	692	410	<5	Steady	7.93	604	404	<5	Steady	7.97	606	414	<5
Apr-22	Steady	7.91	712	392	<5	Steady	7.98	772	442	<5	Slow	7.95	741	406	<5	Slow	8.02	741	413	<5
May-22	Steady	7.99	783	402	<5	Steady	8.04	820	436	<5	Slow	8.06	827	444	<5	Slow	8.07	820	426	<5

Notes to Table:

Denotes an exceedance of the 90%ile trigger limit as applicable for the flow conditions

Denotes an exceedance of the maximum trigger limit as applicable for the flow conditions

\- unable to obtain a sample due to water level being too low to sample

Bowmans Creek Water Quality Results																				
Month	BCK3					BCK4					BCK5						BCK6 (Downstream)			
	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)	Flow	pH	EC (µS/cm)	TDS (mg/L)	TSS (mg/L)
Jun-21	Slow	7.98	832	481	6	Slow	7.94	840	503	6	Slow	8.02	864	539	<5	Slow	7.93	855	532	<5
Jul-21	Slow	7.88	826	528	<5	Slow	7.92	836	516	<5	Slow	7.98	852	530	<5	Slow	7.89	838	514	<5
Aug-21	Slow	8.04	933	528	<5	Trickle	7.89	942	536	23	Trickle	7.9	994	574	<5	Trickle	7.55	929	546	<5
Sep-21	Slow	8.09	951	530	7	Slow	7.99	959	540	16	Slow	7.93	987	546	10	Slow	7.83	979	540	6
Oct-21	Trick le	8.02	921	524	<5	Trickle	7.94	926	524	10	Trickle	7.98	955	549	15	Trickle	7.94	957	564	10
Nov-21	Fast	7.66	237	196	17	Moderate	7.65	237	212	18	Moderate	7.67	237	196	17	Fast	7.65	235	208	20
Dec-21	Slow	7.86	587	423	7	Steady	7.88	589	358	8	Steady	7.96	599	372	<5	Steady	8.01	586	360	<5
Jan-22	Slow	7.84	770	460	20	Slow	7.84	784	468	29	Slow	7.94	792	456	14	Steady	7.86	704	438	16
Feb-22	Slow	7.98	861	534	20	Slow	8	868	535	23	Slow	8.07	879	544	16	Slow	7.82	851	526	15
Mar-22	Slow	7.74	666	440	8	Steady	7.89	639	432	<5	Steady	7.91	659	425	<5	Steady	7.94	639	406	<5
Apr-22	Slow	7.84	781	444	11	Slow	7.93	776	469	5	Slow	8.01	782	473	<5	Slow	7.96	775	463	<5
May-22	Slow	8.15	851	462	<5	Slow	7.99	856	430	<5	Slow	8.08	865	438	<5	Slow	8.02	853	436	<5

Notes to Table:

Denotes an exceedance of the 90%ile trigger limit as applicable for the flow conditions

Denotes an exceedance of the maximum trigger limit as applicable for the flow conditions

\- unable to obtain a sample due to water level being too low to sample

As per the WMP monitoring program and Trigger Action Response Plan (TARP), exceedances of surface water trigger levels are required to be sustained for three consecutive months to initiate an investigation and therefore were no investigations or notifications to DPE, DAWE or DPE Water required by the surface water TARP during the reporting period.

5.1.2.1 BCK1A and Mountain Block Dam 6 Investigation

In previous Annual Reports, LCO stated that exceedances of the 90th%ile trigger limits for EC and TDS had occurred at BCK1A triggering investigation into whether the increased salinity in the creek was associated with adjacent historical mining areas, circa 1980-early 2000's. These exceedances continued into early 2020. The investigation findings were reported noting that as per the WMP investigation protocol, LCO had progressed to undertake further investigations to determine the source of the seep observations by commencing a management/mitigation TARP. Management/mitigation measures occurred including dewatering an adjacent water management structure (Dam 6) to create a local groundwater sink to redirect and capture potential groundwater flow from the historical mining area and conducting further studies in consultation with relevant NSW Government agencies.

On the 9 September 2020, LCO submitted a BCK1A Management TARP investigation report detailing the results of management/mitigation investigation TARP. Stage 1 of the investigation comprised of developing a conceptual site model (CSM) to assess the mechanisms that may be causing the elevated salinity. This hydrogeological assessment identified the complexity of the groundwater within which a number of potential mechanisms ('natural' processes and 'man-made stressors') for the elevated salinity were identified and hence recommended that further works, Stage 2, be undertaken to confirm or negate potential mechanisms.

Stage 2 work was completed to address the identified knowledge gaps and included installation of a targeted groundwater-monitoring network, testing relative hydraulic conductivity of strata, a review of groundwater quality in the area and further refinement of the CSM.

LCO additionally commissioned studies to characterise the ecological health of Bowmans Creek and identify potential impacts to ecological health, which may be associated with observed changes in water quality.

The overall findings of the mitigation TARP studies completed by LCO can be summarised as follows:

- Groundwater within the spoil, alluvium and bedrock is discharging to Bowmans Creek;
- It is expected that pre-mining groundwater flow (or flux) in the area of interest will be the same post mining;
- Dewatering of Dam 6 has minimised the flow of brackish groundwater to Bowmans Creek;
- Reduced rainfall and increased evaporation also contribute to elevated salinity to Bowmans Creek;
- The elevated salinity within Bowmans Creek is localised; and
- Aquatic ecology monitoring has not shown sustained impact to aquatic health of Bowmans Creek.

Follow up review of monitoring data collected until end January 2021 was undertaken to determine whether:

- there are any further refinements to the conceptual site model
- the conclusion that the electrical conductivity (EC) trigger exceedances are anticipated to be predominantly a result of the adverse climatic conditions remains valid.

The elevated EC in Bowmans Creek persisted until mid-2020 and has subsequently reduced to below trigger values, expectedly the result of the cessation of drought conditions in the region. Currently the EC remains below the trigger values.

The elevated EC is expected to have been a result of the following:

- groundwater flow discharging to Bowmans Creek, particularly from the west and north
- low rainfall, resulting in limited surface flow and less dilution of the brackish groundwater discharging to Bowmans Creek
- high evaporation.

The above conclusion did not change with the updated assessment.

Groundwater discharge to Bowmans Creek is not evident during the current monitoring period. Groundwater is still expected to discharge, however the differing climatic conditions of below average evaporation and above average rainfall has resulted in the dilution of brackish groundwater discharging to Bowmans Creek.

Determining whether the EC exceedance in Bowmans Creek prior to mid-2020 was a result of mining is difficult to definitively ascertain without baseline monitoring data since mining in this area occurred from the 1980s. However, the following is a summary of the key aspects we know or can surmise:

- groundwater flow direction, in the area of interest, is expected to be similar now as it was prior to mining
- groundwater within spoil is anticipated to flow at a higher rate than within the in-situ pre-mined bedrock, with the potential for higher rates of discharge than in a pre-mining situation
- in the approximately ten years prior to the recent EC exceedances in Bowmans Creek (BCK1A), during a period of predominantly above average rainfall, the EC has been mostly below the trigger level
- there have been no recent activities in the Mountain Block rehabilitated area that would cause the consecutive exceedances in the EC trigger
- since mid-2020 and the return of above average rainfall and below average evaporation, there have been no EC exceedances.

