

GLENCORE

Glendell Mine Modification 4

STATEMENT OF ENVIRONMENTAL EFFECTS

November 2018



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MODIFICATION 4 STATEMENT OF ENVIRONMENTAL EFFECTS

Glendell Mine

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mt Owen Pty Limited

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Rev No.	Reviewer / Approved for Issue		
	Name	Date	Signature
Final	Bret Jenkins	12/11/2018	

Executive Summary

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton and 24 km south-east of Muswellbrook (refer to **Figure 1.1**) and consists of the Glendell Mine (Barrett Pit), Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit). Mt Owen Pty Ltd (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore) currently operates the Glendell Mine under development consent DA 80/952, which regulates the mining of coal from the Glendell Mine and the rehabilitation of the mining area. The processing of coal mined from the Glendell Mine and the transportation of coal is regulated by development consent SSD-5850 (Mount Owen Continued Operations) which also regulates mining at the Mount Owen and Ravensworth East Mines, and associated activities. DA 08/952 (as modified) provides for continued operations at the Glendell Mine until 2024 and the extraction of approximately 50 million tonnes run of mine (Mt ROM) coal at an annual production rate of 4.5 million tonne per annum (Mtpa).

DA 80/952 provides for mining operations at Glendell until 2024, based on the current mining schedule mining operations are scheduled to cease in 2022, Mount Owen are seeking a minor extension to the approved pit shell in order to access an additional approximately 2.5 Mt ROM Coal from the Barrett Pit and approximately eight months of continued mining operations (the Proposed Modification).

An additional 12 hectares (ha) of disturbance is required along the western boundary of the approved disturbance area in order to accommodate the proposed mine plan changes, however the currently approved disturbance area (per DA 80/952) has been revised to remove an area previously approved for disturbance on the eastern boundary of the approved disturbance area. An area of approximately 15.5 ha will be removed from the approved disturbance area as part of the Proposed Modification, therefore there will be a net decrease (3.5 ha) in the overall disturbance area associated with the Glendell Mining operations.

No changes are proposed to the current approved mine life, mining methods, extraction limits, processing rates, transportation methods, operational hours or workforce numbers.

Key Benefits of the Proposed Modification include:

- Continuity of mining operations at Glendell Mine, providing additional economic benefit and ongoing employment of the existing mine workforce (during the assessment of the GCOP);
- Implementation of initial mine plan changes in order to efficiently implement and progress the proposed GCOP mine plan (should the GCOP be approved); and
- Minimising the environmental impact associated with the approved disturbance area in DA 80/952 through a reduction in the overall approved disturbance area.

In addition, Glencore are currently preparing an application for the Glendell Continued Operations Project (GCOP) (subject to separate approval process) which will seek approval to extend open cut mining operations north from the Barrett Pit and extending the mine life to 2044.

The proposed minor expansion of the Barrett Pit will assist in ensuring there is a continuous transition in production from the current Glendell mine into the proposed GCOP mining area, (should GCOP be approved). The Proposed Modification will also provide for an additional approximately 8 months of mining operations and continuity of employment at the Glendell Mine pending the determination of the development application for the GCOP.

A key consideration in designing the conceptual mine plans for the Proposed Modification was minimising the associated environmental impact, relative to the approved operations, as far as practicable whilst providing for operational efficiencies and continuity of mining operations at Glendell Mine. This has been achieved through:

- Retaining sufficient separation distance to the Swamp Creek alluvium;
- Continuing the progression of mining north away from sensitive receivers in Camberwell so that existing air quality and noise criteria can be achieved; and
- Relinquishing an area previously approved to be disturbed, to achieve a net decrease in disturbance associated with the mining operations approved under DA 80/952.

This Statement of Environmental Effects (SEE) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to support an application to modify DA 80/952 pursuant to Section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Overview of Environmental Outcomes

Given the minor nature of the Proposed Modification, targeted assessment of the potential environmental outcomes has been undertaken. A summary of the key findings of the relevant assessment process is provided in **Table ES1.1**.

Table ES1.1 Summary of the Key Environmental Assessment Findings

Environmental Issue	Overview of Key Outcomes
Air Quality	The Proposed Modification will not involve any activity that will change the nature of air quality impacts at Glendell Mine, relative to the approved operations. A review of the potential air quality impacts associated with the Proposed Modification has been undertaken. This indicates that the Proposed Modification will be minor in nature and consistent with the predicted impacts associated with the approved operations. The Glendell mining operations will continue to be managed in accordance with the existing Mount Owen Complex Air Quality Management Plan to manage any potential off-site area quality impacts, consistent with the approved operations.
Noise	Glendell Mine currently operates in accordance with the Mount Owen Complex Noise Management Plan and DA 80/952 includes specific environmental noise performance conditions and criteria, applicable to the approved operations. Noise modelling undertaken indicates implementation of the Proposed Modification can continue to achieve the existing noise criteria at surrounding sensitive receivers. This will be achieved through the design of the proposed mining area and progression of mining moving further away from sensitive receivers and through the continued implementation of the noise management measures currently implemented at Glendell Mine, in accordance with the Mount Owen Complex Noise Management Plan.
Groundwater	The proposed conceptual mine plans have been designed to avoid disturbance to the Swamp Creek Alluvium. Glendell Mine is located in close proximity to the Bowmans Creek and Swamp Creek (a tributary of Bowmans Creek) alluvium. The proposed mining area will extend to within 100 metres (m) of the Swamp Creek Alluvium. The Groundwater Assessment has determined that the Swamp Creek alluvial aquifer is considered to be a less productive alluvial water source (under the AIP guidelines). This is due to the low natural flow volumes (considered insufficient to yield more than 5 L/sec from a bore), and water quality as monitoring indicates high salinity (>1,500 mg/L), low transmissivity and low saturated thickness.

Environmental Issue	Overview of Key Outcomes
	There are no private water supply bores within proximity to Glendell Mine or the proposed modification. The Proposed Modification was determined to not exceed the Level 1 minimal impact consideration thresholds specified in the Aquifer Interference Policy (AIP) guidelines. In accordance with the AIP, where the predicted impacts are less than the Level 1 thresholds, then the predicted impacts are acceptable. The assessment indicates depressurisation of the coal seams and the interburden has occurred in areas adjacent to the Barrett pit, however monitoring indicates that the depressurisation is not propagating into the overlying Swamp Creek alluvium and is not inducing leakage. This outcome is not expected to change due to the proposed modification. The Proposed Modification is expected to slightly extend the predicted zone of depressurisation occurring within the Permian coal seams. . The proposed Modification does not seek to gain additional water licences. Groundwater monitoring will continue as outlined within the Mount Owen Complex Groundwater Management Plan.
Surface Water	Given the minor nature of the Proposed Modification, there will be negligible impacts on flow, water quality and water users downstream of the Glendell Mine, consistent with the current approved operations. No significant change to the water balance is associated with the Proposed Modification with water continuing to be managed within the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Flood mitigation measures will be incorporated into the detailed mine design to provide for flood protection consistent with Glencore standard flood mitigation measures (subject to the 0.1% AEP flood event).
Ecology	A Biodiversity Development Assessment Report (BDAR) has been prepared to assess the potential biodiversity impacts of the Proposed Modification in accordance with the Biodiversity Assessment Method (BAM) under the <i>Biodiversity Conservation Act 2016</i> (BC Act). The vegetation within the Proposed Disturbance Area (12 ha) comprises grassland with patches of regenerating trees and is considered to have relatively low biodiversity value. An area on the eastern side of the site (15.5 ha) currently approved for disturbance is proposed to be removed from the approved disturbance area, this area comprises areas of grassland and larger areas of established trees. 102 ecosystem credits are required to offset the impacts of the Proposed Modification. Fulfilling offset requirements under the BC Act will be undertaken using one or a combination of the following offset strategies: • In-perpetuity conservation through the establishment of a biodiversity stewardship site/s and the retirement of credits; • Securing required credits through the open credit market; • Payment to the Biodiversity Conservation Fund; and/or • Funding a Biodiversity Conservation Action (if applicable).
Aboriginal Archaeology	An Aboriginal Archaeology Due Diligence Assessment was undertaken in 2017. During the additional field survey undertaken in conjunction with the GCOP in 2018 with Registered Aboriginal Parties, surface artefacts at six sites were recorded. These sites are considered to be highly disturbed and of low scientific value. The Mount Owen Complex ACHMP will be updated to include the recording and collection of surface artefacts recorded during the survey works. The collection of surface artefacts will be undertaken in accordance with the procedure set out in the Mount Owen Complex ACHMP. Updates to the ACHMP will include consultation with the Aboriginal community.

Environmental Issue	Overview of Key Outcomes
Mine Closure and Rehabilitation	The Proposed Modification will result in minimal change to the design of the conceptual final landform. The Proposed Modification does not alter the mine closure and rehabilitation commitments and practices currently implemented at Glendell Mine. The key final landform design parameters relate to the establishment of a natural undulating landform and meeting the rehabilitation objectives relevant to the approved operations. Although Glencore are currently preparing an assessment for the GCOP which, if approved, will provide for continued mining operations at Glendell Mine to 2044, a revised conceptual final landform is proposed, should the GCOP not proceed and the mine closure plan and conceptual final landform under DA 80/952 is required to be implemented.

Mount Owen has a number of existing strategies and approved environmental management plans in place that will continue to address the potential impacts of the continued operations at Glendell Mine. Mount Owen also has a Stakeholder Engagement Strategy that outlines how and when they communicate with stakeholders, including their directly impacted neighbours. This document is reviewed annually.

Although the scale of the extraction associated with the Proposed Modification is limited (5% of the total approved extraction of approximately 50 Mt ROM coal), economic benefit to the local and broader Hunter economy will occur through the continuation of the employment of the existing Glendell Mine employees for an additional approximately 8 months and continuation of service and supply contacts. Economic efficiencies will also be achieved in relation to the GCOP through the continuation of the existing operations and implementation of early mine plan changes to provide for efficient advancement of mining should the GCOP be approved.

Based on the minor nature of the Proposed Modification and the minimal impacts expected to be associated with the Proposed Modification as compared to the approved operations, should the Proposed Modification be approved, the development (as modified) will remain substantially the same as the development that is currently approved.

Further details of the predicted environmental impacts of the Proposed Modification are provided in the main text of this SEE and associated technical reports in the appendices. Through the continued implementation of the management, mitigation and offset measures proposed by Mount Owen, it is considered that the Proposed Modification will result in a minimal incremental environmental impact, relative to the approved operations.

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1.0 Introduction

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton and 24 km south-east of Muswellbrook (refer to **Figure 1.1**) and consists of the Glendell Mine (Barrett Pit), Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit). Mount Owen Pty Ltd (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore) currently operates the Glendell Mine under development consent DA 80/952, which regulates the mining of coal from the Glendell Mine and the rehabilitation of the mining area (refer to **Figure 1.2**). The processing of coal mined from the Glendell Mine and the transportation of coal is regulated by development consent SSD-5850 (Mount Owen Continued Operations) which also regulates mining at the Mount Owen and Ravensworth East Mines, and associated activities.

Development Consent DA 80/952 was originally granted in 1983, mining commenced in 2009 following two subsequent modifications to the consent in 1997 and 2007. An additional modification to DA 08/952 was also granted in 2016 to provide for the realignment of an existing powerline. DA 08/952 (as modified) provides for continued operations at the Glendell Mine until 2024 and extraction of approximately 50 million tonnes run of mine (Mt ROM) coal at an annual production rate of 4.5 million tonne per annum (Mtpa), (approved operations).

Although DA 80/952 provides for mining operations at Glendell until 2024, based on the current mining schedule mining operations are scheduled to cease in 2022, Mount Owen are seeking a minor extension to the approved pit shell in order to access an additional approximately 2.5 Mt ROM Coal from the Barrett Pit and provide for an additional eight months of mining operations (the Proposed Modification), refer to **Figure 1.3**.

An additional 12 hectares (ha) of disturbance is required along the western boundary of the approved disturbance area in order to accommodate the proposed mine plan changes, however the currently approved disturbance area (as per DA 80/952) has been revised to remove an area previously approved for disturbance on the eastern boundary of the approved disturbance area. An area of approximately 15.5 ha will be removed from the approved disturbance area as part of the Proposed Modification, refer to **Figure 1.3**. Therefore there will be a net decrease (3.5 ha) in the overall disturbance area associated with the Glendell Mining operations.

No changes are proposed to the current approved mining methods, extraction limits, processing rates, transportation methods, operational hours or workforce numbers.

Glencore are currently preparing an application for the Glendell Continued Operations Project (GCOP) (subject to a separate approval process) which will seek approval to extend open cut mining operations north from the Barrett Pit extracting approximately 140 Mt ROM Coal and extending the mine life to 2044.

The proposed minor expansion of the Barrett Pit will assist in ensuring there is a continuous transition in production from the current Glendell mine into the proposed GCOP mining area, (should GCOP be approved. The Proposed Modification will also provide for an additional approximately 8 months of mining operations and continuity of employment at the Glendell Mine pending the determination of the development application for the GCOP.

Key Benefits of the Proposed Modification include:

- Extraction of an additional 2.5 Mt ROM coal utilising the existing workforce and equipment with potential environmental impacts being consistent with the predicted impacts associated with the approved operations.

- Continuity of mining operations at the Glendell Mine, providing additional economic benefit and approximately eight months of ongoing employment of the existing mine workforce;
- Ongoing employment of the existing workforce pending the determination of the development application for the GCOP;
- Implementation of initial mine plan changes in order to efficiently implement and progress the proposed GCOP mine plan, should GCOP be approved; and
- Minimising the environmental impact associated with approved disturbance area through a reduction in the overall approved disturbance area.

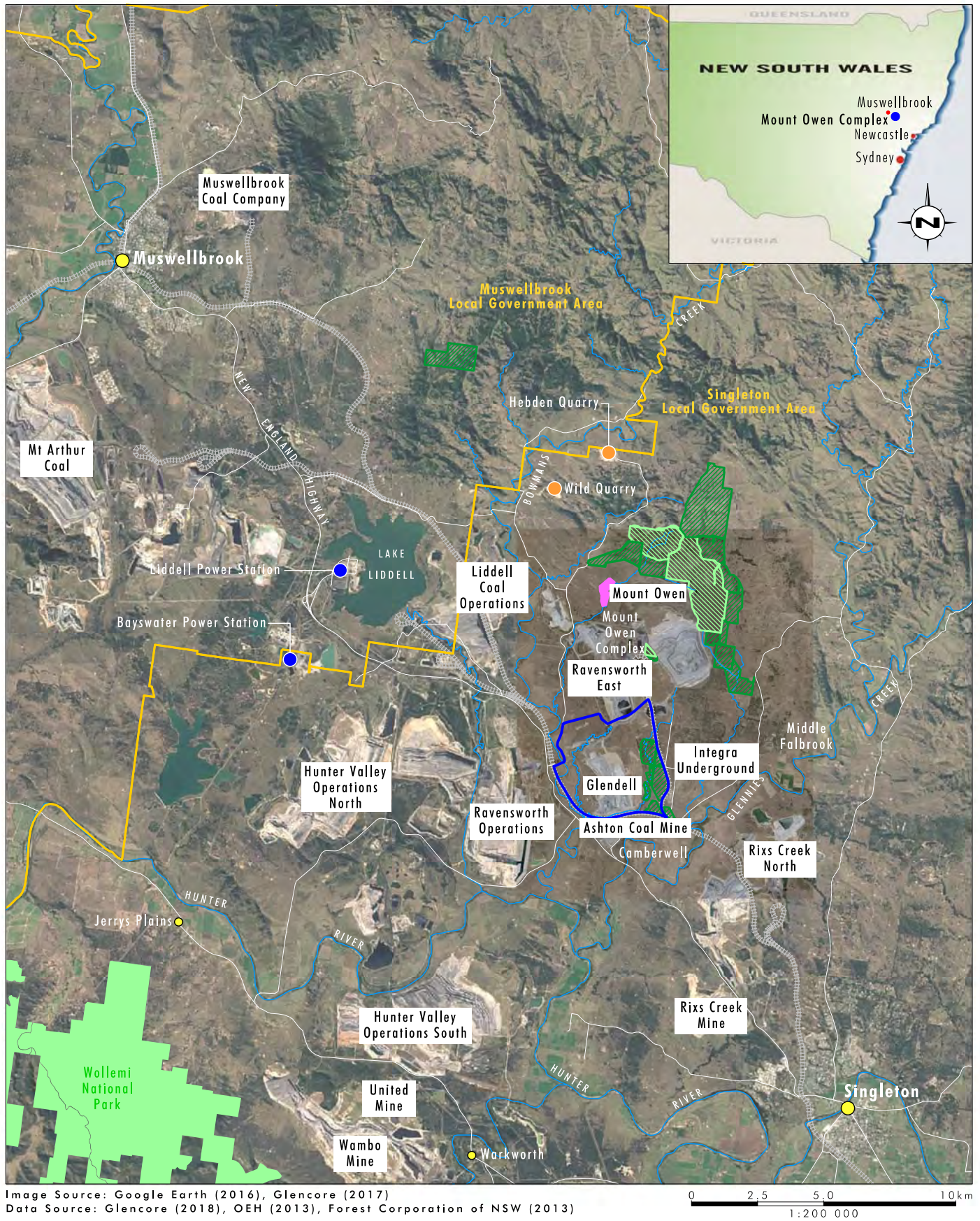
Table 1.1 provides a comparison of the approved operations and the Proposed Modification. A detailed description of the Proposed Modification is provided in **Section 2**.

Table 1.1 Comparison of the Approved Operations and the Proposed Modification

	Approved Operations	Proposed Modification
Mining Method	Truck and excavator	No change to mining methods
Target Seams	Down to approximately 200 metre (m) depth	No change to mining depth
Total Reserve Recovered	Total of approximately 50 Mt ROM coal	Additional approximately 2.5 Mt ROM coal (approximately 5% of total approved resource)
Disturbance Area	Approved disturbance area of approximately 834 ha	Additional proposed disturbance of approximately 12 ha Reduction of approved disturbance area associated with an area of undisturbed vegetation of approximately 15.5 ha Net decrease in approved disturbance area of approximately 3.5 ha
Annual Production	4.5 Mtpa	No change to annual production
Mine Life	2024	Additional approximately 8 months of mining Current approved mining operations will cease in 2022 (based on current mining schedule). Proposed mining will cease Q1 2023. No increase to approved mine life.
CHPP Capacity	Up to 17 Mtpa (under SSD-5850)	No change
Management of Mining Waste	Emplacement of waste in-pit and out-of-pit up to maximum height of 160 m	No change to the height of emplacement areas
Water Management	Existing Swamp Creek and Bettys Creek diversion Management of water within the existing water management system and the GRAWTS	No change to existing approved creek diversions Extension of water management system to proposed disturbance area and continued management of water within the GRAWTS
Operational Workforce	Up to approximately 300 employees	No change to operational workforce
Hours of Operation	24 hours, 7 days per week	No change to hours of operation

	Approved Operations	Proposed Modification
Final Landform	One approved void (Barrett Pit) Rehabilitation strategy includes progressive rehabilitation to create a stable final landform with incorporated vegetation corridors providing links between the offset areas and existing remnant vegetation and post mining land use a combination of grazing land and bushland.	No change to approved rehabilitation strategy Minor changes to the design of the final landform to incorporate proposed changes to the mine plans.

This Statement of Environmental Effects (SEE) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to accompany an application to modify DA 80/952 pursuant to Section 4.55 (1A) of the Environmental Planning and Assessment (EP&A) Act. This SEE provides a targeted assessment of the potential environmental impacts associated with the Proposed Modification to demonstrate the Proposed Modification will have minimal environmental impact relative to the approved operations. The form of this SEE generally follows the requirements of the Department of Planning and Environment (DPE) Mine Application Guideline (October 2015), which outlines the requirements for development applications and modification applications for State Significant Developments.



Legend

- | | |
|--|--|
| Glendell Mine DA Boundary (DA 80/952) | Road |
| Local Government Area Boundary | Railway |
| Existing Biodiversity Offset Area | Drainage Line |
| Ravensworth State Forest | ● Towns |
| Yorks Creek Voluntary Conservation Area | ● Power Stations |
| National Park | ● Quarry |

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FIGURE 1.1

Upper Hunter Valley Context and
Approved Glendell Mine Operations

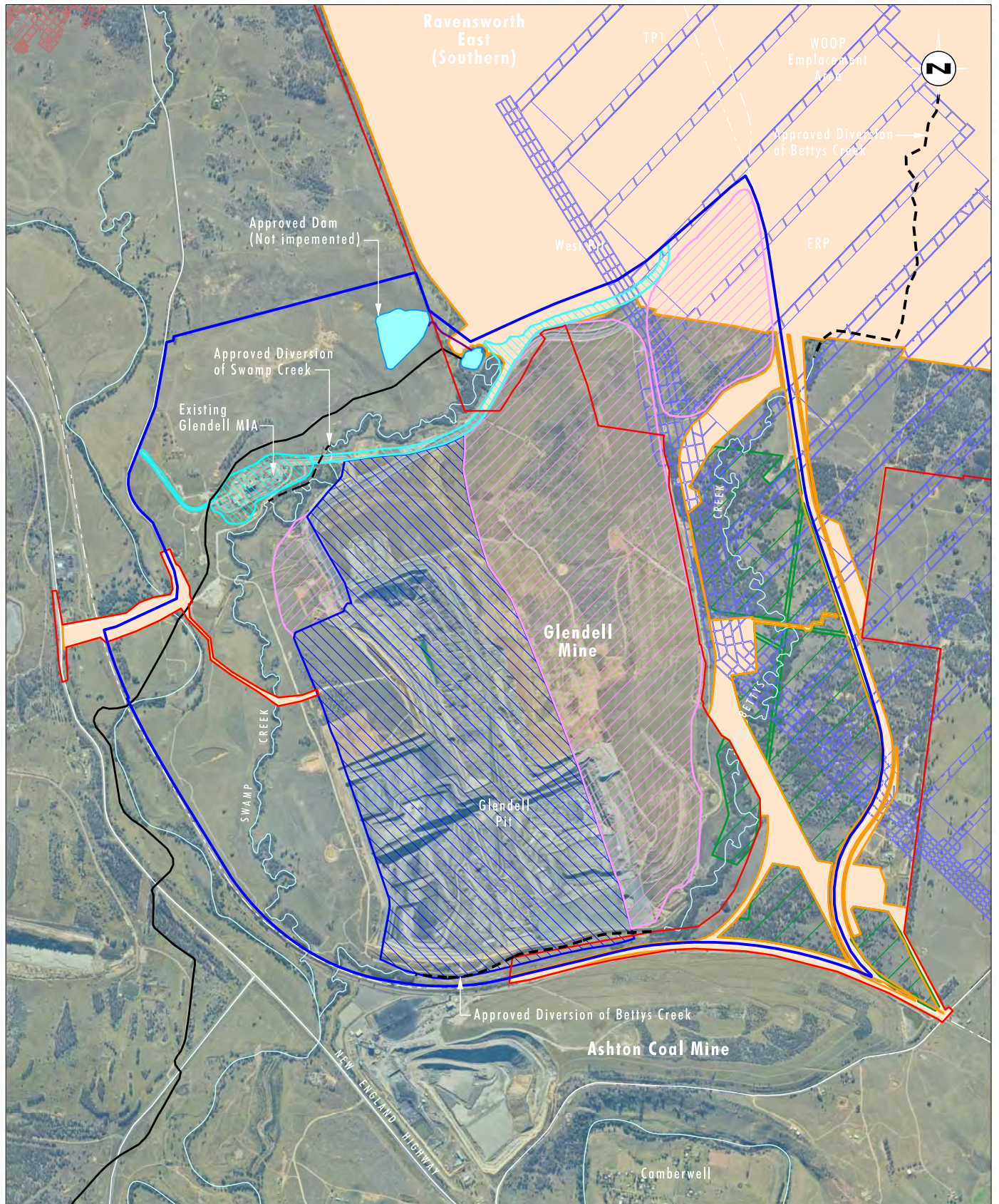


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Legend

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| Glendell Consent Boundary (DA 80/952) | Existing Creek Diversion |
| Mount Owen Consent Boundary (SSD-5850) | Existing GRAWTS pipeline |
| Mount Owen Continued Operations Disturbance Area | Approved Integra Underground Mining Area - Middle Liddell Seam Workings |
| Approved Glendell Overburden Emplacement Area | Liddell Underground Mining Area |
| Approved Glendell Mining Area | Bettys Creek Habitat Management Area |
| Approved Glendell Water Storage | |
| Approved Infrastructure Area | |

FIGURE 1.2

Approved Operations

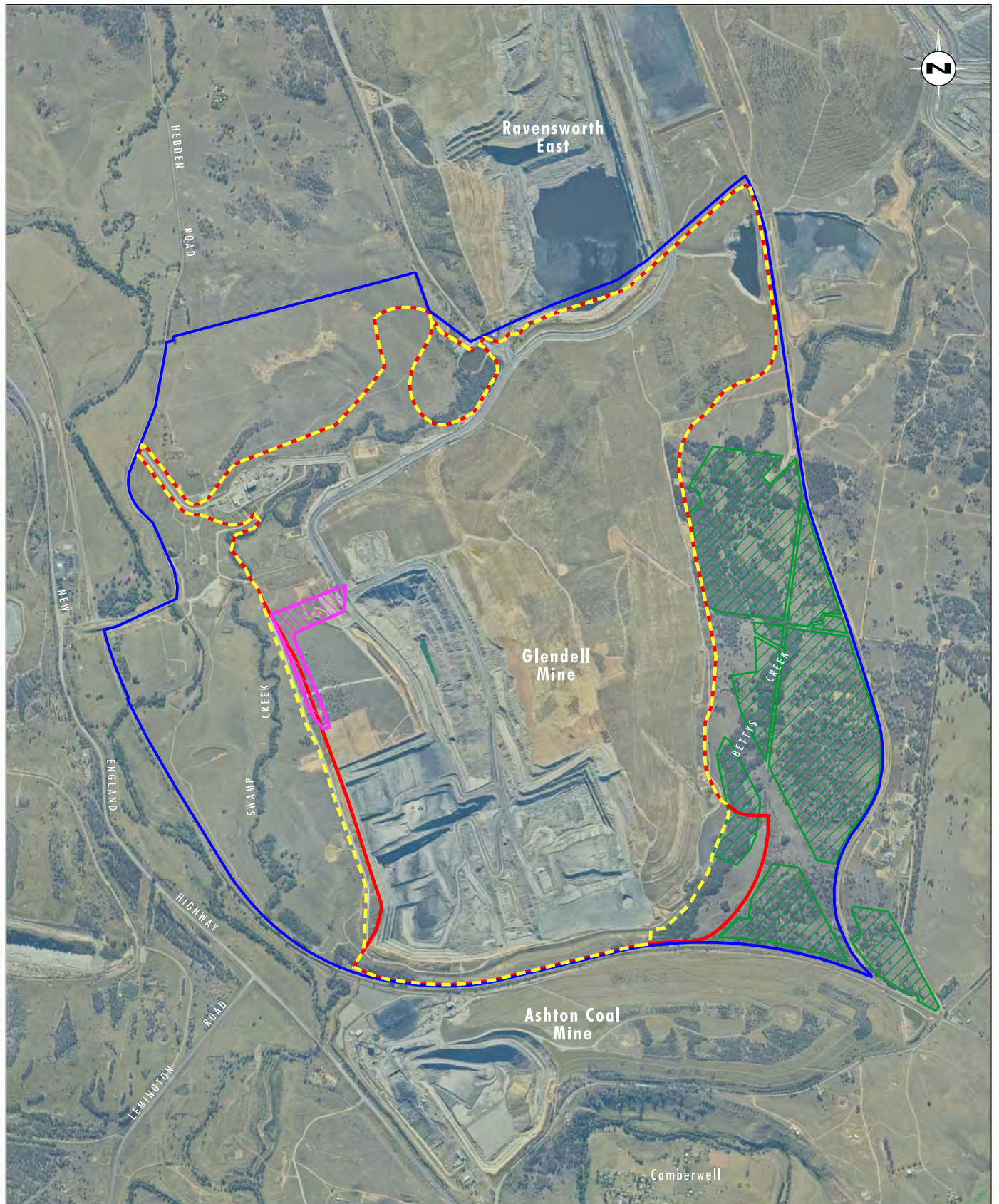


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Legend

- Glendell Consent Boundary (DA 80/952)
- Approved Disturbance Area (DA 80/952)
- - - Proposed Disturbance Area
- ▨ Bettys Creek Habitat Management Area
- ▨ Proposed Mining Area

FIGURE 1.3

Proposed Modification Overview

2.0 Description of Proposed Modification

The Proposed Modification will provide for an additional approximately 8 months of mining allowing the extraction of approximately 2.5 Mt ROM coal utilising the existing mine workforce, equipment and approved management systems. This section provides an overview of the approved operations and a detailed description of the Proposed Modification.

2.1 Overview of Approved Operations

The original Glendell Mine consent was granted in May 1983. Modification 1, approved in 1997, provided for amendments to the mining and emplacement areas, however mining did not commence until the approval of modification 3, granted in February 2008, which reduced the mining area and provided for the integration of the Glendell Mine with the broader Mount Owen Complex. This modification removed the duplication of coal processing, handling and transport infrastructure and enabled integrated water and tailings management across the Mount Owen Complex. The 2008 modification also reduced the proposed disturbance area to reduce the environmental impact of the mining operations and increased the annual ROM coal extraction to 4.5 Mtpa for up to 16 years (2024). Note, Mount Owen and Ravensworth East Mines operate under development consent SSD-5850.

Table 2.1 summarises the development consents for the approved Glendell Mine and the previous modifications.

Table 2.1 Glendell Mine Development Consent History

Development Consent Reference	Title	Description	Approval Granted	Expiry
Glendell Consent				
DA 80/952	Glendell Mine	Initial approval of Glendell Mine operations Dragline and truck and shovel mining methods Production Rate of 3.6 Mtpa	2/5/1983	2/5/2013
DA 80/952 Modification No.1	Glendell Open Cut	Approval to use the Swamp Creek Mine South Void for overburden emplacement and extension of mining area	1997	30/6/ 2013
DA 80/952 Modification No.2	Glendell Mine Operations	Modification of mining footprint and integration with Mount Owen Complex coal handling, processing and transport facilities. Increase in production rate to 4.5 Mtpa Extended approved mining operations to 30 June 2024.	February 2008	30/6/2024
DA 80/952 Modification No.3	Powerline Relocation	Realignment of a 2.7 km section of an existing 132 kV Ausgrid powerline and associated activities	1/12/2016	30/6/2024

The Glendell Mine forms part of the broader Mount Owen Complex with integrated coal handling and processing facilities, product transport, tailings disposal and water management systems. ROM coal extracted from the Barrett Pit is transported to the Mount Owen CHPP for processing. The Mount Owen CHPP is currently approved for up to 17 Mtpa ROM coal (Mount Owen Complex) throughput. Product coal is transported from the Mount Owen Complex using the Mount Owen Rail Loop or to the Liddell or Bayswater Power stations by conveyor. Up to 2 Mtpa ROM coal and/or crushed gravel can also be transported by conveyor from the Mount Owen Complex to the Liddell Coal Mine and/or Ravensworth Coal Terminal.

The integration of water management and tailings disposal systems within the Mount Owen Complex and between the other Glencore operated mines of Integra Underground, Liddell Coal and Ravensworth Operations is also approved under the various development consents and project approvals for each operation. This integrated water and tailings management system is known as the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS) and enables water and tailings to be transferred between sites to optimise water use and management at these operations and provide for more efficient management of fine tailings from CHPPs.

Mount Owen currently operates the Glendell Mine, Mount Owen CHPP and associated infrastructure, and the Ravensworth East Mine (Bayswater North Pit).

The Approved Operations are undertaken in accordance with the approved environmental management plans, strategies and monitoring programs currently approved and implemented at the Mount Owen Complex. The applicable management plans and strategies include:

- Water Management Plan (including sub plans)
- Air Quality Management Plan
- Noise Management Plan
- Blast Management Plan
- Rehabilitation Management Plan
- Biodiversity and Offset Management Plan
- Aboriginal Cultural Heritage Management Plan
- Historic Heritage Management Plan
- Greenhouse Gas and Energy Efficiency Plan

The currently approved environmental management plans, strategies and monitoring programs are available on the Mount Owen Complex website (www.mtowencomplex.com.au).

The outcomes of monitoring programs are reported annually to the community and regulators through the Annual Review and monthly monitoring reports available on the Mount Owen Complex website.

2.2 Proposed Modification Description

DA 80/952 currently provides for mining operations at Glendell Mine until 2024, however based on the current mining schedule mining operations will cease in 2022, Mount Owen are now seeking a minor extension to the approved mining area in the Barret Pit in order to access an additional approximately 2.5 Mt ROM Coal and provide for an additional 8 months of mining (approximately to Q1 2023), refer to **Figure 1.3**.

The Proposed Modification will provide for continued mining operations at the Glendell Mine and the continued employment of the existing workforce for an additional approximately 8 months and continuity of mining operations pending the determination should the approval process for of the GCOP be delayed, however this will not extend the currently approved mine life as the proposed operations are scheduled to cease prior to the currently approved mine life of 2024.

The proposed minor expansion of the Barrett Pit will also provide for the implementation of the initial mine plan changes to the current mining operations in the Barrett pit in order to progress efficiently into the planned Glendell Pit Extension area, should the GCOP be approved. Extending the approved mining area at the time that the approved mining operations progress through this area represents the most efficient option in implementing the proposed GCOP mine plan, whilst maintaining the associated environmental impacts consistent with the current predicted impacts and not significantly modifying the approved conceptual final landform.

The proposed disturbance area is located within the original approved disturbance area under DA 80/952, and has therefore been subject to previous environmental assessment. The approved disturbance area was reduced through the redesign of the conceptual mine plans as part of the 2008 modification (refer to **Figure 2.1**).

An additional 12 ha of disturbance is required along the western boundary of the currently approved disturbance area in order to accommodate the proposed mine plan changes. In addition, the currently approved disturbance area is proposed to be revised to remove an area previously approved for disturbance on the eastern boundary of the approved disturbance area. An area of approximately 15.5 ha will be removed from the approved disturbance area as part of the Proposed Modification which will no longer be disturbed, refer to **Figure 1.3**). Therefore there will be a net decrease (3.5 ha) in the overall disturbance area associated with the Glendell Mining operations. No changes are proposed to the current approved mine life, mining methods, extraction limits, processing rates, transportation methods, operational hours or workforce numbers.

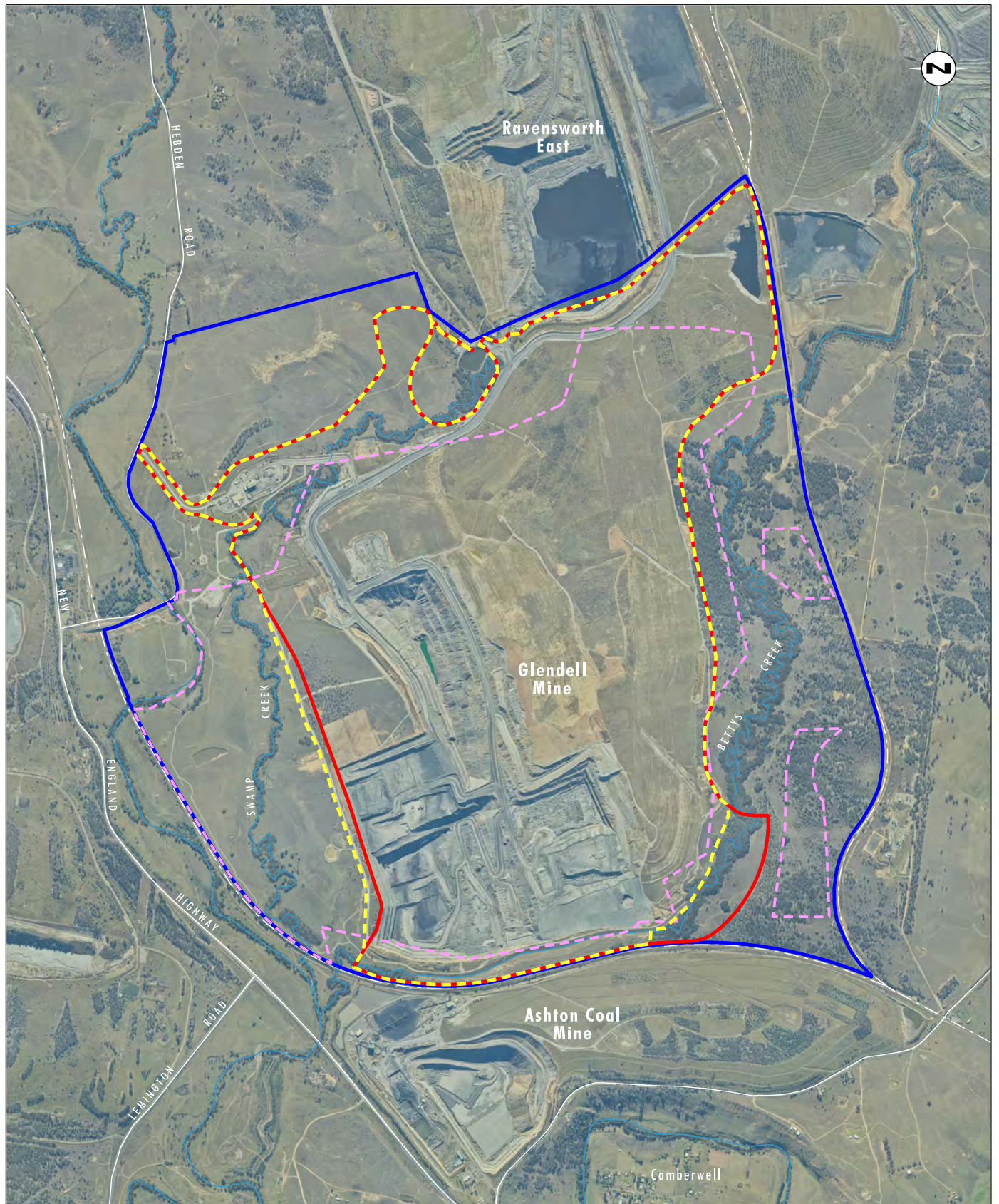


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Approved Disturbance Area (DA 80/952) 1997
- Approved Disturbance Area (DA 80/952) 2008
- Proposed Disturbance Area

FIGURE 2.1

Approved and Proposed
Disturbance Area Comparison

2.2.1 Conceptual Mine Plans

As previously discussed, the approved mining area within the Barrett Pit will be extended further north and west in order to provide for the extraction of an additional approximately 2.5 Mt ROM coal. **Figure 2.2** provides a conceptual mine plan stage that depicts the proposed minor extension to the Barrett Pit. As previously discussed the proposed extension to the Barrett Pit has been designed to avoid the Swamp Creek alluvium and ensure there is no material increase in environmental impacts, particularly air quality and noise, relative to the approved operations.

Year 2023 (Figure 2.2) - represents the conceptual final year of mining (as modified) with the progression of mining moving further north and reaching the northern extent of proposed mining. This mine plan replaces the approved Year 12 conceptual mine plan. Minor changes to the currently approved operations will also be implemented including hauling overburden along the western edge of the Barrett Pit at surface, providing for efficient establishment of the overburden emplacement area at the southern end of the Barrett Pit. During unfavourable meteorological conditions, alternate arrangements for the haulage of overburden can occur along a western bench within the Barrett Pit (below surface) to assist in managing any potential off-site air quality and noise impacts. Modifications to the haul road, existing truck parking areas and WMS structures will also be implemented to accommodate the progression of mining.

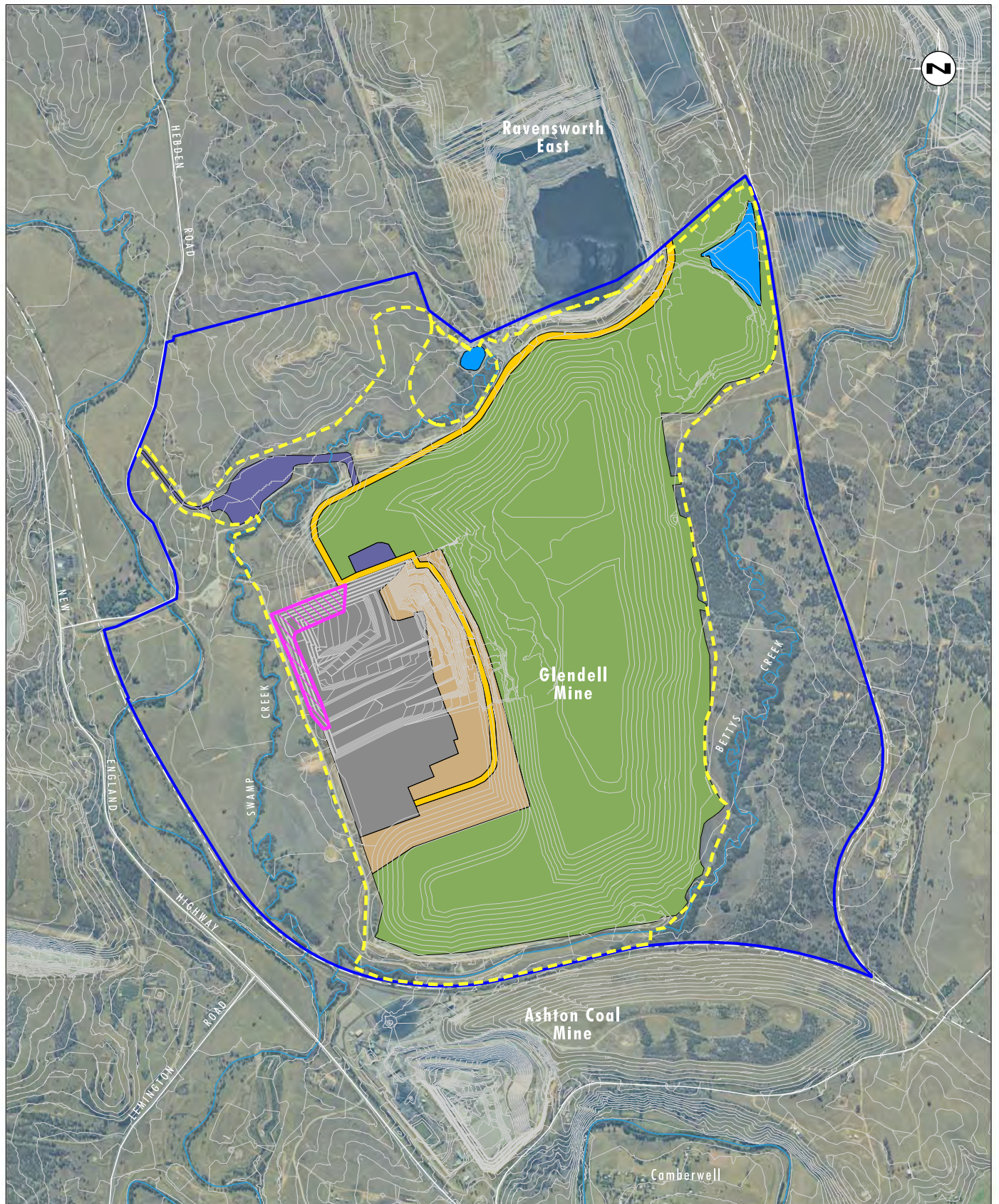


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- | | |
|---|---|
| — Glendell Mine DA Boundary (DA 80/952) | — Haul Road |
| ▨ Proposed Mining Area | — Rehabilitation |
| - - - Proposed Disturbance Area | — Water Storage |
| — Active Mining | |
| — Active Overburden Emplacement Area | |
| — Infrastructure | |

FIGURE 2.2

Conceptual Mine Plan
2023

2.2.2 Rejects and Tailings Emplacement

As discussed in **Section 2.1**, coal processing and tailings management at the Mount Owen Complex is currently undertaken in accordance with SSD-5850, which allows for the emplacement of tailings in pit within voids at Ravensworth East and Mount Owen Mines and transfer under the GRAWTS.

Coarse reject will continue to be emplaced in pit at the Mount Owen Complex, up to the approved emplacement height of approximately 160 m within the Barrett Pit, in accordance with current practices for the approved operations.

2.2.3 Rehabilitation and Final Landform

The primary objective of the approved rehabilitation strategy for the Glendell Mine is to create a stable final landform that maximises the extent of drainage reporting to the surrounding catchments and provides an acceptable post mining land use capability. Rehabilitation currently occurs progressively on site with rehabilitation works scheduled to occur as soon as practicable after mining disturbance. The rehabilitation plan for the site is to return to a condition where the landform, soil, hydrology, flora and fauna are self-sustaining, and compatible with the surrounding landuse. The proposed end land use includes a combination of grazing land and native woodland, with a focus on implementing vegetation corridors designed to link rehabilitation areas to the Bettys Creek Habitat Management Area and existing areas of adjacent remnant vegetation.

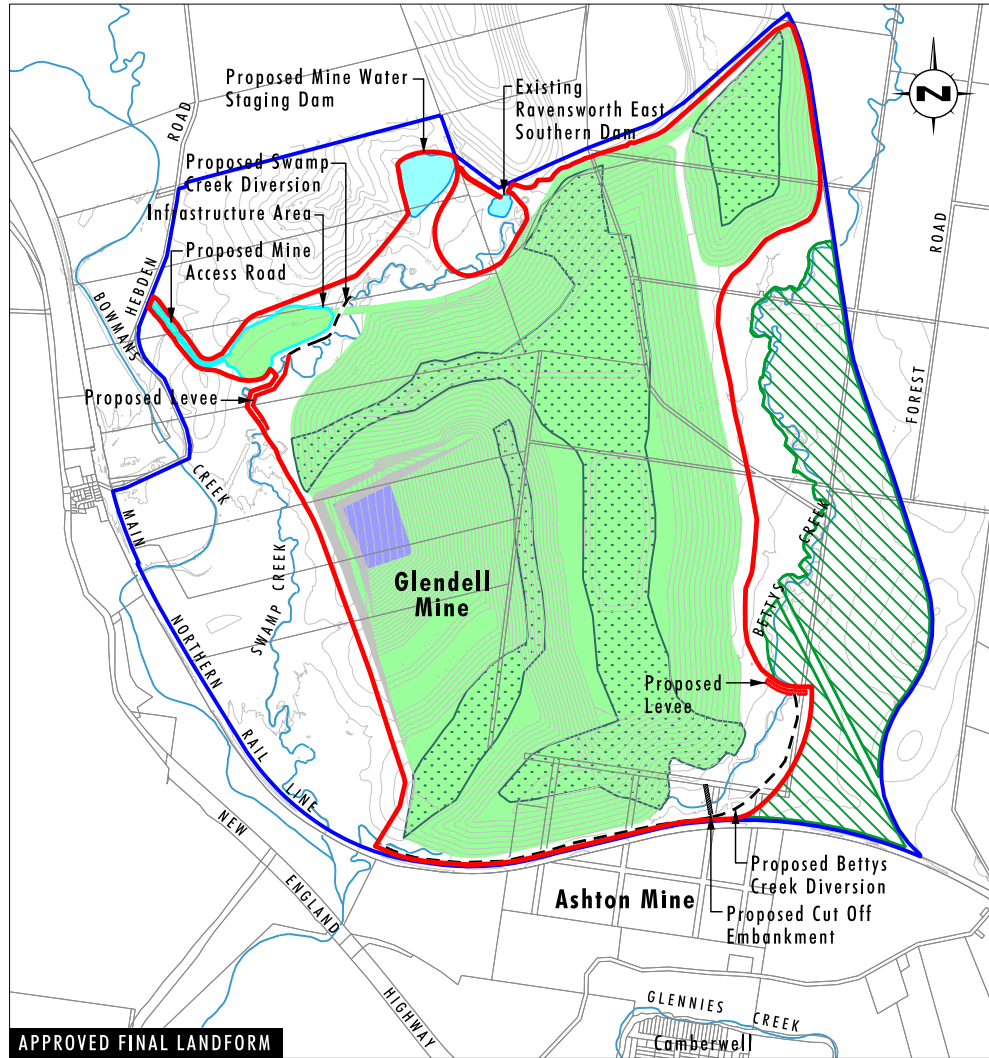
The approved conceptual final landform includes one final void located on the northwest side of the site and predominantly consists of rehabilitated slopes from 10 to 14° with a remnant highwall in the northwest corner of the final void (refer to **Figure 2.3**). Minor design amendments are required to the approved final landform in order to accommodate the extension of the Barrett Pit and associated emplacement of additional overburden. No change is proposed to the current progressive rehabilitation commitments and practices as part of the Proposed Modification and the proposed conceptual final landform has been designed to be consistent with the design objectives utilised for the approved conceptual final landform. **Figure 2.3** provides a comparison of the approved and proposed conceptual final landforms and demonstrates that the Proposed Modification conceptual final landform is consistent with the currently approved conceptual final landform, albeit with the key features relocated approximately 130 m north and 60 m to the west.

2.2.4 Ancillary Developments

The Proposed Modification relates specifically to the amendment to the approved mine plans only. The existing infrastructure at the Mount Owen Complex will support the continued mining at the Glendell Mine with the exception of the implementation of minor water management infrastructure no other additional infrastructure approvals required or modifications to the existing mining operations.

2.2.5 Development Schedule

No significant construction is required as part of the Proposed Modification. The current mine schedule indicates mining operations will cease at the Glendell Mine in mid-2022. The initial changes to the mining operations within the currently approved mining limit will commence in 2019, should the Proposed Modification be approved. Mining operations under the Proposed Modification are expected to be completed by 2023, at which stage mining will commence under the GCOP, should the GCOP be approved. Should the GCOP not be approved, the proposed conceptual final landform would be implemented and the detailed closure plan will continue to be developed in accordance with relevant consent requirements under DA 80/952.

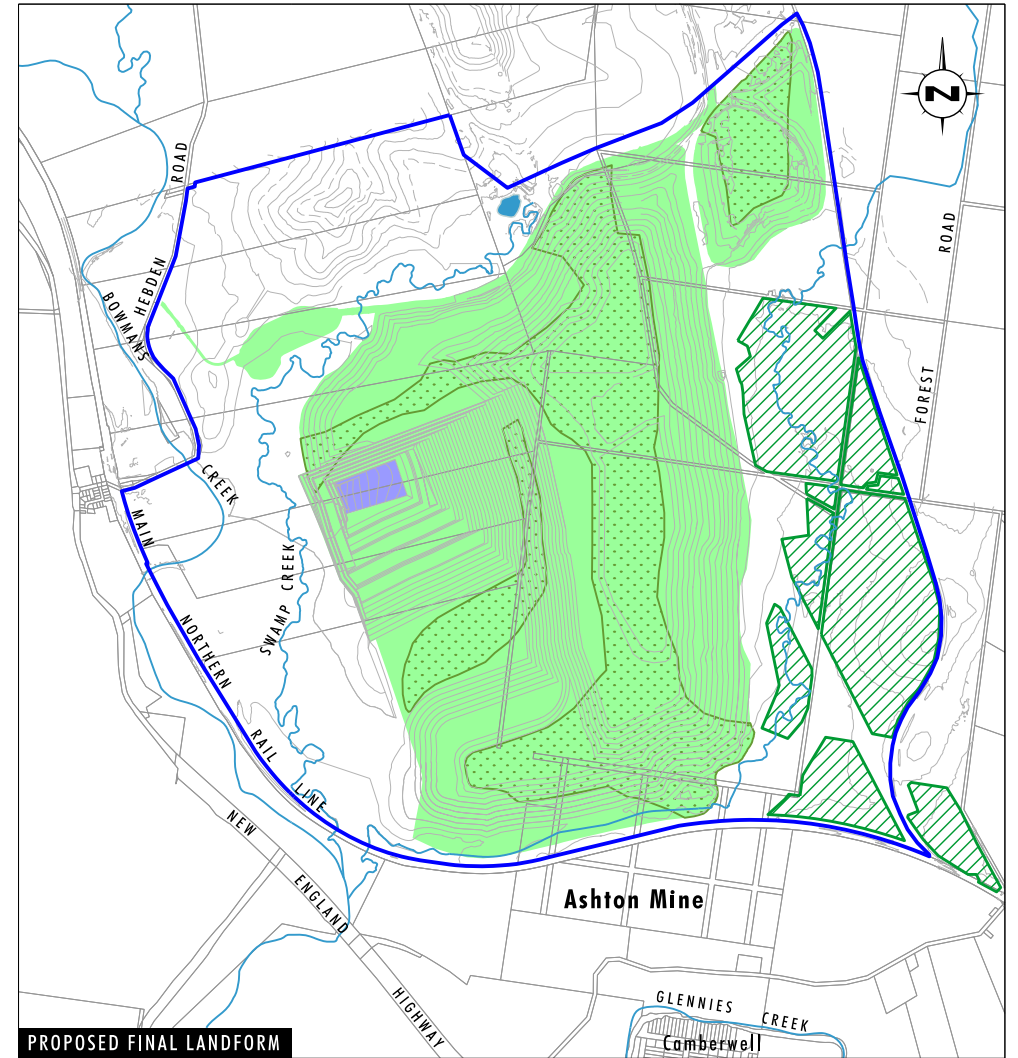


Data Source: Glencore (2018)

Legend

- Glendell Consent Boundary (DA 80/952)
- Approved Disturbance Area (DA 80/952)
- Glendell Infrastructure Area
- Rehabilitated Area
- Final Void
- Proposed Habitat Management Area
- Treed Rehabilitated Area
- Creek Diversion

File Name (A4): R07/4052_051.dgn
20181026 15.03



0 0.5 1.0 2.0 km
1:40 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Betty Creek Habitat Management Area
- Rehabilitated Area
- Final Void

FIGURE 2.3

Approved and Proposed
Final Landform

2.3 Management Commitments

As discussed in **Section 2.1**, the approved operations at the Mount Owen Complex are undertaken in accordance with the approved environmental management plans and strategies. Should the Proposed Modification be approved, minor updates will be undertaken to incorporate the management requirements resulting from the Proposed Modification. This will include general updates to reflect the modified operations as well as specific revisions to reflect updated and revised management commitments required as a result of the Proposed Modification.

The proposed updates to the relevant management commitments are summarised below and further detail relating to the associated environmental assessment is provided in **Section 6.0**:

- Revisions to the Water Management Plan (Surface Water Management and Monitoring Plan) to include operational updates to the approved Water Management System (refer to **Section 6.4**).
- Revisions to the Biodiversity and Offset Management Plan to include the revised disturbance limit boundary and the proposed Biodiversity Offset Strategy for the Proposed Modification, once finalised (refer to **Section 6.5**).
- Revisions to the Aboriginal Cultural Heritage Management Plan, to include the recording and collection of surface artefacts recorded at six sites (refer to **Section 6.6**).

3.0 Strategic Context

This section provides a description of the:

- target resource (including applicable mining tenements, target coal resource and exploration activities),
- regional context (including land use, biophysical, environmental and heritage constraints, and economic considerations), and
- permissibility and Strategic Planning (including all relevant Commonwealth and State legislative requirements applicable to the Proposed Modification).

3.1 Target Resource

3.1.1 Mining Tenements

The existing mining tenements relevant to the existing Glendell Mine are presented in **Table 3.1**. **Table 3.1** also presents the approved depths of each mining tenement shown on **Figure 3.1**.

Table 3.1 Mining Tenements Relevant to the Glendell Mine

Reference	Authority Type	Expiry	Holder	Depth (m)
Mining leases				
CL 358	Mining Lease	27/03/2032	Glendell Tenements Pty Ltd	Varying
CL 382	Mining Lease	11/11/2033	HV Coking Coal Pty Ltd	Varying
CCL 708	Mining Lease	30/12/2023	Liddell Tenements Pty Ltd	Varying
ML 1410	Mining Lease	04/07/2020	Glendell Tenements Pty Ltd	Surface to 106.68 m
ML 1476	Mining Lease	23/11/2021	Glendell Tenements Pty Ltd	Varying
ML 1629	Mining Lease	09/03/2030	Mt Owen Pty Ltd	Surface to 15.24 m
ML 1673	Mining Lease	11/11/2033	Mt Owen Pty Ltd	Varying
ML 1694	Mining Lease	22/10/2034	Mt Owen Pty Ltd	Varying
MPL 343	Mining Lease (Mining Purposes)	04/01/2026	Glendell Tenements Pty Ltd	Surface to 5 m
EL 8184*	Exploration Licence	14/10/2018	Glendell Tenements Pty Ltd	Surface to 15.24 and 20 m in Project area

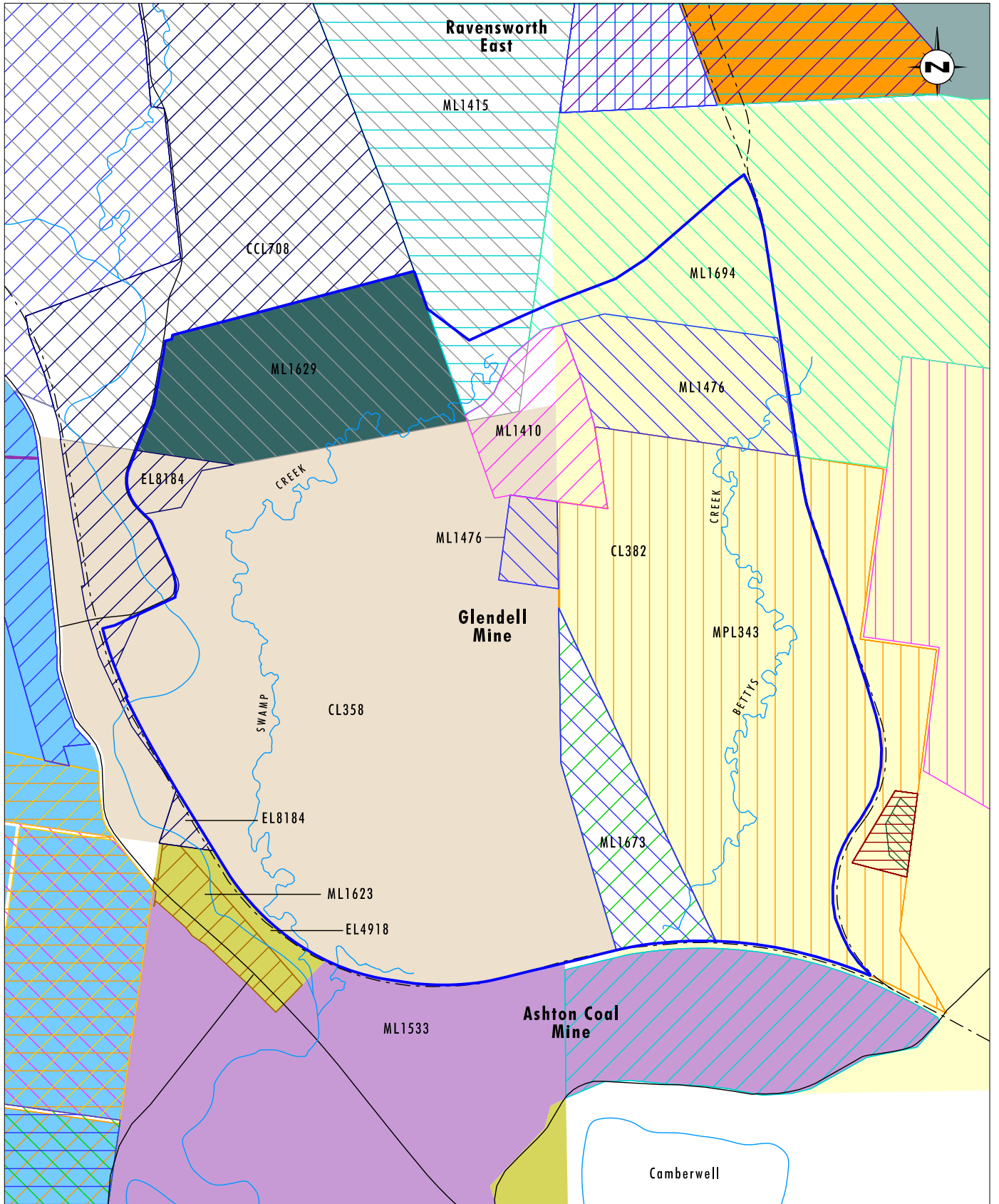
* Renewal application lodged

No additional mining leases are required for the Proposed Modification

3.1.2 Exploration Activities

Mount Owen undertakes exploration and prospecting activities across the Mount Owen Complex approved lease areas for the purposes of geotechnical, geological, geophysical, hydrogeological and gas investigations.

The recent exploration program undertaken to inform the preparation of the GCOP, identified the coal reserves to be extracted as part of the Proposed Modification and the geological data obtained from drilling programs has been utilised to guide the development of the conceptual mine plans and also to inform the specialist assessments undertaken to support the Proposed Modification.



Data Source: Glencore (2018), Minview (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

Glendell Consent Boundary (DA 80/952)	EL6594	ML1477	ML1668
AUTH268	EL8184	ML1484	ML1673
CCL708	ML1348	ML1485	ML1676
CL358	ML1349	ML1525	ML1694
CL380	ML1355	ML1529	MPL343
CL382	ML1410	ML1533	
CL580	ML1415	ML1561	
EL4918	ML1475	ML1623	
EL5824	ML1476	ML1629	

FIGURE 3.1

Mining Tenements Relevant to
Glendell Mine

3.1.3 Geology and Resource Description

The Barrett Pit, is located along the Camberwell Anticline. The Camberwell Anticline is the major structural feature in the area and runs in a general north-south alignment through the Glendell Mine. The Camberwell Anticline exhibits steep dips ($>20^{\circ}$) on its eastern flank, and dips up to 12° on its western flank. The main open cut resources occur along the axis of the anticline with deeper resources present on the western and eastern margins.

The target coal reserve within the Barrett Pit contains a number of seams of the Foybrook Formation, which is the lowermost coal bearing formation of the Wittingham Coal Measures. Eight seams with open cut potential exist from the Lemington seam to the Hebden seam, mining within the Barrett Pit occurs down to the Barrett Seam, ranging in depth to approximately 200 m (refer to **Figure 3.2**).

The target coal seams are approximately 1 to 2 m thick and exhibit a relatively simple structural arrangement of splitting and coalescence about the crest and flanks of the north plunging, north-north-west trending Camberwell Anticline. Mining of the target coal seams are not constrained by any significant faults or igneous intrusions and generally exhibit a low propensity for spontaneous combustion.

3.2 Regional Context

3.2.1 Land Use Constraints

The immediate area surrounding the Mount Owen Complex is dominated by established mining operations including Liddell Coal Operations, Ravensworth Operations, Integra Underground Mine, Ashton Mine and Rix's Creek North (refer to **Figure 1.1**). The Proposed Disturbance Area is bound by Swamp Creek to the east, Glendell Mining operations to the north and west and the Main Northern Rail Line to the south with Ashton Coal Mine beyond.

Although large portions of land within and surrounding the Mount Owen Complex are owned by Glencore or other mining operations, there are private residences located to the south east of Glendell Mine, with the closest private residence subject to acquisition rights under DA 80/952, and to the South in Camberwell. The majority of the residences in Camberwell are now mine owned with the remaining residences being subject to acquisition rights from other mining operations, refer to **Figure 3.3**.

An existing ridgeline and the existing rehabilitated Ashton Mine overburden emplacement area provides a substantial elevated barrier between the Glendell Mine site and Camberwell, however the original air quality impact assessment undertaken to support the 2008 Modification to DA 80/952 identified Camberwell as an area subject to potential cumulative impacts due to contributions from mining operations and other existing sources, which is still an ongoing issue. To address this issue the approved mine plans were redesigned to commence mining within the northern extent of the Glendell Mine site with subsequent mining initially advancing in a southerly direction prior to turning and continuing in a northerly direction minimising interactions with surrounding operations and changing the timing of emission contributions from the Glendell Mine. The proposed modification continues mining in a northerly direction away from Camberwell further reducing the contribution to cumulative emissions in Camberwell.

Privately owned land is located to the north, north-east and north-west of the Mount Owen Complex however there is significant separation between the Glendell Mine and privately owned land to the North which provides a buffer. Mining operations will move only marginally closer to these residences.

Glencore owns an extensive area of land surrounding the majority of the Mount Owen Complex with some land to the immediate west owned by AGL Macquarie. Enx Foydell Pty Ltd (a subsidiary of Glencore) owns all the land within the Proposed Disturbance Area.

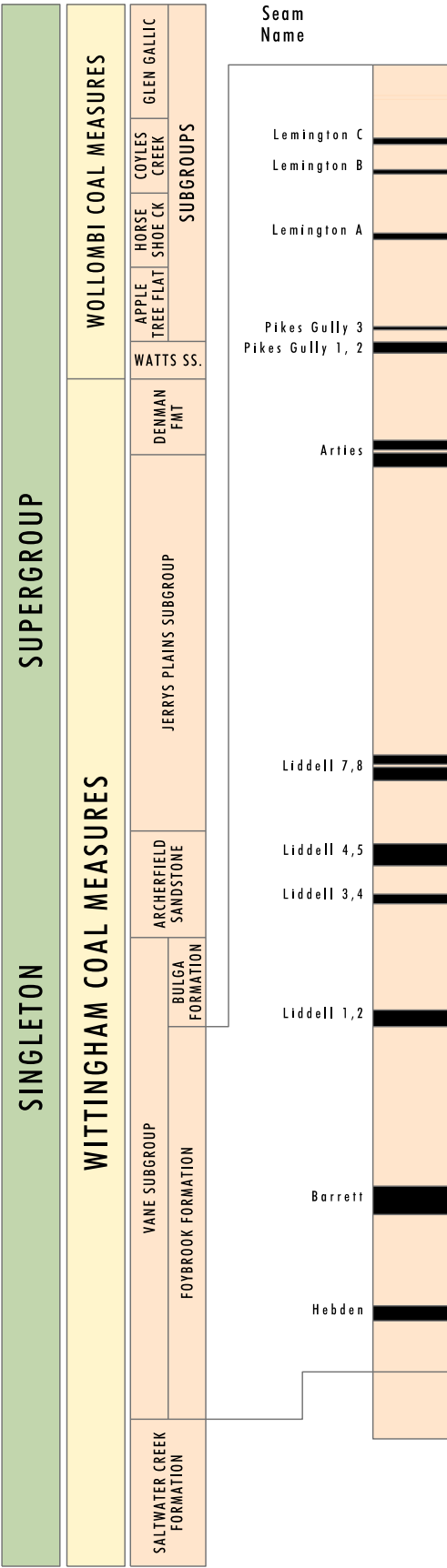
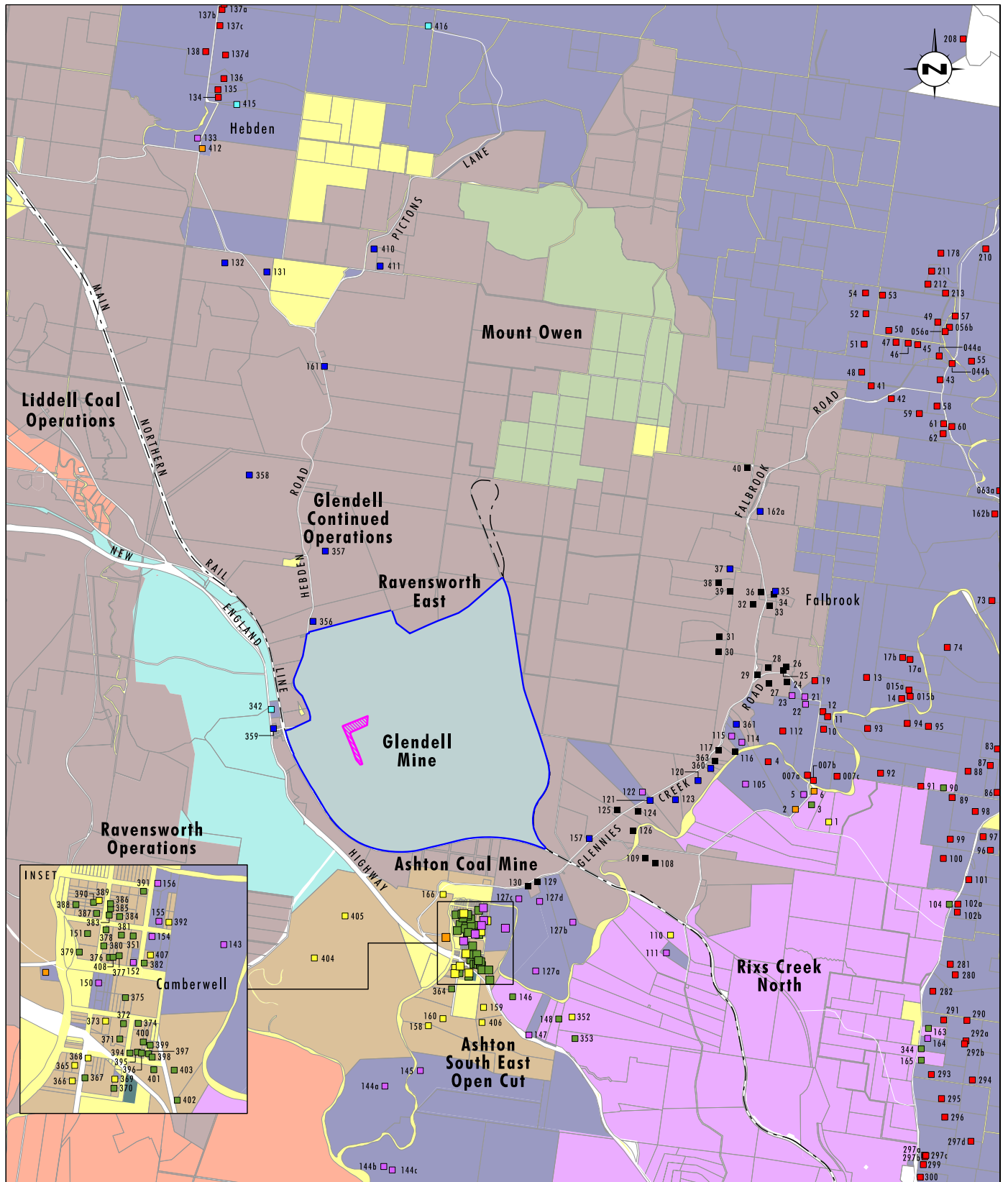


FIGURE 3.2
Stratigraphic Column



Data Source: Glencore (2018), Department of Finance & Innovation (2017)

0 1 2 4 km
Scale 1:90 000

Legend

- | | |
|--|--|
| Glendell Consent Boundary (DA 80/952) | State Forest |
| Proposed Mining Area | Community Infrastructure |
| Ashton Coal | Glencore Owned |
| Bloomfield Collieries | Glencore Owned - Vacant |
| Coal and Allied | Other Mine Owned |
| Crown Land | Other Mine Owned - Vacant |
| Glencore | Private |
| Government Authority | Private - Subject to Acquisition Rights |
| AGL Macquarie Pty Ltd | Private Infrastructure |
| Private | |

FIGURE 3.3

Land Ownership Surrounding
the Glendell Mine

3.2.2 Biophysical, Environmental and Heritage Constraints

Land within and surrounding the Mount Owen Complex has been subject to historical disturbance associated with agricultural land uses and, in the last 40 years, coal mining developments. Prior to the commencement of mining operations, the Glendell Mine site was predominately used for grazing purposes with only small areas of remnant and regrowth vegetation. The majority of the existing vegetation within and surrounding the Mount Owen Complex exists as a result of extensive re-growth over the past 30 years (Umwelt 2014). The Proposed Disturbance Area predominately comprises derived native grassland and limited areas of regenerating trees.

The topography of the Glendell Mine site is characterised by an undulating landscape extending to lower areas associated with Swamp, Bettys and Bowmans Creeks, a notable topographical feature in the east of the Glendell Mine site is a ridgeline extending north to south to a height of approximately 120 m Australian Height Datum (mAHD). The topography of the Proposed Disturbance Area does not pose any constraints to mining operations or associated water management infrastructure.

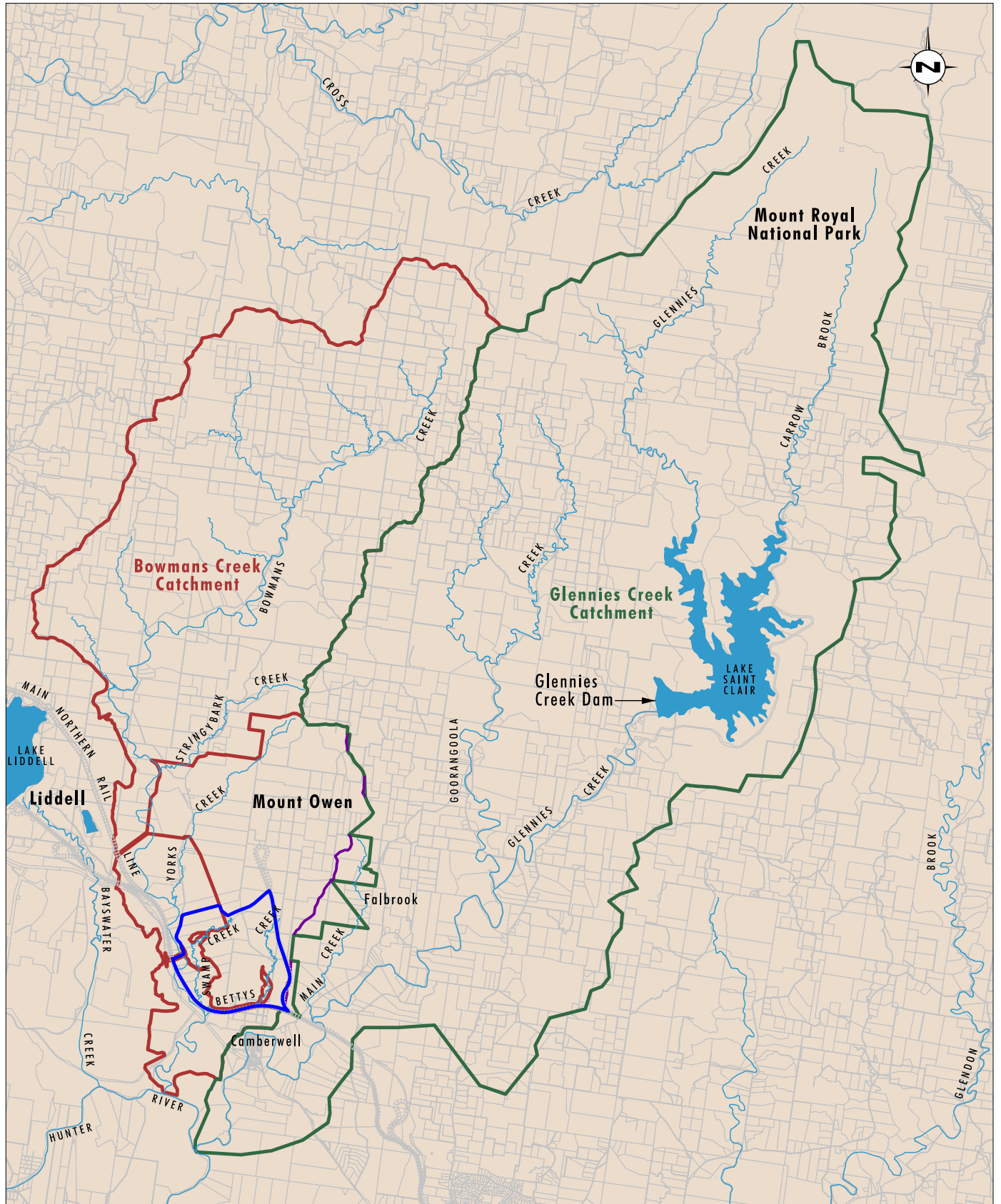
The Glendell Mine site is located primarily in the catchment of Bettys Creek and Swamp Creek. Both Bettys Creek and Swamp Creek have been subject to approved diversion works as a result of the approved mining operations, and flow into Bowmans Creek to the south-west of the Glendell Mine site. Bowmans Creek also intersects the western extent of the Glendell Mine and continues south and joins the Hunter River approximately 3.5 km downstream of the Glendell Mine (refer to **Figure 3.4**).

As discussed in **Section 2.2**, the proposed mining area will extend further towards Swamp Creek and the associated alluvium. Mount Owen has recently undertaken detailed survey and assessment to confirm and map the extent of the alluvium associated with Swamp and Bowmans Creek, based on site specific assessments. The assessment of the extent of the alluvium included review of available published data sets, in addition to detailed fieldwork comprising geophysical survey and targeted test pits. The extent of Swamp Creek alluvium is shown on **Figure 3.5**. The depth of the Swamp Creek and alluvium was also confirmed through targeted test pits and review of monitoring data from the existing groundwater monitoring network, refer to **Section 6.3** for further detail.

At a regional scale, the Proposed Disturbance Area is mapped as Biophysical Strategic Agricultural Land (BSAL) (Upper Hunter Strategic Regional Landuse Plan 2012) however, the Proposed Disturbance Area is subject to an existing Mining Lease and no further mining leases are required in relation to the Proposed Modification, therefore no further assessment is required.

Extensive archaeological investigation and survey has been undertaken across the Glendell Mine site and within and around the Proposed Disturbance Area in relation to previous approvals and the GCOP. The Proposed Disturbance Area has been subject to further archaeological survey and assessment as part of the Proposed Modification which identified 3 additional aboriginal sites, all of which are located in highly disturbed areas and have a low scientific value, these sites would be salvaged should the Proposed Modification be approved.

No historic heritage sites/items with statutory heritage listings are located within the Proposed Disturbance Area. No identified listed heritage items within the vicinity of the Mount Owen Complex will be directly or indirectly impacted as part of the approved operations or the Proposed Modification.



Data Source: Glencore (2018), Geoscience Australia (2006), LPI (2017)

0 2.5 5.0 10.0km
1:200 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Glennies Creek Catchment Area
- Bowmans Creek Catchment Area
- Intersection of Catchment Boundary
- Cadastre
- ▤ Railway
- Drainage Line

FIGURE 3.4
Catchment Context

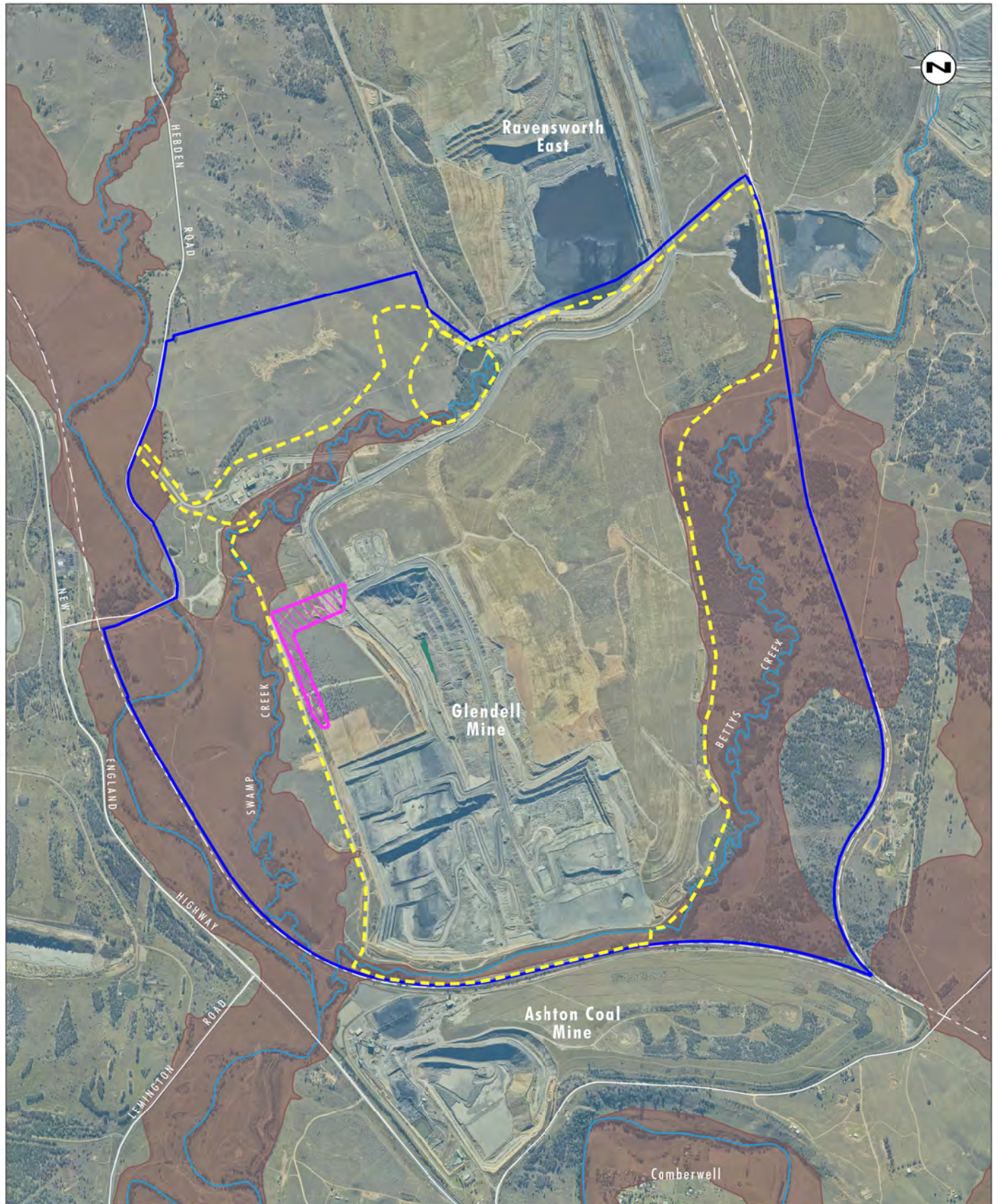


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Proposed Disturbance Area
- Proposed Mining Area
- Alluvium Mapping (AGE 2018)

FIGURE 3.5
Alluvium Mapping

3.2.3 Economic Considerations

As an existing mining operation the Glendell Mine currently provides employment approximately 300 employees. Disposable income of employees and economic flow-on effects from service and supply contracts contribute to the local, regional and state economies. Further economic contributions are provided through the payment of royalties to the State Government and taxes to both Federal and State governments. The proposed modification will provide for the extraction of an additional approximately 2.5 Mt ROM coal providing for continuing economic benefit beyond the original approved mining limit and also provides the benefit of the continuity of mining during the assessment of GCOP.

The GCOP (subject to approval) would provide for the extraction of an additional approximately 140 Mt ROM coal and extend the life of mining operations at Glendell to approximately 2044 and provide ongoing employment for the existing workforce, as well as create additional employment opportunities. This will result in significant flow on effects for the local and regional economy, payment of royalties to the NSW Government and export earnings for Australia.

3.3 Permissibility and Strategic Planning

This section identifies relevant Commonwealth and State Legislation and discusses the application of these provisions to the Proposed Modification.

3.3.1 Commonwealth Legislation

Table 3.2 provides a review of the relevant Commonwealth environment and planning legislation and its relevance to the Proposed Modification.

Table 3.2 Summary of Commonwealth Legislation and Relevance to the Proposed Modification

Planning Provision	Comment	Approval Required?
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	The EPBC Act is the primary environmental and planning regulatory instrument relevant to the Proposed Modification at a Commonwealth level. Under the EPBC Act the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on any matters of national environmental significance (MNES). MNES are as follows: • World Heritage property • National heritage place • wetlands of international importance (listed under the Ramsar Convention) • threatened species and communities listed under the EPBC Act • migratory species listed under the EPBC Act • nuclear actions • marine areas or reserves • a water resource, in relation to coal seam gas development and large coal mining development, and • Commonwealth land. DA 80/952 predates the requirement to refer projects under the EPBC Act, and the modifications to DA 80/952 did not result in any additional impacts to matters of national environmental significance compared to the original approved operations. Therefore the existing approved operations is not subject to an existing EPBC approval.	No

Planning Provision	Comment	Approval Required?
	Detailed ecological and water resources assessments were undertaken to support the Proposed Modification which have concluded that the Proposed Modification would not have a significant impact on relevant MNES, including the Significant Impact Guidelines for impacts on water resources, therefore the Proposed Modification has not been referred to the Commonwealth Minister for the Environment.	
<i>Native Title Act 1993</i>	The <i>Native Title Act 1993</i> is administered by the National Native Title Tribunal. The Tribunal is responsible for maintaining a register of native title claimants and bodies to whom native title rights have been granted. These native title holders and claimants must be consulted prior to the granting of a mining lease over land to which the native title claim or right applies. This Act prescribes that native title can be extinguished under certain circumstances, including the granting of freehold land. The <i>Native Title Act 1993</i> has implications for the grant of mining leases under the <i>Mining Act 1992</i> where there is potentially claimable land within the lease application area. There is no Crown land within the Proposed Disturbance Area and no new mining leases are required for the Proposed Modification.	No

3.3.2 New South Wales Legislation

The EP&A Act is the primary legislation governing environmental planning and assessment for NSW. The Proposed Modification is characterised as being 'coal mining' and is therefore considered State Significant Development (SSD) as defined by the provisions of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) and requires development consent under Part 4 of the EP&A Act. DA 80/952 was originally granted under Part 4 of the EP&A Act in 1983 and subsequent modifications to date have been approved subject to Section 75W of the EP&A Act (pursuant to the previous section 8J(8) of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation)). Recent amendments to the EP&A Act have repealed S75W, with modifications to existing Part 4 approvals now subject to Section 4.55 of the EP&A Act. Clause 3BA of Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017 (S&T Regulation)*, provides that in the application of section 4.55(1A) of the EP&A Act to development that was taken to be an approved project pursuant to clause 8J(8) of the EP&A Regulation and whose consent was modified under section 75W, the consent authority need only be satisfied that the development to which the consent as modified relates is substantially the same development as the development authorised by the consent (as last modified under section 75W).

As discussed in **Section 1.0**, it is proposed to modify the existing development consent DA 80/952 under Section 4.55(1A) of the EP&A Act. This assessment pathway was discussed in consultation with DPE during the preparation of this SEE, subject to the Proposed Modification representing minimal environmental impact compared to the existing approved Glendell Mine.

Section 4.55(1A) states that *a consent authority may, on application being made by the applicant or any other person entitle to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if:*

- (a) *It is satisfied that the proposed modification is of minimal environmental impact, and*
- (b) *It is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified*

(c) *It has notified the application in accordance with:*

- i) *The regulations, the regulations so require, or*
- ii) *A development control plan, if the consent authority is a council that has made a development control plan that requires notification or advertising of applications for modifications of a development consent, and*

d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be.

The Proposed Modification is expected to have minimal incremental environmental impact compared to the approved operations as the impacts associated with the Proposed Modification application are expected to be consistent with those impacts that are approved under the DA 80/952, and are predicted to comply with all the existing environmental impact criteria that currently apply to DA 80/952.

