LIDDELL

GLENCORE

EPBC Approval 2013/6908 - 2019 Annual Report

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1 Introduction

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** 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. 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 this approval, including implementation of the management plans required by the Approval. This report has been developed to meet the requirements of Condition 19 for the period 19 May 2018 to 18 May 2019.

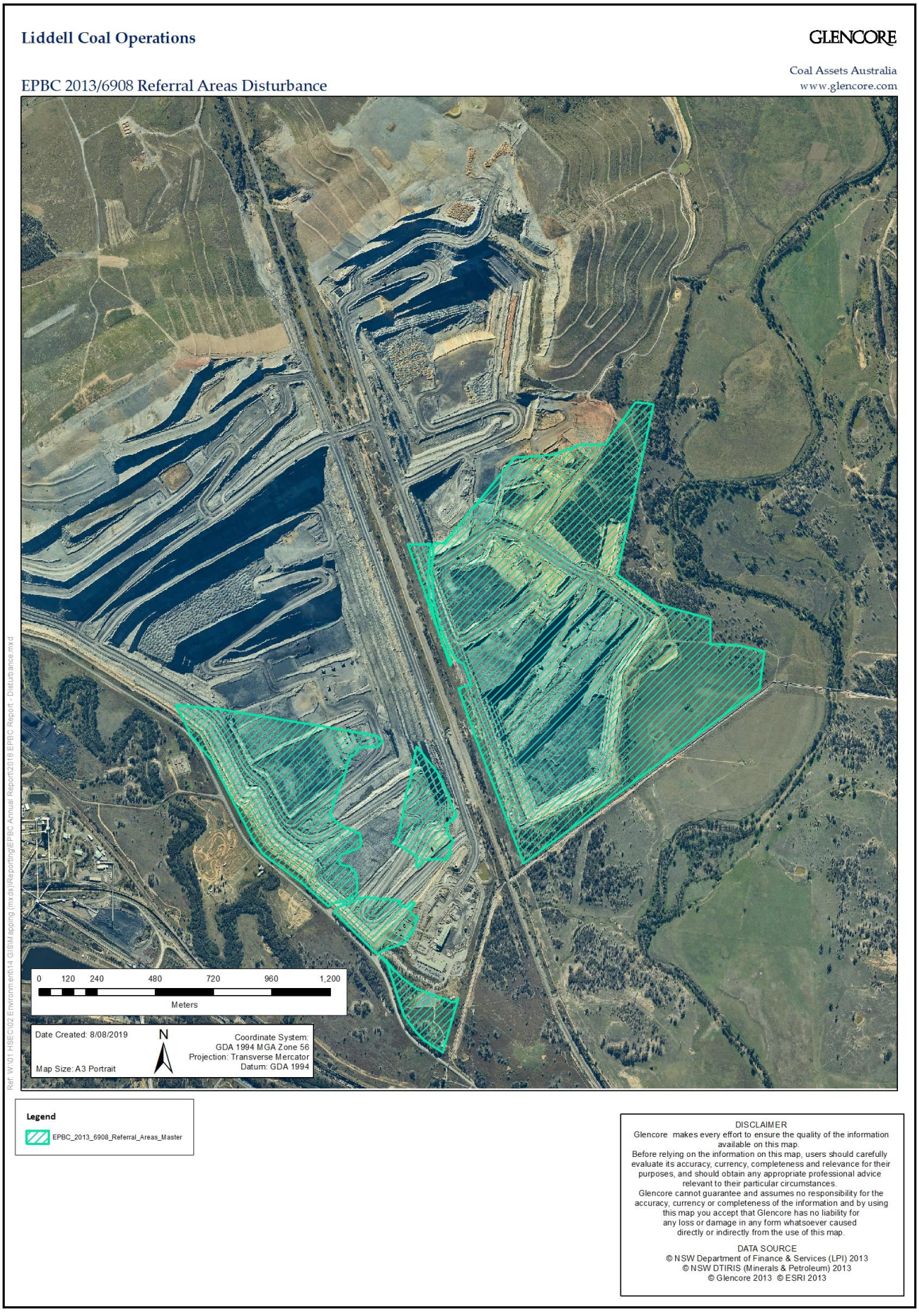

Figure 1 – LCO EPBC 2013/6908 Referral Areas

2 Statement of Compliance

This section being summarised as **Table 2** outlines the conditions of EPBC Approval 2013/6908, a summary of actions completed during the reporting period with a respect to each condition, and the corresponding compliance status with reference to **Table 1**.

Table 1 reproduces the "risk levels" from the Audit Guidelines which were attributed to the non-compliances identified during the audit period.

Where a non-compliance is identified in **Table 2,** it have been ranked in accordance with the *Independent Audit Guideline. Post-approval requirements for State significant developments* (Audit Guidelines) (DP&E, 2015).

Table 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 - 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.	Since commencement of the action LCO has cleared 136.03ha of land within the referral area; of which 98.31ha consisted of native woodland including regenerating woodland During the reporting period (19 May 2017 to 18 May 2018) LCO has cleared 16.47ha of land within the referral area, which consisted of 1.27ha of native woodland and 15.20ha of 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. Revised BMP submitted on 23 June 2016 in accordance with Condition 22. 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. Revised BMP submitted on 23 June 2016 in accordance with Condition 22. Implementation of the BMP commenced after approval and a summary of activities completed to date is provided in **Section 3.1**.	Compliant

Condition	Actions During Reporting Period	Status
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. Revised BMP submitted on 21 November 2018 in accordance with Condition 22.	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 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.	LCO undertook rehabilitation in accordance with the Rehabilitation Environmental Management Plan (RMP/MOP). A revised copy of the RMP/MOP was forwarded to the Department on the 31 December 2017. Further detail is provided in **Section 3.1.3**	Compliant
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). During the reporting period, LCO finalised the required content and details of the CA documentation in consultation with representatives from the NSW Biodiversity Conservation Trust (BCT). During December 2018, LCO returned executed copies of the Agreements to BCT for signing by the OEH on behalf of the Minister administering the NSW NPWS Act.	Compliant

Condition	Actions During Reporting Period	Status
	We have since received advice from BCT representatives confirming that the Chief Executive of NSW OEH has now signed the documents. The Agreements are undergoing a final check by the BCT prior to forwarding to NSW Land Registry Services (LRS) for registration on title. An extension till 30 November 2019 was granted by the Minister on 2 July 2019 to allow completion of the process.	
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 areas. Consequently LCO submitted revised attribute data to the Department on 24 December 2018.	Compliant
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;	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. A revised Biodiversity Offset Management Plan (BOMP) was submitted to the Department on 13 April 2017 seeking to adjust the boundaries of the Bowmans Creek Riparian Corridor. The BOMP was deemed to meet the requirements of Condition 8 and approved on 4 December 2017. Since then, the BOMP was revised in 2018 and submitted in accordance with Condition 22 on 21 November 2018.	Compliant

Condition	Actions During Reporting Period	Status
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.	Operations have continued to be implemented as per the Biodiversity Offset Management Plan detailed in **Section 4.1**.	
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. 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.	Compliant

Condition	Actions During Reporting Period	Status
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.	The IOP was originally approved on 5 May 2016 and revision subsequently approved in September 2017. Implementation of approved projects under the IOP is discussed in further detail 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 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;	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 21 November 2018.	Compliant

Condition	Actions During Reporting Period	Status
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.	LCO did not conduct any discharge event under the Hunter River Salinity Trading Scheme during the reporting period. Further information is provided in **Section 5**.	Compliant
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;	The Bowmans Creek groundwater drawdown ITARP was not triggered during the reporting period. Further information is provided in **Section 5**.	Compliant

Condition	Actions During Reporting Period	Status
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: 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 – 2018 Annual Report was published on the LCO public website on 16 August 2018. Notification of this was also provided to the Department on 16 August 2018. This is within three months of the 12 month anniversary of commencing the action on 19 May.	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	Not triggered during the reporting period.	Compliant

Condition	Actions During Reporting Period	Status
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.		
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 to the revised plans on the 21 November 2018 to the department in accordance with Condition 22: • Biodiversity Management Plan; • Water Management Plan; and • Biodiversity Offset Management Plan	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 143A of the Act, the plan approved by the Minister must be implemented.	Not triggered during the reporting period.	Compliant
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 applicable (NA)	NA

Condition	Actions During Reporting Period	Status
23. Revoked.	NA	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 published on the website within 1 month of being approved and remain published for the life of the approval.	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

3 Avoidance and 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 3 performance criteria during this reporting period. **Table 3** summarises the performance criteria set for year 3 of operation of the BMP; and actions completed to date.