Further hydrogeological assessment to review the 2021 monitoring data along with the outcomes of the previous Stage 1 and 2 works has since been completed. The Stage 3 scope of works included:

- A review of the surface water and groundwater quality data available from January to December 2021 (inclusive).
- A review of groundwater levels including manual measurements during each sampling event and downloaded data from dataloggers. Groundwater flow directions and any potential response to rainfall recharge will be assessed.
- A comparison with the water levels in the dams and Bowmans Creek.
- A review of stream flow data from gauge 202000610 (also referred to as 300090), located about 50 m downstream of BCK1A.
- A review of rainfall and evaporation.
- A comparison of recent data considering the recent climatic conditions to more historical data.

- Determine if there are any refinements to the conceptual site model.
- Consideration on whether the recent data alters the conclusion that the EC trigger exceedances are anticipated to be predominantly a result of the adverse climatic conditions.
- Recommendations for further work depending on the outcome of the above works.

The Stage 3 works found only one minor refinement to the conceptual site model, being the response of specific bores to rainfall. Other than the refinement outlined, the following key conceptualisations were noted:

- Groundwater discharge to Bowmans Creek is not evident from the water quality data from mid-2020 to the end of the current monitoring period (December 2021). Groundwater is still expected to discharge, with the differing climatic conditions of below average evaporation and above average rainfall resulting in the dilution of brackish groundwater discharging to Bowmans Creek.
- Determining whether the EC exceedance in Bowmans Creek prior to mid-2020 was a result of mining is difficult to definitively ascertain without baseline monitoring data. There have been hydrogeological changes as a result to mining, however since the return of above average rainfall and below average evaporation, there have been no EC exceedances, suggesting climate was the primary cause for the EC trigger exceedances.

Whilst the studies evidence that the elevated salinity is not directly linked to historical mining activities and Dam 6, groundwater flows are interacting with soil in backfilled extraction areas and out of pit dumps before exiting to Bowmans Creek. In line with investigation recommendations, LCO intends to continue monitoring to inform mine closure planning and ability to progress this area for mining title relinquishment in the future.

5.1.3 HRSTS Discharge Monitoring

Any discharges from the Liddell Coal must be undertaken in accordance with the Hunter River Salinity Trading Scheme (HRSTS). During the reporting period LCO discharged mine water under the provisions of the HRSTS during November and December 2021, and during January, March and April 2022. There was no exceedance of any compliance limits applicable to the discharge events. ***Table 5-4*** summarises the discharge events.

Table 5-4 - HRSTS Discharge Summary

RIVER REGISTER INFORMATION		DISCHARGE RECORD							CREDIT REGISTER INFORMATION
Block ID	**Total allowable discharge**	**Start**		**Finish**		**Volume discharged**	**Mean EC**	**Salt load**	**Number of credits held**
(1 block / line)	Tonnes	Time	Date	Time	Date	ML	uS/cm	Tonnes	
2021-320	1572	8:35	15/11/21	19:30	15/11/21	8.95	5887	31.50	70
2021-321	1181	19:30	15/11/21	19:30	16/11/21	32.16	5867	113.17	229
2021-322	799	19:30	16/11/21	19:30	17/11/21	37.40	5751	129.06	229
2021-323	419	19:30	17/11/21	16:35	18/11/21	16.93	5682	57.71	229
2021-327	6753	14:05	22/11/21	19:30	22/11/21	8.16	5386	26.33	70
2021-328	3494	19:30	22/11/21	19:30	23/11/21	35.75	5337	114.51	70
2021-329	2819	19:30	23/11/21	19:30	24/11/21	19.89	5194	61.99	52
2021-330	2766	19:30	24/11/21	19:30	25/11/21	30.12	5096	92.12	90
2021-331	2507	19:30	25/11/21	19:30	26/11/21	40.27	4833	116.69	90
2021-332	7394	19:30	26/11/21	19:30	27/11/21	42.47	4187	106.71	100
2021-333	1838	19:30	27/11/21	19:30	28/11/21	43.80	4027	105.84	90
2021-334	9011	19:30	28/11/21	19:30	29/11/21	30.71	3903	72.43	40
2021-335	5168	19:30	29/11/21	19:30	30/11/21	39.44	4043	95.68	30
2021-336	2982	19:30	30/11/21	19:30	1/12/21	39.31	4092	96.52	50
2021-337	1578	19:30	1/12/21	19:30	2/12/21	39.29	3916	92.27	95

RIVER REGISTER INFORMATION		DISCHARGE RECORD							CREDIT REGISTER INFORMATION
2021-338	2016	19:30	2/12/21	19:30	3/12/21	39.33	4127	97.39	140
2021-339	1176	19:30	3/12/21	19:30	4/12/21	39.00	4103	96.03	167
2021-340	1705	19:30	4/12/21	19:30	5/12/21	39.09	3915	91.81	167
2021-341	1146	19:30	5/12/21	19:30	6/12/21	39.25	4059	95.60	167
2021-342	842	19:30	6/12/21	17:10	7/12/21	33.61	4555	91.88	167
2021-345	7976	20:10	9/12/21	19:30	10/12/21	38.19	2281	51.14	70
2021-346	6750	19:30	10/12/21	19:30	11/12/21	40.28	3238	78.47	70
2021-347	3765	19:30	11/12/21	19:30	12/12/21	40.27	4715	113.92	70
2021-348	2512	19:30	12/12/21	19:30	13/12/21	39.92	4762	114.07	70
2021-349	1761	19:30	13/12/21	19:30	14/12/21	40.06	4799	115.36	90
2021-350	1313	19:30	14/12/21	19:30	15/12/21	40.01	4919	118.09	120
2021-351	822	19:30	15/12/21	19:30	16/12/21	39.91	5084	121.73	167
2021-352	607	19:30	16/12/21	19:30	17/12/21	39.62	5168	122.81	257
2021-353	464	19:30	17/12/21	19:30	18/12/21	32.65	5289	103.63	331
2021-358	306	12:00	23/12/21	19:30	23/12/21	5.92	5646	20.12	451
2021-359	273	19:30	23/12/21	18:45	24/12/21	17.25	5720	59.19	451
2022-012	940	14:55	11/01/22	19:30	11/01/22	3.69	5980	13.38	229
2022-013	724	19:30	11/01/22	19:30	12/01/22	19.60	6033	70.93	229
2022-014	1103	19:30	12/01/22	19:30	13/01/22	20.66	6106	75.68	85

RIVER REGISTER INFORMATION		DISCHARGE RECORD							CREDIT REGISTER INFORMATION
2022-015	875	19:30	13/01/22	19:30	14/01/22	20.57	6156	76.01	167
2022-016	677	19:30	14/01/22	19:30	15/01/22	25.49	6202	94.84	326
2022-017	599	19:30	15/01/22	16:00	16/01/22	16.34	6158	60.05	326
2022-020	392	10:45	19/01/22	19:30	19/01/22	4.68	6133	16.73	326
2022-021	380	19:30	19/01/22	19:30	20/01/22	20.72	6131	76.42	326
2022-022	684	19:30	20/01/22	19:15	21/01/22	36.29	6129	132.88	247
2022-023	555	7:40	22/01/22	19:30	22/01/22	9.07	6122	33.55	331
2022-024	665	19:30	22/01/22	19:30	23/01/22	19.43	6116	71.28	331
2022-025	731	19:30	23/01/22	19:30	24/01/22	26.07	6090	95.46	331
2022-026	594	19:30	24/01/22	19:30	25/01/22	24.96	6071	90.61	331
2022-027	436	19:30	25/01/22	16:10	26/01/22	17.59	6041	63.50	331
2022-064	1948	15:40	4/03/22	19:30	4/03/22	1.05	5795	3.54	70
2022-065	1931	19:30	4/03/22	19:30	5/03/22	21.11	5083	64.50	70
2022-066	9146	19:30	5/03/22	19:30	6/03/22	34.22	6076	124.90	70
2022-067	6013	19:30	6/03/22	19:30	7/03/22	34.80	5025	105.32	28
2022-068	Flood	19:30	7/03/22	19:30	8/03/22	36.32	3648	79.83	25
2022-069	Flood	19:30	8/03/22	19:30	9/03/22	39.09	2826	66.21	70
2022-070	Flood	19:30	9/03/22	19:30	10/03/22	40.01	2809	67.42	70
2022-071	Flood	19:30	10/03/22	19:30	11/03/22	40.23	2760	66.63	70