The Proposed Modification will provide for a minor extension to the currently approved mining area at Glendell Mine, providing for the extraction of an additional 2.5 Mt ROM coal, representing an increase of approximately 5% of the total approved resource without extending the approved mine life or the annual production limit. The proposed mine plan has been designed to limit the associated impacts on air quality, noise and water resources with negligible incremental environmental impacts relative to the approved operations. The associated environmental impacts are discussed further in **Section 6.0**.

Based on the minor nature of the Proposed Modification and the minimal impacts expected to be associated with the Proposed Modification as compared to the approved operations, should the Proposed Modification be approved, the development (as modified) will remain substantially the same as the development that is currently approved.

Permissibility

The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) provides that mining is permissible with development consent on land where development for the purposes of agriculture or industry may be carried out.

The DA 80/952 consent boundary is located wholly within the area of the Singleton Local Environmental Plan (LEP) 2013. Under the Singleton LEP (Singleton Council 2013a) the Glendell Mine is zoned Rural RU1 Primary Production. Both coal mining and agriculture are permissible land uses within the Rural RU1 Primary Production zone under the Singleton LEP, and therefore the Proposed Modification is permissible with consent.

There are no other environmental planning instruments that regulate the permissibility of mining in the Proposed Disturbance Area except to the extent that the operation of the Singleton LEP in relation to mining is constrained by the State Environmental Planning Policies, which prevail over LEPs to the extent of any inconsistency.

3.3.2.1 Assessment Requirements

Under section 4.55(3) of the EP&A Act in determining an application for the modification of development consent, the consent authority must take into consideration such of the matters referred to in Section 4.15(1) as of relevance to the development the subject of the application. These matters for consideration by the consent authority and the sections where they are addressed in this SEE are provided in **Table 3.3**. **Section 6.0** includes an assessment of relevant environmental impacts associated with the Proposed Modification to determine the level of assessment completed to support the SEE.

Table 3.3 Section 4.15 Matters for Consideration

Matters for Consideration	Relevant SEE Section
(i) any environmental planning instrument	Section 3.3.3
(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and	Section 3.3.3
(iii) any development control plan,	Not Applicable based on SSD provisions, refer to Section 3.3.3
(iiia) any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4	Section 6.0
(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph),	Not applicable
(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality	Section 6.0
(c) the suitability of the site for the development,	Sections 3.0, 6.0 and 7.0
(d) any submissions made in accordance with this Act or the regulations	N/A
(e) the public interest	Sections 4.0 and 6.0

Additionally, under Section 4.55(3) the consent authority must also take into consideration the reasons given by the consent authority for approving the consent that is sought to be modified.

DA 80/952 was most recently modified in 2016, this modification included the relocation of an existing transmission line only and did not include any modification to the existing mining operation. As discussed in **Section 2.0**, mining commenced at the Glendell Mine following a modification to DA 80/952 in 2008 (the most recent relevant modification) which was approved by the then Minister for Planning. The modification was approved based on the following:

- *The assessment found that the modification would not result in any significant increase in environmental impacts over and above those associated with the mine as approved, particularly as the modification reduced the disturbance associated with the mining operations.*
- *The assessment demonstrated that the incremental and cumulative air quality and noise impacts associated with the mining operation could be adequately mitigated, managed, offset and/or compensated for.*
- *The modification represented a logical amendment to DA 80/952 providing an opportunity to integrate the mining operation with the Mount Owen Complex and other nearby mining operations under the same ownership.*
- *The benefit of the modification sufficiently outweighed the costs, was able to be conducted in a manner broadly consistent with the objects of the EP&A Act and was therefore in the public interest.*

The above mentioned reasons for approval have been considered during the preparation of this SEE and have been addressed in **Section 6.0**. This SEE has also been prepared in consideration of the factors identified in Section 4.55 of the EP&A Act and Clause 115 of the Environmental Planning & Assessment (EP&A) Regulation.

3.3.3 Environmental Planning Instruments

The environmental planning instruments applicable to the Proposed Modification are discussed in the following section.

3.3.3.1 State Environmental Planning Policies

State Environmental Planning Policy (State and Regional Development) 2011

The SRD SEPP identifies development to which the State Significant Development assessment and determination process under Part 4 of the EP&A Act applies. As discussed in **Section 3.3.2**, the Proposed Modification is for the purpose of coal mining and is State Significant Development as defined by the provisions of the SRD SEPP and requires development consent under Part 4 of the EP&A Act.

The Independent Planning Commission is the consent authority for State Significant Development where certain objections and disclosures referred to in subclause 8A (1) of the SRD SEPP are made in respect to an application. For State Significant Development where such objections and disclosures are not made the Minister for Planning is the consent authority (section 4.5(a) of the EP&A Act).

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Part 3 of the Mining SEPP requires specific matters to be considered in relation to development applications for applications that will affect existing or proposed mining operations. These requirements are set out below, and the section of the SEE in which each matter is addressed is shown in bold, where relevant.

Clause 12AB of the Mining SEPP identifies non-discretionary development standards for mining that if complied with, prevents the consent authority from requiring more onerous standards for those matters (however does not prevent the consent authority granting consent even though any such standard is not complied with). The prescribed criteria are summarised below in italics, with the relevant assessment outcomes noted below each criteria in normal type.

Cumulative Air Quality

The development does not result in a cumulative annual average level greater than 25 µg/m³ of PM10 or 8 µg/m³ of PM2.5 for private dwellings.

The Proposed Modification involves the progression of mining further from residences and other sensitive receivers than existing approved operations and will not result in any increases in production or significant changes in areas of disturbance relative to the approved operations. Additionally the Proposed Modification does not seek any change to the approved mine life. A qualitative air quality review (refer to **Section 6.1**) has been undertaken for the proposed modification which confirms that the proposed modification can be undertaken within the existing air quality criteria under DA 80/952. The proposed modification will not increase cumulative impacts relative to the current approved operations, refer to **Section 6.1.1** for further detail.

Cumulative Noise Level

The development does not result in a cumulative amenity noise level greater than the recommended amenity noise levels, as determined in accordance with Table 2.2 of the Noise Policy for Industry, for residences that are private dwellings.

The Proposed Modification meets all relevant noise criteria as outlined in DA 80/952 and Table 2.1 of the NSW Industrial Noise Policy (EPA 2000) (INP) as detailed in **Section 6.2**.

Airblast Overpressure

Airblast overpressure caused by the development does not exceed:

- (a) 120 dB (Lin Peak) at any time, and*
- (b) 115 dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months,*

Blasting activities associated with the Proposed Modification will continue to be designed such that the criteria as outlined above will not be exceeded.

Ground Vibration

Ground vibration caused by the development does not exceed the following at any private dwelling or noise sensitive receiver:

- (a) 10 mm/sec (peak particle velocity) at any time;*
- (b) 5 mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months*

Blasting activities associated with the Proposed Modification will continue to be designed such that the criteria as outlined above will not be exceeded.

Aquifer Interference

Any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified in item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy (AIP) for each relevant water source listed in column 1 of that table.

The Proposed Modification does not exceed Level 1 minimal impact consideration under the AIP. The Swamp Creek alluvium is not considered to be highly productive as the alluvium has limited saturated thickness, or is dry, and also contains brackish to saline groundwater (TDS > 1500 mg/L).

A summary of the results of the Groundwater assessment in relation to the minimal harm criteria for both the alluvial and hard rock water sources relevant to the Proposed Modification is provided in **Section 6.3**.

12 Compatibility of proposed mine, petroleum production or extractive industry with other land uses

Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider:

- i) the existing uses and approved uses of land in the vicinity of the development, and*
- (ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
- (iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*
- (b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and*
- (c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).*

The Glendell Mine forms part of the Mount Owen Complex which has been coexisting with neighbouring land uses, with mining at the Mount Owen Complex dating back to the early 1960s. The surrounding land use is largely dominated by other mining operations and the Proposed Modification has been designed with consideration of maintaining minimal environmental impact and compatibility with surrounding land uses. The compatibility of the approved operations and the Proposed Modification with the surrounding land uses is considered in more detail in **Section 3.2** and **Section 6.0**.

12A Consideration of voluntary land acquisition and mitigation policy

(2) Before determining an application for consent for State significant development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider any applicable provisions of the voluntary land acquisition and mitigation policy and, in particular:

(a) any applicable provisions of the policy for the mitigation or avoidance of noise or particulate matter impacts outside the land on which the development is to be carried out, and

(b) any applicable provisions of the policy relating to the developer making an offer to acquire land affected by those impacts

DA 80/952 (as modified) predates the original Voluntary Land Acquisition and Mitigation Policy (NSW Government 2014) (VLAMP). The current VLAMP (2018) *applies to:*

Modification applications that involve increases to the approved dust or noise impacts of a development

It is considered that the air quality and noise impacts associated with the Proposed Modification are consistent with the approved operations and therefore the VLAMP does not apply. Therefore the current acquisition and mitigation conditions under DA 80/952 (refer to **Appendix 2**) will continue to apply to the development as modified, which include:

13 Compatibility of proposed development with mining, petroleum production or extractive industry

Clause 13 requires the consent authority to consider development on land that is, immediately before the application is determined:

(a) in the vicinity of an existing mine, petroleum production facility or extractive industry, or

(b) identified on a map (being a map that is approved and signed by the Minister and copies of which are deposited in the head office of the Department and publicly available on the Department's website) as being the location of State or regionally significant resources of minerals, petroleum or extractive materials, or

(c) identified by an environmental planning instrument as being the location of significant resources of minerals, petroleum or extractive materials

And before determining an application to which the clause applies the consent authority must consider:

(i) the existing uses and approved uses of land in the vicinity of the development, and

(ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and

(iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and

(b) evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).

The Proposed Disturbance Area will be located entirely within existing Glencore mining tenements. The geology is well understood and the mine plan design has been chosen to minimise the potential environmental impact associated with the proposed mining operations, additionally the mining operation will continue to utilise the existing mine infrastructure.

The Proposed Modification is unlikely to impact on the potential for viable petroleum production from within the Mount Owen Complex as the deeper coal seams typically targeted for petroleum production will not be impacted by the operations at Glendell Mine. The Proposed Modification will not adversely impact on any known extractive material resources and is considered compatible with the current and future use of the land.

14 Natural Resource Management and Environmental Management

Clause 14 of the Mining SEPP requires the consent authority to consider whether the consent should be issued subject to conditions aimed at ensuring the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:

- (a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
- (b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
- (c) that greenhouse gas emissions are minimised to the greatest extent practicable.*

Clause 14 also states that a consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or National policies, programs or guidelines concerning greenhouse gas emissions.

The Glendell Mine will continue to operate in accordance with the existing approved Greenhouse Gas and Energy Efficiency Plan to ensure Glendell Mine continues to meet all statutory requirements in accordance with Schedule 3 condition 51 of DA 80/952.

Clause 14(3) also states without limiting subclause (1), in determining a development application for development for the purposes of mining, the consent authority must consider any certification by the Chief Executive of the Office of Environment and Heritage or the Director-General of the Department of Primary Industries that measures to mitigate or offset the biodiversity impact of the proposed development will be adequate.

The proposed offset strategy is outlined in **Section 6.5**.

15 Resource Recovery

Clause 15 of the Mining SEPP requires the consent authority to have regard to the efficiency of a proposed mining development in terms of its ability to optimise extraction of the target reserves.

The proposed mining area has been designed for efficient extraction of additional resources, restricting the impact to Swamp Creek alluvium and provide for the continuity of mining operations at the Glendell Mine pending the determination of the development application for the GCOP.

16 Transport

Clause 16 requires the consent authority to consider whether or not the mining development under consideration should be subject to conditions restricting the use of public roads for product transport or other mining related traffic.

All product coal from the Mount Owen Complex will continue to be transported to the Port of Newcastle by rail. ROM coal is also able to be transported to Liddell Coal Operations and/or Bayswater and Liddell power stations on an as required basis via the existing conveyor.

17 Rehabilitation

Clause 17 of the Mining SEPP requires a consent authority determining a development application for a mining development to have regard to whether or not to impose specific conditions regarding the rehabilitation of land affected by the proposed mining development.

As described in **Section 2.0**, the mining and overburden emplacement areas will continue to be progressively rehabilitated as the proposed mining operations progress and the Glendell Mine will implement the proposed conceptual final landform, should the GCOP not proceed. The Mount Owen Complex infrastructure areas will be rehabilitated as part of the applicable closure process following completion of mining operations under SSD-5850. The Mount Owen Rail Line will be rehabilitated if no other appropriate future use is identified.

Part 4AA Mining and Petroleum Development on Strategic Agricultural Land

Part 4AA of the Mining SEPP provides for the consideration of the NSW Government's Strategic Regional Land Use Plan (SRLUP) and the gateway process. The gateway process applies to proposed development located within Biophysical Strategic Agricultural Land (BSAL) and Critical Industry Clusters (CIC) (as defined by the regional mapping presented in the Upper Hunter SRLUP) outside of existing lease areas.

At a regional scale, the Proposed Disturbance Area is mapped as Biophysical Strategic Agricultural Land (BSAL) (Upper Hunter Strategic Regional Landuse Plan 2012) however, the Proposed Disturbance Area is subject to an existing Mining Lease and no further mining leases are required in relation to the Proposed Modification, therefore no further assessment is required.

State Environmental Planning Policy No 33 – Hazardous and Offensive Development

SEPP 33 requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A hazard assessment is completed for potentially hazardous development to assist the consent authority to determine acceptability.

The Proposed Modification will not result in any changes to the Approved Operations which are not considered hazardous or offensive, therefore no further consideration of SEPP 33 is required.

State Environmental Planning Policy No 44 – Koala Habitat Protection

SEPP 44 restricts a Council from granting development consent for proposals on land identified as core koala habitat without preparation of a plan of management. Singleton LGA is listed in Schedule 1 of SEPP 44 and therefore the SEPP applies to the Proposed Modification.

A Biodiversity Development Assessment Report has been prepared (refer to **Section 6.6**), which concludes that the koala is not predicted to occur within the proposed disturbance area. Therefore it is unlikely that the koala would be impacted by the Proposed Modification and the requirement for the preparation of a koala plan of management does not apply.

State Environmental Planning Policy No 55 – Remediation of Land

SEPP 55 aims to provide a state-wide planning approach to the remediation of contaminated land and to reduce the risk of harm to human health and the environment by consideration of contaminated land as part of the planning process. Under SEPP 55, a consent authority must not consent to the carrying out of development on land unless it has considered any potential contamination issues.

There are no contaminated sites currently recorded within the Glendell Mine. Activities carried out at the Glendell Mine which have the potential to cause contamination are appropriately managed and any contamination of the land will not affect the suitability of the site for operating as a mine.

3.3.4 Upper Hunter Strategic Regional Land Use Plan 2012

The Upper Hunter SRLUP requires the assessment of impacts from mining and coal seam gas development on land identified as being strategic agricultural land. There are two types of strategic agricultural land identified in the Upper Hunter SRLUP, BSAL and CICs. As discussed in **Section 3.3.3**, at a regional scale, part of the Proposed Disturbance Area is mapped as BSAL, however, the Proposed Disturbance Area is subject to an existing Mining Lease and no further mining leases are required in relation to the Proposed Modification, therefore no further assessment is required.

The Upper Hunter SRLUP also requires all development applications for mining development that is State Significant Development, and which would potentially impact on agricultural resources and industries, to be accompanied by an Agricultural Impact Statement (AIS). The Proposed Disturbance Area (12 ha) immediately adjoins the existing approved mining area at the Glendell Mine and has been designed to avoid the mapped extent of the Swamp Creek alluvium. It is therefore considered that the Proposed Modification will not have a significant impact on agricultural land uses relative to the approved operations and no further assessment is warranted.

3.3.5 NSW Aquifer Interference Policy

The AIP clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation, and establishes and objectively defines considerations in assessing and providing advice on whether more than minimal impacts might occur to a key water-dependent asset.

The AIP requires that, where mining will result in a loss of water from an overlying source covered by a water sharing plan (WSP), a water access licence is required under the *Water Management Act 2000* (WM Act) to account for this loss of water. In addition, the AIP requires proponents of mining projects seeking development consent under Part 4 of the EP&A Act to provide estimates of all quantities of water likely to be taken from any water source during and following cessation of the activity, and all predicted impacts associated with the activity. Potential groundwater impacts associated with the Proposed Modification are discussed in **Section 6.3**.

The AIP requires that potential impacts of the Proposed Modification on groundwater sources, including groundwater users and groundwater dependent ecosystems (GDEs), be assessed against the minimal impact considerations. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The groundwater assessment indicates the Level 1 minimal impact considerations will not be exceeded (refer to **Section 6.3**).

3.3.6 Other State Legislation

The Proposed Modification will also be subject to a number of separate regulatory approval processes if approved. As an existing operation, a number of the additional approvals required are already held; however, some will require variation as a result of the Proposed Modification.

Under State Significant Development, the assessment and approval process for a number of these approvals is aligned with the development application assessment process under Part 4. Section 4.42 of the EP&A Act requires that a number of approvals, if required for a State Significant Development, must be granted consistent with the terms of any development consent granted for the development. Section 4.41 of the EP&A Act removes the requirement for a number of approvals for approved State Significant Developments. The approval requirements under Sections 4.41 and 4.42 of the EP&A Act are included in **Table 3.4**.

Table 3.4 Other Relevant State Legislation

Act	Comment	Further Approval or Assessment Required?
Approval which does not apply (Section 4.41)		
Fisheries Management Act 1994	A permit under section 201 (dredging or reclamation work), s. 205 (harming marine vegetation) or s. 219 (blocking of fish passage).	No
Heritage Act 1977	An approval under Part 4 (effect on interim heritage orders and listing on State Heritage Register), or an excavation permit under section 139 (disturbance or excavation of relic) and Division 8 Part 6 of the Act.	
National Parks and Wildlife Act 1974	An Aboriginal heritage impact permit (AHIP) under s. 90 (Aboriginal Heritage Impact Permit).	
Rural Fires Act 1997	A bushfire safety authority under section 100B (bushfire safety authority).	
Water Management Act 2000	A water use approval under section 89; a water management work approval under section 90; an activity approval (other than an aquifer interference approval) under section 91.	
Approvals Legislation to be applied Consistently with Development Consent (Section 4.42)		
Mine Subsidence Compensation Act 1961 (MSC Act)	An approval under section 15 from the NSW Mine Subsidence Board (MSB) for development within a mine subsidence district.	No
Fisheries Management Act 1994	An aquaculture permit under section 144. An aquaculture permit will not be required for the Proposed Modification.	No
Mining Act 1992 (Mining Act)	Mining operations will be undertaken within existing mining leases. The Mining Act requires all mining operations be subject to a Mining Operations Plan (MOP) approved by the NSW Resources Regulator. The relevant MOP will be updated to include the revised mine plans.	Yes
Protection of the Environment Operations Act 1997 (POEO Act)	The POEO Act regulates pollution to the environment and requires licences for environmental protection including waste, air, water and noise pollution control. Coal mining and coal works are scheduled activities which require licensing under the POEO Act. The existing Environment Protection Licence (EPL12840) for the approved operations is considered adequate for the Proposed Modification.	No
Other State Legislation relevant to the Proposed Modification		
Biodiversity Conservation Act 2016 (BC Act)	State Significant Development (SSD) requires assessment under the Biodiversity Assessment Method (BAM) under the BC Act. A Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the BAM (refer to Section 6.5).	Yes

Act	Comment	Further Approval or Assessment Required?
<i>Crown Lands Act 1989</i> (Crown Lands Act)	The Crown Lands Act provides for the administration and management of Crown land in the eastern and central divisions of NSW. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the <i>Crown Land (Continued Tenures) Act 1989</i> . There is no crown land, including crown roads, within the Proposed Disturbance Area.	No
<i>Dams Safety Act 1978</i> (Dams Safety Act)	The Dams Safety Act requires that the NSW Dams Safety Committee (DSC) periodically review large dams that may constitute a hazard to human life and property. These dams are known as prescribed dams and are listed in Schedule 1 of the Dams Safety Act. Any new prescribed dams are to be designed to the satisfaction of the DSC. No new dams are required for the Proposed Modification.	No
<i>Explosives Act 2003</i> (Explosives Act)	A licence is required for the storage of explosives on site. The Explosives Act is administered by WorkCover NSW. Mount Owen's explosives contractor holds the relevant licence to possess and store explosives at the Mount Owen Complex, including Glendell Mine. There will be no change in the quantities of explosive materials as a result of the Proposed Modification.	No
<i>Environmentally Hazardous Chemicals Act 1985</i> (EHC Act)	Under the EHC Act, a licence is required for any storage, transport or use of prescribed chemicals. Should such a licence be required under this Act during the life of the Proposed Modification, Mount Owen, or the relevant contractor, will obtain a licence prior to the storage, transport or use of prescribed chemicals.	If required
<i>Water Management Act 2000</i> (WM Act)	The Water Sharing Plan (WSP) for the Hunter Unregulated and Alluvial Water Sources 2009 (in force under the WM Act) applies to the surface waters and alluvial groundwater of Bowmans Creek (Jerrys Water Source) and its catchments. The WSP for the North Coast Fractured and Porous Rock Groundwater Sources 2016 applies to the coal measure aquifers relevant to the Glendell Mine under the WM Act. Relevant consideration is required for impacts on surface water, in particular Bowmans Creek, Swamp Creek and Bettys Creek which, as outlined above, are all regulated within the framework of the WM Act. A WSP indicates that water extraction and interference licensing is required to account for any water loss over the life of the mine and until such time as those losses are negated. Mount Owen currently hold sufficient licences to meet the water requirements associated with the Proposed Modification. Approval will not be required under sections 89, 90 or 91 of the WM Act due to the exemptions outlined under Section 4.41 of the EP&A Act.	No

4.0 Consultation

Targeted consultation suited to the nature and scale of the Proposed Modification has been undertaken with relevant Government Authorities and the community.

4.1 Government Authority Consultation

Table 4.1 provides a summary of the engagement undertaken with the relevant government authorities.

Table 4.1 Government Authority Consultation

Government Authority	Engagement Undertaken
DPE	Initial briefing in August 2018 to provide an overview of the Proposed Modification, intended approval pathway under section 4.55(1A) of the EP&A Act and intended level of assessment.
Dol Water	Dol Assessment and Compliance officers visited the Mount Owen Complex in August 2018, inspecting the approved operations and the proposed disturbance area Dol water provided specific advice regarding the scope of the Groundwater Assessment
Singleton Council	Briefing in October 2018 to provide an overview of the Proposed Modification

4.2 Community Consultation

Mount Owen has an ongoing community engagement program which includes regular engagement with both individuals and groups from the local and regional communities via a range of mechanisms including:

- regular newsletters (biannual) to update the community on the existing operations and Mount Owen Complex initiatives,
- face to face meetings with individuals and/or groups as required/requested, including any meetings required in response to complaints, and
- regular meetings (2 per year) with the Mount Owen Complex Community Consultative Committee (CCC). The Mount Owen Complex CCC comprises 8 community representatives, one Singleton Council representative and Mount Owen representatives, and is periodically attended by State government agency representatives.

Given the minor nature of the Proposed Modification, specific consultation with the community included:

- Notification of the Proposed Modification through inclusion in the Greater Ravensworth Newsletter (Winter 2018 edition), distributed to surrounding landholders and published on the Mount Owen Complex website.
- Notification of the Proposed Modification at the Mount Owen CCC meeting 11 October 2018.

5.0 Proposed Modification Rationale

The Proposed Modification has been designed to ensure an appropriate balance between providing for operational timeframe contingencies and avoiding and minimising potential environmental impacts relative to the approved operations. The design of the Proposed Modification focused on:

- maximising reserve recovery while minimising the overall Proposed Disturbance Area as far as practicable as well as providing for additional economic life of the Glendell Mine; and
- minimising the Proposed Disturbance Area as far as practicable

Further detail regarding the refinement of the proposed disturbance area and other alternatives considered during the Proposed Modification design are discussed below.

5.1.1 Proposed Disturbance Area

The extent of the Proposed Disturbance Area has been designed to provide for the extraction of additional coal reserves and provides for:

- separation from Swamp Creek and the associated alluvium to minimise the potential groundwater impacts associated with the Proposed Modification relative to the approved operations
- reduction of the approved disturbance area (approximately 15.5 ha) on the eastern boundary
- utilisation of existing infrastructure with only minor additional water management infrastructure required
- provision of adequate disturbance area around the proposed extent of mining to enable the development of essential access and infrastructure corridors including water management structures.

As discussed in **Section 3.2.2**, Mount Owen has undertaken detailed geophysical survey to map the extent of the Swamp Creek alluvium. The alluvium mapping has guided the design of the extent of the Proposed Disturbance Area to allow a separation between the proposed mining area and the Swamp Creek alluvium (refer to **Figure 3.6**).

As discussed in **Section 2.2**, the proposed disturbance area has been located in an area of relatively low biodiversity value, resulting in a relatively small area of disturbance to native vegetation. Additionally a 15.5 ha area located to the southeast of the Barrett Pit that was approved for disturbance under DA 80/952 will no longer be disturbed. Mount Owen has redesigned the Proposed Disturbance Area to remove this area resulting in a net decrease (3.5ha) in the overall disturbance area associated with the Glendell Mining operations.

The Proposed Modification requires only minor amendments to the approved Barrett Pit mine plan and associated minor ancillary infrastructure, including water management infrastructure. Mining operations (as modified) will continue utilising all existing Mount Owen Complex infrastructure with no significant infrastructure construction required. Minor modification to the water management infrastructure within the Proposed Disturbance Area will be required, however there is minimal additional disturbance associated with these works.

5.1.2 Conceptual Mine Plan Development

The Proposed Modification has been designed to implement early mine plan changes in order to provide the following:

- Implementation of mine plan refinements to provide for improved mining efficiencies (including implementation of the western haul road);
- efficient progression of the proposed mining under the GCOP (should it be approved)
- progression of mining pending the determination of the GCOP; and
- an additional approximately 8 months of mining should the GCOP not proceed.

The design of the proposed mining area has been undertaken in consideration of restricting the environmental impact of the Proposed Modification as far as practicable, consistent with the predicted impacts associated with the approved operations.

The proposed mining area has been designed to reduce the potential environmental impact associated with the Proposed Modification, particularly in relation to Swamp Creek alluvium, without the need for further mitigation measures. The amendments also provide for changes to the mine plans to be incorporated as mining progresses that will provide for the efficient continuation of mining proposed under the GCOP.

Mount Owen has also sought to restrict any impact associated with the proposed mining operations on surrounding sensitive receivers particularly in relation to air quality and noise impacts. The proposed mining operations will progress in a northwest direction away from the closest sensitive receivers. No changes are proposed to the current approved mine life, mining methods, extraction limits, processing rates, transportation methods or hours of operation.

5.1.3 Alternative of not proceeding with the Proposed Modification

Mount Owen is seeking a minor extension to the approved mining area at Glendell Mine in order to access an additional approximately 2.5 Mt ROM Coal. This will provide for an additional approximately 8 months of mining operations, and continuity of mining operations and continuity of workforce employment beyond the current scheduled mining operations, pending the determination of the GCOP. Mine plan refinements in the Barrett pit will facilitate efficient progress into the planned Glendell Pit Extension area, should the GCOP be approved. It should be noted that should the GCOP not be approved, the proposed conceptual final landform as shown in **Figure 2.3**, being consistent with the currently approved conceptual final landform, would be achievable. A care-and-maintenance strategy would be implemented while options for the future mining of the coal resource would be further considered, and preparation of a detailed mine closure planning process would be undertaken.

Not progressing with the Proposed Modification could result in the Glendell Mine being required to cease operations prior to the end of the currently approved mine life (2024), which would put at risk the prospect for continued employment for the existing Glendell Mine workforce (up to 150 employees) which in-turn would have detrimental social impacts and flow on economic impacts in the local and regional economies.

The Glendell Mine is approved to operate until 2024 and the Proposed Modification does not propose any increase to the current approved mine life, additionally the predicted environmental impacts associated with the Proposed Modification are generally consistent with the currently approved operations.

6.0 Environmental Assessment

Table 6.1 identifies the key environmental issues that are relevant to the Proposed Modification and identifies where further assessment has been required considering the potential impact of the Proposed Modification relative to the approved operations. Where aspects have been identified as requiring further detailed assessment, this is outlined in the following sections including detailed technical studies, where relevant, provided as appendices to this report.

Table 6.1 Potential environmental impacts associated with the Proposed Modification and further assessment required

Aspect	Environmental Assessment	Further Assessment Required?
Air Quality	The Proposed Modification does not involve any activity that will change the nature of air quality impacts at Glendell Mine, relative to the approved operations. A qualitative assessment of air quality impacts associated with the Proposed Modification has been undertaken.	Yes, refer to Section 6.1 and Appendix 3
Noise	The revisions to the Glendell Mine plan including the increased disturbance area and minor changes to overburden emplacement has the potential to change the noise emissions generated by the Proposed Modification relative to Approved Operations.	Yes, refer to Section 6.2
Groundwater	The revised mine plan proposes a minor extension to the currently approved mining area which has the potential to impact the groundwater regime. Additionally, proposed mining will occur closer to the alluvium associated with Swamp Creek.	Yes, refer to Section 6.3 and Appendix 4
Surface Water	The Proposed Modification will result in only minor changes to the interaction of the mining operation with surface water. Minor changes are proposed to the existing water management system associated with the proposed disturbance area and additional management in relation to flooding.	Yes, refer to Section 6.4
Ecology	The Proposed Modification will result in the disturbance of an additional 12 ha of land requiring further assessment of potential impacts on threatened fauna species, flora species and vegetation communities, in accordance with BAM under the BC Act.	Yes, refer to Section 6.5 and Appendix 5
Aboriginal Archaeology	The Proposed Modification has the potential to impact on Aboriginal Archaeology as a result of the disturbance of an additional 12 ha of land. A due diligence assessment has been undertaken to support the Proposed Modification.	Yes, refer to Section 6.6 and Appendix 6
Mine Closure and Final Rehabilitation	The proposed modification will result in minor changes to the design of the approved conceptual final landform.	Yes Refer to Section 6.7
Economic	Employment generated through the approved operations at the Glendell Mine since mining commenced in 2008 has had significant economic flow on effects in the local and regional communities. In addition, substantial industry expenditure through service and supply contracts associated with the Mount Owen Complex occurs locally, primarily within Singleton and Muswellbrook, but also filters to the broader Hunter and NSW region.	No

Aspect	Environmental Assessment	Further Assessment Required?
	The Proposed Modification will provide for the extraction of an additional approximately 2.5Mt ROM Coal (5% of the total approved extraction of approximately 50Mt ROM Coal). The additional coal extraction (whilst considered minor in comparison to the approved operations) will generate economic benefits to the NSW region and royalties to the NSW Government in addition to that generated by currently approved mining. Although the scale of the extraction associated with the Proposed Modification is limited, significant economic benefit to the local and broader Hunter economy will occur through providing greater certainty regarding the continuation of the employment of the existing Glendell Mine employees (around 300 FTE) for an additional approximately 8 months, and the associated economic flow-on effects. Economic efficiencies will also be achieved in relation to the GCOP through the continuation of the existing operations and implementation of early mine plan refinements to provide for efficient advancement of mining should the GCOP be approved.	
Social Impacts	The original Glendell Mine approval was supported by a social impact assessment. Although there has been substantial changes to the locality since the time of approval, it is considered that any potential social impacts associated with the Proposed Modification would not be new or significantly different (in terms of scale and intensity) to those approved under the existing consent. Subsequently there will be minimal potential for any additional impact to the local community as a result of the Proposed Modification. In contrast, the greatest potential for social impacts would result from the potential early cessation of mining at the Glendell Mine prior to commencement of mining proposed under the GCOP. Subsequently, the Proposed Modification provides a mitigation strategy against the significant social impacts that could result from a discontinuity in mining production at the Glendell Mine pending the determination of the development application for the GCOP. Mount Owen maintains an ongoing Complaints Register to record all community complaints, investigations and outcomes. The Complaints Register is available to the public via the Mount Owen Complex website at www.mtowencomplex.com.au. Mount Owen records all relevant contact with the community via the complaints line even if an investigation concludes that the mine's activities remain in compliance with development consent (and other regulatory) limits or the reported instance is not able to be attributed to the Approved Operations. Mount Owen has a number of existing strategies in place which will continue to address the potential impacts of the continued operations at the Glendell Mine. Mount Owen also has a Stakeholder Engagement Strategy that outlines how and when they communicate with stakeholders, including their directly impacted neighbours. This document is reviewed annually and revised in response to community feedback. The Mount Owen Complex Stakeholder Engagement Strategy is available on the Mount Owen Complex website www.mtowencomplex.com.au/en/community/documents. Every 3 years Glencore undertake a detailed community survey, and the findings of that survey along with the annual review of the Stakeholder Engagement Strategy, will inform future operational and community engagement for the operations at the Mount Owen Complex.	No

Aspect	Environmental Assessment	Further Assessment Required?
Blasting	There will be no change to the blasting practices currently undertaken within the Barrett Pit. Additionally, there will be no significant change in the location of blasting as a result of the Proposed Modification relative to the approved operations or relative to sensitive receivers. As a result, no detailed blast impact assessment has been undertaken. Blasting activities within the Barrett Pit will continue to be managed under the existing Blast Management Plan to ensure there is no exceedance of current blast impact criteria. A review of the most recent (2016/2017) Annual Review, indicates that Glendell Mine has complied with the relevant ground vibration and airblast overpressure impact criteria from DA 80/952. As part of operational procedures, Mount Owen will continue to undertake regular high wall monitoring generally consistent with the current Principle Hazard Management Plan Ground or Strata Failure, developed in accordance with the Work Health and Safety (Mines and Petroleum) Regulation 2014) in order to monitor any potential impact of blasting on Swamp Creek and the associated alluvium.	No
Agricultural Resources	The Proposed Mining Area immediately adjoins the existing approved mining area at the Glendell Mine. Given the close proximity of Swamp Creek a small area within the Proposed Disturbance Area (12 ha) has been mapped as BSAL, at a regional scale. However, the Proposed Disturbance Area is located wholly within existing mining leases which provide for the proposed future mining operations associated with the Proposed Modification. Therefore in accordance with the Mining SEPP, no further assessment is required. Based on this, and the small area of additional proposed disturbance, it is considered that the Proposed Modification will not have a significant impact on agricultural land uses relative to the approved operations and no further assessment is warranted.	No
Traffic and Transport	Given there will be no significant construction or increase in the operational workforce as part of the Proposed Modification, traffic levels are anticipated to continue to be similar to current approved traffic levels and no additional impact is anticipated to traffic conditions or road service levels as a result of the Proposed Modification. The original traffic impact assessment undertaken in 2007 to support the approved operations concluded that the existing level of service of Hebden Road was not expected to be significantly impacted by the Approved Operations, this included consideration of the Ravensworth East and Mount Owen Mine workforce which was in operation at the time. More recently, a detailed Traffic Impact Assessment was undertaken to assess the road traffic impacts associated with the Mount Owen Continued Operations Project which considered the traffic generation associated with the Glendell Mine. The Mount Owen Continued Operations Project was not expected to result in unacceptable traffic conditions or road service levels. In addition, the construction of the new dual lane bridge over Bowmans Creek and rail overpass over the Main Northern Rail Line on Hebden Road, approved under SSD-5850, was considered to provide improvements to road service levels and safety to all traffic associated with the Mount Owen Complex, included traffic generated by Glendell Mine.	No

Aspect	Environmental Assessment	Further Assessment Required?
Historic Heritage	No historic heritage sites/items with statutory heritage listings are located within the DA 80/952 consent boundary. In addition, none of the identified listed heritage items within the vicinity of the Mount Owen Complex have been found to be directly impacted as part of the Approved Operations as part of detailed assessments undertaken for the original approval and the most recent assessment to support the Mount Owen Continued Operations Project. Based on this it is considered that the Proposed Modification will not have a significant impact on any historic heritage sites or items.	No
Greenhouse Gas and Energy	The Proposed Modification provides the potential for Glendell Mine to generate additional greenhouse gas emissions from energy use and fugitive emissions. The recovery and processing of an additional 2.5 million tonne of ROM Coal is expected to release fugitive emissions, and increase the demand for diesel and electricity relative to the approved operations. The Greenhouse Gas and Energy Assessment (GHGEA) completed to support the Approved Operations, found Glendell Mine may (HAS, 2007): • release approximately 2,821,000 t CO₂-e Scope 1 and 2 emissions • be associated with approximately 83,611,000 t CO₂-e Scope 3 emissions The Proposed Modification provides the potential for: • the consumption of approximately 17,750 kL of diesel • the consumption of approximately 645 GJ of electricity • the generation of approximately 184,000 t CO₂-e Scope 1 and 2 emissions • the generation of approximately 3,990,000 t CO₂-e Scope 3 emissions (not directly associated with Glendell Mine) In order to manage the potential greenhouse gas emissions associated with the Proposed Modification Glendell Mine will continue to operate in accordance with the existing Greenhouse Gas and Energy Efficiency Plan, subject to Schedule 3, condition 51 of DA 80/952. The approved Greenhouse Gas and Energy Efficiency Plan outlines the greenhouse gas and energy efficiency controls applicable to the Glendell mining operations and ensures Glendell Mine meets all statutory requirements. The approved Greenhouse Gas and Energy Efficiency Plan will be reviewed and updated as required should the Proposed Modification be approved.	No
Waste Management	The Proposed Modification is not expected to generate any additional waste streams or increase annual waste volumes relative to the Approved Operations. The Glendell Mine will continue to be included in the Mount Owen Complex approved Waste Management Program, in addition, the existing tailings and coarse rejects management strategy will continue to be implemented.	No

Aspect	Environmental Assessment	Further Assessment Required?
Hazards	Mount Owen currently uses a range of hazardous substances on site for its mining operations and coal processing. This includes the utilisation of explosive materials which are supplied by an external contractor. Mount Owen hold the relevant dangerous goods licences required for the storage of explosive materials located at the Glendell Mine. The storage quantities of explosive materials will not change as a result of the Proposed Modification. Other hazardous materials stored on site are managed by Mount Owen in accordance with the existing hazard management system which ensures that those current risks posed to surrounding land users are managed. Should any new hazardous substances or dangerous goods be introduced to the site, they will be identified and managed in accordance with the existing procedures and management plans.	No
Bushfire	No significant infrastructure is proposed that would warrant further bushfire threat assessment. Bushfire threat at the Glendell Mine will continue to be managed in accordance with the bushfire management controls included in the approved Mount Owen Complex Bushfire Management Plan, which will continue to be reviewed and updated as required, in consultation with the Rural Fire Service (RFS).	No

6.1 Air Quality

The Proposed Modification does not involve any activity that will change the nature of air quality impacts at the Glendell Mine, relative to the approved operations. Jacobs Group (Australia) Pty Limited (Jacobs) has completed a review of the potential air quality impacts associated with the Proposed Modification. A qualitative approach to the assessment of potential air quality impacts is considered appropriate considering:

- The proposed extension to mining operations will progress to the northwest, away from nearby sensitive receivers
- The final modelling year (Year 12 - project only) of the approved Glendell Mine represented lower air quality risk than earlier years, due to the progression of mining to the north away from sensitive receivers; and
- No changes are proposed to the current approved mine life, mining methods, mining extraction rates, processing rates, transportation methods or hours of operation.

The air quality review undertaken by Jacobs involved:

- Identifying the key aspects of the Proposed Modification that relate to air quality;
- Characterising the existing air quality environment; and
- Determining the likely effect of the Proposed Modification on local air quality, with regard to the existing effects of the Approved Operations.

6.1.1 Air Quality Criteria

The air quality assessment criteria applicable to the approved operations under DA 80/952, are consistent with the approved methods for the modelling and assessment of air pollutants in NSW (DEC 2005). The relevant air quality criteria in accordance with Schedule 3, Condition 20 of DA 80/952 is provided below.

Impact Assessment Criteria

The applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria listed in Tables 8, 9 and 10 at any residence on privately-owned land, except for the residences shown in Table 1 as being eligible for acquisition on request on the basis of air quality impacts.

Table 8: Long term impact assessment criteria for particulate matter

Pollutant	Averaging period	^a Criterion
Total Suspended Particulate (TSP) Matter	Annual	^a 90 µg/m ³
Particulate Matter < 10 µm (PM ₁₀)	Annual	^a 30 µg/m ³

Table 9: Short term impact assessment criterion for particulate matter

Pollutant	Averaging Period	^a Criterion
Particulate matter <10 µm (PM ₁₀)	24 hour	^b 50 µg/m ³

Table 10: Long term impact assessment criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
c Deposited dust	Annual	^b 2 g/m ² /month	^a 4 g/m ² /month

Notes to Tables 8-10:

- a - total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
- b - Incremental impact (i.e. incremental increase in concentrations due to the development on its own).
- c - Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and analysis of Ambient Air – Determination of Particulate Matter – Deposited Matter – Gravimetric Method.
- d - excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the secretary.

6.1.2 Existing Environment

As discussed in **Section 3.2.1**, the closest private residences to the existing Glendell Mine are located directly to the south within Camberwell, it should be noted that majority of the land within Camberwell is now owned by various mining operations, with the remaining private residences being subject to acquisition rights as a result of the impacts associated with neighbouring mining operations.

Mount Owen has a network of meteorological and ambient air quality monitoring equipment that is used to collect data for supporting the management of daily operations at the Mount Owen Complex. The data are also used for determining compliance against the relevant development consent conditions. **Figure 6.1** shows the locations of the air quality monitoring sites.

The potential air quality impacts associated with the Approved Operations were quantified by Holmes Air Sciences and documented in the Air Quality Impact Assessment: Proposed Glendell Mine Modification to Development Consent (HAS, 2007). HAS 2007 considered monitoring data from 2001 to 2006, collected from the Mount Owen Complex air quality monitoring network. The annual average TSP concentrations ranged between 28 µg/m³ and 79 µg/m³ during the monitoring period (criteria 90 µg/m³) and the annual average PM₁₀ concentrations ranged between 16 µg/m³ and 26 µg/m³ (criteria 30 µg/m³). PM₁₀ 24 hour maximum concentrations were above the relevant 50 µg/m³ criteria on a number of occasions in each year between 2001 and 2006, these exceedances were attributed to a range of sources including other mining activities, traffic on unsealed roads, local building and construction activities, farming, animal grazing and periodic events such as bushfires.

Dust Deposition data within the surrounding areas typically range from 2 g/m²/month to 6 g/m²/month with higher levels measured in proximity to mining areas. Annual average dust deposition levels within proximity to Camberwell measured between 1.9 g/m²/month and 2.0 g/m²/month during 2006 (criteria allowed an increment of approximately 2 g/m²/month (annual average)).

Jacobs recently undertook a detailed review of the current air quality in relation to the Mount Owen Continued Operations Modification 2 (Jacobs, 2018), which is located within the same air-shed as the Glendell Mine. This assessment identified PM₁₀ as one of the key existing air quality issues, based on measured concentrations that have historically approached the assessment criteria noted by the EPA. The outcomes of the review are summarised below:

- There are seasonal variations in particulate matter concentrations, with PM₁₀ levels higher in spring and PM_{2.5} levels higher in winter.
- There are daily variations in particulate matter concentrations, with levels typically highest in the morning and evening.
- In terms of PM₁₀ concentrations, most monitoring sites in the vicinity of Mount Owen Complex have experienced at least one day above the EPA's PM₁₀ 24hr 50 µg/m³ criterion in the past 5 years, but annual averages have complied with EPA criteria for all locations.

- TSP and NO₂ concentrations are below their relevant EPA criteria.
- Deposited dust levels have exceeded EPA criteria at 5 of the 13 monitoring locations on occasion.
- Within the vicinity of Camberwell the PM₁₀ annual average is generally consistent with or greater than the revised PM₁₀ criteria of 25 µg/m³.
- The two closest PM_{2.5} monitoring stations, Camberwell and Singleton, have measured PM_{2.5} concentrations which are close to or have exceeded the EPA criteria. A study by the OEH (2013b) found that wood smoke was one of the main factors that influenced PM_{2.5} concentrations, especially in winter.

Figure 6.2 provides a spatial variation in annual average PM₁₀ concentrations around the Mount Owen Complex, from 2012 to 2016. Note that the 30 µg/m³ criterion has since been revised to 25 µg/m³, PM₁₀ concentrations have complied with the, then applicable, 30 µg/m³ criterion at all Mount Owen monitoring sites. Levels in Camberwell have typically been higher than at other locations and exceeding 25 µg/m³ in two years (2012 and 2013). These measurements will have included all sources which were at some stage upwind of the monitor. The data from Camberwell is represented in a different colour as this monitor is operated by OEH.

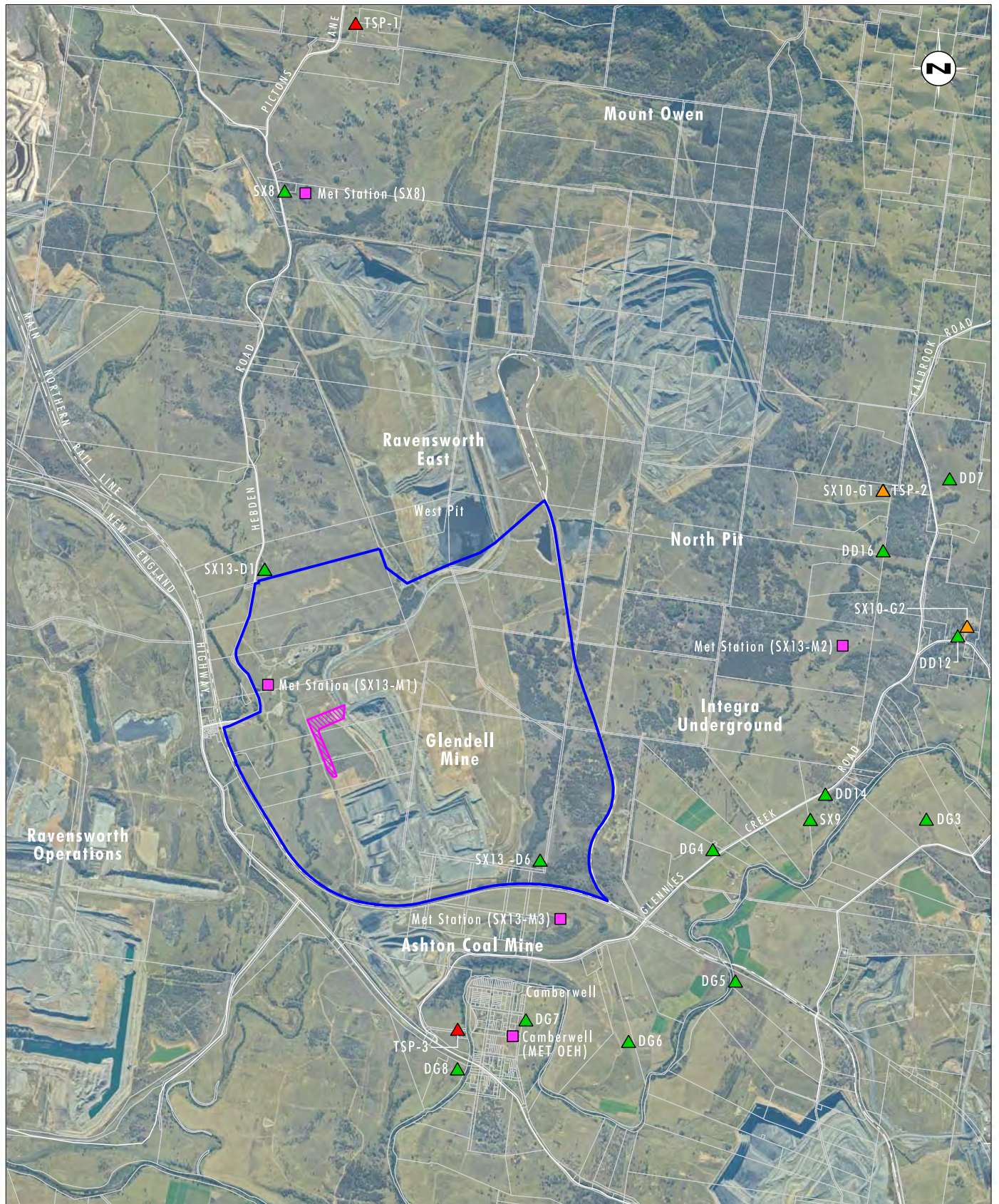


Image Source: Glencore (Jul 2018)

Data Source: Glencore (2018), Department of Finance, Services & Innovation (2018)

0 1.0 2.0 3.0 km
1:60 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Proposed Mining Area
- ▲ Depositional Dust Monitoring Location
- ▲ PM10 Monitoring Location (Continuous)
- ▲ TSP Monitoring Location
- MET Station

FIGURE 6.1

Air Quality Monitoring Network

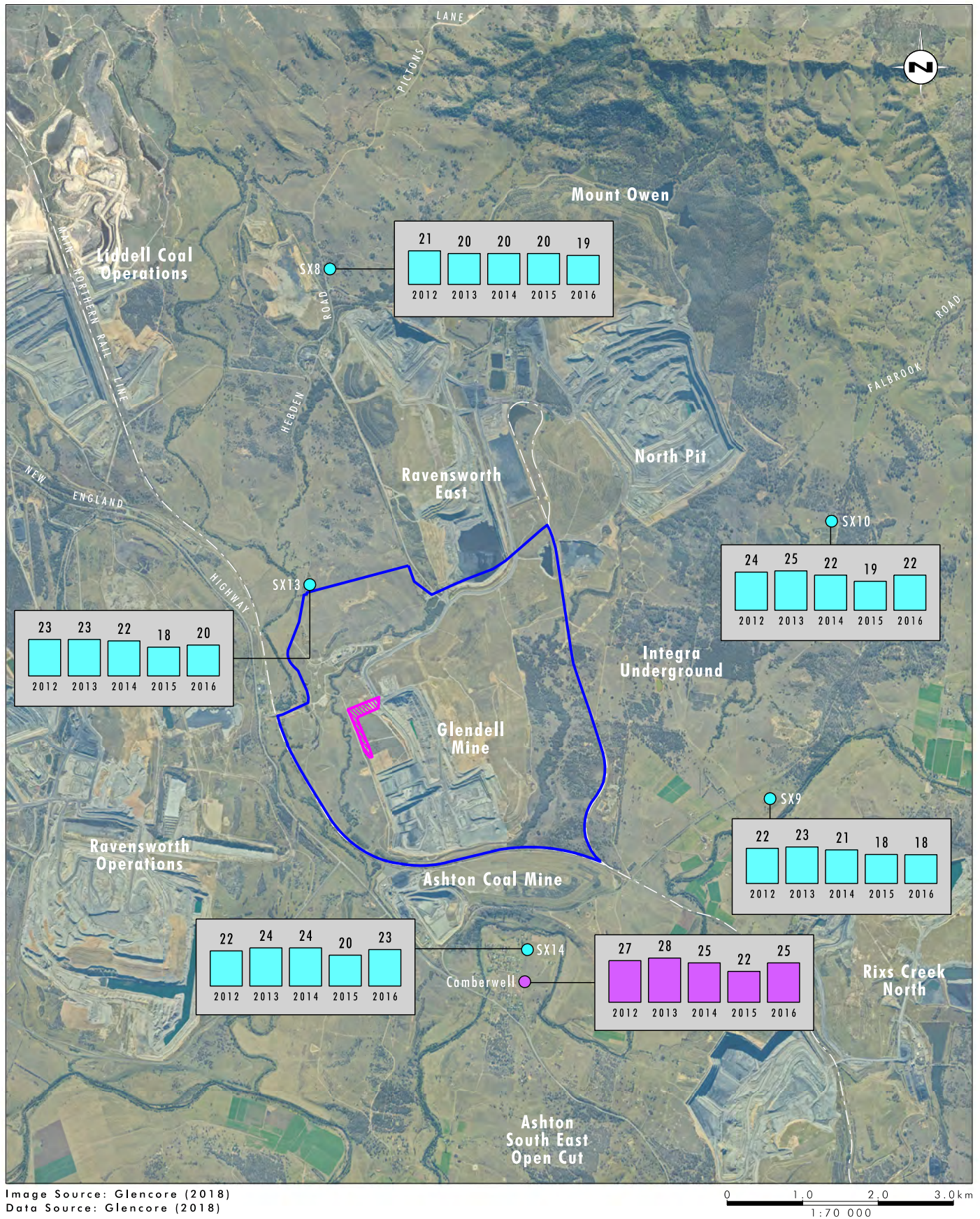


FIGURE 6.2

Spatial Variation Annual Average
PM₁₀ Concentrations (μg/m³)

6.1.3 Air Quality Impact Assessment Overview – Approved Operations

The HAS 2007 assessment utilised computer-based dispersion model to predict ground-level dust concentration and dust deposition levels, due to the potential dust generating activities associated with the Glendell Mining operation. The dispersion modelling considered local meteorology, terrain information and dust emission estimates to predict air quality impacts for 5 representative stages (Years 1.5 (2009/2010), 3(2011), 6 (2014), 9(2017) and 12(2021)) of the Glendell operations. The stages were selected to represent a range of mine production levels and active pit locations, including the mine stages where dust emissions were expected to be highest.

The original model predictions (HAS, 2007) indicated that when the Glendell Mine was considered in isolation:

- There were no private residences predicted to experience maximum 24-hour average PM10 predictions above the 50 µg/m³ criterion for any of the modelled years.
- There were no private residences predicted to experience annual average PM10 predictions above the 30 µg/m³ criterion for any of the modelled years.
- There were no private residences predicted to experience annual average TSP predictions above the 90 µg/m³ criterion for any of the modelled years.
- There were no private residences predicted to experience annual average dust deposition above the 2 g/m²/month (proposed modifications only) criterion.

The project only modelling results indicated that Year 9 (approximately 2017) presented the worst-case stage of mining operations in terms of potential impacts on private residences, due to mining reaching the southern extent of the Barrett pit during this stage, with mining operations located in close proximity to private residences to the southeast of Glendell Mine and within Camberwell. Modelling results indicated that for the Year 12 Stage (approximately 2021) there was a decrease in potential air quality impacts due to mining operations moving in a northerly direction away from private residences in Camberwell. It should be noted that the proposed mining activities will progress further north from the location indicated on the approved Year 12 stage plan, away from private properties located in Camberwell.

Potential cumulative impacts identified in the HAS 2007 modelling, indicated that the contribution from the Glendell Mine was considered to be low, between 1 and 5 µg/m³, decreasing as mining progressed north away from Camberwell Village. One objective of the design of the approved mine plans was to help minimise the potential cumulative air quality impacts in Camberwell, prior to the cessation of other neighbouring mining operations particularly Ashton Coal Mine. Whilst it is acknowledged that the cumulative modelling undertaken considered only contributions from approved mining operations at the time, the majority of which were considered to cease mining prior to completion of mining at Glendell, the contribution from Glendell Mine alone was considered to be low.

The air quality review undertaken to support the Proposed Modification included a review of the most recent (2012-2017) Annual Review, which indicates that Glendell Mine has complied with the relevant air quality impact assessment criteria from DA 80/952.

6.1.3.1 Review of impacts – Proposed Modification

The potential changes to air emissions and potential impacts (i.e. ambient concentrations) associated with the Proposed Modification could result from:

- Changes to haul distances;
- Changes to the extent of exposed areas;
- Changes to the proximity of emission sources to sensitive receptors; and
- Changes to the duration of activities.

The air quality review undertaken to support the Proposed Modification has considered these elements in order to determine whether the Proposed Modification could lead to an increased potential for air quality impacts, relative to the approved operations. **Table 6.2** provides a review of the mining operations, potential changes as a result of the Proposed Modification and resulting effects on emissions and potential air quality impacts.

Table 6.2 Potential Air Quality Effects associated with the Proposed Modification

Element	Proposed Modification	Effects on emissions and potential air quality impacts
Haul road distances	Mining operations will progress in a northerly direction, closer to the main haul road which leads from the Glendell Mine to the ROM pad. The proposed progression of mining will result in haul distances generally consistent with the current Approved Operations. Haul distances from pit to emplacement areas will remain unchanged. Hauling overburden at surface along the western boundary of the mining limit during favourable meteorological conditions will provide for the efficient establishment of the overburden emplacement areas. Alternate arrangements for the haulage of overburden can occur along a western bench within the Barrett Pit (below surface) to assist in managing any potential off-site air quality impacts associated with the Proposed Modification. There will be no change to the machinery used for transporting coal and overburden on haul roads. There will be no change to the hours when machinery transport coal and overburden on haul roads. There will be no change to the quantities of coal and overburden transported on haul roads.	Progression of mining away from sensitive receivers and a reduction in emissions will typically result in a lower potential for off-site air quality impacts. Mining activities and equipment related emissions from vehicles on haul roads will most likely decrease as a result of the shorter haul distance. Utilisation of the western haul road will also reduce overburden haul distances associated with the establishment of the southern end of the overburden emplacement area.
Exposed areas	There will be minimal increase to the extent of exposed areas. There will be progressive rehabilitation of mined areas, consistent with the Approved Operations.	No change to overall site emissions relating to wind erosion from exposed areas.

Element	Proposed Modification	Effects on emissions and potential air quality impacts
Proximity of mining operations to sensitive receivers	Mining will progress in a northwest direction, away from the key sensitive receptor area of Camberwell.	The contribution of emissions from Glendell Mine to air quality in Camberwell is expected to decrease in comparison to the predicted emissions associated with the approved operations, due to the increasing distance between the mine and Camberwell.
Duration of changes	The Proposed Modification will represent an additional approximately eight months of mining.	Emissions from Glendell Mine will be present for an additional approximately eight months, however while mining is currently approved to 2024, the current approved mining operations are expected to cease in July 2022 and the proposed modification will provide for mining operations until end of Q1 2023. Therefore, there will not be an extension to approved mine life.

From this information it has been concluded that the changes due to the Proposed Modification are unlikely to result in an increase in air quality impacts relative to the approved operations.

6.1.4 Management and Mitigation

Mining operations will continue to be managed in accordance with the existing Mount Owen Complex Air Quality Management Plan. As discussed in **Section 6.1.3**, recent monitoring data demonstrates that the Glendell Mine has complied with relevant impact assessment criteria from DA 80/952.

The air quality review includes a detailed summary of the standard emission management measures from the Mount Owen Complex Air Quality Management Plan and provides a comparison to the measures outlined in the “NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining” (Donnelly et al, 2011), refer to **Appendix 3** for further detail. The review indicates that the majority of the existing management measures are consistent with best practice dust mitigation measures. In addition to the measures included in the Mount Owen Complex Air Quality Management plan, Mount Owen implements both proactive and reactive dust control strategies. Reactive air quality management include the modification or suspension of activities in response to the visual, meteorological or ambient air quality triggers. These triggers are defined in the Mount Owen Complex Air Quality Management Plan and are linked to specific actions for managing dust at both private and mine owned residences.

As discussed in **Section 6.1.3**, the existing Mount Owen Complex meteorological and air quality monitoring network is suitably established to measure the key air quality parameters, compliance with air quality criteria, and to allow for the contribution of mining activities to be determined. This air quality monitoring network will continue to be operated to monitor the mining operations (as modified).

The Air Quality Review undertaken by Jacobs indicates that from an air quality perspective, the Proposed Modification will be minor in nature and provided the mining operations continue to be managed in accordance with the existing Mount Owen Complex Air Quality Management Plan, there will not be an increase in the potential air quality impacts, relative to the approved operations.

6.2 Noise

The Approved Operations currently operate in accordance with the approved Mount Owen Complex Noise Management Plan (NMP) subject to DA 80/952. The NMP details the noise management system currently implemented on site, which includes the commitments to the implementation of noise control measures to minimise noise emissions to the extent practicable and to meet the existing noise criteria at surrounding private residences.

Umwelt has undertaken noise modelling to confirm the proposed mine plan changes can be implemented and meet relevant project specific noise levels (PSNL) applied to the approved operations under DA 80/952, however a detailed noise impact assessment has not been undertaken for the Proposed Modification. This approach is considered appropriate given:

- There are no changes are proposed to the current approved mine life, mining methods, extraction limits, processing rates, transportation methods or hours of operation, and
- Mining operations will progress further from surrounding sensitive receivers and the final modelling year of the approved Glendell Mine represented lower noise impact than earlier years.

The following section provides a qualitative assessment of the noise impacts associated with the Proposed Modification.

6.2.1 Existing Noise Consent Requirements and Criteria

DA 80/952 for the Approved Operations includes specific environmental noise performance conditions and criteria. The relevant noise conditions, including condition 2, 3 and 4 of Schedule 3 – Specific Environmental Conditions. Condition 5 relates to Construction noise only, and as no specific construction activities are proposed condition 5 is not relevant to the Proposed Modification

Noise Impact Assessment Criteria

1. *The applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 2 at any residence on privately-owned land, or on more than 25% of any privately-owned land.*

Table 2: Noise Impact Assessment Criteria dB(A)

Land Number/Receiver	Day/Evening/Night $L_{Aeq}(15 \text{ minute})$	Night $L_{A1}(1 \text{ minute})$
Camberwell Village A		
30, 33, 37c, 53	42	45
11, 22b, 35	41	45
Other privately-owned land in Camberwell Village A	40	45
Camberwell Village B		
20, 21a and 21b, 38, 47 (private 152) & 50	42	45
6, 24	40	45
4, 40	39	45
32, 44	38	45
All other privately-owned land in Camberwell Village B	37	45
Camberwell Village C		
27 (private 156)	40	45
31 (private 155)	38	45
Other privately-owned land in Camberwell Village C	35	45
Other privately-owned land		
37a & 37b (private 127a&b), 83, 110 (private 111)	37	45
34, 87		
9, 18, 45 & 46	36	45
All other privately-owned land	35	45
Camberwell Hall, St Clements Church	40	-

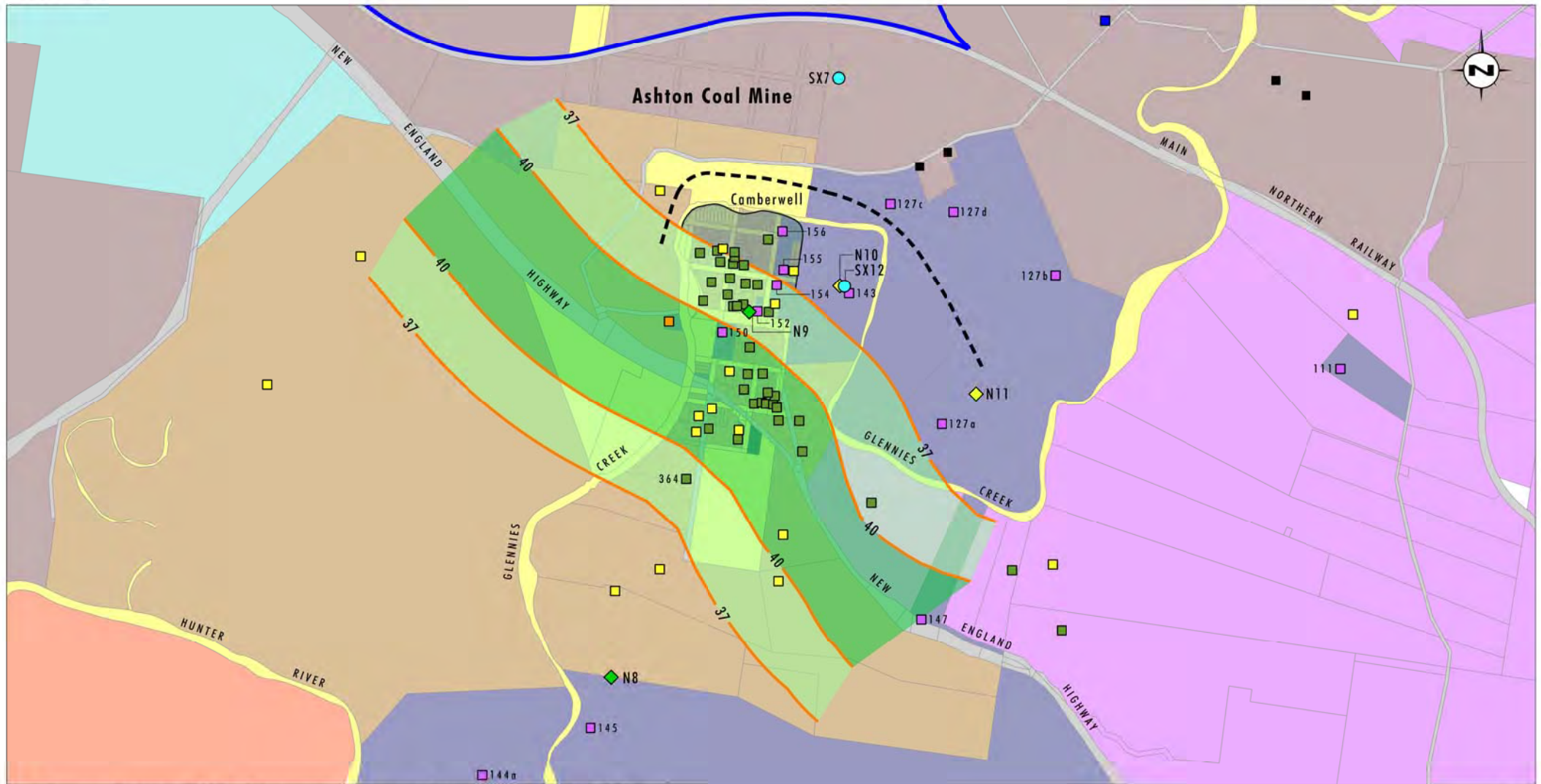
Note: properties currently in private ownership are noted and current Res ID information provided in brackets, all other properties are now mine owned

Cumulative Noise Criteria

2. *The Applicant shall take all reasonable and feasible measures to ensure that the noise generated by the development combined with the noise generated by other mines does not exceed the following amenity criteria at any residence on privately-owned land, or on more than 25% of any privately-owned land, excluding the land listed in Table 1, to the satisfaction of the Director-General:*
 - LAeq(11 hour) 50 dB(A) – Day;
 - LAeq(4 hour) 45 dB(A) – Evening; and
 - LAeq(9 hour) 40 d(BA) – Night
3. *If the noise generated by the development combined with the noise generated by other mines exceeds the following amenity criteria at any residence on privately-owned land, or on more than 25% of any privately-owned land, excluding the land listed in Table 1, then upon receiving a written request for acquisition from the landowner, the Applicant shall acquire the land on as equitable basis as possible with the relevant mines, in accordance with the procedures in conditions 9-11 of Schedule 4 of DA 80/952, to the satisfaction of the Director-General:*
 - LAeq(11 hour) 53 dB(A) – Day;
 - LAeq(4 hour) 48 dB(A) – Evening; and
 - LAeq(9 hour) 43 d(BA) – Night

The noise management areas applicable to Camberwell and identified in Table 2 above are shown on **Figure 6.3**.

As discussed in **Section 3.3.3**, a number of the properties identified as being subject to acquisition rights under DA 80/952 have now been acquired, and the relevant changes in ownership and updated residence ID numbering is provided in the table. A number of properties were also afforded mitigation rights with mitigation works undertaken in accordance with the requirements under DA 80/952 at these properties.



Data Source: Glencore (2018), Department of Finance, Services & Innovation (2018)

Legend

- Glendell Consent Boundary (DA 80/952)
- Project Specific Noise Criteria
- Ridge Line
- Ashton Coal
- Bloomfield Collieries
- Coal & Allied
- Crown Land

- Glencore
- Government Authority
- AGL Macquarie Pty Ltd
- Private
- State Forest
- Community Infrastructure
- Glencore Owned

- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private - Subject to Acquisition Rights
- Rural Residence Label
- Combined - Adopted Compliance Attended Noise Monitoring Location
- Glendell - Adopted Compliance Attended Noise Monitoring Location

- Real Time Continuous Noise Monitoring Location
- Noise Receiver Areas:
- Camberwell Village A
- Camberwell Village B
- Camberwell Village C

0 0.5 1.0 1.5 km
1:30 000

FIGURE 6.3

DA 80/952 Project Specific
Noise Criteria - Camberwell

6.2.2 Operational Management Controls

The Glendell Mine currently operates in accordance with an approved Mount Owen Complex NMP which has been approved by the Secretary. The NMP:

- describes the measures to be implemented to ensure compliance with the noise limits and operating conditions in DA 80/952; and
- provides a detailed description of the noise management system including the monitoring program, compliance assessment methodology and reporting protocols; and a detailed description of the real-time noise monitoring system.

Mount Owen's approach to effective noise management includes:

- identification of effective noise management controls during the mine planning, assessment and operational phases
- minimum requirements to be implemented for effective noise management to reduce the potential for noise related impacts, including the implementation of activity specific noise controls and site-wide management systems and procedures
- use of automated systems for early identification of adverse meteorological conditions which are likely to result in noise impacts, i.e. gradient winds and temperature inversions
- monitoring and reporting requirements for noise management
- requirements for the implementation of noise awareness training for employees to facilitate effective noise management.

The management of noise associated with the Glendell mining operations is monitored by both the continuous real time noise monitoring network and attended noise monitoring which requires the implementation of various operational noise controls in order to achieve existing noise criteria. Noise management controls are currently implemented in response to the real time noise monitoring network. This may include:

- The management of mobile machines during adverse weather conditions, which is when wind conditions or temperature inversion conditions enhance noise propagation towards sensitive receiver locations. In order to control noise impacts this may include:
 - providing alternative dumping locations
 - moving parts of the fleet to locations deeper in the pit, and/or
 - revising mining operations to reduce noise impacts including the implementation of a hierarchy of controls ranging from review of equipment locations and nature of activity, through to shut down of equipment as required to maintain compliance with noise criteria.
- Managing a number of ancillary activities to limit their occurrence during adverse meteorological conditions, such as those which may occur during winter night-times, including:
 - limiting ancillary mining equipment (e.g. dozers on overburden dumps, drills) during times of adverse weather conditions
 - reducing bulldozer activity on exposed rehabilitation areas, and/or
 - managing activities located at or near ground surface, such as top-soil and pre-strip, during the later stage of the mine life.

6.2.3 Noise Monitoring

The existing noise monitoring program at Mount Owen Complex is a combination of unattended continuous real-time noise monitoring and attended noise monitoring.

6.2.3.1 Unattended Continuous Noise Monitoring

The current unattended continuous monitoring network (refer to **Figure 6.4**) consists of five fixed units. The monitoring units:

- Specifically assess operational performance against the intrusiveness criteria using a LAeq, 15 minute descriptor;
- Measure and assess the environmental noise levels due to industrial noise sources using the amenity assessment descriptor of LAeq, Period; and
- Measure and assess the transient noise levels due to industrial noise sources using the LA1, 1 minute sleep disturbance criteria descriptor.

6.2.3.2 Attended Noise Monitoring

The frequency of attended monitoring is currently undertaken in accordance with the requirements of DA 80/952 and the requirements of the applicable EPL. Attended compliance noise monitoring for Glendell Mine is currently undertaken in accordance with the approved NMP at 6 locations (N3, N4, N8, N9, N10 and N11), that are considered to be representative of the most sensitive noise receivers (refer to **Figure 6.4**). Routine monitoring is also undertaken at N2 to validate the monitoring results from the reference continuous noise monitor SX 5.

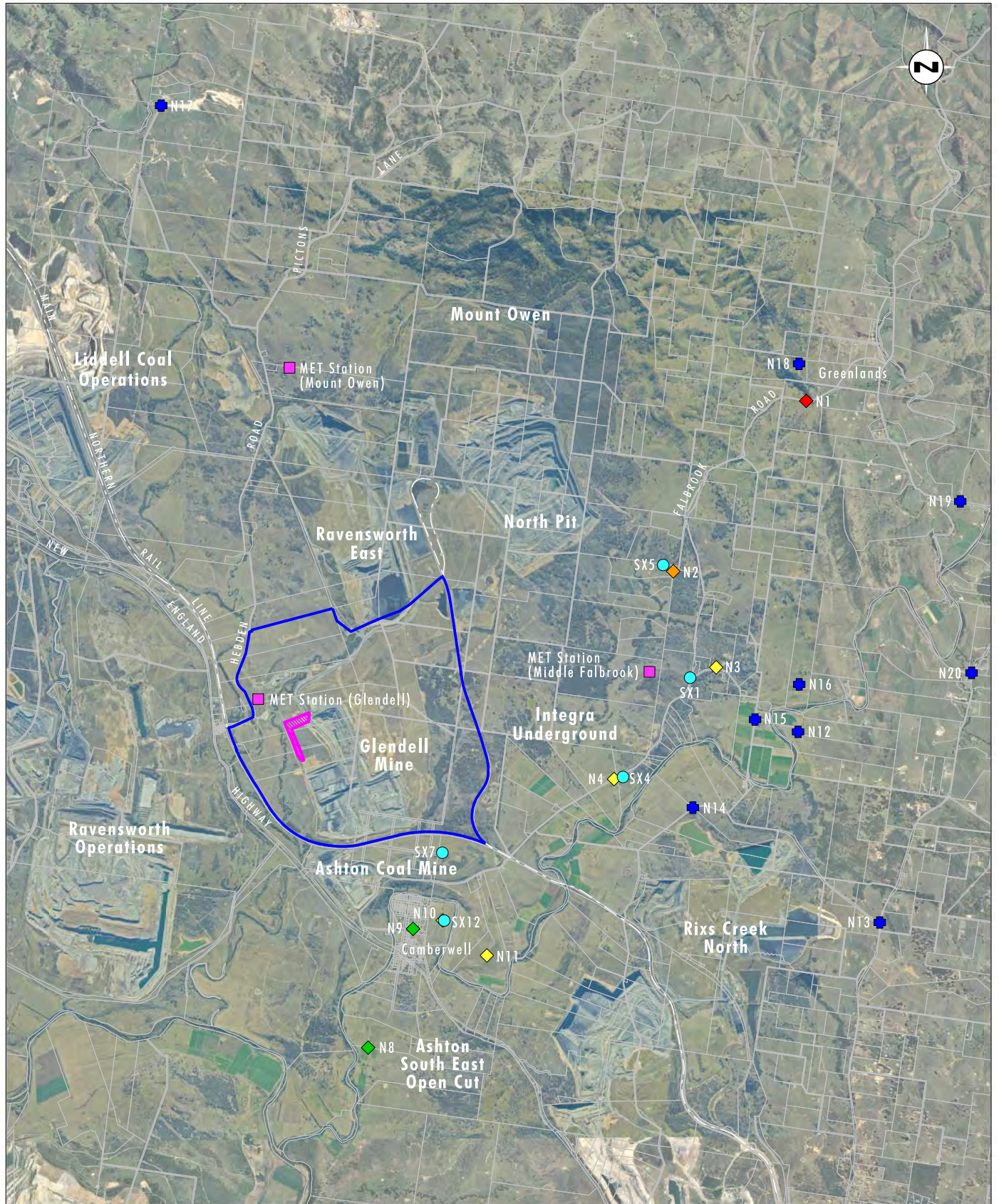


Image Source: Glencore (Jul 2018)

Data Source: Glencore (2018)

0 1.0 2.0 4.0 km
Scale 1:90 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Proposed Mining Area
- ◆ Routine Validation Attended Noise Monitoring Location
- ◆ Combined - Adopted Compliance Attended Noise Monitoring Location
- ◆ Glendell - Adopted Compliance Attended Noise Monitoring Location
- ◆ Mount Owen - Adopted Compliance Attended Noise Monitoring Location

- Meteorological Station Location
- Real Time Continuous Noise Monitoring Location
- Supplementary Performance Management Attended Noise Monitoring Location

FIGURE 6.4

Existing Noise
Monitoring Locations

6.2.4 Noise Impact Assessment

6.2.4.1 Noise Impact Assessment – Approved Operations

Advitech Pty Limited undertook the Noise Impact Assessment (NIA) to support the 2007 modification to DA 80/952 in 2007 (Advitech, 2007). The current project specific noise levels applicable to the approved operations (refer to **Section 6.2.1**), were calculated using the Environmental Noise Model (ENM). ENM predicts noise levels under various meteorological conditions and accounts for topography and equipment positioning for each conceptual mine stage plan. The noise levels were calculated for all potentially affected residences for 5 conceptual mine plan stage years (Years 1.5, 3, 6, 9 and 12) and for four meteorological scenarios representative of weather conditions within the area surrounding Glendell Mine.

The maximum noise impacts as a result of the approved operations were predicted to occur during the initial start up stages (the initial 1.5 years of proposed mining), and during Year 9 (approximately 2017) of the approved Glendell operations (Advitech, 2007). During Year 9 of the approved operations, mining activities reached the southern extent of the Glendell mining area prior to turning west and then proceeding back towards the north. Noise impacts were predicted to be the highest at this stage of mining, particularly during adverse weather conditions, in areas to the south of Glendell Mine, including Camberwell.

The Advitech 2007 modelling results indicated that two private residences were predicted to be significantly impacted and were afforded acquisition rights (where PSNL was predicted to be exceeded by greater than 5 dB(A)). The noise impact criteria applied to DA 80/952 to all other relevant private receivers is achieved through proactive management of noise levels as detailed in **Section 6.2.2**.

6.2.4.2 Noise Modelling – Proposed Modification

Noise modelling undertaken by Umwelt (2018), included a sensitivity analysis in order to evaluate the proposed mine plan changes, this included the revised mining area and potential for an alternative haul route located along the western side within the Barrett Pit. This analysis included the upgrade of the approved year 12 ENM (Advitech, 2007) to include an additional haul route located along the western side of the Barrett Pit. This haul route would be utilised to haul overburden, and provides two alternate haul locations along the western edge of the pit; being one located at the surface and one located below surface (within the Barrett Pit starting at RL 0 m (south) to RL35 m (north)). These alternative haul road locations provide for operational efficiencies in establishment of overburden emplacement within the Barrett Pit. The alternating use of these haul roads will be dependent on the meteorological conditions, this will be undertaken in accordance with existing noise management practices as outlined in the Mount Owen Complex Noise Management Plan. The noise model inputs, fleet numbers and sound power levels were consistent with the approved operations and noise modelling methodology adopted in the original ENM modelling so that the 2018 ENM predictions were directly comparable to the original 2007 modelling results.

The sensitivity analysis indicates the mining operations can achieve the existing DA 80/952 noise criteria at surrounding sensitive receivers, with the proposed modification to the conceptual mine plans implemented. The existing criteria will be achieved through the location of the mining operations moving further away from sensitive receivers, the use of alternate haul locations depending on meteorological conditions along the western boundary of the Barrett Pit (at surface and below surface within the pit) and through the continued implementation of the Mount Owen Complex Noise Management Plan.

The management of noise associated with the Glendell operations is monitored by both the continuous real time noise monitoring network and attended noise monitoring (refer to **Section 6.2.3**). During 2017 no exceedance of the noise criteria under DA 80/952 occurred, indicating current operational noise controls are effective in the mitigation of noise impacts associated with the Approved Operations and also validating the ENM predictions for the current approved operations.

6.3 Groundwater

A groundwater assessment (GWA) has been undertaken by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to assess the potential incremental impacts of the Proposed Modification on the existing groundwater regime. The GWA provides a qualitative assessment of the potential groundwater impacts associated with the Proposed Modification to address the requirements of the AIP 2012.

This section provides a summary of the key findings of the GWA, the GWA report prepared by AGE is attached (refer to **Appendix 4**).

6.3.1 Existing Hydrogeology

The main hydrogeological features relevant to the Glendell Mine are the alluvial aquifers associated with Swamp and Bettys Creeks and the deeper hard rock aquifers that contain the coal seams. As discussed in **Section 3.2.2**, the proposed mining area is located in close proximity to the Swamp Creek alluvium, extensive geophysical survey has been undertaken to confirm the extent of the Swamp Creek alluvium and monitoring data has been examined in detail to determine the thickness, permeability and water quality of the alluvium (refer to **Figure 6.5**).

Swamp Creek Alluvium

The Swamp Creek alluvium does not exhibit characteristics of a productive aquifer as the alluvium has limited saturated thickness, or is dry, and also contains brackish to saline groundwater. Groundwater levels within the alluvium vary, monitored groundwater levels in the area show a relationship with climatic conditions, with a rise in levels aligning with above average rainfall in 2015, followed by a declining trend since this time in response to below average rainfall. There are monitoring bores within the network that have been monitored since mining operations commenced at Glendell Mine (2009) and whilst the data indicates groundwater levels are currently relatively low within the alluvium, there is no obvious long term trend of declining groundwater levels that would be attributable to the mining operations within the Barrett Pit.

Groundwater quality within the alluvial system of Swamp Creek is highly variable. Groundwater monitoring data indicates electrical conductivity (EC) ranges from fresh (230 $\mu\text{S}/\text{cm}$) to saline (18,720 $\mu\text{S}/\text{cm}$) depending on time and location. The natural variability of salinity within the alluvium suggests poor interconnectivity within the groundwater system. The EC at each monitoring bore location also has a wide range, which may be due to the timing of the sample events (eg. fresher groundwater would likely be sampled after rainfall recharge events).

As noted previously the saturated thickness within the Swamp Creek alluvium is relatively limited (refer to **Figure 6.5**), and this combined with the presence of clay rich sediments between Bowmans and Swamp Creeks and high salinity means the alluvium does not form a productive aquifer.

Hard Rock Aquifer

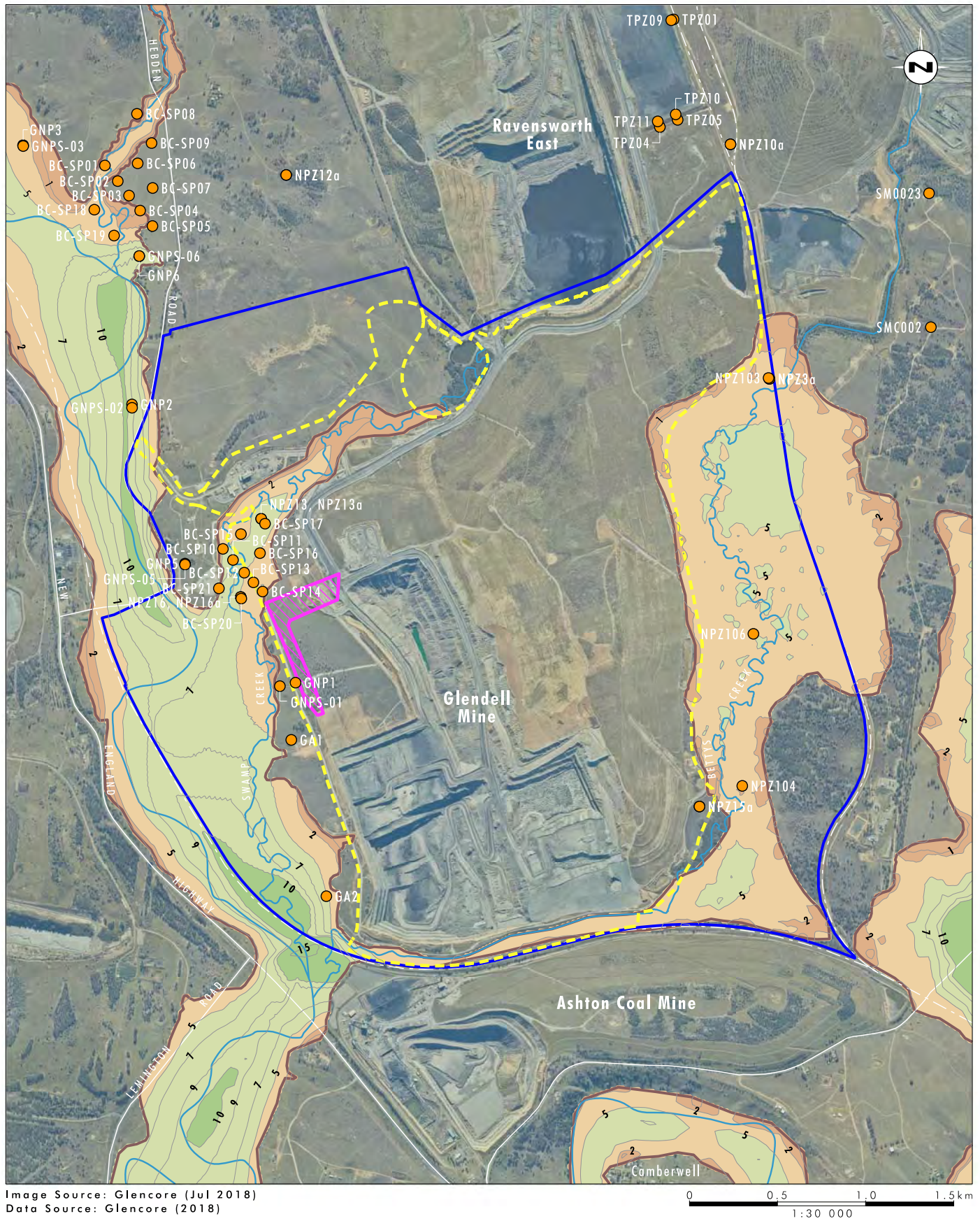
The saturated thickness of the Permian strata is limited to the coal seams, as the interburden does not transmit significant volumes of groundwater and acts as an aquitard confining the coal seams. The coal seams range between 2.5 and 10 m in thickness, the limited saturated thickness combined with high salinity result in the coal seams not forming productive aquifers.

As the coal seams are exposed in the pit face, depressurisation occurs. However, limited seepage of groundwater occurs through the coal seams being mined at Barrett Pit and the rate of evaporation of water from the mined face commonly exceeds the seepage rate, meaning the volume of groundwater from the mining area that requires pumping is limited.

Monitoring data indicates a general decline in pore-water pressures within the coal seams over time. The pore-water pressure elevations range from 0 to 33 m AHD, in proximity to mining at depths between 75m and -105m AHD. This is a typical response for coal seams in proximity to mining operations and was a process predicted by the groundwater assessment undertaken to support the approved operations. The pore pressures within the coal seams are approximately 40 m below the level of groundwater occurring within the Swamp Creek alluvium, which are around 70 m AHD. This difference indicates that despite the depressurisation of the coal seams the groundwater levels within the overlying alluvial systems are not detectably affected.

6.3.1.1 Existing Groundwater Monitoring Network

Mount Owen monitors groundwater levels within the alluvium and hard rock aquifers at the Mount Owen Complex using a network of monitoring bores and vibrating wire piezometers (refer to **Figure 6.5**). The hard rock aquifer is monitored using a combination of monitoring bores and arrays of vibrating wire pressure sensors (VWPs) for the deeper strata within the geological sequence.