Table 3 - BMP Implementation Summary

Action/Item	Performance Indicators	Completion Criteria	Performance Comment
Year 3 2018			
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	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	
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 rehabilitation success.	Weeds are managed in line with Weed Action Plan. Preclearance survey identifies any weed infestations requiring further management prior to topsoil stripping.
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 2018 BMP monitoring.
Seed Collection			
Where suitable remnant vegetation is available,	Pre-clearing surveys identify potential seed sources.	Complaint.	Seed resources being collected and substituted in

Action/Item	Performance Indicators	Completion Criteria	Performance Comment
implementation of seed collection and handling program for use in revegetation/rehabilitation works.	Seeds are collected, stored and handled according to appropriate program. Collected seed resources are used in revegetation/rehabilitation works.		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.
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 translocated to Mountain Block BOA and has been subject to monitoring as required. 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 Indicators	Completion Criteria	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 W02, R01 and WR02.
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. Weed management actions of infestations are undertaken in accordance with current or other best practice approaches.	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. 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,	Inspections completed every two months, followed by implementation of required control methods, as required.	Compliant	Feral animal inspections are undertaken every two months in accordance with commitments of the BMP. Foxes (Vulpes vulpes), were identified in low

Action/Item	Performance Indicators	Completion Criteria	Performance Comment
frequency, target species and methods to be used.			numbers and subsequently should be key species for management in 2019. Unlike previous monitoring years, the pig (Sus scrofa) presence appears to be declining.
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 2018. 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 2018.
Blue-billed Duck Management			
Complete habitat enhancement, maintenance and monitoring works (as required) for the blue-billed duck	Ongoing habitat 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 in 2018 monitoring. Both provide low habitat value due to drought reducing vegetation cover, and 2018 water levels in Triangle Dams were low.
Habitat Enhancement			
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.
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.

Action/Item	Performance Indicators	Completion Criteria	Performance Comment
Timing of nest box installation	Removed hollows will be replaced (with nest boxes) within six months of each discrete clearing event.	Compliant	46 hollows, stag trees or trees with sheeting bark cleared during 2018. Hollows and logs removed during clearing works have been placed in offset and rehabilitation areas. 266 nest boxes have been installed as part of an ongoing program in the offset and BMP areas during 2018. Ongoing habitat augmentation works will continue. 60 nest boxes have been ordered to replace hollows removed during 2019 clearing.
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 a cattle grazing trial and rotate stock between paddocks under supervision of district agronomist
Bushfire Management			
Bushfire Management Plan will be implemented	Implementation of requirements of updated Bushfire Management Plan.	Compliant	Bushfire Management Plan updated in 2018. No signs of bushfire impacts were noted during the 2018 monitoring event.
Ecological Monitoring			
Undertake floristic, fauna, LFA, waterbird, nest box, stygofauna and instream/riparian monitoring program throughout LCO	Monitoring program completed and reported.	Compliant	Monitoring indicates remnant sites have remained relatively stable since commencing of monitoring; however rehabilitation sites are 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.

3.1.2 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.

In general remnant vegetation sites have maintained broadly consistent vegetation and fauna diversity and abundance since monitoring commenced in 2012. Both provide a range of habitat features that

have remained intact and unaltered by mining and mining-related activities. Floristic monitoring identified higher than average overall floristic diversity at one remanent site with lower than average overall floristic diversity monitored at the second remanent site. This also was correlated with native diversity at the remanent sites. It was noted that fluctuations in floristic diversity seem to be related to changes in grassy vegetation cover which are directly related to the prolonged drought conditions. Introduced flora species diversities were similar between remanent and monitoring sites with floristic data collected shows that introduced species coverage has not substantially increased since 2016.

Other key findings of the 2018 biodiversity monitoring program were as follows:

- Substantial weed and pest management works have been undertaken by LCO throughout 2018.
- Remanent vegetation at W02 is generally in good condition; however some potentially problematic weed species are present in this area which require management.
- Riparian remnant site R01 is dominated by introduced species in the groundcover.
- Rehabilitated vegetation at WR02 has undergone a slight increase in native diversity that correlates with a decline in weed species cover.
- There has not been a notable increase in the extent of feral species presence. This appears to be being suppressed by LCO management actions.
- No signs consistent with myrtle rust, Phytophthora or Chytrid fungus were identified.
- Stygofauna diversity at all sites remain low.
- Rehabilitated vegetation at WR02 is in 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 increase diversity of native flora species in the groundcover.

LCO will continue to implement the BMP commitments and recommendations detailed in the 2018 BMP monitoring report (Umwelt, 2019). Key recommendations to be implemented during 2019 by LCO will include:

- Continued supplementary plantings to assist in infilling vegetation where gaps in certain strata have been identified.
- Progressive installation of habitat features such as boulders, rocks and logs prior to seeding/planting activities, and/or adjacent to established rehabilitation areas.
- Continued weed and feral fauna management.

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 2018 Annual Ecological Monitoring Program is available on the LCO website

3.1.3 Rehabilitation Program

Rehabilitation activities during the reporting period were completed generally in accordance with the approved Mining Operations Plan (MOP). LCO achieved the 2018 rehabilitation targets as specified in the 2018-2020 MOP during the reporting period when considering the cumulative variance of rehabilitation.

Overall, LCO achieved 67ha of rehabilitation during 2018 compared to 68.3ha as described in the MOP. Despite a 1.3ha reduction in planned rehabilitation for 2018, LCO remain at +6ha variance for the planned rehabilitation during the MOP term due to the additional 7ha completed in 2017. LCO will continue to implement the MOP/RMP and BMP to progressively rehabilitate the operation. Rehabilitation monitoring results are included in the BMP **Section 3.1.2**.

4 Offsetting of Residual Impacts

4.1 Biodiversity Offsets

The Biodiversity Offset Management Plan (BOMP) was developed to guide 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, as well as to provide a description of the measures to be implemented to achieve this over the next three years.

Although this reporting period begins in May 2018, annual objectives detailed in the BOMP for each year are measured from the approved date of the BOMP i.e. year 3 commences 5th January 2018. Therefore, performance against year 3 performance criteria is outlined in this section.

The following **Table 4** summarises the performance criteria set for year 3 of operation of the BOMP, and actions completed to date.

Table 4 - BOMP Implementation Summary

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
Pathogen Management	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	Removal of redundant fences.	Continued removal of redundant fences as required.	Compliant	Large sections have been removed in accordance with the BOMP
	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	Fenceline inspections are undertaken every two months in accordance with the BOMP
	Information signage for the spotted-tailed quoll.	Informational signage (for the spotted-tailed quoll) is maintained.	Compliant	Signage is installed and in good condition. New offset signage also present.
Grazing Management	All stock to be removed from BOAs	No stock grazing	Partially complaint	No evidence of cattle grazing was evident during 2018 in Mitchell Hills South or Mountain Block. Cattle grazing was observed at Bowmans Creek Riparian Corridor site W07.
	Minimum bi-monthly inspections to determine presence of rogue stock and assess condition of fences.	To be completed bi-monthly.	Compliant	Cattle inspections are undertaken bi-monthly in accordance with the BOMP. No cattle were identified in Mitchell Hills South or Mountain Block. Cattle were present from time to time in Bowmans Creek however are being relocated as required.
	Remove reported rogue stock and repair damaged fences.	Action and remove reported rogue stock and repair damaged fences.	Compliant	Fence reparation works are undertaken in accordance with the BOMP.