RIVER REGISTER INFORMATION		DISCHARGE RECORD							CREDIT REGISTER INFORMATION
2022-072	6401	19:30	11/03/22	19:30	12/03/22	40.08	2506	60.20	20
2022-073	2669	19:30	12/03/22	19:30	13/03/22	41.30	2089	51.66	45
2022-074	2361	19:30	13/03/22	19:30	14/03/22	36.79	2071	45.91	50
2022-075	1761	19:30	14/03/22	19:30	15/03/22	36.23	2912	63.27	60
2022-076	1284	19:30	15/03/22	19:30	16/03/22	35.03	2867	60.25	105
2022-077	1197	19:30	16/03/22	19:30	17/03/22	35.20	3005	63.80	105
2022-078	1052	19:30	17/03/22	19:30	18/03/22	35.71	3273	70.10	95
2022-079	826	19:30	18/03/22	19:30	19/03/22	35.89	3379	72.79	150
2022-080	621	19:30	19/03/22	19:30	20/03/22	35.99	3342	72.14	229
2022-081	555	19:30	20/03/22	19:30	21/03/22	36.12	3231	70.01	229
2022-082	571	19:30	21/03/22	19:30	22/03/22	36.36	3197	69.78	229
2022-083	475	19:30	22/03/22	19:30	23/03/22	36.48	3278	71.68	229
2022-084	2358	19:30	23/03/22	19:30	24/03/22	27.85	2703	44.94	284
2022-085	1219	19:30	24/03/22	19:30	25/03/22	16.96	2295	28.88	234
2022-086	2620	19:30	25/03/22	19:30	26/03/22	40.22	4209	101.20	234
2022-087	3364	19:30	26/03/22	19:30	27/03/22	40.34	4178	101.16	115
2022-088	2711	19:30	27/03/22	19:30	28/03/22	40.56	4253	103.14	110
2022-089	1981	19:30	28/03/22	19:30	29/03/22	36.79	4187	91.95	75
2022-090	4184	19:30	29/03/22	19:30	30/03/22	48.50	3903	113.60	120

RIVER REGISTER INFORMATION		DISCHARGE RECORD							CREDIT REGISTER INFORMATION
2022-091	4520	19:30	30/03/22	19:30	31/03/22	48.59	3754	109.52	70
2022-092	3144	19:30	31/03/22	19:30	1/04/22	47.48	4485	127.32	70
2022-093	2757	19:30	1/04/22	19:30	2/04/22	45.83	4317	118.92	70
2022-094	2312	19:30	2/04/22	19:30	3/04/22	46.79	4048	113.74	90
2022-095	1352	19:30	3/04/22	19:30	4/04/22	47.19	4625	131.02	120
2022-096	1423	19:30	4/04/22	19:30	5/04/22	48.08	5073	146.33	150
2022-097	1200	19:30	5/04/22	19:30	6/04/22	44.43	5081	135.40	160
2022-098	928	19:30	6/04/22	19:30	7/04/22	47.29	5080	144.25	234
2022-099	764	19:30	7/04/22	19:30	8/04/22	48.48	5076	148.11	234
2022-100	2123	19:30	8/04/22	19:30	9/04/22	47.34	5167	146.78	331
2022-101	2942	19:30	9/04/22	19:30	10/04/22	47.15	5247	148.40	331
2022-102	1609	19:30	10/04/22	18:00	11/04/22	41.28	5239	129.18	331
2022-106	986	9:45	15/04/22	19:30	15/04/22	9.12	5229	28.82	331
2022-107	787	19:30	15/04/22	19:30	16/04/22	23.67	5340	75.84	331
2022-108	879	19:30	16/04/22	19:30	17/04/22	23.51	5534	78.06	331
2022-109	787	19:30	17/04/22	19:30	18/04/22	21.34	5703	73.04	331
2022-110	618	19:30	18/04/22	15:10	19/04/22	16.78	5736	57.50	331

5.2 Groundwater

LCO is located within an area of the Upper Hunter Valley subject to extensive underground and open cut mining activities since the early 20th century. Current and historical mining operations have extensively altered the physical features and environmental setting of the local area, including the region's surface water and groundwater systems.

Mining operations to the west, south and east of LCO, Lake Liddell to the west, and the major geological feature Hunter Thrust to the north, all have major influence on groundwater levels in the region. Due to such operations and features regional groundwater levels largely reflect current and past mining activities, with water levels varying with time and location according to local mining activities.

The WMP groundwater monitoring program adopts site specific trigger levels for impact investigation and assessment. If monitoring results suggest significant and continuous deviation from historical or background trends in water quality, further investigations into potential impacts are conducted. These are either Investigation Trigger Action Response Plans (ITARP) or Management Triger Action Response Plans (MTARP) as per the WMP.

It is highlighted that, due to changes in land-use in the vicinity of LCO through both mining and agriculture, as well as local variability in groundwater conditions, there is limited opportunity for establishment of groundwater reference sites. Hence, the appropriateness site specific trigger levels is based on historical measurements. Currently, investigations into potential impacts are conducted if there are three consecutive exceedances of the nominated triggers. As is detailed in the WMP, LCO has adopted investigation trigger limits for groundwater monitoring bores regardless of whether they are predicted to be impacted due to current approved mining operations or not.

5.2.1 Groundwater Quality Investigation Trigger Definitions

There are two components to the groundwater quality trigger definitions. These are described in detail in the WMP and summarised as follows:

1. *EC investigation trigger* – An investigation trigger because of a monthly measurement either below the 20th percentile baseline (20th%ile) or above the 80th percentile baseline (80th%ile) on three consecutive occasions. Note the 20th%ile triggers levels are designed to identify downward leakage from the alluvium to the shallow bedrock to provide another mechanism to detect potential alluvial impacts in addition to the water level triggers.
2. *pH investigation trigger* - An investigation trigger because of a monthly measurement either above or below the default pH trigger values from ANZECC (2000) for lowland rivers located in NSW.

5.2.2 Groundwater Level Investigation Trigger Definitions

Groundwater level monitoring is carried out at least monthly on the shallow, unconfined, water table aquifers of Bowmans Creek alluvium and the underlying shallow bedrock. Water pressure monitoring is carried out at least monthly on the deeper, confined, hard rock aquifers.

There are three components to the groundwater level trigger definitions. These are described in detail in the WMP (LCO, 2021) and summarised as follows:

- *Definition 1. Impact trigger* – An impact trigger is drawdown of 2m in the alluvium compared to the local reference site for the northern and southern impact zone as shown in the WMP, only applicable at ALV9 and ALV8L.

- *Definition 2. Investigation trigger* – An investigation trigger and is measurement below the monthly, baseline (10th percentile) water level on three consecutive occasions. The purpose of this trigger is to identify unexpected changes to groundwater level.