Legend

- | | |
|---|---|
| — Glendell Consent Boundary (DA 80/952) | Thickness (m) |
| - - - Proposed Disturbance Area | 0 - 2 |
| Proposed Mining Area | 2 - 5 |
| Alluvium Mapping (AGE 2018) | 5 - 10 |
| ● Groundwater Monitoring Location | Greater than 10 |
| | — Thickness Contour |

FIGURE 6.5
Alluvium Thickness

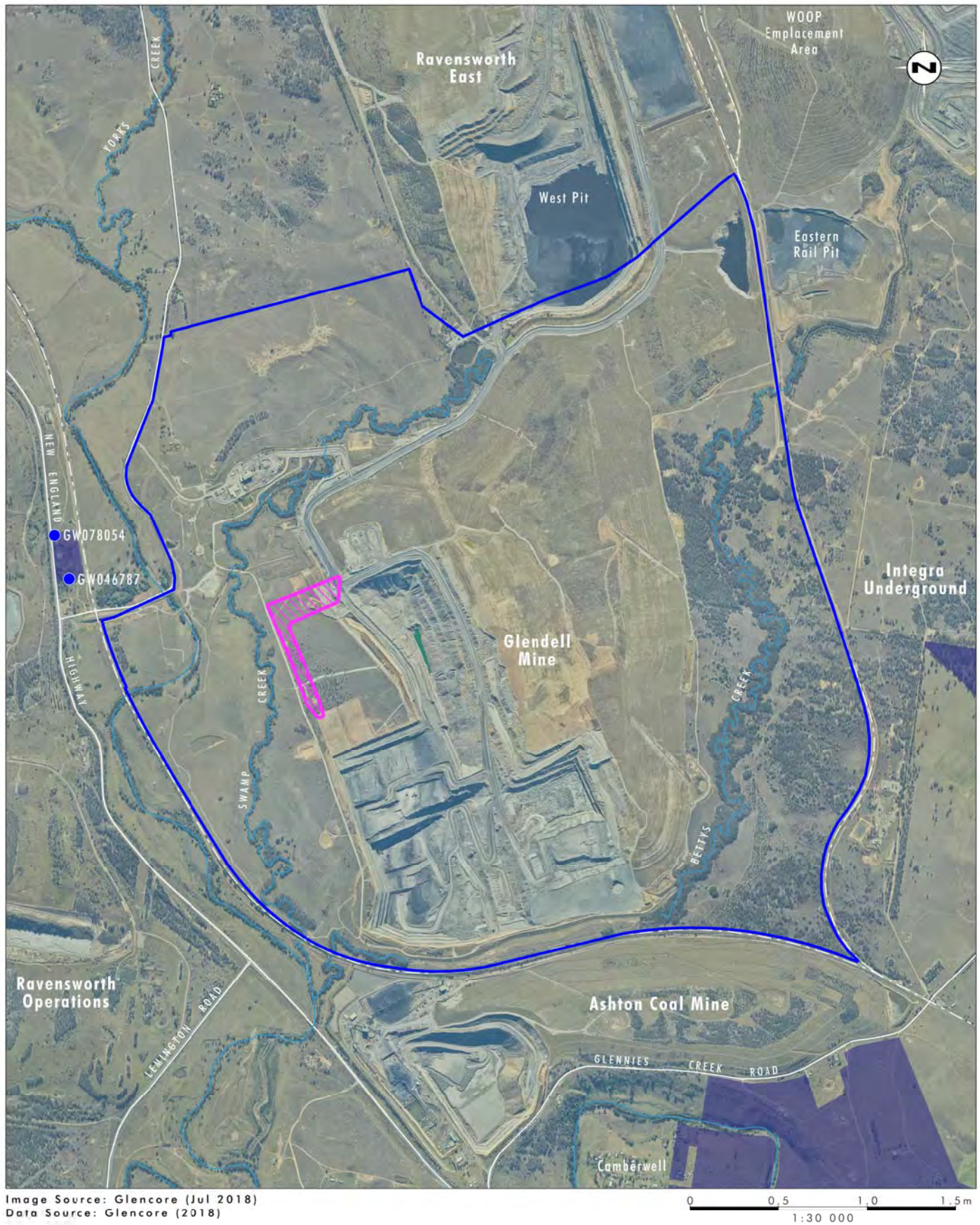
6.3.1.2 Groundwater Bores

A search of the NSW State Government groundwater bore database was conducted by AGE to identify the locations of any private water supply bores in proximity to the Approved Operations (refer to **Figure 6.6**). Glencore owns all the land within the Glendell Mine consent boundary as well as the surrounding land over the wider Mount Owen Complex. There are no bores on private land in the immediate vicinity of the Glendell Mine.

6.3.1.3 Groundwater Dependent Ecosystems

Vegetation mapping indicates Central Hunter Swamp Forest occurs in stands along Bettys Creek and Swamp Creek with Hunter Valley River oak forest occurring adjacent to Bowmans Creek (refer to **Figure 6.7**). Whilst it has not been determined if this vegetation depends on underlying groundwater, the general lack of saturation within the upstream areas of the Swamp Creek alluvium along with the accumulation of salinity within the groundwater suggests it is unlikely.

A register of water-dependent assets in the Hunter subregion has been prepared as a component of the Federal Governments Bioregional Assessments Process (Macfarlane, et al., 2016). Figures within the register indicate the Bowmans Creek has a moderate potential for groundwater interaction. Neither Swamp nor Bettys Creek are noted as alluvial aquifer assets.



Legend

- Glendell Consent Boundary (DA 80/952)
- Proposed Mining Area
- Private Land
- Registered Groundwater Bore

FIGURE 6.6

Registered Groundwater Bores on Private Land

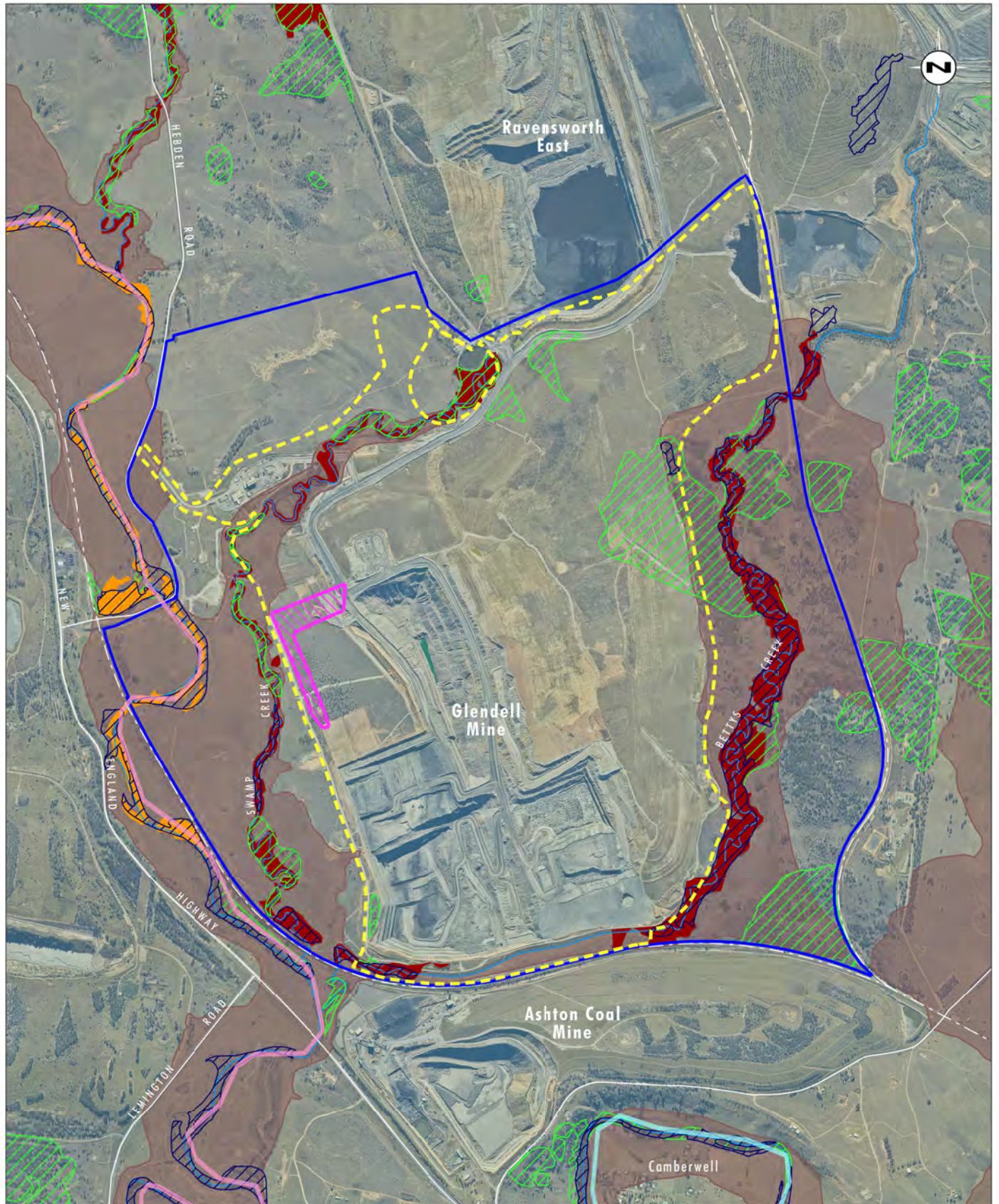


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018), AGE (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- | | |
|---|--|
| <ul style="list-style-type: none"> Glendell Consent Boundary (DA 80/952) Proposed Disturbance Area Proposed Mining Area Alluvium Mapping (AGE 2018) Central Hunter Swamp Oak Forest Hunter Valley River Oak Forest | <ul style="list-style-type: none"> Aquatic GDEs: High Potential for GW Interaction Moderate Potential for GW Interaction Terrestrial GDEs: High Potential GDE Low Potential GDE |
|---|--|

FIGURE 6.7

Potential Groundwater
Dependent Ecosystems

6.3.2 Groundwater Impact Assessment

As previously discussed, given the Proposed Mining Area is considered minor in nature the potential groundwater impacts were assessed qualitatively relying upon extrapolation of monitoring data collected during mining operations to date. The results of the groundwater modelling undertaken to support the approved operations and the predicted impacts associated with the Proposed Modification are discussed in the following sections.

6.3.2.1 Original Groundwater Modelling Results

The groundwater impact assessment undertaken in 1996 by Rust PPK to support the 1997 modification to DA 80/952 included drilling, permeability testing, groundwater monitoring analysis and numerical groundwater modelling to simulate the groundwater flow and estimates rates of seepage. The numerical groundwater model was used to simulate pit inflows and depressurisation over the 20 year mine life. The model results included a prediction of net change in the alluvium leakage balance and potential drawdown impacts to local bores. Potential drawdown impacts were dependent on the varying recharge rates applied to the alluvium.

The modelling results indicated the coal seams would be depressurised in excess of one kilometre in all directions as a result of the approved mining operations. Leakage from the alluvium was determined to be limited to within 500 m of the Barrett Pit mine workings, with the alluvium providing recharge to the underlying strata. Estimated pit seepages with no alluvium seepage were approximately 1.3 ML/day, while pit seepage with leakage from the alluvium ranged from zero to 6 ML/day after 20 years of mining. Operational experience has indicated the seepage rates predicted by the modelling are conservative with actual inflow, whilst difficult to measure, likely to be less than 1 ML/day.

Monitoring data indicates that although there is depressurisation occurring within the underlying Permian strata, subsurface seepage from the overlying alluvium is constrained by the permeability of the deeper coal seams, which is extremely low. The alluvium receives input from rainfall which maintains groundwater levels and exceeds leakage rates to deeper underlying strata depressurised by mining.

6.3.2.2 Impact Assessment

A detailed review of the monitoring data was undertaken by AGE to support the GWA for the Proposed Modification indicates the following is expected to occur as a result of the implementation of the Proposed Mining Area within the Barrett Pit:

- the zone of depressurisation within the coal seams would extend in the order of 60 m to the west and 130 m to the north;
- the groundwater levels within the surrounding alluvial groundwater systems would not record a detectable change and therefore riparian vegetation would remain unaffected; and
- the seepage rates of groundwater into the active mining areas would not be detectably different from those currently experienced during approved mining operations.

The proposed modification is expected to slightly extend the predicted zone of depressurisation occurring within the Permian coal seams. However, this impact is not expected to have any consequence as the monitoring data indicates the depressurisation of the coal seams does not propagate upwards sufficiently to influence shallow groundwater levels within the weathered zone and the Swamp Creek alluvium. This response is expected to remain if the Barret Pit is extended for the Proposed Modification. Whilst the Proposed Mining Area moves the pit boundary closer to the Swamp alluvium it does not intercept the alluvium and in this location the alluvium is dry, or of limited saturation, therefore the Proposed Modification is not predicted to significantly increase leakage from the Swamp Creek alluvium.

The Greater Ravensworth Groundwater Model recently updated and utilised for the groundwater impact assessment completed for the Mount Owen Continued Operations Project Modification 2 simulated cumulative impacts of surrounding mines (AGE, 2018). The simulated results showed that the cumulative drawdown within Swamp Creek and Bowmans Creek was generally less than 0.2 m. The drawdown in the Permian Strata (Liddell coal seam) was greatest at the Integra underground and Ravensworth open cut, located east and west of Glendell Mine respectively. As the Proposed Modification does not propose an increase in the approved depth of mining within the Barrett Pit, there is unlikely to be any increase in the cumulative impacts on Swamp Creek or Bowmans Creek.

Monitoring data indicates that there is no drawdown occurring in the Swamp Creek alluvium, despite depressurisation occurring within the underlying Permian strata. This indicates that although the alluvium is hydraulically connected to the underlying Permian strata, the rate of exchange is extremely low (undetectable) due to the relative impermeability of the underlying hardrock strata. As previously discussed, subsurface seepage is constrained by the permeability of the deeper coal seams, which is extremely low. The alluvium receives input from rainfall which maintains groundwater levels and exceeds leakage rates to deeper underlying strata depressurised by mining.

There are no private groundwater users that will be impacted by the Proposed Modification and based on the information reviewed, there is unlikely to be any impact on the alluvium as a result of the Proposed Modification.

Monitoring data indicates that the Swamp Creek alluvium saturated thickness is limited, with generally fewer than two metres and limited in extent to the area near the Bowmans Creek confluence. Therefore, the aquifer is of limited extent and does not contain a usable amount of groundwater. Groundwater quality is also highly variable and generally poor quality, influenced by rainfall recharge and local lithology. However is generally above the beneficial use of stock watering quality.

6.3.3 Aquifer Interference Policy

The AIP describes the requirements in designing a project, completing an assessment, and how the NSW Government will assess and regulate aquifer interference activities, and also describes minimal impact considerations (or minimal harm criteria) for water pressure, water table and water quality.

As discussed in **Section 6.3.1**, the Swamp Creek alluvial aquifer is considered to be a less productive alluvial water source (under the AIP guidelines), due to the low natural flow volumes (considered insufficient to yield more than 5 L/sec from a bore), and water quality as monitoring indicates high salinity (>1,500 mg/L), low transmissivity and low saturated thickness. The Proposed Modification was determined to have a Level 1 impact as defined in the AIP.

The GWA undertaken by AGE provides a detailed assessment against the requirements of the AIP (refer to **Appendix 4**). A summary of the results of the assessment against the minimal harm criteria for both the alluvial and hard rock water sources is provided in **Table 6.3**.

Table 6.3 Summary of Assessment of Minimal Harm Criteria

	Alluvium	Porous and Fractured Rock
<u>Water Table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. or A maximum of a 2 m decline cumulatively at any water supply work.	Detectable drawdown within the adjacent alluvial aquifers is considered unlikely. No Culturally Significant Sites or high priority GDEs located within 40 m of the proposed mining area. There are no private water supply bores within proximity to Glendell Mine or the proposed mining area. Previous modelling (Rust PPK, 1996) indicated that drawdown would not exceed 0.5 m in the alluvium. Leakage from alluvium has been less than the model results. Observed groundwater levels during mining have not shown any long-term decline. Therefore, the minor change in mine footprint, is not predicted to exceed 2 m decline at any water supply work.	No Culturally Significant Sites or high priority GDEs located within 40 m of the proposed mining area. There are no water supply works in proximity of the proposed modification.
<u>Water Pressure</u> Porous and Fractured Rock: A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.		Groundwater level drawdown resulting from the approved operations and modification may exceed 2 m adjacent to the mining area in the Permian strata, however there are no water supply works within the less productive Permian strata in the vicinity. Monitoring will continue to assess the drawdown that may occur. Reviews are also conducted 3 yearly to compare predictions against observed groundwater levels.
<u>Water Quality</u> Alluvium: Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Porous and Fractured Rock: Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The water quality monitoring data indicates that the quality of the groundwater is variable and detected high salinity can constrain the beneficial use of the alluvial groundwater. Monitoring data also indicates no significant changes in alluvial groundwater levels can be attributable to the approved mining operations. Therefore no predicted change in beneficial use of alluvial groundwater is expected as a result of the Proposed Modification. Swamp Creek is ephemeral in nature and does not have a permanent baseflow, therefore no change in salinity of surface water is expected.	The beneficial use of groundwater occurring within the Permian is limited by the low yields and high salinity. Any change in beneficial use due to the Proposed Modification is considered unlikely.

6.3.4 Groundwater Licencing

Groundwater licence allocations are held by Mount Owen and managed under the approved Groundwater Management and Monitoring Plan. Licence entitlements for extraction from the regional hard rock aquifer are summarised in **Table 6.4**.

Table 6.4 Water Licensing – North Coast Fractured and Porous Rock WSP

Licence No.	Abstraction purpose	Units
20BL169337	Groundwater extraction for dewatering purposes – Mount Owen North Pit	140
20BL170294	Groundwater extraction for dewatering purposes – Eastern Rail Tailings Pit	220
20BL170295	Groundwater extraction for dewatering purposes – Bayswater North and West Pits	800

The Barrett Pit operates in a relatively low permeability geological regime where groundwater is not problematic for mining and is commonly evident only as damp evaporating seeps in the mine faces. There are currently no significant flows of groundwater into the Barrett Pit that require continuous pumping and therefore the volume of groundwater intercepted by the mining operations cannot be directly measured. It should be noted, that the fact that groundwater does not need pumping does not indicate it is not entering the mine, but rather that it is largely evaporated or adheres to mined materials preventing it from accumulating on the pit floor. Given the limited extent of the Proposed Mining Area there is not expected to be a notable increase in groundwater seepage into the Barrett Pit and the WALs currently held are expected to be sufficient to account for any groundwater intercepted by the Barrett Pit operations.

6.3.5 Groundwater Monitoring

The GWA indicates depressurisation of the coal seams and the interburden has occurred in areas adjacent to the Barrett Pit, however the depressurisation is not propagating into the overlying Swamp Creek alluvium and inducing leakage. This outcome is not expected to change due to the Proposed Modification given the extent of the Proposed Mining Area is considered minor. Therefore the existing groundwater monitoring network is considered sufficient to monitor and determine the impact of the continued mining operations. AGE consider no additional monitoring points are required and recommend that groundwater monitoring continue as outlined within the Mount Owen Complex Groundwater Management Plan and continue to be reported annually.

6.4 Surface Water

6.4.1 Surface Water Context

Glendell Mine site is located within the Bowmans, Swamp and Bettys Creek catchments (refer to **Figure 3.5**). The Proposed Disturbance Area is primarily located within the catchments of Swamp and Bettys Creeks, which are sub catchments of Bowmans Creek. Swamp and Bettys Creek drain into Bowmans Creek at a confluence immediately south-west of the Glendell Mine. Bowmans Creek drains to the Hunter River approximately 3.5 kilometres downstream of Glendell Mine.

The catchments of Swamp and Bettys Creeks have been substantially modified by the approved operations at the Glendell Mine and within the wider Mount Owen Complex. Swamp Creek was diverted in accordance with the original approval and large sections of Swamp and Bettys Creek catchment are now incorporated into the approved Mount Owen Water Management System (WMS). Catchment runoff from within these areas does not enter Swamp Creek but is captured by the WMS.

6.4.1.1 Water Quality Monitoring

Mount Owen monitors surface water quality in accordance with the Mount Owen Complex Surface Water Management and Monitoring Plan, refer to **Figure 6.8**. This plan includes monitoring of the following elements of the WMS and surrounding creeks:

- surface water flows and quality in upstream and downstream watercourses
- channel stability in upstream and downstream watercourses
- stream health conditions in upstream and downstream watercourses, and
- on-site water storages.

The surface water monitoring program covers all three water category areas within the Mount Owen Complex: clean; dirty (sediment laden); and mine water systems. The clean water system consists of runoff from undisturbed or rehabilitated areas. The dirty water system consists of runoff from disturbed areas (excluding mine water). The mine water system consists of runoff from areas exposed to coal or water used in coal processing or from coal stockpile areas.

The approved Surface Water Management and Monitoring Plan require monthly monitoring at all monitoring locations within the clean water system for the following parameters:

- flow (by way of visual observation as streams are ephemeral)
- pH
- electrical conductivity (EC)
- total suspended solids (TSS), and
- total dissolved solids (TDS).

Mount Owen also monitors a number of organic and metal/metalloid parameters in the dirty and mine water systems.

Using historical data sets and methods outlined in the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines, site specific water quality triggers have been developed for pH, EC, TSS and TDS and are included in the approved Mount Owen Complex Surface Water Management and Monitoring Plan.

Water quality monitoring data for pH, EC, TSS and TDS are reported in the Annual Review. Integra Underground Mine also monitors water quality in Glennies Creek. Data presented in the Annual Review indicates that mining activities have had negligible impact on the water quality in downstream creek systems, including Bowmans Creek, Yorks Creek, Swamp Creek, and Bettys Creek.

6.4.1.2 Water users

The majority of land adjacent to the Approved Operations and Proposed Disturbance Area is owned by Glencore subsidiaries. All land downstream of the Glendell Mine with access to Swamp and Bowmans Creek to the confluence with the Hunter River is mine owned.

6.4.1.3 Surface Water Licences

The Proposed Modification is not expected to result in any change to current water demands associated with the approved operations and no additional water licences will be required. Mount Owen hold water access licences (WALs), water supply works and water use approvals under the WM Act 2000 for the extraction of water from Glennies Creek (Glennies Creek Management zone, under the Water Sharing Plan (WSP) for the Hunter Regulated River Water Source 2016), and the approved diversions of Betty and Swamp Creeks, refer to **Table 6.5**.

Table 6.5 Mount Owen Complex Water Licence Summary

Mount Owen Complex – Water Licence Summary			
Hunter Unregulated WSP			
Licence No.	Water Source/Management Zone	Type	Units
WAL18310	Jerrys Water Source	Surface Water	200
WAL18000	Glennies Water Source	Surface Water	17
Hunter Regulated WSP (Glennies Management Zone 3a)			
Licence No.	Type	Units	
WAL704	High Security	3	
WAL1118	High Security	3	
WAL7814	High Security	1000	
WAL9521	High Security	50	
Total High Security		1056	
WAL612	General Security	147	
WAL613	General Security	192	
WAL637	General Security	384	
WAL705	General Security	27	
WAL1119	General Security	60	
WAL1215	General Security	48	
Total General Security		858	
WAL1364	Supplementary	2.2	
WAL1420	Supplementary	29	
Total Supplementary		31.2	
WAL706	Domestic and Stock	8	
WAL754	Domestic and Stock	16	
WAL1218	Domestic and Stock	3	
WAL7817	Domestic and Stock	3	
WAL7823	Domestic and Stock	9	
Total Domestic and Stock		39	

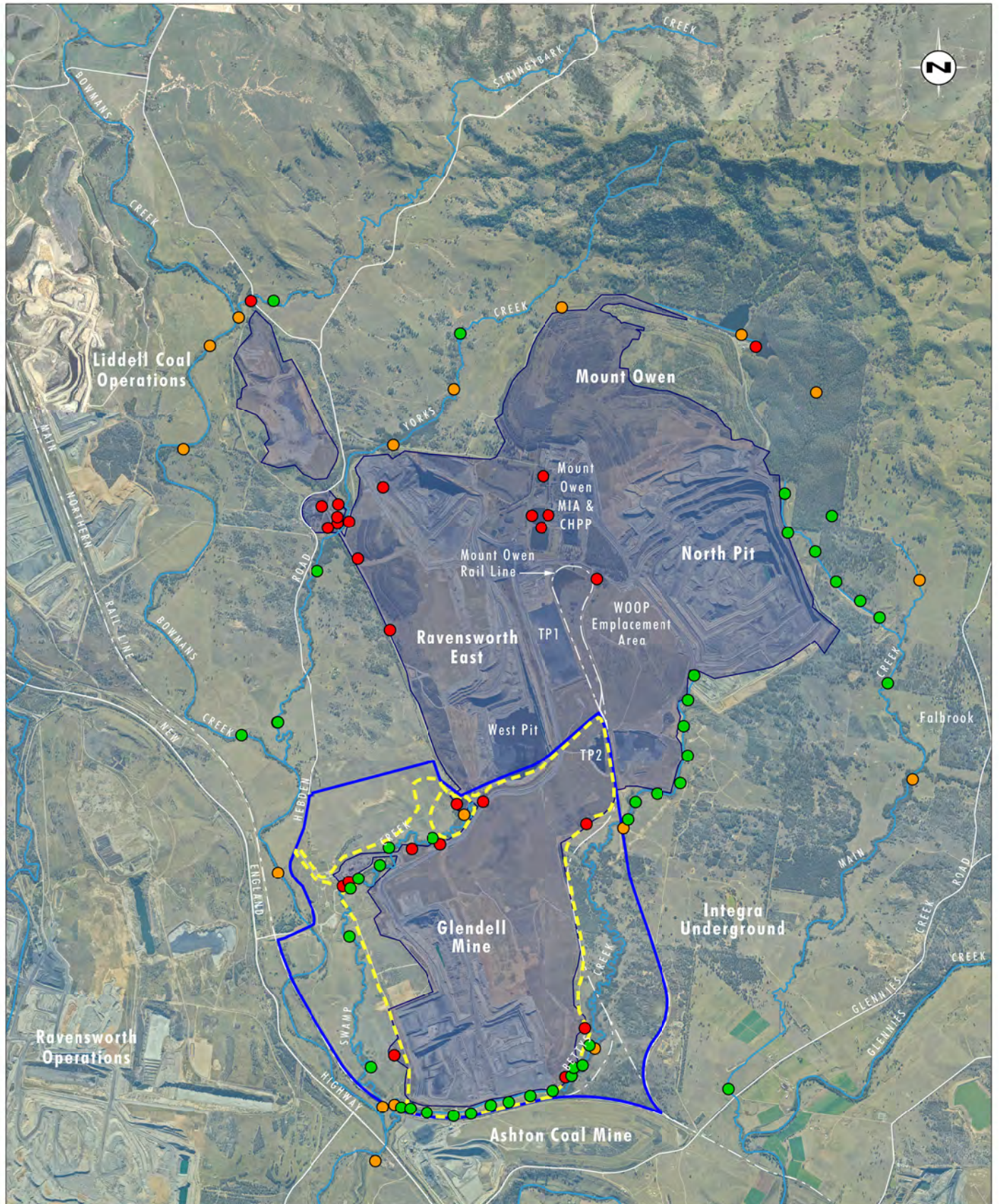


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 1.0 2.0 3.0 km
1:60 000

Legend

- ▬ Glendell Consent Boundary (DA 80/952)
- ▬ Proposed Disturbance Area
- ▬ Water Management System Catchment Boundary
- Drainage Line

Surface Water Monitoring Locations:

- Surface Water - Channel Stability and Stream Health
- Surface Water Onsite Storage
- Surface Water - Watercourse

File Name (A4): R07/4052_043.dgn
20181026 12.55

FIGURE 6.8

Mount Owen Complex
Catchments and Surface Water
Monitoring Locations

6.4.2 Water Management System

The Mount Owen Complex operates in accordance with a comprehensive approved WMS, which includes mine dewatering systems, water storages, sedimentation and retention basins, settling and tailings ponds, diversion drains, levee banks and earth bunding around coal stockpiles, laydown hardstand and fuelling areas.

The WMS at the Mount Owen Complex is an integrated system, that is, the water from the Glendell, Mount Owen and Ravensworth East Mines is managed together within the integrated WMS. In addition, the Mount Owen Complex forms part of the GRAWTS with Ravensworth Operations, Integra Underground and Liddell Coal Operations. The GRAWTS allows greater flexibility in the management of water by Mount Owen and other participating operations, allowing increased recycling of water between operations which limits the requirement to extract water from surrounding watercourses.

The approved Mount Owen Complex WMS has the following key objectives and functions:

- diversion of clean water around mining operations to minimise capture of upslope runoff and separate clean water runoff from mining activities
- segregating mine impacted water and runoff from undisturbed and revegetated areas with better water quality to minimise the volume of mine impacted water that requires reuse
- reuse of mine impacted water within the WMS and within the GRAWTS to reduce reliance on raw/clean water (e.g. extraction from Glennies Creek)
- minimising adverse effects on downstream waterways (i.e. hydraulic and water quality impacts).

Water management at the Mount Owen Complex considers three categories of water, each with different potential to cause environmental harm. The target design criteria for each of the three categories of water are summarised in **Table 6.6**.

Table 6.6 Approved WMS design criteria

Water Category	Water Description	Target Design Criteria
Clean	Runoff from undisturbed or rehabilitated areas.	Release, where practicable, to downstream environment.
Dirty	Runoff from disturbed areas (does not include water captured in mining pit areas or runoff from mine infrastructure areas).	Managed in line with the Blue Book (Managing Urban Stormwater: Soils and Construction Volumes 1 and 2E). Designed to manage runoff from the 5 day, 95 th percentile rainfall event.
Mine	Runoff from areas exposed to coal or water used in coal processing or from coal stockpile areas.	Contained for events up to and including the 1% annual exceedance probability (AEP) 24 hour storm event.

A key objective of the WMS is to convey clean water around the mining operation areas or, when runoff water from rehabilitated areas becomes clean, enable the runoff from these rehabilitated areas to flow directly to the downstream environment as opposed to being managed as part of the WMS.

There are no licensed discharge points from the Mount Owen Complex to any creek systems. It should also be noted that no discharge has occurred from the Mount Owen Complex WMS over the last 12 years. Water captured within the WMS is reused on site with surplus water transferred from the Mount Owen Complex to storages within the GRAWTS in accordance with existing approvals. There is also approval for the GRAWTS to discharge from Ravensworth Operations and Liddell Coal Operations licensed discharge points, in accordance with the HRSTS and relevant EPLs.

6.4.2.1 Proposed Water Management

It is proposed to modify the existing WMS to incorporate the Proposed Disturbance Area and Mining Area. Given the limited extent of the Proposed Mining Area and Disturbance Area, only minor modifications to the existing WMS will be required. In addition, the existing WMS will continue to be operate as a component of the GRAWTS.

As discussed in Section 2.2, the progression of mining at the Glendell Mine is considered to be generally in accordance with the approved conceptual mine plans however the established rehabilitated conceptual landform and progression of mining differs from that approved under DA 80/952. The conceptual WMS components relating to the Proposed Modification for Year 2023 is presented in **Figure 6.9**. The conceptual WMS for 2023 presents the WMS to be implemented to manage water to undertake the proposed minor modification to the approved mining activities.

6.4.2.2 Water Balance

The water balance undertaken to support the approved operations predicted that the Glendell operations would have a net water surplus for the life of the proposed operations. The volume of the predicted water surplus was dependent on climatic conditions and the stage of the proposed Glendell operations (which was predicted to peak during Year 9 (approximately 2017) with an excess of approximately 600 ML/Year).

As previously discussed the surplus water produced by the Glendell Mine is reused on site and surplus water transferred from the Mount Owen Complex to storages within the GRAWTS in accordance with existing approvals. The Proposed Modification is not predicted to result in any significant changes to the water balance associated with the approved operations, given the amendments to the conceptual mine plans is considered to be only minor. Additionally the Proposed Modification will have negligible influence on the ability of the GRAWTS to operate and manage potential water discharges via the HRSTS. Additionally there will be no increase in discharges than what is permitted to occur at Ravensworth Operations and Liddell Coal Operations as a result of the Proposed Modification.

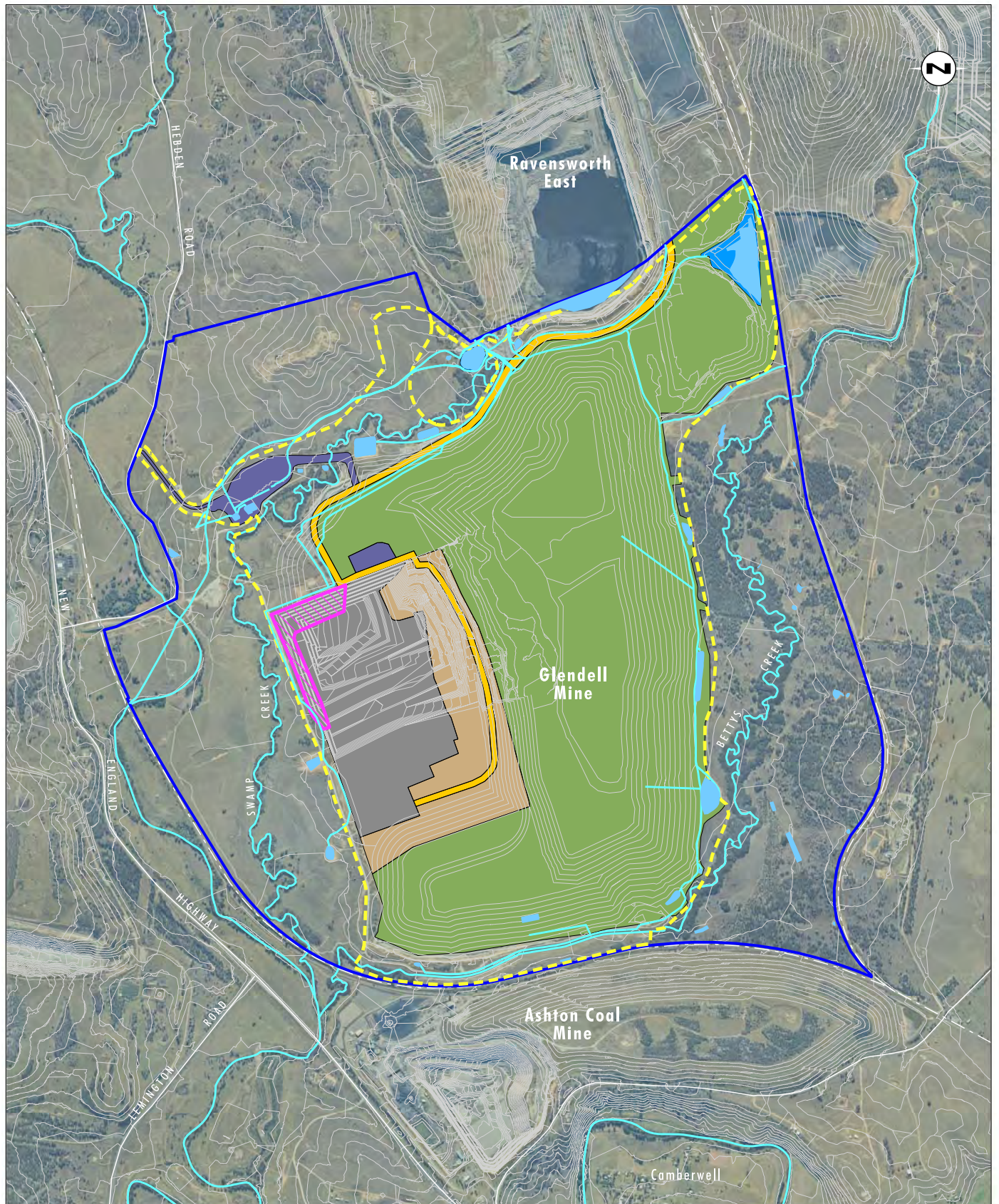


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Mine DA Boundary (DA 80/952)
- ▨ Proposed Mining Area
- - - Proposed Disturbance Area
- Active Mining
- Active Overburden Emplacement Area
- Infrastructure
- Haul Road
- Rehabilitation
- Water Storage

FIGURE 6.9

Conceptual Water
Management System

6.4.3 Surface Water Impacts

6.4.3.1 Catchment Areas

As discussed in **Section 6.4.1**, the Glendell Mine site is located within the Bowmans, Swamp and Bettys Creek catchments and the Proposed Disturbance Area is primarily located within the catchments of Swamp and Bettys Creeks. The catchments of Swamp and Bettys Creeks have been substantially modified by the approved operations at Glendell Mine and within the wider Mount Owen Complex. The Proposed Modification will result in only a minor reduction in the catchment of Swamp Creek, which is predicted to have negligible impact to surface water resources relative to the approved operations.

6.4.3.2 Flooding

Detailed flood modelling was undertaken using XPStorm in 2014, to support the Mount Owen Continued Operations Project (Umwelt, 2015). Flood events that were simulated include the 10%, 5% and 1% AEP events, Mount Owen committed to the implementation of flood mitigation measures as part of the Mount Owen Continued Operations project including flood detention measures in order to reduce the potential impact of flooding in Yorks Creek, upstream of the Glendell Mine.

The 1% AEP flood event extends along Swamp Creek and the majority of this predicted flooding is associated with backwater flows from Bowmans Creek and will extend to within approximately 30 m of the proposed pitshell (refer to **Figure 6.10**). As part of highwall access and safety works Mount Owen will construct road safety berms for flood mitigation for the 0.1% AEP flood event. Given the location of these works outside of the predicted flood extent there is unlikely to be any significant impact on flood flow velocities or afflux effects. The Mount Owen Complex WMP will be updated to include the details of the road safety berm and flooding interactions.

6.4.3.3 Water Quality

The Mount Owen Complex WMS is designed to enable Mount Owen to manage and operate the Approved Operations to meet licence conditions within the requirements of the POEO Act, taking account of both historical and current water qualities in the surrounding watercourses, and current and future downstream water users. Consistent with the Approved Operations, no discharges will occur from the Mount Owen Complex as a result of the Proposed Modification with any surplus water transferred via the GRAWTS.

Mount Owen will continue to monitor water quality in accordance with the existing Mount Owen Complex WMP (refer to **Section 6.4.2**).

6.4.3.4 Cumulative Impacts

As discussed, given the limited potential for any increase in impacts associated with the Proposed Modification relative to the approved operations, there is expected to be negligible additional impact on flow, water quality and water users relative to the Approved Operations downstream, on Swamp Creek, Bowmans Creek, and on the Hunter River.

Therefore it is considered that the Proposed Modification will have negligible cumulative impacts on flows in downstream watercourses, water quality and downstream users relative to the Approved Operations.

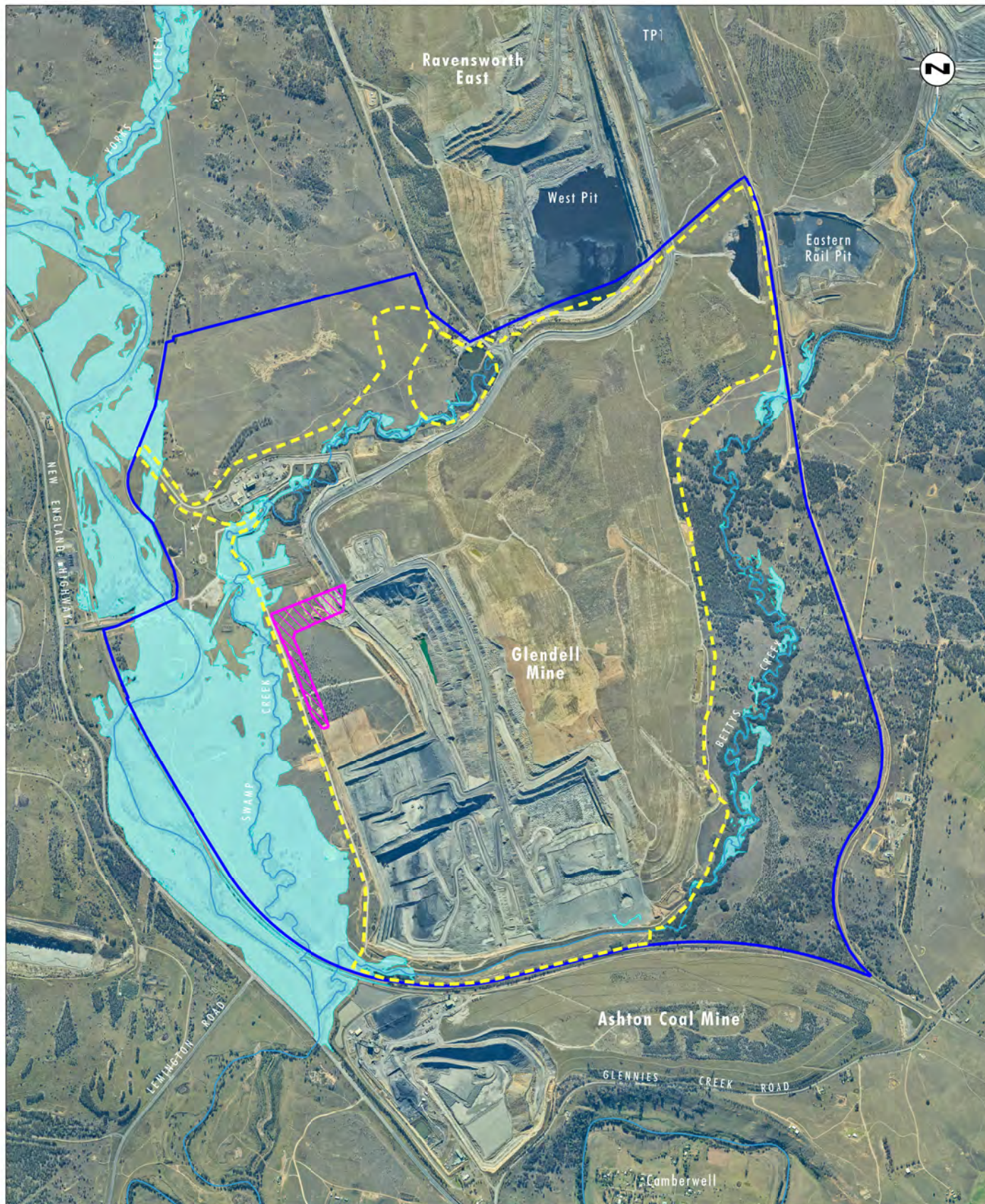


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- ▨ Proposed Mining Area
- - - Proposed Disturbance Area
- 1% AEP Flood Extent - Mount Owen Continued Operations Project - 2014

FIGURE 6.10

Modelled Flood Extents for
the 1% AEP Event

6.4.4 Management, Monitoring, Licencing and Reporting

The Proposed Modification includes minor works to the existing WMS. During operations, the WMS components will continue to be constructed as work progresses. The operational phase will involve the ongoing management of the WMS. Erosion and sediment control measures are proposed to minimise potential water quality impacts associated with disturbance activities.

The Mount Owen Complex Erosion and Sediment Control Plan (ESCP) provides a framework for the management of erosion and sedimentation at the Mount Owen Complex. The objective of the ESCP is to ensure that appropriate structures and programs of work are in place to:

- identify activities that could cause erosion and generate sediment
- describe the location, function and capacity of erosion and sediment control structures required to minimise soil erosion and the potential for transport of sediment downstream
- ensure erosion and sediment control structures are appropriately maintained
- fulfil the statutory conditions of the project approval.

Erosion and sediment control will continue to be undertaken in accordance with the ESCP.

The Mount Owen Complex WMP includes specific monitoring for:

- erosion and sediment control measures
- water balance monitoring
- watercourse stability monitoring and management
- surface water quality monitoring
- flow monitoring
- contingency measures
- decommissioning of the WMS.

Watercourse monitoring will continue on an annual basis for watercourse stability and stream health. Surface water monitoring results will continue to be provided as part of the Annual Review, consistent with the Approved Operations.

6.5 Ecology

A BDAR has been prepared by Umwelt to assess the potential biodiversity impacts of the Proposed Modification in accordance with the BAM under the BC Act (refer to **Appendix 5**).

6.5.1 Local Ecological Context

The Glendell Mine site has been subject to extensive clearing as a result of previous agricultural activities and associated with the approved mining operations. Where there is remnant native vegetation in the locality, a number of Threatened Ecological Communities (TECs) are known to occur including Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions endangered ecological community (EEC) listed under the BC Act; Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC listed under the BC Act; and Central Hunter Valley Eucalypt Forest and Woodland critically endangered ecological community (CEEC) listed under the EPBC Act.

The Proposed Disturbance Area is located within an existing coal mine and the land uses surrounding the site predominantly include open-cut and underground coal mining operations and agriculture. The vegetation present in the Proposed Disturbance Area comprises grassland with patches of regenerating trees. Swamp Creek and Bettys Creek are located within 50 m of the Proposed Disturbance Area.

6.5.2 Method

The methods executed in the BDAR were undertaken in accordance with the Biodiversity Assessment Method Order 2017 and the Biodiversity Assessment Method Operational Manual (Stage 1). A total of 5 BAM plots were conducted within the Proposed Disturbance Area during the field survey (refer to **Figure 6.11**). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (OEH 2017a), as shown in **Table 6.7**.

Table 6.7 Adequacy of Floristic and Vegetation Integrity Survey in the Proposed Disturbance Area

Veg. Zone	Plant Community Type (PCT) <i>Condition Class</i>	Approximate area in the Proposed Disturbance Area (ha)	Number of Floristic and Vegetation Integrity Plots		Rapid Assessment
			Required	Completed	
1	PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.9	1	1	2
2	PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	6.4	3	4	2
-	Cleared land	4.7	0	0	0
TOTAL		12	4	5	4



Image Source: Glencore (Jul 2018)

Data Source: Glendell (2018), Umwelt (2014-2018)

0 100 250 500m
1:10 000

Legend

- Proposed Additional Disturbance Area
- Survey Tracks
- BAM Plot Location
- Rapid Assessment
- Remote Camera
- Diurnal Bird Survey
- Reptile Search
- UHSA Survey (2015): Anabat Survey

FIGURE 6.11

Survey Effort

6.5.3 Results

6.5.3.1 Landscape Value

The 1500 m buffer area surrounding the Proposed Disturbance Area contains a range of landscape features typical of the landscapes around the central Hunter Valley, refer to **Table 6.8**.

Table 6.8 Landscape Features in the Development Footprint

Landscape Features	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Hunter
Mitchell Landscape	Central Hunter Foothills
Rivers, Streams, Estuaries	Two 1 st Order Streams running through Development Footprint and adjacent to a 2 nd Order Stream (Swamp Creek).
Wetlands (within, adjacent to and downstream)	None identified
Native Vegetation Extent	525.9 ha in the 1500 m buffer area (39%)
Connectivity Features	The Development Footprint is not an important link for any fauna movement and has not been identified in connectivity mapping.
Areas of Geological Significance and Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	4.7 ha within the Development Footprint
Connectivity Features	Not identified within a Priority Investment Area, but located near to an area identified as Priority 2 Investment Area (OEH 2017b). Not identified as an important flyway for migratory species. Development footprint is located adjacent to Swamp Creek which forms part of a local corridor. Development footprint is not identified in any corridor mapping and does not form part of a local corridor that contributes significantly to movement and viability of flora and fauna in the locality.

6.5.3.2 Native Vegetation

During the field survey two Plant Community Types (PCTs) were identified within the Proposed Disturbance Area, each with one condition class (refer to **Figure 6.12**):

- PCT1692 Bull Oak grassy woodland of the central Hunter Valley - *Regeneration*
- PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter - *Derived Native Grassland*

Descriptions of the vegetation zones are outlined in the BDAR, refer to **Appendix 5**.

6.5.3.3 Threatened Ecological Communities

No threatened ecological communities were recorded in the Proposed Disturbance Area. The woodland form of PCT1691 is consistent with Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) and Central Hunter Eucalypt Forest and Woodland CEEC (EPBC Act), however due to the absence of characteristic canopy species, the derived native grassland of this PCT is not consistent with the EEC or CEEC.

PCT1692 may conform to Central Hunter Eucalypt Forest and Woodland CEEC (EPBC Act) when characteristic canopy species are present in sufficient numbers. No characteristic canopy species of the CEEC were recorded within the Proposed Disturbance Area and therefore the CEEC is not present.

6.5.3.4 Vegetation Integrity Score

Table 6.9 details the vegetation integrity scores for each of the vegetation zones in the Proposed Disturbance Area. The vegetation integrity data for each of the vegetation zones is provided in the BDAR, refer to **Appendix 5**.

Table 6.9 Vegetation Zone Integrity Scores

Veg Zone	PCT Name	Composition	Structure	Function	Current Vegetation Integrity Score
1	PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	47.7	47.6	63.4	52.4
2	PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	29.3	41.7	17.1	27.5

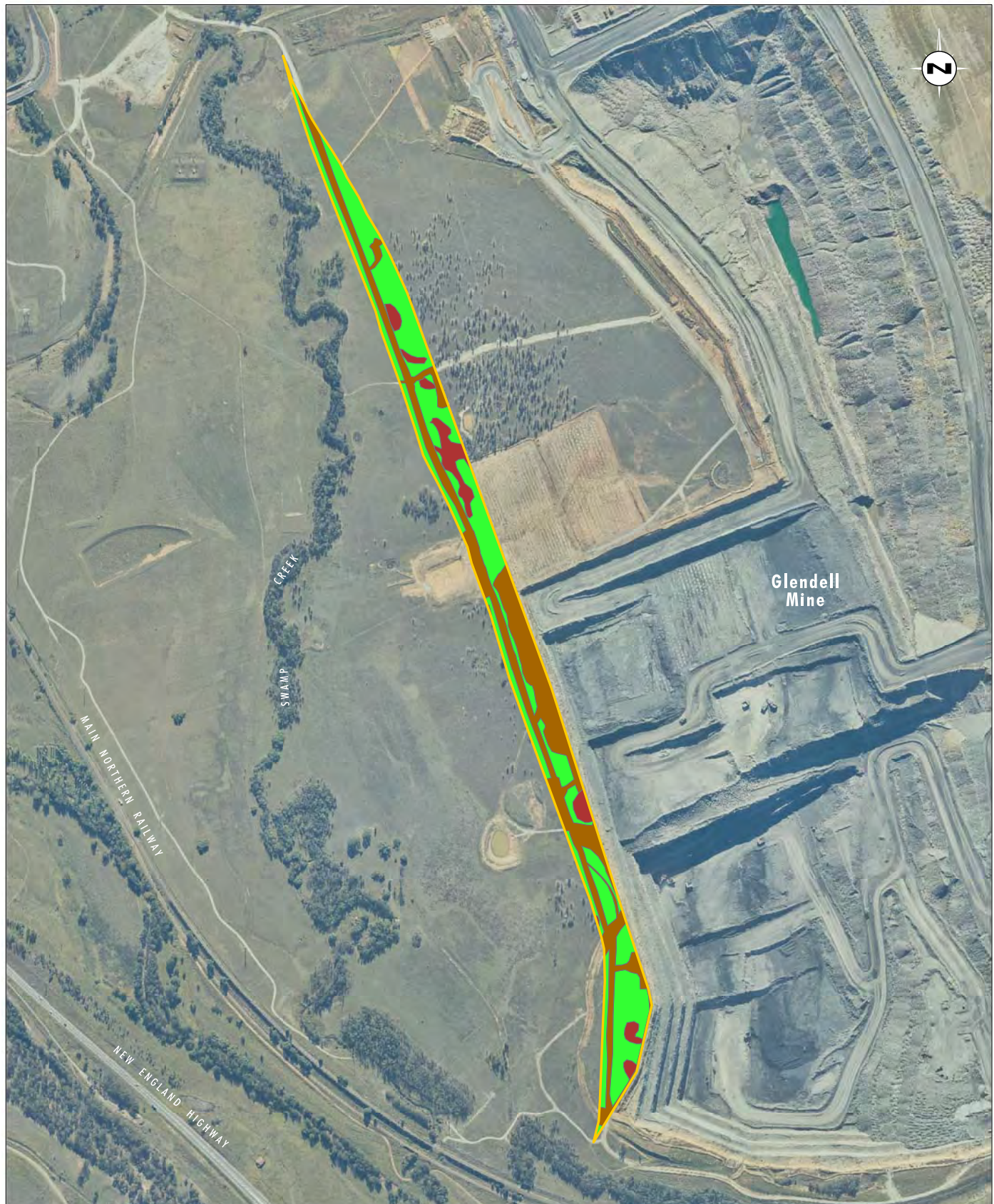


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 100 250 500m
1:10 000

Legend

- Proposed Additional Disturbance Area
- 1691 - Narrow-leaved ironbark - grey box grassy woodland of the central and upper hunter - derived native grassland
- 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Regeneration
- Disturbed Land

FIGURE 6.12

**Vegetation Zones in the
Proposed Additional
Disturbance Area**

6.5.4 Threatened Species

A list of the ecosystem-credit species and species-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Proposed Disturbance Area is provided in the BDAR, refer to **Appendix 5**. Threatened species records are shown on **Figure 6.13**.

6.5.5 Avoidance and Minimisation of Impacts

6.5.5.1 Avoidance and Minimisation of Impacts

The total Proposed Disturbance Area has been designed to avoid the alluvium associated with Swamp Creek to the west and north of the pit boundary, thereby reducing the total area of native vegetation to be impacted as well as avoiding all existing dams. The Proposed Disturbance Area has been located in an area of relatively low biodiversity value, resulting in a relatively small area of disturbance to native vegetation as a result of the Proposed Modification. Additionally an area of approximately 15.5 ha located to the southeast of the Barrett Pit that was approved for disturbance in 2008 is no longer required as part of the Glendell mining operations and will not be disturbed. Based on vegetation mapping undertaken by Umwelt for the Flora and Fauna Assessment for the Modification of Glendell Mine Operations (Umwelt 2007) this reduced area of disturbance contains three PCTs, as shown in **Figure 6.14** and **Table 6.10**.

Table 6.10 PCTs to be retained in area previously approved for disturbance

PCT Name	Area (ha)
PCT 1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley <i>Moderate</i>	4.7
PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.1
PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	10.7
Total	15.5

Mount Owen has committed to the design and implementation of a biodiversity mitigation strategy to mitigate the unavoidable impacts of the Proposed Modification, in accordance with existing impact minimisation measures outlined in the Mount Owen Complex Biodiversity and Offset Management Plan (Glencore 2017). The avoidance and minimisation measures relating to biodiversity management proposed for the Proposed Modification including the timing, action, outcome and responsibility of these measures are detailed in the BDAR, refer to **Appendix 5**. Each of these control measures will contribute to the maintenance of habitat quality adjacent to the Development Footprint outside existing approved disturbance.

The following management plans and programs are implemented at Mount Owen Complex and contribute to the management of potential indirect impacts of biodiversity features and values:

- Air Quality Management Plan
- Noise Monitoring Program
- Rehabilitation Management Plan
- Surface Water Management Plan and Monitoring Plan.

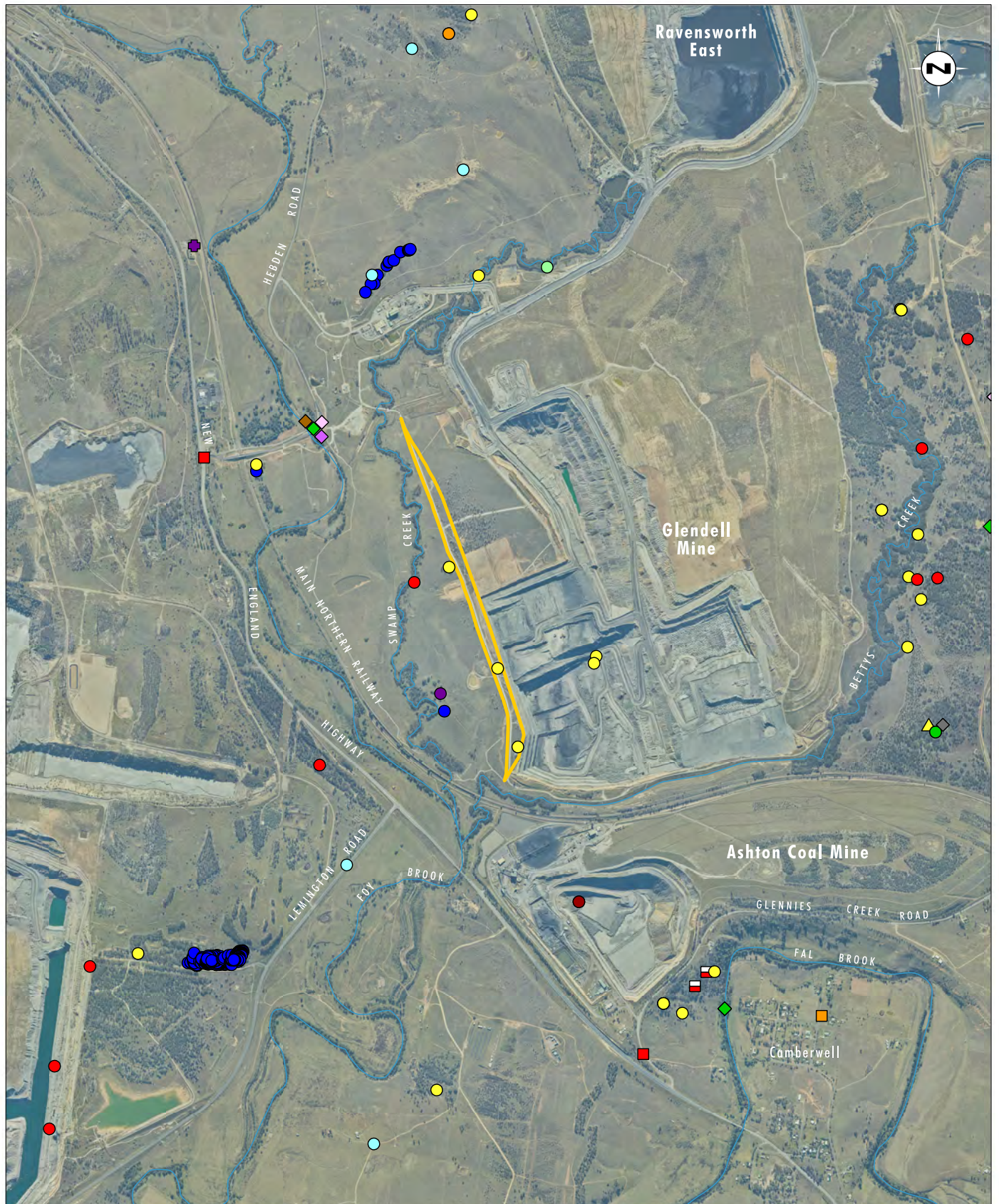


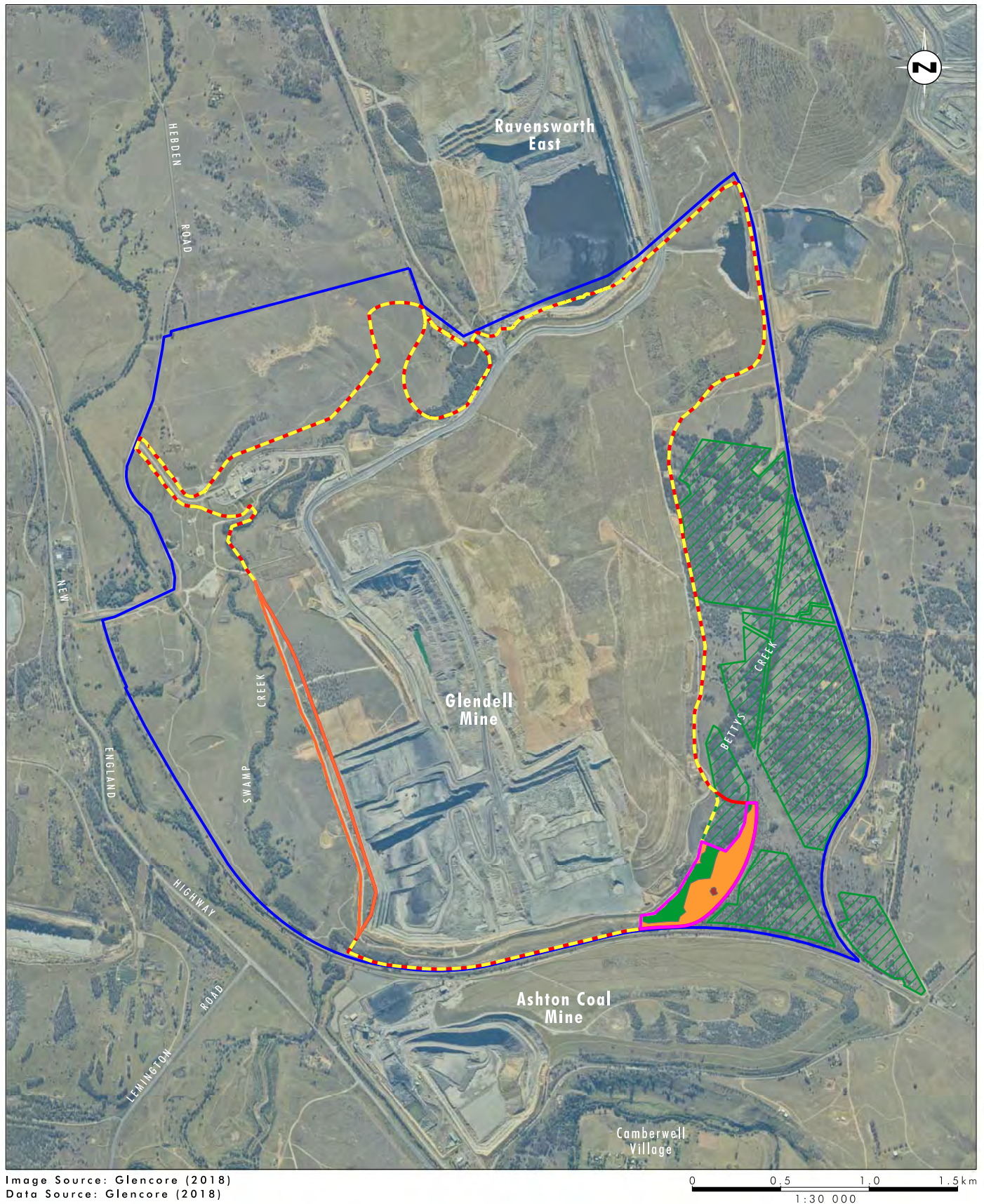
Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- | | | |
|---|---|---|
| Proposed Additional Disturbance Area | ● Grey-crowned Babbler (eastern subspecies) | ■ Spotted-tailed Quoll |
| ■ Black-necked Stork | ■ Koala | ◆ Yellow-bellied Sheath-tail-bat |
| ● Brown Tree-creeper (eastern subspecies) | ◆ Large-eared Pied Bat | ● <i>Acacia pendula</i> |
| ■ Brush-tailed Phascogale | ● Scarlet Robin | ● <i>Asperula asthenes</i> |
| ◆ Eastern Bentwing-bat | ◆ Southern Myotis | ● <i>Cymbidium canaliculatum</i> |
| ◆ Eastern Freetail-bat | ● Speckled Warbler | ● <i>Eucalyptus camaldulensis</i> |
| ▲ Flame Robin | ● Spotted Harrier | |

FIGURE 6.13
Threatened Species



Legend

- Glendell Mine DA Boundary (DA 80/952)
- - - Glendell Approved Disturbance Area (DA 80/952)
- - - Proposed Disturbance Area
- Proposed Additional Disturbance Area
- Decreased Disturbance Area
- PCT 1691 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter - Derived Native Grassland
- PCT 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Regeneration
- PCT 1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley
- ▨ Bettys Creek Habitat Management Area

FIGURE 6.14

**Vegetation Previously
Approved for Disturbance**

6.5.6 Assessment of Impacts

6.5.6.1 Impacts on Native Vegetation and Habitat

Direct impacts as a result of the Proposed Modification include the loss of vegetation and fauna habitats as a result of clearance works and subsequent mining operations. Approximately 7.3 ha of native vegetation will be directly impacted as a result of the Proposed Modification. The Proposed Disturbance Area contains a low abundance of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat) and no species-credit species have been predicted to occur within the Proposed Disturbance Area.

The Proposed Modification is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands. No indirect impacts are expected to occur in relation to surrounding connectivity, corridors or habitat fragmentation, however, some minor indirect impacts associated with noise, dust, light emissions, weeds and feral animals may occur during the construction and operation of the Proposed Modification. However, there will be no substantial change to noise, weed species, pest animal and dust impacts given that the Proposed Modification is part of, and adjacent to an existing mining operation with existing impacts. Any additional impacts resulting from the Proposed Modification are not expected to be of any level of significance in relation to threatened species, populations and communities.

There is no potential for any prescribed impacts as defined under the BC Regulation as a result of the Proposed Modification. Uncertain impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes and increased vehicle strikes. Indirect impacts associated with the interruption of ecosystem processes are also complex and difficult to quantify. Based on the nature and location of the Proposed Modification, it is unlikely that any uncertain prescribed impacts will occur.

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales.

Six species-credit species predicted by the BAM calculator for this Proposed Modification are listed as a serious and irreversible impact (SAIL) entities in the Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact (OEH 2017c), (regent honeyeater (*Anthochaera phrygia*), large-eared pied bat (*Chalinolobus dwyeri*), swift parrot (*Lathamus discolor*), little bentwing-bat (*Miniopterus australis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), brush-tailed rock-wallaby (*Petrogale penicillata*). None of these species or ecological communities listed as SAIL entities are likely to occur within the Proposed Disturbance Area and as such no further assessment of SAIL is required.

6.5.7 Biodiversity Credit Impact Summary

Under the BAM, impacts to areas of land without native vegetation do not require further assessment. The Proposed Disturbance Area contains approximately 4.7 hectares of cleared land that does not contain native vegetation. This impact does not require further assessment under the BAM.

Impacts to native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is associated with ecosystem-credit habitat or a VEC) or less than 15 (where it is representative of a EEC or CEEC). Both vegetation zones identified within the Proposed Disturbance Area have vegetation integrity scores above the thresholds. Therefore, both vegetation zones require offsetting under the BAM.

A full Biodiversity Credit Report is included in the BDAR, refer to **Appendix 5**. A summary of the key outcomes is provided in **Table 6.11**.

Table 6.11 Credits Required to Offset the Proposed Modification

PCT/Species-credit	Credits Required
Ecosystem Credits	
PCT1692 Bull Oak grassy woodland of the central Hunter Valley	21
PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of Central and Upper Hunter	88
Total	109

6.5.8 Biodiversity Offset Strategy

Mount Owen is committed to delivering a Biodiversity Offset Strategy that appropriately addresses the unavoidable loss of biodiversity values as a result of the Proposed Modification under the BC Act and Biodiversity Conservation Regulation 2017.

Mount Owen has sought to avoid and minimise biodiversity impacts during the Proposed Modification planning stage, which included the avoidance of 15.5 ha of land previously approved for disturbance, and the adoption of a range of impact mitigation strategies to mitigate the impact on ecological values prior to the consideration of offsetting requirements.

Fulfilling offset requirements under the BC Act will be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Biodiversity stewardship site/s and the retirement of credits
- Securing required credits through the open credit market
- Payments to the Biodiversity Conservation Fund and/or
- Funding a Biodiversity Conservation Action (if applicable).

6.6 Aboriginal Archaeology

An Aboriginal Archaeological Due Diligence Assessment has been undertaken by OzArk Environmental and Heritage Management Pty Limited to support the Proposed Modification, refer to **Appendix 6**.

The assessment follows the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (Due Diligence; DECCW 2010). Associated field assessment and reporting followed the Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011).

6.6.1 Assessment Methodology

The Due Diligence Code of Practice has been applied, in the completion of an Aboriginal archaeological assessment. The original fieldwork component of this assessment was undertaken by OzArk on Wednesday, 23 August 2017. Additional field survey was undertaken in April/May by OzArk and the Registered Aboriginal Parties (RAP's) as part of the Aboriginal Archaeological Assessment for the GCOP.

Survey included standard archaeological field survey and recording methods (Burke & Smith 2004). The study area was traversed by pedestrian means; first by walking south to the west of the light vehicle access road and then north to the east of the light vehicle access road, refer to **Figure 6.15**.

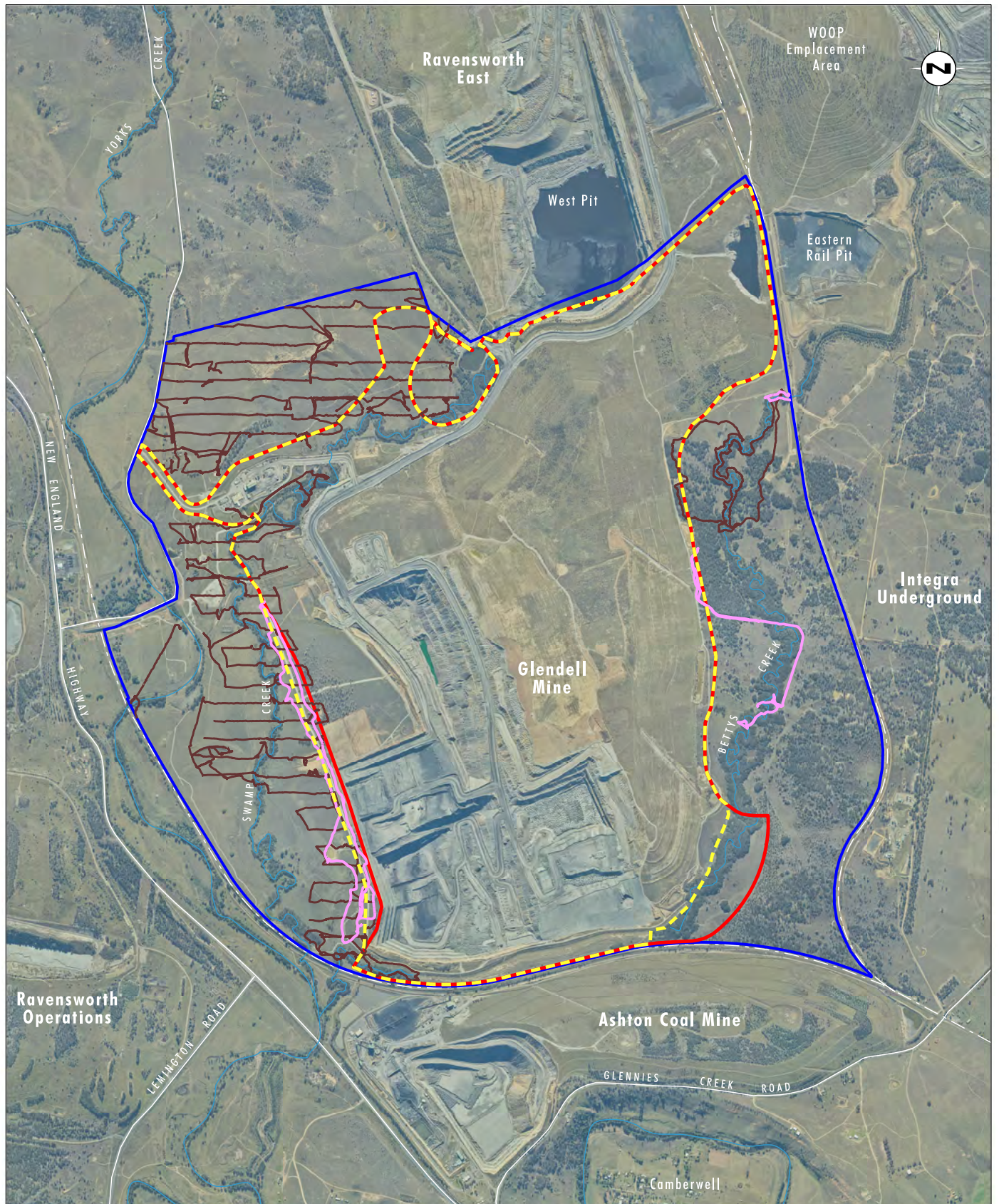


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018), OzArk (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Approved Disturbance Area (DA 80/952)
- - - Proposed Disturbance Area
- GCOP 2018 Survey Track
- Proposed Modification August 2017 Survey Track

FIGURE 6.15

Aboriginal Archaeology
Survey Effort

6.6.2 Landscape Context

The availability of semi-reliable water sources close to the study area (Swamp and Bowmans Creek) indicates that the broader area would have been a favourable location for Aboriginal occupation in the past. While alternations to the landscape as a result of previous landuse activities makes it difficult to accurately identify what other resources may have been available in the past, the relatively temperate climate and availability to reliable water sources would have enabled occupation of the area during all seasons.

The generally high degree of landform modification from both agricultural uses (vegetation clearing, grazing etc), as well as more recent mining activities (roads and drainage works), indicates that the integrity of any archaeological features such as artefact scatters, had they existed within the Proposed Disturbance Area, are likely to have been diminished or dispersed.

6.6.3 Regional Archaeological Context

Extensive heritage assessment work has been undertaken within the Hunter Valley, and in particular within the Mount Owen Complex in relation to numerous approvals. Of most relevance to the Glendell Mine is the Aboriginal archaeological assessment undertaken by Umwelt in 2001 for the approved Glendell mining operations, which included the Proposed Disturbance Area.

The assessment concluded that the entire Glendell consent boundary would have supplied adequate resources for small groups of hunter-gatherers living a mobile lifestyle. Nearby Bowmans Creek was highlighted as an area that should have formed the focus of camping activities of longer duration, possibly by larger numbers of people, due to an increased abundance and reliability of the resource base.

Other areas, such as the lower western slopes adjacent to Bettys Creek were assessed as having attracted groups of people for short-term visits to harvest abundant seasonal foods. Bowmans Creek was therefore cited as likely to have the largest sites in terms of spatial extent and numbers of artefacts. Bettys Creek and Swamp Creek were listed as likely to have evidence of more sporadic and short-term use as overnight camping locations.

6.6.4 Aboriginal Cultural Values

During the assessment for the Mount Owen Continued Operations Project, an extensive assessment of Aboriginal cultural heritage values was undertaken (Umwelt, 2015). No known cultural values are known to exist specifically in relation to the Proposed Disturbance Area. However, previous assessments have indicated that the landscape and waterways within or near the Proposed Disturbance Area, including Swamp Creek, Bettys Creek and Bowmans Creek, have cultural value for the local Aboriginal community in a general manner as these features are part of the community's Country.

No Aboriginal community members accompanied the survey of the Proposed Disturbance Area during the August 2017 survey and no sites were observed within the Proposed Disturbance Area during the 2017 survey. However, Aboriginal community were present during the April/May 2018 survey undertaken for the GCOP which included the Proposed Disturbance Area, and no specific cultural values pertaining to the study area were raised by the RAP's.

6.6.5 Results

Four Aboriginal sites, Swamp Creek IF-1 to Swamp Creek IF-4, were recorded as a result of the 2017 survey (refer to **Table 6.12** and **Figure 6.16**).

Table 6.12 Survey Results

Site Name	Coordinates (GDA Zone 56)	Site type	Site extent	Landform
Swamp Creek IF-1	318640E 6407727N	Isolated find	2m x 2m	Flat
Swamp Creek IF-2	318807E 6407327N	Isolated find	2m x 2m	Lower slope
Swamp Creek IF-3	318805E 6407330N	Isolated find	2m x 2m	Lower slope
Swamp Creek IF-4	318805E 6407340N	Isolated find	2m x 2m	Lower slope

It is considered that the survey results support the general archaeological context developed through previous assessment at the Mount Owen Complex, where Swamp Creek is likely to indicate short-term or sporadic use; numbers of sites away from waterways is greatly reduced; lower slope landforms are likely to record sites; there is unlikely to be subsurface deposits associated with sites and sites are likely to have been previously disturbed.

Given that only isolated finds in a secondary context were recorded during the survey, and that a high degree of land-use disturbance was noted, there is a low likelihood of intact sub-surface archaeological deposits being present within the study area.

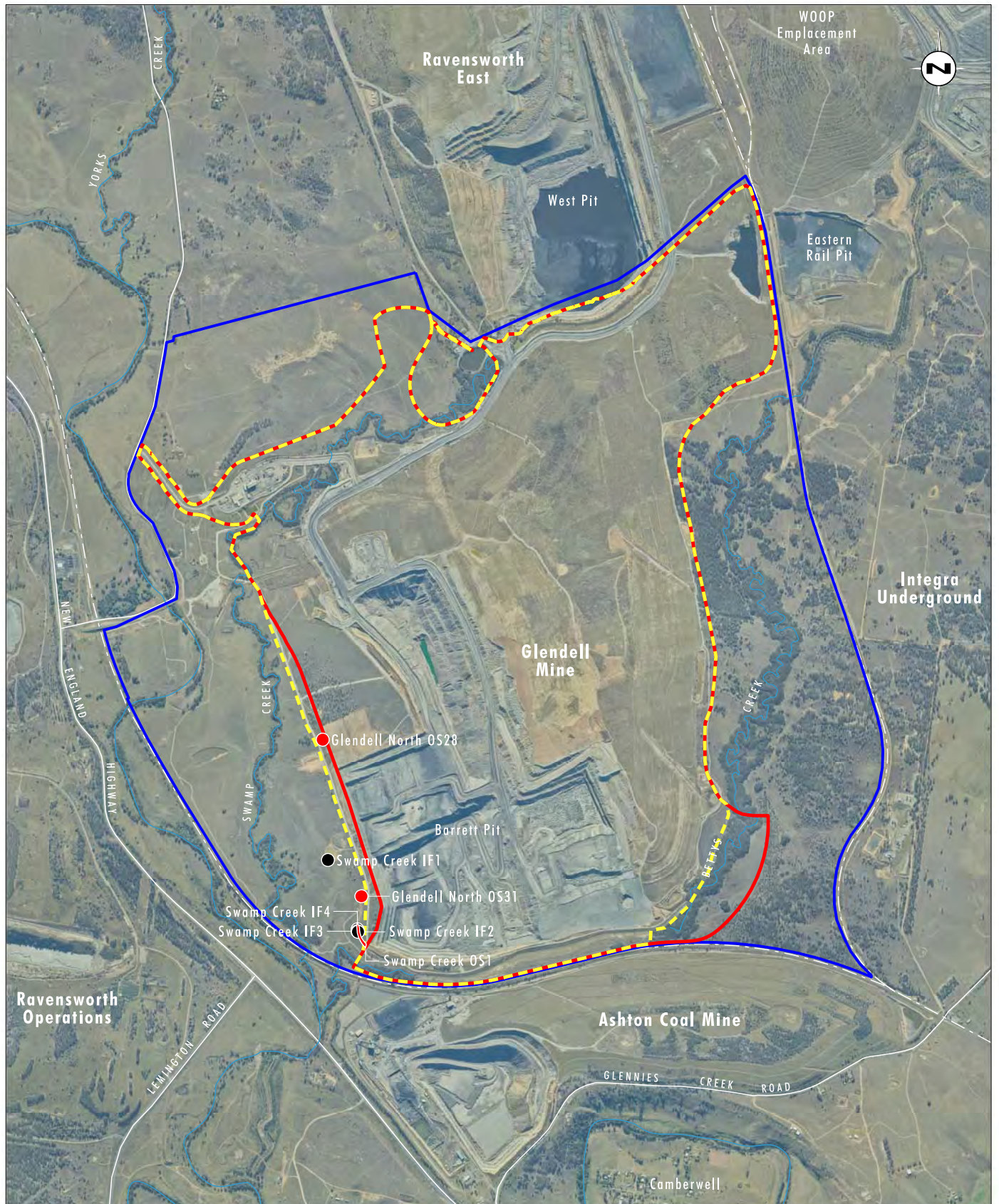


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018), OzArk (2018)

0 0.5 1.0 1.5 m
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- Approved Disturbance Area (DA 80/952)
- - - Proposed Disturbance Area
- Artefact scatter
- Isolated Find

FIGURE 6.16
Recorded Sites

6.6.6 Significance Assessment

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed development. Aboriginal heritage is of great value to many people and the site therefore has social value. Any assessment of social or cultural value is typically determined through consultation with the Aboriginal community. As community consultation has not been completed as part of the current due diligence assessment, all newly recorded sites have been provisionally assigned high social/cultural value. **Table 6.13** provides a summary of the significance assessment of the recorded sites.

Table 6.13 Significance Assessment of Recorded Sites – 2017 Survey

Site Name	Social or Cultural Value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
Swamp Creek IF-1	High	Low	Low	None
Swamp Creek IF-2	High	Low	Low	None
Swamp Creek IF-3	High	Low	Low	None
Swamp Creek IF-4	High	Low	Low	None

6.6.6.1 Likely Impacts to Aboriginal Heritage

While all sites recorded as part of the visual inspection of the 2017 survey area are outside of the Proposed Disturbance Area, three sites recorded subsequent to the 2017 survey, as part of the recent 2018 survey for the GCOP are either wholly within or partially within the Proposed Disturbance Area, refer to **Figure 6.16**.

Table 6.14 details the impact assessment relevant to the Proposed Modification.

OzArk recommend that the two sites recorded that are partially within the Proposed Disturbance Area be entirely salvaged should the Proposed Modification be approved. The reason for this is that both sites are highly disturbed with all artefacts in a secondary context along an existing drainage bund. It therefore serves no purpose to leave a portion of the site intact. Additionally the benefit of the full salvage of these sites as it will allow the artefacts to be moved to a safe location and prevent inadvertent impacts to the remainder of these sites as they would be in close proximity to impacts arising from the proposed mining operations. As three of the isolated finds recorded during the 2017 survey are now part of a larger artefact scatter (Swamp Creek OS1) that will be recommended for salvage, the three isolated finds will also be recommended for salvage.

Table 6.14 Impact Assessment

Site Name	AHIMS ID	Degree of disturbance	Archaeological/ Scientific significance	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequence of Harm (Total/Partial/ No Loss of Value)
Swamp Creek IF-1	37-3-1491	High	Low	None	None	No loss of value
Swamp Creek IF-2	37-3-1492	High	Low	Direct	Total	Total loss of value
Swamp Creek IF-3	37-3-1493	High	Low	Direct	Total	Total loss of value
Swamp Creek IF-4	37-3-1494	High	Low	Direct	Total	Total loss of value
Swamp Creek OS1	37-3-1499	High	Low	Direct	Total	Total loss of value

Site Name	AHIMS ID	Degree of disturbance	Archaeological/ Scientific significance	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequence of Harm (Total/Partial/ No Loss of Value)
Glendell North OS28	pending	High	Low	Direct	Total	Total loss of value
Glendell North OS31	pending	High	Low	Direct	Total	Total loss of value

6.6.7 Aboriginal Heritage Management and Mitigation

As all sites liable to be harmed by the Proposed Modification are in highly disturbed contexts and have a low scientific value, it is considered an appropriate mitigation would be to undertake a recording and collection of all low density surface artefacts. The protocol for the collection of surface artefacts at these sites should follow the current Mount Owen Complex ACHMP Section 6.2.1.1. The four newly-recorded sites will also be registered with OEH AHIMS by OzArk.

Based on the recommendations from the Due Diligence Assessment, the following mitigation measures will be implemented should the Proposed Modification be approved:

- The Mount Owen Complex ACHMP will be updated to include the recording and collection of surface artefacts occurring at six sites: Swamp Creek IF-2; Swamp Creek IF-3; Swamp Creek IF-4; Swamp Creek OS1; Glendell North OS28; and Glendell North OS31. The collection of surface artefacts should follow the procedure set out in the Mount Owen Complex ACHMP Section 6.2.1.1. Updates to the ACHMP will include consultation with the Aboriginal community is required as set out in Section 8.1 of the Mount Owen Complex ACHMP.

6.7 Mine Closure and Rehabilitation

Progressive rehabilitation is undertaken at the Glendell Mine in accordance with the Mount Owen Complex Mining Operations Plan (MOP) and the Mount Owen Complex Biodiversity and Offset Management Plan (BOMP). The Proposed Modification does not alter the broad mine closure and rehabilitation commitments and practices currently implemented at Glendell Mine. The key final landform design parameters relate to the establishment of a natural undulating landform and meeting the rehabilitation objectives relevant to the Approved Operations. There are no additional voids within the final landform as part of the Proposed Modification.

6.7.1 Rehabilitation

The primary objective of mine rehabilitation is to create a stable final landform with acceptable post-mining land use capability. The proposed end land use for the existing Glendell Mine includes a combination of grazing land and bushland. Rehabilitation of the overburden emplacement areas and backfilled pits are conducted progressively over the life of the mine, as an integral component of mining operations. All rehabilitation works are scheduled to occur progressively as soon as practicable after mining disturbance. Existing rehabilitation methods include shaping, vegetation establishment, fencing, feral animal control and bushfire management.

The approved conceptual final landform was designed to maintain consistency with the local area predominantly consisting of an undulating landform reflecting the dominant features of the existing environment. Mount Owen undertaken geotechnical investigations as mining progresses, investigations to date indicate the western and northern highwall of the Barrett Pit can be constructed to form a stable landform, the additional disturbance proposed along the western highwall is proposed to assist with the implementation of additional earthworks in order to provide for greater stability of the highwall.

The final landform predominantly consists of slopes of 10 degrees increasing to up to a maximum of 14 degrees in places. Rehabilitation will include a drainage pattern capable of conveying runoff from the established landform and minimise the risk of erosion and sedimentation. Consistent with the Approved Operations a final void will remain post closure. In accordance with condition 41 of DA 80/952, a Final Void Management Plan will be prepared as part of the mine closure planning process.

The Proposed Modification will result in only minor changes to the conceptual final landform (refer to **Figure 2.4**) and maintains the commitments and strategies developed for the approved operations to maximise the visual and ecological benefits of the rehabilitation, which includes:

- Rehabilitated areas will include pastures with a minimum of 30% native tree lots and corridors for the purpose of stock shade and shelter, and habitat restoration.
- Trees will be located where they will have the greatest visual and corridor continuity benefits. This will include slopes facing towards the road and other viewing points.
- Treed areas will be sympathetically married into the landform. Trees will be positioned around slopes and across grade changes.
- Irregular shaped treed areas will be created with undulating edges. Straight lines and rectangular areas will be avoided.
- New treed areas will be blended in with older sites and with natural vegetation. This is both visually and ecologically sound.
- The formation of wildlife corridors is a key component of the program.
- Species composition and density will be varied in order to create diversity.
- Elements such as drainage paths, contour drains, ridgelines, and emplacements will be shaped, where possible, in undulating informal profiles in keeping with natural landforms of the surrounding environment. The diverse topography will provide opportunities for a greater diversity of plant species and communities over time.
- Topsoiled areas will have a nominal land capability of class IV or V depending on slope and landscape position. Areas rehabilitated without topsoil will have an end land capability of Class VI.

6.7.2 Mine Closure

Mount Owen has prepared a conceptual Mine Closure Plan for the Glendell Mine in accordance with Condition 42 of DA 80/952. The conceptual mine closure plan provides a clear, planned and executable mine closure process for the Glendell Mine, and the broader Mount Owen Complex. The conceptual mine closure plan is developed in accordance with relevant legislation and guidelines. The conceptual mine closure plan details the requirements of the relevant legislation, post-mining landuse and closure objectives, mine design and planning, rehabilitation/environmental management/monitoring and social and community engagement. The conceptual mine closure plan will be refined through additional analysis and assessment and confirmed prior to closure.