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
Access Track Maintenance	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.	Compliant	Due diligence assessments have been completed for all biodiversity offset areas.
	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.	Complaint	Access tracks inspections are undertaken bi-annually in accordance with BOMP commitments
	Rehabilitation of unnecessary access tracks.	Tracks no longer required will be rehabilitated.	Compliant	All tracks present are considered necessary
Pest Management	Complete feral animal inspections of Bowmans Creek Riparian Corridor 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, as required.	Compliant	Feral animal inspections are undertaken every two months in accordance with commitments of the BOMP. Foxes (Vulpes vulpes), and dogs (Canis lupus familiaris) were identified in low numbers, do not appear to be increasing in abundance and subsequently should be key species for management in 2019, whereas pig (Sus scrofa) numbers were less than during baseline monitoring.
	Complete feral animal inspections of Mountain Block and Mitchell Hills South every four 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 four months, followed by implementation of required control methods, as required.	Compliant	Feral fauna were all identified in low numbers and do not appear to be increasing in abundance. Feral animal inspections are undertaken every four months in accordance with commitments of the BOMP.
	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 2018. Pest numbers appeared to be stable during monitoring events.

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
	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. Monitoring of impacts of fox, feral cat and feral dog control on spotted-tailed quoll population.	Compliant	Feral dogs and foxes were identified in 2018 in Mountain Block and Bowmans Creek Riparian Corridor, but not in Mitchell Hills. Feral fauna were all identified in low numbers and do not appear to be increasing in abundance. Pig presence was not detected during 2018. Dog and fox baiting and pig trapping has been completed by LCO.
	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 developed and implemented.
Weed control	Complete weed inspections every two months in Bowmans Creek Riparian Corridor 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 requiring management were identified for Bowmans Creek Riparian Corridor. Evidence of galenia and introduced grass spraying was evident and appeared successful. Weed inspections are completed by LCO with actions generated to correct as required.
	Complete weed inspections every four months in Mountain Block and Mitchell Hills South to document diversity and abundance of noxious weed records.	Inspections completed every four months, followed by implementation of required control methods, as required.	Compliant	Inspections completed in accordance with the BOMP. Weeds requiring management were identified during 2018 annual monitoring.
Natural Regeneration of Mountain Block and Mitchell Hills South	Control of weeds and feral animals in regeneration areas.	Weed and feral animal control works are completed, as required.	Compliant	Targeted weed control works and targeted feral fauna control programs were undertaken in 2018 in response to species identified during the 2017 monitoring.
	Confirmation of mapping of areas for regeneration, including appropriateness of target community	Revised in ongoing monitoring works, as needed.	Compliant	No change identified from 2017 monitoring. Target revegetation communities are appropriate.

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
				Natural recruitment is occurring in both Biodiversity Offset Areas. Assisted regeneration work is occurring in both Biodiversity Offset Areas.
	Management of regeneration progress is responsive to monitoring outcomes.	Monitoring of regeneration areas.	Compliant	Monitoring of regeneration progress was made in 2018
Assisted Regeneration of Mountain Block and Mitchell Hills South	Review need for assisted regeneration where outcomes of natural regeneration is deemed lacking.	Natural regeneration.	Compliant	Natural regeneration was identified in BOAs. Assisted regeneration activities were undertaken in 2018 with variable success
Rehabilitation Works in Bowmans Creek Riparian Corridor and Mountain Block Offset Area	Develop detailed performance criteria for all management zone types.	Detailed criteria developed based on annual monitoring of analogue sites.	Compliant	BOMP criteria updated in 2018 in response to progressive monitoring results.
	Implement rehabilitation/ revegetation program.	Implementation of plan.	Compliant	Log stockpiles to increase habitat value were identified in central Bowmans Creek Riparian Corridor (not present in monitoring sites). Revegetation works commenced in Bowmans Creek Riparian Corridor and Mountain Block. Nest boxes have been installed in both BOAs.
	Positive feedback loop from monitoring results.	Feedback from monitoring is incorporated into ongoing review and improvement of plan.	Compliant	Feedback from monitoring actioned and incorporated to ensure positive feedback loop.
	Develop detailed performance criteria for all management zone types.	Detailed criteria developed based on annual monitoring of analogue sites.	Compliant	BOMP criteria updated in 2018 in response to progressive monitoring results.

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
Habitat Augmentation	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	Large log piles and rock piles have been installed in central Bowmans Creek Riparian Corridor.
	Nest boxes are providing habitat value for native fauna.	Continue staged installation of nest boxes.	Compliant	Nest box installation is taking place in this BOA. Signs of presence and actual occupation of nest boxes is occurring.
	Salvaged–reinstated hollows	Established nest boxes are subject to annual inspection and maintenance.	Compliant	Salvaged and reinstated log piles were identified in central Bowmans Creek Riparian Corridor; however not in monitoring sites.
	Timing of nest box installation	Salvaged and re-instated hollows are subject to annual monitoring in conjunction with nest boxes.	Compliant	Bowmans Creek Riparian Corridor nest boxes were monitored in 2018.
	Salvaging, stockpiling and deployment of habitat features	Removed hollows will be replaced (with nest boxes) within six months of each discrete clearing event.	Compliant.	Salvaged and reinstated log piles present in central Bowmans Creek Riparian Corridor; however not in monitoring sites.
	Habitat augmentation will occur in Mountain Block and Mitchell Hills South BOAs if monitoring identifies a dearth of key habitat features like hollows or log/boulder piles.	Suitable habitat features identified and salvaged as part of pre-clearing process. These are then stockpiled until deployed in target areas once	Compliant	Nest boxes have been installed in all BOAs. Log pile installation continuing along Bowmans Creek Riparian Corridor.

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
		rehabilitation/regeneration works are complete.		
Translocation works	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	One tiger orchid successfully translocated to Mountain Block in 2018.
Creek and drainage line protection on Bowmans Creek Riparian Corridor	Fencing/protection of LCO controlled side of riparian corridor.	Riparian corridor will be fenced from human and livestock access.	Compliant	Compliant. Fencing is in place to secure the offset area.
	Rehabilitation works to address stabilisation and erosion issues, as necessary.	Implementation, as needed.	Compliant	Areas targeted for stabilisation and erosion control works have been identified and addressed as part of the detailed remediation strategy.
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	No substantial seeding resources identified during 2018 monitoring. Seed collection has been occurring as resources are available.
Erosion and Sediment Control	Undertake erosion and sediment inspection and map areas requiring remediation.	Complete inspection and mapping (year 1).	Appropriate erosion and sediment control measures required have been identified and implemented.	Erosion and sediment control structures and measures are inspected and monitored regularly in accordance with the LCO WMP. Remedial works required for erosion in Mountain Block Offset. Planning has commenced and consultation completed with Liddell Registered Aboriginal Parties due to archaeological objects required to be managed during remediation.
	Develop remediation plan and implement.	Earthworks complete and vegetation establishing on previously eroded areas.	Compliant	There are no areas of significant erosion or sedimentation.
	Monitor completed erosion works and action repairs if required.	Monitor completed erosion works and action repairs if required.	Complaint	No major erosion control works completed.
Bushfire Management	The current Bushfire Management Plan will be updated according to the approved modification. Bushfire Management Plan will be implemented.	Implementation of requirements of updated Bushfire Management Plan.	Compliant	Bushfire Management Plan covering the offset areas is in place and being implemented. No bushfire activity was

Management Strategy	Action	Year 3 Performance Criteria	Compliance	Performance Comment
				evident in any of the offset areas during the reporting period.
Ecological Monitoring	Undertake floristic, fauna, LFA and nest box monitoring program	Monitoring program completed and reported	Compliant	Compliant. Ecological monitoring program completed. Results summarised in **Section 4.1.2.**
	Undertake annual inspections of LCO rehabilitation and active regeneration areas	Annual inspections completed	Compliant	Compliant. Annual Rehabilitation Inspection completed.
	Native fauna presence in rehabilitation/regeneration areas	Fauna monitoring completed	Compliant	Compliant. Native fauna recorded within rehabilitation and regeneration areas during annual ecological monitoring program.

4.1.2 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. Works have been targeted at areas deemed in greatest need of management. Of particular note was the decline in occurrence of African lovegrass (Eragrostis curvula) across all BOAs as a result of targeted weed spraying works. This should allow for recovery of small native herbs and grasses that had potential to be out competed by this invasive species.