  ALV9 does not have an investigation trigger because these triggers were developed using historical baseline data and ALV9 was a recent installation (December 2017) to provide greater coverage for the identification of alluvial groundwater impacts in the northern drawdown area.

- *Definition 3. Subsequent Investigation Trigger* - A Subsequent Investigation Trigger is designed to address the potential for harm to listed threatened species, communities and migratory species of concern to EPBC Approval 2013/6908 due to continuing exceedance of the lower 10th percentile trigger. Following an investigation of an exceedance of Groundwater Level Trigger Definition #2 that concludes the exceedance is not mining-related, should groundwater levels continue to be measured below the lower 10th percentile for a further nine months, such that the exceedance has continued continuously for 12 months, then a subsequent investigation shall be undertaken to confirm that the exceedance remains unrelated to mining activity.

Table 5-4 presents the current site specific investigation trigger levels for water level and groundwater quality and shows the data relevant to the reporting period.

In addition to the Investigation Triggers described above, LCO also have Management / Mitigation Triggers. These occurs when a nominated trigger value is exceeded three or more times, and a potential impact to a receptor and or the potential for environmental harm is identified. Action is taken in the form of further detailed hydrogeological studies to investigate the cause of the exceedance, determination of appropriate mitigation strategy for detailed design and implementation. To date, LCO has not identified any applicable Management / Mitigation Trigger observations.

Monitoring results observed during the reporting period are summarised in following Section 5.2.3 and Section 5.2.4 with the breakdown of:

- Section 5.2.3 Groundwater quality monitoring
    - Groundwater quality of alluvial and shallow bedrock aquifers
    - Groundwater quality of hard rock (Coal Measures) aquifer
- Section 5.2.4 Groundwater level monitoring
    - Groundwater levels of alluvial and shallow bedrock aquifers
    - Groundwater levels of hard rock (Coal Measures) aquifer

5.2.3 Impact Assessment Criteria

Groundwater quality monitoring results and trigger limits for the alluvial and shallow bedrock aquifers during the reporting period are shown in ***Table 5-5***.

Table 5-5 - Groundwater Impact Assessment Criteria

Groundwater Impact Assessment Criteria							
		Groundwater Elevation (mAHD) – Definition #2 & #3		**EC (µS/cm)**			**pH**
		10th%ile	Ref. Min	20%ile	80%ile	Max	
Alluvial and Shallow Bedrock Aquifers							
ALV1	Alluvial aquifer (L)	106.22	104.88	N/A	1370	2020	6.5 – 8.5
	Shallow bed rock (S)	106.44	104.35	N/A	1560	1770	
LBH	Alluvial aquifer (L)	105.74	104.55	N/A	1550	3090	
ALV3	Alluvial aquifer (L)	103.81	102.43	N/A	1390	3080	
	Shallow bed rock (S)	103.52	102.25	N/A	2800	4510	
ALV4	Alluvial aquifer (L)	102.14	100.97	N/A	1920	3080	
	Shallow bed rock (S)	101.42	100.28	N/A	5310	6430	
ALV2	Alluvial aquifer (L)	93.08	91.12	N/A	2830	4160	
	Shallow bed rock (S)	93.21	89.35	2560	2820	3370	
ALV7	Alluvial aquifer (L)	87.02	86.43	N/A	1780	2310	
	Shallow bed rock (S)	83.56	82.39	N/A	2230	2540	
ALV8	Alluvial aquifer (L)	85.06	83.66	N/A	1310	1880	
	Shallow bed rock (S)	82.99	80.94	1540	1990	2400	
Hard Rock Aquifers (Coal Measures)							
PGW5 *	Overburden (L)	N/A	N/A	N/A	N/A	N/A	6.5 – 8.5
	Coal Measure (S)	N/A	N/A	N/A	N/A	N/A	
Groundwater Level Trigger Definition #1 – 2m drawdown in Bowmans Creek Alluvium							
ALV9L	Groundwater elevation of monitoring piezometer ALV2L minus 5.0m (AHD).						
ALV8L	Groundwater elevation of monitoring piezometer ALV7L minus 4.5m (AHD).						

* - Investigation triggers removed from hard rock aquifer bores PGW5S and PGW5L as per consultation and management plan update during 2017.

5.2.4 Groundwater Quality Monitoring

5.2.4.1 Groundwater quality of alluvial and shallow bedrock aquifers

As established by long term monitoring results, climatic variations significantly influence the hydraulic behaviour/interactions and water quality in the shallow groundwater systems being monitored. Further, LCO has undertaken statistical analysis regarding groundwater quality and climatic trends with the intent to quantitatively establish relationship between groundwater measurements and climatic factors during differing climatic periods. The statistical analysis completed for subsequent ITARP investigations have identified that the mechanisms driving changes to groundwater quality (particularly EC) cannot be easily characterised using the Spearmans' Coefficient statistical analysis method (Jacobs, 2020). This is likely due to other external factors, in addition to rainfall recharge, influencing EC of the Bowmans Creek system such as geological unit subcrops, discharge rates and concentrations from hydrogeological units and hydraulic gradient changes (Jacobs, 2020). The varying climatic variations can be readily described as a period of extreme drought conditions (below average rainfall and above average evaporation) during 2016 to late 2019 followed by a gradual return to conditions similar to long term average (average evaporation and rainfall).

Groundwater pH

Groundwater pH monitoring results measured and a comparison with the investigation trigger levels during the reporting period are presented in Table 5-6 below. There were several instances of minor exceedances of the pH however none of which were sustained or triggered a pH investigation trigger. The pH level across both systems appear to have a relatively stable trend that has existed throughout the data collection period as shown in **Table 5-6**.

Table 5-6 - Groundwater pH results for Alluvial and Shallow Bedrock Aquifers

Alluvial and Shallow Bedrock Groundwater Quality - pH													
Site	**ALV1L**	**ALV1S**	**ALV2L**	**ALV2S**	**ALV3L**	**ALV3S**	**ALV4L**	**ALV4S**	**ALV7L**	**ALV7S**	**ALV8L**	**ALV8S**	**LBH**
Trigger	6.50 – 8.50												
Jun-21	6.84	7.71	7.08	7.57	6.98	7.67	6.79	7.36	7.15	7.58	*	7.01	6.84
Jul-21	7.45	8.12	8.6	8.03	7.55	8.04	7.09	7.87	7.73	7.98	8.55	8.5	7.4
Aug-21	6.71	7.49	7.8	8.04	7.87	8.19	6.66	7.26	7.02	7.35	*	6.96	7.8
Sep-21	6.86	7.71	7.01	7.47	6.9	7.47	6.8	7.29	7.04	7.43	*	7.02	6.92
Oct-21	6.8	7.55	6.98	7.48	6.88	7.46	6.7	7.31	7.03	7.48	*	7.01	6.78
Nov-21	7.35	7.85	7.4	7.43	7.29	7.63	6.87	7.37	7.35	7.43	7.29	7.25	7.09
Dec-21	6.52	7.22	6.77	7.09	6.54	7.04	6.46	6.89	6.84	7.13	6.67	6.75	6.43
Jan-22	7.36	8.25	7.51	7.87	6.92	7.28	6.83	7.26	7.34	7.61	7.44	7.49	6.69
Feb-22	6.66	7.24	6.80	7.19	6.74	7.23	6.74	7.00	7.00	7.16	6.97	7.03	6.63
Mar-22	6.88	7.53	7.09	7.58	6.89	7.39	6.95	7.38	6.94	7.53	6.85	7.14	6.76
Apr-22	6.80	7.79	6.74	7.11	7.45	7.92	6.70	6.99	6.61	7.30	6.78	6.93	7.10
May-22	7.00	7.65	6.70	7.14	6.90	7.46	7.34	7.06	7.84	8.27	7.41	7.58	7.13

Notes to Table:

* bore dry or water level too low to sample

Groundwater EC

Table 5-7 below summarises the Electrical Conductivity (EC) measurements of groundwater, with comparison to the applicable trigger levels. There have been numerous exceedances of the EC upper limit and subsequent investigations undertaken during the reporting period. From December 2021 through to May 2022 the ALV8(S) bore triggered below the 20%ile level.