It should be noted that should the GCOP be approved, the closure of the Glendell Mine will not occur following completion of mining under the Proposed Modification and mining will continue in accordance with the development consent granted for GCOP.

6.7.3 Post Mining Land Use

The Proposed Modification will result in only minor changes to the approved conceptual final landform, and no change to the approved final land use is proposed. Mount Owen has integrated the rehabilitation objectives and design across the Mount Owen Complex. The proposed final landform design will provide for a mix of open grassland capable for sustaining grazing and native vegetation. Native vegetation corridors will link open woodland and forest rehabilitation areas with native remnant vegetation, Ravensworth State Forest, biodiversity offset areas within the Mount Owen Complex and at neighbouring mining operations. The largest areas of open grassland will be implemented within the Glendell Mine final landform. The overall rehabilitation objective for the Glendell Mine has been to form predominately pastures with a minimum of 30% native tree lots and corridors for the purpose of stock shade and shelter, and habitat restoration.

Final landuse planning is undertaken as part of the development of the conceptual mine closure plan. A range of potential final land use options will be investigated during the development and refinement of the Mine Closure Plan. The rehabilitation of the site with a mix of grassland and vegetation corridors lends itself to the development of potential agricultural and/or conservation land use. Additionally the established infrastructure areas could also be adapted to industrial land uses. Further investigation and assessment will be undertaken in finalising the mine closure plan for the Glendell Mine including detailed cost-benefit analysis, closer to the point of mine closer. Integration with the broader Mount Owen Complex final land use strategy and the incorporation of compatible land uses is also an important consideration.

Should the GCOP be approved, mining operations will continue until 2044 and detailed final land use (post mining) will be determined through the assessment process for the GCOP.

7.0 Conclusion and Justification

This section provides a conclusion discussing the justification for the Proposed Modification, taking into consideration the environmental impacts of the Proposed Modification and the suitability of the site, to assist the consent authority to determine whether or not the Proposed Modification is in the public interest.

7.1 Environmental Impacts

As detailed in **Section 6.0**, the potential environmental impacts of the Proposed Modification have been identified and are the subject of a detailed assessment based on:

- assessment of the site characteristics (existing environment)
- focused consultation with relevant government agencies
- application of the principles of ecologically sustainable development, including the precautionary principle, inter-generational equity and conservation of biological diversity and ecological integrity, and
- expert technical review/assessment (where relevant).

The Proposed Modification will have minimal incremental environmental impacts relative to the approved Glendell Mine operations. Any potential impact associated with the Proposed Modification has been kept to a minimum through limiting the associated disturbance, refinement to the conceptual mine plans and continued commitment to the implementation of management and monitoring measures to avoid, minimise, mitigate or offset potential environmental impacts.

7.2 Suitability of the Site

The Glendell Mine forms part of the Mount Owen Complex, which is surrounded by established mining operations with private residences also located to the south and south-east of the Glendell Mine. Mount Owen has limited the modification of the approved mine plans to ensure the Proposed Modification will result in minimal environmental impact relative to the approved operations, and ensure the mining operations at Glendell Mine can continue to be managed to meet the current DA 80/952 criteria for noise and air quality for neighbouring private receiver locations.

The Proposed Modification provides operational contingencies to aid planning for future operations at the Mount Owen Complex and will continue to utilise existing and approved mining infrastructure and continued implementation of existing environmental mitigation and management strategies to control the predicted impacts associated with the mining operations, thereby limiting potential for conflicts with other land uses, particularly the surrounding private residences.

7.3 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) is one of a number of objectives of the EP&A Act and is defined by Section 6(2) of the *Protection of the Environment Administration Act 1991*. This section provides an assessment of the Proposed Modification in relation to the principles of ESD.

To justify the Proposed Modification with regard to the principles of ESD, the benefits of the Proposed Modification in an environmental and socio-economic context should outweigh any negative impacts. The principles of ESD encompass the following:

- the precautionary principle

- inter-generational equity
- conservation of biological diversity
- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality than the one that is inherited

7.3.1 The Precautionary Principle

The EP&A Regulation defines the precautionary principle as:

‘if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

- careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
- an assessment of the risk-weighted consequences of various options.’*

The assessment process has involved a focussed study of the existing environment and the use of engineering and scientific modelling to assess and determine potential impacts as a result of the Proposed Modification relative to the Approved Operations. The proposed amendments to the conceptual mine plans has been designed to limit any potential incremental environmental impact, with any potential environmental impact being generally consistent with the approved operations. To this end, there has been careful evaluation to avoid, where possible, irreversible damage to the environment.

Detailed mitigation and monitoring measures will continue to be implemented in accordance with the relevant approved management and monitoring plans which will be updated as required as part of the Proposed Modification (refer to **Sections 2.3** and **5.0**).

7.3.2 Intergenerational Equity

The EP&A Regulation defines the principle of intergenerational equity as:

‘that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.’

Intergenerational equity is based on the principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The design of the Proposed Modification has sought to:

- Provide continuity of mining operations at the Glendell Mine during the assessment of the GCOP
- Implement the initial mine plan changes in order to efficiently implement and progress the proposed GCOP mine plan (should the GCOP be approved)
- Provide additional economic benefit and ongoing employment of the existing mine workforce (during the assessment process for the GCOP)
- Minimise the environmental impact through restricting the additional proposed disturbance area and reducing the overall approved disturbance area through relinquishing an area previously approved for disturbance.

There will be no material increase in impact associated with the Proposed Modification relative to the Approved Operations. The design of the Proposed Modification and Mount Owen's continued commitment to the management of environmental issues as outlined in this SEE will maintain the health, diversity and productivity of the environment for future generations.

7.3.3 Conservation and Biological Diversity

The EP&A Regulation identifies that the principle of conservation of biological diversity and ecological integrity should be a fundamental consideration in the decision making process. The conservation of biological diversity refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the Proposed Modification are described in the SEE (refer in particular to **Section 6.5** and **Appendix 5**).

Although an additional 12 ha of disturbance is required along the western boundary of the approved disturbance area, the approved disturbance area has also been revised to remove an area previously approved for disturbance on the eastern boundary of the site (15.5 ha). Therefore there will be a net decrease (3.5 ha) in the overall disturbance area associated with the Glendell Mining operations.

The final biodiversity offset strategy to be delivered for the Proposed Modification will include some or all of the following offsetting options:

- In-perpetuity conservation through the establishment of a biodiversity stewardship site/s and the retirement of credits
- Securing required credits through the open credit market
- Payments to the Biodiversity Conservation Fund and/or
- Funding a Biodiversity Conservation Action (if applicable).

7.3.4 Valuation and Pricing of Resources

The goal of improved valuation of natural capital has been included in Agenda 21 of Australia's Intergovernmental Agreement on the Environment. The principle has been defined in the EP&A Regulation as:

'that environmental factors should be included in the valuation of assets and services, such as:

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'

With regard to the polluter pays principle, all surface water associated with mining operations is managed within the GRAWTS, and there is no discharge from the Mount Owen Complex. Pricing of resources is also captured in the regulatory regime applying to surface and groundwater extractions.

Mount Owen has considered the costs of management measures to minimise potential environmental and social impacts over the life of the Glendell mining operations. There will also be additional costs associated with establishing and managing ecological offsets to reduce the magnitude of ecological impacts associated with the Proposed Modification, and these costs have been accounted for.

Consistent with the Approved Operations, Mount Owen will continue to optimise the valuation and pricing of the coal reserves with minimal impact by:

- optimising available use of the existing coal processing and transportation facilities to wash coal and to transport product coal to existing markets, and
- maximising the efficient extraction of the coal reserves and avoiding the isolation and sterilisation of coal through effective mine planning and location of site infrastructure.

7.4 Conclusion

As outlined in **Section 7.3**, the Proposed Modification has been assessed against the principles of ESD as required by the EP&A Act. This assessment has indicated that the Proposed Modification is consistent with the principles of ESD. On this basis, it would be reasonable to consider that with the continued implementation of the management, mitigation and offset measures proposed by Mount Owen, the potential impacts associated with the Proposed Modification will be minimal, and generally consistent with the approved operations.

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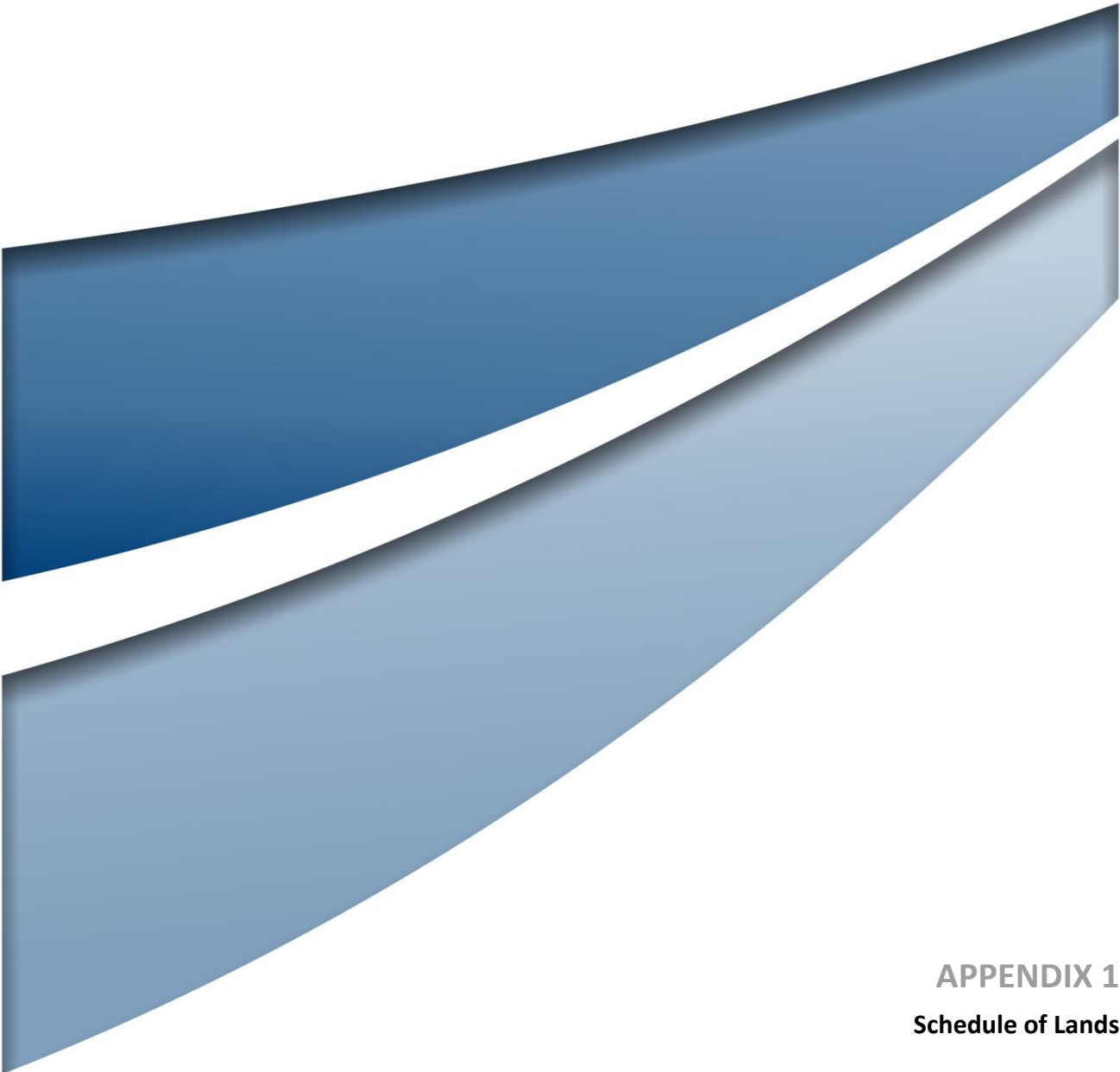
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9.0 Abbreviations and Glossary

Terms	Definition
ACHA	Aboriginal Cultural Heritage Assessment
ACHMP	Aboriginal Cultural Heritage Management Plan
AEP	Annual Exceedance Probability
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AIP	NSW Aquifer Interference Policy
ANZECC	Australian and New Zealand Environment Conservation Council
AQIA	Air Quality Impact Assessment
BAM	Biodiversity Assessment Methodology
BDAR	Biodiversity Development Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
BIA	Blast Impact Assessment
BMP	Blast Management Plan
BOMP	Biodiversity and Offset Management Plan
BSAL	Biophysical Strategic Agricultural Land
CEEC	Critically Endangered Ecological Community
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Clusters
CSG	Coal seam gas
DEC	Department of Environment and Conservation
DoEE	Commonwealth Department of Environment and Energy
DPE	Department of Planning and Environment
DSC	NSW Dams Safety Committee
EA	Environmental Assessment
EC	Electrical Conductivity
EEC	Endangered Ecological Communities
EHC Act	<i>Environmentally Hazardous Chemicals Act 1985</i>
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENM	Environmental Noise Model
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environment Protection Licence
ESCP	Erosion and Sediment Control Plan
FTE	Full time equivalent

Terms	Definition
GCOP	Glendell Continued Operations Project
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GRAWTS	Greater Ravensworth Area Water and Tailings Scheme
GWIA	Groundwater Impact Assessment
HRSTS	Hunter River Salinity Trading Scheme
HVO	Hunter Valley Operations
IESC	Independent Expert Scientific Committee
INP	Industrial Noise Policy
LEP	Local Environment Plan
LGA	Local Government Area
LOM	Life of Mine
mAHD	Metres above Australian Height Datum
MIA	Mine Infrastructure Area
MLA	Mining Lease Application
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MSB	NSW Mine Subsidence Board
MSC Act	<i>Mine Subsidence Compensation Act 1961</i>
Mt	Million tonnes
Mtpa	Million tonnes per annum
NIA	Noise Impact Assessment
NMP	Noise Management Plan
NO _x	Nitrogen Oxide
OEH	Office of Environment and Heritage
PCTs	Plant Community Types
PM	Particulate Matter
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
PSNL	Project Specific Noise Levels
RAPs	Registered Aboriginal Parties
RFS	Rural Fire Service
ROM	Run of mine
SEE	Statement of Environmental Effects
SEOC	South East Open Cut
SEPP	State Environmental Planning Policy
SIA	Social Impact Assessment
SRLUP	NSW Government Strategic Regional Land Use Plan

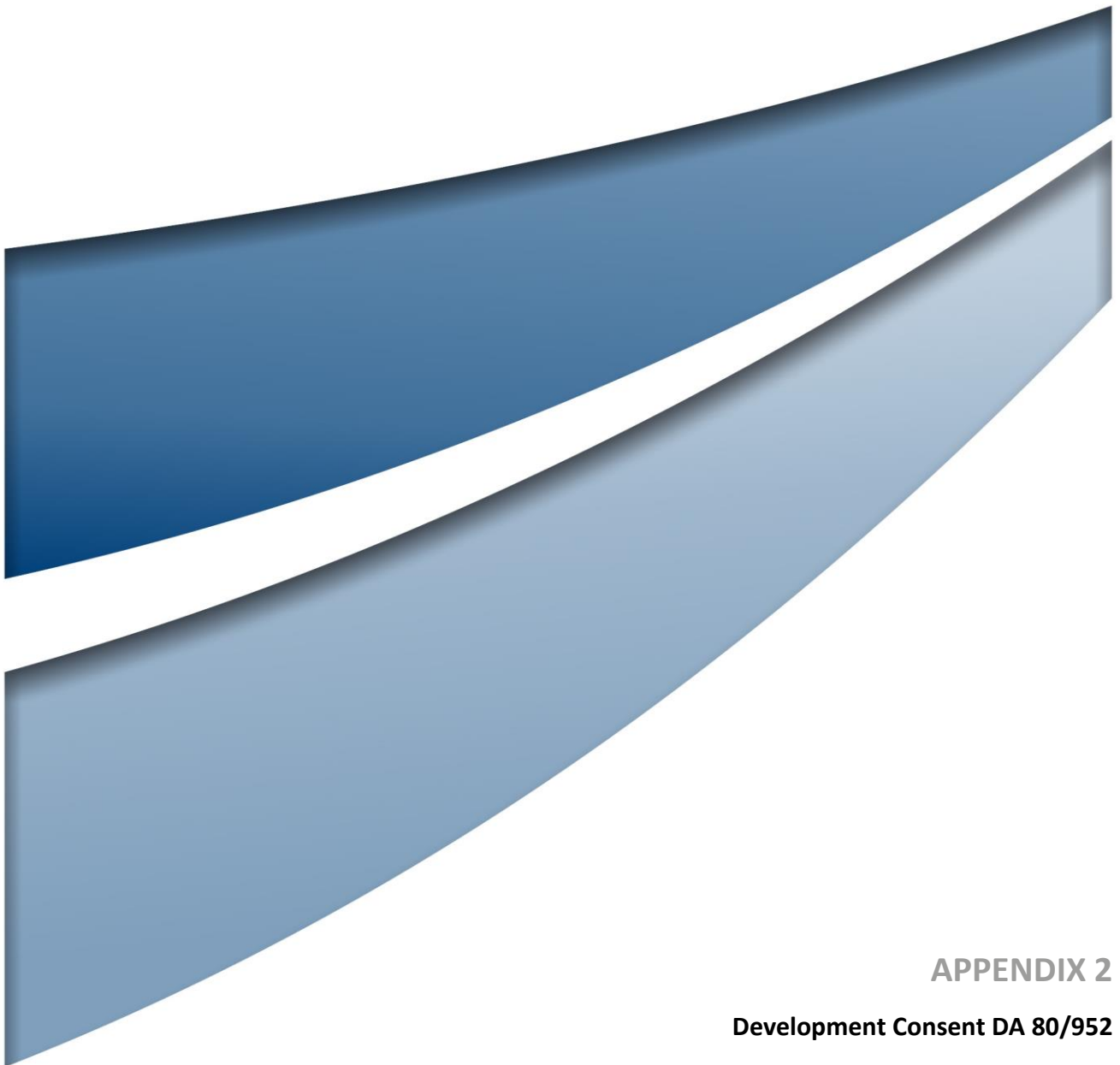
Terms	Definition
SVC	Site Verification Certificate
TSC Act	<i>Threatened Species Conservation Act 1995</i>
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
µg	Micrograms
VIS	Vegetation Information System
VLAMP	Voluntary Land Acquisition and Mitigation Policy 2014
VWPS	Vibrating wire pressure sensors
WM Act	<i>Water Management Act 2000</i>
WMS	Water Management System
WSP	Water Sharing Plan



APPENDIX 1
Schedule of Lands

Schedule of Lands – Glendell Mine Modification 4

Lot Sec DP	Status
1//1180252	Enex Foydell Pty Limited
1//865784	Glendell Tenements Pty Ltd
1//940619	Enex Foydell Pty Limited
11//592404	Enex Foydell Pty Limited
2//1180252	Glendell Tenements Pty Limited
2//6842	Enex Foydell Pty Limited
2//859544	Ravensworth Operations Pty Limited
2//865784	Ravensworth Operations Pty Limited
2A//6842	Enex Foydell Pty Limited
3//1180252	Ravensworth Operations Pty Limited
3//859544	Ravensworth Operations Pty Limited
311//848411	Glendell Tenements Pty Ltd
4//1072124	Mt Owen Pty Limited
5//1077004	Enex Foydell Pty Limited
5//859544	Mt Owen Pty Limited
6//1077004	Enex Foydell Pty Limited
6//859544	Mt Owen Pty Limited
7//1077004	Enex Foydell Pty Limited
71//625171	Enex Foydell Pty Limited
8//6830	Enex Foydell Pty Limited
A//380246	Glendell Tenements Pty Ltd
58//752499	Crown Land
Road Reserves	



APPENDIX 2

Development Consent DA 80/952

Development Consent

Section 101 of the *Environmental Planning and Assessment Act 1979*

I determine the application to carry out the proposed development by granting consent to the application, subject to the conditions in schedules 1 to 5.

2 May 1983

Eric Bedford
Minister for Planning and Environment

SCHEDULE 1 DEVELOPMENT DESCRIPTION

Application Number:	DA 80/952
Applicant:	Mt Owen Pty Limited
Land:	See Appendix 1
Development:	The Glendell Open Cut Coal Mine and Associated Infrastructure

Black type represents Feb 2008 modification – replaced all previous conditions
Blue type represents Dec 2016 modification

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DEFINITIONS

Acquisition Zone	The privately-owned land listed in Table 1 where there are no negotiated agreements in place between the Applicant and the applicable landowner
Annual Review	The review required by condition 5 of schedule 5
Applicant	Mt Owen Pty Limited, or its successors, including any person/s who rely on this consent to carry out development that is subject to this consent
ARTC	Australian Rail Track Corporation Ltd
BCA	Building Code of Australia
CCC	Community Consultative Committee
Conditions of this consent	Conditions contained in Schedules 2 to 5 inclusive
Council	Singleton Shire Council
Day	The period from 7am to 6pm on Monday to Saturday, and 8am to 6pm on Sundays and Public Holidays
Department	Department of Planning & Environment
Development	The development as described in the documents listed in 2(a) of schedule 2
DPI	Department of Primary Industries
DPI Water	Division of Water within the DPI
DST	Daylight Savings Time
DRE	Division of Resources and Energy within the Department of Industry
EA (Mod 2)	Environmental assessment for Modification 2 of DA 80/952, titled <i>Environmental Assessment for Modification of Glendell Mine Operations, Volumes 1-3</i> , dated August 2007 and prepared by Umwelt (Australia) Pty Limited, including the response to submissions document dated October 2007
EA (Mod 3)	Environmental assessment for Modification 3 of DA 80/952, titled <i>Glendell Mine 132 kV Powerline Relocation Modification 3 Environmental Assessment</i> , dated August 2016 and prepared by Hansen Bailey, including the response to submissions document dated September 2016
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPA	Environment Protection Authority
EPL	Environment Protection Licence issued under the <i>Protection of the Environment Operations Act 1997</i>
EST	Eastern Standard Time
Evening	The period from 6pm to 10pm
Feasible	Feasible relates to engineering considerations and what is practical to build or implement
Heritage Branch	Heritage Branch of OEH
Incident	A set of circumstances that: - causes, or threatens to cause, material harm to the environment; and/or - breaches or exceeds the limits or performance measures/criteria in this consent
Land	As defined in the EP&A Act, except for where the term is used in the noise and air quality conditions in Schedules 3 and 4 of this consent where it is defined to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this consent
Material harm to the environment	Actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial
Mine water	Water that accumulates within, or drains from, active mining areas, coal reject emplacement areas, tailings dams and infrastructure areas and any other areas where runoff may have come into contact with coal or carbonaceous material
Mining Area	The area hatched green on the Development Layout Plan in Appendix 2
Minimise	Reduce adverse impacts by implementing all reasonable and feasible mitigation measures
Mining operations	Includes the removal and emplacement of overburden and extraction, processing, handling, storage and transport of coal on site
Minister	Minister for Planning, or delegate
Mitigation	Activities associated with reducing the impacts of the development
Mt Owen Complex	The combined operations of the Mt Owen, Ravensworth East and Glendell mines
Night	The period from 10pm to 7am on Monday to Saturday, and 10pm to 8am on Sundays and Public Holidays
OEH	Office of Environment and Heritage

Offset Strategy	The biodiversity conservation and enhancement strategy described in the documents listed in condition 2(a) of schedule 2, summarised in Table 11 and depicted conceptually in the figure in Appendix 5
Privately-owned land	Land that is not owned by a public agency, or a mining company (or its subsidiary)
Public infrastructure	Linear and related infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas supply, electricity, telephone, telecommunications, etc.
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Rehabilitation	The restoration of land disturbed by the development to a good condition, to ensure it is safe, stable and non-polluting
RMS	Roads and Maritime Services
ROM	Run-of-Mine
Secretary	Secretary of the Department, or nominee
Site	The land referred to in Appendix 1
Statement of Commitments	The Applicant's commitments in Appendix 3

SCHEDULE 2 ADMINISTRATIVE CONDITIONS

Obligation to Minimise Harm to the Environment

1. In addition to meeting the specific performance criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent and/or minimise any material harm to the environment that may result from the construction, operation, or rehabilitation of the development.

Terms of Consent

2. The Applicant must carry out the development:
 - (a) generally in accordance with the EA (Mod 2), EA (Mod 3) and the Development Layout Plan; and
 - (b) in accordance with the Statement of Commitments and the conditions of this consent.

Notes:

- The Development Layout Plan is shown in Appendix 2.
- The Statement of Commitments is reproduced in Appendix 3.

3. If there is any inconsistency between documents listed in condition 2(a) above, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this consent shall prevail to the extent of any inconsistency.
4. The Applicant must comply with any reasonable requirement/s of the Secretary arising from the Department's assessment of:
 - (a) any strategies, plans, programs, reviews, reports, audits or correspondence that are submitted in accordance with this consent (including any stages of these documents);
 - (b) any reviews, reports or audits commissioned by the Department regarding compliance with this consent; and
 - (c) the implementation of any actions or measures contained in these documents.

Limits on Consent

5. Mining operations may take place until the end of June 2024.

Note: Under this consent, the Applicant is required to rehabilitate the site and provide offsets to the satisfaction of the Secretary and DRE. Consequently this consent will continue to apply in all other respects other than the right to conduct mining operations until the site has been rehabilitated and the offsets provided to a satisfactory standard.

6. The Applicant **must** not extract more than 4.5 million tonnes of ROM coal from the site in any calendar year.
7. The Applicant **must** not transport any coal from the site using public roads.
8. (deleted)
9. (deleted)

Structural Adequacy

10. The Applicant **must** ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Notes:

- Under Part 4A of the EP&A Act, the Applicant is required to obtain construction and occupation certificates for the proposed building works.
- Part 8 of the EP&A Regulation sets out the requirements for the certification of the development.

Operation of Plant and Equipment

11. The Applicant **must** ensure that all plant and equipment used on site is:
 - (a) maintained in a proper and efficient condition; and
 - (b) operated in a proper and efficient manner.

Development Contributions

12. By the end of July 2008 (unless otherwise agreed by the [Secretary](#)), the Applicant [must](#) enter into an agreement with Singleton Council to provide development contributions to Council for the development, in accordance with Division 6 of Part 4 of the EP&A Act.

If the Applicant and Council cannot agree on the level or composition of the development contributions, then either party may refer the matter to the [Secretary](#) for resolution.

Demolition

13. The Applicant [must](#) ensure that all demolition work undertaken in relation to the development is carried out in accordance with [AS 2601-2001: The Demolition of Structures](#), or its latest version.

Protection of Public Infrastructure

14. Unless the Applicant and the applicable authority agree otherwise, the Applicant [must](#):
- (a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the development; and
 - (b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the development.

Note: This condition does not apply to any damage to public infrastructure subject to compensation payable under the Mine Subsidence Compensation Act 1961, or to damage to roads caused as a result of general road usage.

Transmission Line

15. Prior to mining within 200 metres of the existing electrical 132 kilovolt transmission line, that traverses the site, the Applicant [must](#):
- (a) relocate the affected section of transmission line to a new alignment as shown conceptually in Appendix 2 (see blue easement) and to the satisfaction of Ausgrid;
 - (b) ensure that any aspects of the new transmission line that occur within or interact with the Main Northern Railway corridor are designed and constructed to the satisfaction of ARTC; and
 - (c) design, install and maintain any infrastructure within 40 metres of watercourses generally in accordance with DPI Water's [Guidelines for Controlled Activities on Waterfront Land](#).
-

SCHEDULE 3 SPECIFIC ENVIRONMENTAL CONDITIONS

ACQUISITION OF AFFECTED PROPERTIES

Acquisition Upon Request

- Upon receiving a written request for acquisition from the owner of the land listed in Table 1, the Applicant **must** acquire the land in accordance with the procedures in conditions 9-11 of schedule 4.

Table 1: Land subject to acquisition upon request

37a & 37b – Richards	Lot 13 DP 6830 – Gardner
61 – Donellan	Lot 12 DP 6830 – Noble
62 – Noble (b)	Lot 1 DP 770733 – Noble
65 – Noble	

Note: Lands titled 62 – Noble (b), 65 – Noble, Lot 13 DP 6830 – Gardner, Lot 12 DP 6830 – Noble and Lot 1 DP 770733 – Noble have been acquired and are now mine-owned.

NOISE

Noise Impact Assessment Criteria

- The Applicant **must** ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 2 at any residence on privately-owned land, or on more than 25% of any privately-owned land.

Table 2: Noise impact assessment criteria dB(A)

Land Number / Receiver	Day/Evening/Night <i>L_{Aeq}(15 minute)</i>	Night <i>L_{A1}(1 minute)</i>
<i>Camberwell Village A</i>		
30 – Ninness 33 – Peachey 37c – Richards 53 – Yates	42	45
11 – Chisholm 22b – Turner 35 – Pugh	41	45
Other privately-owned land in Camberwell Village A	40	45
<i>Camberwell Village B</i>		
20 – Foord 21a & 21b – Merchant 38 – Roberton 47 & 50 – Vollebregt & Clarke	42	45
6 – Bennett 24 – Lopes	40	45
4 – Standing 40 – Smiles	39	45
32 – Green 44 – Stapleton	38	45
Other privately-owned land in Camberwell Village B	37	45
<i>Camberwell Village C</i>		
27 – McInerney	40	45
31 – Olofsson	38	45
Other privately-owned land in Camberwell Village C	35	45
<i>Other Privately-owned Land</i>		
37a & 37b – Richards 83 – Westcott 110 – Hall	38	45

Land Number / Receiver	Day/Evening/Night <i>L_{Aeq}(15 minute)</i>	Night <i>L_{A1}(1 minute)</i>
34 – Poulton 87 – Fairfull	37	45
9 – Burgess 18 – Hall 45 & 46 – Tisdell	36	45
All other privately-owned land	35	45
Camberwell Hall and St Clements Church	40	-

However, if the Applicant has a written negotiated noise agreement with any landowner of the land listed in Table 2, and a copy of this agreement has been forwarded to the Department and EPA, then the Applicant may exceed the noise limits in Table 2 in accordance with the negotiated noise agreement.

Notes:

- The land numbers and receiver references are as described in the [EA \(Mod 2\)](#), and shown on the figures in Appendix 4.
- Lands titled 30 – Ninness, 33 – Peachey, 37c – Richards, 53 – Yates, 11 – Chisholm, 35 – Pugh, 20 – Foord, 21a & 21b – Merchant, 38 – Roberton, 6 – Bennett, 24 – Lopes, 4 – Standing, 40 – Smiles, 32 – Green and 44 – Stapleton have been acquired and are now mine-owned.
- Noise generated by the development is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy (as may be updated from time-to-time).

Land Acquisition Criteria

- If the noise generated by the development exceeds the criteria in Table 3 at any residence on privately-owned land, or on more than 25% of any privately-owned land, the Applicant **must**, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in conditions 9-11 of schedule 4.

Table 3: Land acquisition criteria dB(A)

Land	Day/Evening/Night <i>L_{Aeq}(15 minute)</i>
Camberwell Village A	45
Camberwell Village B	42
Camberwell Village C	40
All other privately-owned land, excluding the land listed in Table 1.	40

Note: Noise generated by the development is to be measured in accordance with the notes presented in Table 2.

Cumulative Noise Criteria

- The Applicant **must** take all reasonable and feasible measures to ensure that the noise generated by the development combined with the noise generated by other mines does not exceed the following amenity criteria at any residence on privately-owned land, or on more than 25% of any privately-owned land, excluding the land listed in Table 1, to the satisfaction of the [Secretary](#):
 - L_{Aeq}(11 hour)* 50 dB(A) – Day;
 - L_{Aeq}(4 hour)* 45 dB(A) – Evening; and
 - L_{Aeq}(9 hour)* 40 dB(A) – Night.
- If the noise generated by the development combined with the noise generated by other mines exceeds the following amenity criteria at any residence on privately-owned land, or on more than 25% of any privately-owned land, excluding the land listed in Table 1, then upon receiving a written request for acquisition from the landowner, the Applicant **must** acquire the land on as equitable basis as possible with the relevant mines, in accordance with the procedures in conditions 9-11 of schedule 4, to the satisfaction of the [Secretary](#):
 - L_{Aeq}(11 hour)* 53 dB(A) – Day;
 - L_{Aeq}(4 hour)* 48 dB(A) – Evening; and
 - L_{Aeq}(9 hour)* 43 dB(A) – Night.

Note: The cumulative noise generated by the development combined with the noise generated by other mines is to be measured in accordance with the relevant procedures in the NSW Industrial Noise Policy.

Construction Noise

- 5A. The Applicant must manage noise associated with construction of the realigned transmission line, the removal of the redundant transmission line and any road works in accordance with the noise management levels defined in Table 2 of the *Interim Construction Noise Guideline*.

Additional Noise Mitigation Measures

6. Upon receiving a written request from:
- a landowner of the land listed in Table 1 (unless the landowner has requested acquisition); or
 - a landowner of the land listed in Table 4 (except where a negotiated noise agreement is in place); or
 - the owner of any residence where subsequent noise monitoring shows the noise generated by the development is greater than, or equal to, the criteria in Table 5 (except where a negotiated noise agreement is in place),
- the Applicant **must** implement additional noise mitigation measures such as double glazing, insulation, and/or air conditioning at any residence on the land in consultation with the landowner.

These additional mitigation measures must be reasonable and feasible.

If within 3 months of receiving this request from the landowner, the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the [Secretary](#) for resolution.

By the end of April 2008, the Applicant **must** notify all applicable landowners that they are entitled to receive additional noise mitigation measures, to the satisfaction of the [Secretary](#).

Table 4: Land subject to additional noise mitigation upon request

6 – Bennett	37a – Richards
20 – Foord	38 – Robertson
21a & 21b – Merchant	47 & 50 – Vollebregt & Clarke
24 – Lopes	83 – Westcott
27 – McInerney	110 – Hall
31 – Olofsson	

Table 5: Additional noise mitigation criteria dB(A)

Land	Day/Evening/Night <i>L_{Aeq}(15 minute)</i>
Camberwell Village A	43
Camberwell Village B	40
Camberwell Village C	38
All other privately-owned land, excluding the land listed in Table 1.	38

Notes to Tables 4-5:

- Noise generated by the development is to be measured in accordance with the notes presented below Table 2.
- Lands titled 6 – Bennett, 20 – Foord, 21a & 21b – Merchant, 24 – Lopes, 31 – Olofsson, 38 – Robertson have been acquired and are now mine-owned.

Continuous Improvement

7. The Applicant **must**:
- implement all reasonable and feasible best practice noise mitigation measures;
 - investigate ways to reduce the noise generated by the development, including maximum noise levels which may result in sleep disturbance; and
 - report on these investigations and the implementation and effectiveness of these measures in the [Annual Review](#).

Monitoring

8. The Applicant **must** prepare a Noise Monitoring Program for the development to the satisfaction of the [Secretary](#). This program must:
- be prepared in consultation with [EPA](#);
 - be submitted to the [Secretary](#) for approval by the end of April 2008; and
 - include a:
 - combination of real-time and supplementary attended monitoring measures; and

- noise monitoring protocol for evaluating compliance with the noise impact assessment and land acquisition criteria in this consent.

The Applicant must implement the approved program as approved from time to time by the Secretary.

BLASTING AND VIBRATION

Airblast Overpressure Impact Assessment Criteria

- The Applicant must ensure that the airblast overpressure level from blasting at the development does not exceed the criteria in Table 6 at any residence on privately-owned land.

Table 6: Airblast overpressure impact assessment criteria

Airblast overpressure level (dB(Lin Peak))	Allowable exceedance
115	5% of the total number of blasts over a period of 12 months
120	0%

Ground Vibration Impact Assessment Criteria

- The Applicant must ensure that the ground vibration level from blasting at the development does not exceed the criteria in Table 7.

Table 7: Ground vibration impact assessment criteria

Receiver	Peak particle velocity (mm/s)	Allowable exceedance
Residence on privately-owned land	5	5% of the total number of blasts over a period of 12 months
	10	0%
St Clements Church	2	5% of the total number of blasts over a period of 12 months
	5	0%
Main Northern Railway culverts and bridges	25	0%
Electricity transmission poles	50	0%

Note: Vibration must be measured in accordance with applicable guidelines, including EPA's Assessing Vibration: A Technical Guideline (2006).

However, if the Applicant has a written negotiated agreement with the relevant service provider, and a copy of this agreement has been forwarded to the Department and EPA, then the Applicant may exceed the criteria for the Main Northern Railway culverts and bridges and electricity transmission poles in accordance with the negotiated agreement.

Blasting Hours

- The Applicant must only carry out blasting on site between 9am and 5pm Monday to Saturday (EST) inclusive, and 9am to 6pm Monday to Saturday (DST) inclusive. No blasting is allowed on Sundays, public holidays, or at any other time without the written approval of the Secretary.

Blasting Frequency

- The Applicant may carry out a maximum of:
 - 2 blasts a day; and
 - 5 blasts a week, averaged over a 12 month period.

This condition does not apply to blasts that generate ground vibration of 0.5 mm/s or less at any residence on privately-owned land, or to blast misfires or blasts required to ensure the safety of the mine, its workers or the general public.

Notes:

- *For the purposes of this condition, a blast refers to a single blast event, which may involve a number of individual blasts fired in quick succession in a discrete area of the mine.*
- *For the avoidance of doubt, should an additional blast be required after a blast misfire, this additional blast and the blast misfire are counted as a single blast, for the purposes of calculating the maximum number of daily and weekly blasts under this condition.*

Operating Conditions

13. During mining operations on site, the Applicant **must** implement best blasting practice to:
 - (a) protect the safety of people, property, public infrastructure, and livestock **from blasting impacts in the areas surrounding blasting operations; and**
 - (b) minimise the dust and fume emissions from blasting at the development, to the satisfaction of the **Secretary**.
14. The Applicant **must** not undertake blasting within 500 metres of any privately-owned land or any land not owned by the Applicant, unless suitable arrangements have been made with the landowner and any tenants to minimise the risk of flyrock-related impact to the property to the satisfaction of the **Secretary**.

Road Closure

15. Prior to blasting within 500 metres of any public road, the Applicant **must** prepare a Road Closure Management Plan for the development **in consultation with Council and to the satisfaction of the Secretary**.

The Applicant must implement the approved plan as approved from time to time by the Secretary.

Public Notice

16. During mining operations on site, the Applicant **must**:
 - (a) notify the landowner/occupier of any residence within 2 kilometres of the mining area who registers an interest in being notified about the blasting schedule at the mine;
 - (b) operate a Blasting Hotline, or alternate system agreed to by the **Secretary**, to enable the public to get up-to-date information on the blasting schedule at the development;
 - (c) advertise the blasting hotline number in a local newspaper at least 4 times each year, and
 - (d) publish an up-to-date blasting schedule on its website, to the satisfaction of the **Secretary**.

Property Inspections

17. At least 6 months prior to blasting within 2 kilometres of any privately-owned land, the Applicant **must** advise applicable landowners that they are entitled to a structural property inspection.

If the Applicant receives a written request for a structural property inspection from the landowner, the Applicant **must** within 3 months of receiving this request and prior to blasting within 2 kilometres of the property:

- (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the **Secretary**, to inspect the condition of any building or structure on the land, and recommend measures to mitigate any potential blasting impacts; and
- (b) give the landowner a copy of the property inspection report.

Property Investigations

18. If any landowner of privately-owned land within 2 kilometres of the mining area claims that buildings and/or structures on his/her land have been damaged as a result of blasting at the development, the Applicant **must** within 3 months of receiving this claim:

- (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the **Secretary**, to investigate the claim; and
- (b) give the landowner a copy of the property investigation report.

If this independent property investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant **must** repair the damages to the satisfaction of the **Secretary**.

If the Applicant or landowner disagrees with the findings of the independent property investigation, then either party may refer the matter to the **Secretary** for resolution.

Blast Monitoring Program

19. The Applicant **must** prepare a Blast Monitoring Program for the development to the satisfaction of the **Secretary**. This program must:
- be prepared in consultation with the **EPA**;
 - be submitted to the **Secretary** for approval by the end of April 2008; and
 - include a protocol for evaluating blasting impacts on, and demonstrating compliance with the blasting criteria in this consent for:
 - privately-owned residences and structures;
 - St Clements Church;
 - Main Northern Railway; and
 - electricity transmission lines.

The Applicant must implement the approved program as approved from time to time by the Secretary.

AIR QUALITY

Impact Assessment Criteria

20. The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria listed in Tables 8, 9 and 10 at any residence on privately-owned land, except for the residences shown in Table 1 as being eligible for acquisition on request on the basis of air quality impacts.

Table 8: Long term impact assessment criteria for particulate matter

<i>Pollutant</i>	<i>Averaging period</i>	<i>^d Criterion</i>
Total suspended particulate (TSP) matter	Annual	^a 90 µg/m ³
Particulate matter < 10 µm (PM ₁₀)	Annual	^a 30 µg/m ³

Table 9: Short term impact assessment criterion for particulate matter

<i>Pollutant</i>	<i>Averaging period</i>	<i>^d Criterion</i>
Particulate matter < 10 µm (PM ₁₀)	24 hour	^b 50 µg/m ³

Table 10: Long term impact assessment criteria for deposited dust

<i>Pollutant</i>	<i>Averaging period</i>	<i>Maximum increase in deposited dust level</i>	<i>Maximum total deposited dust level</i>
^c Deposited dust	Annual	^b 2 g/m ² /month	^a 4 g/m ² /month

Notes to Tables 8-10:

- ^a Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
- ^b Incremental impact (i.e. incremental increase in concentrations due to the development on its own).
- ^c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
- ^d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the Secretary.

21. (deleted)

Operating Conditions

22. The Applicant **must**:
- (a) ensure any visible air pollution generated by the development is assessed regularly, and that mining operations are relocated, modified, and/or stopped as required to minimise air quality impacts on privately-owned land;
 - (b) ensure that the real-time air quality monitoring and meteorological monitoring data are assessed regularly, and that mining operations are relocated, modified and/or stopped as required to ensure compliance with the relevant air quality criteria; and
 - (c) implement all practicable measures to minimise the off-site odour and fume emissions generated by any spontaneous combustion on site, to the satisfaction of the [Secretary](#).

Monitoring

23. The Applicant **must** prepare an Air Quality Monitoring Program for the development to the satisfaction of the [Secretary](#). This program must:
- (a) be prepared in consultation with [EPA](#);
 - (b) be submitted to the [Secretary](#) for approval by the end of April 2008; and
 - (c) include:
 - a combination of real-time monitors, high volume samplers and dust deposition gauges to monitor the dust emissions of the development; and
 - an air quality monitoring protocol for evaluating compliance with the air quality impact assessment and land acquisition criteria in this consent.

[The Applicant must implement the approved program as approved from time to time by the Secretary.](#)

METEOROLOGICAL MONITORING

24. During the life of the development, the Applicant **must** ensure that there is a suitable meteorological station in the vicinity of the site that complies with the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* guideline.

SURFACE AND GROUND WATER

Discharge Limits

25. The Applicant **must** only discharge mine water from the site in accordance with the provisions of an EPL or the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.

Bettys Creek and Swamp Creek Diversions

26. The Applicant **must** design, construct, maintain, and rehabilitate the proposed diversion of Bettys Creek and Swamp Creek, to the satisfaction of the [Secretary](#).
27. Within one month of completing the construction of the Bettys Creek and Swamp Creek diversions, the Applicant **must** submit an as-executed report, certified by a practising registered engineer, to the [Secretary](#) and [DPI Water](#).
28. Prior to destroying the original creek lines, the Applicant **must** demonstrate that the Bettys Creek and Swamp Creek diversions are operating successfully, in consultation with [DPI Water](#), and to the satisfaction of the [Secretary](#).

Site Water Management Plan

29. The Applicant **must** prepare a Site Water Management Plan for the development to the satisfaction of the [Secretary](#). This plan must:
- (a) be prepared in consultation with [EPA](#) and [DPI Water](#) by suitably qualified expert/s whose appointment/s have been approved by the [Secretary](#);
 - (b) be submitted to the [Secretary](#) for approval by the end of April 2008; and
 - (c) include:
 - a Bettys Creek and Swamp Creek Diversion Plan/s;
 - a Site Water Balance;
 - an Erosion and Sediment Control Plan;
 - a Surface Water Management and Monitoring Plan;
 - a Ground Water Monitoring Program; and
 - a Surface and Ground Water Response Plan.

The Applicant must implement the approved plan as approved from time to time by the Secretary.

Note: The Department accepts that the initial Site Water Management Plan may not include the detailed plans for the proposed diversions of Bettys Creek and Swamp Creek. However, if this occurs, the Applicant will be required to seek approval from the [Secretary](#) for an alternative timetable for completion and approval of the diversion plan/s.

Bettys Creek and Swamp Creek Diversion Plan/s

30. The Bettys Creek and Swamp Creek Diversion Plan/s must include:
- (a) a vision statement for the creek relocation;
 - (b) an assessment of the water quality, ecological, hydrological and geomorphic baseline conditions in the creek;
 - (c) the detailed design specifications for the creek relocation;
 - (d) a construction program for the creek relocation, describing how the work would be staged, and integrated with mining operations;
 - (e) a revegetation program for the relocated creek using a range of suitable native species;
 - (f) water quality, ecological, hydrological and geomorphic performance and completion criteria for the creek relocation based on the assessment of baseline conditions; and
 - (g) a program to monitor and maintain the water quality, ecological, hydrological and geomorphic integrity of the creek relocation.

Site Water Balance

31. The Site Water Balance must:
- (a) include details of:
 - sources and security of water supply;
 - water use on site;
 - water management on site;
 - off-site water transfers; and
 - (b) investigate and describe measures to minimise water use by the development.

Erosion and Sediment Control

32. The Erosion and Sediment Control Plan must:
- (a) be consistent with the requirements of [Managing Urban Stormwater: Soils and Construction - Volume 1 and Volume 2E Mines and Quarries, or its latest version](#);
 - (b) identify activities that could cause soil erosion and generate sediment, [including activities on waterfront land \(within 40 metres of a watercourse\)](#);
 - (c) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;
 - (d) describe the location, function, and capacity of erosion and sediment control structures; and
 - (e) describe what measures would be implemented to maintain these structures over time.

Surface Water Monitoring

33. The Surface Water Management and Monitoring Plan must include:
- (a) detailed baseline data on surface water flows and quality in creeks and other waterbodies that could potentially be affected by the development;
 - (b) surface water and stream health impact assessment criteria;
 - (c) a program to monitor surface water flows, quality and impacts on water users (upstream and downstream of the development in Bettys Creek, Swamp Creek and Bowmans Creek);
 - (d) a program to assess stream health conditions in Bettys Creek, Swamp Creek and Bowmans Creek;
 - (e) a program to monitor channel stability in Bettys Creek, Swamp Creek and Bowmans Creek; and
 - (f) reporting procedures for the results of the monitoring program.

Groundwater Monitoring

34. The Groundwater Monitoring Program must include:
- (a) detailed baseline data, based on sound statistical analysis, to benchmark the pre-mining natural variation in groundwater levels, yield and quality (including privately-owned groundwater bores within the predicted drawdown impact zone);
 - (b) groundwater impact assessment criteria (including for monitoring bores);
 - (c) a program for accurately delineating the boundary of the Bettys Creek and Swamp Creek alluvial aquifers in any areas intersected by mining;
 - (d) a program to monitor:

- impacts on the groundwater supply of potentially affected landowners;
 - impacts on the Bettys Creek and Swamp Creek alluvial aquifers;
 - connectivity and groundwater leakage to/from Bettys Creek and Swamp Creek following diversion;
 - impacts on groundwater dependent ecosystems and riparian vegetation;
 - the volume of ground water seeping into the open cut mine workings;
 - regional ground water levels and quality in the alluvial, coal seam, and overburden/interburden aquifers; and
 - the groundwater pressure response in the surrounding coal measures;
- (e) procedures for the verification of the groundwater model; and
- (f) reporting procedures for the results of the monitoring program and model verification.

Surface and Ground Water Response Plan

35. The Surface and Ground Water Response Plan must include:
- (a) a protocol for the investigation, notification and mitigation of any exceedances of the surface water, stream health and groundwater impact assessment criteria;
 - (b) measures to mitigate and/or compensate potentially affected landowners for the loss of surface water flows in Bettys Creek, Swamp Creek and Bowmans Creek downstream of the development;
 - (c) measures to minimise, prevent or offset groundwater leakage from the Bettys Creek and Swamp Creek alluvial aquifers;
 - (d) measures to mitigate any direct hydraulic connection between the backfilled open cuts and the Bettys Creek and Swamp Creek alluvium if the potential for adverse impacts is detected; and
 - (e) the procedures that would be followed if any unforeseen impacts are detected during the development.

REHABILITATION AND LANDSCAPE

Offset Strategy

36. The Applicant **must**:
- (a) implement the Offset Strategy described in the [EA \(Mod 2\)](#), [EA \(Mod 3\)](#) and summarised in [Table 11](#) (shown conceptually in Appendix 5); and
 - (b) make suitable arrangements to provide appropriate long term security for the offset area by April 2011, to the satisfaction of the [Secretary](#).

Table 11: Offset Strategy

Offset Area	Minimum Size
Bettys Creek Habitat Management Area	174 ha

The Offset Strategy must contain specific measures to adequately offset the development's net impact on significant plant communities, including:

- Bulloak Forest;
- Swamp Oak Forest; and
- Box-Ironbark Woodland.

Rehabilitation

37. The Applicant **must** rehabilitate the site in a manner that is generally consistent with the final landform set out in the [EA \(Mod 2\)](#) (shown conceptually in Appendix 6) to the satisfaction of [DRE](#) and the [Secretary](#).

The final landform **must** provide for at least 250 hectares of treed vegetation, in a manner generally consistent with that shown conceptually in Appendix 6.

- 37A. The Applicant **must** rehabilitate the site progressively as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim stabilisation and temporary vegetation strategies must be employed when areas prone to dust generation cannot be permanently rehabilitated.

Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage of the development.

Pre-Clearance Survey

- 37B. Prior to commencing any surface disturbance related to construction or maintenance of the realigned transmission line, including for service roads, the Applicant must ensure that a pre-clearance threatened species survey is undertaken by a suitably qualified expert.

If any additional threatened species, which may be adversely affected by the realigned transmission line, are identified during the pre-clearance survey, the Applicant must not undertake any associated surface disturbance until suitable offsets have been provided in accordance with OEH's *NSW Biodiversity Offsets Policy for Major Projects* (2016), to the satisfaction of the Secretary.

Revegetation & Compensatory Planting

- 37C. The Applicant must:
- plant and maintain, until established, 10 River Oak trees for every established River Oak tree that is removed or severely damaged during construction and maintenance of the realigned transmission line;
 - erect 2 nesting boxes for every identified tree hollow that is removed or severely damaged during the construction and maintenance of the realigned transmission line; and
 - replant or naturally regenerate, with a suitable mix of canopy, mid-storey and groundcover species, any temporarily cleared vegetation for the realigned transmission line that is classified as either Swamp Oak Forest or River Oak Forest,
- to the satisfaction of the Secretary.

Notes:

- An established River Oak tree is considered to be two metres or greater in height.
- A severely damaged tree is considered to be one that is lopped to the extent that half or more of the crown biomass is lost.

New England Highway Tree Screens

38. By the end of October 2008, the Applicant **must** plant additional trees along the New England Highway corridor to provide a tree screen for the development. These trees must be planted in consultation with Council and the relevant landowners, and then subsequently maintained to the satisfaction of the **Secretary**.

Note: If Council and/or the relevant landowners do not agree to the proposed plantings, then the Applicant is not required to undertake the plantings.

Landscape Management Plan

39. The Applicant **must** prepare a detailed Landscape Management Plan for the development to the satisfaction of the **DRE** and **Secretary**. This plan must:
- be prepared in consultation with **EPA, DPI Water, DPI, OEH** and Council by suitably qualified expert/s whose appointment/s have been approved by the **Secretary**;
 - be submitted to the Secretary for approval by the end of April 2008; and
 - include a:
 - Rehabilitation and Offset Management Plan;
 - Final Void Management Plan; and
 - Mine Closure Plan.

The Applicant must implement the approved plan as approved from time to time by the Secretary.

*Note: The Department accepts that the initial Landscape Management Plan may not include the detailed Final Void Management Plan and Mine Closure Plan. However, if this occurs, the Applicant will be required to seek approval from the **Secretary** for an alternative timetable for the completion and approval of the Final Void Management Plan and Mine Closure Plan.*

Rehabilitation and Offset Management Plan

40. The Rehabilitation and Offset Management Plan must include:
- the objectives for rehabilitation of the site and offset area;
 - a detailed description of how the rehabilitation of the site and implementation of the Offset Strategy would be integrated with the rehabilitation and offset strategies of the Mt Owen, Ravensworth East and Ashton mines to ensure there is a comprehensive strategic framework for the restoration and enhancement of the landscape over time;
 - a description of the short, medium, and long term measures that would be implemented to:
 - rehabilitate the site;

- implement the Offset Strategy;
 - manage the remnant vegetation and habitat on the site and in the offset areas;
 - maximise effective linkages to the offset areas at Mt Owen, Ravensworth East and Ashton mines; and
 - implement the New England Highway tree screens;
- (d) detailed performance and completion criteria for the rehabilitation of the site and implementation of the Offset Strategy and New England Highway tree screens;
- (e) a detailed description of how the performance of the rehabilitation of the mine, the offset areas and the New England Highway tree screens would be monitored over time to achieve the stated objectives;
- (f) a detailed description of what measures would be implemented over the next 3 years to rehabilitate the site, and implement both the Offset Strategy and tree screens along the New England Highway including the procedures to be implemented for:
- progressively rehabilitating areas disturbed by mining;
 - implementing revegetation and regeneration within the disturbance areas and offset areas, including establishment of canopy, sub-canopy (if relevant), understorey and ground strata;
 - reducing the visual impacts of the development;
 - protecting areas outside the disturbance areas;
 - rehabilitating creeks and drainage lines on the site, to ensure no net loss of stream length and aquatic habitat;
 - undertaking pre-clearance surveys;
 - managing impacts on fauna;
 - landscaping the site to minimise visual impacts;
 - conserving and reusing topsoil;
 - collecting and propagating seed for rehabilitation works;
 - salvaging and reusing material from the site for habitat enhancement;
 - controlling weeds and feral pests;
 - controlling access;
 - bushfire management; and
 - managing any potential conflicts between the offset strategy and Aboriginal cultural heritage;
- (g) a description of the potential risks to successful rehabilitation and/or revegetation, and a description of the contingency measures that would be implemented to mitigate these risks;
- (h) details of who is responsible for monitoring, reviewing, and implementing the plan;
- (i) [a description of riparian revegetation and maintenance works associated with EA \(Mod 3\), that has been prepared generally in accordance with DPI Water's Guidelines for Controlled Activities on Waterfront Land; and](#)
- (j) [a description of revegetation and rehabilitation measures that would be implemented during the construction and maintenance of the realigned transmission line.](#)

Final Void Management

41. The Final Void Management Plan must:
- (a) justify the final location and future use of the final void;
 - (b) incorporate design criteria and specifications for the final void based on verified groundwater modelling predictions and a re-assessment of post-mining groundwater equilibration;
 - (c) assess the potential interactions between creeks on the site and the final void; and
 - (d) describe what actions and measures would be implemented to:
 - minimise any potential adverse impacts associated with the final void; and
 - manage and monitor the potential impacts of the final void.

Mine Closure Plan

42. The Mine Closure Plan must:
- (a) define the objectives and criteria for mine closure;
 - (b) investigate options for the future use of the site, including the final void;
 - (c) investigate ways to minimise the adverse socio-economic effects associated with mine closure, including reduction in local employment levels;
 - (d) describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the development; and
 - (e) describe how the performance of these measures would be monitored over time.

Conservation and Biodiversity Bond

43. Within 3 months of the approval of the Landscape Management Plan, the Applicant [must](#) lodge a conservation and biodiversity bond with the Department to ensure that the Offset Strategy is implemented in accordance with the performance and completion criteria of the Landscape

Management Plan. The sum of the bond **must** be determined by:

- (a) calculating the full cost of implementing the Offset Strategy (Bettys Creek Habitat Management Area); and
- (b) employing a suitably qualified rehabilitation expert or quantity surveyor to verify the calculated costs,

to the satisfaction of the Secretary.

The calculation of the conservation and biodiversity bond **must** be submitted to the Department for approval at least 1 month prior to the lodgement of the bond.

The conservation and biodiversity bond **must** be reviewed and, if required, an updated bond **must** be lodged with the Department within 3 months of any of the following:

- (a) an approved revision of the Landscape Management Plan;
- (b) the completion of an Independent Environmental Audit in which recommendations relating to the implementation of the Landscape Management Plan have been made; or
- (c) in response to a request by the Secretary.

Notes:

- If the Offset Strategy is completed *generally in accordance with the performance and completion criteria of the Landscape Management Plan* to the satisfaction of the Secretary, the Department will release the conservation and biodiversity bond.
- If the Offset Strategy is not completed *generally in accordance with the performance and completion criteria of the Landscape Management Plan* to the satisfaction of the Secretary, all or part of the conservation and biodiversity bond will be used to ensure the satisfactory completion of the relevant works.

ABORIGINAL CULTURAL HERITAGE

Aboriginal Cultural Heritage Management Plan

44. The Applicant **must** prepare an Aboriginal Cultural Heritage Management Plan to the satisfaction of the Secretary. This plan must:
- (a) be prepared in consultation with OEHS and the Aboriginal communities;
 - (b) be submitted to the Secretary for approval by the end of April 2008 and prior to the disturbance of any Aboriginal object or site; and
 - (c) include a:
 - management plan for all Aboriginal sites and potential archaeologically sensitive areas within the development disturbance area;
 - detailed description of the measures that would be implemented to protect Aboriginal sites and potential archaeologically sensitive areas outside the development disturbance area;
 - description of the measures that would be implemented if any new Aboriginal objects or skeletal remains are discovered during the development; and
 - protocol for the ongoing consultation and involvement of the Aboriginal communities in the conservation and management of Aboriginal cultural heritage on the site.

The Applicant **must** implement the approved plan as approved from time to time by the Secretary.

HERITAGE

45. The Applicant **must** prepare an archival record of the heritage items listed in the table in Appendix 7, prior to any activity associated with the development that may disturb these sites, in consultation with, and in accordance with the requirements of, the Heritage Branch, and to the satisfaction of the Secretary.

TRANSPORT

Monitoring of Coal Transport

46. The Applicant **must** keep records of the amount of coal transported from the site each year, and include these records in the Annual Review.

Traffic Management

47. The Applicant **must** construct the Hebden Road/Site Access Road intersection to the satisfaction of Council, by the end of September 2008.
48. The Applicant **must** prepare (and subsequently implement) a construction traffic management plan for the development, to the satisfaction of Council, prior to re-commencing construction activities that require access from Hebden Road to the site.

49. The Applicant **must** review, and if necessary upgrade the New England Highway/Hebden Road intersection to provide:
- (a) street lighting in accordance with the relevant Australian Standards; and
 - (b) road shoulders that comply with the RMS's Road Design Guide, to the satisfaction of the RMS, by the end of December 2008.

VISUAL

50. The Applicant **must**:
- (a) ensure that all external lighting associated with the development complies with *Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting*, or its latest version;
 - (b) take all practicable measures to mitigate off-site lighting impacts from the development; and
 - (c) minimise the visual impacts of the development, to the satisfaction of the Secretary.

GREENHOUSE & ENERGY EFFICIENCY

51. The Applicant **must** prepare a Greenhouse and Energy Efficiency Plan for the development to the satisfaction of the Secretary. This plan must:
- (a) be prepared generally in accordance with the *Guidelines for Energy Savings Action Plans* (DEUS 2005, or its latest version);
 - (b) be submitted to the Secretary for approval by the end of July 2008;
 - (c) include a program to monitor greenhouse gas emissions and energy use generated by the development;
 - (d) include a framework for investigating and implementing measures to reduce greenhouse gas emissions and energy use at the site; and
 - (e) describe how the performance of these measures would be monitored over time.

The Applicant must implement the approved plan as approved from time to time by the Secretary.

WASTE

52. The Applicant **must**:
- (a) monitor the amount of waste generated by the development;
 - (b) investigate ways to minimise waste generated by the development;
 - (c) implement reasonable and feasible measures to minimise waste generated by the development;
 - (d) ensure irrigation of treated wastewater is undertaken in accordance with EPA's *Environmental Guideline for the Utilisation of Treated Effluent*; and
 - (e) report on waste management and minimisation in the Annual Review, to the satisfaction of the Secretary.
-

SCHEDULE 4 ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS

1. By the end of April 2008, the Applicant **must** notify the landowners of the land listed in Table 1 in writing that they have the right to require the Applicant to acquire their land at any stage during the development.
2. If the results of monitoring required in schedule 3 identify that impacts generated by the development are greater than the impact assessment criteria in schedule 3, except where this is predicted in the **EA (Mod 2)**, and except where a negotiated agreement has been entered into in relation to that impact, then the Applicant **must** notify the **Secretary** and the affected landowners and/or existing or future tenants (including tenants of mine owned properties) accordingly, and provide quarterly monitoring results to each of these parties until the results show that the development is complying with the criteria in schedule 3.
3. The Applicant **must** develop a brochure to advise landowners and/or existing or future tenants (including tenants of mine owned properties) of the possible health and amenity impacts associated with exposure to particulate matter, to the satisfaction of the **Secretary**. The brochure **must** be prepared in consultation with NSW Health, and be submitted to the **Secretary** within 6 months of the date of this consent.

The Applicant **must** review relevant human health studies and update this brochure every 3 years, to the satisfaction of the **Secretary**.

The Applicant **must** provide this brochure (and associated updates) to all landowners and/or existing or future tenants (including tenants of mine owned properties) of properties where:

- (a) the predictions in the **EA (Mod 2)** identify that the dust emissions generated by the development are likely to be greater than the air quality land acquisition criteria in condition **Error! Reference source not found.** of schedule 3; and
- (b) monitoring results identify that the mine is exceeding the air quality land acquisition criteria in condition **Error! Reference source not found.** of schedule 3.

INDEPENDENT REVIEW

4. If a landowner considers the development to be exceeding the impact assessment criteria in schedule 3, then he/she may ask the **Secretary** in writing for an independent review of the impacts of the development on his/her land.

If the **Secretary** is satisfied that an independent review is warranted, the Applicant **must** within 2 months of the **Secretary**'s decision:

- (a) consult with the landowner to determine his/her concerns;
 - (b) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the **Secretary**, to conduct monitoring on the land, to:
 - determine whether the development is complying with the relevant impact assessment criteria in schedule 3; and
 - identify the source(s) and scale of any impact on the land, and the development's contribution to this impact; and
 - (c) give the **Secretary** and landowner a copy of the independent review.
5. If the independent review determines that the development is complying with the relevant impact assessment criteria in schedule 3, then the Applicant may discontinue the independent review with the approval of the **Secretary**.
 6. If the independent review determines that the development is not complying with the relevant impact assessment criteria in schedule 3, and that the development is primarily responsible for this non-compliance, then the Applicant **must**:
 - (a) take all reasonable and feasible measures, in consultation with the landowner, to ensure that the development complies with the relevant criteria; and
 - (b) conduct further monitoring to determine whether these measures ensure compliance.

If the additional monitoring referred to above subsequently determines that the development is complying with the relevant criteria in schedule 3, or the Applicant and landowner enter into a negotiated agreement to allow these exceedances, then the Applicant may discontinue the independent review with the approval of the **Secretary**.

7. If the independent review determines that the relevant criteria in schedule 3 are being exceeded, but that more than one mine is responsible for this non-compliance, then the Applicant **must**, together with the relevant mine/s:
- (a) take all reasonable and feasible measures, in consultation with the landowner, to ensure that the relevant criteria are complied with; and
 - (b) conduct further monitoring to determine whether these measures ensure compliance; or
 - (c) secure a written agreement with the landowner and other relevant mines to allow exceedances of the criteria in schedule 3,
- to the satisfaction of the **Secretary**.

If the additional monitoring referred to above subsequently determines that the developments are complying with the relevant criteria in schedule 3, then the Applicant may discontinue the independent review with the approval of the **Secretary**.

8. If the landowner disputes the results of the independent review, either the Applicant or the landowner may refer the matter to the **Secretary** for resolution.

LAND ACQUISITION

9. Within 3 months of receiving a written request from a landowner with acquisition rights, the Applicant **must** make a binding written offer to the landowner based on:
- (a) the current market value of the landowner's interest in the property at the date of this written request, as if the property was unaffected by the development the subject of the development application, having regard to the:
 - existing and permissible use of the land, in accordance with the applicable planning instruments at the date of the written request; and
 - presence of improvements on the property and/or any approved building or structure which has been physically commenced at the date of the landowner's written request, and is due to be completed subsequent to that date, but excluding any improvements that have resulted from the implementation of the 'additional noise mitigation measures' in condition 6 of schedule 3;
 - (b) the reasonable costs associated with:
 - relocating within the Singleton local government area, or to any other local government area determined by the **Secretary**;
 - obtaining legal advice and expert advice for determining the acquisition price of the land, and the terms upon which it is required; and
 - (c) reasonable compensation for any disturbance caused by the land acquisition process.

However, if at the end of this period, the Applicant and landowner cannot agree on the acquisition price of the land, and/or the terms upon which the land is to be acquired, then either party may refer the matter to the **Secretary** for resolution.

Upon receiving such a request, the **Secretary** shall request the President of the NSW Division of the Australian Property Institute to appoint a qualified independent valuer or Fellow of the Institute, to consider submissions from both parties, and determine a fair and reasonable acquisition price for the land, and/or terms upon which the land is to be acquired.

Within 14 days of receiving the independent valuer's determination, the Applicant **must** make a written offer to purchase the land at a price not less than the independent valuer's determination.

If the landowner refuses to accept this offer within 6 months of the date of the Applicant's offer, the Applicant's obligations to acquire the land shall cease, unless otherwise agreed by the **Secretary**.

10. The Applicant **must** bear the **reasonable** costs of any valuation or survey assessment requested by the independent valuer, or the **Secretary**, and the costs of determination referred above.
11. If the Applicant and landowner agree that only part of the land shall be acquired, then the Applicant **must** pay all reasonable costs associated with obtaining Council consent for any plan of subdivision (where permissible), and registration of the plan at the Office of the Registrar-General.

SCHEDULE 5
ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Adaptive Management

1. The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and/or performance measures in Schedule 3. Any exceedance of these criteria and/or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, at the earliest opportunity:

- (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
- (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
- (c) implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.

Environmental Management Strategy

2. If the Secretary requires, the Applicant must prepare an Environmental Management Strategy for the development to the satisfaction of the Secretary. This strategy must:
 - (a) be submitted to the Secretary for approval prior to the commencement of development under this consent, unless the Secretary agrees otherwise;
 - (b) provide the strategic framework for the environmental management of the development;
 - (c) identify the statutory approvals that apply to the development;
 - (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;
 - (e) describe the procedures that would be implemented to:
 - keep the local community and relevant agencies informed about the operation and environmental performance of the development;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the course of the development;
 - respond to any non-compliance;
 - respond to emergencies; and
 - (f) include:
 - copies of any strategies, plans and programs approved under the conditions of this consent; and
 - a clear plan depicting all the monitoring required to be carried out under the conditions of this consent.

The Applicant must implement the approved strategy as approved from time to time by the Secretary.

Management Plan Requirements

3. The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:
 - (a) detailed baseline data;
 - (b) a description of:
 - the relevant statutory requirements (including any relevant approval, licence or lease conditions);
 - any relevant limits or performance measures/criteria;
 - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;
 - (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
 - (d) a program to monitor and report on the:
 - impacts and environmental performance of the development;
 - effectiveness of any management measures (see c above);
 - (e) a contingency plan to manage any unpredicted impacts and their consequences;
 - (f) a program to investigate and implement ways to improve the environmental performance of the development over time;
 - (g) a protocol for managing and reporting any:
 - incidents;

- complaints;
 - non-compliances with statutory requirements; and
 - exceedances of the impact assessment criteria and/or performance criteria; and
- (h) a protocol for periodic review of the plan.

Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.

Relationships between Management Plans and Annual Review

4. With the agreement of the Secretary, the Applicant may combine any strategy, plan, program or Annual Review required by this consent with any similar strategy, plan, program or Annual Review required for Mt Owen, Ravensworth East and Integra Underground mines, or any other adjoining operation in common ownership or management.

Annual Review

5. By the end of March each year, or as otherwise agreed with the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must:
- (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;
 - (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against the:
 - relevant statutory requirements, limits or performance measures/criteria;
 - monitoring results of previous years; and
 - relevant predictions in the documents listed in condition 2(a) of Schedule 2;
 - (c) identify any non-compliance over the past year, and describe what actions were (or are being) taken to ensure compliance;
 - (d) identify any trends in the monitoring data over the life of the development;
 - (e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
 - (f) describe what measures will be implemented over the next year to improve the environmental performance of the development.

Revision of Strategies, Plans and Programs

6. Within 3 months of:
- (a) the submission of an Annual Review under condition 5 above;
 - (b) the submission of an incident report under condition 9 below;
 - (c) the submission of an audit under condition 11 below; or
 - (d) any modification to the conditions of this consent (unless the conditions require otherwise);
- the Applicant must review the strategies, plans and programs required under this consent, to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted for the approval of the Secretary.

Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.

Updating & Staging Strategies, Plans or Programs

7. The Applicant may at any time submit revised strategies, plans or programs for the approval of the Secretary. With the agreement of the Secretary, the Applicant may also submit any strategy, plan or program required by this consent on a staged basis.

With the agreement of the Secretary, the Applicant may prepare a revision or stage of any strategy, plan or program required under this consent without undertaking consultation with all parties nominated under the applicable condition in this consent.

Notes:

- While any strategy, plan or program may be submitted on a staged basis, the Applicant must ensure that the existing operations on site are covered by suitable strategies, plans or programs at all times.
- If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage to which the strategy, plan or program applies, the relationship of this stage to any future stages, and the trigger for updating the strategy, plan or program.

Community Consultative Community

8. The Applicant must operate a CCC for the development to the satisfaction of the Secretary. This CCC must be operated in general accordance with the *Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects* (Department of Planning, 2007 or its latest version or replacement).

Notes:

- The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Applicant complies with this consent.
- In accordance with the guideline, the Committee should be comprised of an independent chair and appropriate representation from the Applicant, Council, recognised environmental groups and the local community.
- The CCC may be combined with similar committees established for the adjoining Mt Owen, Ravensworth East and Integra Underground mines.

REPORTING

Incident Reporting

9. The Applicant must immediately notify the Secretary and any other relevant agencies of any incident. Within 7 days of the date of the incident, the Applicant shall provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

Regular Reporting

10. The Applicant must provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent, and to the satisfaction of the Secretary.

INDEPENDENT ENVIRONMENTAL AUDIT

11. By the end of December 2010, and every 3 years thereafter, unless the Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:
 - (a) be conducted by a suitably qualified, experienced, and independent team of experts whose appointment has been endorsed by the Secretary;
 - (b) include consultation with the relevant agencies and the CCC;
 - (c) assess the environmental performance of the development and assess whether it is complying with the requirements in this consent and any relevant EPL or Mining Lease or necessary water licences (including any assessment, plan or program required under these approvals);
 - (d) review the adequacy of strategies, plans or programs required under the abovementioned approvals (including whether the development has met or is trended towards the progressive performance and completion criteria detailed in these strategies, plans or programs);
 - (e) recommend appropriate measures or actions to improve the environmental performance of the development, and/or any strategy, plan or program required under these approvals; and
 - (f) be conducted and reported to the satisfaction of the Secretary.

Note: This audit team should be led by a suitably qualified auditor and include experts in any fields specified by the Secretary.

12. Within 12 weeks of commissioning of this audit, or as otherwise agreed by the Secretary, the Applicant must submit a copy of the audit report to the Secretary and any other NSW Government agency that request it, together with its response to any recommendations contained in the audit report and a timetable for the implementation of these recommendations, as required. The Applicant must implement the audit report recommendations, to the satisfaction of the Secretary.

ACCESS TO INFORMATION

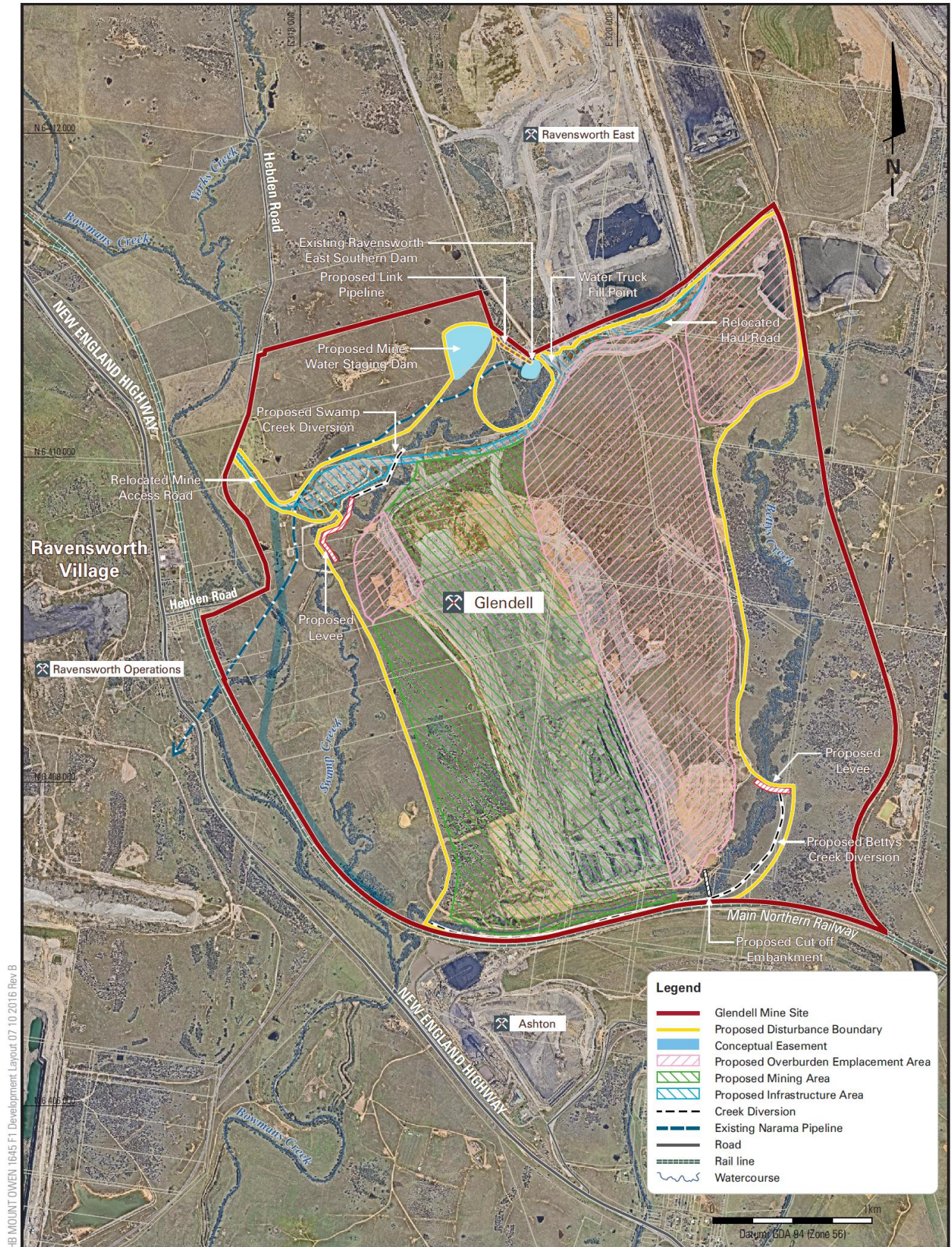
13. The Applicant must:
 - (a) make copies of the following publicly available on its website:
 - the documents listed in condition 2(a) of Schedule 2;
 - current statutory approvals for the development;
 - approved strategies, plans or programs required under the conditions of this consent;
 - a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications of any conditions of this consent, or any approved plans or programs;
 - a complaints register, which is to be updated monthly;
 - minutes of CCC meetings;
 - the Annual Reviews of the development (for the last five years);

- any independent environmental audit of the development, and the Applicant's response to the recommendations in any audit; and
 - any other matter required by the Secretary; and
- (b) keep this information up to date,
to the satisfaction of the Secretary.
-

APPENDIX 1: SCHEDULE OF LAND

Parcels within Glendell Mine Site			
<i>Lot</i>	<i>DP</i>	<i>Parish</i>	<i>County</i>
2	6842	Vane	Durham
2A	6842	Vane	Durham
11	592404	Liddell	Durham
A	380246	Liddell	Durham
71	625171	Vane	Durham
58	752499	Vane	Durham
1	865784	Vane	Durham
Pt Lot 6	859544	Vane	Durham
8	6830	Vane	Durham
1	940619	Vane	Durham
2	859544	Vane	Durham
5	859544	Vane	Durham
3	859544	Vane	Durham
2	865784	Vane	Durham
5	1077004	Vane	Durham
6	1077004	Vane	Durham
7	1077004	Vane	Durham
3	662944	Vane	Durham
Hebden Road Reserve		Vane	Durham
Various Crown Road Reserves		Vane	Durham
Ravensworth East Crushing Station and Conveyor Parcels			
9	6842	Liddell	Durham
352	867083	Liddell	Durham
25	841160	Liddell	Durham
22	841165	Liddell	Durham
180	858299	Liddell	Durham
1	135026	Liddell	Durham

APPENDIX 2: DEVELOPMENT LAYOUT PLAN



GLENDALL MINE

APPENDIX 3: STATEMENT OF COMMITMENTS

Production and Life of Operation

- 1.1.1 A Mining Operations Plan (MOP) for the modified Glendell operations will be developed and submitted for approval of [DRE](#), prior to the commencement of mining operations.

Coal Processing and Transportation

- 1.2.1 All coal produced by the proposed Glendell operations will be transported by haul road to the Mt Owen Complex for processing in the Mt Owen Coal Handling and Preparation Plant (CHPP) or the Ravensworth East Mine crushing station.
- 1.2.2 Product coal from Glendell Mine will be transported:
- by rail via the approved Mt Owen rail load out facilities, Mt Owen rail loop and Main Northern Railway; and
 - up to 1 Mtpa will be transported to domestic power stations via the approved Ravensworth East mine infrastructure.

Rejects and Tailings Management

- 1.3.1 All rejects and tailings produced from the processing of coal produced by the proposed Glendell Mine operations will be incorporated into the Mt Owen Complex life of mine rejects and tailings management strategy.

Air Quality

Air Quality Controls

- 1.4.1 [The Applicant](#) will minimise areas disturbed by mining activities and undertake prompt rehabilitation of disturbed areas following completion of mining.
- 1.4.2 [The Applicant](#) will undertake watering road surfaces, including haul roads, and hardstand areas using water carts, where required.
- 1.4.3 [The Applicant](#) will continue monitoring of meteorological conditions and consideration of weather data in the timing of blasts to minimise the impacts of blast generated dust, particularly on residents to the south and south-east of the project.
- 1.4.4 Ongoing use of an alarm generated for elevated dust levels from the Mt Owen Complex continuous PM₁₀ monitoring network and notification of operational personnel to review the ability to restrict dumping where practical on exposed faces during periods of high wind.
- 1.4.5 Expansion of the existing dust monitoring network for the Mt Owen Complex to include additional continuous PM₁₀ monitoring sites within the Camberwell Village area.
- 1.4.6 Provision of in-pit dumping locations for periods of high wind, where practicable.
- 1.4.7 Restricting vehicle movements to formed and watered roads, particularly during periods of potentially high dust generation.
- 1.4.8 Use of adequate stemming in blast holes.

Greenhouse and Energy Management

- 1.5.1 [The Applicant](#) will assess the viability of the following approaches to improving energy efficiency and reducing greenhouse emissions from the proposed Glendell operations:
- use of energy management systems; and
 - seeking continuous improvement in energy efficiency in the mining fleet, stationary equipment, mining processes and coal preparation.
- [The Applicant](#) will continue to assess and implement energy and greenhouse management initiatives during the project design, operation and decommissioning.

Noise

Noise Mitigation Measures

The following noise control measures will be employed throughout the life of the project unless otherwise agreed in writing by the Department.

- 1.6.1 A progressive equipment replacement program that seeks to incorporate best practice noise attenuation on mining equipment.
- 1.6.2 Ongoing use of an alarm generated for elevated noise levels from the Mt Owen Complex continuous noise monitoring network and notification of operational personnel to review the ability to modify operations where practical during periods of adverse weather conditions.
- 1.6.3 Design of the out of pit dumping sequence to allow for mining equipment to dump in higher exposed areas in the day time and within protected lower areas during night time periods, where practicable during adverse weather conditions.
- 1.6.4 The use of a continuous noise monitoring system to assist with managing operational noise performance and determine further noise controls, as necessary.
- 1.6.5 [The Applicant](#) will amend the Mt Owen Complex Noise Management and Monitoring Plans and Protocols to include provisions for the management and monitoring of noise emissions from proposed Glendell operations.
- 1.6.6 [The Applicant](#) will investigate reported [exceedances](#) of relevant project specific noise criteria at private residences on a case by case basis. This includes the monitoring of noise emissions at a particular receiver for comparison with the predicted cumulative noise exceedance probabilities outlined in the noise impact assessment. This approach is consistent with the existing noise management and monitoring processes at the Mt Owen Complex.
- 1.6.7 Where it is established that the relevant project specific noise criteria have been exceeded by activities from Glendell, [the Applicant](#) will investigate additional noise mitigation strategies in consultation with the landholder.

Noise Monitoring

- 1.7.1 [The Applicant](#) will continue to implement the noise monitoring network currently in place for the Mt Owen Complex. [The Applicant](#) will continue with the ongoing operation of three continuous noise monitors within the Glennies Creek and Middle Falbrook areas.
- 1.7.2 [The Applicant](#) proposes to install a further two continuous noise monitors, one reference monitor located between Glendell Mine and Ashton Mine and one within the Camberwell Village area.

Blast and Vibration

Blasting in Proximity to Infrastructure

- 1.8.1 [The Applicant](#) will undertake further consultation with ARTC, including entering into an agreement to cover blasting practices in proximity to the Main Northern Railway, prior to mining being undertaken within 500 metres of the Main Northern Railway.
- 1.8.2 [The Applicant](#) will undertake further consultation with [Ausgrid](#) prior to undertaking detailed design of blasts in proximity to the 132 kV transmission line within the Glendell Mine site.
- 1.8.3 [The Applicant](#) will undertake further consultation with surrounding mining companies to seek to establish blasting protocols which minimise potential cumulative impacts of blasting practices.

Blast Controls

Other blast controls will include:

- 1.9.1 designing and undertaking blasts to ensure that vibration and airblast limits are met, including consideration of wind speed and direction prior to blasting to minimise impacts on neighbours;
- 1.9.2 design blasts so that predicted vibration levels at the Camberwell Church are less than 2 mm/s;

- 1.9.3 detailed monitoring of blasts over the life of the mine to inform the detailed design of blasts and modification of blast designs as necessary;
- 1.9.4 training all relevant personnel on environmental obligations in relation to blasting controls;
- 1.9.5 monitoring blasts at the nearest non mine-owned residence and Camberwell Church to verify whether vibration and airblast limits are met;
- 1.9.6 documentation of the date, location of blast holes and quantity of explosive used each day; and
- 1.9.7 periodic review of blast management procedures to evaluate performance and identify corrective action, if required.

Water Management

The Applicant has committed to the implementation of the following in relation to the management of water resources.

- 1.10.1 Design surface water controls to ensure that clean runoff is separated from runoff within disturbed mining and infrastructure areas. Design sediment and erosion controls to ensure any runoff from disturbed areas is appropriately treated.
- 1.10.2 The proposed diversions of Swamp and Bettys Creeks will be designed and constructed in accordance with the conceptual designs developed in the water resources assessment.
- 1.10.3 **The Applicant** will install cut off embankments along Bettys Creek to restrict alluvium inflows into the proposed pit area in accordance with the conceptual design developed in the water resources assessment.
- 1.10.4 **The Applicant** will prepare a Groundwater Management Plan to detail the monitoring and management commitments relating to the Swamp Creek alluvial system, prior to mining occurring within this alluvial area.
- 1.10.5 **The Applicant** will continue the groundwater monitoring at the existing groundwater monitoring locations within the alluvium of Swamp and Bettys Creeks, aside from monitoring location NPz14 which will be impacted by the proposed Glendell operations.
- 1.10.6 If groundwater monitoring indicates it is required, a barrier cut off wall within the alluvium associated with Swamp Creek will be constructed to limit groundwater seepage into the mine.
- 1.10.7 **The Applicant** will extend its existing surface water monitoring program to include surface water monitoring to be undertaken at Glendell, as follows:
 - two additional surface water monitoring locations on Bowmans Creek upstream and downstream of the confluence with Swamp and Bettys Creeks;
 - two additional sites on Swamp Creek upstream and downstream of the proposed open cut pit; and
 - two additional sites on Bettys Creek upstream and downstream of the open cut pit.

Flora and Fauna Management and Site Rehabilitation

- 1.11.1 **The Applicant** will implement a Rehabilitation Strategy that aims to create a stable final landform that is dominated by pastures with a minimum of 30 per cent native tree lots and corridors for the purpose of stock shade and shelter, and habitat restoration.
- 1.11.2 The specific rehabilitation strategies to be implemented at the Glendell Mine will be detailed within a revised Mining Operations Plan and will be consistent with the rehabilitation practices employed at the Mt Owen Complex, where relevant.
- 1.11.3 **The Applicant** will establish a Habitat Management Area in the south-eastern extent of Glendell Mine site. Existing vegetation within the Habitat Management Area will be augmented through protection, regeneration and revegetation practices. Specific vegetation augmentation techniques will be outlined in a Biodiversity and Land Management Plan developed for the Glendell Mine site.
- 1.11.4 **The Applicant** will develop and implement a Biodiversity and Land Management Plan for Glendell Mine specifying ecological management and monitoring measures consistent with the principles of the Mt Owen Complex Flora and Fauna Management Plan, where relevant.

- 1.11.5 [The Applicant](#) will obtain approval from the [DRE](#) for any final landform design that exceeds 10 degrees.