The 2018 monitoring, particularly remote cameras, identified low utilisation of monitoring sites by foxes (Vulpes vulpes) and no pigs (Sus scrofa) were identified in 2018. This low utilisation may be attributable to management actions of these species or could correlate with a poor breeding season as a result of reduced resources. This result may lead to an increased usage of some areas by spotted-tailed quolls (Dasyurus maculatus maculatus) during the 2019 monitoring event. Ongoing management of these feral species is recommended as a priority to retain these low levels of occurrence.

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 planted begin to grow and provide improved habitat value (canopy coverage and foraging resources).

Management actions undertaken during the reporting period have included by not limited to:

- Supplementary planting of 18,000 Narrow-leaved Ironbark – Spotted Gum Woodland and Central Hunter Box Ironbark Woodland tube stock in Mountain Block.
- Supplementary planting of 1,500 tube stock in Mitchell Hills South consistent with Spotted Gum Forest species.
- Supplementary planting of 4,900 tube stock in Bowmans Creek Riparian Corridor consisted with Narrow-Leaved Ironbark Spotted Gum Woodland
- Herbicide application, stem injecting and rotor wiping targeting coolatai grass (Hyparrhenia hirta) and African lovegrass (Eragrostis curvula), fireweed (Senecio madagascariensis), African turnip weed (Sisymbrium thellungii), prickly pear (Opuntia stricta), thistle (Virsium vulgare), galenia (Galenia pubescens), verbena (verbena bonariensis) and African olive (Olea europaea subsp. cuspidata) throughout Mountain Block.
- Herbicide application throughout Mitchell Hills South targeting stinking roger (Tagetes minuta) and general weeds
- Herbicide application throughout Bowmans Creek Riparian Corridor targeting blue heliotrope (Heliotropium amplexicaule), castor oil (Rincius communis), common thornapple (Datura stramonium), Paterson's curse (Echium plantagineum), African lovegrass (Eragrostis curvula), guinea grass (Megathyrsus maximus), mother-of-millions (Bryophyllum delagoense), prickly pear (Opuntia stricta), tiger pear (Opuntia aurantiaca), galenia (Galenia pubescens), fireweed (Senecio madagascariensis), verbena (verbena bonariensis) and thistle (Virsium vulgare).
- A site wide 1080 baiting program for wild dogs (Canis lupus familiaris) and foxes (Vulpes vulpes)
- An aerial 1080 baiting program in Mitchell Hills South and the northern extents of Mountain Block
- Baited pig (Sus scrofa) trapping in Mountain Block
- Open range shoot in Bowmans Creek Riparian Corridor focusing on kangaroos and rabbits/hares.

- Investigation into erosion in Mountain Block southern paddock by expert soil scientist to characterise soils, determine amelioration requirements, undertake watershed analysis and provide revegetation options and strategic advice whilst taking into account aboriginal heritage items.

Key findings of the 2018 biodiversity offset monitoring program were as follows:

- Some declines were evident in floristic and fauna diversity in 2018 from previous events, however these declines directly relate to the prolonged drought conditions being experienced.
- Substantial revegetation works have been undertaken in 2018 in Bowmans Creek Riparian Corridor. Unfortunately this revegetation is not necessarily reflected in monitoring data, as drought conditions have led to substantial sapling mortality.
- Remnant revegetation is generally in good condition; however some potentially problematic weed species are encroaching in these areas (particularly riparian vegetation and grassland areas which has particularly high occurrence of exotic grass in patches) despite management activities.
- Level of feral pig appear to have reduced since the baseline monitoring event and 2016, this is likely as a result of management actions being implemented. These actions will assist in the local recovery of the threatened spotted-tailed quoll.
- Substantial nestbox installation has been undertaken in all three offsets. Preliminary monitoring of these nest boxes are promising for colonisation by local hollow-dependent fauna, including the threatened species the brush-tailed phascogale (Phascogale tapoatafa tapoatafa).
- Substantial increases in size and presence of eastern grey kangaroo (Macropus giganteus) mobs were identified in 2018 compared to previous years. This species is likely moving into these areas (particularly grasslands) due to lack of available resources elsewhere as a consequence of the drought.
- No signs of pathogens myrtle rust, Phytophthora cinnamomi or chytrid fungus were identified.

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 planted tube stock begins to grow and provide improved habitat value in the form of canopy coverage and foraging resources.

Recommendations for the enhancement of existing ecological values and improved rehabilitation/ regeneration were received as part of the 2018 monitoring program; refer to the full offset monitoring report Umwelt 2019.

Liddell has actioned on 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. This indirect offset was agreed to be 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 developed to satisfy this condition and was approved by the DoE on 2nd March 2016. The objective of this IOP is to specify how the $243,000 indirect offset (by way of financial contribution over not more than five years) will be used to support recovery actions for the quoll. A revised IOP was submitted on the 23th March 2017 and subsequently approved by the Australian Government Department of Environment & Energy (DoEE) on the 5 May 2018. The revised IOP details amended projects Task 2 Surveying/Monitoring STQ Populations and Task 3 Assess Habitat Use by Female STQ.

4.2.1 Management Actions during the reporting period

Task 1 Development of Individual Recognition Software for Quolls

To recap Task 1 involves the development and sharing of computer software that enables the identification of individual quolls from remote camera data. In the 2017 Annual Report we advised that the software development was successful, with the initial build of the Quoll Identification Toolkit (QIT) completed utilising $80,000 funds providing by LCO under research agreement with Invasive Animals Limited (IAL). During the reporting period, further work was completed with the support from OEH funding to refine the identification algorithm in the QIT and its transferability to a freely available software platform.

As documented in the 2017 report the software developer Delves Falzon Pty Limited recommended a number of actions to complete before publicly releasing the QIT. IAL have advised the following summary in **Table 5**.

Table 5 - QIT Development Progress

Action	Status
1. Continue to refine Matlab based version (address issues raised in initial testing).	Complete
2. Conduct user testing with NSW OEH Saving our Species and UNE/NSW Dept. Primary Industries project groups.	Progressing in 2018/19 FY with additional funding from OEH.
3. Undertake refinements to QIT once testing is complete	Awaiting outcome of user-testing
4. Prepare scientific paper for publication	In progress
5. Develop user manual	In progress
6. Release of QIT for use	In progress

Task 2 Surveying/Monitoring STQ Populations

A PHD student was engaged and employed to oversee the completion of the project and continue from the camera trapping network installations in 2018. The camera trapping program was successfully implemented at the Middle Foy Brook area with over 30 individuals being identified (~90% of the total camera sightings could be assigned to unique individuals).

Deployment of the program into the Mt Royal and Wollemi National Parks was delayed during the reporting period whilst awaiting Scientific Licence approval from OEH. This has now been approved with Scientific Licence (SL102237) granted.

Task 3 Assess Habitat Use by Female STQ

Implementation of Task 3 was successful, capturing and fitting telemetry tracking collars on 6 female quolls from the Liddell Coal/Middle Foy Brook site. During the exercise, sixteen Quoll captures were recorded during the first trapping period in accordance with approvals from UNE Animal Ethics Committee and OEH Scientific Licensing.

Five out of the six of these individuals had been previously identified through camera trapping and the remaining female was not identified in the camera trapping program.

The details the invoices issued and payments completed by LCO to fund the project to date are shown in **Table 6**. The funding is being utilised to purchase necessary cameras and consumables to establish the project.

Table 6 - Payments Completed 2018-19 FY

Payment	Invoice No.	Milestone	Amount	Date Paid
1	F1013471	3 – Establish Project 2 – Female STQ tracking program	$28,773	28/02/2019

In accordance with the requirements of the IOP, an annual progress report was submitted on the 26 July 2019 and should be read in conjunction with this report.