Investigations into EC levels have determined that EC levels are varying due to climatic factors rather than a direct impact by mining operations.

Table 5-7 - Groundwater results for EC in Alluvial and Shallow Rock Aquifers

Alluvial and Shallow Bedrock Groundwater Quality - EC (ms/m)													
Site	ALV1L	ALV1S	ALV2L	ALV2S	ALV3L	ALV3S	ALV4L	ALV4S	ALV7L	ALV7S	ALV8L	ALV8S	LBH
80th %ile	1.37	1.56	2.83	2.82	1.39	7.26	6.73	7.42	1.78	2.23	1.31	1.99	1.55
20th %ile				2.56								1.54	
Jun-21	1.721	1.642	4.15	3.86	0.988	1.972	1.631	6.4	1.709	3.64	*	1.77	1.415
Jul-21	1.571	1.501	3.91	3.49	0.916	1.765	1.455	5.64	1.634	3.35	1.15	1.65	1.229
Aug-21	1.56	1.511	3.93	3.61	0.931	1.836	1.561	5.87	1.691	3.38	*	1.71	1.265
Sep-21	1.592	1.524	3.88	3.7	0.991	1.634	1.612	5.85	1.829	3.45	*	1.76	1.271
Oct-21	1.483	1.481	3.83	3.61	0.988	1.73	1.611	5.81	1.806	3.4	*	1.74	1.246
Nov-21	1.123	1.51	2.856	3.53	0.922	1.596	1.107	5.76	1.797	3.35	1.25	1.81	1.279
Dec-21	1.471	1.505	2.854	3.38	0.864	1.593	1.619	5.53	1.223	3.32	1.01	1.52	1.229
Jan-22	1.34	1.40	3.22	3.02	0.75	1.53	1.58	4.94	1.35	2.83	0.99	1.40	1.13
Feb-22	1.18	1.27	3.25	2.9	0.69	1.42	1.39	4.87	1.27	2.71	0.74	1.27	0.93
Mar-22	1.24	1.26	2.70	2.93	0.72	1.34	1.49	4.97	1.17	2.78	0.81	1.19	0.91
Apr-22	1.21	1.29	3.42	3.06	0.62	1.37	1.50	5.14	1.01	2.56	0.78	1.12	0.92
May-22	1.23	1.36	3.67	3.22	0.73	1.45	1.59	5.31	1.32	2.65	0.74	1.17	0.86

Notes to Table:
Denotes an exceedance of the 80th%ile trigger limit
Denotes an exceedance of the 20th%tile trigger limit
* bore dry or water level too low to sample

As required by the WMP, ITARP investigations have been triggered and completed where monitoring has identified consecutive exceedances of the EC trigger levels. The conclusions of each investigation (***LCO 2020, LCO 2021***) are summarised in below in ***Table 5-8***.

Table 5-8 - ITARP investigations for quality triggers completed in reporting period

Month of 3rd exceedance	Month exceedance reported	Site	Conclusions
June 21	July 21	ALV2L EC	• Groundwater level trends in ALV2(L) and ALV2(S); and generally, in the Bowmans Creek monitoring bore network more widely show a correlation to the rainfall and evaporation CRD trends. The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. • EC levels are currently below the reference period maximum. EC and water levels at the bores are trending together with near equivalency in both. The increase in EC that has been observed since 2020 correlates with the end of the drought and average to above average rainfall conditions. The change in the CRD has resulted in an increase in interaction between the saline shallow bedrock and fresh alluvium and subsequent increase in measured EC levels. • Whilst the measured EC levels at ALV2(S) have exceeded reference maximums to date it is not expected that there is potential for harm to the environment as the system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material.
July 21	August 21	ALV1L, ALV2L and ALV2S EC	• Groundwater level trends in ALV2(L) and ALV2(S); and generally, in the Bowmans Creek monitoring bore network more widely show a correlation to the rainfall and evaporation CRD trends. The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. • EC levels at ALV2(L) are currently below the reference period maximum whilst ALV2(S) is marginally (0.12ms/cm over the reference period maximum. EC and water levels at the bores are trending together with near equivalency in both. The increase in EC that has been observed since 2020 correlates with the end of the drought and average to above average rainfall conditions. The change in the CRD has resulted in an increase in interaction between the saline shallow bedrock and fresh alluvium and subsequent increase in measured EC levels. • Whilst the measured EC levels at ALV2(S) have exceeded reference maximums to date it is not expected that there is potential for harm to the environment as the system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material.
August 2021	September 2021	ALV4S and ALV7S EC	• Groundwater level trends in ALV4S and ALV7S; and generally, in the Bowmans Creek monitoring bore network more widely and show a clear correlation to the rainfall and evaporation CRD trends. The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are

			due to climatic variations rather than a specific mining related impact. • Both triggering locations have ceased increasing and stabilised at a level higher than the pre drought conditions. ALV4(S) EC levels have stabilised between the 80th%ile and reference maximum levels. ALV7(S) EC levels are on a sustained downwards trend towards long term averages. Whilst, measured EC levels at ALV7S have exceeded reference maximums it is expected that this is driven from long term drought conditions and subsequent commencement of system recovery from the drought through an increase in rainfall. Therefore, it is not expected that there is potential for harm to the environment as the system is varying naturally in response to rainfall recharge.
September 2021	October 2021	ALV1L EC	• Mining extraction has not occurred in the northern extents of the operation for many years nor has there been any failure of mine water containment system. • Groundwater level and EC trends in ALV1(L); and generally, in the Bowmans Creek monitoring bore network more widely show a correlation to the rainfall and evaporation CRD trends. The 2017-2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. The recent extended period of above average rainfall has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. • At ALV1 there is an upward hydraulic gradient indicating saline shallow bedrock underneath being pressurised by increasing rainfall recharge and interacting with overlying alluvium. EC levels at ALV1(L) are very similar to that of the underlying shallow bedrock in this location; this indicates that EC levels at ALV1(L) are expectedly being influenced by the recharging shallow bedrock influence. • Measured EC levels at ALV1L have remained relatively stable between the reference 80th%ile and maximum levels since initially exceeding in October 2019. There has been minor monthly variability in EC levels indicating stabilisation. • Continued exceedances of investigation trigger limits are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period which was average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. Since the system is responding naturally to climatic variations, it is considered there is no potential for environmental harm.
October 2021	November 2021	AVL2L EC	• There has not been any failure of mine water containment system. • The 2017-2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. The recent extended period of above average rainfall reduced to average rainfall March 2021 and has resulted in

			recovery of groundwater levels in the alluvium and shallow bedrock systems. • At ALV2 there is an upward hydraulic gradient indicating saline shallow bedrock underneath being pressurised by increasing rainfall recharge and interacting with overlying alluvium. EC levels and groundwater pressures at ALV2(L) are very similar to that of the underlying shallow bedrock ALV2(S) in this location. • EC levels at ALV2(L) are currently below the reference period maximum whilst ALV2(S) is marginally over the reference period maximum. Measured EC levels at ALV2 have remained relatively stable between the reference 80th%ile and maximum levels since initially exceeding in October 2019. There has been minor monthly variability and decreasing trend in EC levels indicating stabilisation during the last 12months. • Continued exceedances of investigation trigger limits are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period which was average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • Whilst the measured EC levels at ALV2(S) have exceeded reference maximums to date it is not expected that there is potential for harm to the environment as the system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. Since the system is responding naturally to climatic variations, it is considered there is no potential for environmental harm.
November 2021	December 2021	ALV7S EC	• There has not been any failure of mine water containment system. • The 2017-2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. The recent extended period of above average rainfall reduced to average rainfall March 2021 and has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. • EC levels at ALV7(L) and ALV4(S) are currently below the reference period maximum. ALV7(S) is remains above the reference period maximum. • Whilst the measured EC levels at ALV7(S) have exceeded reference maximums to date it is not expected that there is potential for harm to the environment as the system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material. • Continued exceedances of investigation trigger limits are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period which was average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact.