Heritage

Aboriginal Cultural Heritage Management Plan

- 1.12.1 Within 12 months of granting of the modified consent, [the Applicant](#) will complete (and following approval implement) an Aboriginal Cultural Heritage Management Plan (ACHMP), in consultation with [OEH](#) and relevant Aboriginal stakeholders, and will incorporate the relevant outcomes of this approval. The plan will include provisions for the conservation of the seven remaining registered Aboriginal sites within the Glendell Mine site and for the management of the Bettys, Swamp and Bowmans Creek areas that fall outside the Proposed Disturbance Area which despite being salvaged, still retain Aboriginal and archaeological values that require protection. Specific initiatives under the plan will include implementation of a Management Committee composed of the Environmental and Community Officer and the Mine Management and at least three representatives of the Aboriginal stakeholder groups. The Management Committee will also have access to a qualified Archaeologist to assist with issues as required. The Management Committee will have the responsibility of strategic overview and input during the implementation of the following:
- the formulation of an Aboriginal cultural heritage awareness training package to be incorporated into the mine and contractor induction process;
 - fencing of remaining sites and sensitive areas outside the Proposed Disturbance Area to protect them from further disturbance. The fencing will be undertaken in accordance with the specific requirements outlined in the ACHMP;
 - annual monitoring of the remaining sites and sensitive areas remaining within the Glendell Mine site by representatives of the Management Committee to monitor ongoing protection; and
 - developing management procedures for control of:
 - feral animals, livestock and noxious and pest weeds;
 - erosion;
 - bushfire hazard; and
 - any other environmental management strategies or procedures which have the potential to affect the *in situ* management of sites or sensitive areas outlined in the ACHMP.

Historical Heritage

- 1.13.1 [The Applicant](#) will commission archival recording of sites identified within the Glendell Mine site by a qualified heritage consultant to [Heritage Branch](#)'s standards of local significance prior to the commencement of mining.
- 1.13.2 Install fencing to protect remaining sites (Items 4a to 4d and Item 5) to manage these sites *in situ*.
- 1.13.3 [The Applicant](#) will submit an application for exemption to the *Heritage Act 1977* to the [Heritage Branch](#) for relevant items within the Glendell Mine site prior to mining commencing.

Traffic and Transport

- 1.14.1 [The Applicant](#) will review the adequacy of street lighting at the intersection of the New England Highway and Hebden Road in consultation with the [RMS](#).
- 1.14.2 The intersection of Hebden Road and the proposed mine access road will be relocated approximately 800 metres north along Hebden Road from the approved mine access road to provide improved sight distances and will be a Type B rural layout in accordance with Austroads guidelines.
- 1.14.3 [The Applicant](#) will obtain a Section 138 approval under the *Roads Act 1993*, from Singleton Council, prior to the conduct of these works on Hebden Road.

Visual Controls

Vegetative Screenings

- 1.15.1 Screening plantings in strategically located positions to limit views into the Glendell mining area from the New England Highway will be maintained.

Rehabilitation and Final Landform

- 1.16.1 Shaping, stabilisation and rehabilitation of the out of pit overburden emplacement area will be undertaken as soon as practicable as part of progressive mining to minimise the impact of the proposed Glendell operations on the visual amenity of the surrounding area.

Operational Controls

- 1.17.1 Ensure that all external lighting associated with the project complies with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*; and
- 1.17.2 [The Applicant](#) will aim to minimise night lighting impacts on surrounding land owners by ensuring, where practicable, that lighting plants are positioned such that light is directed towards work areas and not towards private residences.

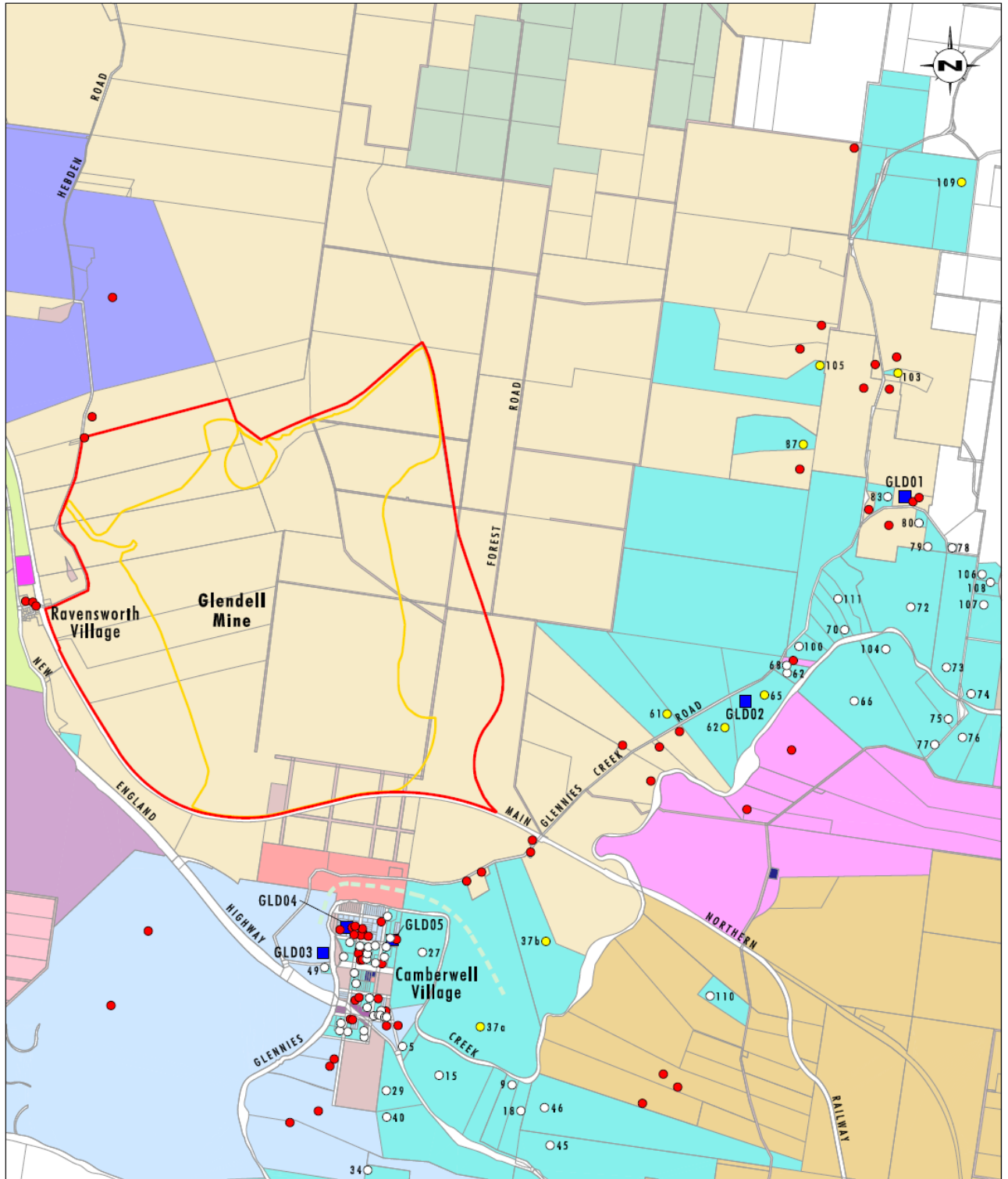
General Environmental Management, Monitoring, Auditing and Reporting

- 1.18.1 Environmental management of Glendell Mine will be integrated into an updated Mt Owen Complex environmental management strategy and environmental monitoring program.
- 1.18.2 [The Applicant](#) will employ a suitably qualified environmental officer with the responsibility of coordinating environmental management practices of the modified Glendell operations.

Additional Commitments following Modification 3

- 2.1.1 [The Applicant](#) will undertake a threatened species survey by a relevantly qualified person prior to any disturbance construction works commencing.
- 2.1.2 [Field identification of the *Acacia pendula* and *Eucalyptus camaldulensis* adjacent to the southern existing track will be undertaken by an appropriately qualified person prior to any transmission line relocation works, if any works are to be undertaken in the immediate vicinity of this area.](#)
- 2.1.3 [The Applicant will conduct a due diligence assessment of each mature River Oak tree to be lopped, prior to disturbance. For any mature River Oak tree that is lopped, ten \(10\) trees will be planted; and two \(2\) nesting boxes will be erected for any tree hollow identified.](#)
- 2.1.4 [Any tree lopping required along Bowmans Creek and Swamp Creek in the riparian zone will be undertaken manually with chainsaws to allow the root structures to remain in situ.](#)
- 2.1.5 [Redundant power poles will be removed from site and the holes will be backfilled with suitable material and rehabilitated.](#)
- 2.1.6 [The Applicant will update the Biodiversity Management Plan to include appropriate riparian revegetation works and the incorporation of the 4 ha area to be managed by the Applicant, consistent with the commitments of the adjacent Habitat Management Area.](#)
- 2.1.7 [The Applicant will implement identified management measures to avoid potential impacts to Aboriginal heritage sites MOCO OS-10 and Sensitive Areas 1 to 6 during MOD 3 activities.](#)
- 2.1.8 [Should any unidentified Aboriginal archaeological sites be located during operations, the procedures of the approved ACHMP and the '*Unanticipated Finds Protocol*' will be followed.](#)
- 2.1.9 [Historic Heritage item 7g will be identified in the field to ensure it is not disturbed by MOD 3 activities.](#)
- 2.1.10 [The dilapidated shed associated with Historic Heritage item 8b will be manually dismantled, with salvaged materials removed from site.](#)
- 2.1.11 [The Applicant will implement suitable erosion and sediment controls prior to the commencement of works, to minimise the potential for inadvertent impacts to local water resources.](#)
- 2.1.12 [If groundwater is intercepted during construction of the realigned transmission line, DPI Water will be notified immediately.](#)
- 2.1.13 [The Applicant will update the plans contained in the Mining Operations Plan to include the location of the relocated transmission line.](#)

APPENDIX 4: LANDOWNER/RECEIVER LOCATION PLANS



Source: LPI, NSW (2003), Advitech (2007)
 Note: Land Ownership current to April 2007

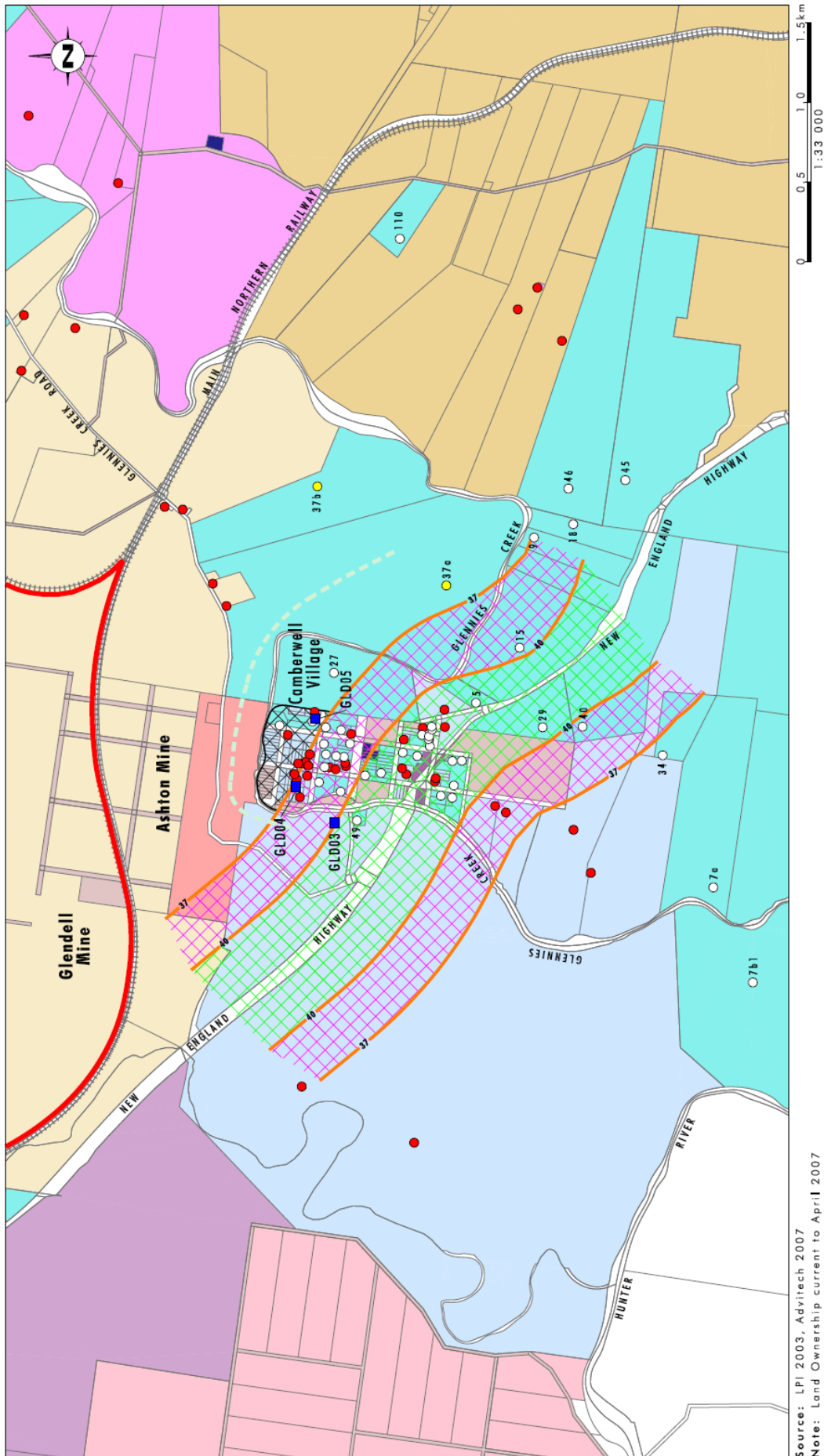
0 1.0 2.0 2.5km
 1:50 000

Legend

- | | | |
|---|--|---|
| Glendell Mine Site | Crown Land | Mine Owned - Newpac |
| Proposed Disturbance Area | No Title | Macquarie Generation |
| Ridge Line | Mine Owned - Xstrata or Subsidiary | Private Residence |
| State of NSW | Mine Owned - RHA Pastoral Company Pty Ltd | Private Residence with Acquisition Rights under Existing Consents |
| RTA | Mine Owned - Liddell Joint Venture | Mine Owned Residence |
| Ravensworth State Forest | Mine Owned - Narama Joint Venture | Noise Monitoring Location |
| Private | Mine Owned - Integra | 34 Rural Residence Label |
| Boral | Mine Owned - Ashton | |

FIGURE 5.15

Noise Monitoring Locations
 Used in Assessment



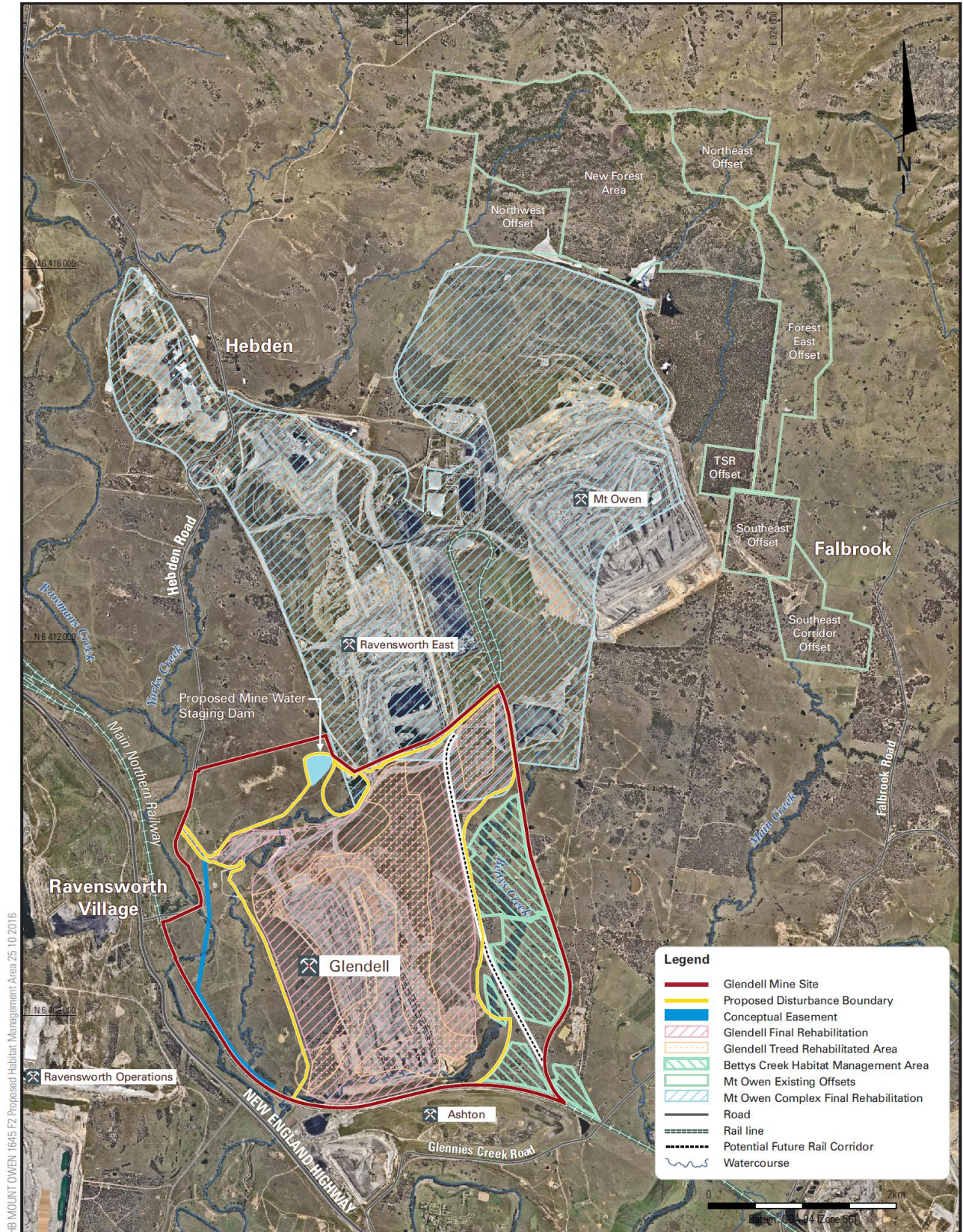
Source: LPI 2003, Advitech 2007
 Note: Land Ownership current to April 2007

- Legend**
- Glendell Mine Site
 - Project Specific Noise Criteria
 - Ridge Line
 - State of NSW
 - RTA
 - Private
 - Boral
 - Crown Land
 - No Title
 - Mine Owned - Xstrata or Subsidiary
 - Mine Owned - RHA Pastoral Company Pty Ltd
 - Mine Owned - Narama Joint Venture
 - Mine Owned - Integra
 - Mine Owned - Ashton
 - Mine Owned - Newpac
 - Private Residence
 - Private Residence with Acquisition Rights under Existing Consents
 - Mine Owned Residence
 - Noise Monitoring Locations
 - Rural Residence Label
 - Noise Receiver Areas
 - Camberwell Village A
 - Camberwell Village B
 - Camberwell Village C

FIGURE 5.16

Project Specific Noise Criteria Camberwell Village

APPENDIX 5: OFFSET STRATEGY PLAN



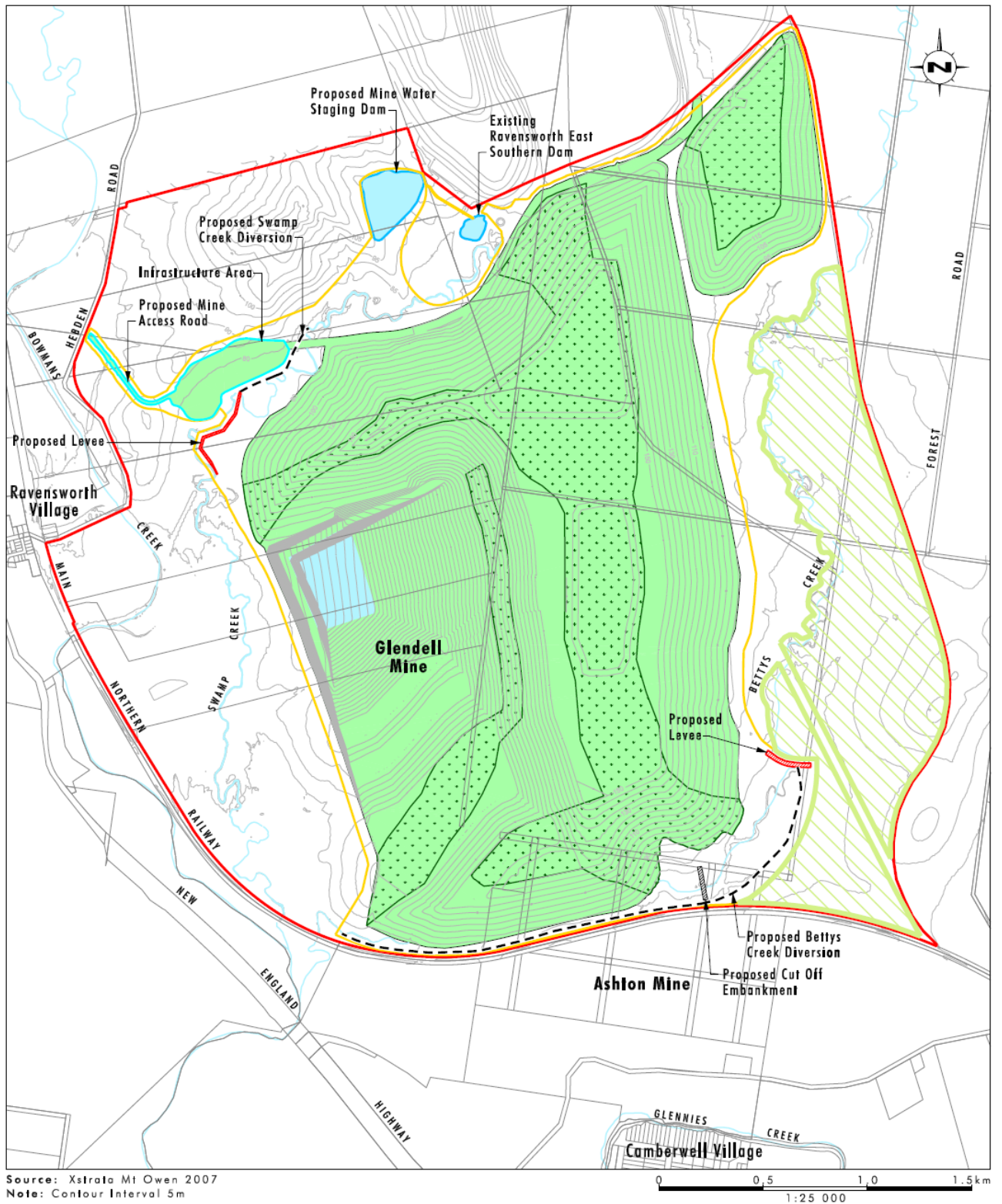
GLENDALL MINE

GLENCORE

HansenBailey
ENVIRONMENTAL CONSULTANTS

Proposed Habitat Management Area

APPENDIX 6: CONCEPTUAL REHABILITATION PLAN



Legend

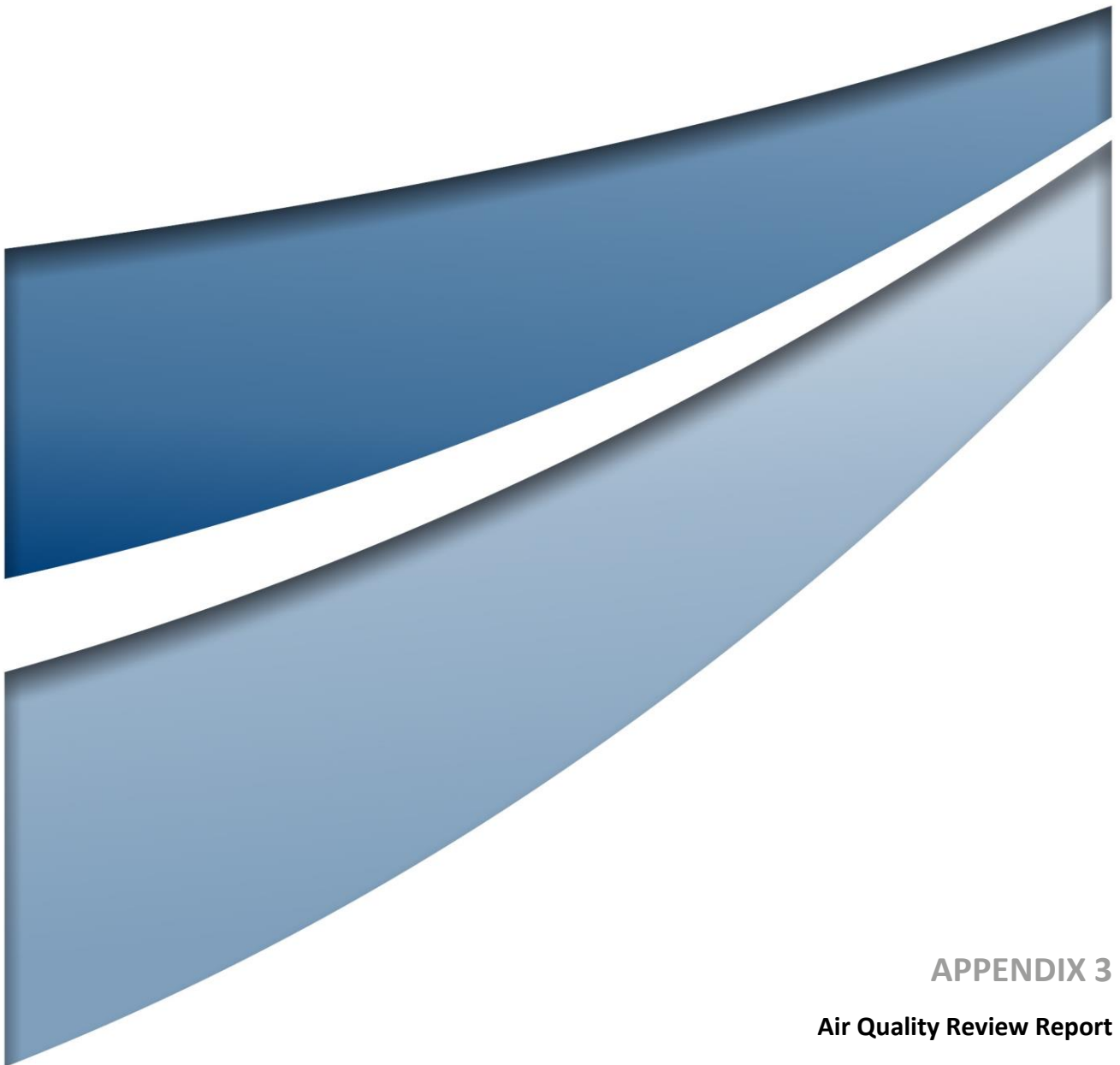
- Glendell Mine Site
- Proposed Disturbance Area
- Glendell Infrastructure Area
- Rehabilitated Area
- Final Void
- Proposed Habitat Management Area
- Treed Rehabilitated Area
- Creek Diversion
- Creek

FIGURE 5.6

Proposed Glendell Final Landform

APPENDIX 7: HERITAGE ITEMS FOR ARCHIVAL RECORDING

Item ID	Complex	Description
1	-	Wooden bridge across Swamp Creek to the west of the former Marali homestead site
2	-	Tree stump bearing surveyors mark
3	-	Cattle yard remains
4a to 4d	Unidentified Potential Dairy Site	Sandstone and conglomerate concrete footings (items 4a & 4b); mortar lined drain/gutter (item 4c); machine made and sandstock wire cut bricks (item 4d)
5	-	Corduroy road remains
6a to 6l	Unidentified Ruined Homestead	Peppercorn trees and footings (item 6a); house footings (item 6b); bricks (item 6c); footings of associated structures (item 6d); sandstone footings (item 6e); salt glazed drainage pipes (item 6f); shaft/well (item 6g); water tank, combine box and fence line remains (item 6h); <i>in situ</i> wall (item 6i); borehole (item 6j); scatter of ceramic and glass (item 6k); fence line remains (item 6l).
7a to 7i	Ruins of Marali Homestead	House ruins (item 7a), a telegraph pole (item 7b); wooden bridge across Swamp Creek (item 7c); footbridge remains (item 7d); shed (item 7e); yards associated with shed (item 7f); yards in paddock (item 7g); water tank (item 7h); well, trough and yards (item 7h and 7i).
8a to 8c	Ruins of Hillview Homestead	House ruins (item 8a); sheds (items 8b and 8c).
9	Great Northern Road	Former road



APPENDIX 3

Air Quality Review Report

Jacobs Group (Australia) Pty Ltd
710 Hunter Street
Newcastle West NSW 2302 Australia
Postal Address
PO Box 2147 Dangar NSW 2309 Australia

T: +61 2 4979 2600
F: +61 2 4979 2666
www.jacobs.com



Umwelt (Australia) Pty Limited
75 York Street
Teralba NSW 2284

Attention: Penelope Williams

31 October 2018

Your reference: 4052C

Dear Penelope

Air quality review of the proposed Glendell Mine modification

See attached for the review of potential air quality impacts associated with the Glendell Mine Proposed Modification 4.

Please contact me on (02) 4979 2663 if you require any further information.

Yours sincerely

Shane Lakmaker

Principal (Air Quality)
(02) 4979 2663 shane.lakmaker@jacobs.com

1. Introduction

Mount Owen Pty Ltd (Mt Owen) is seeking approval to modify their existing Glendell Mine development consent (DA 80/952) to provide an additional 8 months of mining and to access an additional 2.5 million tonnes (Mt) of run-of-mine (ROM) coal (the Proposed Modification).

Umwelt (Australia) Pty Ltd has been engaged by Mount Owen to manage the preparation of the Statement of Environmental Effects (SEE). Jacobs Group (Australia) Pty Ltd (Jacobs) has been engaged by Umwelt, on behalf of Mount Owen, to complete a review of the potential air quality impacts associated with the Proposed Modification.

This air quality review has involved:

- Identifying the key aspects of the Proposed Modification that relate to air quality;
- Characterising the existing air quality environment; and
- Determining the likely effect of the Proposed Modification on the existing air quality environment, with regard to the existing effects of the Approved Operation.

2. Description of the Approved Operation

DA 80/952 was originally granted by the then Minister for Planning and Environment on 2 May 1983. In 1997, DA 80/952 was modified to provide for overburden emplacement in the south void and extension of the approved mining area.

DA 80/952 was modified under section 75W of the *Environmental Planning and Assessment Act 1979* (EPA Act) on 25 February 2008. This modification is supported by an Environmental Assessment for the Modification of Glendell Mine Operations (Umwelt, 2007) (Glendell EA) and permits mining operations to take place until the end of June 2024. This modification generally permitted the following changes to operations and infrastructure at Glendell Mine:

- Extraction of up to 4.5 million tonnes per annum (Mtpa) ROM coal using existing and approved Mt Owen Complex services and infrastructure;
- Integration of the management of Glendell Mine into the Mount Owen Complex;
- Relocation of mine infrastructure area and access road;
- Extension of the mining lease to 2024; and
- Mining in a general north to south direction.

Construction of Glendell Mine commenced in April 2008 with the first coal extracted in June 2008.

The potential air quality impacts of the existing Approved Operations were quantified by Holmes Air Sciences (2007). This assessment identified Camberwell as an area where there may be potential cumulative air quality impacts, due to contributions from mining operations and other existing sources.

3. Description of the Proposed Modification

The Proposed Modification will involve minor changes to the mine plan along the northern and western limit to access an additional ~2.5Mt of ROM coal and to allow for an additional approximately eight months of mining.

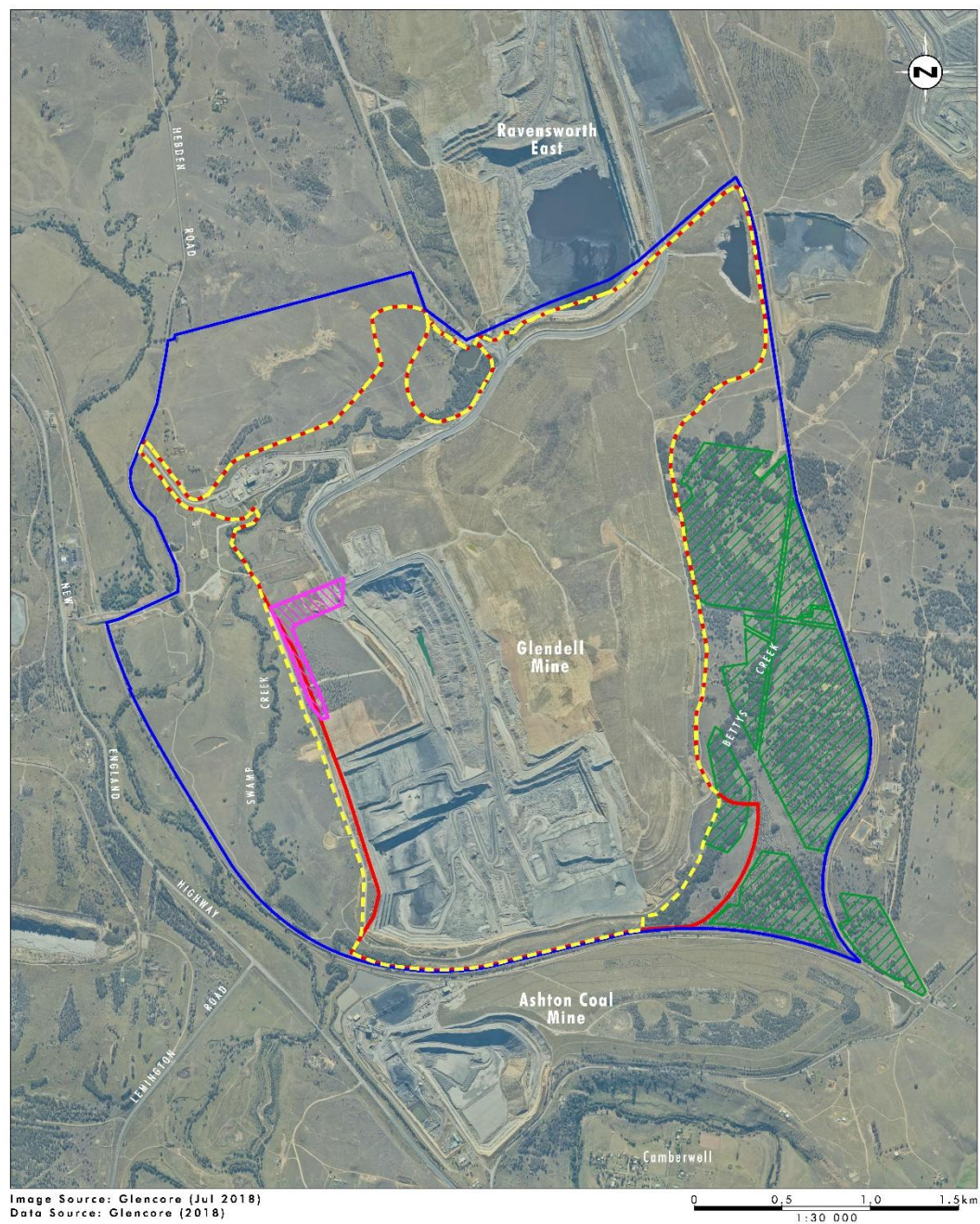
There will be no change to the approved ROM coal extraction limit of 4.5 Mtpa, machinery, hours of operation, total material moved or total rejects/tailings disposed.

Figure 1 provides an overview of the Proposed Modification. Mining will progress approximately 130 metres (m) north and 60 m to the west of the approved mining extent. Minor changes will also be implemented including hauling overburden along the western edge of the Barrett Pit at surface, providing for efficient establishment of the overburden emplacement area at the southern end of the Barrett Pit. Haulage of overburden will occur along a western bench within the Barrett Pit (below surface) during unfavourable meteorological conditions. This approach aims to assist with the management of potential off-site air quality impacts. Modifications to the haul road, existing truck parking areas and water management system structures will also be implemented to accommodate the progression of mining.

Air quality issues can arise when emissions from an industry or activity lead to deterioration in the ambient air quality. Emissions will occur from a variety of activities including material handling, material transport, processing, wind erosion, blasting and potentially, from the spontaneous combustion of coal. These emissions will mainly comprise of particulate matter in the form of total suspended particulates (TSP), particulate matter with equivalent aerodynamic diameter of 10 microns or less (PM₁₀) and particulate matter with equivalent aerodynamic diameter of 2.5 microns or less (PM_{2.5}). There would also be relatively minor emissions from machinery exhausts such as carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate matter. Spontaneous combustion of coal has historically not been an issue at Glendell Mine.

The Proposed Modification does not involve any activity that will change the nature of air quality issues at Glendell Mine, relative to the Approved Operations. In particular, the key air quality issues have been identified, and will remain, as:

- Dust (that is, particulate matter in the form of TSP, deposited dust, PM₁₀ or PM_{2.5}) from the general mining activities;
- Fume (that is, NO_x emissions) from blasting;
- Emissions of substances from machinery exhausts, that is, diesel exhaust emissions.



- Legend**
- Glendell Consent Boundary (DA 80/952)
 - Approved Disturbance Area (DA 80/952)
 - Proposed Disturbance Area
 - Bettys Creek Habitat Management Area
 - Proposed Mining Area

Figure 1 Proposed Modification Overview

4. Existing Environment

The existing environment can be characterised from local meteorological and ambient air quality data. Mount Owen has a network of meteorological and ambient air quality monitoring equipment that is used to collect data for supporting the management of daily operations at the Mount Owen Complex. The data are also used for determining compliance against the relevant development consent conditions. **Figure 2** shows the locations of the monitoring sites.

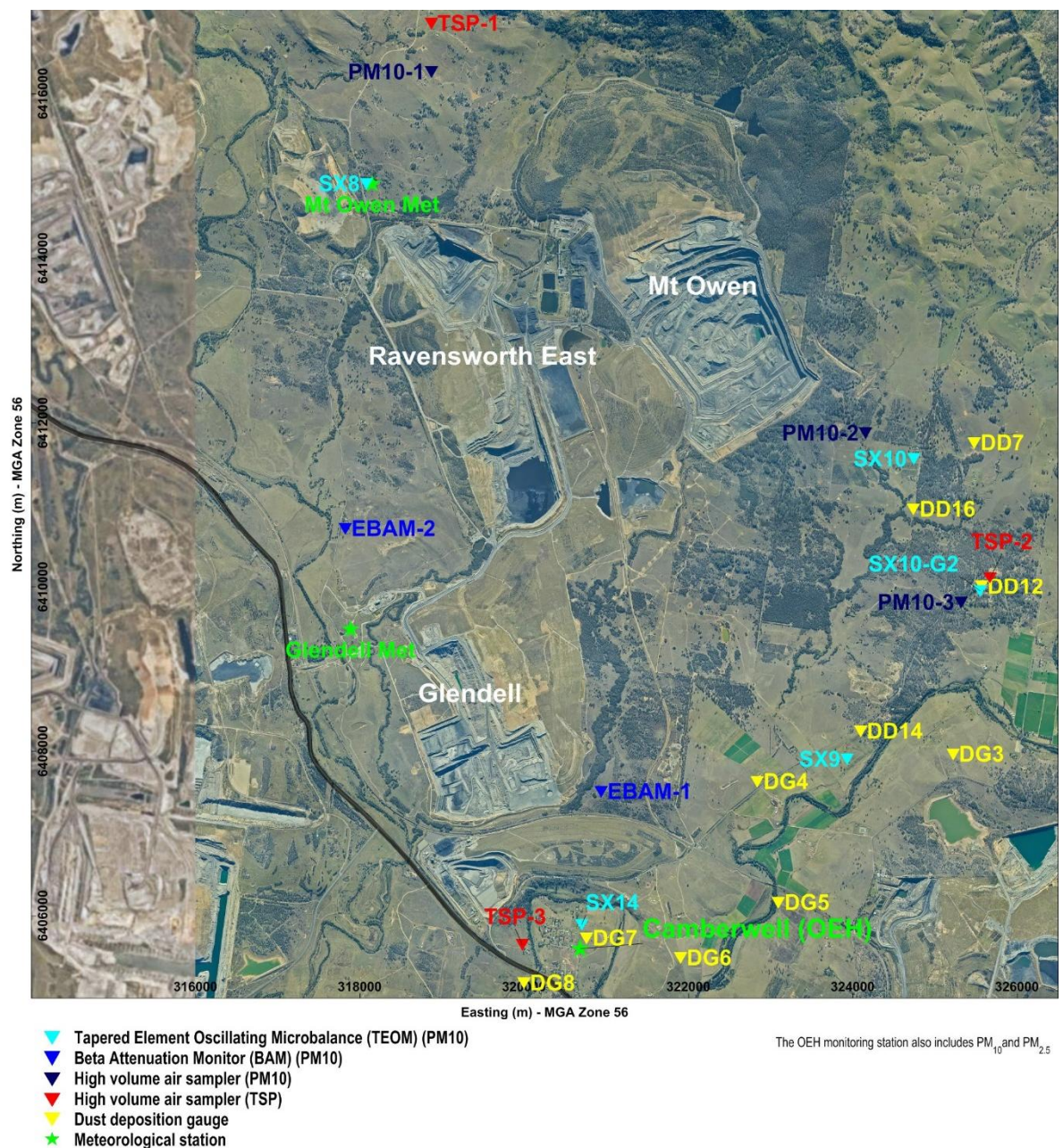


Figure 2 Location of air quality and meteorological monitoring sites

4.1 History of Compliance

Mount Owen is required to report on compliance with the conditions of DA 80/952 in their Annual Environmental Management Reports (AEMRs). DA 80/952 includes specific impact assessment criteria for air quality, as shown in **Table 1**, and compliance with these criteria is determined from analysis of the data collected at each of the monitoring sites shown in **Figure 2** (with the exception of EBAM-1, EBAM-2 and Camberwell). Data from EBAM-1 and E-BAM-2 are used for operations management and not for measuring compliance. The Camberwell monitoring station is operated by the Office of Environment and Heritage (OEH). It should be noted that, prior to 2018, a TEOM referred to as SX13 was historically operating at the location of EBAM-2.

Table 1 Air quality impact assessment criteria from development consent (DA 80/952)

Substance	Averaging time	Criterion	Application
Particulate matter (PM ₁₀)	24-hour	50 µg/m ³	Incremental impact (i.e. incremental increase in concentrations due to the development on its own)
	Annual	30 µg/m ³	Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
Particulate matter (TSP)	Annual	90 µg/m ³	Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)
Deposited dust	Annual (maximum increase)	2 g/m ² /month	Incremental impact (i.e. incremental increase in concentrations due to the development on its own)
	Annual (maximum total)	4 g/m ² /month	Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources)

The Mount Owen AEMRs (see references) include all relevant air quality monitoring data for determining compliance with the impact assessment criteria from DA 80/952. The AEMRs from the most recent five years, 2013 to 2017 inclusive, have been reviewed. These reports indicate that Glendell Mine has complied with the impact assessment criteria from DA 80/952.

4.2 Summary of Existing Environment

A detailed review of the existing air quality was also presented in a recent air quality assessment for the Mount Owen Continued Operations Modification 2 (Jacobs 2018). This assessment identified PM₁₀ as one of the key existing air quality issues, based on measured concentrations that have historically approached the assessment criteria noted by the Environment Protection Authority (EPA). The current assessment provides only a brief summary of the existing air quality conditions, focussing on annual average PM₁₀ concentrations, as the main objective was to determine the potential change in air quality as a result of the Proposed Modification.

Figure 3 shows the spatial variation in annual average PM₁₀ concentrations around the Mount Owen Complex, for 2012 to 2016. At the time the EPA criterion was 30 µg/m³, however this criterion has since been revised to 25 µg/m³ (EPA 2016).

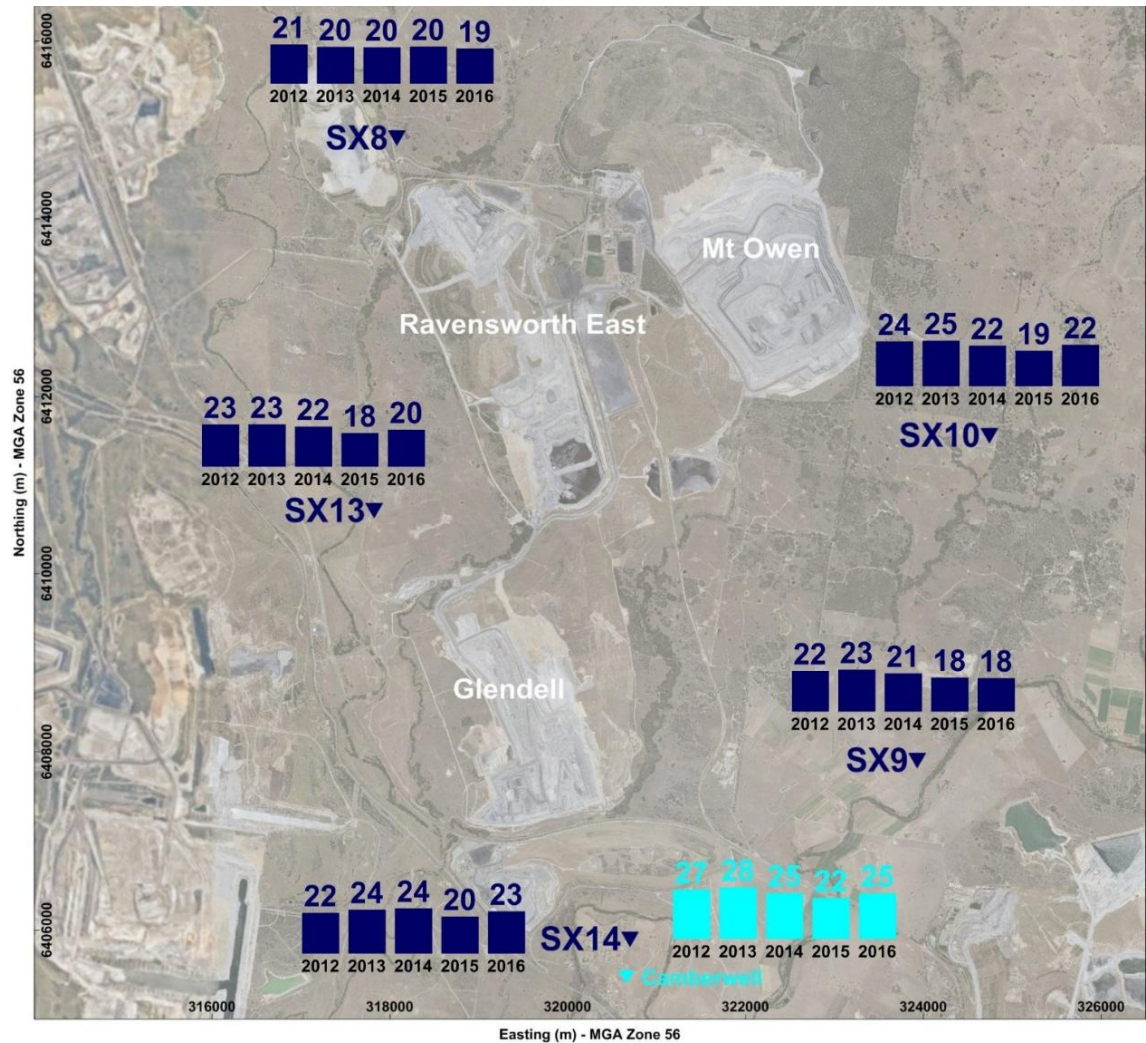


Figure 3 Spatial variation in annual average PM₁₀ concentrations (µg/m³)

Figure 3 shows that PM₁₀ concentrations have complied with the, then applicable, 30 µg/m³ criterion at all Mount Owen monitoring sites. Levels in Camberwell have typically been higher than at other locations and exceeding 25 µg/m³ in two years (2012 and 2013). These measurements will have included all sources which were at some stage upwind of the monitor. The data from Camberwell have been represented in a different colour as this monitor is operated by the OEH.

5. Review of Impacts

The emissions and existing extent of air quality impacts due to the Approved Operations have been quantified in the Environmental Assessment (Umwelt 2007) and by Holmes Air Sciences (2007). Changes to air emissions and potential impacts (i.e. ambient concentrations) associated with the Proposed Modification can result from:

- Changes to haul distances;
- Changes to the extent of exposed areas;
- Changes to the proximity of emission sources to sensitive receptors; and
- Changes to the duration of activities.

Each of these elements has been considered in order to determine whether the Proposed Modification will lead to an increased potential for air quality impacts, over the potential that is currently approved. **Table 2** provides the discussion on potential effects. From this information it has been concluded that the changes due to the Proposed Modification are unlikely to result in an increase in the currently approved air quality impacts of Glendell Mine.

Table 2 Proposed Modification and potential air quality effects

Element	Proposed Modification	Effects on emissions and potential air quality impacts
Haul distances	Mining will progress in a northerly direction, closer to the main haul road which leads from the Glendell Mine Pit to the ROM pad. This progression of mining will result in a shorter haul distance than for the current Approved Operations. Haul distances from pit to emplacement areas will remain unchanged. There will be no change to the machinery used for transporting coal and overburden on haul roads. There will be no change to the hours when machinery transport coal and overburden on haul roads. There will be no change to the quantities of coal and overburden transported on haul roads.	Mining activities and equipment related emissions from vehicles on haul roads will most likely decrease as a result of the shorter haul distance. A reduction in emissions will typically result in a lower potential for off-site air quality impacts.
Exposed areas	The extent of exposed areas will not increase under the Proposed Modification. There will be progressive rehabilitation of mined areas, as is the case for the Approved Operations.	No change to overall site emissions relating to wind erosion from exposed areas.
Proximity of mining to sensitive receptors	Mining will progress in a northerly direction, away from the key sensitive receptor area of Camberwell.	The contribution of emissions from Glendell Mine to air quality in Camberwell is expected to decrease, due to the increasing distance between the mine and village.
Duration of changes	The Proposed Modification will represent an additional approximately eight months of mining.	Emissions from Glendell Mine will be present for an additional eight months, however while mining is

Element	Proposed Modification	Effects on emissions and potential air quality impacts
		currently approved to 2024, the current approved mining operations are expected to cease in 2020 and the proposed modification will provide for mining operations until 2021. Therefore, there will not be an extension to the approved mine life.

6. Air Quality Management

Table 3 summarises the standard emission management measures, currently implemented as part of the existing Air Quality Management Plan, that will continue to be adopted as part of the Proposed Modification. The dust management measures as outlined in **Table 3** have been compared to the measures outlined in the “NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining” (Donnelly et al, 2011). This comparison shows that the majority of proposed measures are consistent with best practice dust mitigation measures.

Table 3 Emission management measures

Activity	Emission management measures	Measures identified from Donnelly et al (2011)	Consistent with best practice
Stripping topsoil by scraper	Watering of haul routes Restricting vehicle speeds	Control measures for this activity are not specifically identified but can be inferred from the bulldozers information below.	Y
Drilling overburden	Water injection and application of water to drill cuttings upon removal Dust curtains Ceasing operations if dust suppression systems are inoperable or if dust is visible above the drill deck level for a sustained period	<i>“Best practice control measures include air extraction to a bag filter. No mines were found to use this practice.”</i>	N (bag filters are not best practice in NSW)
Blasting overburden	Pre-blast checks including review of meteorological conditions	<i>“Best practice control measures include delaying shot to avoid unfavourable weather conditions and minimising the area blasted”</i>	Y
Hauling overburden and coal on unsealed roads	Watering of haul routes Gravel compaction and maintenance of haul routes Restricting vehicle speeds Clearly marked haul routes Fleet optimisation to reduce vehicle kilometres travelled Prompt clean-up of any material spillage	<i>“Control measures include watering, grading, well-defined haul routes, speed limits to 40 km/h and/or the use of suppressants.”</i>	Y

Activity	Emission management measures	Measures identified from Donnelly et al (2011)	Consistent with best practice
Loading and unloading of overburden	Minimisation of fall distances during unloading and loading Planning of dump locations based on weather conditions Ceasing operations during adverse dust conditions	<i>"Current practices adopted to control emissions from loading and dumping overburden were found to be water application, minimisation of drop heights and suspension or modification of activities during adverse weather conditions. Best practice control measures were identified as minimising drop heights and / or the application of water".</i>	Y
Unloading coal to ROM hopper	Water sprays and partial enclosure	<i>"Best practice control measures for minimising emissions from the ROM hopper is enclosure with air extraction to a fabric filter or other control device. No mines in the GMR adopt this approach."</i>	N (additional control devices are not best practice in NSW)
Coal processing	Enclosure	Control measures for this process are not specifically identified.	N/A
Dozers or loaders on ROM and product coal stockpiles	Watering of travel routes Minimisation during dusty conditions Reduced travel speed during dusty conditions	<i>"Best practice control measures include minimising the travel speed and distance travelled by bulldozers and the application of water to keep travel routes moist"</i>	Y
Conveyors to stockpiles	Covered / enclosure Belt cleaning	<i>"The use of wind shielding on conveyor sides, water sprays at conveyor transfers, enclosure of transfer points, and, soft-loading chutes."</i>	Y (except for water sprays and soft-loading chutes)
Wind erosion from partially rehabilitated dumps	Partial rehabilitation / stabilisation	<i>"Control measures include watering exposed areas, minimising areas of disturbance, progressive rehabilitation and use of suppressants"</i>	Y
Wind erosion from ROM and product coal stockpiles	Water sprays on the hoppers, triggered by wind conditions Water carts in the event of excessive dust emissions Minimisation of FEL drop heights when loading	<i>"Control measures include watering exposed areas, minimising areas of disturbance, progressive rehabilitation and use of suppressants"</i>	Y
Grading roads	Watering of haul routes Restricting vehicle speeds Clearly marked routes	Control measures for this activity are not specifically identified. This activity forms part of the control measures for haul roads.	N/A

Activity	Emission management measures	Measures identified from Donnelly et al (2011)	Consistent with best practice
Machinery exhausts and plant and equipment	Servicing all machinery in accordance with maintenance contracts and adopting original equipment manufacturer recommendations for maintenance. Targeting the maintenance to ensure equipment remains fit for purpose over its whole life cycle. Defining failure modes, effects and criticality. Constructing timelines for downtimes.	Control measures for this activity are not specifically identified.	N/A

In addition to the measures listed above Mount Owen implements both proactive and reactive dust control strategies. Reactive air quality management include the modification or suspension of activities in response to the visual, meteorological or ambient air quality triggers. These triggers are defined in the Mount Owen Complex Air Quality Management Plan and are linked to specific actions for managing dust at both private and mine owned residences.

The meteorological and air quality monitoring network currently operated by Mount Owen (refer to **Section 4**) is suitably setup to measure the key air quality parameters, compliance with air quality criteria, and to allow for the contribution of mining activities to be determined. This monitoring network will continue to be operated as part of the Proposed Modification.

7. Conclusions

This review has highlighted that, from an air quality perspective, the Proposed Modification will be minor in nature and that there will not be an increase in the potential air quality impacts, over and above that currently approved. Activities and emissions associated with the extraction of the additional 2.5 Mt ROM coal and additional eight months duration of mining will however need to be managed in accordance with current air quality management practices.

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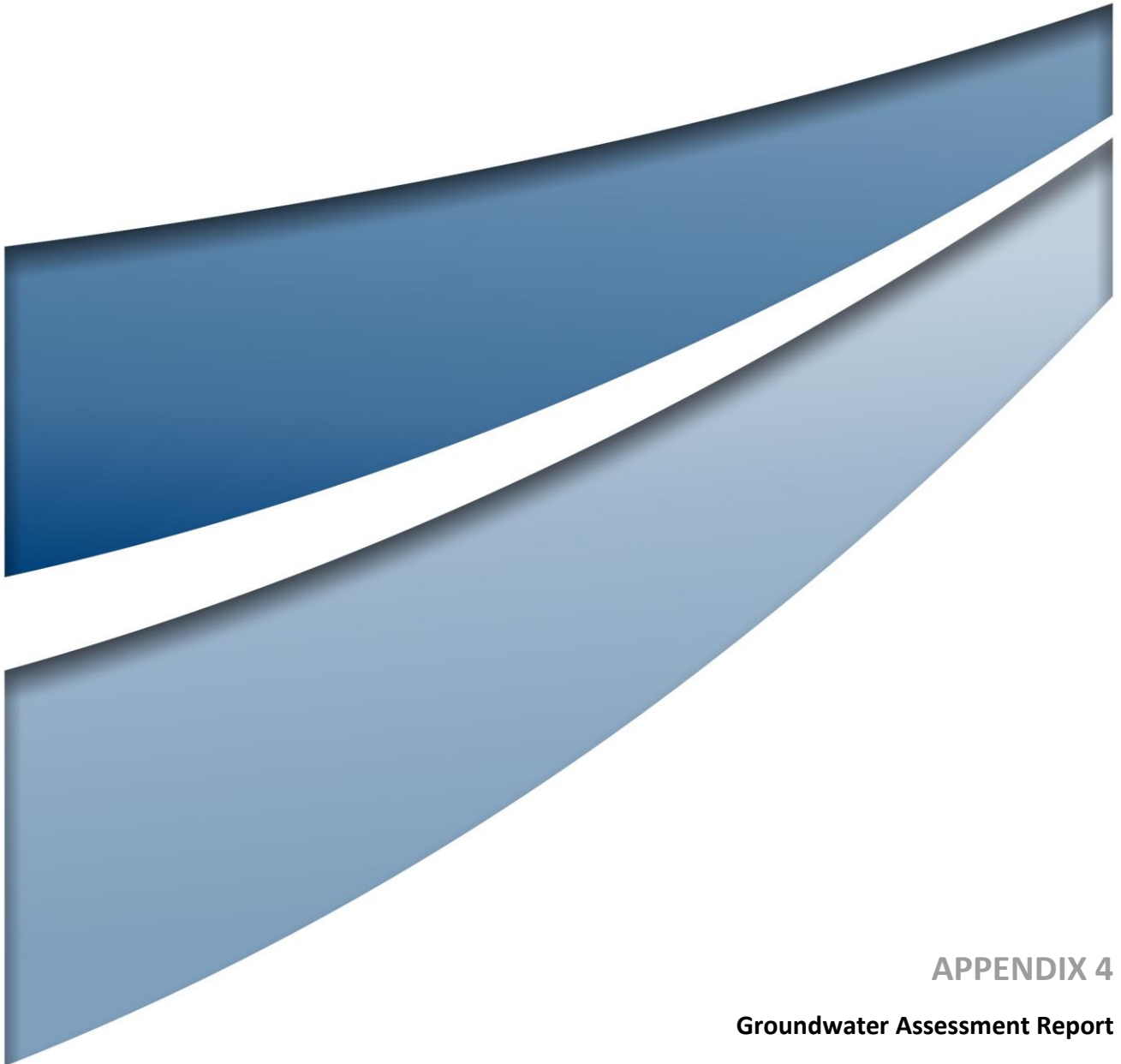
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APPENDIX 4

Groundwater Assessment Report



Australasian Groundwater and
Environmental Consultants Pty Ltd



Report on

Glendell Coal Mine Modification

Prepared for
Glencore Coal Pty Ltd

Project No. G1874D October 2018
www.ageconsultants.com.au ABN 64 080 238 642

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Glendell Coal Mine Modification

1 Introduction

Glendell Mine is part of the Mount Owen Complex which is operated and owned by Mt Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Ltd (Glencore). Glendell Mine operates within mining lease CL358 under development consent DA 80/952 (Glendell Consent) that was originally granted by the NSW Department of Planning and Environment on 2 May 1983, and subsequently modified in 1997, 2008 and 2016. Mount Owen is seeking to extend Glendell Mine beyond its current approved mining extent to the north and west of the existing Barrett Pit (proposed modification). The proposed modification represents an incremental change to the already existing operations.

To facilitate this Mount Owen commissioned a Statement of Environmental Effects (SEE) to support the proposed modification under Section 4.55(1A) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This groundwater impact assessment (GIA) has been prepared by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to support the SEE for the proposed modification.

Historical groundwater levels during the mining, groundwater quality, location of groundwater dependent ecosystems (GDEs) and private water bores were reviewed as part of this GIA. The groundwater assessment addresses the requirements of the New South Wales Aquifer Interference Policy (2012) (AIP). The groundwater impact assessment has been peer reviewed. A summary of peer review comments are provided in Appendix A.

Following a review of the available information the proposed modification would not have an impact on the environment greater than what is already approved under the existing Glendell Consent.

2 Project location and setting

2.1 Location

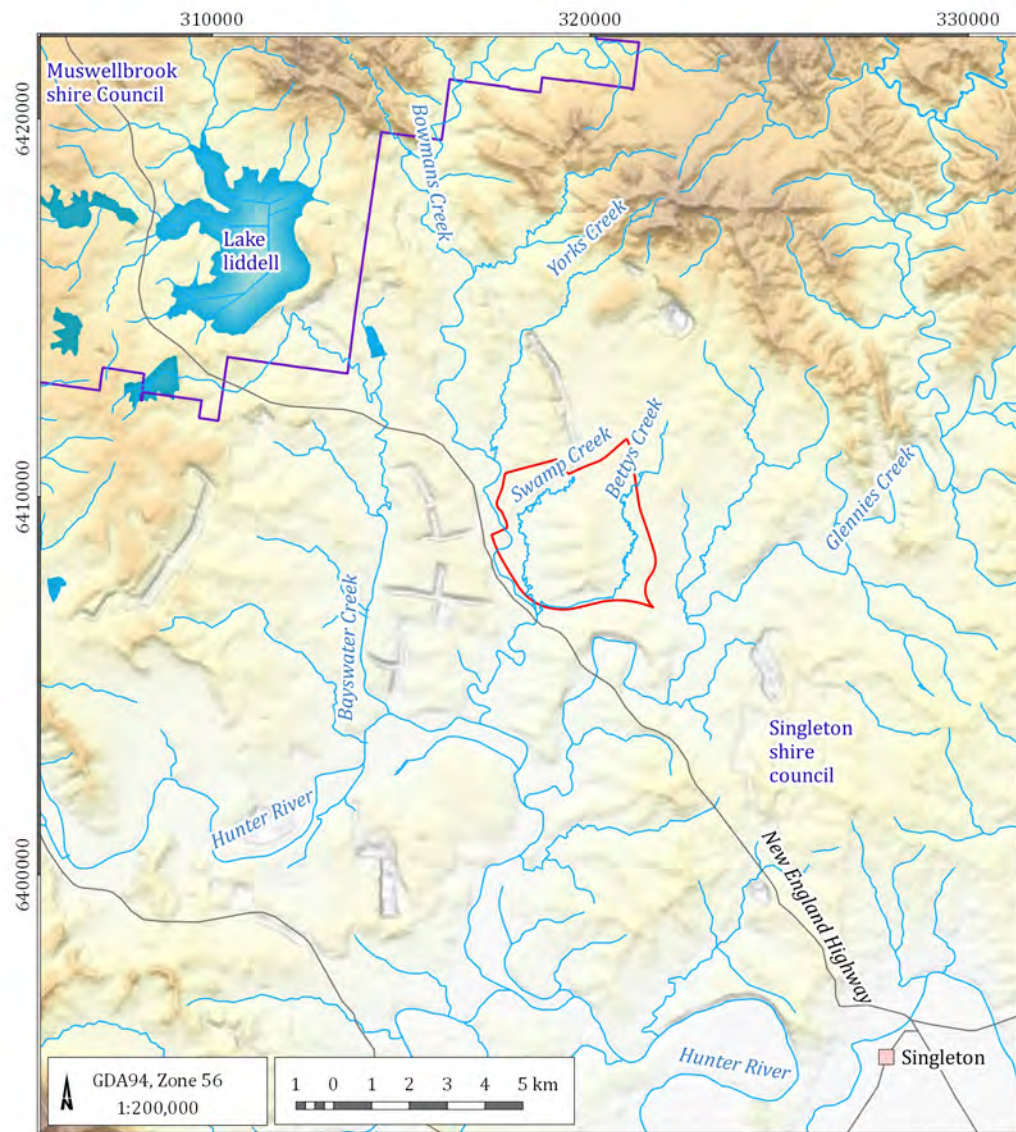
Glendell Mine is located within the Hunter Coalfields of the Sydney Basin approximately 20 km north-west of the Singleton town centre (Figure 2.1). Surrounding mines include the Ashton mine directly to the south, Integra Underground to the east and Ravensworth Operations to the west. Surrounding land uses in the locality include mining and mining related development as well as agricultural activities such as cropping and grazing.

2.2 History and proposed modification

The Glendell Consent was granted on 2 May 1983, with the first hydrogeology investigation of the mining area conducted in 1995 (Rust PPK, 1996). A modification of the Glendell Consent was granted in 1997 which provided for amendments to the mining operations and the overburden emplacement areas and then in February 2008 that allowed for the integration of Glendell Mine with the Mount Owen Complex.

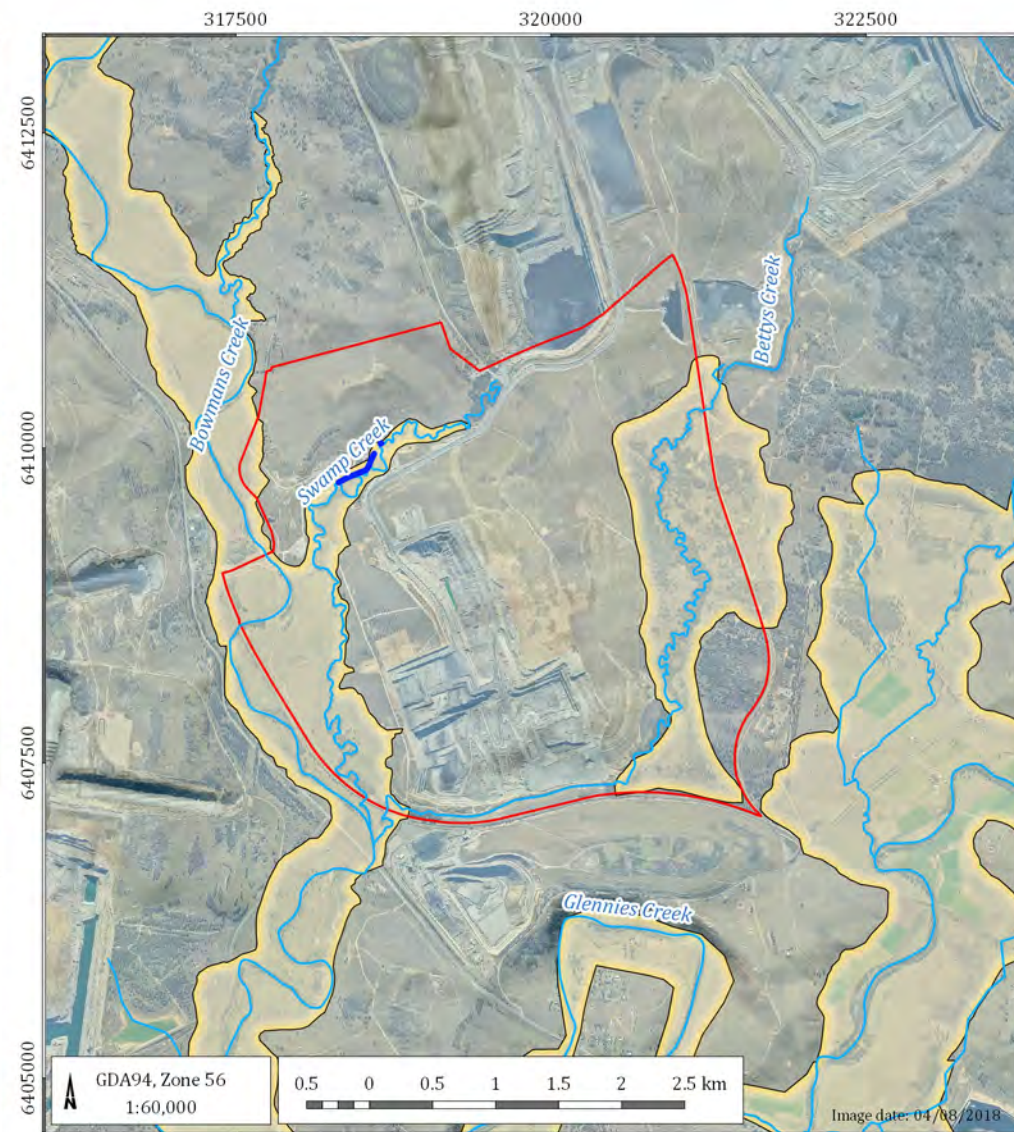
The Glendell Consent allows for mining of up to 4.5 Mtpa of ROM coal, by open cut methods until 2024. Mining commenced in the Barrett Pit at Glendell Mine in 2009. The mining occurs along the crest of an anticline that runs through the site in a north-south alignment. Mining occurs in the Vane subgroup coal seams from the Lemington to the Barrett coal seam.

The proposed modification seeks to extend Barrett Pit by 60 m to the west and 130 m to the north. The extension will place the edge of the pit approximately 50 m from Swamp Creek, which is a minor tributary of Bowmans Creek. The extension of the pit crest will allow access to an additional 2.5 Mt ROM Coal and an additional 8 months of mining operations. The currently approved mining area and the proposed modification are shown on Figure 2.2. The proposed modification represents a footprint of 0.2 km² in addition to the approved mining.



LEGEND

- Populated place
- Local government boundary
- Project boundary
- Extent of Quaternary alluvium
- Water area
- Road
- Drainage
- Swamp Creek diversion



Glendell Mine MOD (G1874D)



Project location

DATE
10/10/2018

FIGURE No:
2.1



LEGEND

- Extent of Quaternary alluvium
- Proposed Mining Area
- Approved Mining Area
- Drainage
- Swamp Creek diversion

Glendell Mine MOD (G1874D)

Proposed modification



DATE
10/10/2018

FIGURE No:
2.2

2.3 Climate

The climate in the region is temperate and is characterised by hot summers with regular thunderstorms and mild dry winters. Climate data was obtained from the Scientific Information for Land Owners (SILO) database of historical climate records for Australia (DSITI 2015). The average annual rainfall at Glendell Mine is 675 mm, with wetter months occurring during the summer. Evaporation of 1554 mm, exceeds the rainfall throughout the year, with the highest moisture deficit occurring in summer.

Long-term rainfall trends can be characterised using the Cumulative Rainfall Departure (CRD) method. CRD shows trends in rainfall relative to the long-term monthly average and provides a historical record of wetter and drier periods. A rising trend in slope in the CRD plot indicates periods of above average rainfall, while a declining slope indicates periods of below average rainfall. CRD has been used in this study to better understand the influence of climatic conditions on groundwater levels within the alluvial groundwater systems.

The monthly CRD is presented on Figure 2.3. The falling trend shown on the graph in recent years is due to below average rainfall since 2016, with very low rainfall since 2017. Groundwater levels within shallow groundwater systems would be expected to decline naturally during these drier periods due to ongoing drainage from the aquifers exceeding the replenishment rate from rainfall recharge.

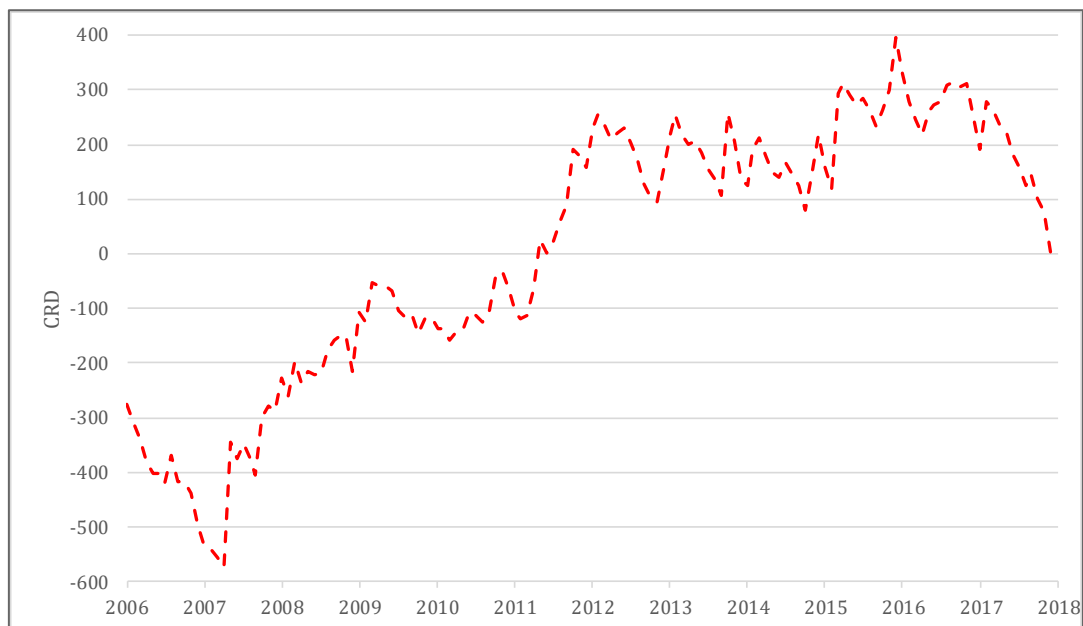


Figure 2.3 Cumulative rainfall departure

2.1 Land use, terrain and drainage

The Hunter Valley coalfields have a long history of mining the Permian Coal Measures, dating back to the 1950's. Land use within the vicinity of Glendell Mine is primarily coal mining and agriculture. Agricultural and environmental land use includes:

- cattle grazing in open pastures;
- improved pasture and cropping along the flood plains; and
- vegetation, including riverine vegetation along drainage lines.

The terrain at Glendell Mine is gently sloping towards the surrounding drainage lines, with steeper slopes occurring where mining spoils have been placed. The mine is located adjacent to a number of water courses, the most significant being Bowmans Creek located to the west of the mine. Bowmans Creek flows in a southerly direction and enters the Hunter River 3.5 km to the south of Glendell Mine. Tributaries of Bowmans Creek adjacent to the mine are Swamp Creek to the north and west, and Bettys Creek to the south and east.

The catchment of Swamp Creek is within the approved Mount Owen and Glendell Mine disturbance areas with the upper catchment approved to be redirected towards Swamp Creek once mining and rehabilitation are completed. A section of Swamp Creek to the immediate north of Barrett Pit has been diverted around the mine infrastructure area. To the south Bettys Creek has also been diverted around the southern end of the Barrett Pit. In this area thin Quaternary alluvial sediments associated with Bettys Creek have been removed. Both Bettys Creek and Swamp Creek are ephemeral water courses, with no permanent groundwater fed baseflow (Figure 2.4).



Figure 2.4 Bettys Creek diversion (left) and Swamp Creek (right)

3 Geology

The Glendell Mine is located within the Sydney Basin and targets coal seams within the Permian Vane Subgroup. The coal measures are weathered at the land surface and overlain by thin sequences of Quaternary alluvium accumulated along drainage lines. Ranges to the north are exposed Sydney Basin basement and consist of Carboniferous age sedimentary, marine and volcanic rocks of the New England Orogen. The surface geology in the vicinity of Glendell Mine is shown on Figure 3.1.

3.1 Quaternary alluvium

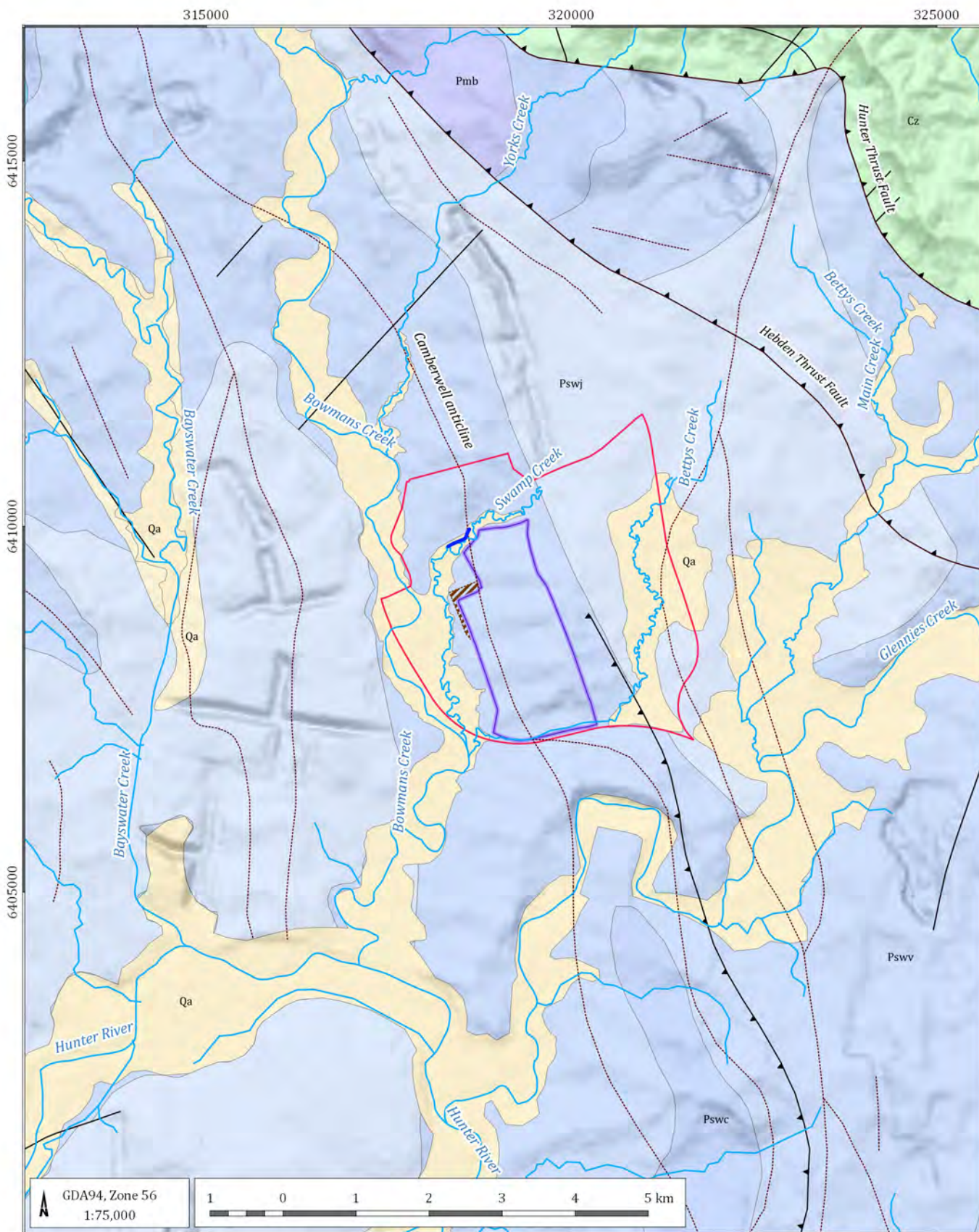
Quaternary alluvium is limited to the main drainages in the area surrounding the Glendell Mine. These are Bowmans Creek and Swamp Creek on the west and Bettys Creek to the east and south. The extent of the alluvium has been previously defined by the review of existing drillhole logs and excavated test pits to examine the soil profile (AGE, 2018). The results of the 2017-18 test pit program undertaken by AGE were used to update the extent of alluvium indicated from geological maps. The extent and thickness of the Quaternary alluvium across the flood plain areas is presented in Figure 3.2. The figure shows the alluvium is typically up to 10 m thick within the Bowmans Creek flood plain and substantially thinner in Swamp Creeks where it is up to 6 m thick. The thickness of the alluvium is shown on Figure 3.2.

The alluvial deposits typically comprise loams overlying silty and clayey sands. The lithology of Bowmans Creek alluvium is typically clayey sand with silt, sand and gravel (AGE, 2018). Swamp Creek alluvium lithology comprises fining up sequence, with clay layers (0.3 m thick) and or with sand to very thickly bedded (>1 m) sand to gravel.

3.2 Permian coal measures– Vane Subgroup

The Late Permian Vane Subgroup which is targeted for mining at Glendell Mine is subdivided into the Foybrook Formation and the Archerfield Sandstone. The uppermost unit is the Archerfield Sandstone which comprises well-sorted quartz lithic sandstone deposited in a wave or current dominated lower delta plain setting. The Foybrook Formation comprises coal bearing sequences with wedges of siltstone and sandstone. There are six main coal seams within the Foybrook Formation; in stratigraphic order (youngest to oldest) coal seams include Lemington, Pikes Gully, Arties, Liddell, Barrett and Hebden Seams. A weathered profile up to 25 m occurs across the Permian strata that are exposed at the land surface.

The Glendell Mine is located along the Camberwell Anticline, which is a major structural feature aligned in a north-south direction. The Camberwell Anticline exhibits steep dips (>20 degrees) on the eastern flank, and up to 12 degrees on the western flank. Glendell mine extracts the coal seams on the eastern and western side of the anticline from the Lemington through to the Barrett seams. The proposed modification is occurring on the western side of the anticline.



LEGEND

- Project boundary
- Proposed Mining Area
- Approved Mining Area
- Drainage
- Swamp Creek diversion
- ▲— Thrust fault
- Fault
- Fold

Surface geology

- Qa - Quaternary alluvium
- Pswj - Jerrys Plains Subgroup
- Pswv - Archerfield sandstone, Vane Subgroup
- Pswc - Saltwater Creek Formation
- Pmb - Braxton Formation
- Cz - Carboniferous tuff and ignimbrite
- water

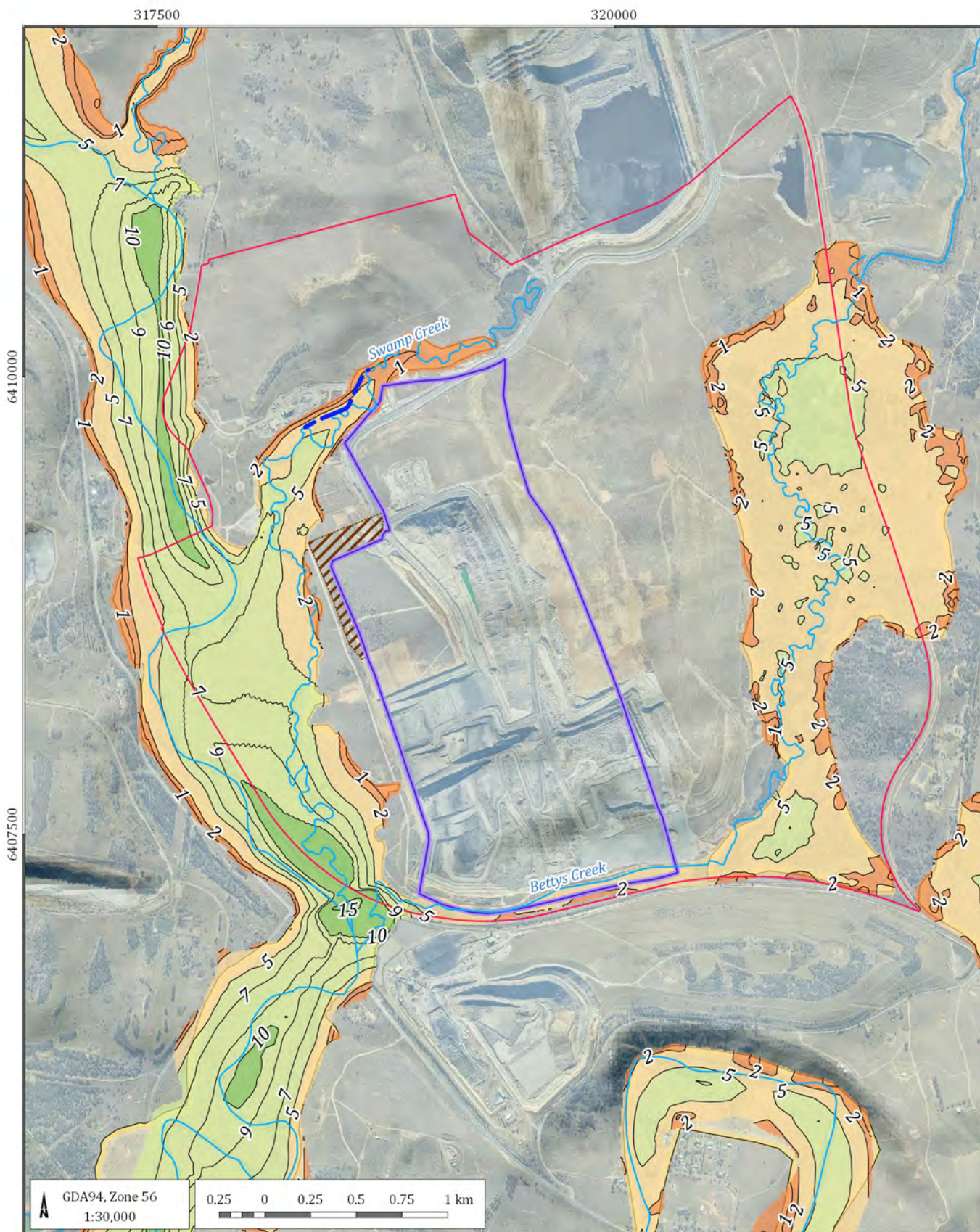
Glendell Mine MOD (G1874D)

Surface geology



DATE
10/10/2018

FIGURE No:
3.1



LEGEND

- Project boundary
- Proposed Mining Area
- Approved Mining Area
- Extent of Quaternary alluvium
- Drainage
- Swamp Creek diversion

Thickness (m)

- 0
- 2
- 5
- 10
- 20
- Thickness contour (m)

Glendell Mine MOD (G1874D)

Alluvium Thickness



DATE
10/10/2018

FIGURE No:
3.2

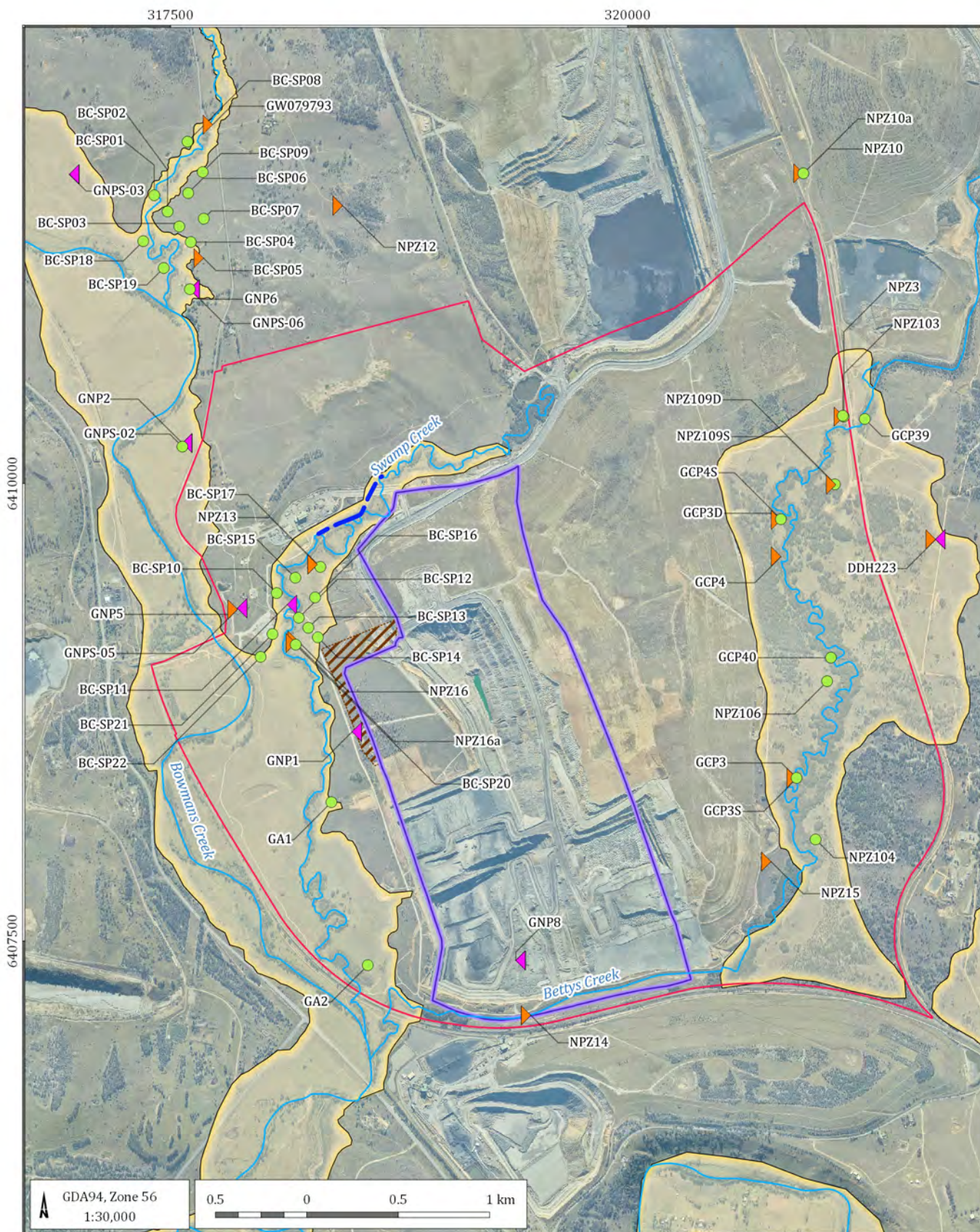
4 Hydrogeology

The Quaternary alluvium and the Permian coal measures form two distinct 'hydrostratigraphic units' based on their ability to store and transmit groundwater. Section 4.2 to Section 4.3 provide detail on the hydrogeological characteristics of the Quaternary alluvium and Permian coal measures.