5 Water Resources

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 Water Management Plan (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.**

The WMP sets impact assessment criteria for both Bayswater and Bowmans Creek. The criterion has been determined based on a statistical analysis of data collected over a 5 year period. In accordance with ANZECC (2000) guidelines a 90th percentile concentration is appropriate for maintaining water quality. Due to the disturbed nature of both catchments and ephemeral nature of each creek, this is deemed to be an appropriate statistical criterion to adopt whilst mining operations are ongoing. Additionally, since the creeks are known to cease surface flow naturally at different points due to climatic variances, different trigger levels are adopted to reflect the flow state at each location. This reflects the natural ponding and varying quality of both creeks. The creek trigger levels are presented in **Table 7**.

Table 7 - WMP trigger values for surface water quality

	pH lower limit[4]	pH upper limit		EC 90th %tile[1]	EC Max[2]	TDS 90th %tile[1]	TDS Max[2]	TSS 90th %tile[1]	TSS 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

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

Trigger Level when creek is flowing
Trigger Level when no flow in creek

Figure 2 below shows the locations of each of the surface water monitoring sites.

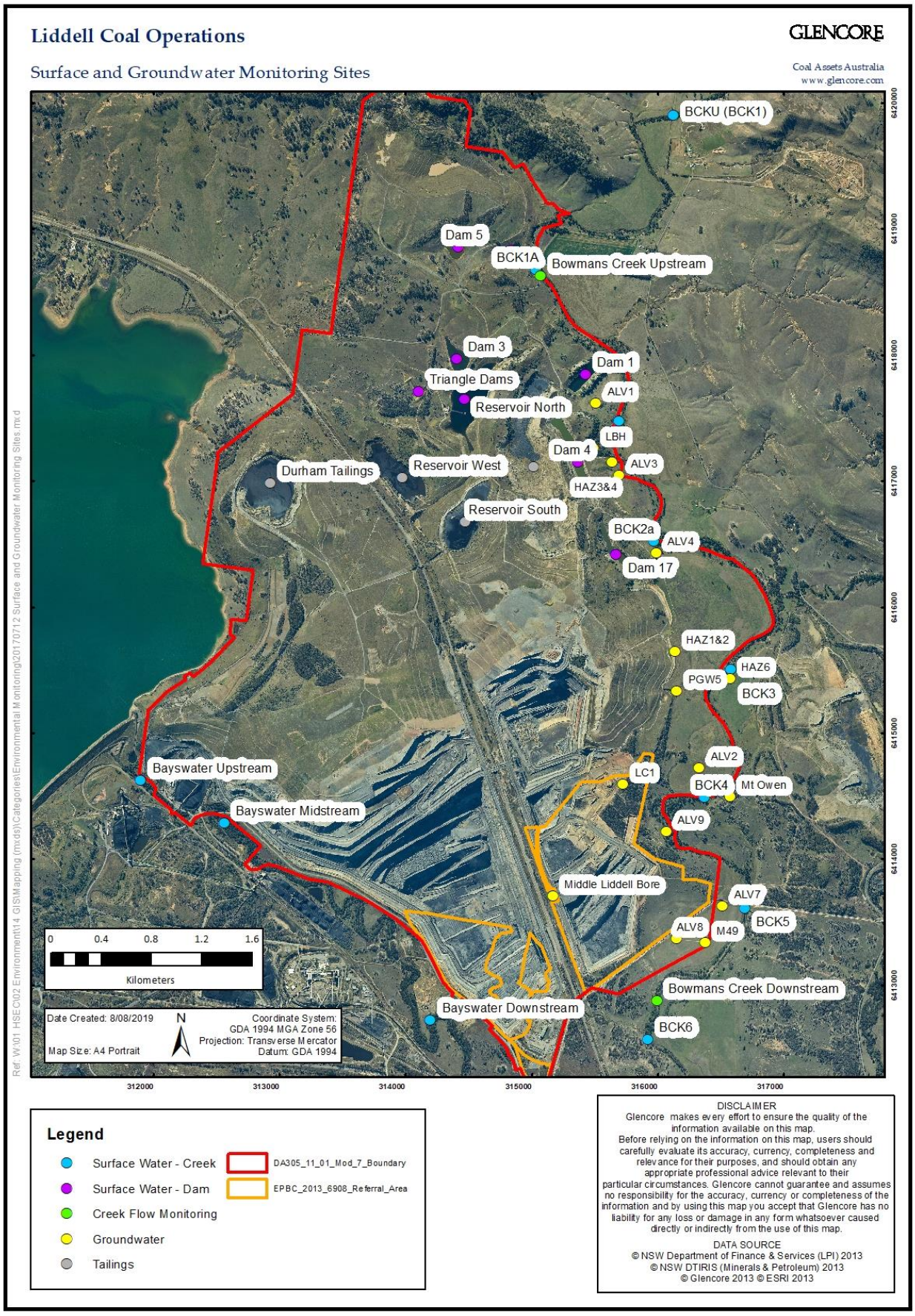

Figure 2 – Location of surface and groundwater monitoring sites

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. There was no exceedance of flow or no flow applicable water management plan trigger levels,

Table 8 below summarises the monitoring program results and identifies that no trigger limits were exceeded in Bayswater Creek during the reporting period.

Table 8 - Bayswater Creek Trigger Limit Summary

Bayswater Creek Water Quality Results														
Month	Bayswater Creek Upstream					Bayswater Creek Midstream					Bayswater Creek Downstream			
	pH	EC (µS/cm	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm	TSS (mg/L)	TDS (mg/L)
Jun-18	7.78	3360	<5	2090	Trickle	8.02	4450	<5	2990	Still	Dry			
Jul-18	7.95	3460	<5	2270	Trickle	8.19	4470	5	2940	Still	Dry			
Aug-18	7.95	3460	<5	2270	Trickle	8.19	4470	5	2940	Still	Dry			
Sep-18	8.13	3220	6	2230	Slow	8.20	3970	<5	2820	Still	Dry			
Oct-18	7.76	3500	8	2110	Trickle	7.99	4420	<5	2660	Still	Dry			
Nov-18	7.92	3790	<5	1940	Trickle	7.90	5190	<5	3100	Still	Dry			
Dec-18	7.91	3290	8	2180	Slow	8.05	4790	17	3150	Still	Dry			
Jan-19	7.77	3320	13	2340	Slow	7.87	4880	8	3410	Still	Dry			
Feb-19	8.23	3660	<5	2350	Trickle	8.35	5270	16	3400	Still	Dry			
Mar-19	7.99	2570	18	1320	Trickle	8.11	3950	<5	2480	Still	Dry			
Apr-19	8.1	3450	23	2050	Trickle	8.15	4560	17	2510	Still	Dry			
May-19	8.12	3710	6	2160	Trickle	8.09	5050	8	3180	Still	Dry			

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. With these considerations (as detailed in the WMP), trigger limits are dependent on the flow conditions at time of monitoring. **Table 9** summarises the monitoring results and identifies any trigger limit exceedances in Bowmans Creek during the reporting period.

Table 9 - Bowmans Creek Trigger Limit Summary

Bowmans Creek Water Quality Results																				
Month	BCK1 (Upstream)					BCK 1A					BCK2					BCK2A				
	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow
Jun-18	7.65	1040	<5	596	Slow	7.82	3690	<5	2330	Trickle					Dry					Dry
Jul-18	7.88	1100	8	656	Slow	7.96	3550	<5	2420	Slow					Dry					Dry
Aug-18	8.01	1100	<5	564	Slow	7.89	2960	16	1950	Slow					Dry					Dry
Sep-18	8.03	1070	8	644	Slow	7.95	3900	7	3010	Slow					Dry					Dry
Oct-18	7.99	1170	9	616	Trickle	7.59	6650	11	4480	Trickle					Dry					Dry
Nov-18	7.71	1030	15	510	Still	7.44	5600	<5	3390	Trickle					Dry					Dry
Dec-18	7.74	1020	14	674	Still	7.65	6730	45	4860	Trickle					Dry					Dry
Jan-19	7.36	1160	13	689	Trickle	7.76	6410	12	4880	Trickle					Dry					Dry
Feb-19	8.18	1200	<5	748	Trickle	8.16	6840	6	4790	Trickle					Dry					Dry
Mar-19	7.82	1050	12	619	Still	7.99	5970	20	3570	Still					Dry					Dry
Apr-19	8.02	1030	10	663	Slow	8.17	4120	8	2260	Slow					Dry					Dry
May-19	8	1190	11	688	Still	8.19	3690	6	2090	Trickle					Dry					Dry