			Since the system is responding naturally to climatic variations, it is considered there is no potential for environmental harm. •
January 2022	February 2022	ALV2S and ALV2L EC	• There has not been any failure of mine water containment system. • The 2017 - 2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. 2020 was a period of above average rainfall, which reduced to average rainfall March 2021. This has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. • EC levels at ALV2S and ALV2L are both currently below the reference period maximum. • It is not expected that there is potential for harm to the environment as the Bowmans Creek system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material. Further, EC levels are within historical ranges. • Continued exceedances of investigation trigger limits are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period which was average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact.
February 2022	March 2022	ALV7S and ALV8S EC	• There has not been any failure of mine water containment system. • The 2017 - 2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. 2020 was a period of above average rainfall, which reduced to average rainfall March 2021. This has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. • In 2021, mining impacts to the shallow bedrock aquifer (ALV7S and ALV8S) were evident. However the groundwater investigations completed to date have not concluded that mining activities have resulted in impacts not approved for LCO. • Since late 2020, EC levels at ALV7S has been on a steady decline, back towards the reference period maximum. • Since late 2021, EC levels at ALV8S have declined below the 20th percentile trigger due to recharge from the fresher overlying alluvium. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. • Continued exceedances of investigation trigger limits at ALV7S are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period i.e. average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • It is not expected that there is potential for harm to the environment as the Bowmans Creek system is varying naturally in response to

			an increase in groundwater level and interaction with the saline shallow bedrock material.
May	March 2022	ALV2S, ALV7S and ALV8S EC	• There has not been any failure of mine water containment system. • The 2017 - 2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. 2020 was a period of above average rainfall, which reduced to average rainfall March 2021. This has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. • In 2021, mining impacts to the shallow bedrock aquifer (ALV7S and ALV8S) were evident. However, the groundwater investigations have confirmed that these are consistent with those predicted in LCO project. • Since late 2020, EC levels at ALV7S has been on a steady decline, back towards the reference period maximum. • Since late 2021, EC levels at ALV8S have declined below the 20th percentile trigger due to recharge from the fresher overlying alluvium. • The direct relationship between these monitoring observations and rainfall; as well as the trending relationship with EC and residual mass curves, implies that the measurements are due to climatic variations rather than a specific mining related impact. • Continued exceedances of investigation trigger limits at ALV7S are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period i.e. average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • It is not expected that there is potential for harm to the environment as the Bowmans Creek system is varying naturally in response to an increase in groundwater level and interaction with the saline shallow bedrock material.

5.2.4.2 Groundwater Quality Summary

Based on the conclusions regarding the various trigger exceedances discussed above, LCO has determined that no environmental harm has occurred as a result of any mining impact during the reporting period.

LCO will continue to monitor the groundwater quality as per the WMP.

5.2.5 Groundwater Level Monitoring

LCO monitor the groundwater level of the Bowmans Creek alluvial and shallow bedrock aquifers to identify any potential impacts from mining such as depressurisation. Hydrographs for piezometers targeting the alluvium and shallow bedrock are displayed ***Figure 5-2*** and ***Figure 5-3*** respectively.

The residual mass curve for rainfall is also presented in ***Figure 5-2*** and ***Figure 5-3***. The residual mass curve for rainfall calculates the difference between observed rainfall and the average amount of rainfall for that time of the year (defined monthly). The CRDs trends for rainfall and evaporation provide the information to understand climatic conditions; for instance, a decreasing rainfall CRD trend indicates measured rainfall is below the long-term average and an increasing CRD indicates measured evaporation greater than long term averages. This was developed from the LCO onsite meteorological station to ensure data is most representative of conditions on site.

Groundwater elevations within the water table aquifer decrease with distance downstream. This is because the elevation of the water table within a near surface aquifer (for example, the water table aquifer at LCO), is typically a subdued reflection of surface topography. I.e. in the same way that a surface water course flows from high topographic elevation to low topographic elevation. The steepness of the hydraulic gradient (slope of groundwater elevation with distance down-gradient) reflects other factors including the permeability of aquifer material, differences in propensity for recharge as well as groundwater/surface water interaction.

With reference to full historical monitoring results, the sympathetic response in water levels observed in the paired bores indicate similar processes are driving the recharge for both the alluvial aquifer and shallow bedrock aquifer. The different absolute levels for the paired bores reflect the different hydraulic connectivity between the alluvium and shallow bedrock. Water level relationships show a shift from slight upward pressures (gaining stream) upstream (ALV1), through to equal pressures adjacent to LCO (ALV3, ALV4, ALV2) to slight downward pressures (losing stream) to the south (ALV7, ALV8). Rainfall (recharge) appears to be the dominant driver for groundwater level variability for the Bowmans Creek alluvium and underlying shallow bedrock.

With reference to rainfall and evaporation trends during the previous and current reporting period; the decline in residual mass curve (rainfall) coupled with an increasing residual mass curve (evaporation) suggested that drought conditions (below average rainfall and higher than average evaporation) prevailed until an increase in rainfall was measured throughout 2020 reversing the rainfall CRD gradient. This Increase in rainfall and decrease in evaporation conditions throughout 2020-22 and has resulted in recharge throughout the Bowmans Creek system which is demonstrated through the majority of the groundwater bores which were dry in 2019 now recovering or have recovered to pre-drought levels with sustained rainfall recharge required to continue to maintain this.

With respect to trigger exceedances, there were no exceedances of the Impact Triggers for alluvial draw down impact assessment (Definition 1). There were a number of Investigation and Subsequent Investigation (Definition 2 & 3 respectively) trigger level exceedances summarised herein.