4.1 Groundwater monitoring network

Glencore monitor groundwater levels within the Quaternary alluvium (Bowmans, Swamp, Yorks and Bettys Creeks) and Permian coal measures using a network of monitoring bores and vibrating wire piezometers (VWPs) installed across the mid Hunter region at each of its operations. Of relevance to the proposed modification are the monitoring networks installed adjacent to Barrett Pit at Glendell Mine, and to the north of the Barrett Pit. Groundwater monitoring at Glendell Mine is conducted in accordance with the Mount Owen Complex [Groundwater Management and Monitoring Plan](#) (GMP).

Monitoring bores within the Quaternary alluvium are typically shallow, owing to the nature of the local alluvium deposits. The Permian strata is monitored using a combination of monitoring bores and VWPs arrays for the deeper strata within the geological sequence. The locations of the monitoring bores and VWPs are presented in Figure 4.1. Figure 4.1 shows a cluster of monitoring bores within the Swamp Creek alluvium adjacent to the proposed modification at the north-western edge of the pit (BC series). These bores were installed previously to evaluate the hydrogeological properties of Swamp Creek to support the overall development of the Barret pit and future projects including Glendell North. They provide useful information on the groundwater system that occurs within the adjacent Quaternary alluvium. There are also a few monitoring bores installed along the western side of the pit (GA series) that provide information on the groundwater system and potential impacts from mining.



LEGEND

- Project boundary
- Extent of Quaternary alluvium
- Approved mining area
- Proposed Mining Area
- Drainage
- Swamp Creek diversion

Mine monitoring bores & VWPs

- Alluvium - Monitoring Bore
- ▲ Permian - Monitoring Bore
- ▲ Permian - Vibrating Wire Piezometer

Glendell Mine MOD (G1874D)

Groundwater monitoring network



DATE
10/10/2018

FIGURE No:
4.1

4.2 Quaternary alluvium

Where saturated the Quaternary alluvium forms a groundwater system with varying productivity. The potential to form a useful groundwater resource is controlled by the aquifer thickness and the water quality. The alluvial material typically offers significantly increased groundwater storage when compared to the underlying Permian coal seams, through higher interstitial porosity.

The pit boundary of the proposed modification extends Barrett Pit to some 50 m from the northern edge of the Swamp Creek alluvium at its closest point. The available information indicates that in this area the Swamp Creek alluvium has limited saturated thickness or is dry. Where the alluvium is saturated in this section of Swamp Creek, water quality testing indicates the aquifer contains brackish to saline groundwater. The alluvial aquifer close to the proposed extension to Barrett Pit is therefore not considered a highly productive aquifer (as defined in the AIP). Further information from the monitoring network is provided within the sections below.

4.2.1 Groundwater levels

Groundwater levels measured within monitoring bores installed within the Swamp Creek alluvium are presented on Figure 4.2. The groundwater levels within the BC series range from 70 mAHD to 73.5 mAHD, while the GA series that are further down-stream are slightly lower at between 64 mAHD (GA2) and 68 mAHD (GA1). Groundwater levels as expected show a relationship with climatic conditions as indicated by the CRD. A rise in groundwater levels occurred during 2015 aligning with above average rainfall, followed by a declining trend since this time in response to below average rainfall.

The groundwater levels from the GA1 and GA2 monitoring bores are particularly useful as they have been measured since the commencement of Barrett Pit mining in 2009. Whilst groundwater levels are currently relatively low within the Quaternary alluvium, there is no obvious long term trend of declining groundwater levels that would be attributable to mining activities with Barrett Pit.

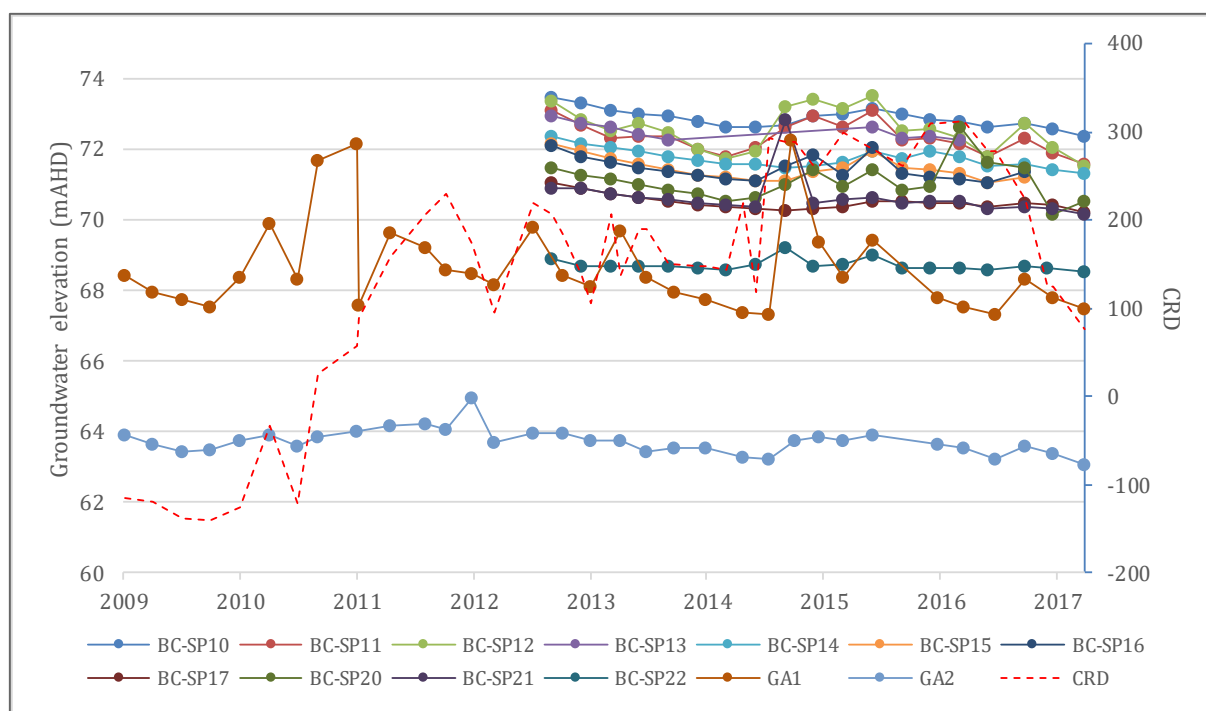


Figure 4.2 Swamp Creek groundwater levels

4.2.2 Groundwater quality

Salinity is the key constraint to groundwater use and can be described by total dissolved solid (TDS) concentrations. Electrical conductivity can be used to estimate TDS concentrations by multiplying by 0.67 (ANZECC 2000). TDS concentrations are commonly classified on a scale ranging from fresh to extremely saline. FAO (2013) provide a useful set of categories for assessing salinity based on TDS concentrations as follows:

- Fresh water <500 mg/L (EC – 745 $\mu\text{S}/\text{cm}$);
- Brackish (slightly saline) 500 to 1,500 mg/L (EC -745 – 2,340 $\mu\text{S}/\text{cm}$);
- Moderately saline 1,500 to 7,000 mg/L (EC -2,340 – 10,450 $\mu\text{S}/\text{cm}$);
- Saline 7,000 to 15,000 mg/L (EC -10,450 – 22,390 $\mu\text{S}/\text{cm}$);
- Highly saline 15,000 to 35,000 mg/L (EC -22,390 – 52,240 $\mu\text{S}/\text{cm}$); and
- Brine >35,000 mg/L (EC >52,240 $\mu\text{S}/\text{cm}$).

Groundwater quality within the shallow alluvial system of Swamp Creek is highly variable. Groundwater electrical conductivity (EC) measured in the Swamp Creek monitoring bores, shown on Figure 4.3, highlights the natural variability within the shallow alluvial aquifer. EC ranges from fresh (230 $\mu\text{S}/\text{cm}$) to saline (18,720 $\mu\text{S}/\text{cm}$) depending on time and location with the means ranging from brackish to saline. The natural variability of salinity within the alluvium suggests poor interconnectivity within the groundwater system. The EC at each monitoring bore location also has a wide range, which may be due to the timing of the sample events (eg. fresher groundwater would likely be sampled after rainfall recharge events). Monitoring is conducted monthly in accordance with the [GMP](#).

The two monitoring bores with the lowest means (BC-SP12 and BC-SP21) are located close to the main channel of Swamp Creek indicating a greater influence of streamflow recharge at these locations. Monitoring bores located further from the main channel generally have a higher salinity.

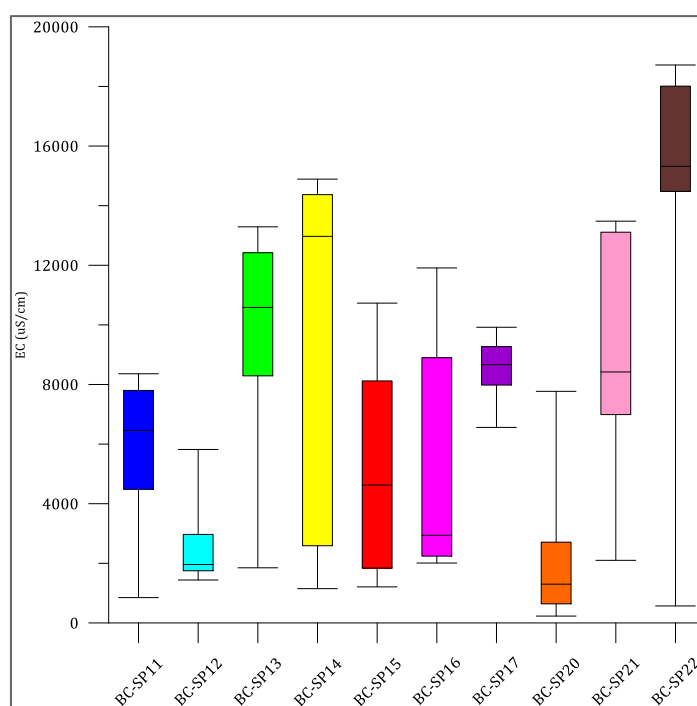
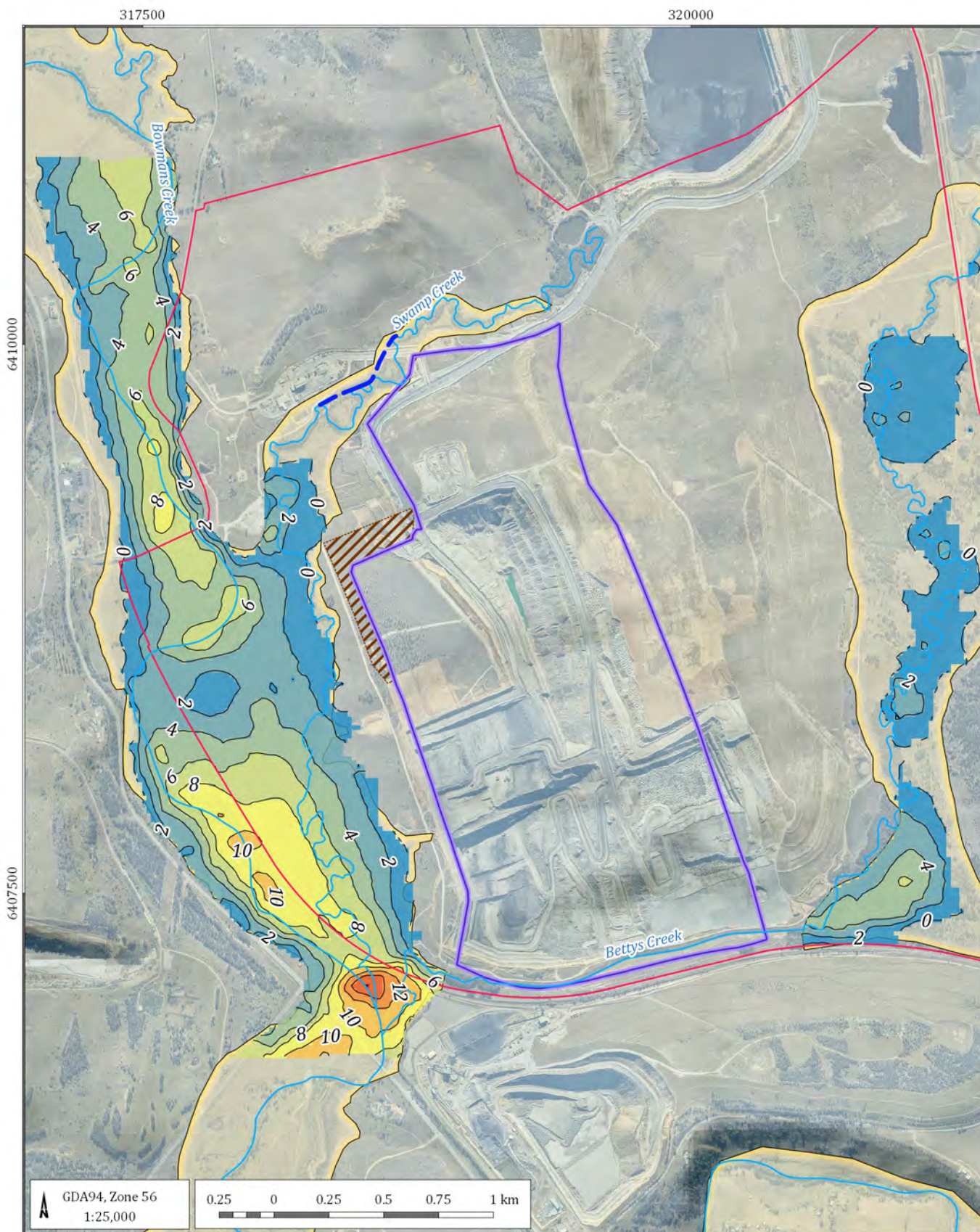


Figure 4.3 Swamp Creek electrical conductivity

4.2.3 Saturated thickness and yield

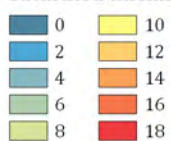
The saturated thickness of the Swamp Creek alluvium is shown on Figure 4.4. The figure was developed using measured average groundwater levels from the monitoring bore network. The average groundwater level from each bore was used to interpolate water levels across the Quaternary alluvium and estimate the saturated thickness of alluvium adjacent to Barrett pit. As noted previously the saturated area within the Swamp Creek alluvium is relatively limited, and this combined with the presence of clay rich sediments between Bowmans and Swamp Creeks (AGE, 2018) and high salinity means the alluvium does not form a productive aquifer.



LEGEND

- Project boundary
- Extent of Quaternary alluvium
- Proposed Mining Area
- Approved Mining Area
- Drainage
- Swamp Creek diversion

Saturated thickness (m)



— Saturated thickness contour (m)

Glendell Mine MOD (G1874D)

Saturated thickness



DATE
10/10/2018

FIGURE No:
4.4

4.3 Permian coal measures

4.3.1 Groundwater flow and levels

Groundwater flow within the Permian sediments can be divided into:

- thin, sometimes dry and variably permeable weathered rock (regolith);
- very low to low permeability and very low yielding sandstone, siltstone and conglomerate interburden/overburden that are classified as aquitards; and
- low to moderately permeable coal seams, each typically ranging in thickness from 2.5 m to 10 m, which are poor water bearing strata, but are the main units containing groundwater within the Permian sequence.

These zones can be seen in a photograph of the Barrett Pit highwall below (Figure 4.5) which shows the limited seepages of groundwater occurring through the coal seams being mined. The photograph highlights how the rate of evaporation of water from the mined face commonly exceeds the seepage rate, meaning the volume of groundwater from the mining area that requires pumping is limited.



Figure 4.5 Barrett Pit looking north & west (20 June 2018)

As the coal seams are exposed in the pit face depressurisation of the coal seams occurs. Two VWP arrays, GNP1 and GNP5, located on the north-western and western side of Barrett Pit, respectively, and are presented to show the depressurisation occurring within the coal seams due to mining. The piezometric elevation changes within the coal seams are shown on Figure 4.6 (GNP1) and Figure 4.7 (GNP5). The locations of the VWP's are shown on Figure 4.1.

GNP1 is located approximately 500 m west of the former Barrett Pit working area and 500 m north-west of the current active pit area. The hydrographs for this site shows a general decline in piezometric elevations within the coal seams over time. The piezometric elevations range from 0 mAH to 33 mAH. This is a typical response for coal seams in proximity to mining as expected from previous hydrogeological studies. The piezometric elevations within the coal seams are approximately 40 m below the level of groundwater occurring within the Swamp Creek alluvium (Figure 4.2), which are around 70 mAH. This difference indicates that despite the depressurisation of the coal seams the groundwater levels within the overlying alluvial systems are not detectably affected.

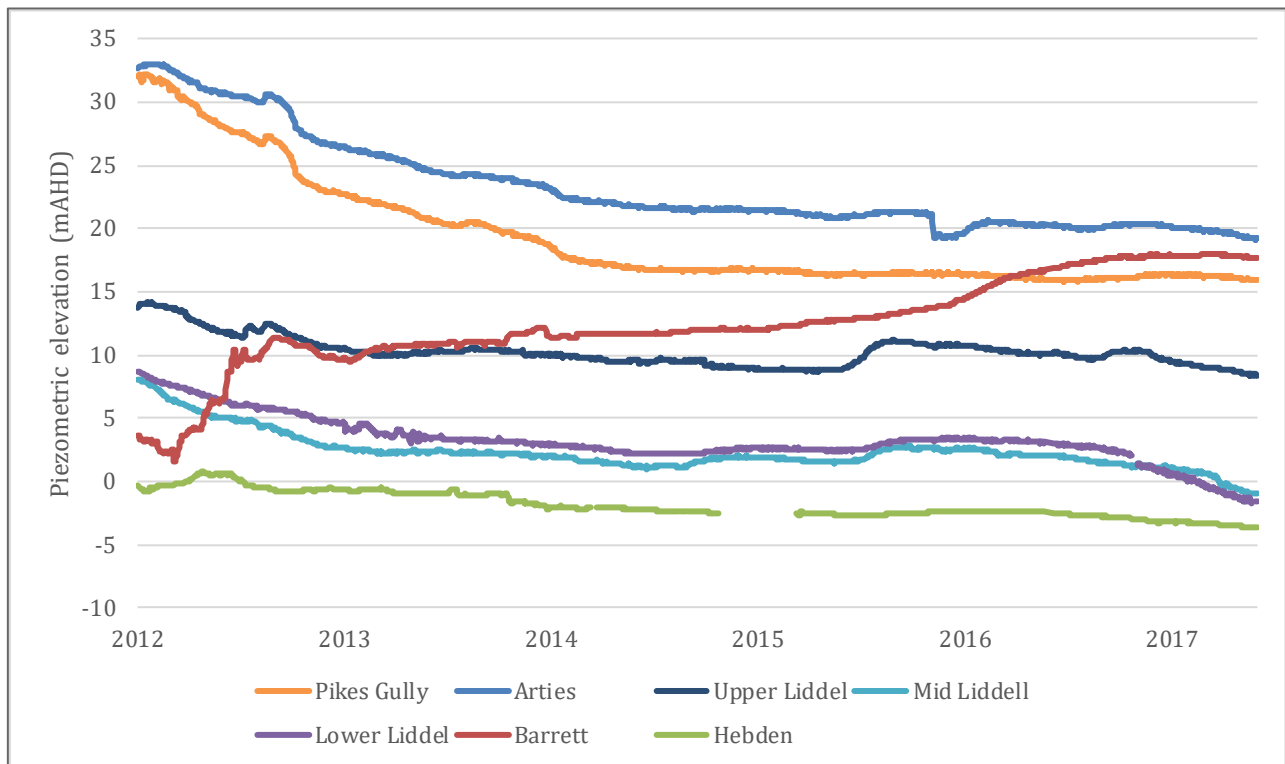


Figure 4.6 GNP1 VWP pore-water pressure

GNP5 is located approximately 250 m west of Swamp Creek and 1400 m north-west of the current active mining pit. This site has also recorded a general decline in the piezometric elevations within the coal seams over time due to mining. Whilst the coal seams have been depressurised, the piezometric elevations recorded within the upper interburden (GNP5-Int_40m) does not show any decline and is a similar elevation as the Swamp Creek alluvium groundwater levels (~70 mAH). This again indicates that the depressurisation of the coal seams is not propagating upwards and essentially confined to within the coal seams which are being mined.

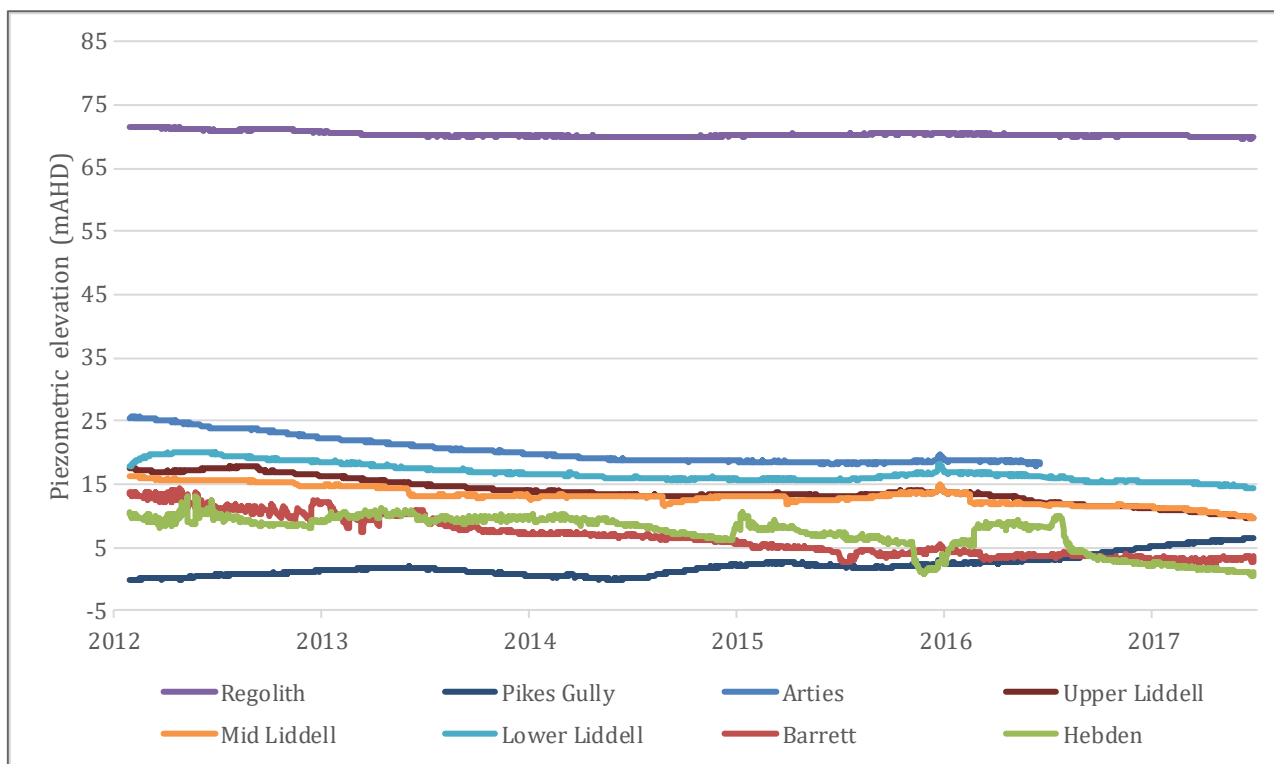


Figure 4.7 GNP5 VWP pore-water pressure

4.3.2 Groundwater quality

Groundwater quality within the deeper Permian is saline and does not vary between the different lithologies. EC measured in the Permian monitoring bores, shown on Figure 4.8, highlights the consistency across the different lithologies and that the EC is much higher and less variable than the overlying alluvium. Given the confined nature of this groundwater system, this consistency is expected.

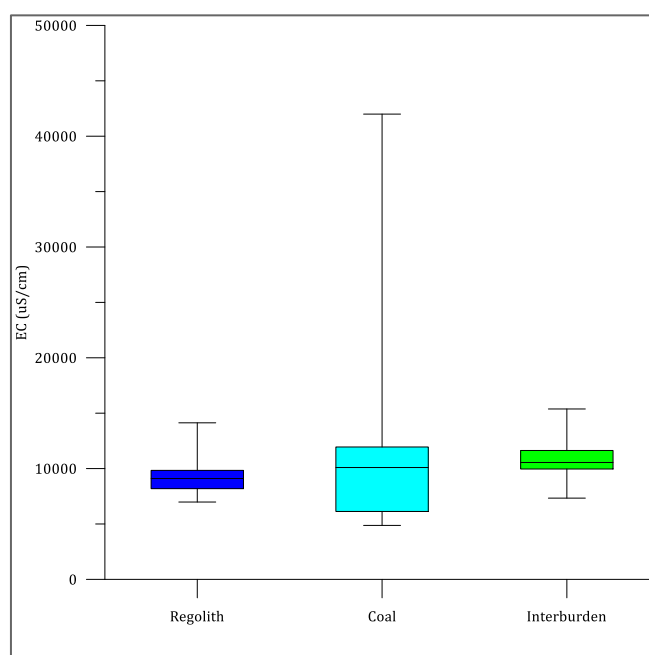


Figure 4.8 Permian strata electrical conductivity

4.3.3 Saturated thickness and yield

Saturation of the Permian strata occurs in both the coal seams and interburden. The ability to yield water is limited to the coal seams, as the interburden does not transmit significant volumes of groundwater and acts as an aquitard confining the coal seams. The coal seams range between 2.5 m and 10 m. the yield from the coal seams into Barrett pit is influenced by surrounding mines which are extracting the same coal seams. As groundwater drains from the coals seams down dip and Barrett pit extracts the coal from higher elevations, the potential yield is reduced. This limited saturated thickness and very low yield combined with high salinity means the coal seams do not form productive aquifers.

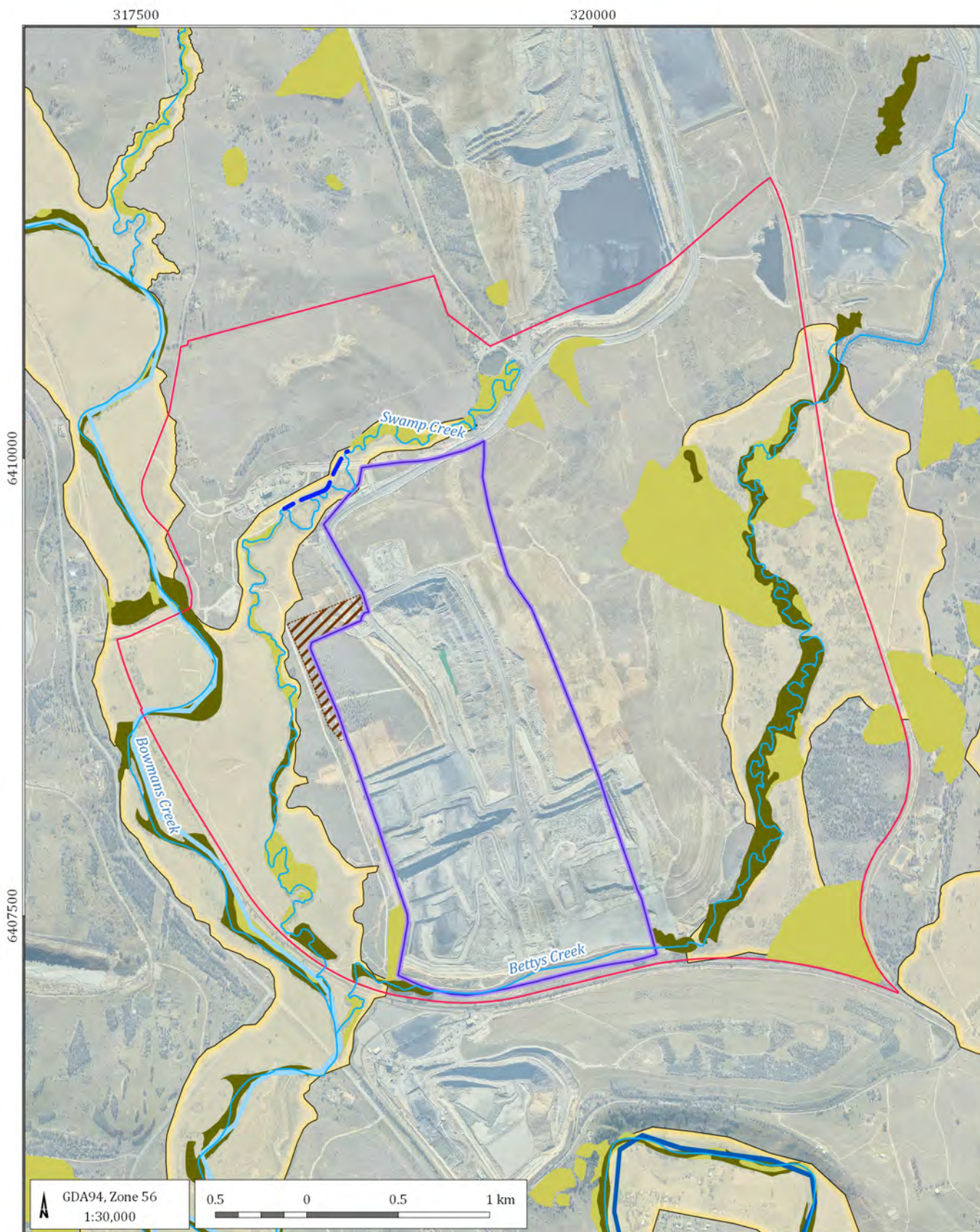
4.4 Groundwater dependent ecosystems

A review of the Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (GDE Atlas) shown on Figure 4.9 shows mapped aquatic and terrestrial GDEs surrounding Glendell Mine. The GDE Atlas was developed as a national dataset of Australian GDEs to inform groundwater planning and management.

The register indicates there are areas of low and high potential terrestrial GDE interaction along Bettys Creek, Swamp Creek and Bowmans Creek. There is moderate potential aquatic GDE along Bowmans Creek.

4.5 Private groundwater users

Glencore own the land where Glendell Mine is situated as well as land over the wider Mount Owen Complex. There are no bores on private land in the vicinity of the proposed modification. Figure 4.10 shows the land ownership surrounding Glendell mine and water bores registered on the NSW groundwater database.



LEGEND

- Project boundary
- Extent of Quaternary alluvium
- Proposed mining area
- Approved Mining Area
- Drainage
- Swamp Creek diversion

Aquatic

- High potential GDE
- Moderate potential GDE

Terrestrial

- High potential GDE
- Low potential GDE

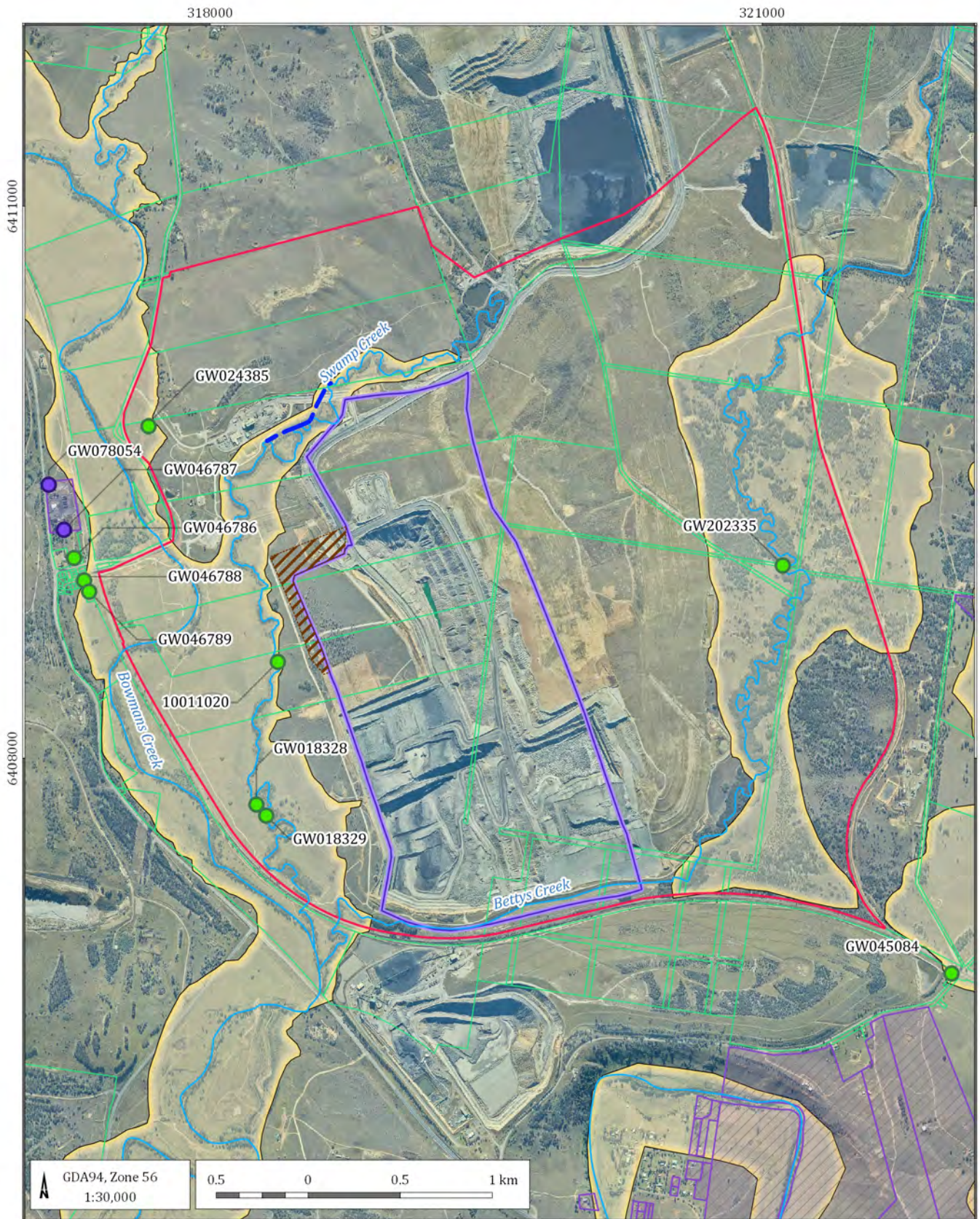
Glendell Mine MOD (G1874D)

Potential groundwater dependent ecosystems



DATE
31/10/2018

FIGURE No:
4.9



LEGEND

- ▬ Project boundary
- Extent of Quaternary alluvium
- Proposed Mining Area
- Glencore owned land
- Private properties
- Drainage
- Swamp Creek diversion
- Bores on Glencore owned land
- Bores on private land

Glendell Mine MOD (G1874D)

Private bores and land ownership



DATE
10/10/2018

FIGURE No:
4.10

4.6 Previous modelling

Rust PPK conducted the first groundwater investigation at Glendell Mine in 1996 as part of the Statement of Environmental Effects for DA 80/952. The groundwater study included drilling, permeability testing (slug tests, pumping and injection tests and packer tests), groundwater monitoring and numerical groundwater modelling to simulate the groundwater flow and to estimate rates of seepage.

The numerical groundwater model was used to simulate pit inflows and depressurisation over the 20 year mine development. The modelling included two simulation scenarios; 1) pit seepage with leakage from the overlying alluvium and 2) pit seepage without leakage from the overlying alluvium. The model results included a prediction of net change in the alluvium leakage balance and potential drawdown impacts to local bores. Potential drawdown impacts were dependent on the recharge rates applied to the alluvium.

Modelled estimates of pit seepage with no alluvium seepage were approximately 1.3 ML/day, while modelled pit seepage which included leakage from the alluvium ranged from zero to 6 ML/day after 20 years of mining. Operational experience has indicated the seepage rates predicted by the modelling were conservative with actual inflow, whilst difficult to measure, is less than 1 ML/day. The modelling indicated the coal seams would be depressurised to a distance in excess of one kilometre in all lateral directions. Leakage from the alluvium was determined to be limited to within 500 m of the pit workings, with the alluvium providing recharge to the underlying strata.

Because Glendell is surrounded by numerous other mining operations there have been more recent groundwater models developed to assess the impacts of adjacent operations that also cover Glendell to represent cumulative impacts. The Greater Ravensworth Model is the most up to date model recently developed to assess the impact of Modification 2 at the Mount Owen Mine (AGE, 2018). The model covers Glendell Mine and other mines including approved and foreseeable operations at IUG (including Modification 8), Rix's Creek/Rix's Creek North, Ravensworth East, Ravensworth Operations, Liddell Mine, Ashton Underground, and Hunter Valley Operations (HVO) North Mine. Although the model was not focused on Glendell Mine, the predicted cumulative impacts cover the mine and provide an indication of impacts from approved mining.

This model indicated a maximum of 0.5 m of drawdown within the Swamp Creek alluvium and around 0.2 m in the centre of the drainage due to cumulative impacts at closure of the Mount Owen Mine. Drawdown within Bowmans creek alluvium generated by the cumulative impact of mining was estimated to be around 0.2 m. The limited drawdown predicted by the numerical model generally aligns with the lack of observed drawdown within alluvial groundwater systems surrounding Glendell Mine. The proposed modification is not expected to significantly increase the extent of drawdown generated by the cumulative impacts of mining. The reasons for this conclusion are outlined further in sections below.

4.7 Groundwater regime and conceptual groundwater model

The groundwater regime at Glendell Mine consists of three low productivity groundwater systems, namely the:

- alluvium along the Bowmans Creek, Swamp Creek and Betty's Creek;
- weathered bedrock (regolith); and
- the coal seams of the Permian Coal Measures of the Vane Subgroup.

As discussed in Section 4.2 and shown in Figure 4.4, the saturated thickness of the alluvium is limited, and only becomes significant adjacent to Bowmans Creek which is not in proximity to the proposed modification. The groundwater levels within the alluvium respond to climatic conditions but have not shown a detectable response to the depressurisation occurring in the underlying Permian strata.

The regolith (weathered bedrock) occurs directly below the ground surface and is in direct connection with both the overlying alluvium (where present) and the underlying Permian strata. A similar response to the alluvium is observable, with no detectable dewatering attributable to mining activities. The regolith groundwater system represents a less significant water source than the alluvial aquifers in terms of both water volume and quality but is the most readily accessible outside the alluvial areas. The regolith is

The Permian coal measures do not form a productive aquifer. While some coal seams may show an elevated hydraulic conductivity, the dominant interburden sections are of very low hydraulic conductivity due to the low porosity and limited jointing. Occurrence and flow of groundwater is governed by the presence of micro faults, joints, fractures, and bedding planes which are often locally discontinuous. As shown on Figure 4.6 and Figure 4.7, depressurisation of the deeper Permian strata is evident, while the overlying regolith and Quaternary alluvium show less impacts from mining.

Hydraulic connectivity between the underlying Permian strata and the alluvial material via the regolith may occur, but the rate of exchange (i.e. the flux between the units) is extremely low due to the low permeability of the Permian lithologies (coal seams and interburden). It is also noted that mining of the Barrett Pit along the anticline means the coal seams intersected by the pit dip to the west and increase in depth below the alluvium. This further reduces the likelihood of hydraulic connectivity between the Permian strata being depressurised and saturated areas of the alluvial material to the west of the Glendell Mine.

Surrounding mines that intersect and extract the same coal seams (down dip) contribute to the depressurisation of the coal seams since they drain groundwater to the lowest point. Barrett pit is located along the Camberwell anticline and the coal seams are therefore higher than the surrounding mines. Therefore, given that surrounding mines are also depressurising the coal seams and there is no observable impact of the Swamp Creek alluvium groundwater levels, the flux of groundwater between the Swamp Creek alluvium and underlying Permian strata would be very low.

As discussed in Section 4.2.2, while two of the monitoring bores within the Quaternary alluvium close to Swamp Creek show mean salinity levels at the upper end of the brackish range, the water quality close to the proposed Barrett Pit extension are moderately saline or saline. All Permian systems have saline water quality. As outlined in Section 4.2.3, yields from both the Quaternary and Permian systems do not meet NSW government criteria to be classified as a “highly productive” groundwater source, which requires TDS concentrations less than 1500 mg/L and contain water supply works that can yield water at a rate greater than 5 L/s. Therefore, the Quaternary and Permian systems are both classified as “less productive” groundwater sources according to NSW government policy.

5 Impact assessment

The proposed modification seeks to extend Barrett Pit by 60 m to the west and 130 m to the north. Given the limited footprint of the proposed modification the impacts were assessed qualitatively relying upon extrapolation of monitoring information collected during mining to date. Predictions from numerical models for surrounding projects have also been considered. The available information indicates the following would occur should the Barrett Pit be extended:

- the zone of depressurisation within the coal seams would extend in the order of 60 m to the west and 130 m to the north;
- the groundwater levels within the surrounding alluvial groundwater systems would not record a detectable change and therefore riparian vegetation would remain unaffected; and
- the seepage rates of groundwater into the active mining areas would not be detectably different from those currently experienced during mining.

The proposed modification is expected to slightly extend the zone of depressurisation occurring within the Permian coal seams. This impact is not expected to have any material consequence as the available monitoring data indicate the depressurisation of the coal seams does not propagate upwards sufficiently to influence shallow groundwater levels within the weathered zone and the Quaternary alluvium. As the Permian coal seams depressurised by (surrounding) mining activities in the proposed extension dip to the west away from the Camberwell anticline, the additional separation between saturated areas of the Quaternary alluvium and the depressurised Permian systems decrease the chance for connectivity between the systems. This response is expected to remain if the Barrett Pit were extended. Whilst the proposed pit extension moves the pit closer to the Swamp Creek alluvium it does not intercept the alluvium. In addition, the alluvium in proximity to the proposed modification is dry, or of limited saturation (Figure 2.2). Therefore, the proposed modification would not significantly increase leakage from the alluvium.

The groundwater levels in the Swamp Creek monitoring bores (Figure 4.2) indicate that there is no drawdown occurring in the Swamp Creek alluvium, even though depressurisation is occurring in the underlying Permian strata (Figure 4.6 and Figure 4.7). Even though the alluvium is hydraulically connected to the underlying Permian strata, the rate of exchange is extremely low (undetectable) due to the relative impermeability of the underlying hardrock strata. Subsurface seepage is constrained by the permeability of the deeper coal seams, which is extremely low. The alluvium receives input from rainfall which maintains groundwater levels and exceeds leakage rates to deeper underlying strata depressurised by mining.

The Greater Ravensworth groundwater model has been used for recent groundwater impact assessment completed for the Mount Owen Modification 2 simulated cumulative impact of surrounding mines (AGE, 2018). The simulated results showed that the cumulative drawdown within Swamp Creek and Bowmans Creek was generally less than 0.2 m. The drawdown in the Permian Strata (Liddell coal seam) was greatest at the Integra underground and Ravensworth open cut, located east and west of Glendell respectively. Since the proposed modification does not intend to deepen the mine it would not be expected to increase the cumulative impacts on Swamp Creek or Bowmans Creek.

The groundwater levels also indicate that the Swamp Creek alluvium saturated thickness is limited (Figure 4.4). Saturated thickness is generally fewer than two metres and limited in extent to the area near Bowmans Creek confluence. Therefore, the aquifer is of limited extent and does not contain a usable amount of groundwater.

The water quality (Figure 4.3) of Swamp Creek groundwater is highly variable and generally of poor quality. The EC has a wide range and would be influenced by rainfall recharge and local lithology. High concentrations of TDS commonly prevents beneficial use of the groundwater for stock watering.

A search of the DoI Water registered bore database indicates that there are no private groundwater users that would be impacted by the proposed Modification.

Based on the information reviewed, there is unlikely to be any impact on the alluvium as a result of the proposed modification.

6 Aquifer interference policy – minimal impact considerations

The Aquifer Interference Policy (AIP) outlines requirements for obtaining water licences (WAL) and the assessment of aquifer interference activities. It establishes and objectively defines considerations in assessing the minimal impacts that may occur to key water dependent assets. The sections below compare the expected impacts against the requirements of the AIP and discuss compliance with the policy.

The proposed Modification does not seek to gain additional WALs. The AIP has been used to objectively assess if the potential impact on the Swamp Creek alluvium is within the minimal impact considerations.

6.1 Minimal impact considerations

The minimal impact considerations are a series of thresholds that define minimal impacts from aquifer interference activities. There are two levels of minimal impact considerations specified in the AIP, being Level 1 and Level 2. If the predicted impacts are less than the threshold level specified by the Level 1, then these impacts are acceptable under the AIP. Where the predicted impacts are greater than the Level 1 minimal impact considerations, then additional studies are required to fully assess and manage these predicted impacts. If this assessment shows that the predicted impacts do not prevent the long-term viability of the relevant water-dependent asset, then the impacts will be considered to be acceptable.

Table 6.1 compares the potential modification impacts with the minimal impact considerations for less productive alluvial water sources. Table 6.2 addresses the less productive porous and fractured rock water sources.

Table 6.1 Minimal impact considerations – less productive alluvial water sources

Water sharing plan: Hunter Unregulated and Alluvial Water Sources	
Aquifer	Alluvial aquifer (Hunter Unregulated and Alluvial Water Sources)
Category	Less Productive
Level 1: Minimal Impact Consideration	Preliminary assessment
<u>Water table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. or A maximum of a 2 m decline cumulatively at any water supply work.	As outlined within Section 5 detectable drawdown within the adjacent alluvial aquifers are not considered likely. At the time of writing, there was no Culturally Significant Sites or high priority GDEs located within the study area according to Hunter Unregulated and Alluvial Water Sources WSP. Hence there are no known risks to such sites at this time. There are no private water supply bores within proximity to Glendell Mine or the proposed modification. Previous modelling (Rust PPK, 1996) indicated that drawdown would not exceed 0.5 m in the alluvium. Leakage from alluvium has been less than the model results. Observed groundwater levels during mining have not shown any long-term decline. Recent modelling for adjacent operations (AGE, 2018) also indicated similar results with drawdown within adjacent alluvial systems from cumulative impacts predicted to be less than 0.5 m. Therefore, the minor change in mine footprint, is not predicted to exceed 2 m decline at any water supply work. Conclusion: does not exceed Level 1 minimal impact consideration thresholds.
<u>Water quality</u> Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity.	Water quality salinity can constrain the beneficial use of the alluvial groundwater. Given this, no change in beneficial use of alluvial groundwater is expected. The creeks surrounding the proposed modification are ephemeral and do not have a permanent baseflow, therefore no change in salinity of surface water is expected. Conclusion: does not exceed Level 1 minimal impact consideration thresholds.

Table 6.2 Minimal impact considerations – less productive porous and fractured rock water sources

Water sharing plan: North Coast Fractured and Porous Rock Groundwater Sources	
Aquifer	Permian (Sydney Basin) Porous rock - North Coast Groundwater Source
Category	Less Productive
Level 1: Minimal Impact Consideration	Preliminary assessment
<u>Water table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. or A maximum of a 2 m decline cumulatively at any water supply work.	At the time of writing, there were no Culturally Significant Sites or high priority GDEs located in the study area according to the North Coast Fractured and Porous Rock Groundwater Sources WSP. Hence there are no known risks to such sites at this time. There are no water supply works in proximity of the proposed modification. Conclusion: does not exceed Level 1 minimal impact consideration thresholds.
<u>Water pressure</u> A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.	Groundwater level drawdown resulting from the approved operations and modification may exceed 2 m adjacent to the mining area in the Permian strata, however there are no water supply works within the less productive Permian strata in the vicinity. Monitoring will continue to assess the drawdown that may occur. Reviews are also conducted 3 yearly to compare predictions against observed groundwater levels. Conclusion: does not exceed Level 1 minimal impact consideration.
<u>Water quality</u> Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The beneficial use of groundwater occurring within the Permian is limited by the low yields and high salinity. No change in beneficial use due to the proposed modification is considered likely. Conclusion: does not exceed Level 1 minimal impact consideration thresholds.

6.2 Water licensing

Groundwater licence allocations are held by Mt Owen Coal mine and managed under the approved [GMP](#). Licence entitlements for extraction from the regional hard rock aquifer are summarised in Table 6.3.

Table 6.3 Water licensing - North Coast Fractured and Porous Rock WSP

Licence No.	Abstraction purpose	Units
20BL169337	Groundwater extraction for dewatering purposes – Mt Owen North pit	140
20BL170294	Groundwater extraction for dewatering purposes – Eastern Rail tailings pit	220
20BL170295	Groundwater extraction for dewatering purposes –Bayswater North and West pits	800

The Barrett Pit operates in a relatively low permeability geological regime where groundwater is not problematic for mining and is commonly evident only as damp evaporating seeps in mine faces. There are no significant flows of groundwater into the pit that require continuous pumping and therefore the volume of groundwater intercepted by the mining operations cannot be directly measured. The fact that groundwater does not need pumping does not indicate it is not entering the mine, but rather that it is largely evaporated or adheres to mined materials preventing it from accumulating on the pit floor. Given the limited footprint associated with the proposed modification there is not expected to be a notable increase in seepage into the mining area and the licence allocations currently held are expected to be sufficient to account for groundwater intercepted by the Barrett Pit operations.

7 Conclusion

To facilitate the proposed modification, Mount Owen commissioned a Statement of Environmental Effects (SEE) to support the proposed modification under Section 4.55(1A) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This groundwater impact assessment (GIA) has been prepared to support the SEE for the proposed modification.

Historical groundwater levels during the mining, groundwater quality, location of groundwater dependent ecosystems (GDEs) and private water bores were reviewed as part of this GIA. The groundwater assessment addresses the requirements of the New South Wales Aquifer Interference Policy (2012) (AIP).

The assessment indicates depressurisation of the coal seams and the interburden has occurred in areas adjacent to the Barrett pit, but the depressurisation is not propagating into the overlying Swamp Creek alluvium and inducing leakage. This outcome is not expected to change due to the proposed modification and would not have an impact on the environment greater than what is already approved under the Glendell Consent. Groundwater monitoring should continue as outlined within the groundwater management plan and be reported annually.

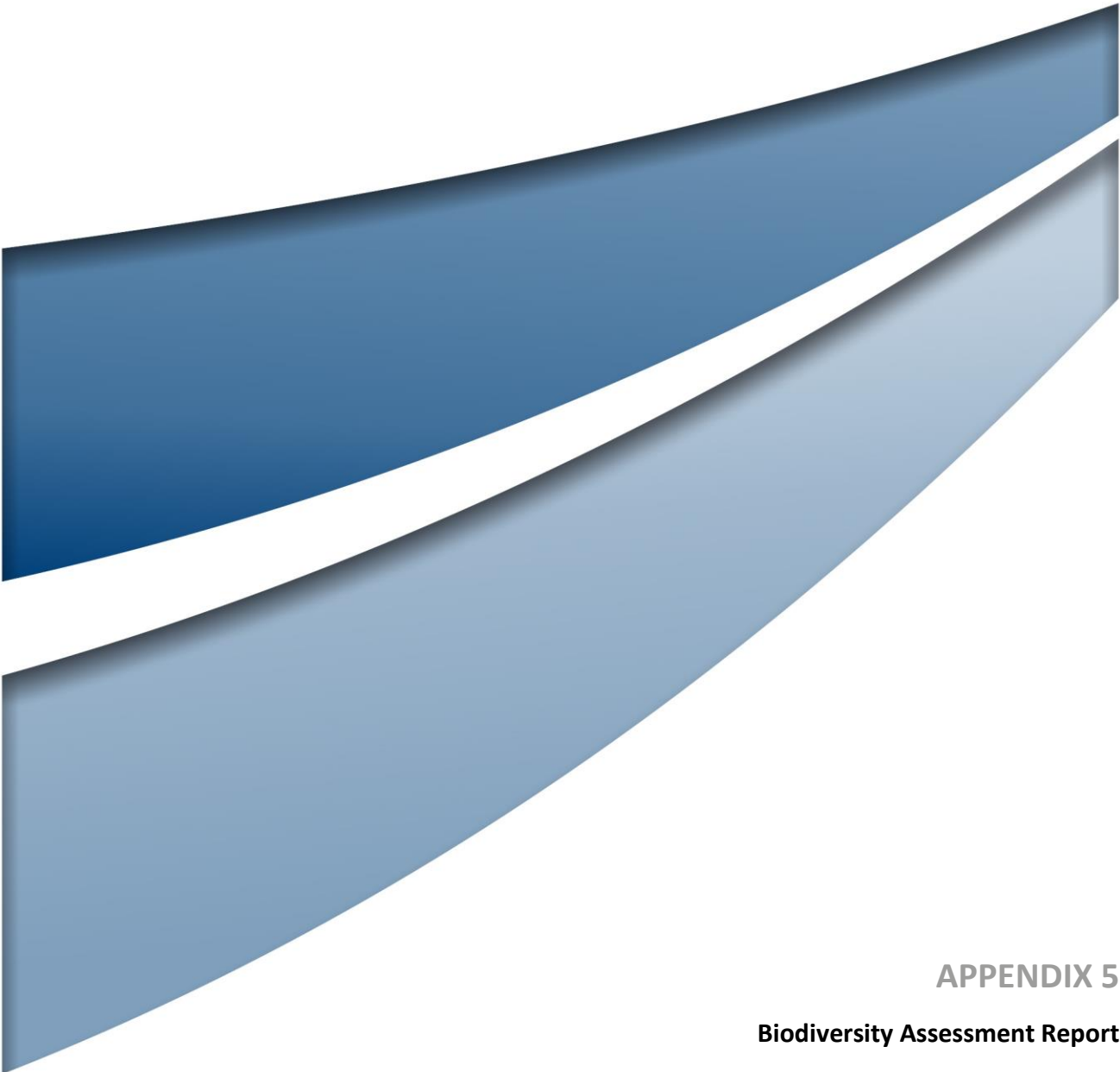
8 References

- AGE. (2018). *G1862A.Mount Owen Continued Operations Modification 2 - Groundwater Impact Statement*.
- AGE. (2018). *G1874.Glendell North alluvium assessment*.
- Macfarlane, C., Rachakonda, P. K., Herron, N. F., Marvanek, S. P., Wang, J., Moore, B., et al. (2016). *Description of the water-dependent asset register for the Hunter subregion. Product 1.3 for the Hunter subregion from the Northern Sydney Basin Bioregional Assessment*. . Department of the Environment, Bureau of Meteorology, CSIRO and Geoscience Australia, Australia.
- Rust PPK. (1996). *Glendell mine groundwater studies*.

Appendix A **Peer review comments**

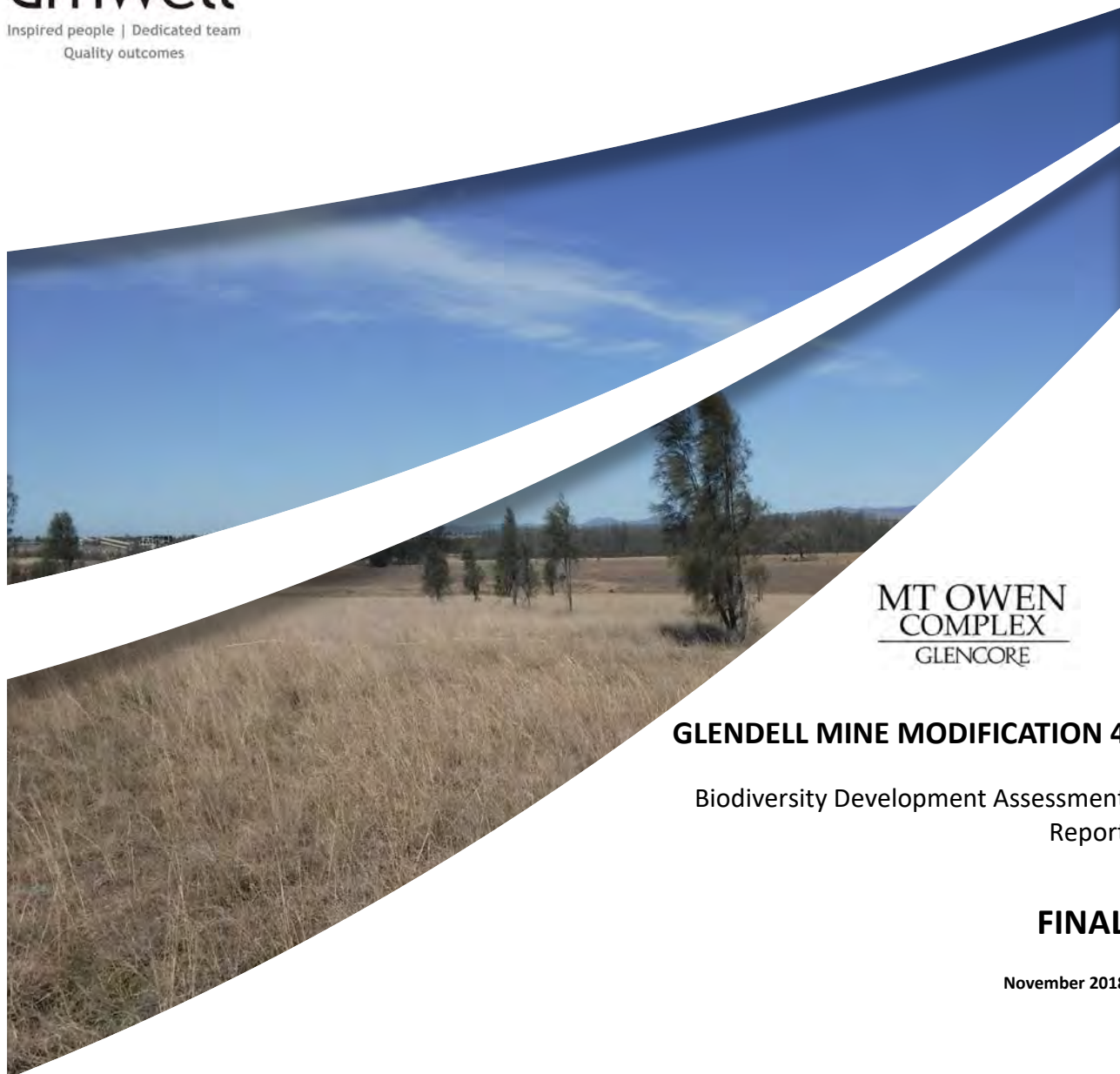
Table A.1 Peer review comments

Section	Comment	Response
4.3.1	Potentiometric head (mAHD). Pressure is the wrong term as its unit is kPa	Changed to piezometric head
4.3.3	Re-word this. The interburden is still saturated – it just has low yield	Updated text
4.4	Mark Blakelys Red Gum on Figure 4.9	Marked on figure
4.6	I do not understand the two alternatives. Are they different scenarios? Unusual to have scenarios based on alluvial recharge	Paragraph updated to explain that there were 2 scenarios simulated
4.6	Mention more recent modelling with findings as dot points, and a statement that original modelling is confirmed/consistent/similar	Included reference to Glencore Greater Ravensworth groundwater model
5	Does this mean better or worse? Re-word	Updated. Means higher TDS (worse than)
6	“take” is not a prescribed minimal impact consideration	Paragraph updated
Figure 4.1	Add footnote in text: SP tag = standpipe; otherwise VWP	Updated figure symbology
Figure 4.10	Add bore ID	Added to figure
Figure 4.9	Note if low, moderate or high dependence	Added to figure legend
Table 6.1	Update to more recent work	Included reference to Glencore Greater Ravensworth groundwater model



APPENDIX 5

Biodiversity Assessment Report



MT OWEN
COMPLEX
GLENORE

GLENDELL MINE MODIFICATION 4

Biodiversity Development Assessment
Report

FINAL

November 2018



GLENDELL MINE MODIFICATION 4

Biodiversity Development Assessment Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Glencore

Project Director:	Bret Jenkins
Project Manager:	Penelope Williams
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Report No.	4052/R08/V2/FINAL
Date:	November 2018



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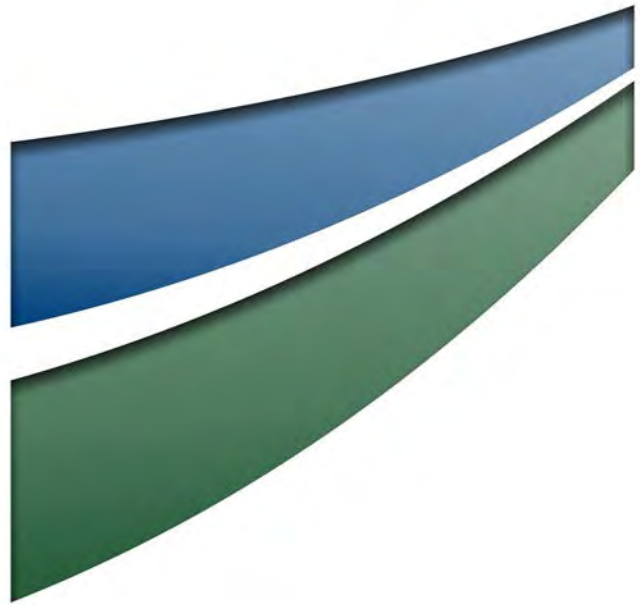
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This report was prepared using
Umwelt's ISO 9001 certified
Quality Management System.

Executive Summary



Mt Owen Pty Ltd (Mount Owen) is seeking development consent to extend mining operations at Glendell Mine (Barrett Pit) in order to access an additional approximately 2.5 Mt ROM Coal. The Proposed Modification will also provide for an additional approximately 8 months of mining operations.

The Development Footprint is located in the locality of Hebden, within the Singleton LGA, and covers an area of approximately 12 hectares. It is bound to the east by the existing Glendell Mine. Swamp Creek is located to the west of the Development Footprint and Bettys Creek is located to the south.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt Environmental and Social Consultants (Umwelt) on behalf of Mount Owen to assess the potential biodiversity impacts of the Proposed Modification in accordance with the BAM.

Surveys of the Development Footprint identified two Plant Community Types (PCTs) in regenerating or derived grassland condition being:

- PCT1692 Bull Oak grassy woodland of the central Hunter Valley
- PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter.

Following the application of avoidance and mitigation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Proposed Modification:

- 21 ecosystem credits for PCT1692 Bull Oak grassy woodland of the central Hunter Valley
- 88 ecosystem credits for PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter

Mount Owen is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Proposed Modification as required under the *Biodiversity Conservation Act 2016*. This will be undertaken using one or more of the following options:

- The establishment and retirement of credits within a Stewardship site
- Securing required credits through the open credit market, and/or
- Payments to the Biodiversity Conservation Fund.

Glossary

BDAR	Biodiversity Development Assessment Report
BAM	Biodiversity Assessment Methodology
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CEEC	Critically Endangered Ecological Community
Development Footprint	The total impact area associated with the Project. The proposed disturbance area is referred to throughout this report as the Development Footprint in accordance with the BAM.
DoE	Commonwealth Department of the Environment
DNG	Derived Native Grasslands
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur within a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GDEs	Groundwater-dependent Ecosystems
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
LGA	Local Government Area
MGA	Map Grid of Australia
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
SEARs	DPE Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates.
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

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1 Introduction

Mt Owen Pty Ltd (Mount Owen) is seeking development consent to extend mining operations at Glendell Mine (Barrett Pit) in order to access an additional approximately 2.5 Mt ROM Coal. The Proposed Modification will also provide for an additional approximately 8 months of mining operations.

The existing Glendell Mine forms part of the Mount Owen Complex located in the Hunter Coalfields in the Upper Hunter of New South Wales (NSW) approximately 20 kilometres (km) north-west of Singleton and 24 km south-east of Muswellbrook (refer to **Figure 1.1**). It is located within the suburb of Hebden, in the Singleton Government Area (LGA).

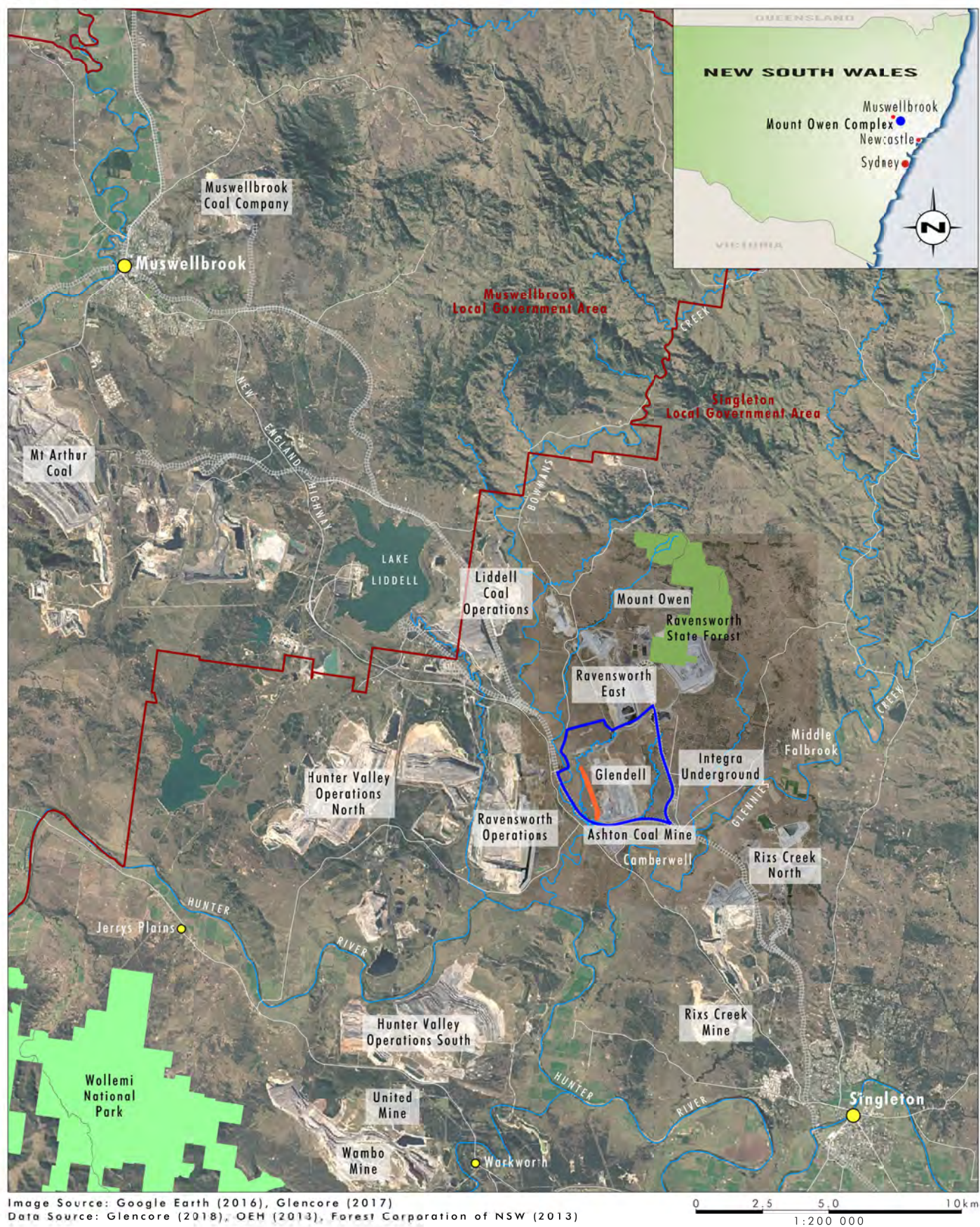
As the Proposed Modification is State Significant Development (SSD) it requires assessment using the Biodiversity Assessment Method (BAM) under the *Biodiversity Conservation Act 2016*. Approval is sought under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), for which the Minister for Planning is the consent authority.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt Environmental and Social Consultants (Umwelt) to assess the potential biodiversity impacts of the Project in accordance with the BAM and to address the requirements of the NSW Department of Planning and Environment (DP&E) SEARS as detailed in **Section 1.2**.

1.1 The Proposed Modification

The Proposed Modification of the existing approval (DA 80/952) is shown on **Figure 1.2** and includes the following:

- Extension of the northern and western boundary of the approved pit shell covering an additional area of approximately 12 hectares (ha) in order to access additional 2.5 Mt ROM Coal.
- Removal of approximately 15.5 ha from the approved disturbance area, resulting in a net decrease (approximately 3.5 ha) in the overall disturbance area associated with the Glendell Mining operations.



Legend

- Glendell Consent Boundary (DA 80/952)
- Development Footprint
- Local Government Area Boundary
- National Park
- State Forest
- Road
- Railway
- Drainage Line
- Towns

FIGURE 1.1
 Locality Plan

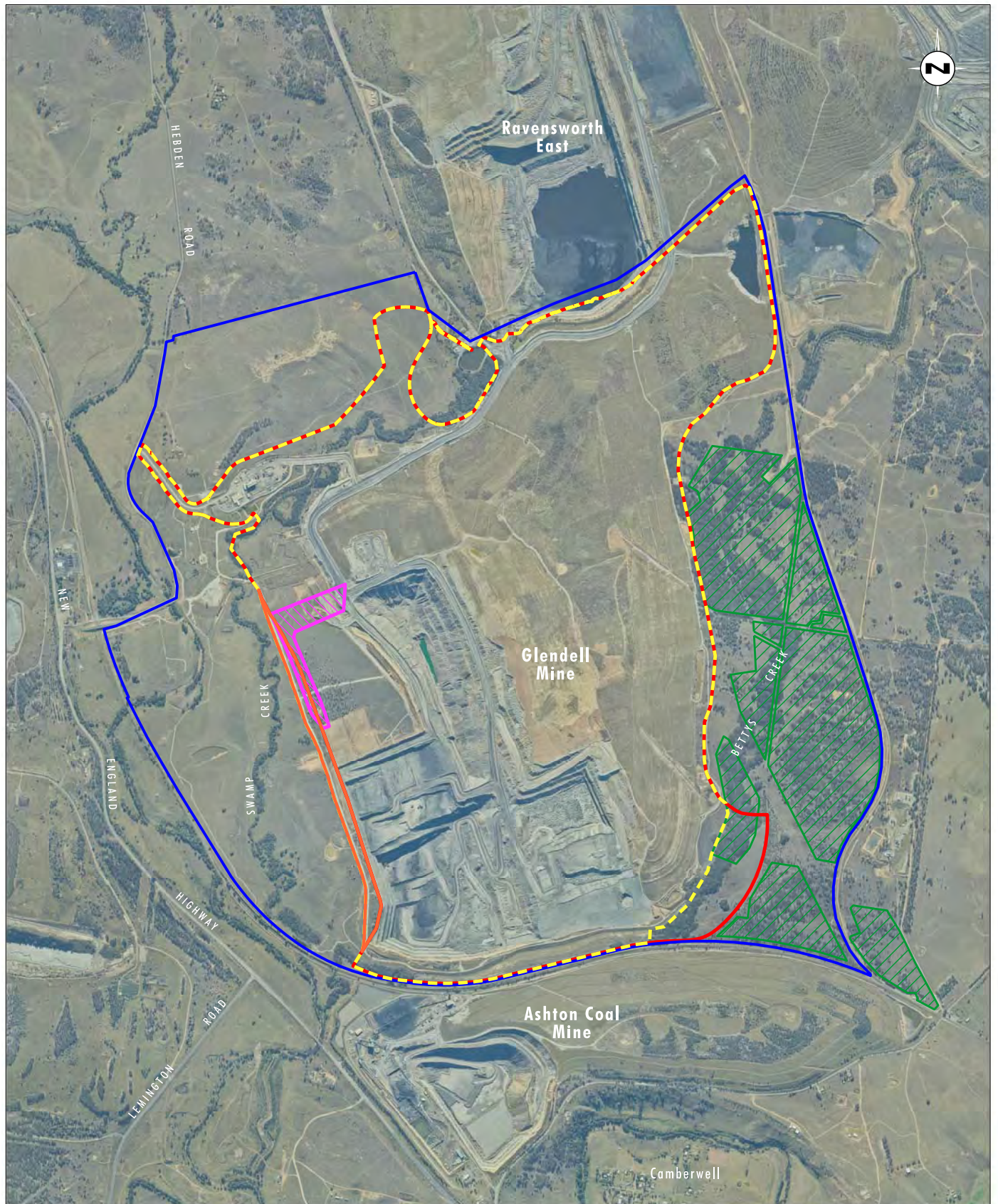


Image Source: Glencore (Jul 2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Glendell Consent Boundary (DA 80/952)
- - - Approved Disturbance Area (DA 80/952)
- Development Footprint
- - - Proposed Disturbance Area
- ▨ Betty's Creek Habitat Management Area
- ▨ Proposed Mining Area

FIGURE 1.2

Proposed Modification Overview

1.2 Development Footprint Information

The Development Footprint will be subjected to a range of disturbances as outlined in **Section 5.0**. The Development Footprint is shown on **Figure 1.3**.

The Development Footprint comprises regrowth and derived vegetation and adjoins the western boundary of the existing Glendell Mine (Barrett Pit). The Development Footprint predominantly comprises derived native grassland containing areas of regenerating native trees.

1.2.1 Location

The Development Footprint is located in the suburb of Hebden, within the Singleton LGA, and covers an area of approximately 12 hectares. It is bound to the east by the existing Glendell Mine. Swamp Creek is located to the west of the Development Footprint and Bettys Creek is located to the south.

The location of the Development Footprint and other relevant landscape features that pertain to this assessment are shown on **Figures 1.3 to 1.5**. Refer to **Table 1.2** for a summary of the Development Footprint's location in the landscape.

Table 1.1 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Hunter
Mitchell Landscape	Central Hunter Foothills
LGA	Singleton
Assessment Type	Site-based
Development Footprint Size	12.01 hectares

1.2.2 Local Ecological Context

The Development Footprint is located in the Hunter Coalfields in the Upper Hunter of NSW. The land uses surrounding the site predominantly includes open-cut and underground coal mining operations and agriculture. The vegetation present in the Development Footprint comprises grassland with patches of regenerating trees. Swamp Creek and Bettys Creek are located within 50 metres of the Development Footprint.

Where there is remnant native vegetation in the locality, a number of Threatened Ecological Communities (TECs) are known to occur including Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions endangered ecological community (EEC) listed under the *Biodiversity Conservation Act 2016* (BC Act); Central Hunter Ironbark - Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC listed under the BC Act; and Central Hunter Valley Eucalypt Forest and Woodland critically endangered ecological community (CEEC) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

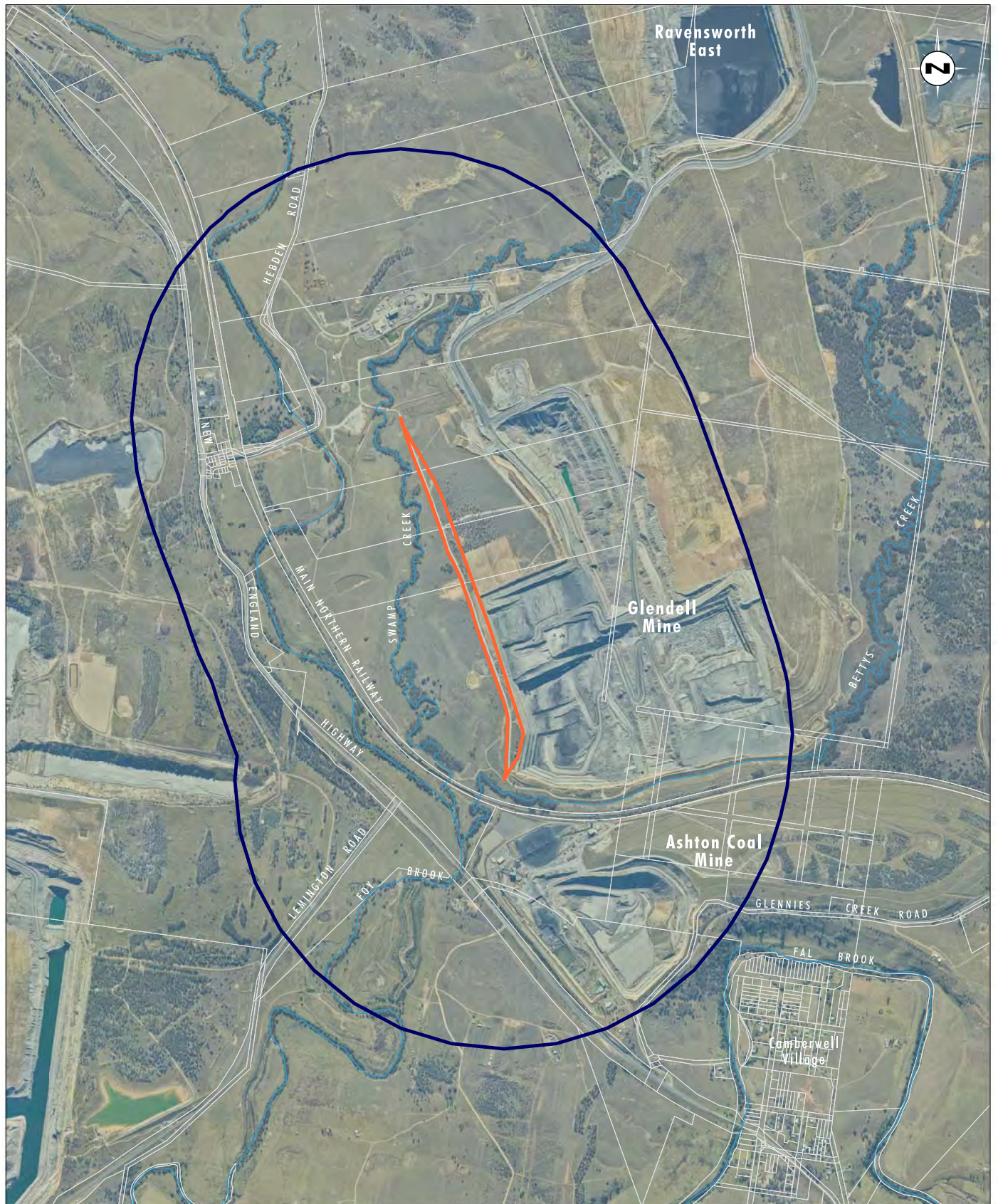


Image Source: Glencore (2018)
Data Source: Glencore (2018)

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1:30 000

Legend

- Development Footprint
- 1500m Buffer Area
- Cadastre

FIGURE 1.3

Site Map

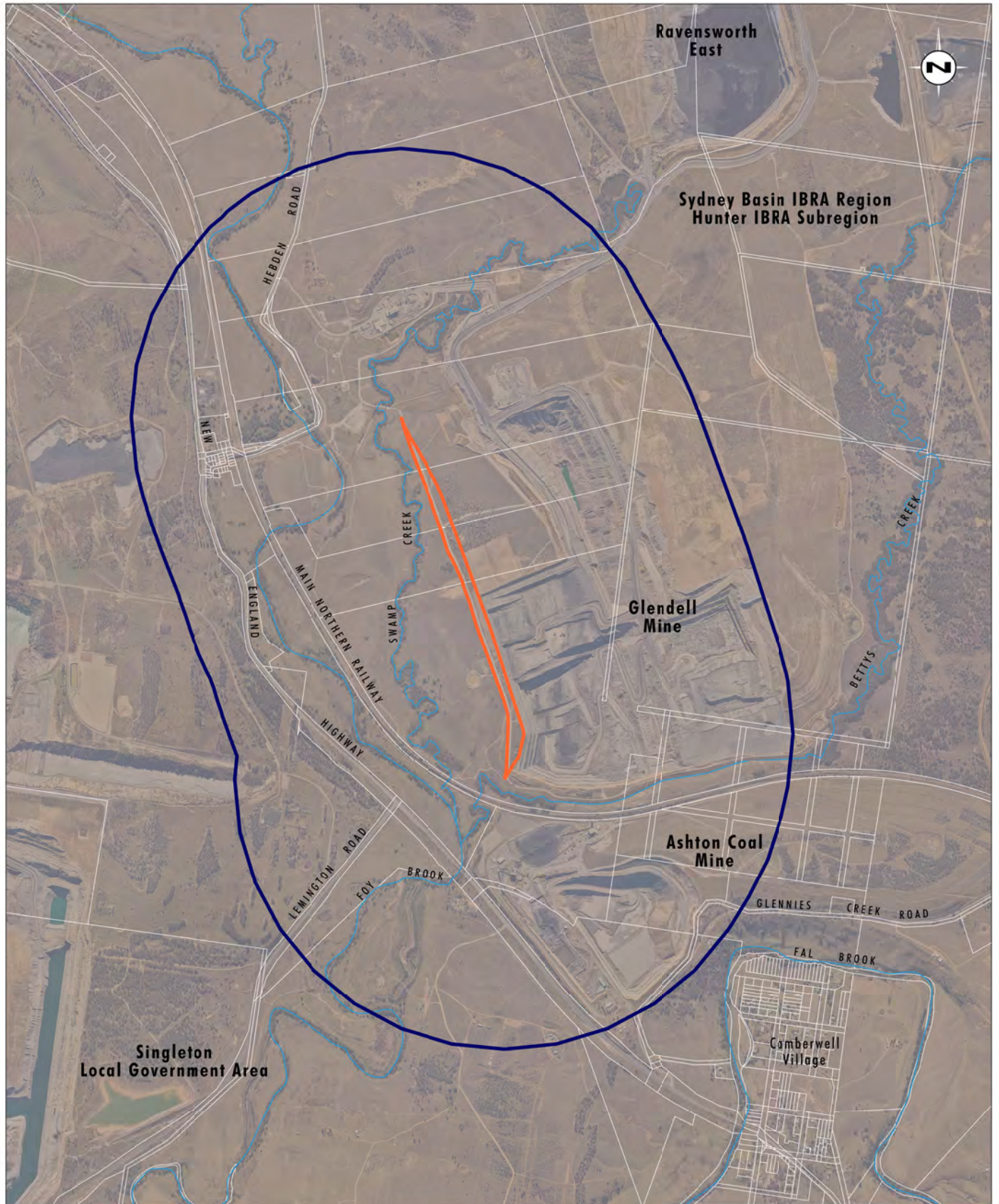


Image Source: Glencore (2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- Development Footprint
- 1500m Buffer Area
- Singleton Local Government Area
- Cadastre

FIGURE 1.4

Location Map - IBRA Regions/Subregions
and Local Government Area

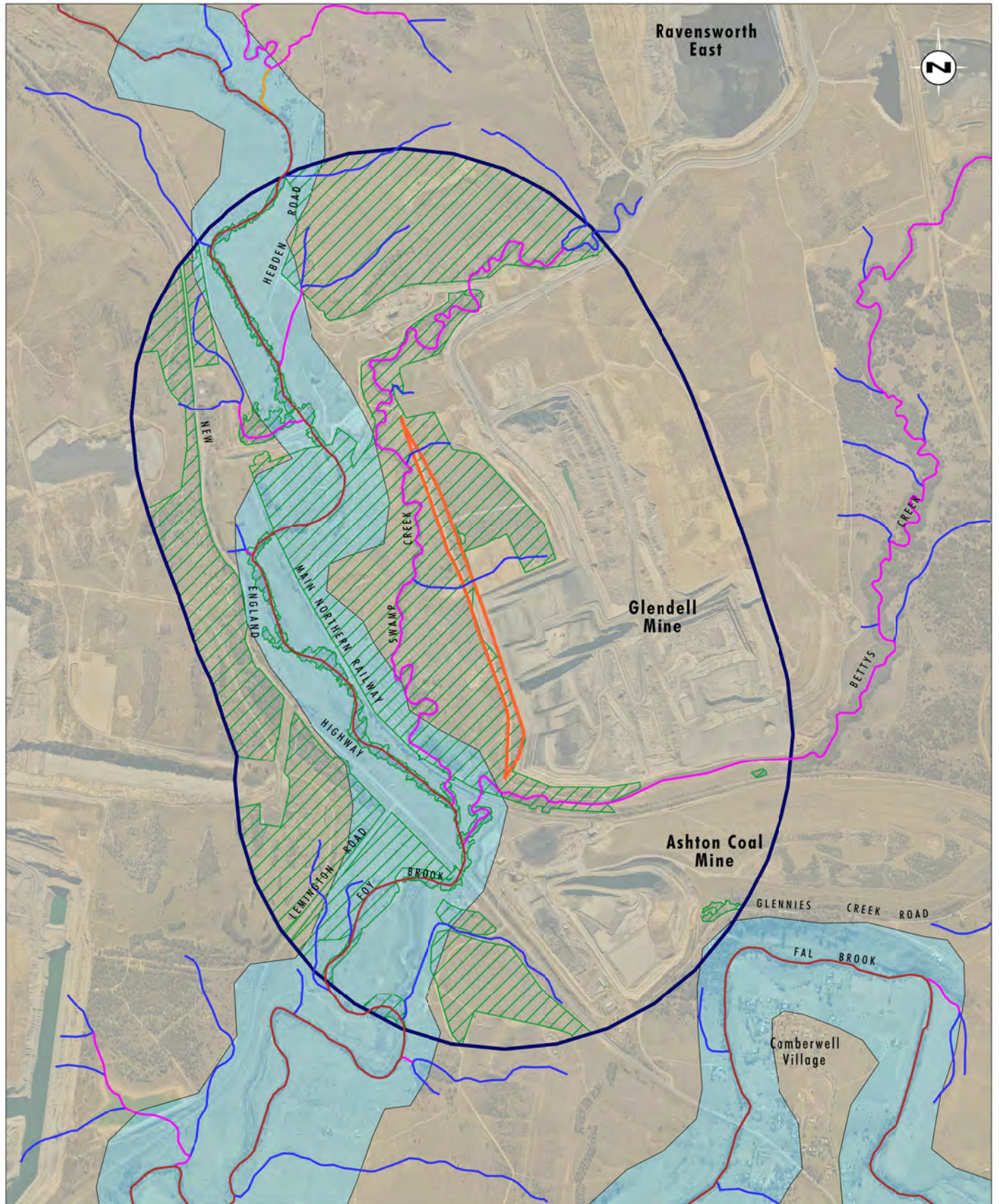


Image Source: Glencore (2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- ▬ Development Footprint
- ▬ 1500m Buffer Area
- ▨ Native Vegetation
- Mitchell Landscapes:
- ▨ Central Hunter Foothills
- ▨ Upper Hunter Channels and Floodplain

Stream Order:

- ▬ 1st Order Stream
- ▬ 2nd Order Stream
- ▬ 3rd Order Stream
- ▬ 4th Order Stream
- ▬ > 5th Order Stream

FIGURE 1.5

Location Map - Landscape Features

1.3 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BDAR:

- Biodiversity Assessment Method Order 2017
- Biodiversity Assessment Method Operational Manual (Stage 1)
- Biodiversity Assessment Calculator
- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2018a), accessed August 2018
- Threatened Biodiversity Data Collection (TBDC) (OEH 2018b), accessed August 2018
- Vegetation Information System (VIS) Classification Database (OEH 2018c), accessed August 2018
- NSW Guide to Surveying Threatened Plants (OEH 2016) and
- Department of the Environment (DoE) Protected Matters Search Tool (DoE 2018), accessed August 2018.