Orange Shading – Denotes an exceedance of the 90$^{\%}$ile or maximum trigger limit as applicable for the flow conditions

Bowmans Creek Water Quality Results																				
Month	BCK3					BCK4					BCK5					BCK6 (Downstream)				
	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow	pH	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Flow
Jun-18	7.88	1280	13	718	Still	8.01	1960	10	1020	Still	8.14	2190	7	1330	Still	7.43	1910	<5	1270	Still
Jul-18	8.03	1360	15	814	Still	8.12	1990	15	1220	Still	8.15	2330	18	1480	Still					Dry
Aug-18	8.19	1380	20	846	Slow	8.25	1960	22	1240	Slow					Dry					Dry
Sep-18	7.97	1370	32	798	Slow	8.27	1870	42	1180	Still					Dry					Dry
Oct-18	7.97	1540	21	830	Still	8.12	2060	53	1110	Still	8.05	2370	27	1360	Still					Dry
Nov-18	8.17	1540	33	744	Still	8.38	2100	102	1070	Still	8.59	2350	114	1340	Still					Dry
Dec-18	7.7	1590	19	1060	Still	8.10	2170	96	1470	Still					Dry					Dry
Jan-19	7.93	1890	83	1140	Still	8.84	2290	90	1500	Still					Dry					Dry
Feb-19					Too low to sample					Too low to sample					Dry					Dry
Mar-19					Dry					Dry					Dry					Dry
Apr-19	7.74	1180	31	710	Still	8.11	2810	<5	1770	Still					Dry					Dry
May-19	6.73	2380	529	1540	Still	8.09	2800	9	1760	Still					Dry					Dry

During the reporting period, there were a number of isolated water exceedances at varying sites, reflecting the ephemeral nature of the creek. These isolated exceedances occurred during periods of low flow and often just prior to periods of no flow.

As per the WMP monitoring program and Trigger Action Response Plan (TARP), exceedances of trigger levels are required to be sustained to initiate an investigation. During the reporting period, surface water observations at BCK1A triggered a number of investigations, each at the same monitoring location BCK1A. In accordance with the surface water trigger action response plan, DPE, DOE and DoI were notified in August 2018, November 2018, February 2019 and May 2019; after each consecutive exceedance continued for at three month intervals. Investigations were undertaken for each and a summary of findings is provided below. A copy of the ITARP investigations can be provided upon request.

BCK1A TARP Investigations

Surface water monitoring at BCK1A identified exceedances of the 90th%ile trigger limits for EC and TDS from June 2018 to May 2019. The four investigations included the following:

- Field inspections of the site
- Review of flow conditions within the creek system
- Review of monitoring results
- Review of operational storages and water management controls

The findings determined by each of the investigations included:

- It is unlikely that potential harm has occurred or will occur at the observed levels.
- Mine water storages do not appear to indicate leakage or connectivity to the creek system as supported by water quality analysis of the isolated pools surrounding BCK1A and visual observations.
- Mining activities have not caused the observed levels.
- The climate data shows high evaporation and below average rainfall with significant variation in residual rainfall mass curve that is the longest downward trend since 2005. Since rainfall and subsequent creek flow has a large impact on the water quality of the creek system, it is likely the absence of rain has contributed to the observed quality levels.
- The climate, creek flow and water quality monitoring observations corroborate the understanding the monitored EC & TDS levels are naturally driven. This is demonstrated most recently by the decreasing EC & TDS trend as rainfall during the last six months normalises.
- It is likely that decreases in water levels within the alluvial system, as a result of the continued dry conditions, could reduce the confining pressures of the underlying weathered and hard rock water bodies. There this could lead to increase interaction between surface water and the underlying saline water, increasing EC and TDS levels.
- The upstream and downstream monitoring locations have recorded ‘still’ or ‘dry’ flow conditions during the same trigger period indicating that the creek is behaving in an ephemeral manner and likely transitioning slowly to the ‘no flow’ applicable investigation trigger levels.

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). There were no discharge events from LCO under the HRSTS during the reporting period.

5.1.4 Incidents

Discharge Event

A single offsite discharge of sediment laden water was recorded at LCO during the reporting period. This event was reported to the NSW EPA and other required authorities in accordance with the LCO Pollution Incident Response Management Plan (PIRMP) and Water Management Plan (WMP) (approved under NSW DA305-11-01 and EPBC Approval 2013/6908). Notification was provided to DOEE on 30 November 2018. An investigation was subsequently undertaken in accordance with the

LCO WMP. An incident investigation report was submitted on 10 December 2018. Details of this investigation are summarised below.

On 28 November 2018, LCO recorded a total of 35.6mm of rainfall. Whilst completing routine high rainfall inspections in accordance with the WMP a supervisor observed sediment laden runoff breaching a containment drain blocked by blast heave. This sediment laden runoff was observed to mix with run off from undisturbed areas of remnant vegetation and follow existing drainage lines to an isolated and pooled section of Bowmans Creek.

Actions to control and contain the sediment laden water were commenced immediately after identifying the failure. This included drainage repairs, pumping, water sampling and reporting to relevant authorities.

The captured sediment laden water was subsequently pumped from the isolated pool back into the LCO mine water system.

As the incident was responded to in a timely manner to mitigate potential impacts, it has not resulted in potential or actual environmental harm. LCO has identified and implemented system improvements to mitigate likelihood of a similar event reoccurring.

Based on investigations completed by the Environmental Protection Agency, it was determined that LCO contravened section 120 of the POEO Act on the 28 November 2018 and subsequently received a Penalty Infringement Notice on the 4 June 2019.

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 LCO Water Management Plan (WMP) documents the processes and responsibilities of all aspects of the site water management system.

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 based on historical measurements. Currently, investigations into potential impacts are conducted if there are three consecutive exceedances of the nominated triggers.

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, baseline (20th%ile) or above the monthly 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 and.

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.

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, 2018) 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. 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 10 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.

The WMP groundwater monitoring program was implemented during the reporting period with the results indicating that no potential mining impacts occurred. Monitoring results observed during the reporting period are summarised in following **Section 5.2.1** and **Section 5.2.2** with the breakdown of:

- Section 5.2.1 Groundwater quality monitoring
    - Groundwater quality of alluvial and shallow bedrock aquifers
    - Groundwater quality of hard rock (Coal Measures) aquifer
- Section 5.2.2 Groundwater level monitoring
    - Groundwater levels of alluvial and shallow bedrock aquifers
    - Groundwater levels of hard rock (Coal Measures) aquifer

Table 10 - 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.

5.2.1 Groundwater Quality Monitoring

Groundwater quality of Alluvial and Shallow Bedrock Aquifers

Groundwater quality monitoring results and trigger limits for the alluvial and shallow bedrock aquifers during the reporting period are shown in **Table 12** (pH) and **Table 13** (EC) below.

LCO received average rainfall for 2018 and 2019 with a total of 525 mm recorded at the LCO meteorological monitoring station for the reporting period. The review of climate data during ITARP investigations also identified high evaporation rates during the equivalent period. It is considered that the observed changes in pH and EC across the monitoring locations are a result of these prolonged dry conditions.

During the reporting period there were no investigations triggers relating to pH. During the months of September and October, the lower limit for pH of 6.5 was exceeded at a five bores. The exceedances represent the lowest pH data for the alluvial and shallow bedrock monitoring bores since data collection began. The exceedances occurred over one or two data points and were not sustained; the pH level at those sites have since returned the relatively stable trend. The exceedances coincide with relatively low groundwater and stream flow levels, however groundwater and stream flow levels continued to decline following the exceedances, so the low pH values are unlikely to be related to low groundwater and/or streamflow levels. There is no indication that the observed pH fluctuation could be mining related. The monitoring program will continue to be implemented to observe changes in groundwater pH.