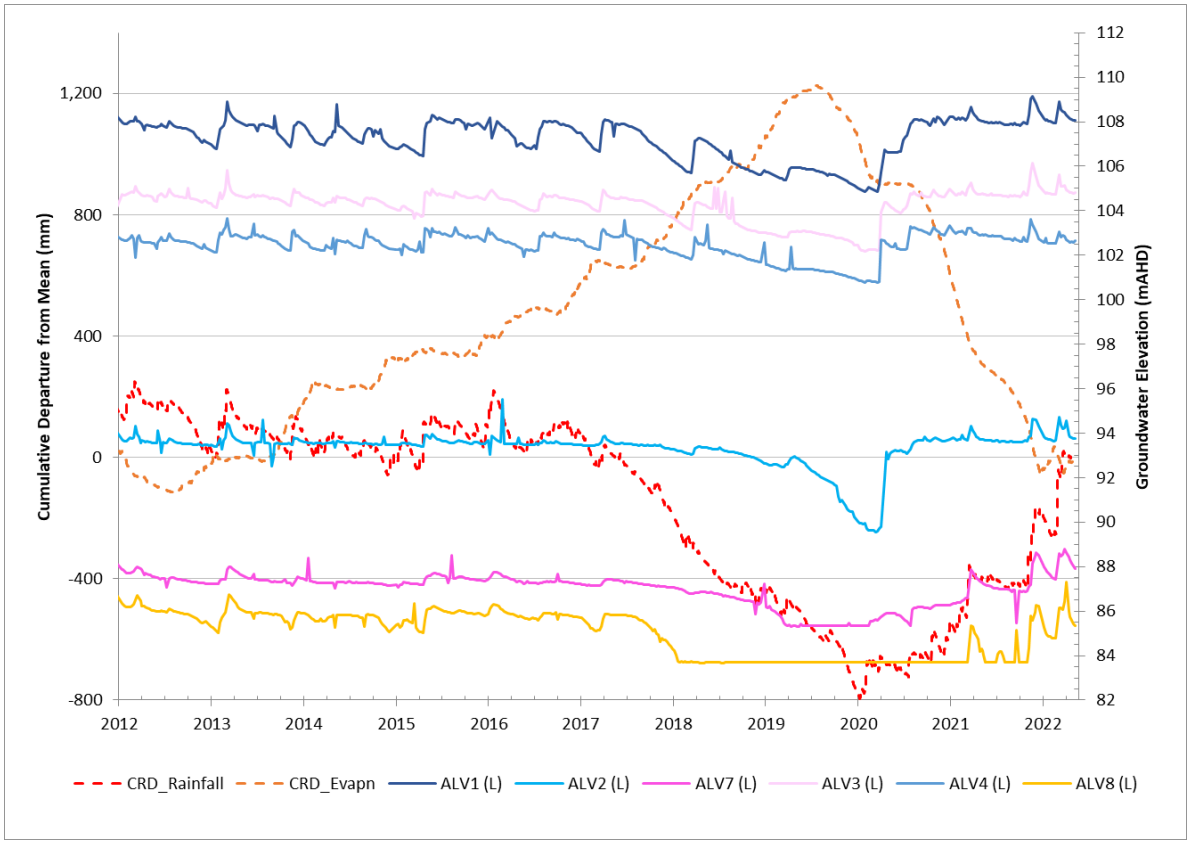

Figure 5-2 – Groundwater - alluvial elevations

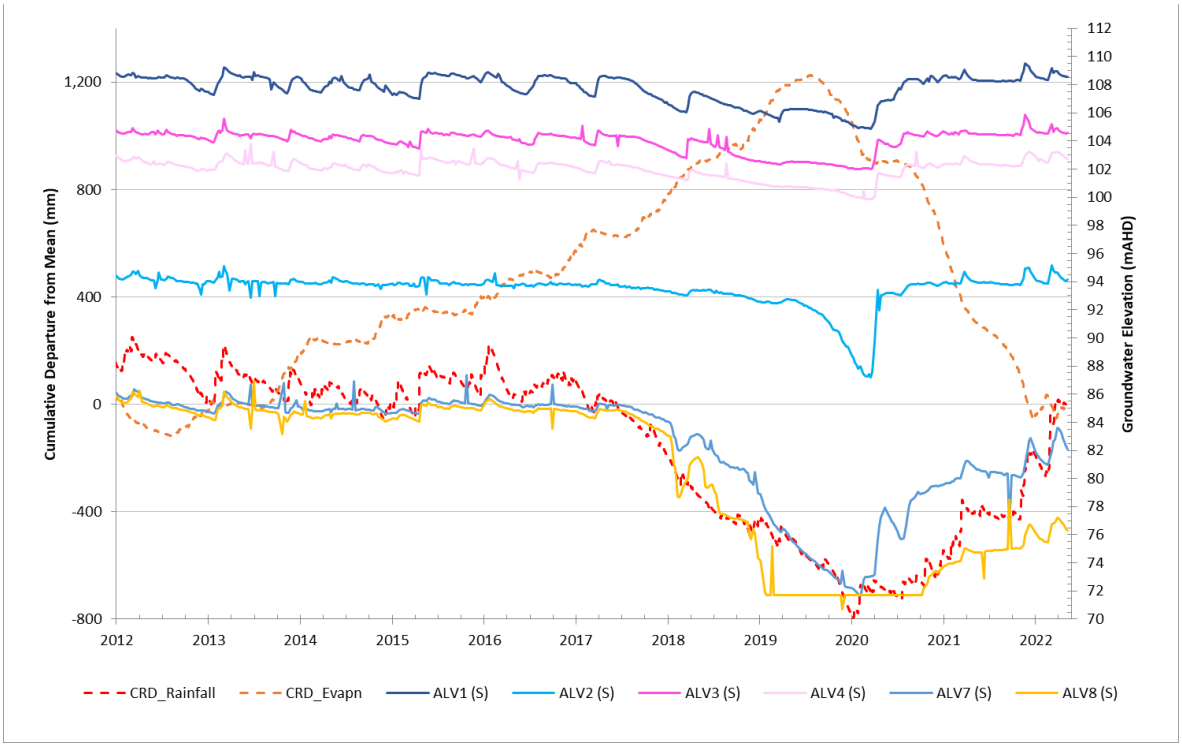

Figure 5-3 – Groundwater – shallow bedrock elevations

Table 5-9 presents recorded groundwater depth to water measurements as well as exceedances of investigation trigger limits during the monitoring period. ***Table 5-9*** presents a summary of the ITARP

investigations completed during the reporting period. Noteworthy, in accordance with the WMP, where groundwater levels continuously trigger after the initial investigation (triggered on three consecutive months) and it has been determined not to be a mining related impact; subsequent investigations occur at 12 consecutive months and then at 24 consecutive months unless otherwise recommended through the investigation findings. ALV9 does not have an applicable Definition #2 investigation trigger as these triggers were developed using historical baseline date and ALV9 installed in 2017 is in place to detect potential draw down impacts based on measured differences with nearby reference bore ALV2L.

Groundwater investigations completed to date have not concluded that mining activities have resulted in impacts exceeding that approved for LCO.

Table 5-9 - Depth to Water Monitoring Results and Trigger Exceedances

Site	ALV1L	ALV1S	ALV2L	ALV2S	ALV3L	ALV3S	ALV4L	ALV4S	ALV7L	ALV7S	ALV8L	ALV8S	LBH
10th %ile	4.97	4.75	4.8	4.67	5.7	5.99	5.56	6.28	6.75	10.21	6.96	9.03	5.05
Max	6.31	6.84	6.76	8.53	7.08	7.26	6.73	7.42	7.34	11.38	8.36	11.08	6.24
Jun-21	3.22	2.91	4.22	3.92	4.73	5.05	4.83	5.35	6.68	13.24	8.36	19.11	3.55
Jul-21	3.24	2.90	4.23	3.95	4.77	4.99	4.87	5.35	6.73	13.23	7.85	17.16	3.59
Aug-21	3.33	2.96	4.28	4.08	4.84	5.08	4.97	5.10	6.82	13.38	8.36	19.13	3.72
Sep-21	3.29	2.90	4.28	4.10	4.79	5.43	4.97	5.47	6.57	13.54	8.36	17.06	3.66
Oct-21	3.28	2.92	4.27	4.09	4.76	5.02	5.05	5.50	6.89	13.56	8.36	16.99	3.87
Nov-21	2.16	2.22	4.01	3.67	3.75	4.36	4.08	5.02	6.50	13.33	7.20	16.74	2.44
Dec-21	2.67	2.20	3.56	3.20	4.38	4.58	4.95	4.52	5.27	10.92	5.80	15.32	3.28
Jan-22	3.03	1.40	4.04	3.77	4.65	4.87	5.14	4.83	5.78	11.96	6.77	15.93	3.45
Feb-22	3.22	1.27	4.23	3.99	4.74	4.98	5.19	5.22	6.27	12.71	7.21	16.50	3.55
Mar-22	2.68	1.26	3.55	3.13	4.41	4.68	4.91	4.42	5.31	11.06	5.91	15.21	3.33
Apr-22	3.05	1.29	4.06	3.69	4.67	4.90	5.11	4.75	5.49	10.88	6.29	15.24	3.50
May-22	3.15	1.36	4.19	3.78	4.69	4.96	5.11	5.06	5.98	11.92	6.80	15.90	3.57