1.4 Report Preparation

This BDAR was prepared by Trish Robinson (Senior Ecologist - Botanist) and James Garnham (Senior Ecologist), with review and technical direction from Allison Riley (NSW Ecology Manager). Field surveys were undertaken by Trish Robinson and James Garnham with vegetation mapping verified by Trish Robinson. Trish Robinson and Allison Riley are Accredited BAM Assessors under the BC Act. **Table 1.3** below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the Proposed Modification.

Table 1.2 Accredited BAM Assessors and their Role on the Proposed Modification

Name	Assessor ID	Role
Allison Riley NSW Ecology Manager	BAAS17042	Review and technical direction
Trish Robinson <i>Senior Ecologist - Botanist</i>	BAAS18123	BDAR preparation BAM calculator application Field surveys

2 Methods

The methods executed in this Biodiversity Development Assessment Report (BDAR) were undertaken in accordance with the Biodiversity Assessment Method Order 2017 and the Biodiversity Assessment Method Operational Manual (Stage 1). Further details on the methodologies used to complete this assessment are outlined in **Appendix A** as directed by **Table 2.1** below.

Table 2.1 Methods

Methods Undertaken	Relevant Appendix E Section
Native Vegetation Assessment	
Literature and Database Review	Section 10.2.1
Floristic and Vegetation Integrity Surveys	Section 10.2.2
Meandering Transects	Section 10.2.3
Digital Aerial Photo Interpretation	Section 10.2.4
Plant Identification and Nomenclature Standards	Section 10.2.5
Vegetation Mapping	Section 10.2.6
Threatened Ecological Community Delineation	Section 10.2.7
Plant Community Type Allocation	Section 10.2.8
Threatened Species	
Literature and Database Review	Section 10.3.1
Ecosystem-Credit Species Assessment	Section 10.3.2
Species-Credit Species Assessment	Section 10.3.3

A total of five BAM plots were conducted within the Development Footprint during the surveys undertaken for this assessment (refer to **Figure 2.1**). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (OEH 2017a), as shown in **Table 2.2**.

Table 2.2 Adequacy of Floristic and Vegetation Integrity Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) <i>Condition Class</i>	Area in the Development Footprint (ha)	Number of Floristic and Vegetation Integrity Plots		Rapid Assessment
			Required	Completed	
1	PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.9	1	1	2
2	PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	6.4	3	4	2
-	Cleared land	4.7	0	0	0
TOTAL		12	4	5	4

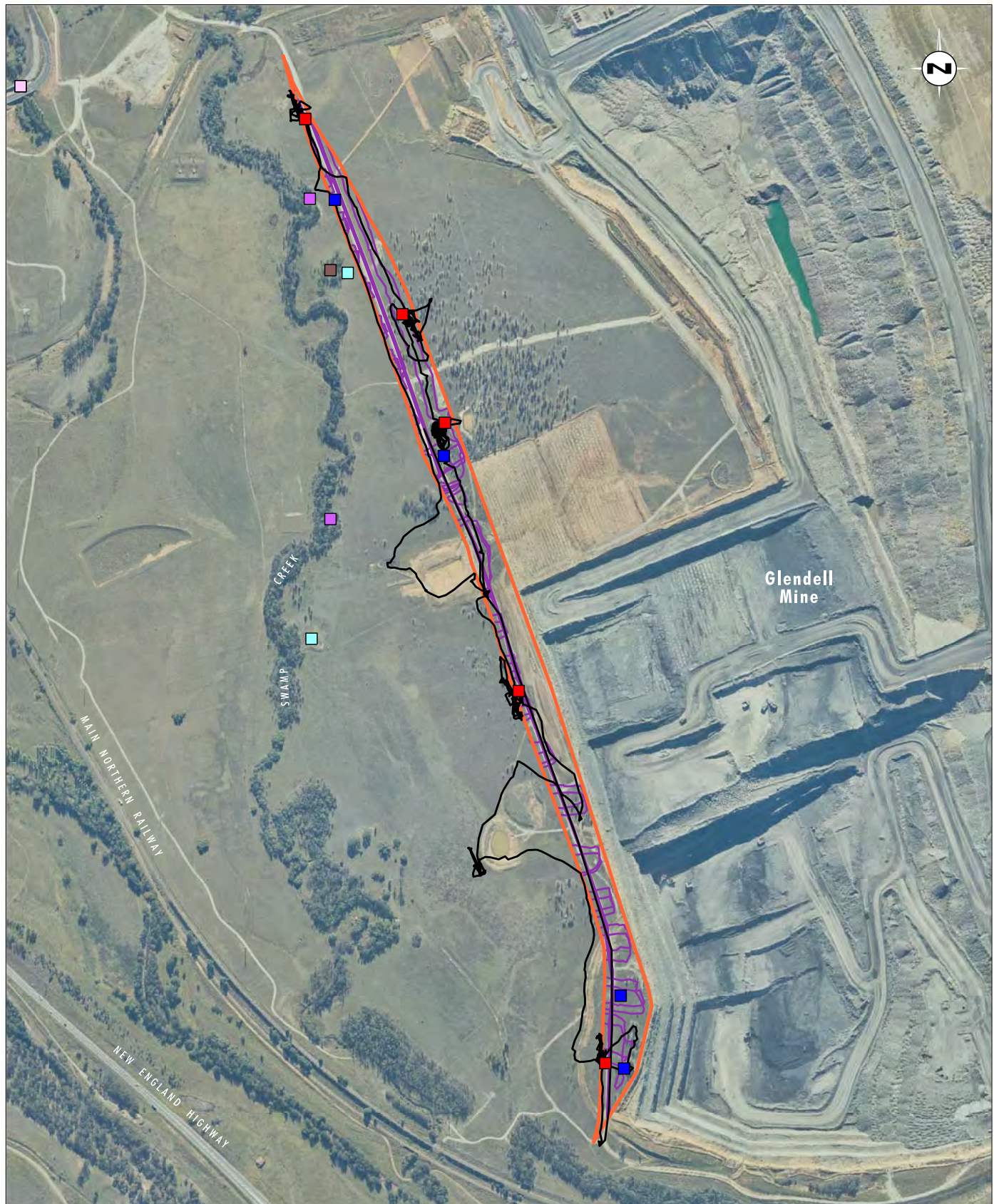


Image Source: Glencore (Jul 2018)

Data Source: Glendell (2018), Umwelt (2014-2018)

0 100 250 500m
1:10 000

Legend

- Development Footprint
- Survey Tracks - August 2018
- Survey Tracks - September 2018
- BAM Plot Location
- Rapid Assessment
- Remote Camera
- Diurnal Bird Survey
- Reptile Search
- Anabat Survey

FIGURE 2.1

Survey Effort

3 Results

3.1 Landscape Value

3.1.1 Landscape Features

The 1500 metre buffer area surrounding the Development Footprint contains a range of landscape features typical of the landscapes around the central Hunter Valley. These landscape features are shown in **Figures 1.4 to 1.5** and outlined in relation to the Development Footprint in **Table 3.1** below.

Table 3.1 Landscape Features in the Development Footprint

Landscape Features	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Hunter
Mitchell Landscape	Central Hunter Foothills
Rivers, Streams, Estuaries	Two 1 st Order Streams running through Development Footprint and adjacent to a 2 nd Order Stream (Swamp Creek).
Wetlands (within, adjacent to and downstream)	None identified
Native Vegetation Extent	525.9 hectares in the 1500m buffer area (39%)
Connectivity Features	The Development Footprint is not an important link for any fauna movement and has not been identified in connectivity mapping.
Areas of Geological Significance and Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	4.7 hectares within the Development Footprint
Connectivity Features	Not identified within a Priority Investment Area, but located near to an area identified as Priority 2 Investment Area (OEH 2017b). Not identified as an important flyway for migratory species. Development footprint is located adjacent to Swamp Creek which forms part of a local corridor. The development footprint is not identified in any corridor mapping and does not form part of a local corridor that contributes significantly to movement and viability of flora and fauna in the locality.

3.2 Native Vegetation within the Development Footprint

3.2.1 Plant Community Types and Vegetation Zones

Surveys of the Development Footprint identified two Plant Community Types (PCTs), each with one condition class (refer to **Figure 3.1**):

- PCT1692 Bull Oak grassy woodland of the central Hunter Valley
 - o *Regeneration*
- PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter
 - o *Derived Native Grassland*

Descriptions of the vegetation zones are outlined below and a flora species list is included in **Appendix B**.

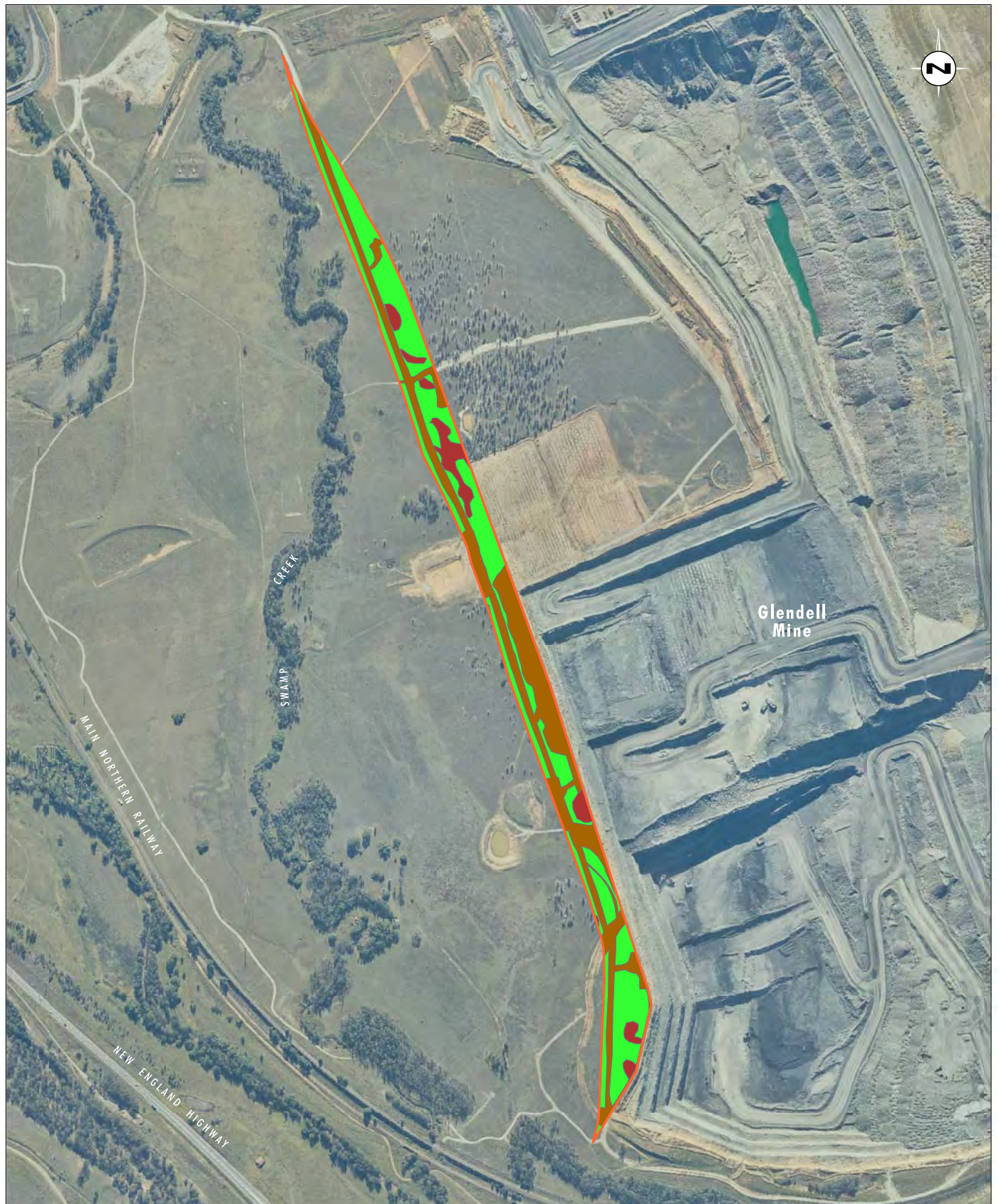


Image Source: Glencore (2018)

0 100 250 500m
1:10 000

Legend

- ▬ Development Footprint
- ▬ PCT1691 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the central and upper hunter
- ▬ PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Regeneration
- ▬ Disturbed Land

FIGURE 3.1

Vegetation Zones in the Development Footprint

3.2.1.1 Zone 1 – PCT1692 – Bull Oak Grassy Woodland of the Central Hunter Valley

PCT Name	PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley	
Condition	Regeneration	
PCT Formation	KF_CH3 Grassy Woodlands	
PCT Class	Coastal Valley Grassy Woodlands	
PCT Per cent cleared	53.00	
Area (ha)	0.9	
Patch Size Class (ha)	101	
General Description	Small, scattered patches of this vegetation zone occur throughout the Development Footprint (refer to Figure 3.1).	
Canopy Description	This vegetation zone supports a sparse to mid-dense canopy dominated by regenerating bulloak (<i>Allocasuarina luehmannii</i>). The height of the canopy ranges from 5 to 8 metres.	
Mid-storey Description	Not present.	
Ground Cover Description	This vegetation zone is characterised by a sparse to mid-dense ground layer less than 0.5 metres in height. Common forbs, ferns and rushes include poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), common everlasting (<i>Chrysocephalum apiculatum</i>), amulla (<i>Eremophila debilis</i>), common woodruff (<i>Asperula conferta</i>) and wattle mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>). Native grass species present include purple wiregrass (<i>Aristida ramosa</i>), tall chloris (<i>Chloris ventricosa</i>), common couch (<i>Cynodon dactylon</i>), barbed wire grass (<i>Cymbopogon refractus</i>), red grass (<i>Bothriochloa macra</i>) and slender rat’s tail grass (<i>Sporobolus creber</i>). Introduced species generally occur at low abundance in this vegetation zone. Commonly recorded species include galenia (<i>Galenia pubescens</i>), lamb’s tongues (<i>Plantago lanceolata</i>) and fireweed (<i>Senecio madagascariensis</i>).	
PCT Allocation	This vegetation zone has been attributed to PCT1692 based on its position in the landscape, the dominance of bulloak in the canopy, and floristic similarity. A total of six (67 per cent) of characteristic species for PCT1692 were recorded, based on the information contained in the VIS Classification Database (OEH 2018c). PCT1603 was also considered and a total of six (43 per cent) of characteristic species for PCT1603 were recorded. Due to the dominance of bulloak, absence of eucalypt species and the higher floristic similarity, PCT1692 was considered to be a more accurate allocation.	
BC Act Status	Not consistent with any listed TEC under the BC Act.	
EPBC Act Status	Not consistent with any listed TEC under the EPBC Act.	

3.2.1.2 Zone 2 – PCT1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter

PCT Name	PCT1691 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	
Condition	Derived Native Grassland	
PCT Formation	KF_CH3 Grassy Woodlands	
PCT Class	Coastal Valley Grassy Woodlands	
PCT Per cent cleared	79.00	
Area (ha)	6.4	
Patch Size Class (ha)	0	
General Description	This is the dominant vegetation zone in the Development Footprint and occurs across the lower and mid slopes (refer to Figure 3.1). The identification of this vegetation zone was based on information collected during surveys of adjoining areas, as well as taking into consideration topography and landscape position.	
Canopy Description	Scattered regenerating bulloak (<i>Allocasuarina luehmannii</i>) are present in this vegetation zone.	
Mid-storey Description	None present.	
Ground Cover Description	This vegetation zone was characterised by a diverse and dense ground layer generally less than 1 metre in height. Common herbs, sedges, ferns and rushes included common everlasting (<i>Chrysocephalum apiculatum</i>), poison rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), wattle mat-rush (<i>Lomandra filiformis</i> subsp. <i>filiformis</i>), and common woodruff (<i>Asperula conferta</i>). Native grasses included barbed wire grass (<i>Cymbopogon refractus</i>), purple wiregrass (<i>Aristida ramosa</i>), slender rats tail grass (<i>Sporobolus creber</i>), red grass (<i>Bothriochloa macra</i>), and common couch (<i>Cynodon dactylon</i>). Introduced species generally occur at low abundance in this vegetation zone. Commonly recorded groundcover species include lambs tongues (<i>Plantago lanceolata</i>), catsear (<i>Hypochaeris radicata</i>) scarlet pimpernel (<i>Anagallis arvensis</i>) and saffron thistle (<i>Carthamus lanatus</i>).	

PCT Name	PCT1691 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
Condition	Derived Native Grassland
PCT Allocation	A large area managed by Glendell Mine is currently subject to ecological surveys for a future project and a large number of BAM plots have been completed for this larger project. Based on the data that has been collected across the larger Glendell Mine area and considering landscape position and soil types, the grasslands present are likely to be derived from the dominant remnant woodland community in the area, being woodland dominated by narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and grey box (<i>Eucalyptus moluccana</i>), with occurrences of bulloak (<i>Allocasuarina luehmannii</i>). In the PCT allocation process for the larger Glendell Mine project two PCTs were considered as the most likely, being PCT1691 and PCT1603. The two PCTs are very closely aligned, with one of the main differences being the inclusion of bulloak (<i>Allocasuarina luehmannii</i>) in the list of characteristic mid-storey species for PCT1603. Whilst bulloak occurs abundantly across the Glendell Mine area, a higher proportion of characteristic species from PCT1691 (85 per cent) have been recorded when compared with PCT1603 (71 percent) with reference to the information contained in the VIS Classification Database (OEH 2018c). Based on these factors and for consistency with vegetation mapping conducted over the larger Glendell Mine area, this vegetation zone is considered to be a derived form of PCT1691.
BC Act Status	Not consistent with any listed TEC under the BC Act.
EPBC Act Status	Not consistent with any listed TEC under the EPBC Act.

3.2.2 Threatened Ecological Communities

No threatened ecological communities were recorded within the Development Footprint.

The woodland form of PCT1691 is consistent with Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) and Central Hunter Eucalypt Forest and Woodland CEEC (EPBC Act), however due to the absence of characteristics canopy species, the derived native grassland of this PCT is not consistent with the EEC or CEEC.

PCT1692 may conform to Central Hunter Eucalypt Forest and Woodland CEEC (EPBC Act) when characteristic canopy species are present in sufficient numbers. No characteristic canopy species of the CEEC were recorded within the Development Footprint and therefore the CEEC is not present.

3.2.3 Vegetation Integrity Score

Table 3.2 below details the vegetation integrity scores for each of the vegetation zones in the Development Footprint. The vegetation integrity data for each of the vegetation zones is provided in **Appendix C**.

Table 3.2 Vegetation Zone Vegetation Integrity Scores

Veg Zone	PCT Name	Composition	Structure	Function	Current Vegetation Integrity Score
1	PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	47.7	47.6	63.4	52.4
2	PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	29.3	41.7	17.1	27.5

3.3 Threatened Species within the Development Footprint

3.3.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Development Footprint is provided in **Appendix D**. Threatened species records are shown on **Figure 3.2**.

3.3.2 Species-credit Species

A list of the species-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Development Footprint is provided in **Appendix D**. Threatened species records are shown on **Figure 3.2**.

3.3.3 Species Habitat Polygons and Biodiversity Risk Weighting

No habitat for species-credit species was identified in the Development Footprint and therefore no species habitat polygons are required.

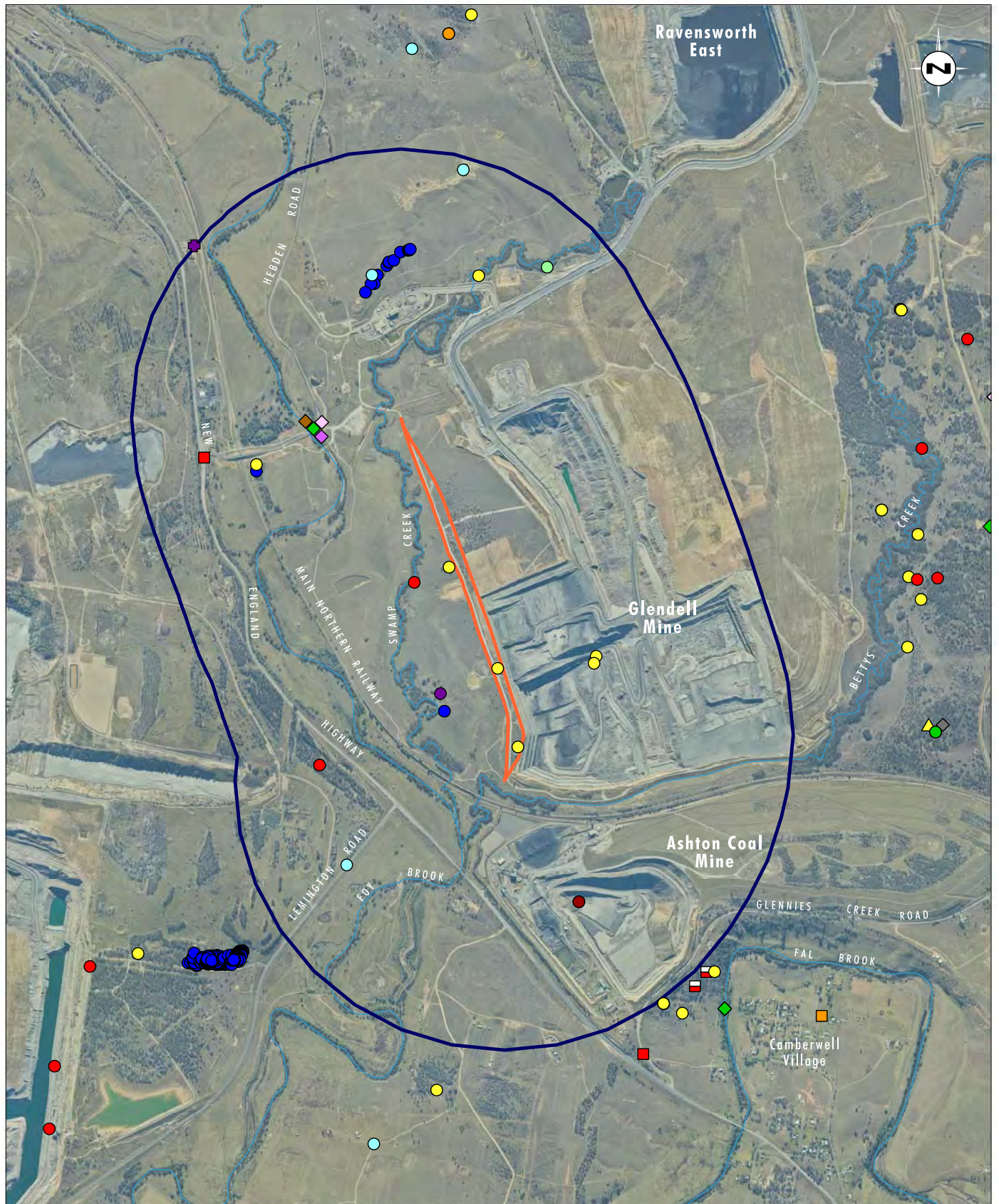


Image Source: Glencore (2018)
Data Source: Glencore (2018)

0 0.5 1.0 1.5 km
1:30 000

Legend

- ▬ Development Footprint
- ▬ 1500m Buffer Area
- Black-necked Stork
- Brown Treecreeper (eastern subspecies)
- Brush-tailed Phascogale
- ◆ Eastern Bentwing-bat
- ◆ Eastern Freetail-bat
- ▲ Flame Robin

- Grey-crowned Babbler (eastern subspecies)
- Koala
- ◆ Large-eared Pied Bat
- Scarlet Robin
- ◆ Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll

- ◆ Yellow-bellied Sheath-tail-bat
- *Acacia pendula*
- *Asperula asthenes*
- *Cymbidium canaliculatum*
- *Eucalyptus camaldulensis*

FIGURE 3.2

Threatened Species

4 Avoidance and Minimisation of Impacts

4.1 Avoidance of Impacts

4.1.1 Avoidance of Native Vegetation and Habitat

The total disturbance area for the Proposed Modification was minimised as much as possible. Initially a larger Disturbance Footprint was investigated, however the western extent was reduced, thereby reducing the total area of native vegetation to be impacted as well as removing all dams from the Development Footprint. The Development Footprint was also designed to avoid the alluvium associated with Swamp Creek located to the north and west.

A 15.5 ha area located to the east of the Barrett Pit that was approved for disturbance in 2008 is no longer required as part of the Glendell mining operation and will be retained on site. Based on vegetation mapping undertaken by Umwelt for the Flora and Fauna Assessment for the Modification of Glendell Mine Operations (Umwelt 2007) this area contains three PCTs, as shown in **Figure 4.1** and **Table 4.1**.

Table 4.1 PCTs to be retained in area previously approved for disturbance

PCT Name	Area (ha)
PCT 1731 - Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley Moderate	4.7
PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.1
PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	10.7
Total	15.5

4.1.2 Avoidance of Prescribed Impacts

The following impacts are considered ‘prescribed impacts’ under the BC Regulation:

- impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation.
- impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- impacts on movement of threatened species that maintains their life cycle
- impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

- impacts of wind turbine strikes on protected animals
- impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

As outlined in **Section 4.1.1** above, Mount Owen sought to avoid and minimise the potential impacts on the ecological values of the Proposed Modification primarily through the reduction in the size of the Development Footprint and by avoiding alluvium and dams. The Development Footprint has been located in an area of relatively low biodiversity value, resulting in a relatively small area of disturbance to native vegetation as a result of the Proposed Modification.

Further detail on the assessment of prescribed impacts is outlined in **Section 5.2**.

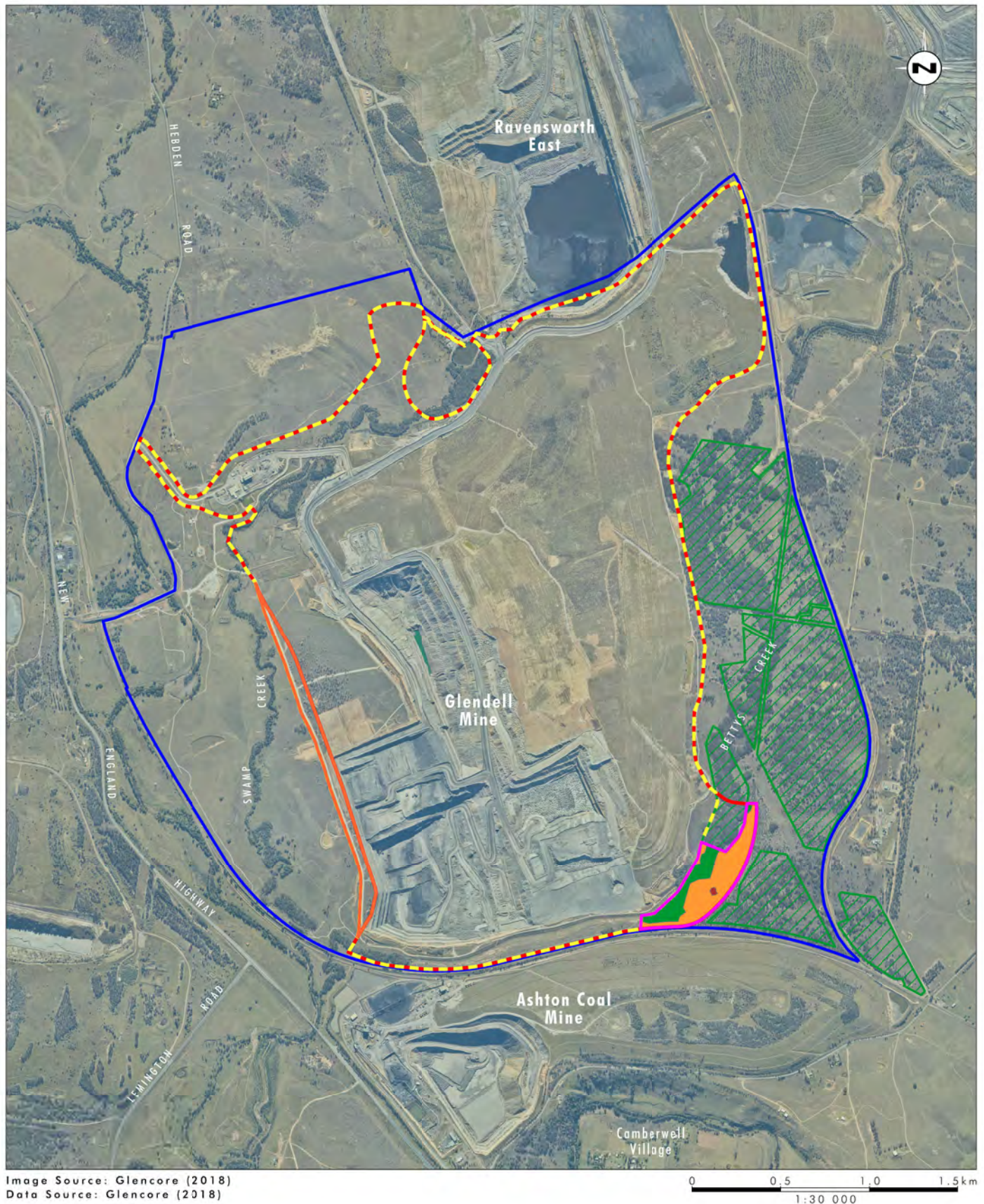
4.2 Minimisation of Impacts

4.2.1 Minimisation Measures

Mount Owen has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Proposed Modification, in accordance with existing impact minimisation measures outlined in the Mount Owen Complex Biodiversity and Offset Management Plan (Glencore 2017). **Table 4.1** below outlines the avoidance and minimisation measures relating to biodiversity management proposed for the Proposed Modification including the timing, action, outcome and responsibility of these measures. Each of these control measures will contribute to the maintenance of habitat quality adjacent to the Development Footprint outside existing approved disturbance.

In addition, the following plans and programs are implemented at Mount Owen Complex which also contribute to the management of potential indirect impacts of biodiversity features and values:

- Air Quality Management Plan
- Noise Monitoring Program
- Rehabilitation Management Plan
- Surface Water Management Plan and Monitoring Plan.



Legend

- ▬ Glendell Mine DA Boundary (DA 80/952)
- ▬ Glendell Approved Disturbance Area (DA 80/952)
- ▬ Proposed Disturbance Area
- ▬ Development Footprint
- ▬ Decreased Disturbance Area
- ▬ PCT 1691 - Narrow-leaved Ironbark - Grey Box Grassy Woodland of the Central and Upper Hunter - Derived Native Grassland
- ▬ PCT 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Regeneration
- ▬ PCT 1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley
- ▨ Bettys Creek Habitat Management Area

FIGURE 4.1

**Vegetation Previously Approved
for Disturbance**

Table 4.2 Avoidance and Minimisation Measures

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Preliminary ecological site inspection	Pre-project design	N/A	N/A	Preliminary assessment of areas of avoidance to inform project design.
Location and design of works in existing disturbed areas.	Project design	N/A	N/A	Focus impacts on areas of low biodiversity value.
Demarcation of approved clearance boundaries	Prior to clearance and during clearance activities	Site Manager	Clearly identify areas not proposed for clearance.	Minimisation of unnecessary impacts to surrounding vegetation and habitats.
Weed management	Construction and operation	Site Manager	- Chemical and physical removal of invasive weed species in accordance with the <i>Noxious and Environmental Weeds Handbook</i> (DPI 2014). - Regular inspection of the Mount Owen Complex to identify potential weed infestations.	- Minimisation of environmental and noxious weeds in the site in accordance with the Mount Owen Complex Biodiversity and Offset Management Plan (Glencore Coal 2017). - Minimisation of weed spread from and into the wider locality.
Pest animal control	Operation	Site Manager	- Regular monitoring to be undertaken to assess the level of impact by feral animals. - Feral animal control works to be undertaken as required to provide for the suppression of feral animals.	- Minimisation of pest animals in the site and the locality in accordance with the Mount Owen Complex Biodiversity and Offset Management Plan (Glencore Coal 2017). - Minimise potential impacts to native fauna species from out-competition and/or predation by pest or feral animal species.

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Fencing and access control	Construction and operation	Site Manager	Where required, fencing will not include barbed wire on the top line of the fence.	- Provides for access control to avoid unwanted human interference and disturbance to non-operational areas. - Minimisation of impacts to native fauna species from the use of barbed-wire fences.
Bushfire management	Construction and operation	Site Manager	Bushfire management will consider asset protection and the consideration of the sensitivities of threatened species and threatened ecological communities.	Protect life and property, while supporting appropriate conditions for the existing ecological features.
Erosion and sedimentation control	Construction and operation	Site Manager	Divert run-off water around disturbed areas	Provide long term stability of the land surface and downstream water quality in accordance with the Mt Owen Complex Biodiversity and Offset Management Plan (Glencore Coal 2017).

5 Assessment of Impacts

5.1 Impacts on Native Vegetation and Habitat

5.1.1 Direct Impacts

The development of the Proposed Modification will result in direct impacts on biodiversity values. Direct impacts include the loss of vegetation and fauna habitats as a result of clearance works and subsequent mining operations. The Development Footprint contains a low abundance of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat) and no species-credit species have been predicted to occur within the Development Footprint.

Table 5.1 below outlines the direct impacts on native vegetation, which totals approximately 7.3 hectares. The final development footprint is shown in **Figure 5.1**. Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Section 4.0** above.

Table 5.1 Direct Impacts of the Proposed Modification on Biodiversity Features

Species	Area within the Development Footprint (ha)
Plant Community Type	
PCT1692 Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.9
PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived native Grassland</i>	6.4



Image Source: Glencore (2018)

0 100 250 500m
1:10 000

Legend

- Development Footprint
- Final Development Footprint

FIGURE 5.1

Final Development Footprint

5.1.2 Indirect Impacts

The Proposed Modification is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands. No indirect impacts are expected to occur in relation to surrounding connectivity, corridors or habitat fragmentation, however, some minor indirect impacts associated with noise, dust, light emissions, weeds and feral animals may occur during the construction and operation of the Proposed Modification. These are discussed below in **Table 5.2**. No indirect impact zones have been identified for this Proposed Modification.

Table 5.2 Indirect Impacts

Impact	Description
Noise	Noise may disturb the roosting and foraging behaviour of fauna species, and reduce the occupancy of areas of suitable habitat. With regard to potential impacts on biodiversity, there will be no substantial change to noise impacts given that the proposed modification is part of, and adjacent to, an existing operation with existing impacts. Any additional impacts resulting from noise emissions are not expected to be of any level of significance in relation to threatened species, populations and communities.
Weed management	Weed species could be inadvertently brought into the Development Footprint with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Development Footprint has the potential to decrease the value of extant vegetation to native species. Mitigation measures outlined in Section 4.0 will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.
Pest animal species	Populations of feral fauna species such as foxes, rabbits and cats can increase and quickly populate new areas as a result of disturbance. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species. Mitigation measures outlined in Section 4.0 will minimise the potential for feral animal spread and impacts into surrounding areas around the Development Footprint.
Dust impacts	Dust impacts have the potential to adversely impact native species during ground disturbing works, including blasting. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth. The design of the Proposed Modification will include inherent measures to minimise the potential for adverse dust impacts. These include progressive rehabilitation and stabilisation of disturbed land, and dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions.
Light emissions	Light emissions may disturb the roosting and foraging behaviour of fauna species, and reduce the occupancy of areas of suitable habitat. With regard to potential impacts on biodiversity, there will be no substantial change to light emissions given that the proposed modification is part of, and adjacent to, an already existing operation with existing impacts. Any additional impacts resulting from light emissions are not expected to be of any level of significance in relation to threatened species, populations and communities.

With regard to potential impacts on biodiversity, there will be no substantial change to noise, weed species, pest animal and dust impacts given that the Proposed Modification is part of and adjacent to an existing operation with existing impacts. Any additional impacts resulting from the Proposed Modification are not expected to be of any level of significance in relation to threatened species, populations and communities.

5.2 Prescribed Impacts

Prescribed impacts are described in **Section 4.1.2** and an assessment of potential prescribed impacts is provided in **Table 5.3**.

Table 5.3 Prescribed Impacts

Prescribed Impact	Potential for Impact	Justification
Impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation	No	Karst, caves, crevices, cliffs and other geological features of significance, rocks or human-made structures that have potential to provide habitat for threatened fauna species are not located within, or in proximity to, the Development Footprint.
Impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	No	Important connectivity and movement habitat is unlikely to be impacted by the Proposed Modification. The Development Footprint's current disturbed state does not provide any substantial movement habitat for terrestrial, arboreal or aquatic threatened species. The Development Footprint's location in the landscape is not conducive for fauna movement due to its proximity to current mining operations and lack of intact woodland vegetation.
Impacts on movement of threatened species that maintains their life cycle	No	Nests of the grey-crowned babbler were identified in the Development Footprint, however it is possible that the habitats in the Development Footprint are no longer used due to the loss of adjoining habitat associated with adjacent mining operations. The habitat present in the Development Footprint is of low quality due to its small size and distance to other woodland remnants and is unlikely to be important to the movement of threatened species. An intact riparian corridor is located approximately 100 metres west of the Development Footprint.

Prescribed Impact	Potential for Impact	Justification
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	No	As noted in Section 4.1.1 above, two dams located west of the Development Footprint were specifically excluded from the Development Footprint (refer to Figure 4.1). These dams have potential to provide low quality habitat for frog species, specifically the green and golden bell frog (<i>Litoria aurea</i>), however due to the very low occurrence of fringing and emergent vegetation, this is considered unlikely. There is potential for the quantity and quality of water entering the dams to be reduced as a result of the Proposed Modification, however this will be managed in accordance with the site water management system and management plan.
Impacts of wind turbine strikes on protected animals	No	The impacts of wind turbines are not applicable to this Proposed Modification.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	No	No change is proposed to vehicle site access.

5.2.1 Uncertain Prescribed Impacts

Uncertain impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes and increased vehicle strikes. Indirect impacts associated with the interruption of ecosystem processes are also complex and difficult to quantify.

Based on the nature and location of the Proposed Modification, it is unlikely that any uncertain prescribed impacts will occur.

5.3 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These are impacts that:

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

Six species-credit species predicted by the BAM calculator for this Proposed Modification are listed as a serious and irreversible impact (SAIL) entities in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (OEH 2017c). These species include:

- regent honeyeater (*Anthochaera phrygia*)
- large-eared pied bat (*Chalinolobus dwyeri*)
- swift parrot (*Lathamus discolor*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- brush-tailed rock-wallaby (*Petrogale penicillata*)

The large-eared pied bat, little bentwing-bat and eastern bentwing-bat are listed as SAIL entities due to their dependence on rocky areas containing caves, overhangs or crevices, or old tunnels or culverts, for breeding habitat (OEH 2017c).

The brush-tailed rock-wallaby is also dependent on rocky outcrops, cliffhills, escarpments, gorges, steep slopes and boulder piles and a one kilometre area with such habitats. While the Development Footprint may contain foraging habitat for the SAIL bat species, no rocky areas supporting the aforementioned habitat features are present, and therefore no impact on breeding habitat for the large-eared pied bat, little bentwing-bat or eastern bentwing-bat will occur as a result of the Proposed Modification. The Development Footprint is not located within one kilometre of potential brush-tailed rock-wallaby habitat and therefore no impacts on this species will occur as a result of the Proposed Modification.

The mapping for regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*) as SAIL entities has not yet been released. These species are not likely to occur within the Development Footprint due to the lack of suitable breeding and foraging habitat and therefore no impacts on these species, or their habitats, are likely to occur as a result of the Proposed Modification.

No species or ecological communities listed as SAIL entities are likely to occur within the Development Footprint and no further assessment of SAIL is required.

6 Biodiversity Credit Impact Summary

6.1 Impacts Not Requiring Assessment

Under the BAM impacts to areas of land without native vegetation do not require further assessment. The Development Footprint contains approximately 4.7 hectares of cleared land that will be removed as a result of the Proposed Modification that does not contain native vegetation. This impact does not require further assessment under the BAM.

Figure 6.1 shows the areas within the Development Footprint not requiring assessment in accordance with Section 10.4 of the BAM.

6.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is associated with ecosystem-credit habitat or a VEC) or less than 15 (where it is representative of a EEC or CEEC).

Both vegetation zones identified within the Development Footprint have vegetation integrity scores above the thresholds (refer to **Table 3.2**). Therefore, both vegetation zones require offsetting under the BAM.

6.3 Impacts Requiring Offset

Two PCTs are considered to require offsetting in accordance with the BAM (OEH 2017a). **Table 6.1** summarises this outcome.

Table 6.1 Impacts Requiring Offset

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
1	PCT1692 Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	52.4	0.0	-52.4	0.92	21
2	PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived native Grassland</i>	27.5	0.0	-27.5	6.37	88



Image Source: Glencore (2018)

0 100 250 500m
1:10 000

Legend

- Development Footprint
- Area not requiring further assessment, area not required to be offset

FIGURE 6.1

Offsetting Requirement

7 Biodiversity Credit Report

A full Biodiversity Credit Report is included in **Appendix E**.

A summary of the key outcomes is provided in **Table 7.1**.

Table 7.1 Credits Required to Offset the Proposed Modification

PCT/Species-credit	Credits Required
Ecosystem Credits	
PCT1692 Bull Oak grassy woodland of the central Hunter Valley	21
PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	88
Total	109

8 Biodiversity Offset Strategy

Mount Owen is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Proposed Modification under the BC Act and *Biodiversity Conservation Regulation 2017*. Firstly, Mount Owen has altered the Proposed Modification to avoid and minimise biodiversity impacts during the Proposed Modification planning stage, which included the avoidance of 20.4 ha of land previously approved for disturbance, and the adoption of a range of impact mitigation strategies to mitigate the impact on ecological values (refer to **Section 4.0**) prior to the consideration of offsetting requirements.

Fulfilling offset requirements under the BC Act will be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site/s and the retirement of credits
- Securing required credits through the open credit market
- Payments to the Biodiversity Conservation Fund and/or
- Funding a Biodiversity Conservation Action (if applicable).

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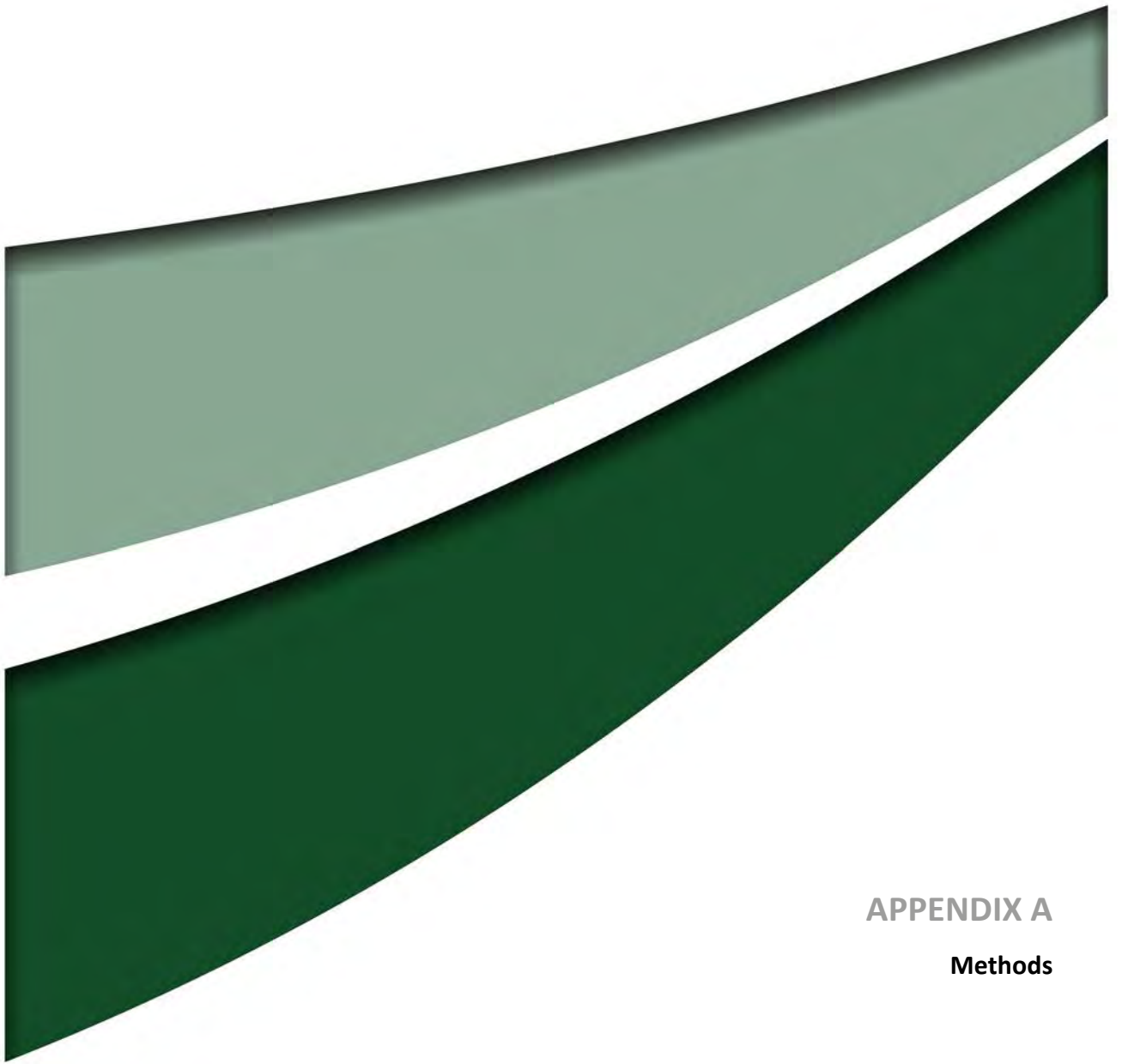
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APPENDIX A

Methods

A1 Methods

A1.1 Landscape Features and Site Context

Landscape features such as IBRA bioregions, IBRA subregions and NSW Mitchell Landscape regions, native vegetation extent within a 1500m buffer area, cleared areas, rivers, streams, wetlands and connectivity features were identified within the Development Footprint where appropriate in accordance with Section 4.2 of the BAM (OEH 2017a).

Determining the 'Site Context' of the Development Footprint is calculated by assessing the native vegetation cover and patch size within the Development Footprint in accordance with Section 4.3 of the BAM (OEH 2017a).

A1.2 Native Vegetation Assessment

A1.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Proposed Modification was undertaken. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and TECs.

Relevant documents included:

- VIS Classification Database (OEH 2018c), accessed August 2018
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed August 2018.
- Flora and Fauna Assessment for the Modification of Glendell Mine Operations (Umwelt 2007)

A1.2.2 Floristic and Vegetation Integrity Survey

Floristic and vegetation integrity surveys with habitat assessment and threatened species searches were undertaken on 13 August 2018. Rapid floristic assessments and threatened species searches were undertaken on 11 July 2017.

A total of five BAM plots were conducted within the Development Footprint during the surveys undertaken for this assessment (refer to **Figure 2.1**). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (OEH 2017a).

At each floristic and vegetation integrity plot, data was recorded according to Section 5 of the BAM (OEH 2017a). This involved setting out 20 x 50 m, 20 x 20 m and 1 x 1m plots. The location of each plot was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of any shrub, mid-storey, canopy and emergent layers were also thoroughly examined.

Semi-quantitative rapid assessments were undertaken at five locations (refer to **Figure 2.1**). At each location the dominant species in each stratum were recorded to assist in vegetation mapping and PCT allocation.

Table A.1 outlines the floristic survey effort in the Development Footprint.

Table A.1 Adequacy of Floristic and Vegetation Integrity Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) <i>Condition Class</i>	Area in the Development Footprint (ha)	Number of Floristic and Vegetation Integrity Plots		Rapid Assessment
			Required	Completed	
1	PCT1692 - Bull Oak grassy woodland of the central Hunter Valley <i>Regeneration</i>	0.9	1	1	2
2	PCT1691 - Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter <i>Derived Native Grassland</i>	6.4	3	4	2
-	Cleared land	4.7	0	0	0
TOTAL		12.0	4	5	4

A1.2.3 Meandering Transects

Meandering transects were walked across the Development Footprint. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and otherwise significant species, endangered populations and TECs. Records along transects supplemented floristic sampling carried out in plots, however, the data collected are in the form of presence records, rather than semi-quantitative cover abundance scores.

Meandering transects provided information on spatial patterns of vegetation that informed vegetation community mapping of the Development Footprint.

A1.2.4 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping of the Development Footprint.

Vegetation communities in the Development Footprint were mapped on-screen overlaying the July 2018 high resolution aerial photographs provided by Mount Owen. Mapping was undertaken using the Manifold System 8.0 GIS and ESRI ArcMaps 10.6.

A1.2.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2018).

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

A1.2.6 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of PCTs (OEH 2018) and previous mapping undertaken in the area (Umwelt 2015)
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data, and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

A1.2.7 Threatened Ecological Community Delineation Techniques

Where applicable, vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic plot assessments and meandering surveys to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of ‘important species’ as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth Department of Environment and Energy (DoEE) and the NSW OEH
- comparison with other assessments of TECs in the region.

A1.2.8 Plant Community Type (PCT) Allocation

Each of the vegetation communities described within the Development Footprint were aligned with an equivalent PCT as detailed in the VIS Classification Database (OEH 2018c). For each vegetation community described in the Development Footprint, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCT were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Further detail regarding this allocation for individual PCT is outlined in **Section 3.2.1**.

A1.3 Threatened Species

A1.3.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included ecological reports, previous ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design where required, and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2018a), accessed August 2018
- OEH Threatened Biodiversity Data Collection (OEH 2018b) for known/predicted threatened species in the Hunter IBRA subregion, accessed August 2018
- PlantNET (Botanic Gardens Trust) database search for threatened plants within a 10 kilometre radius search from Eraring, accessed August 2018
- DoEE Protected Matters Search Tool (DoEE 2018) for known/predicted EPBC Act-listed species, accessed August 2018.

A preliminary assessment using the TBDC was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TBDC review were used to design the appropriate survey requirements for species-credit species.

A1.3.2 Ecosystem-credit Species

Ecosystem-credit species are those threatened species that can be predicted by vegetation surrogates and landscape features. Ecosystem-credit species are not required to be specifically targeted during field surveys, however an assessment of the suitability of habitat in the Development Footprint is undertaken to determine the species presence or otherwise in the vegetation zones identified.

Appendix D outlines the ecosystem credit species predicted by the BAM calculator or identified in the literature review.

A1.3.3 Species-credit Species

Targeted and opportunistic surveys and walking transects for species-credit species were undertaken across the Development Footprint (refer to **Figure 2.1**). **Table A.2** below outlines the dates, methods and species targeted during the surveys.

Appendix D outlines the species-credit species predicted by the BAM calculator or identified in the literature review and the targeted survey effort undertaken in accordance with BAM survey requirements.

Appendix D also notes where species-credit species were not considered to require further survey in accordance with Section 6.4 (Step 3) of the BAM (2017a).

Species-credit surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* – Working Draft (DEC 2004)
- *NSW Guide to Surveying Threatened Plants* (OEH 2016)
- *Draft Survey Guidelines for Australia's Threatened Orchids* (DoE 2013).

Table A.2 Species credit species survey methodology and timing

Survey Date	Method	Species Targeted
11 July 2017	Rapid floristic assessments	N/A
	Opportunistic observations and habitat assessments	<i>Acacia pendula</i> <i>Cymbidium canaliculatum</i> <i>Eucalyptus camaldulensis</i> <i>Eucalyptus glaucina</i>
26 October 2017	Targeted threatened species transect (western extent of Development Footprint)	<i>Diuris tricolor</i>
13 August 2018	BAM floristic surveys	N/A
	Threatened species transects Opportunistic observations and habitat assessments	<i>Acacia pendula</i> <i>Cymbidium canaliculatum</i> <i>Eucalyptus camaldulensis</i> <i>Eucalyptus glaucina</i>
28 September 2018	Targeted threatened species transects	<i>Diuris tricolor</i>

A1.4 Weather Conditions and Limitations

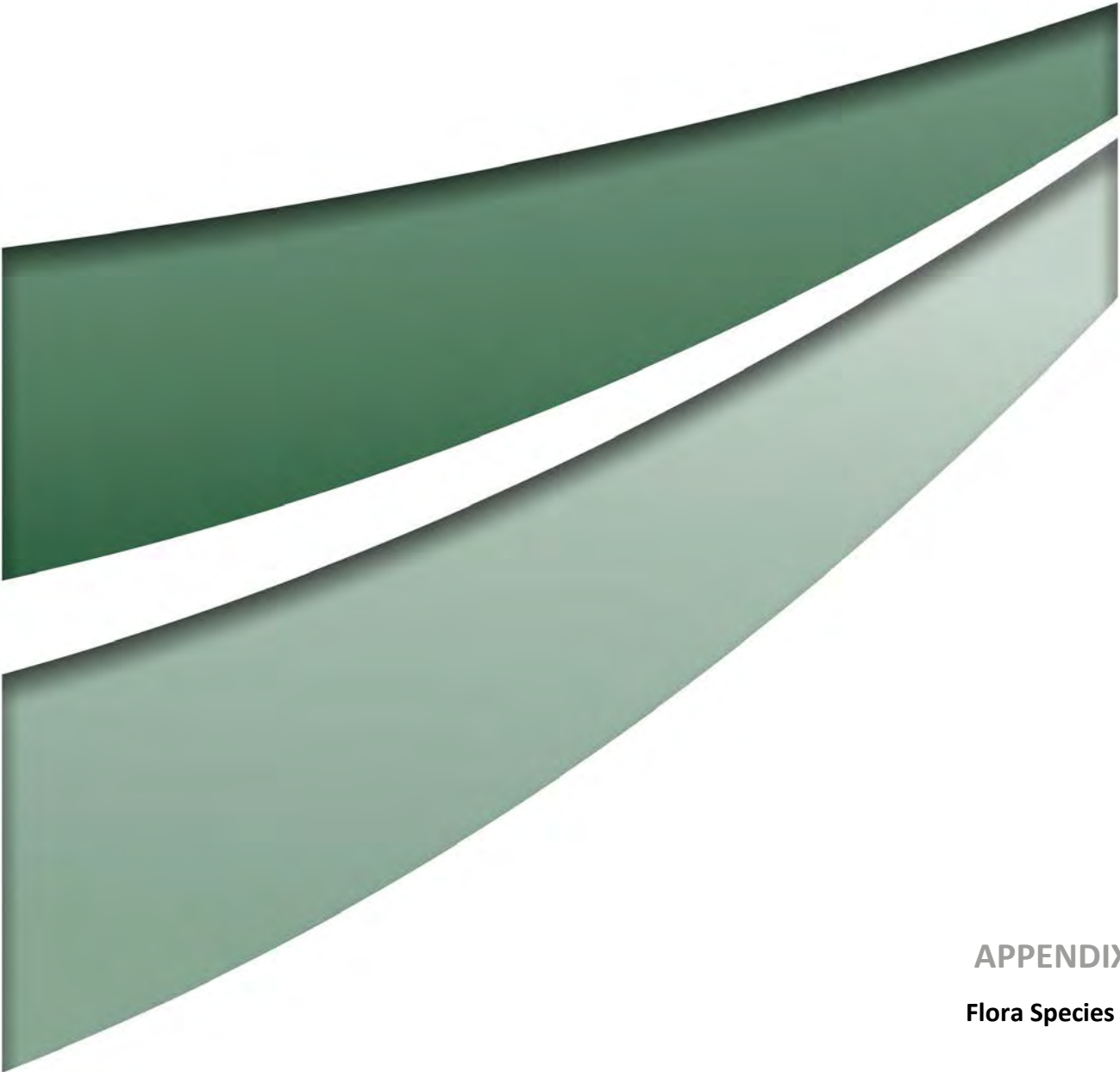
Table A.3 below outlines the weather conditions for the surveys. Data is derived from the Singleton weather station in Singleton (061397) from the Bureau of Meteorology (BOM) (2018).

Table A.3 Weather Conditions for Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (°C) (mean)	Rainfall (mm) (total)	Relative Humidity (%) (mean)
11 July 2017	-3.0 - 18.1	0	76	1.6 - 19.7	2.0	72
26 October 2017	14.0 - 30.4	0	81	11.9 - 27.3	59.8	66
13 August 2018	8.2 - 19.9	0	49	6.0 - 20.3	9.0	60
28 September 2018	7.0 - 31.5	0	56	9.4 - 23.2	20.8	61

The floristic surveys were conducted in one season, being winter (July 2017 and August 2018). Surveys were conducted during a period of prolonged drought in the Hunter region (BOM 2018).

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. The specimens collected during the survey that were lacking adequate flowering or fruiting material were not of potential significance or importance and so were identified to genus level only.



APPENDIX B

Flora Species List

Flora Species List

The following list was developed from the floristic plot rapid transect surveys. It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

AR denotes abundance rating according to BAM

C cover measure according to BAM

asterisk (*) denotes species non-native species

double asterisk (**) denotes High Threat Weed species under the BAM

subsp. subspecies and

var. variety.

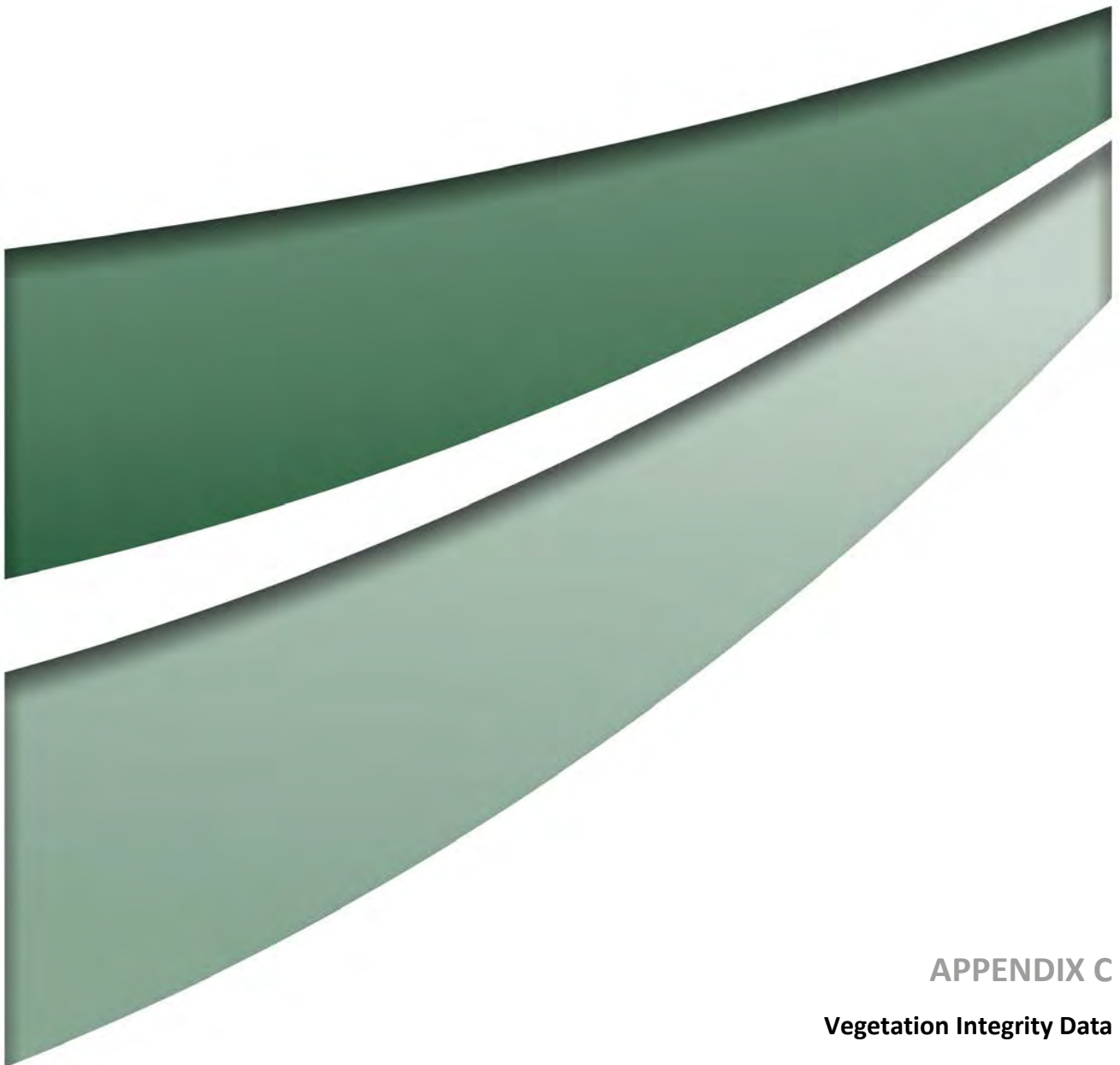
All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2018), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family	Scientific Name	Common Name	Zone 1 PCT1692 <i>Regenerating</i>		Zone 2 PCT1691 <i>Derived Native Grassland</i>							
			Q06		Q01		Q03		Q04		Q05	
			PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Filicopsida (Ferns)												
Adiantaceae	<i>Cheilanthes distans</i>	bristly cloak fern									5	0.1
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	rock fern	10	0.1	5	0.1	1000	0.5			100	0.1
Magnoliopsida - Lilidae (Monocots)												
Alliaceae	<i>*Nothoscordum borbonicum</i>				20	0.1						
Juncaceae	<i>Juncus subsecundus</i>	finger rush							2	0.1		
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>		20	0.2	1	0.1	50	0.2			50	0.2
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush	1	0.1			5	0.2			4	0.1
Poaceae	<i>*Setaria parviflora</i>						3	0.1				
Poaceae	<i>Aristida ramosa</i>	purple wiregrass	500	20	500	5	50	0.2	10	0.1	500	50
Poaceae	<i>Bothriochloa macra</i>	red grass	100	1	1000	50	50	0.2	100	0.5	500	5
Poaceae	<i>Chloris divaricata</i> var. <i>divaricata</i>										20	0.2
Poaceae	<i>Chloris ventricosa</i>	tall chloris	50	0.2							10	0.1
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass	50	1	50	1	1000	60			100	1
Poaceae	<i>Digitaria divaricatissima</i>	umbrella grass	1	0.1								
Poaceae	<i>Eragrostis leptostachya</i>	paddock lovegrass	10	0.1	20	0.1	10	0.1			10	0.1
Poaceae	<i>*Hyparrhenia hirta</i>	coolatai grass					5	0.1				
Poaceae	<i>Microlaena stipoides</i>	weeping grass	10	0.1								
Poaceae	<i>Sporobolus creber</i>	slender rat's tail grass	100	0.3	100	5	50	0.1	100	0.5	100	0.5
Poaceae	<i>Cynodon dactylon</i>	common couch	100	10	50	1	500	10	1000	60	50	0.5
Poaceae	<i>Eragrostis brownii</i>	Brown's lovegrass					10	0.1	5	0.1		
Poaceae	<i>Digitaria</i> sp.	a finger grass	100	0.2					100	0.5		
Magnoliopsida - Magnoliidae (Dicots)												
Aizoaceae	<i>*Galenia pubescens</i>	galenia	100	1	20	0.2	5	0.2			2	0.1
Asteraceae	<i>Calotis lappulacea</i>	yellow burr-daisy	1	0.1								

Family	Scientific Name	Common Name	Zone 1 PCT1692 <i>Regenerating</i>		Zone 2 PCT1691 <i>Derived Native Grassland</i>							
			Q06		Q01		Q03		Q04		Q05	
			PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Asteraceae	<i>*Carthamus lanatus</i>	saffron thistle	10	0.1	500	5					50	0.2
Asteraceae	<i>*Cirsium vulgare</i>	spear thistle							2	0.1	2	0.1
Asteraceae	<i>*Facelis retusa</i>						10	0.1			3	0.1
Asteraceae	<i>*Sonchus oleraceus</i>	common sowthistle	2	0.1	3	0.1	3	0.1				
Asteraceae	<i>*Senecio madagascariensis</i>	fireweed	50	0.1	20	0.1	50	0.1	20	0.1	100	0.1
Asteraceae	<i>*Soliva sessilis</i>	bindyi			50	0.1						
Asteraceae	<i>Chrysocephalum apiculatum</i>	common everlasting	500	0.2	1000	1	500	1	10	0.1	1000	0.5
Asteraceae	<i>*Hypochaeris radicata</i>	catsear	20	0.1			1000	5	20	0.1	50	0.1
Asteraceae	<i>*Conyza</i> sp.	fleabane	1	0.1							1	0.1
Brassicaceae	<i>*Lepidium africanum</i>	common peppergrass	1	0.1								
Brassicaceae	<i>*Brassica</i> sp.	mustards	2	0.1	1	0.1						
Cactaceae	<i>*Opuntia aurantiaca</i>	tiger pear			2	0.1						
Cactaceae	<i>*Opuntia humifusa</i>	creeping pear	1	0.1	2	0.1						
Casuarinaceae	<i>Allocasuarina luehmannii</i>	bulloak	50	25							0	0.2
Chenopodiaceae	<i>Enchylaena tomentosa</i>	ruby saltbush	5	0.1								
Convolvulaceae	<i>Dichondra repens</i>	kidney weed									1	0.1
Fabaceae (Faboideae)	<i>*Medicago</i> sp.	a medic			100	0.2						
Geraniaceae	<i>Erodium crinitum</i>	blue crowfoot			100	0.1						
Geraniaceae	<i>Geranium solanderi</i>	native geranium			50	0.1						
Goodeniaceae	<i>Goodenia</i> sp.				100	0.5						
Lamiaceae	<i>Mentha satureioides</i>	native pennyroyal	5	0.1			20	0.1				
Lamiaceae	<i>*Stachys arvensis</i>	stagger weed			100	0.1						
Malvaceae	<i>*Sida rhombifolia</i>	Paddy's lucerne	1	0.1	5	0.1						
Myoporaceae	<i>Eremophila debilis</i>	amulla	10	0.2								
Myrsinaceae	<i>*Anagallis arvensis</i>	scarlet pimpernel	10	0.1	10	0.1	500	0.3	3	0.1	5	0.1

Family	Scientific Name	Common Name	Zone 1 PCT1692 <i>Regenerating</i>		Zone 2 PCT1691 <i>Derived Native Grassland</i>							
			Q06		Q01		Q03		Q04		Q05	
			PC	AA	PC	AA	PC	AA	PC	AA	PC	AA
Oxalidaceae	<i>Oxalis exilis</i>		2	0.1					1	0.1	1	0.1
Plantaginaceae	<i>*Plantago lanceolata</i>	lamb's tongues	500	0.5	1000	10	500	0.5	1000	1	1000	1
Polygonaceae	<i>Rumex brownii</i>	swamp dock	2	0.1								
Rubiaceae	<i>Asperula conferta</i>	common woodruff	10	0.1					20	0.1	20	0.1
Solanaceae	<i>Solanum cinereum</i>	narrawa burr	2	0.1	50	0.2						
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia									1	0.1
Verbenaceae	<i>*Verbena bonariensis</i>	purpletop							20	0.2	5	0.1
Verbenaceae	<i>*Verbena sp.</i>						1	0.1				



APPENDIX C

Vegetation Integrity Data

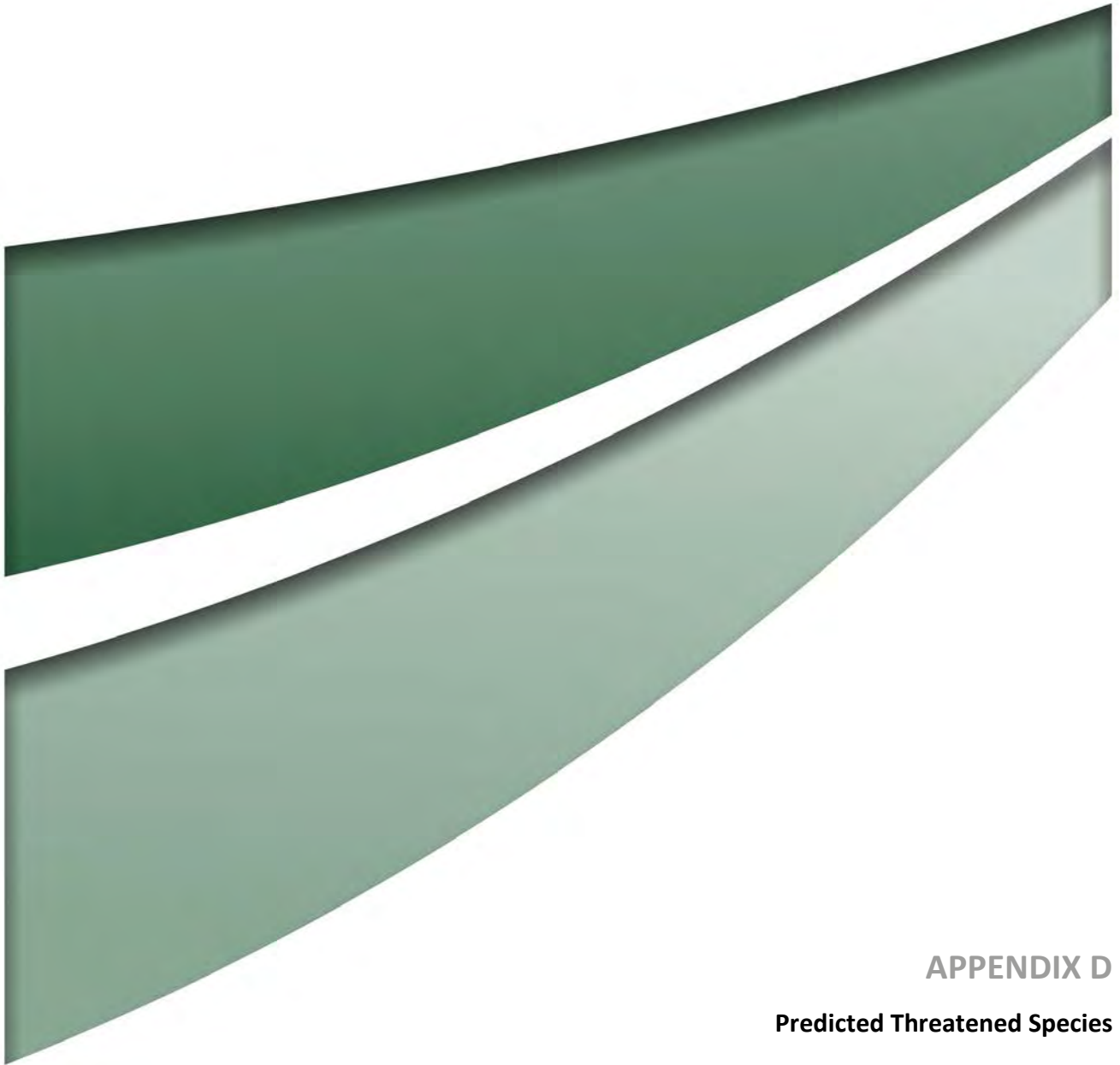
Vegetation Integrity Data

The following vegetation integrity data was collected from surveys of the Glendell Modification Development Footprint. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each PCT in the Development Footprint.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form)

	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													>5	5-10	10-20	20-30	30-50	50-80					
Vegetation Zone 1 - PCT1692 Bull Oak grassy woodland of the central Hunter Valley																							
Regeneration																							
Q06	1	3	12	6	1	0	25	0.4	33.3	0.7	0.1	0	1	1	1	1	0	0	1	1	41	18	2.5
Vegetation Zone 2 – PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter																							
Derived native Grassland																							
Q01	0	1	7	4	1	0	0	0.2	62.2	1.7	0.1	0	0	0	0	0	0	0	0	0	24	1.5	5.5
Q03	0	0	9	3	1	0	0	0	71.1	1.2	0.5	0	0	1	0	0	0	0	0	0	24	3.0	0.4
Q04	0	0	7	3	0	0	0	0	61.8	0.3	0	0	0	0	0	0	0	0	0	0	45	0	0.1
Q05	1	0	10	5	2	0	0.2	0	57.7	0.9	0.2	0	1	0	0	0	0	0	0	0	36	0	0.4



APPENDIX D

Predicted Threatened Species

Predicted Ecosystem Credit Species

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	Vegetation Zone Prediction
regent honeyeater (foraging) <i>Anthochaera phrygia</i>	CE	CE	High	-	1691 – Derived Native Grassland
gang-gang cockatoo (foraging) <i>Callocephalon fimbriatum</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
glossy black-cockatoo (foraging) <i>Calyptorhynchus lathami</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
speckled warbler <i>Chthonicola sagittata</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
spotted harrier <i>Circus assimilis</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
brown treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i>	V	-	High	-	1691 – Derived Native Grassland
varied sittella <i>Daphoenositta chrysoptera</i>	V	-	Moderate	-	1691 – Derived Native Grassland
spotted tailed quoll <i>Dasyurus maculatus</i>	V	E	High	-	1692 – Regeneration 1691 – Derived Native Grassland

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	Vegetation Zone Prediction
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
little lorikeet <i>Glossopsitta pusilla</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
painted honeyeater <i>Grantiella picta</i>	V	V	Moderate	Mistletoes present at a density greater than five mistletoes per hectare	1692 – Regeneration 1691 – Derived Native Grassland
white-bellied sea-eagle (foraging) <i>Haliaeetus leucogaster</i>	V	-	High	Within 1 km of a river, lake, large dam or creek, wetlands and coastlines.	1692 – Regeneration 1691 – Derived Native Grassland
little eagle (foraging) <i>Hieraaetus morphnoides</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
swift parrot (foraging) <i>Lathamus discolor</i>	E	CE	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
square-tailed kite (foraging) <i>Lophoictinia isura</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
hooded robin (south-eastern form) <i>Melanodryas cucullata cucullata</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	Vegetation Zone Prediction
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis gularis</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
little bentwing-bat (breeding) <i>Miniopterus australis</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
eastern bentwing-bat (foraging) <i>Miniopterus schreibersii oceanensis</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
eastern freetail-bat <i>Mormopterus norfolkensis</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
turquoise parrot <i>Neophema pulchella</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
barking owl (foraging) <i>Ninox connivens</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
powerful owl (foraging) <i>Ninox strenua</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
scarlet robin <i>Petroica boodang</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
flame robin <i>Petroica phoenicea</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	Vegetation Zone Prediction
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
grey-headed flying-fox (foraging) <i>Pteropus poliocephalus</i>	V	V	High	-	1692 – Regeneration 1691 – Derived Native Grassland
yellow-bellied sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland
diamond firetail <i>Stagonopleura guttata</i>	V	-	Moderate	-	1692 – Regeneration 1691 – Derived Native Grassland
masked owl (foraging) <i>Tyto novaehollandiae</i>	V	-	High	-	1692 – Regeneration 1691 – Derived Native Grassland

Predicted Species Credit Species

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
<i>Acacia pendula</i> population in the Hunter catchment	EP	-	N/A	-	N/A	Not present in Development Footprint. This endangered population is located approximately 330 metres west of the Development Footprint (OEH 2018). The Development Footprint was comprehensively surveyed in August 2018 and July 2017 and this species is highly detectable. This endangered population is not present in the Development Footprint.
regent honeyeater (breeding) <i>Anthochaera phrygia</i>	CE	CE	High	As per mapped areas from OEH.	Yes	No further survey required. This species is a species-credit species for breeding habitat only and this is determined by important mapped areas to be provided by OEH. It is understood that this mapping is not currently available. Furthermore, this species has not been recorded and no breeding records are known within the locality of the Development Footprint (OEH 2018).

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
bush stone-curlew <i>Burhinus grallarius</i>	E	-	High	Fallen/standing dead timber including logs.	No	No further survey required. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. There are no previous records of the species within 10 km of the Development Footprint (OEH 2018). The Development Footprint is highly disturbed and fragmented and unlikely to be suitable habitat for the species, which was not recorded during surveys undertaken in the Development Footprint for this assessment. No targeted surveys for the species are considered to be required.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
gang-gang cockatoo (breeding) <i>Callocephalon fimbriatum</i>	V	-	Moderate	Eucalypt tree species with hollows greater than 9 cm diameter.	No	No further survey required. This species is a species-credit species for breeding habitat only for eucalypt tree species with hollows greater than 9 cm diameter. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential breeding habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. While previous records of the species are known to occur in the locality (OEH 2018) the species was not recorded during surveys undertaken in the Development Footprint for this assessment and no suitable breeding hollows were recorded. As breeding habitat was not recorded in the Development Footprint, targeted surveys for breeding pairs is not considered required in the October – January survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
glossy black-cockatoo (breeding) <i>Calyptorhynchus lathami</i>	V	-	High	Living or dead trees with hollows greater than 15 cm diameter, and greater than 5 m above ground.	No	Not present. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential breeding habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. This species is a species-credit species for breeding habitat only for eucalypt tree species with hollows greater than 15 cm diameter and greater than 5 m above the ground. There are no previous records of the species within 10 km of the Development Footprint (OEH 2018) and the species was not recorded during surveys undertaken in the Development Footprint for this assessment and no suitable breeding hollows were recorded. As breeding habitat was not recorded in the Development Footprint, no further targeted surveys for breeding pairs is considered to be required.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
eastern pygmy-possum <i>Cercartetus nanus</i>	V	-	High	-	No	No further survey required. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. The Development Footprint was found to be lacking suitable intact and healthy foraging habitat for the species. There are no previous records of the species within 10 km of the Development Footprint (OEH 201a). The Development Footprint is highly disturbed and fragmented and unlikely to be suitable habitat for the species, which was not recorded during surveys undertaken in the Development Footprint for this assessment. No targeted surveys for the species are considered to be required in the October – March survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
large-eared pied bat <i>Chalinolobus dwyeri</i>	V	V	Very High	Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2 km of old mines or tunnels.	Yes	No further survey required. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. No rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or old mines or tunnels are located within 2 km of the Development Footprint. The Development Footprint is highly disturbed and fragmented and unlikely to be suitable habitat for the species. The nearest record of this species is approximately 85 metres west from the Development Footprint in 2014 within riparian vegetation. As per the habitat constraints outlined in the TBDC for this species, the woodland and forest vegetation in proximity to the Development Footprint may provide suitable foraging habitat for the species (DoEE 2018), however these habitats are not present within the Development Footprint. No targeted surveys for the species are considered to be required.
<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	EP	-	N/A	-	N/A	Not present in Development Footprint. The Development Footprint was comprehensively surveyed in August 2018 and July 2017 and this species is highly detectable. This endangered population is not present in the Development Footprint.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
pine donkey orchid <i>Diuris tricolor</i>	V	-	Moderate	-	No	Not present in Development Footprint. No records occur in the immediate locality (OEH 2018) and the Development Footprint is highly disturbed. The closest record of this species is 16 km north-west from the Development Footprint (OEH 2018). The Development Footprint was surveyed for this species in September 2018, which was not recorded. This species is not likely to be present in the Development Footprint.
<i>Eucalyptus camaldulensis</i> population in the Hunter Catchment	EP	-	N/A	Floodplains of watercourses, including rivers, creeks, intermittent streams or billabongs	No	Not present in Development Footprint. This endangered population is located approximately 320 metres west of the Development Footprint. The Development Footprint was comprehensively surveyed in August 2018 and July 2017 and this species is highly detectable. This endangered population is not present in the Development Footprint.
slaty red gum <i>Eucalyptus glaucina</i>	V	V	High	-	No	Not present in Development Footprint. The Development Footprint was comprehensively surveyed in August 2018 and July 2017 and this species is highly detectable. This species is not present in the Development Footprint.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
white-bellied sea-eagle <i>Haliaeetus leucogaster</i>	V	-	High	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	No	Not present. This species is a species-credit species for breeding habitat only being nest trees within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. While it is acknowledged that the species has been recorded in the wider locality, ranging from approximately 2.2 km to 9.5 km from the Development Footprint (OEH 2018), the Development Footprint does not contain any historic or active nest trees for this species. No living or dead mature trees occur within the Development Footprint. Therefore there is no suitable breeding habitat for the white-bellied sea eagle. Breeding habitat for this species will not be impacted by the Proposed Modification.
little eagle (breeding) <i>Hieraaetus morphnoides</i>	V	-	Moderate	Nest trees - live (occasionally dead) large old trees within vegetation.	No	Not present. This species is a species-credit species for breeding habitat only, being large nest trees. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. While it is acknowledged that the species has been recorded in the wider locality (OEH 2018), the Development Footprint does not contain any historic or active nest trees for this species.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
pale-headed snake <i>Hoplocephalus bitorquatus</i>	V	-	High	-	No	No further survey required. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. The Development Footprint was found to be lacking suitable intact habitat for the species. There are no previous records of the species within 10 km of the Development Footprint (OEH 2018). The Development Footprint is highly disturbed and fragmented and unlikely to be suitable habitat for the species, which was not recorded during surveys undertaken in the Development Footprint for this assessment. No targeted surveys for the species are considered to be required in the November – March survey period.
swift parrot (breeding) <i>Lathamus discolor</i>	E	CE	Moderate	As per mapped areas from OEH.	Yes	No further survey required. This species is a species-credit species for breeding habitat only and this is determined by important mapped areas to be provided by OEH. It is understood that this mapping is not currently available. Furthermore, breeding habitat for this species is only known to occur in Tasmania and therefore there is not potential for breeding habitat to occur in the Development Footprint.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
green and golden bell frog <i>Litoria aurea</i>	E	V	High	Within 1km of semi-permanent/ephemeral wet areas, swamps or waterbodies.	No	Not present. No suitable wetland habitat occurs within the Development Footprint. The dams located within 150 m of the Development Footprint provide low quality potential habitat for this species due to the lack of fringing vegetation and the surrounding grassland, including the Development Footprint, does not provide suitable overwintering or refuge habitat for this species. While the species can occur in a wide range of habitats (including disturbed habitats), the green and golden bell frog has not been recorded and is not known to have occurred in, or near, the Development Footprint (OEH 2018). The closest record for the species is approximately 6 km west of the Development Footprint, with seven other records occurring north-west to north-east of the Development Footprint (OEH 2018). It is highly unlikely that this species would be impacted by the Proposed Modification.
square-tailed kite (breeding) <i>Lophoictinia isura</i>	V	-	Moderate	Nest trees.	No	No further survey required. This species is a species-credit species for breeding habitat only, being nest trees. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. This species has not been recorded in the wider locality (OEH 2018) of the Development Footprint, which does not contain any historic or active nest trees for this species. No targeted surveys for the species are considered to be required in the September - January survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
little bentwing-bat (breeding) <i>Miniopterus australis</i>	V	-	High	Caves, tunnels, mine, culverts or other structures known or suspected to be used for breeding.	Yes	No further survey required. This species is a species-credit species for breeding habitat only being caves, tunnels, mines and culverts. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. While it is acknowledged that this species has been previously recorded within the Development Footprint and the wider locality (OEH 2018), the Development Footprint does not contain any suitable breeding habitat for the species. No targeted surveys for the species are considered to be required in the December - February survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
eastern bentwing-bat (breeding) <i>Miniopterus schreibersii oceanensis</i>	V	-	High	Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding.	Yes	No further survey required. This species is a species-credit species for breeding habitat only being caves, tunnels, mines and culverts. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. While it is acknowledged that this species has been previously recorded within the Development Footprint and the wider locality (OEH 2018), the Development Footprint does not contain any suitable breeding habitat for the species. No targeted surveys for the species are considered to be required in the November - February survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
southern myotis <i>Myotis macropus</i>	V	-	High	Hollow-bearing trees or bridges, caves or artificial structures within 200 m of riparian zone.	No	No further survey required. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential habitat available for the species across the Development Footprint. The species is allocated to species credit because it is dependent on waterways with pools of 3 m wide or greater for foraging; habitat surrounding waterways is used for breeding and roosting. Previous records of the species are known to occur in the wider locality with the closest being approximately 500 m from the Development Footprint in riparian vegetation (OEH 2018), however the species has not been recorded within the Development Footprint. Waterways with pools of ≥ 3 m wide or artificial structures are not present within the Development Footprint. A small number of hollow-bearing trees were recorded within the Development Footprint however the hollows were large in size and unlikely to be used by this species. No targeted surveys for the species are considered to be required in the October - March survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
barking owl (breeding) <i>Ninox connivens</i>	V	-	High	Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.	No	Not present. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential breeding habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. This species is a species-credit species for breeding habitat only, being hollows greater than 20 cm diameter and greater than 4 m above the ground. A hollow of appropriate size was recorded in the Development Footprint however it was less than 4 m from ground level and therefore not suitable breeding habitat for this species. Two previous records of the species are known to occur in the wider locality being approximately 7 km and 12 km to the north-east of the Development Footprint (OEH 2018). The species has not been recorded in the Development Footprint and no suitable breeding hollows were recorded. The breeding component of this species' habitat is not present.