There have been 26 exceedances of the EC upper limit and three exceedances of the EC lower limit. On eight occasions the requirement for an investigation has been triggered by three consecutive exceedances of the upper EC limit at ALV1L, LBH, ALV3L, ALV4S, ALV2S, ALV8S. The conclusions of those investigations are summarised in below in **Table 11**. A copy of the relevant ITARP reports can be provided upon request.

Noteworthy, the LCO groundwater impact assessment (SKM, 2014) states there are no known fresh or saline groundwater supported wetlands or recognised aquifer ecosystems present in the area (Umwelt, 2001; Ecological, 2013).

Table 11 ITARP investigations for quality triggers completed in reporting period

Month of 3rd exceedance	Site	Conclusions
October 2018	ALV2S ALV7S	• Groundwater EC trigger values were recently exceeded at ALV2S and ALV7S, situated in the shallow bedrock groundwater systems beneath the alluvium, for three consecutive months (August to October 2018). • The observed deviations beyond the trigger values are less than the reference maximum values and as such are not considered to be representative of conditions which would have potential to harm the environment. • The trigger exceedances are inferred to have occurred due to drier than average climate conditions resulting in reduced net recharge to the groundwater systems.
May 2019	ALV1L ALV2S ALV3L ALV4S ALV7S LBH	• Regarding groundwater levels along the Bowman's Creek system, previous ITARP investigations occurred at each site monitored along the system. Each investigation has yielded clear link between climatic variations and measured groundwater levels. • Observations at have not exceeded reference maximums to date with the exception of May 2019 at ALV7S. • During the previous 24 months, climate data shows high evaporation and below average rainfall with significant variation in residual rainfall mass curve that is the longest downward trend since 2005. Recent minor stabilization of the rainfall CRD aligns directly with increased flows in the creek, increased recharge of groundwater levels and increased EC levels throughout the alluvial and shallow bedrock system. • The direct relationship between these monitoring observations and rainfall implies that the measurements are due to climatic variations rather than a specific mining related impact. • Hence it is not expected that there is potential for harm to the environment as the system is varying naturally.

Table 12 - 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-18	7.04	7.66	7.27	7.61	7.05	7.89	6.86	7.14	7.10	7.24	*	7.19	7.08
Jul-18	6.96	7.50	7.52	7.79	7.16	7.34	7.13	7.22	7.37	7.46	*	7.51	6.96
Aug-18	6.94	7.65	7.21	7.93	6.94	7.26	6.79	7.15	7.15	7.27	*	7.02	6.78
Sep-18	6.34	7.04	6.91	7.59	6.17	6.51	6.06	6.75	7.11	7.30	*	7.12	6.09
Oct-18	6.62	7.11	7.42	7.63	6.81	6.70	6.32	6.21	7.54	7.39	*	7.41	6.35
Nov-18	7.03	7.80	7.10	7.86	*	7.50	6.78	7.59	7.25	7.43	*	7.16	6.98
Dec-18	7.62	7.83	7.83	8.14	7.44	7.68	7.18	7.54	8.06	8.26	*	8.06	7.56
Jan-19	6.76	7.57	7.15	7.56	*	7.21	6.54	7.25	6.96	7.31	*	6.92	6.71
Feb-19	7.68	8.33	7.24	7.76	7.45	7.89	7.27	7.51	6.98	7.38	*	*	7.34
Mar-19	6.98	7.66	7.29	7.76	7.07	7.43	6.77	7.43	*	7.41	*	*	6.92
Apr-19	6.93	7.65	7.35	7.72	7.01	7.44	6.72	7.35	*	7.39	*	*	6.92
May-19	6.93	7.65	7.27	7.66	7.03	7.39	6.65	7.31	*	7.34	*	*	7.08

* - unable to obtain a sample due to lack of water present

Table 13 - Groundwater results for EC in Alluvial and Shallow Rock Aquifers

Alluvial and Shallow Bedrock Groundwater Quality - EC													
Site	ALV1L	ALV1S	LBH	ALV3L	ALV3S	ALV4L	ALV4S	ALV2L	ALV2S	ALV7L	ALV7S	ALV8L	ALV8S
80th %ile	1.37	1.56	1.55	1.39	2.80	1.92	5.31	2.83	2.82	1.78	2.23	1.31	1.99
20th %ile	2.02	1.77	3.09	3.08	4.51	3.08	6.43	4.16	3.37	2.31	2.54	1.88	2.40
Jun-18	1.06	1.16	1.12	1.16	1.60	1.35	4.64	1.74	2.56	1.52	1.98	*	1.50
Jul-18	1.08	1.34	0.91	1.29	1.76	1.52	5.25	1.88	2.54	1.75	0.73	*	1.90
Aug-18	1.20	1.26	1.33	1.32	1.77	1.54	5.25	2.06	2.86	1.71	2.25	*	1.79
Sep-18	1.22	1.31	1.35	1.33	1.78	1.53	5.24	2.31	2.85	1.74	2.28	*	1.87
Oct-18	1.22	1.26	1.39	1.34	1.81	1.49	4.89	2.08	2.88	1.78	2.36	*	1.76
Nov-18	1.20	1.29	1.35	*	1.71	1.45	5.14	2.59	2.73	1.67	2.20	*	1.74
Dec-18	1.10	1.16	1.26	1.16	1.57	1.38	4.10	1.70	2.60	1.56	2.04	*	1.72
Jan-19	1.26	1.25	1.36	0.00	1.73	1.49	5.07	1.84	2.73	1.54	2.24	*	1.75
Feb-19	1.11	1.12	1.25	1.19	1.48	1.29	4.38	2.11	2.45	1.51	2.11	*	*
Mar-19	1.53	1.44	1.59	1.48	1.99	1.71	5.87	2.24	3.27	*	2.78	*	*
Apr-19	1.49	1.47	1.62	1.45	2.01	1.71	5.61	2.10	3.24	*	3.02	*	*
May-19	1.53	1.49	1.65	1.57	2.04	1.72	6.04	2.17	3.33	*	2.83	*	*

Orange Shading – Denotes an exceedance of the 80th%ile trigger limit

Yellow Shading – Denotes an exceedance of the 20th%tile trigger limit

* - unable to obtain a sample due to lack of water present

Groundwater Quality of Hard Rock Aquifer

LCO also monitor a number of hard rock aquifers to provide for the ongoing water management onsite; these sites are considered mine water storages and have no applicable investigation limits.

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.

5.2.2 Groundwater Level Monitoring

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. 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. LCO monitor the groundwater level of the Bowmans Creek Alluvial and Shallow Bedrock Aquifers to identify any potential impacts from mining such as depressurisation.

A review of full historical monitoring results identified that 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.

Similarly to the groundwater quality, 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 groundwater level, further investigations into potential impacts are conducted using the ITARP and MTARP process as described previously. No potential mining impacts were identified during the reporting period.

During the reporting period there has been no exceedances of the Definition 1 Impact (draw down) triggers. There have been numerous exceedances of the groundwater level Definition 2 and 3 investigation trigger levels. Investigations were undertaken for each trigger and each have determined that the observed monitored levels are likely the result of natural climatic variations and not related to mining activities. Further, the number of exceedances are due to a constrained baseline historical data set and prolonged drought conditions. LCO investigated each event and reported to the relevant government departments during the reporting period. No notifications were made to the DoE as environmental harm was not considered to have occurred.

A summary of each investigation conducted during the reporting period is provided below in **Table 14**. A copy of each individual ITARP report can be provided on request. The monthly monitoring results and trigger limits for the alluvial and shallow bedrock aquifers during the reporting period are shown in **Table 15** with results triggering the relevant criteria identified.

Table 14 ITARP investigations for quality triggers completed in reporting period

Month of 3rd exceedance	Site	Conclusions
September 2018	ALV4L and ALV8L	• There appears to be no clear correlation between the levels measured at these bores with that of the underground workings, inferring continued lack of connectivity hence no depressurisation at these bores. • ALV4 is not within the extent of predicted drawdown impacts from mining operations. • Water levels along the whole system have generally declined similarly. Further, the observed decline is consistent for both the shallow bedrock and alluvium along the whole system; implying groundwater levels is driven by climatic variations rather than a specific mining related impact.