Notes to Table:

Denotes an exceedance of the 10th%ile trigger limit

Denotes an exceedance of the maximum result recorded during the baseline period

* bore dry or water level too low to sample

Table 5-10 - ITARP investigations for groundwater level triggers completed in reporting period

Month of 3rd exceedance	Month exceedance reported	Site	Conclusions
August 2021	September 2021	ALV8L	• There has been no exceedance of the groundwater draw down triggers with water levels in ALV8L's reference bore ALV7L following similar water levels and trends. • Groundwater level decline in ALV8L and its reference bore, ALV7L has been observed during previous periods of below average rainfall (including the Millennium Drought) during the reference period (prior to current open cut mining operations). • The 2017-2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. • There has been some recovery in groundwater levels at ALV8L at the peak of the 2020-2021 rainfall CRD trend, though recent below average rainfall conditions correlate with declining water levels at ALV8L and ALV7L. • Groundwater Impact Model Validation assessment indicates that the model is fit for purpose and remains conservative. Further, groundwater observations and model predictions support the understanding that the alluvium is driven by climatic variations rather than mining activities. • Mining extraction has not extended beyond approved limits. Further, mining extraction is not planned to extend to the full extent of approved depths, lateral limits or through geological features (Davis creek fault) associated with modelled peak groundwater impacts. • The sustained, dry alluvium at ALV8L withstands the conclusions of the previous ITARP reports at ALV8L and the Bowmans Creek monitoring network more widely, that groundwater levels are the result of climatic variations rather than mining operations. • Since the system is responding naturally to climatic variations, it is considered there is no potential for environmental harm.
January 2022	February 2022	ALV7S and ALV8S	• There has been no exceedance of the groundwater draw down triggers. • Groundwater levels in the alluvium aquifer at ALV7L and ALV8L have not triggered in recent months and are within or close to the baseline ranges since late 2021. • The 2017-2019 drought climatic conditions measured characterise the most severe drought in the monitoring period and is therefore unprecedented in groundwater monitoring reference period. • Groundwater level decline in ALV8S, and its reference bore ALV7S, was observed during previous periods of

			below average rainfall (including the Millennium Drought) during the reference period (prior to current open cut mining operations). • The recent extended period of above average rainfall has resulted in recovery of groundwater levels in the alluvium and shallow bedrock systems. Groundwater levels in the shallow bedrock aquifer at ALV8S, and its reference bore ALV7S, remain below the triggers of the maximum reference period though are increasing with the above average rainfall conditions since 2020. • The groundwater impact model has been updated since the Mod 5 impact assessment to reflect more available information. Both the 2018 and 2021 Groundwater Impact Model Validation assessments indicates the model is fit for purpose and remains conservative. Further, the following key points are noted: • There are no additional drawdown impacts due to mining beyond what has been approved. • The Permian groundwater units that are affected by mining activities are disconnected to the overlying alluvium. • Groundwater observations and model predictions support the understanding that the alluvium is driven by climatic variations rather than mining activities. • Continued exceedances of investigation trigger limits are due to the distinctly different climatic conditions of the recent years to that of the baseline/reference period which was average to above average rainfall. Hence, investigation trigger levels adopted in the WMP do not reflect the natural variability within the actual system. • Groundwater impacts to the alluvium are less than that predicted/approved. • Mining extraction has not extended beyond approved limits. Further, mining extraction is not planned to extend to the full extent of approved depths, lateral limits or through geological features (Daviszz creek fault) associated with modelled peak groundwater impacts. • The observations at ALV7S and ALV8S support the conclusions of the previous ITARP reports for the Bowmans Creek monitoring network, i.e. groundwater levels are the result of climatic variations rather than mining operations. Since the system is responding naturally to climatic variations, it is considered there is no potential for environmental harm.

5.2.6 Groundwater Levels of Hard Rock Aquifer (Coal Measures)

LCO monitor a number of hard rock aquifers to provide for the ongoing water management onsite. The groundwater elevations within these aquifers vary significantly between the piezometers monitored, reflecting differences in groundwater levels between different stratigraphic layers and as

a consequence of recent and historical mining and dewatering operations. There are no investigation groundwater trigger levels for monitoring of these water bodies.

Noteworthy findings from the ongoing monitoring indicate that there is no significant connectivity between the Hazeldene workings and the actively mined Liddell Seams below. This is supported by the lack in response of groundwater elevations/pressures in the Hazeldene workings when drawn down of the mined Liddell seams occurs

5.2.7 Groundwater Level Summary

Based on the conclusions regarding the various trigger exceedances discussed above, LCO has determined that no environmental harm has occurred as a result of any mining impact during the reporting period.

LCO will continue to monitor the groundwater levels as per the WMP.

6. Reference Information

Reference information, listed in ***Table 6-1***, is information that is directly related to the development of this document or referenced from within this document.

Table 6-1 - Reference Information

Reference	Title
DP&E 2015	*Independent Audit Guideline. Post-approval requirements for State significant developments*
LIDOC-90533967-2881	*Liddell Coal Operations Mining Operations Plan/Rehabilitation Management Plan*
LIDOC-90533967-3755	*Biodiversity Offset Management Plan*
LIDOC-90533967-3687	*Biodiversity Management Plan*
LIDOC-90533967-3776	*Indirect Offset Management Plan*
LIDOC-90533967-3694	*Water Management Plan*
LCO 2022	*Liddell Coal Operations Annual Review 2021*
Umwelt 2021	*2021 Biodiversity Monitoring Report. Prepared for Liddell Coal Operations Pty. Ltd*
Umwelt 2021	*2021 Biodiversity Offset Monitoring Report Prepared for Liddell Coal Operations Pty Ltd*
Umwelt 2022	*2021 Liddell Coal Operations Annual Rehabilitation Monitoring Report (Woodland)*
Future Harvest	*2021 Liddell Coal Operations Annual Rehabilitation Monitoring Report (Whole of Site Walkover and Pasture Areas)*
LCO 2020	*Liddell Coal Operations Groundwater Investigation Trigger Report - June 2021* *Liddell Coal Operations Groundwater Trigger Investigation Report - July 2021* *Liddell Coal Operations Groundwater Trigger Investigation Report - August 2021* *Liddell Coal Operations Groundwater Trigger Investigation Report - September 2021* *Liddell Coal Operations Groundwater Trigger Investigation Report - October 2021* *Liddell Coal Operations Groundwater Trigger Investigation Report - November 2021*
LCO 2021	*Liddell Coal Operations Groundwater Trigger Investigation Report - January 2022* *Liddell Coal Operations Groundwater Trigger Investigation Report - February 2022* *Liddell Coal Operations Groundwater Trigger Investigation Report - May 2021*

GLENCORE