		• ALV8 is paired with reference bore ALV7 to monitor for potential drawdown and has not exceeded drawdown trigger investigation limits. ALV7L has consistently exceeded specific groundwater level definition triggers for eight consecutive months. This indicates the decrease in water levels is not localised (as per EA predictions) and likely driven by regional climatic conditions. • Groundwater levels at ALV4L and ALV8L represent natural variability due to climatic factors. No mining-related impact or potential for environmental harm.
October 2018	ALV1L, ALV3L and ALV3S	• Dry climate conditions and subsequent reduced net recharge are inferred to have caused the decline in groundwater levels. A prolonged period of declining rainfall CDFM between late April 2017 to early August 2018 supports this conclusion. • Groundwater levels at ALV1L, ALV3L and ALVS3 represent natural variability due to climatic factors. No mining-related impact or potential for environmental harm.
October 2018	ALV2S	• It is considered that the groundwater levels measured at ALV2S reflect natural variability due to climatic factors and there is not a mining-related impact. The climate data shows below average rainfall for around two years, which is considered to have resulted in the observed groundwater levels. • It is highlighted that the observed groundwater level at ALV2S is not outside of the maximum range recorded and is not of sufficient magnitude to lead to a down gradient impact on beneficial use. • ALV2S is not within the extent of drawdown from mining operations and there are no potential seepage sources. Furthermore, ALV2L is used as the reference site for the northern drawdown impact monitoring location • Water levels along the whole system are generally declining. Further, the observed decline is consistent for both the shallow bedrock and alluvium along the whole system; implying groundwater levels is driven by climatic variations rather than a specific mining related impact. This conclusion has been corroborated by previous ITARP investigations at LCO, which have all yielded a clear link between climatic variations and low groundwater levels. This investigation was notified and reported under the WMP in March 2019.
November 2018	ALV4S and LBH	• Water levels along the whole system have generally declined similarly. Further, the observed decline is consistent for both the shallow bedrock and alluvium along the whole system; implying groundwater levels is driven by climatic variations rather than a specific mining related impact. • The climate data shows high evaporation and below average rainfall with significant variation in residual rainfall mass curve that is the longest downward trend since 2005. As evidenced by the rainfall CRD and streamflow measurements, there has been no ease in drought conditions. Since there is direct relationship between these bores and rainfall, it is not expected that there is potential for harm to the environment as the system is varying naturally.
December 2018	ALV1S and ALV2L	• There appears to be no clear correlation between the levels measured at these bores with that of the underground workings, inferring continued lack of connectivity hence no depressurisation at these bores. • ALV1 and ALV2 are not within the extent of predicted drawdown impacts from mining operations. Note, ALV2 is the reference point for drawdown monitoring bore ALV9. • Water levels along the whole system have generally declined similarly. Further, the observed decline is consistent for both the shallow bedrock and alluvium along the whole system; implying groundwater levels is driven by climatic variations rather than a specific mining related impact. • The climate data shows high evaporation and below average rainfall with significant variation in residual rainfall mass curve that is the longest downward trend since 2005. As evidenced by the rainfall CRD and streamflow measurements, there has been no ease in drought conditions. Since there is direct relationship between these bores and rainfall, it is not expected that there is potential for harm to the environment as the system is varying naturally. Neither ALV1S or ALV2L have exceeded the reference maximums depth to water measurements supporting this conclusion.
January 2019	ALV7S ALV7L ALV8S	• There appears to be no clear correlation between the levels measured at these bores with that of the underground workings, inferring continued lack of connectivity hence no depressurisation at these bores. • ALV7L and ALV7S are not within the extent of predicted drawdown impacts from mining operations. Whilst ALV8S is in the predicted drawdown location, this bore is not connected to the

		alluvium. Further, ALV7L is used as the reference bore for potential drawdown at ALV8L and there has been no exceedance of drawdown trigger investigation limits. • The large and rapid groundwater level decline at ALV7S and ALV8S is considered to be due to the groundwater storage mechanisms of the shallow bedrock and the dewatering of a fracture horizon and is therefore not considered a mining related impact. • Water levels along the whole system have generally declined similarly. Further, the observed decline is consistent for both the shallow bedrock and alluvium along the whole system; implying groundwater levels is driven by climatic variations rather than a specific mining related impact. • The climate data shows high evaporation and below average rainfall with significant variation in residual rainfall mass curve that is the longest downward trend since 2005. As evidenced by the rainfall CRD and streamflow measurements, there has been no significant ease in drought conditions. Since there is direct relationship between these bores and rainfall, it is not expected that there is potential for harm to the environment as the system is varying naturally.

Table 15 - Groundwater Level Monitoring Results and Trigger Exceedances

Site	ALV1L	ALV1S	LBH	ALV3L	ALV3S	ALV4L	ALV4S	ALV2L	ALV2S	ALV7L	ALV7S	ALV8L	ALV8S	ALV9L*
10th %ile	4.97	4.75	5.05	5.7	5.99	5.56	6.28	4.8	4.67	6.75	10.21	6.96	9.03	N/A
Max	6.31	6.84	6.24	7.08	7.26	6.73	7.42	6.76	8.53	7.34	11.38	8.36	11.08	N/A
Jun-18	4.40	4.13	4.55	5.41	5.71	5.45	6.14	4.60	4.48	7.00	11.70	Dry	12.48	3.90
Jul-18	4.68	4.37	4.40	5.60	5.90	5.65	6.21	4.64	4.63	7.09	12.21	Dry	13.94	4.03
Aug-18	4.98	4.58	5.02	5.87	6.17	5.60	6.28	4.72	4.74	7.14	12.68	Dry	14.61	4.10
Sep-18	5.15	4.70	5.21	6.12	6.43	5.72	6.37	4.77	4.77	7.23	12.94	Dry	14.85	4.13
Oct-18	5.30	4.81	5.36	6.63	6.29	5.80	6.48	4.87	4.87	7.29	13.13	Dry	14.91	4.17
Nov-18	5.43	5.04	5.46	6.41	6.78	5.94	6.58	4.98	4.95	7.35	13.32	Dry	15.07	4.27
Dec-18	5.57	5.25	5.57	6.48	6.92	6.01	6.70	5.09	5.14	7.45	14.21	Dry	15.67	4.32
Jan-19	5.45	5.09	5.59	6.53	7.00	6.14	6.79	5.28	5.36	7.63	15.12	Dry	18.59	4.48
Feb-19	5.66	5.39	5.70	6.61	7.07	6.28	6.89	5.30	5.38	7.85	16.55	Dry	Dry	4.69
Mar-19	5.80	5.56	5.62	6.70	7.16	6.38	6.95	5.42	5.40	8.29	17.37	Dry	Dry	4.84
Apr-19	5.27	4.99	5.33	6.45	7.04	6.32	6.96	5.02	5.21	Dry	17.39	Dry	Dry	4.56
May-19	5.27	4.94	5.22	6.43	6.98	6.31	6.95	5.01	5.17	Dry	18.17	Dry	Dry	4.86

** - Piezometer installed in December 2017. Drawdown criteria limit derived from ALV2L minus 5.0 (AHD).*

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

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

Table 16 - 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 2018	*Liddell Coal Operations Annual Review 2017*
Umwelt 2015	*Biodiversity Monitoring Report. Prepared for Liddell Coal Operations Pty. Ltd*
Umwelt 2015	*Biodiversity Offset Monitoring Report Prepared for Liddell Coal Operations Pty Ltd*
Umwelt 2015	*Rehabilitation Monitoring Report Prepared for Liddell Coal Operations Pty Ltd*
Umwelt 2018	*Biodiversity Monitoring Report. Prepared for Liddell Coal Operations Pty. Ltd*
Umwelt 2018	*Biodiversity Offset Monitoring Report Prepared for Liddell Coal Operations Pty Ltd*
ARRP 2017	*Liddell Coal Operations Annual Rehabilitation Monitoring Report 2017*
Jacobs 2015	*Liddell Coal Operations Investigation Trigger Action Response Plan October 2015*
Jacobs 2016	*Liddell Coal Operations Investigation Trigger Action Response Plan May 2016*