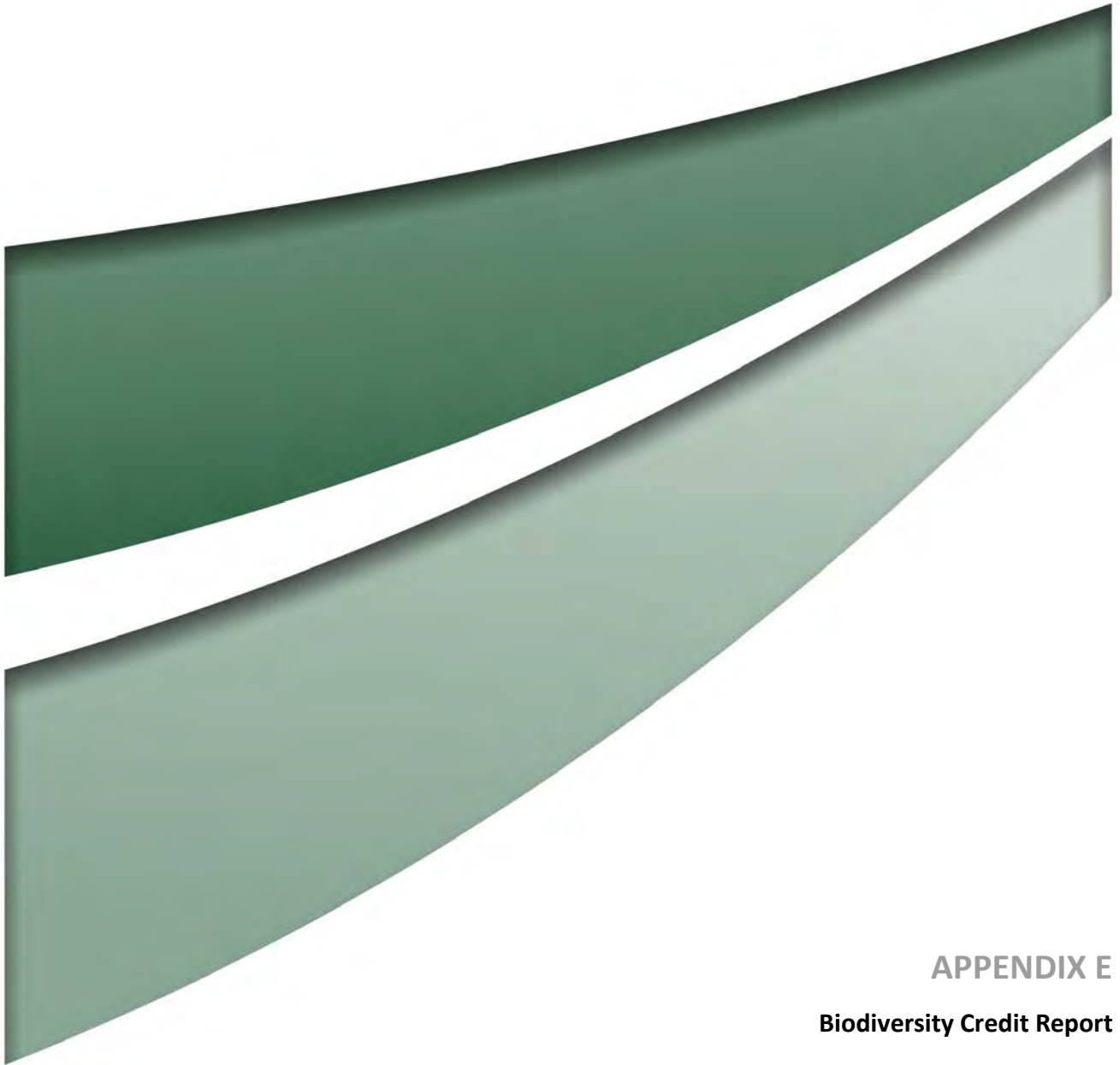
Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
powerful owl (breeding) <i>Ninox strenua</i>	V	-	High	Living or dead trees with hollow greater than 20 cm diameter.	No	Not present. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential breeding habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. Three previous records of the species are known to occur in the locality, being approximately 12 km to the south-west and north-east of the Development Footprint (OEH 2018). One hollow of suitable size for this species (greater than 20 cm diameter) was recorded in the Development Footprint, however no evidence of use by the species was recorded (i.e. whitewash or pellets around the tree). Based on the lack of evidence of use during the species' known breeding/roosting period, it is likely that the habitats present in the development footprint do not provide breeding habitat for this species.
brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E	V	Very High	Lane within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines.	Yes	Not present. No rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliff lines are located within 2 km of the Development Footprint.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
brush-tailed phascogale <i>Phascogale tapoatafa</i>	V	-	High	Hollow bearing trees	No	No further survey required. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. Two hollow bearing trees were recorded within the Development Footprint during targeted habitat assessments conducted in August 2018. However the vegetation in the Development Footprint is highly disturbed and fragmented from historical clearing and unlikely to be suitable habitat for the species due to the absence of woodland vegetation. This species has not been recorded in the Development Footprint. The closest records of this species occur between 2 km and 3 km south and north, respectively, of the Development Footprint (OEH 2018). It is unlikely that this species would be impacted by the Proposed Modification. No targeted surveys for the species are considered to be required.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
common planigale <i>Planigale maculata</i>	V	-	High	-	No	No further survey required. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. Habitat for this species includes hollow logs, under bark, rocks, cracks in soil, grass tussocks or building debris which are largely absent from the Development Footprint. The Development Footprint does not provide suitable intact habitat for the species. There are no previous records of the species within 10 km of the Development Footprint (OEH 2018). No targeted surveys for the species are considered to be required.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
grey-headed flying-fox (breeding) <i>Pteropus poliocephalus</i>	V	V	High	Breeding camps.	No	No further survey required. This species is a species-credit species for breeding habitat only, being flying-fox breeding camps. Habitat assessments were conducted in August 2018 over one day to identify potential habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. No records of the species are known from the locality (OEH 2018) and no active camps are known to occur. The closest historic camp was located in Muswellbrook approximately 25 km from the Development Footprint. Surveys of this site have not located an active camp for many years (DoEE 2018). The Development Footprint does not contain any suitable camp habitat for the species. No targeted surveys for the species are considered to be required in the October - November survey period.

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint	SAIL Entity	Survey Method and Justification
masked owl (breeding) <i>Tyto novaehollandiae</i>	V	-	High	Living or dead trees with hollows greater than 20 cm diameter.	No	Not present. Targeted habitat assessments were conducted in August 2018 over one day to identify any potential breeding habitat available for the species across the Development Footprint. Opportunistic observations were completed during this survey. Previous records of the species are most abundant approximately 6 km to 7 km north-east of the Development Footprint, with the closest record occurs approximately 3.5 km to the south of the Development Footprint (OEH 2018). One hollow of suitable size for this species (greater than 20 cm diameter) was recorded in the Development Footprint, however no evidence of use by the species was recorded (i.e. whitewash or pellets around the tree). Based on the lack of evidence of use during the species' known breeding/roosting period, it is likely that the habitats present in the development footprint do not provide breeding habitat for this species.



APPENDIX E

Biodiversity Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00012005/BAAS18123/18/00012006	Glendell Mod	24/02/2018
Assessor Name	Report Created	BAM Data version *
Patricia Robinson	25/09/2018	3
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18123		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAI	Ecosystem credits
Bull Oak grassy woodland of the central Hunter Valley								
1	1692_Regeneration	52.4	0.9	0.25	High Sensitivity to Potential Gain	1.75		21
							Subtotal	21



BAM Credit Summary Report

Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter

2	1691_DNG	27.5	6.4	0.25	High Sensitivity to Potential Gain	2.00		88
							Subtotal	88
							Total	109

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAIL	Species credits
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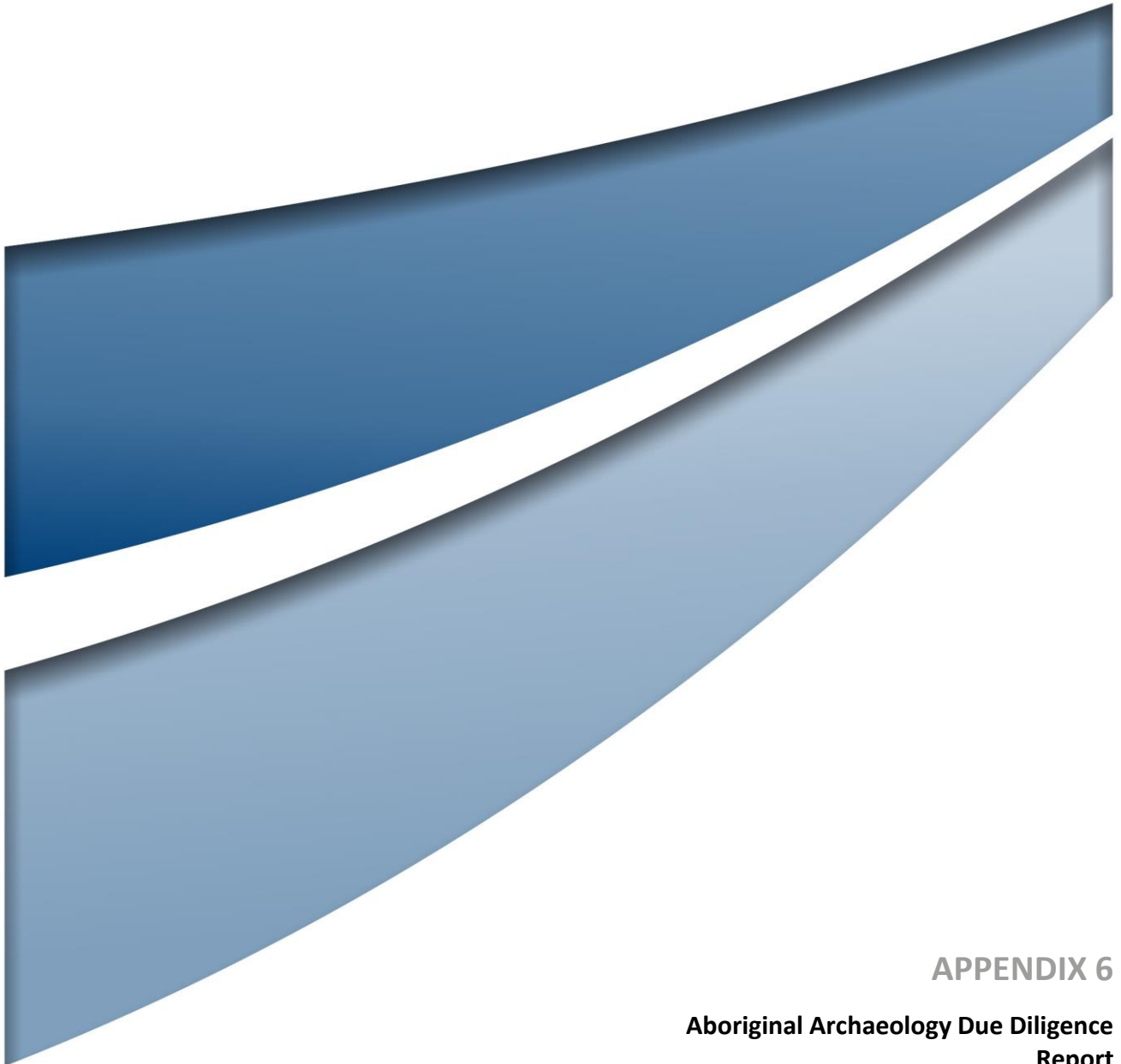
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APPENDIX 6

Aboriginal Archaeology Due Diligence Report



A view of the study area to the west of Glendell's light vehicle access road.

ABORIGINAL DUE DILIGENCE ARCHAEOLOGICAL ASSESSMENT

GLENDELL MINE MODIFICATION 4

MOUNT OWEN COMPLEX

NOVEMBER 2018

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

for Umwelt Environmental & Social Consultants

on behalf of

Mt Owen Pty Ltd



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Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environmental & Heritage Management (OzArk) has been engaged by Umwelt Environmental & Social Consultants (Umwelt), on behalf of Mt Owen Pty Limited (Mount Owen) to complete a Due Diligence archaeological assessment of the proposed Glendell Mine Modification 4 (the Proposed Modification).

OzArk was first engaged in mid-2017 to undertake the assessment of the DA boundary modification as it was then understood. Following the field assessment on Wednesday 23 August 2017, the project was put on hold as Mount Owen evaluated the mine plan in relation to the Glendell Continued Operations Project (GCOP). In mid-2018 the assessment associated with the Proposed Modification was re-initiated. In this time the proposed disturbance area was reduced in size from that assessed in August 2017. All portions of the Proposed Disturbance Area were assessed in 2017. In addition, in April and May 2018 assessment for the GCOP included all of the Proposed Disturbance Area. As a result, the study area was again assessed by OzArk archaeologists and members of the Aboriginal community in 2018.

Four Aboriginal sites, Swamp Creek IF-1 to Swamp Creek IF-4 (37-3-1490 to 37-3-1493), were recorded within the study area assessed as part of the 2017 survey, however, these sites are located outside of the now Proposed Disturbance Area.

The assumption in this report is that all landforms within the study area are liable to be impacted should the Proposed Modification be approved. While all sites recorded as part of the visual inspection of the study area in August 2017 are outside of the Proposed Disturbance Area, three sites recorded subsequent to the August 2017 inspection are either wholly within the study area or partially within the study area (Swamp Creek OS1: 37-3-1499; Glendell North OS28: 37-3-1508; Glendell North OS31: AHIMS pending). It is noted that Swamp Creek OS1 includes three of the isolated find sites recorded in the 2017 survey (Swamp Creek IF-2: 37-3-1492; Swamp Creek IF-3: 37-3-1493; Swamp Creek IF-4: 37-3-1490).

As all sites liable to be harmed by the Proposed Modification are in highly disturbed contexts and have a low scientific value, an appropriate mitigation would be to undertake a recording and collection of all low density surface artefacts.

It will be recommended here that the entirety of the two sites partially within the study area should be salvaged, not just those portions physically within the study area, as all sites are in highly disturbed contexts. As such, six sites will be impacted by the Proposed Modification: three isolated finds; and three low density artefact scatters (Swamp Creek OS1: 37-3-1499; Glendell North OS28: 37-3-1508; Glendell North OS31: AHIMS pending; and the three isolated finds contained within Swamp Creek OS1: Swamp Creek IF-2: 37-3-1492; Swamp Creek IF-3: 37-3-1493; Swamp Creek IF-4: 37-3-1490).

- 1) Should the Proposed Modification be approved, the Mount Owen Complex Aboriginal Cultural Heritage Management Plan (ACHMP) should be updated to include the management recommendations contained in this report. In order to update the ACHMP, consultation with the Aboriginal community is required as set out in Section 8.1 of the Mount Owen Complex ACHMP.
- 2) The updated ACHMP should stipulate that the recording and collection of surface artefacts occur at six sites: Swamp Creek IF-2 (37-3-1492); Swamp Creek IF-3 (37-3-1493); Swamp Creek IF-4 (37-3-1490); Swamp Creek OS1 (37-3-1499); Glendell North OS28 (37-3-1508); and Glendell North OS31 (AHIMS pending). The collection of surface artefacts should follow the procedure set out in the Mount Owen Complex ACHMP Section 6.2.1.1.
- 3) Should Aboriginal artefacts or human skeletal material be uncovered during works within the study area, all work should cease and the Mount Owen Complex ACHMP Sections 6.1 or 6.2 should be followed.
- 4) Work crews should undergo cultural heritage induction to ensure they recognise Aboriginal artefacts and are aware of the legislative protection of Aboriginal objects under the *National Parks and Wildlife Act 1974* and the contents of the Mount Owen Complex ACHMP.

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1 INTRODUCTION

1.1 INTRODUCTION

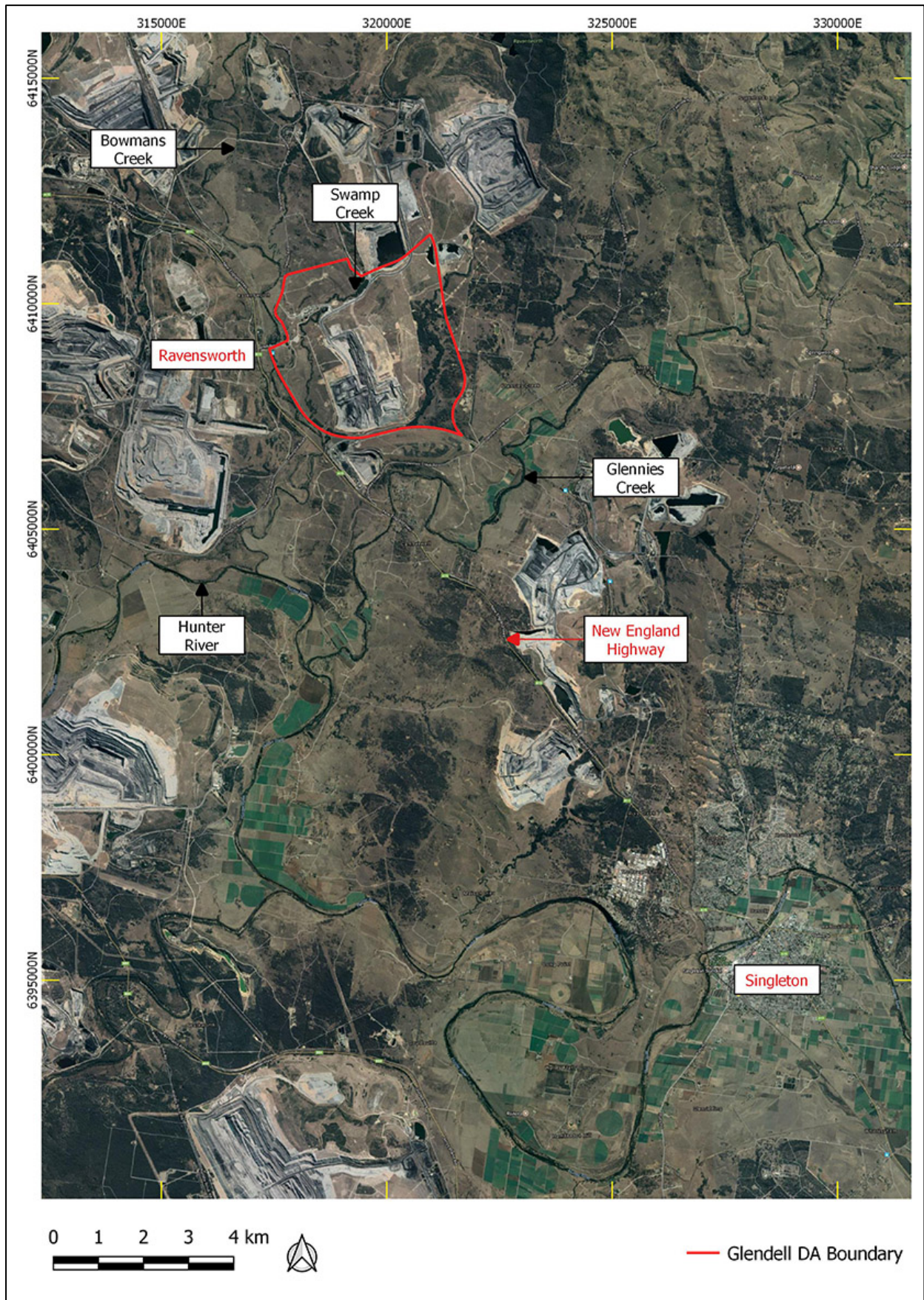
OzArk Environmental & Heritage Management (OzArk) has been engaged by Umwelt Environmental & Social Consultants (Umwelt), on behalf of Mt Owen Pty Limited (Mount Owen) to complete a Due Diligence archaeological assessment of the proposed Glendell Mine Modification 4 (the Proposed Modification).

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) northwest of Singleton and 24 km southeast of Muswellbrook (**Figure 1-1**) and consists of the Glendell Mine (Barrett Pit), Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit). Mount Owen, a subsidiary of Glencore Coal Pty Limited (Glencore) operates Glendell Mine under development consent DA 80/952, which regulates the mining of coal from Glendell Mine and the rehabilitation of the mining area. The processing of coal mined from Glendell Mine and transportation of coal for export is regulated by development consent SSD-5850 (Mount Owen Continued Operations) which also regulates mining at the Mount Owen and Ravensworth East Mines, and associated activities.

Development Consent DA 80/952 was originally granted in 1983. Mining commenced in 2009 following two subsequent modifications to the consent in 1997 and 2008. An additional modification to DA 08/952 was granted in 2016 to provide for the realignment of an existing powerline. DA 08/952 (as modified) provides for mining operations at the Glendell Mine until 2024 and the extraction of approximately 50 million tonnes (mt) run of mine (ROM) coal at an annual production rate of 4.5 million tonne per annum (Mtpa).

Although DA 80/952 provides for mining operations at Glendell until 2024, based on the current mining schedule mining operations will cease in 2020, Mount Owen are seeking a minor extension to the approved pit shell (the Proposed Modification) in order to access additional coal reserves from the Barrett Pit and provide for the continuity of mining operations for approximately an additional 8 months.

Figure 1-1: Location of the Glendell DA boundary.



1.2 BRIEF DESCRIPTION OF THE PROPOSED MODIFICATION

Mount Owen is seeking to modify the approved Glendell mine plan in order to access an additional 2.5 Mt ROM coal and provide for an additional eight months of mining operations. The mine plan will be amended to provide for a minor extension to the approved pit shell.

The extension of the northern and western boundary of the approved pit shell will require an additional approximately 12 hectare (ha) of disturbance in order to accommodate the proposed mine plan changes. However, the approved disturbance area has been revised to remove an area previously approved for disturbance on the eastern boundary of the site. An area of approximately 15.5 ha will be removed from the approved disturbance area as part of the Proposed Modification. This will result in a net decrease (approximately 3.5 ha) in the overall disturbance area associated with the Glendell Mining operations (**Figure 1-2**).

No changes are proposed to the current approved mining methods, extraction limits, processing rates, transportation methods, operational hours or workforce numbers.

Table 1-1 provides a comparison between the Approved Operations and the Proposed Modification.

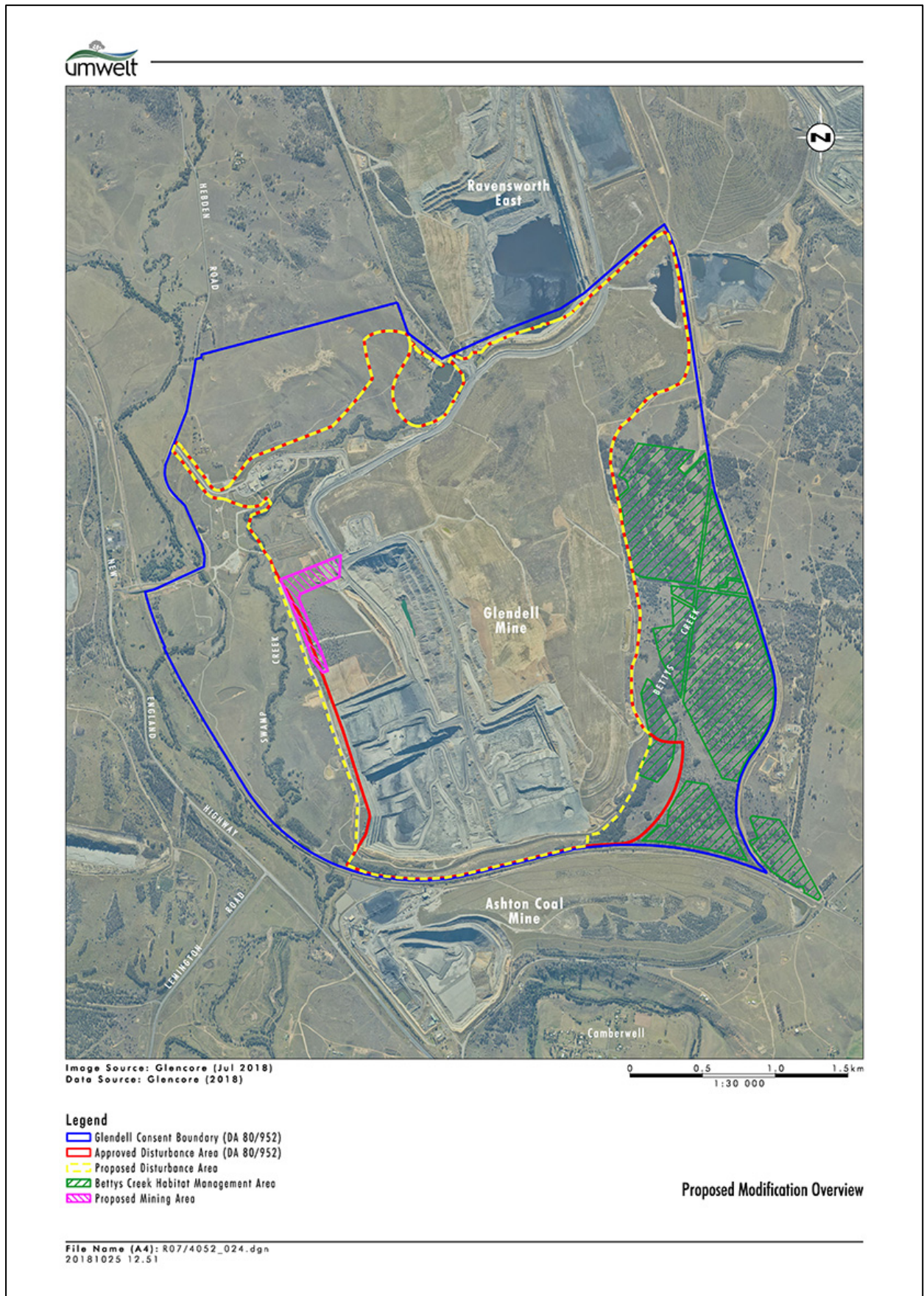
Table 1-1: Comparison between the Approved Operations and the Proposed Modification.

Item	Description	Change from Approved Operations
Mining Method	Truck and excavator	No change to mining methods
Target Seams	To Barrett Seam Down to approximately 200 metre (m) depth	No change to target seam or mining depth
Total Reserve Recovered	Total of approximately 50 Mt ROM coal	Additional approximately 2.5 Mt Rom Coal (approximately 5% of total approved resource)
Disturbance Area	Approved disturbance area of approximately 834 ha	Additional proposed disturbance of approximately 12 ha Reduction of approved disturbance area associated with an area of undisturbed vegetation of approximately 15.5 ha Net decrease in approved disturbance area of approximately 3.5 ha
Annual Production	4.5 Mtpa	No Change to annual production
Mine Life	2024	Additional approximately eight months of mining Current approved mining operations will cease in 2022 (based on current mining schedule) proposed mining will cease 2023 No increase to approved mine life
CHPP Capacity	Up to 17 Mtpa (under SSD-5850)	No change
Management of Mining Waste	Emplacement of waste in-pit and out-of-pit up to maximum height of 160 m	No change to location and height of emplacement areas
Water Management	Existing Swamp Creek and Bettys Creek diversion Management of water within the existing water management system and the GRAWTS	No change to existing approved creek diversions Extension of water management system to proposed disturbance area and continued management of water within the GRAWTS
Operational Workforce	Up to approximately 300 people	No change to operational workforce
Hours of Operation	24 hours, 7 days per week	No change to hours of operation

Item	Description	Change from Approved Operations
Final Landform	One approved void (Barrett Pit) Rehabilitation strategy includes progressive rehabilitation to create a stable final landform with incorporated vegetation corridors providing links between the offset areas and existing remnant vegetation and post mining land use a combination of grazing land and bushland.	No change to approved rehabilitation strategy Minor changes to the design of the final landform to incorporate proposed changes to the mine plans.

1.3 BACKGROUND TO THIS ASSESSMENT

OzArk was first engaged in mid-2017 to undertake the assessment of the DA boundary modification as it was then understood. Following the field assessment in August 2017, the project was put on hold as Mount Owen evaluated the mine plan in relation to the GCOP. In mid-2018 the assessment associated with the Proposed Modification was re-initiated. In this time the disturbance area for the Proposed Modification was reduced in size compared to that assessed in August 2017. As the now Proposed Disturbance Area is located within the 2017 study area, all portions of the Proposed Disturbance Area were assessed in 2017. In addition, in April and May 2018 assessment for the GCOP included all of the 2017 study area. As a result, the 2017 study area was again assessed by OzArk archaeologists and members of the Aboriginal community in 2018.

Figure 1-2: Proposed Modification overview.

1.4 PROPOSED WORK

Mount Owen propose to amend the approved disturbance boundary for the Glendell Mine to include approximately a further 12 ha located along the western boundary of the current DA 08/952 (as modified) approved disturbance area. Apart from this additional 12 ha, all other areas of the Proposed Modification are within the approved disturbance area for the Approved Operations. For the purposes of this report, it is assumed that there are likely to be substantial ground disturbing impacts within the additional 12 ha of the Proposed Disturbance Area.

1.5 STUDY AREA

For the purposes of this report, the study area refers to the additional 12 ha of land that is likely to be impacted should the Proposed Modification be approved. All other impacts associated with the Proposed Modification are located in land already approved for disturbance as part of the Approved Operations.

The study area occupies an approximate 2 km by 100 m (maximum width) strip along the existing western boundary for the current DA 08/952 (as modified) (**Figure 1-3**). The study area is generally parallel and to the east of Swamp Creek; a tributary to Bowmans Creek that it joins just south of the study area. In the main, the study area is within paddocks that has previously been used for agricultural purposes such as grazing. Portions of the study area have more recently been impacted by approved mining infrastructure such as the construction of a light vehicle access road and drainage bunds.

Figure 1-3: Aerial showing the study area.



1.6 RELEVANT LEGISLATION

Cultural heritage is managed by a number of state and national Acts. Baseline principles for the conservation of heritage places and relics can be found in the *Burra Charter* (Australia ICOMOS 2013). The *Burra Charter* has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The *Burra Charter* generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a state level.

A number of Acts of parliament provide for the protection of heritage at various levels of government.

1.6.1 State legislation

Environmental Planning and Assessment Act 1979 (EP&A Act)

This Act established requirements relating to land use and planning. The framework governing environmental and heritage assessment in NSW is contained within the following parts of the EP&A Act:

- **Part 4:** Local government development assessments, including heritage. May include schedules of heritage items;
 - Division 4.7: Approvals process for state significant development;
 - Section 4.55: Modification of consents—generally
 - (1A) Modifications involving minimal environmental impact. A consent authority may modify the consent if:
 - (a) it is satisfied that the proposed modification is of minimal environmental impact, and
 - (b) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted.

National Parks and Wildlife Act 1974 (NPW Act)

Amended during 2010, the NPW Act provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (Part 6), an Aboriginal object is defined as: any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the NPW Act to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, such as:

- The harm was authorised by and conducted in accordance with the requirements of an *Aboriginal Heritage Impact Permit* (AHIP) under Section 90 of the Act
- The defendant exercised 'due diligence' to determine whether the action would harm an Aboriginal object, or
- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the Office of Environment and Heritage (OEH) Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on Aboriginal Heritage Information Management System (AHIMS).

1.6.2 Commonwealth legislation

***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)**

Matters of National Environmental Significance listed under the EPBC Act include the National Heritage List and the Commonwealth Heritage List, both administered by the Commonwealth Department of the Environment and Energy. Ministerial approval is required under the EPBC Act for proposals involving significant impacts to National/Commonwealth heritage places.

1.6.3 Applicability to the Proposed Modification

The Proposed Modification is being sought pursuant to Section 4.55 (1a) of the EP&A Act.

Any Aboriginal sites within the study area are afforded legislative protection under the NPW Act. It is noted there are no Commonwealth or National heritage listed places within the study area, and as such, the heritage provisions of the EPBC Act do not apply.

1.7 ASSESSMENT APPROACH

The current assessment follows the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Due Diligence; DECCW 2010).

Field assessment and reporting followed the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011).

2 THE ARCHAEOLOGICAL ASSESSMENT

2.1 PURPOSE AND OBJECTIVES

The purpose of the current study is to identify and assess heritage constraints relevant to the proposed works.

2.1.1 Aboriginal archaeological assessment objectives

The current assessment will apply the Due Diligence Code of Practice, in the completion of an Aboriginal archaeological assessment, in order to meet the following objectives:

Objective One: Undertake background research on the study area to formulate a predicative model for site location within the study area

Objective Two: Identify and record objects or sites of Aboriginal heritage significance within the study area, as well as any landforms likely to contain further archaeological deposits

Objective Three: Assess the likely impacts of the proposed work to Aboriginal cultural heritage and provide management recommendations.

2.2 DATE OF THE ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk on Wednesday 23 August 2017.

2.3 OZARK INVOLVEMENT

2.3.1 Field assessment

The fieldwork component of the current assessment was undertaken by Ben Churcher, Principal Archaeologist at OzArk (BA [Hons], University of Queensland; Dip Ed, University of Sydney).

2.3.2 Reporting

The reporting component of the assessment was undertaken by:

- Report Author: Stephanie Rusden (OzArk Project Archaeologist, BS University of Wollongong, BA University of New England)
- Contributor: Ben Churcher
- Reviewer: Ben Churcher.

3 LANDSCAPE CONTEXT

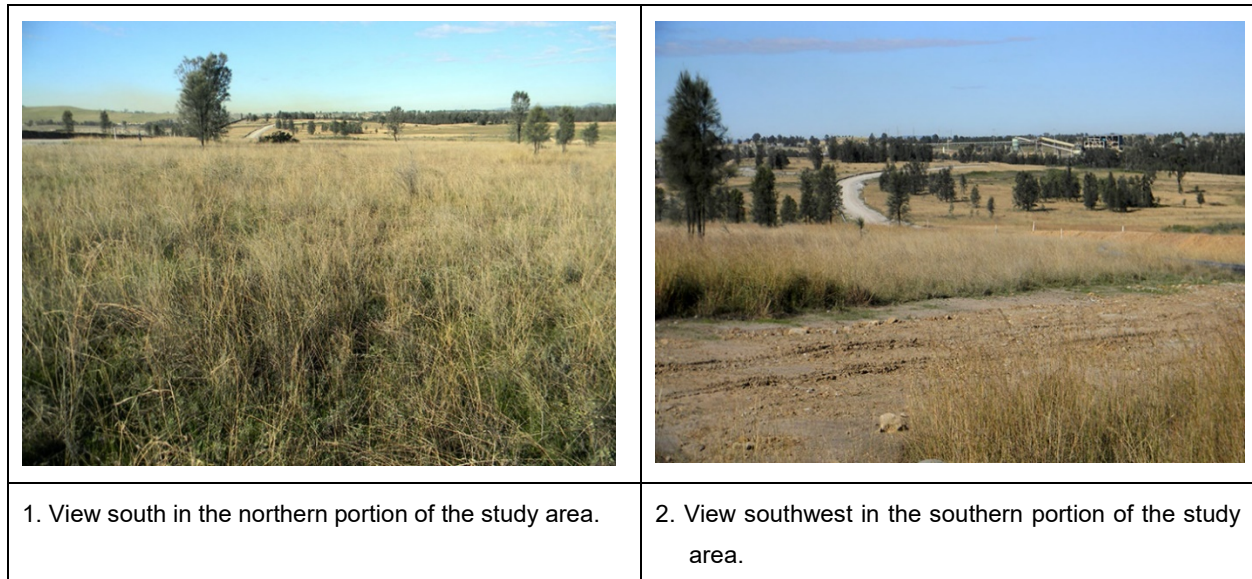
An understanding of the environmental contexts of a study area is requisite in any Aboriginal archaeological investigation (DECCW 2010b). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. In addition, natural geomorphic processes of erosion and/or deposition, as well as humanly activated landscape processes, influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

3.1 TOPOGRAPHY AND HYDROLOGY

The majority of the study area is located within lower slope landforms adjacent to the flat floodplain of Swamp Creek to the west, and mid-slope landforms associated with a north-south trending ridge to the east (**Figure 3-1**).

The study area is generally parallel to Swamp Creek and is located from 50 m to 450 m to the east of Swamp Creek. The study area traverses three highly ephemeral drainage lines that flow into Swamp Creek. While these ephemeral drainage lines would not have retained water for any length of time following rainfall, Swamp Creek would have been (prior to approved mining modifications) a semi-permanent, second order watercourse. At its southern extent, the study area is within 40 m of Bettys Creek which, like Swamp Creek would have been a semi-permanent source of water. At its southern extent, the study area is within 300 m of Bowmans Creek: a regional source of permanent water.

Bettys Creek was once a third order watercourse (Umwelt 2003) prior to approved mining impacts. It has been noted in previous archaeological assessments that during wet periods, Bettys Creek was characterised by a chain of ponds morphology. It was noted that a complete absence of water is also possible (Umwelt 2004). It is also accepted that changes to the hydrology of the area due to mining and creek diversions are likely to have greatly altered the pre-1788 form of Bettys Creek and other creek systems such as Swamp Creek.

Figure 3-1: Examples of the topography within the study area.

3.2 GEOLOGY AND SOILS

The study area is wholly located within the Central Hunter Foothills landscape unit (Mitchell 2002). The geology of this landscape unit is characterised by Permian lithic sandstone, conglomerate, shale and coal (Mitchell 2002: 73). Coal resources come from this landscape unit. As has been commonly reported in other surveys in this region (Brayshaw 1986a), there are two major soil depositional units in the Assessment Boundary. An upper unit (commonly called the A-Horizon), composed primarily of sand and silt but sometimes with gravel present. This upper unit overlies and is very distinct from the underlying clay and gravel B-Horizon which ranges from brown to yellow in colour.

Silcrete was recorded to be outcropping at site MOCO OS-10 (37-3-1198) to the northwest of the study area (OzArk 2013: 113). The outcrop was observed to extend into areas of very low visibility so the extent of the outcrop is uncertain. No large rock formations are known to outcrop within the study area itself.

3.3 VEGETATION

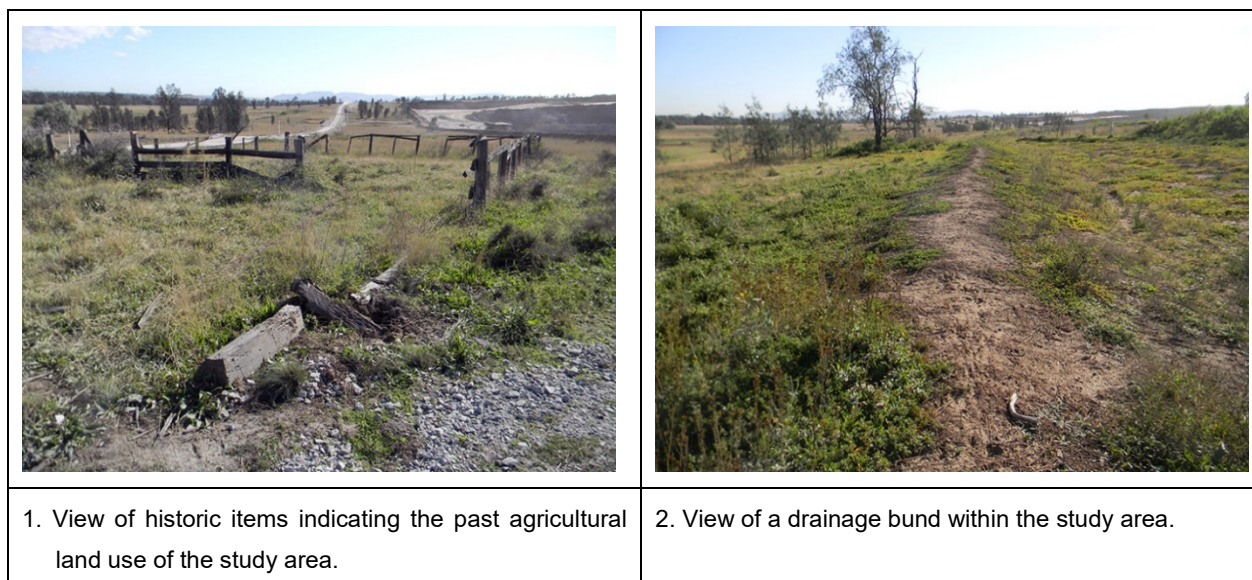
The study area has been entirely cleared of the primary tree and shrub cover and is now dominated by pastoral grasses and a few scattered regrowth Casuarinas. Casuarinas and eucalypt regrowth populate the banks of the nearby creek lines. Prior to European occupation, Mitchell (2002: 73) models that the vegetation within this landscape unit would have been comprised of woodlands to open forest of Spotted Gum, Forest Red Gum, Narrow-Leaved Ironbark, Mugga, and White Box with Kangaroo Grass and Wallaby Grass.

3.4 LAND USE HISTORY AND EXISTING LEVELS OF DISTURBANCE

The study area has been historically used for agricultural purposes. It is uncertain exactly what past land uses took place within the study area, but it is likely that the two most significant causes of disturbance would be associated with grazing and vegetation clearance. Within the study area are the remains of some holding yards that demonstrate the area's long association with husbandry practices and the subsequent disturbances stemming from soil compaction and other impacts to the soil profile (**Figure 3-2**). Other disturbances stem from approved mining activities, such as the construction of a light vehicle access track and drainage bunds (**Figure 3-2**).

As the study area is located within lower slopes, erosion, exacerbated by vegetation clearance, is likely to have had a significant impact on the soil profile over time.

Figure 3-2: Examples of land use disturbances within the study area.



3.5 CONCLUSION

The availability of semi-reliable water sources close to the study area indicate that the area would have been a favourable location for Aboriginal occupation in the past. While the widespread alteration of the landscape makes it difficult to accurately ascertain what other resources may have been available in the past, the relatively temperate climate and availability to reliable water sources would have enabled occupation of the area during all seasons.

The generally high degree of landform modification from both agricultural uses (vegetation clearing etc.), as well as more recent mining activities (roads and drainage works), indicates that the integrity of any archaeological features (i.e. artefact scatters), had they existed within the study area, are likely to have been diminished or dispersed.

4 ABORIGINAL ARCHAEOLOGY BACKGROUND

4.1 ETHNO-HISTORIC SOURCES OF REGIONAL ABORIGINAL CULTURE

The study area is located in the Wonnarua tribal area of the upper Hunter Valley.

The Wonnarua people lived in an environment rich in food resources. Freshwater fish, shellfish, reptiles, mammals, birds and plant food provide a diverse diet (see Brayshaw 1981b). Brayshaw (1986b: 82) suggests that inland groups visited the coast during the summer when marine resources were plentiful, and coastal groups travelled inland to participate in the winter kangaroo hunts. Trade and/or exchange also occurred between the coastal and inland groups. Reed spears and shells were traded inland for possum skin rugs and fur cord (Brayshaw 1986b: 41). Social gatherings were a feature of Aboriginal life in this area.

Visiting by coastal and inland groups for initiations and ceremonies seemed to occur. These were conducted within earthen circles. Carved trees were associated with these sites (Brayshaw 1981b: 12).

Material culture items for this area included many items made of bark obtained from various trees. For example, tea tree bark (*Melaleuca quinquenervia*) was used for the construction of huts, and the bark of the cabbage-tree (*Livistona australis*) and kurrajong (*Brachychiton eopulneus*) were used to make cord for the manufacture of fishing lines and nets and also for sewing up canoes (Brayshaw 1981b). Baskets, shields and canoes were also made from bark. Some shields, however, were also made from the wood of the nettle tree (*Urticaceae*) or fig (*Ficus* spp.). Boomerangs, clubs, spear throwers and hatchets were also manufactured. Spears were of composite manufacture, usually being lengths of grass tree (*Xanthorrhoea australis*) to which points of hard wood were attached. Maintenance tools included stone adzes and chisels, abrasive stones, small fishhook files, bone awls and sharpened shell knives and scrapers (Brayshaw 1981b: 10). After 1788 glass and iron hatchets became sought after items.

There is virtually no reference to flaked stone tools in the nineteenth century descriptions of Aboriginal material culture in the Hunter Valley. This paucity of information is at odds with the types of occupation evidence which are preserved in the valley. By far the most common type of Aboriginal site in the inland part of the valley is the "open campsite" or stone artefact scatter.

There are few records of the Aboriginal population of the central valley. Howe in 1819 reports five people at Jerry's Plains, Dangar in 1824 reports 15 people at Dartbrook, Mathew in 1830 reports 60 people on the Wollombi and 300 men are reported at Patricks Plains in 1834. At least 200 men were involved in the 1826 attack on Merton. Scott and McLeod in 1826 estimated a total of about 500 people at that time (Resource Planning 1991: 17) although this estimate, and the others above, are likely to be highly inaccurate as they are based on assumptions rather than detailed censuses.

From 1825 there is documented conflict between the Aboriginal population and settlers within the Hunter Valley, including the Ravensworth/Foy Brook area (for example, *The Australian*, 9 September 1826 [<http://trove.nla.gov.au/ndp/del/page/4248909>]). Although the exact location of these conflicts is unknown, the history of raids and counter-raids demonstrate that the Wonnarua people were fierce defenders of their tribal lands.

4.2 REGIONAL ARCHAEOLOGICAL CONTEXT

A very large amount of heritage work has been undertaken in the Hunter Valley and a comprehensive study of this is beyond the scope of this assessment. Consequently, only a brief regional archaeological context that focuses on work in similar landforms to the study area is provided here.

Evidence from the Central Lowlands sub-region of the Hunter Valley (broadly between Murrurundi in the north and Cessnock in the south-east), suggests that archaeological material is scattered almost continuously, but in varying density, along most creek banks and flats. It has been suggested that archaeological material is primarily contained in a corridor approximately 100 m wide on either side of a creek channel (Koettig 1990: 13).

In broad terms, these open artefact scatters appear to be confined to the A-Horizon of the soil (topsoil) profile which is generally less than 50 centimetres (cm) in depth (Hughes 1984; Stern 1981). These sites are often disturbed and stratification is unclear (Hughes 1984: 8). Artefacts are generally manufactured from indurated mudstone, with silcrete, fossilised wood and chert occurring less frequently (Hiscock and Koettig 1985). Features found at open surface scatters include hearths, pits, ovens and heat treatment areas (Burton *et al.* 1990). These sites are generally detected where some form of ground disturbance has occurred, for example erosion due to both cultural and non-cultural processes, and thus the extent of the site is often difficult to determine. Often the density of artefacts on the surface do not relate to the amount of subsurface archaeological material (see Koettig 1990: 15).

A review of GHD (2005), HLA-Envirosciences (2005) and Umwelt (2007) provides the following regional synthesis:

- Archaeological sites, even where surface evidence is not present, occur on most landforms. This was confirmed by a HLA-Envirosciences (2005) excavation program, in which Aboriginal sites were encountered on alluvial terraces, flats, slopes, bench areas, spurs and ridgelines. HLA-Envirosciences acknowledges that the sample areas were biased somewhat as they were all near creek lines
- Site frequency and density are dependent on their location in the landscape. This theme is consistent throughout NSW and is influenced by a range of factors, the most relevant of which the existing level of disturbance. More specifically, the potential for undisturbed in situ deposits remaining in the upper Hunter on a mining property is generally low

- The highest concentration of Aboriginal sites on the valley floor surrounds creeks and waterways
- Few scarred trees are recorded reflecting the high degree of tree clearing in the region
- The most frequently recorded raw material is indurated mudstone (a fine grained siliceous material) associated with Hunter River gravels. Other frequently recorded materials include locally sourced silcrete, quartz and volcanic stones.

4.3 LOCAL ARCHAEOLOGICAL CONTEXT

4.3.1 Previous archaeological assessments

4.3.1.1 Umwelt 2004

Umwelt conducted an Aboriginal archaeological assessment for the Glendell Project Area, encompassing the current study area, involving survey during September, October and December 2001, as well as geomorphic investigations during May 2002.

The Glendell survey area incorporated sections of Bowmans Creek, Swamp Creek and Bettys Creek. As part of the archaeological brief, a desk-top study and an in-field reconnaissance were undertaken with the aim of identifying areas within the Glendell Project Area that contained Aboriginal resources. The resources sought for identification within the Glendell Project Area included fresh water supplies, food and medicine plants, faunal prey species, stone suitable for implement manufacture, areas suitable for camping, areas that provided an extensive outlook, areas with major and minor creek confluences that had often been found to have Aboriginal camp sites and the terrain units that may have acted as pathways between resource locations.

The information compiled was then used to assist in the preparation of a predictive model related to the location and nature of sites within the Glendell Project Area. In addition, past land-use practices and geomorphic studies were used to determine areas where artefactual material may remain in a relatively undisturbed context. Geomorphic studies were also used to investigate a buried soil profile within the shared Bowmans Creek/Swamp Creek floodplain and to determine the likelihood of this soil profile containing artefactual material from the late Pleistocene to early Holocene periods.

As a result of the research it was concluded that the entire Glendell Project Area would have supplied adequate resources for small groups of hunter-gatherers living a mobile lifestyle. Bowmans Creek was highlighted as an area that should have formed the focus of camping activities of longer duration, possibly by larger numbers of people, due to an increased abundance and reliability of the resource base.

Other areas, such as the lower western slopes adjacent to Bettys Creek were assessed as having attracted groups of people for short-term visits to harvest abundant seasonal foods. Bowmans

Creek was therefore cited as likely to have the largest sites in terms of spatial extent and numbers of artefacts.

Such sites were predicted as likely to be found on the lower slopes, terraces and floodplains along Bowmans Creek, spreading further across the Bowmans Creek/Swamp Creek floodplain. Bettys Creek and Swamp Creek were listed as likely to have evidence of more sporadic and short-term use as overnight camping locations.

A pattern of site distribution was evident from the previously recorded sites in the locale with the majority of sites located along the watercourses (58%). More of these were associated with ephemeral tributaries (30%) than major creek lines and their associated floodplains and terraces (30%). A little more than half (54%) of the sites were within 30 m of the closest watercourse and 66% within 100 m. In relation to the slopes, sites were more commonly located on the foot slopes/lower slopes (18.5%), than the crest/upper slopes (16.6%) and mid slopes (8%).

A total of 37 previously unrecorded sites were located during the 2001 fieldwork survey of the Glendell Project Area. The sites consisted of 30 artefact scatters, including one small quarry site with an associated artefact scatter, one scatter in an area with a buried soil profile and seven isolated finds. The Bowmans Creek 5 quarry site (37-3-0617) was recorded as having an associated artefact scatter as the majority of the artefacts in the site were manufactured from mudstone and silcrete rather than the quartz and quartzite materials available at the site.

The artefact scatter in the area with the buried soil profile (Bowmans Creek/Swamp Creek Trench; 37-3-0469) was located on the shared floodplain between Bowmans Creek and Swamp Creek. In this area a trench approximately 300 m in length was constructed during the 1980s to divert Swamp Creek into Bowmans Creek. At the time of the 2001 survey the trench was not connected to the creeks (as it remains so today). The artefact scatter eroding from the A-Horizon of the floodplain was observed to be approximately one metre above the buried soil profile. This profile was later determined through geomorphic investigation to be of early Pleistocene to Tertiary age and did not contain any artefactual material.

Artefact analysis of the salvage assemblage recorded:

- Flakes and broken flakes dominated the assemblage (78%), followed by flaked pieces (15%) and cores (3%). Within the flake category, 4% were retouched and half of the retouched flakes were backed. Heat shatter accounted for 3% of the artefacts
- The mudstone and silcrete flakes were of similar size. Volcanic flakes were generally larger and heavier than flakes composed of other raw materials
- Volcanic flakes had a significantly higher percentage of cortex than silcrete or mudstone, and mudstone artefacts had a higher percentage of cortex than silcrete

- Silcrete artefacts had a higher overall rate of retouch than mudstone artefacts (8.2% and 6.3% respectively), and silcrete retouched artefacts were more likely to be backed than retouched mudstone artefacts
- A number of artefacts relating to post-European occupation of the area were also recovered, including fragments of glass and pottery. The location of this material closely correlated with concentrations of Aboriginal stone artefacts. Additionally, at least one Aboriginal artefact manufactured from glass was salvaged, suggesting that the area was used by Aboriginal people in the post-contact period.

4.3.1.2 Umwelt 2013

Salvage of the Glendell Project Area was undertaken under NPWS s.90 Consent #2267 and formed Part 4 of the salvage program for the Bettys Creek valley. This archaeological salvage within the Glendell Project Area was conducted by Umwelt and the Registered Aboriginal Parties (RAPs) between November 2005 and February 2006 on behalf of Glendell Joint Venture, now Mount Owen.

A total of 2,713 artefacts were recovered from the Glendell Project Area salvage including 824 (30.6%) from the surface collection, 274 (10.1%) from Excavation 1 (Bettys Creek 10), 19 (0.7%) from Excavation 2 (Bettys Creek 9), 1,414 (52.1%) from Excavation 3 (Bettys Creek 2) and 177 (6.5%) from the grader scrapes. A total of 2,604 (96%) of the artefacts were recovered from the Bettys Creek catchment, 52 (1.9%) from the Bowmans Creek catchment and 57 (2.1%) from the Swamp Creek catchment.

Observations made from the surface collection assemblage are as follows:

- The highest number of artefacts were collected from Bettys Creek 14 (26.7% of the surface collection assemblage), followed by Bettys Creek 10 (19.5% of the assemblage)
- 60.6% of the artefacts were collected from lower slopes and floodplains associated with creek lines (56.7% from Bettys Creek; 3.3% from Swamp Creek and 0.7% from Bowmans Creek)
- Sites on low but elevated spurs in tributary confluences comprised 22.2% of the assemblage; ridge crests (7.5%); sites on lower slopes on tributary channels more than 150m from the main creek channel (7.5%); mid slope sites (1.3%) and upper slopes (0.6%)
- The dominant artefact type was broken flakes (45%); followed by flakes (26.7%); flaked pieces (10.9%); retouched flakes (10%), cores (3.7%), heat shatter (3.4%) and grindstones (0.4%)
- A total of 31 cores were recovered from the surface collection. Of these, 21 were recovered from the Bettys Creek sites (17 from areas with tributary confluences with Bettys Creek)

- Mudstone was dominant within the assemblage making up 58.5% of the artefacts, followed by silcrete (31.9%) with the remaining raw materials making up 9.6% of the total assemblage.

Excavation was targeted at Bettys Creek 2, Bettys Creek 9 and Bettys Creek 10 indicated the following:

- Bettys Creek 10 and Bettys Creek 2 retained a level of spatial integrity reflected by knapping events and raw material distribution patterns
- Bettys Creek 9 contained artefacts in a secondary context
- All three locations contained backed flakes
- A ground oven identified at Bettys Creek 2 had an absolute date of 2188 $\pm$ 39 BP (years before present)
- It was possible to obtain one radiocarbon date of 3077 $\pm$ 40 BP (calibrated-Wk-20912) from Square K Spit 3 of Excavation 3 within the Mount Owen Extension Area. The date was relative in nature as it belonged to a large piece of burnt wood that was associated with artefacts both above and below it. Thus the artefacts above it must be dated to later than 3077 $\pm$ 40 BP and those below it to earlier
- Broken flakes (45.7%) dominated the artefact assemblage, followed by flakes (38.7%)
- Bettys Creek 10 and Bettys Creek 2 were dominated by mudstone while Bettys Creek 9 was dominated by silcrete. Overall, mudstone was dominate (55.7%) over silcrete (32.3%)
- A small knapping event was evident at Bettys Creek 10, with greater amounts of knapping noted at Bettys Creek 2
- Core to flake ratios for Bettys Creek 10 were 1:28.7 and for Bettys Creek 2 were 1:27.4 suggesting knapping on site.

4.3.1.3 OzArk 2014

From 2012 to 2013, OzArk completed the *Aboriginal Archaeological Values Assessment: Mount Owen Continued Operations* (MOCO) (2014). The assessment covered 464 ha within the Mount Owen Complex and included surface survey and test excavation. In total, 11 artefact scatters, 20 isolated finds and three extensions to previously recorded sites were recorded.

A very small portion of this area is included within the current study area.

The results of the 2012/2013 OzArk assessment were:

- 91% of the newly recorded sites were either isolated finds or low density artefact scatters without associated archaeological deposits
- Test excavation was carried out at two locations. No sub-surface artefacts were retrieved from one site and 114 artefacts were excavated from the other site. At the site that

recorded artefacts (MOCO OS-4), most of the artefacts were concentrated in a small area, representing two or three discreet knapping events of mudstone and silcrete

- Widespread disturbances and thin A-Horizon soils were noted across the assessment area. Thin, or non-existent, A-Horizon soils were also noted during the test excavation at both locations
- The most common raw materials were indurated mudstone and silcrete with smaller quantities of chert, siltstone, quartzite and quartz also identified
- Flakes and flaked pieces accounted for the bulk of assemblages. Proportions of cores and backed blades were low
- Most sites were situated close to drainage lines.

4.3.1.4 OzArk 2017

In early 2017 the MOCO salvage program took place under the authority of the 2016 *Mount Owen Complex Aboriginal Cultural Heritage Management Plan* (ACHMP) (OzArk 2017). This program was completed in the approved disturbance areas associated with the MOCO Project Area located adjacent to the Proposed Modification study area.

This program included the collection of surface artefacts at 30 sites resulting in 189 artefacts being recorded. Included in the tally of 30 sites, were two sites where limited archaeological excavation took place resulting in a further 187 artefacts being recorded. An additional area on the east bank of Bowmans Creek, along an upper terrace landform, was also subject to archaeological investigation by manual excavation but the area proved to be highly disturbed and no artefacts were recorded.

Of all the sites investigated in the 2017 salvage program, MOCO OS-4 recorded the highest artefact density with 71 surface artefacts (35.98% of all surface artefacts recorded during the salvage program) and 186 artefacts recorded in the excavation component of the program (constituting almost all of the artefacts recorded in the excavation component of the program). MOCO OS-4 was located on an unnamed watercourse (termed the 'eastern drainage') approximately 5.4 km northeast from the current study area. MOCO OS-4 was located in area heavily affected by erosion and the investigation showed that while one concentration of artefacts remained in situ, the majority of the site had been displaced by the erosion.

Other sites that recorded more than 10 artefacts during the salvage program were MOCO OS-3, MOCO OS-9 and MOCO OS-10. All other sites recorded very low artefact numbers supporting the conclusion reached in OzArk 2014 that the remaining archaeological values at Mount Owen Complex consist of low density, often displaced, artefact scatters.

The recording of these sites affords with the general picture emerging that sites located away from permanent water are likely to have a low artefact density and low site complexity.

4.3.1.5 OzArk 2018

During the quarterly monitoring program for the Mount Owen Complex (OzArk 2018), a number of further artefacts were noted in the vicinity of Swamp Creek IF-2 to Swamp Creek IF-4 that were recorded in August 2017 as part of the visual inspection for the Proposed Modification (see **Section 6.2, Figure 4-1**). As a result, it was decided that an artefact scatter would be registered in the area which would include the three previously recorded isolated finds. The artefact scatter, Swamp Creek OS1 (37-3-1499), therefore includes:

- Swamp Creek IF-2 (37-3-1492)
- Swamp Creek IF-3 (37-3-1493)
- Swamp Creek IF-4 (37-3-1490).

The southern portion of Swamp Creek OS1 is within the study area although the majority of the site is outside of the study area (**Figure 4-1**).

4.3.1.6 OzArk 2018

During April and May 2018, OzArk completed the *Aboriginal Archaeological Values Assessment: Glendell Continued Operations* Project (2018 forthcoming). This assessment included all of the current study area and was conducted by OzArk archaeologists and members of the Aboriginal community.

Overall, this assessment recorded 33 previously unrecorded artefact scatters, 24 isolated finds, one scarred tree and one potential archaeological deposit (PAD).

This assessment recorded two sites that are located within the study area:

- One low density artefact scatter (Glendell North OS28) is wholly within the study area. This site consists of three artefacts located along a track: a mudstone flake, a mudstone piece of angular shatter and a quartz flake
- A second site, Glendell North OS31, extends into the study area but is mostly located outside of the study area. This site consists of 15 artefacts (12 mudstone, two silcrete and one quartz) located in a disturbed context on the same drainage bund as Swamp Creek IF-2 to Swamp Creek IF-4 (see **Section 6.2**).

In addition, the following sites were recorded in close proximity to the study area:

- Glendell North OS25 is located on the eastern bank of Swamp Creek approximately 60 m west of the study area. Glendell North OS25 consists of two mudstone flakes
- Glendell North OS27 consists of a mudstone flake and a silcrete flake located in a disturbed context on a dam wall 20 m east of the study area
- Glendell North OS30 is located in a disturbed context on a dam wall and consists of three mudstone artefacts including a core. At its closest, Glendell North OS30 is approximately 45 m west of the study area

- Glendell North IF22: an isolated mudstone flake located on the eastern bank of Swamp Creek approximately 28 m west of the study area
- Glendell North IF24: an isolated silcrete flake recorded on a vehicle track approximately 8 m south of the study area.

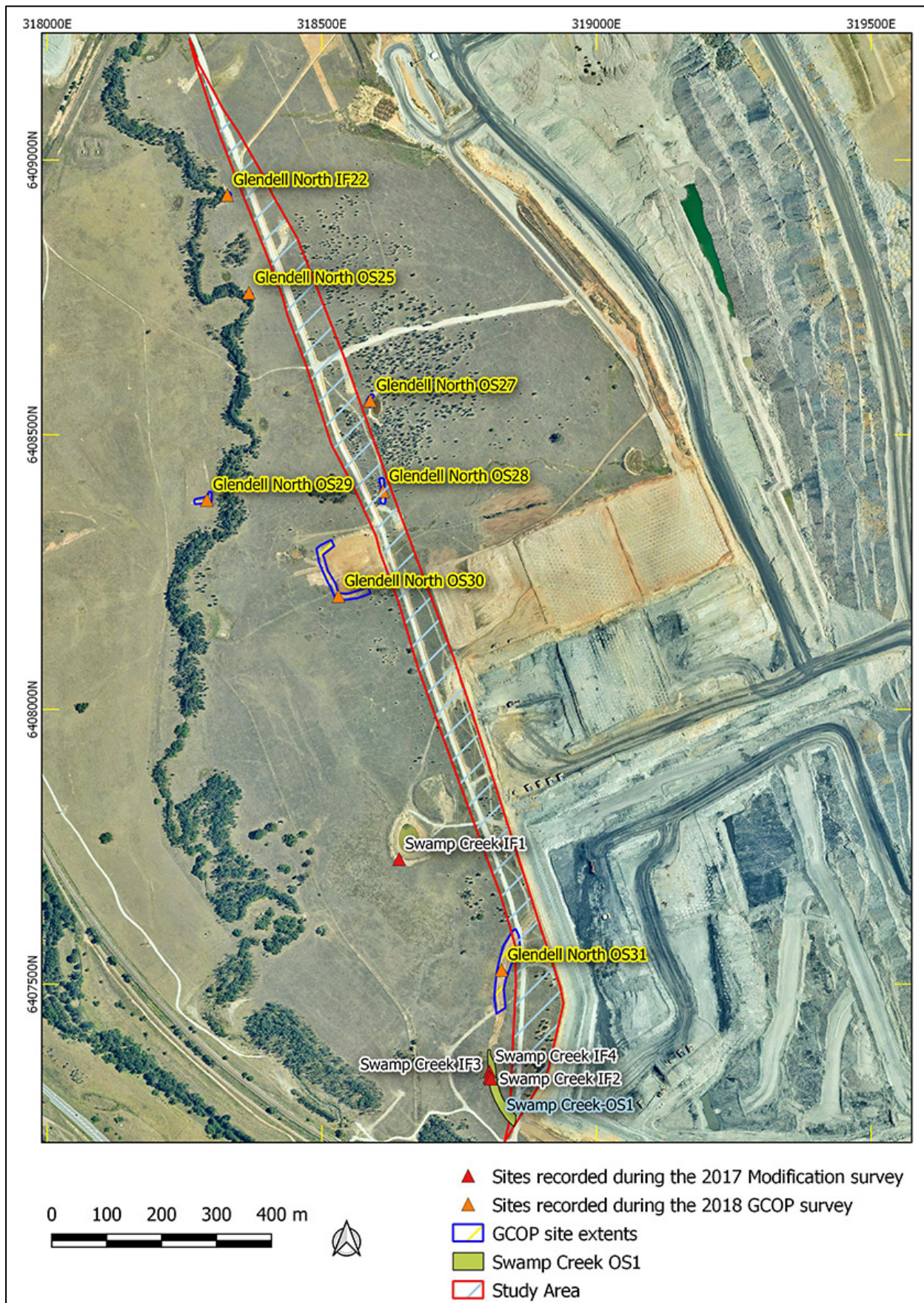
Figure 4-1 shows those sites recorded in 2018 for the GCOP assessment that are either within or closely adjacent to the study area.

The GCOP assessment also included a test excavation program that was undertaken in September 2018. Two locations inspected during this program are in the vicinity of the study area:

- Area 9 located on the western bank of Swamp Creek approximately 85 m west of the study area
- Area 10 located on the eastern bank of Swamp Creek approximately 45 m west of the study area.

As was found elsewhere during the GCOP test excavation program, there was a very low density of subsurface artefacts at both areas. Area 9 recorded a single mudstone flake at a depth of 10–20 cm and Area 10 recorded three artefacts (two mudstone flakes and a piece of angular silcrete shatter) also at a depth of 10–20 cm. These results indicate that there are unlikely to be substantial subsurface archaeological deposits in the vicinity of the study area.

Figure 4-1: Aerial showing the study area in relation to sites recorded during the 2017 and 2018 surveys.



4.3.1.7 Aboriginal cultural values within the study area

During the assessment for the MOCO project, an extensive assessment of Aboriginal cultural heritage values was undertaken (Umwelt 2015). No known cultural values are known to exist pertaining directly to the location of the study area. However, Umwelt 2015 states that the landscape and waterways within or near the study area, including Swamp Creek, Bettys Creek and Bowmans Creek, have cultural value for the local Aboriginal community in a general manner as these features are part of the community's Country.

No Aboriginal community members accompanied the visual inspection of the study area during the August 2017 assessment. However, Aboriginal community were present during the April/May 2018 GCOP assessment that included the study area and no specific cultural values pertaining to the study area were raised.

4.3.2 Desktop database searches conducted

A desktop search was conducted on the following databases to identify any potential previously-recorded heritage within the study area. The results of this search are summarised in **Table 4-1**.

Table 4-1. Aboriginal heritage: desktop-database search results.

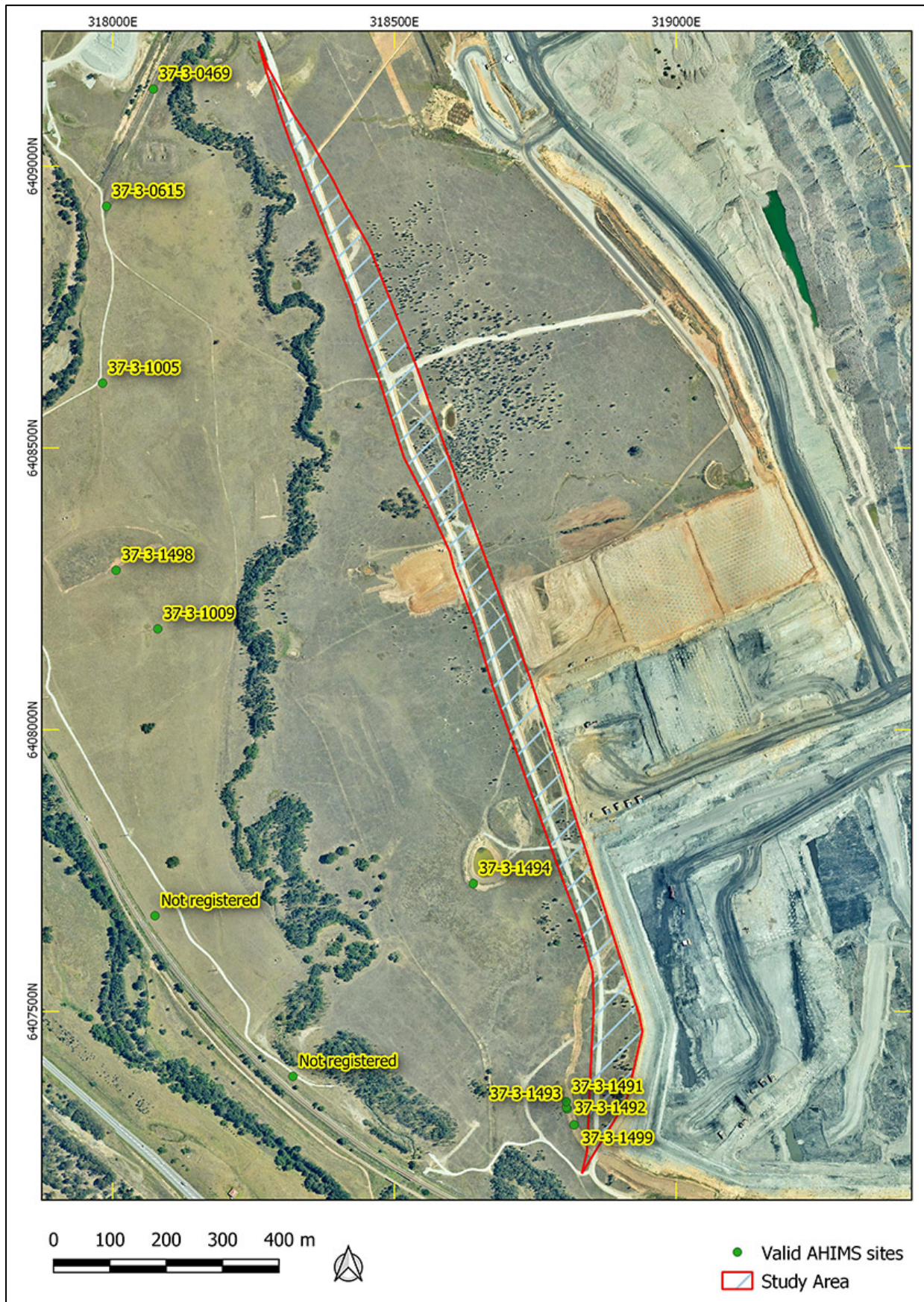
Name of Database Searched	Date of Search	Type of Search	Comment
Commonwealth Heritage Listings	12/9/17	Singleton LGA	No places listed on either the National or Commonwealth heritage lists are located within the study area.
National Native Title Claims Search	12/9/17	Native Title Tribunal spatial data (downloaded 20/4/17)	NC2013/006 (Scott Franks and Anor on behalf of the Plains Clans of the Wonnarua People) covers the study area.
Local Environment Plan (LEP)	12/9/17	Singleton Local Environmental Plan 2013	None of the Aboriginal places noted occur near the study area

As per **Table 4-1**, it is noted that the study area includes land currently subject to Native Title Claim (NC2013/006 Scott Franks and Anor on behalf of the Plains Clans of the Wonnarua People).

A search of the OEH administered AHIMS database was not completed over the study area as the Mount Owen Complex maintains an up-to-date, accurate GIS system of recorded sites within the MOC ACHMP boundary. The sites on the Mount Owen Complex GIS heritage database have been verified against the AHIMS data, as well as being inspected on the ground to verify current site conditions and the accuracy of the AHIMS data at particular sites. As such, there is a high degree of confidence in the data held on the Mount Owen Complex GIS heritage database.

Figure 4-2 shows the location of previously recorded AHIMS sites in relation to the study area. The GCOP sites are shown on **Figure 4-1** and are not shown on **Figure 4-2**.

Figure 4-2: Valid AHIMS sites in the vicinity of the study area.



It can be seen on **Figure 4-2** that a number of sites are located close to the study area although there are no previously recorded sites registered with the AHIMS register that plot to within the study area. Some observations on the data displayed on **Figure 4-2** follow:

- 37-3-1490 to 37-3-1493 (Swamp Creek IF-1 to Swamp Creek IF-4) were recorded as a result of the assessment for the Proposed Modification in August 2017 (see **Section 6.2**). All sites are isolated finds in disturbed contexts. As such, all have low scientific values
- 37-3-1499 (Swamp Creek OS1) was recorded as a result of the quarterly monitoring program at the Mount Owen Complex when further artefacts were noted in the vicinity of Swamp Creek IF-2 to Swamp Creek IF-4. See **Section 4.3.1.5** for further details
- The locations marked 'not registered' on **Figure 4-2** are identified sensitive archaeological landforms. These areas have not recorded Aboriginal objects and therefore are management zones only without statutory protection
- All other sites shown on **Figure 4-2** are stone artefact sites and include three artefact scatters and two isolated finds. All sites have an extremely low artefact density apart from 37-3-0469 that was recorded as containing 479 artefacts (see **Section 4.3.1.1** for further details on this site)
- The majority of sites recorded in the vicinity of the study area are in disturbed contexts where the artefacts are likely to be in secondary contexts. This includes recordings on dam walls, along drainage bunds and associated with major earthworks that took place to construct a trench from Swamp Creek to Bowmans Creek.

4.4 PREDICTIVE MODEL FOR SITE LOCATION

Across Australia, numerous archaeological studies in widely varying environmental zones and contexts have demonstrated a high correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural/mythological significance. Consequently sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter.

In formulating a predictive model for Aboriginal archaeological site location within any landscape it is also necessary to consider post-depositional influences on Aboriginal material culture. In all but the best preservation conditions very little of the organic material culture remains of ancestral Aboriginal communities survives to the present. Generally it is the more durable materials such as stone artefacts, stone hearths, shell, and some bones that remain preserved in the current landscape. Even these however may not be found in their original depositional context since these may be subject to either (a) the effects of wind and water erosion/transport—both over

short and long time scales—or (b) the historical impacts associated with the introduction of European farming practices. Scarred trees, by their nature, may survive for up to several hundred years but rarely beyond.

Knowledge of the environmental contexts of the study area and a desktop review of the known local and regional archaeological record, the following predictions are made concerning the probability of those site types being recorded within the study area:

- Isolated finds may be indicative of: random loss or deliberate discard of a single artefact, the remnant of a now dispersed and disturbed artefact scatter, or an otherwise obscured or sub-surface artefact scatter. They may occur anywhere within the landscape but are more likely to occur in topographies where open artefact scatters typically occur.
 - As isolated finds can occur anywhere, particularly within disturbed contexts, it is predicted that this site type could be recorded within the study area.
- Open artefact scatters are defined as two or more artefacts, not located within a rock shelter, and located no more than 50 m away from any other constituent artefact. This site type may occur almost anywhere that Aboriginal people have travelled and may be associated with hunting and gathering activities, short or long term camps, and the manufacture and maintenance of stone tools. Artefact scatters typically consist of surface scatters or sub-surface distributions of flaked stone discarded during the manufacture of tools, but may also include other artefactual rock types such as hearth and anvil stones. Less commonly, artefact scatters may include archaeological stratigraphic features such as hearths and artefact concentrations which relate to activity areas. Artefact density can vary considerably between and across individual sites. Small ground exposures revealing low density scatters may be indicative of background scatter rather than a spatially or temporally distinct artefact assemblage. These sites are classed as 'open', that is, occurring on the land surface unprotected by rock overhangs, and are sometimes referred to as 'open camp sites'.

Artefact scatters are most likely to occur on level or low gradient contexts, along the crests of ridgelines and spurs, and elevated areas fringing watercourses or wetlands. Larger sites may be expected in association with permanent water sources.

Topographies which afford effective through-access across, and relative to, the surrounding landscape, such as the open basal valley slopes and the valleys of creeks, will tend to contain more and larger sites, mostly camp sites evidenced by open artefact scatters.

- Artefact scatters, as well as isolated stone artefacts, are the predominant site types occurring in the region. The expected location of artefact scatters is on eroded exposures most commonly adjacent to creek lines, such as Swamp Creek, Bettys Creek, and their associated drainages. This site type is likely to be in a secondary context from disturbances such as erosion, farming and mining practices. It is likely that any sites associated with such landforms are likely to have a low artefact density and a low complexity of tool types as the sites are either one-off events or only infrequently used. Should these site types be present, the artefact assemblage is likely to be dominated by flakes from mudstone and silcrete. Other recorded materials could include quartz, chert, tuff, volcanics and petrified wood.

It is noted that the study area has already been subjected to a number of previous archaeological assessments that have recorded a number of sites in the vicinity. This indicates that further artefact scatters could be possible but that previous assessments have probably recorded the larger examples of this site type.

- Aboriginal scarred trees contain evidence of the removal of bark (and sometimes wood) in the past by Aboriginal people, in the form of a scar. Bark was removed from trees for a wide range of reasons. It was a raw material used in the manufacture of various tools, vessels and commodities such as string, water containers, roofing for shelters, shields, and canoes. Bark was also removed as a consequence of gathering food, such as collecting wood boring grubs or creating footholds to climb a tree for possum hunting or bark removal. Due to the multiplicity of uses and the continuous process of occlusion (or healing) following removal, it is difficult to accurately determine the intended purpose for any particular example of bark removal. Scarred trees may occur anywhere old growth trees survive. The identification of scars as Aboriginal cultural heritage items can be problematical because some forms of natural trauma and European bark extraction create similar scars. Many remaining scarred trees probably date to the historic period when bark was removed by Aboriginal people for both their own purposes and for roofing on early European houses. Consequently the distinction between European and Aboriginal scarred trees may not be clear.
 - Due to the near-total clearance of trees from within the study area, this site type is predicted to be very rare. It is also noted that this site type is very rare at a regional level.
- Quarry sites and stone procurement sites typically consist of exposures of stone material where evidence for human collection, extraction and/or preliminary processing has survived. Typically these involve the extraction of siliceous or fine grained igneous and meta-sedimentary rock types for the manufacture of artefacts. The presence of quarry/extraction sites is dependent on the availability of suitable rock formations.
 - This site type could be recorded within the study area should suitable rock outcroppings be available.
- Burials are generally found in soft sediments such as aeolian sand, alluvial silts and rock shelter deposits. In valley floor and plains contexts, burials may occur in locally elevated topographies rather than poorly drained sedimentary contexts. Burials are also known to have occurred on rocky hilltops in some limited areas. Burials are generally only visible where there has been some disturbance of sub-surface sediments or where some erosional process has exposed them.
 - Although it is possible that this site type could be found within the study area, it is considered a rare site type especially given the disturbance that has occurred within the study area.

5 DUE DILIGENCE ASSESSMENT

5.1 INTRODUCTION

The National Parks and Wildlife Regulation 2009 (NPW Regulation) made under the *National Parks and Wildlife Act 1974* (NPW Act) advocates a Due Diligence process to determining likely impacts on Aboriginal objects. Carrying out Due Diligence provides a defence to the offence of harming Aboriginal objects and is an important step in satisfying Aboriginal heritage obligations in NSW.

5.2 DEFENCES UNDER THE NPW REGULATION 2009

The first step before application of the Due Diligence process itself is to determine whether the proposed activity is a “low impact activity” for which there is a defence in the NPW Regulation. The exemptions are listed in Section 80B (1) of the NPW Regulation (DECCW 2010: 6).

The activities of Mount Owen do not fall into any of these exemption categories. Therefore the Due Diligence process must be applied.

Relevant to this process is the assessed levels of previous land-use disturbance.

The NPW Regulation Section 80B (4) (DECCW 2010a: 18) define disturbed land as follows:

Land is disturbed if it has been the subject of a human activity that has changed the land’s surface, being changes that remain clear and observable.

Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.

While there has been a moderate to high degree of land use disturbance within the study area, the majority of the landforms have not been altered in a clear and observable manner and the Due Diligence process must be applied.

5.3 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE TO THE PROPOSAL

To follow the generic Due Diligence process, a series of steps in a question/answer flowchart format (DECCW 2010: 10) are applied to the proposed impacts and the study area, and the responses documented.

The following paragraphs address this due diligence for the study area.

Step 1: Will the activity disturb the ground surface or any culturally modified trees?

Yes. The activity will disturb the ground, however, no culturally modified trees will be impacted. Go to Step 2.

Step 2: Are there any:

- a) Relevant confirmed site records or other associated landscape feature information on AHIMS? and/or
- b) Any other sources of information of which a person is already aware? and/or
- c) Landscape features that are likely to indicate presence of Aboriginal objects?

2a No. At the time of the August 2017 assessment there were no previously recorded sites within the study area. However, as a result of assessments subsequent to August 2017, one valid site (Glendell North OS28) is within the study area. Another two sites (Swamp Creek OS1 [37-3-1499] and Glendell North OS31) partially extend into the study area

2b No. there is no further information to indicate the presence of Aboriginal objects within the study area

2c Landscape features noted here include (DECCW 2010):

- within 200 m of waters, or
- located within a sand dune system, or
- located on a ridge top, ridge line or headland, or
- located within 200 m below or above a cliff face, or
- within 20 m of or in a cave, rock shelter, or a cave mouth

and is on land that is not disturbed land (see **Section 5.2**) then you must go to Step 3.

Yes. A large portion of the study area is within 200 m of Swamp Creek and Bettys Creek. The study area also traverses three ephemeral drainage lines of Swamp Creek.

Step 3: Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?

No: The activity will impact landforms within 200 m of a waterway.

An answer of 'no' to Step 3 advances the process to Step 4, a visual inspection of the study area.

Details of the visual inspection of the study area are presented in **Section 6**.

6 RESULTS OF THE SITE INSPECTION

6.1 SAMPLING STRATEGY AND FIELD METHODS

Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004). The study area was traversed by pedestrian means; first by walking south to the west of the light vehicle access road and then north to the east of the light vehicle access road.

Figure 6-1 shows the pedestrian survey tracks carried out during the site inspection. The yellow line illustrates the survey track of an OzArk archaeologist taken during the 2018 GCOP survey while the black line shows the survey track of the OzArk archaeologist taken during the August 2017 assessment for the Proposed Modification.

Figure 6-1: Survey coverage of the study area.



6.2 ABORIGINAL SITES RECORDED

Four Aboriginal sites, Swamp Creek IF-1 to Swamp Creek IF-4, were recorded as a result of the current assessment (**Table 6-1**). All are located outside of the current study area for the Proposed Modification as the study area in August 2017 was larger than the current study area.

Table 6-1: Survey results.

Site name	Coordinates (GDA Zone 56)	Site type	Site extent	Landform
Swamp Creek IF-1 (37-3-1491)	318640E 6407727N	Isolated find	2m x 2m	Flat
Swamp Creek IF-2 (37-3-1492)	318807E 6407327N	Isolated find	2m x 2m	Lower slope
Swamp Creek IF-3 (37-3-1493)	318805E 6407330N	Isolated find	2m x 2m	Lower slope
Swamp Creek IF-4 (37-3-1490)	318805E 6407340N	Isolated find	2m x 2m	Lower slope

Swamp Creek IF-1 (37-3-1491)

Site Type: Isolated find

GPS Coordinates: GDA Zone 56 318640E 6407727N

Location of Site: Swamp Creek IF-1 is located on the western wall of a dam outside of the study area for the Proposed Modification. The site is 200 m east of Swamp Creek and 170 m west of the light vehicle access road.

Description of Site: The site consists of an isolated mudstone end scraper (**Table 6-2**). Four flakes have been removed along the distal end of the scraper with steep retouch. The scraper was recorded along a dam wall and is therefore in a secondary context (**Figure 6-2**). As a result, it is assessed that Swamp Creek IF-1 is not associated with further, intact, archaeological deposits.

Table 6-2: Swamp Creek IF-1. Recorded artefact attributes.

Artefact type	Material	Integrity	Reduction	Size (mm)	Retouch type
End scraper	Mudstone	Complete	Secondary	48 x 57 x 18	Steep

Figure 6-2: Swamp Creek IF-1. View of site and the recorded artefact.

	
1. View southeast to Swamp Creek IF-1 site location (pink flag).	2. Swamp Creek IF-1: GDA Zone 56 318640E 6407727N. A mudstone end scraper.
	
3. View of retouch along the distal margin of the scraper.	

Swamp Creek IF-2 (37-3-1492)

Site Type: Isolated find

GPS Coordinates: GDA Zone 56 318807E 6407327N

Location of Site: Swamp Creek IF-2 is located along a drainage bund outside of the study area for the Proposed Modification (**Figure 6-3**). The site is 130 m northeast of Bettys Creek and 290 m of Swamp Creek.

Description of Site: The site consists of an isolated mudstone flake (**Table 6-3**). The flake is complete and retains approximately 30% cortex. The flake was recorded on a lower slope landform in an area of exposure along a drainage bund. The site is therefore in a secondary context and as a result, it is assessed that Swamp Creek IF-2 is not associated with further, intact, archaeological deposits.

Table 6-3: Swamp Creek IF-2. Recorded artefact attributes.

Artefact type	Material	Integrity	Reduction	Size (mm)
Flake	Mudstone	Complete	Secondary	41 x 25 x 12

Figure 6-3: Swamp Creek IF-2. View of site and the recorded artefact.

	
1. Swamp Creek IF-2 site location along a drainage bund (pink flag).	2. Swamp Creek IF-2: GDA Zone 56 318807E 6407327N. A mudstone flake.

Swamp Creek IF-3 (37-3-1493)**Site Type:** Isolated find**GPS Coordinates:** GDA Zone 56 318805E 6407330N

Location of Site: Swamp Creek IF-3 is located along a drainage bund outside of the study area for the Proposed Modification (**Figure 6-4**). The site is 4 m northwest of Swamp Creek IF-2; 132 m northeast of Bettys Creek; and 292 m of northeast Swamp Creek.

Description of Site: The site consists of an isolated mudstone flake with a faceted platform (**Table 6-4**). The flake was recorded on a lower slope landform in an area of exposure along a drainage bund. The site is therefore in a secondary context and as a result, it is assessed that Swamp Creek IF-3 is not associated with further, intact, archaeological deposits.

Table 6-4: Swamp Creek IF-3. Recorded artefact attributes.

Artefact type	Material	Integrity	Reduction	Size (mm)
Flake	Mudstone	Complete	Tertiary	14 x 23 x 5

Figure 6-4: Swamp Creek IF-3. View of site and the recorded artefact.

	
1. Swamp Creek IF-3 site location along a drainage bund (pink flag).	2. Swamp Creek IF-3: GDA Zone 56 318805E 6407330N. A mudstone flake.

Swamp Creek IF-4 (37-3-1490)

Site Type: Isolated find

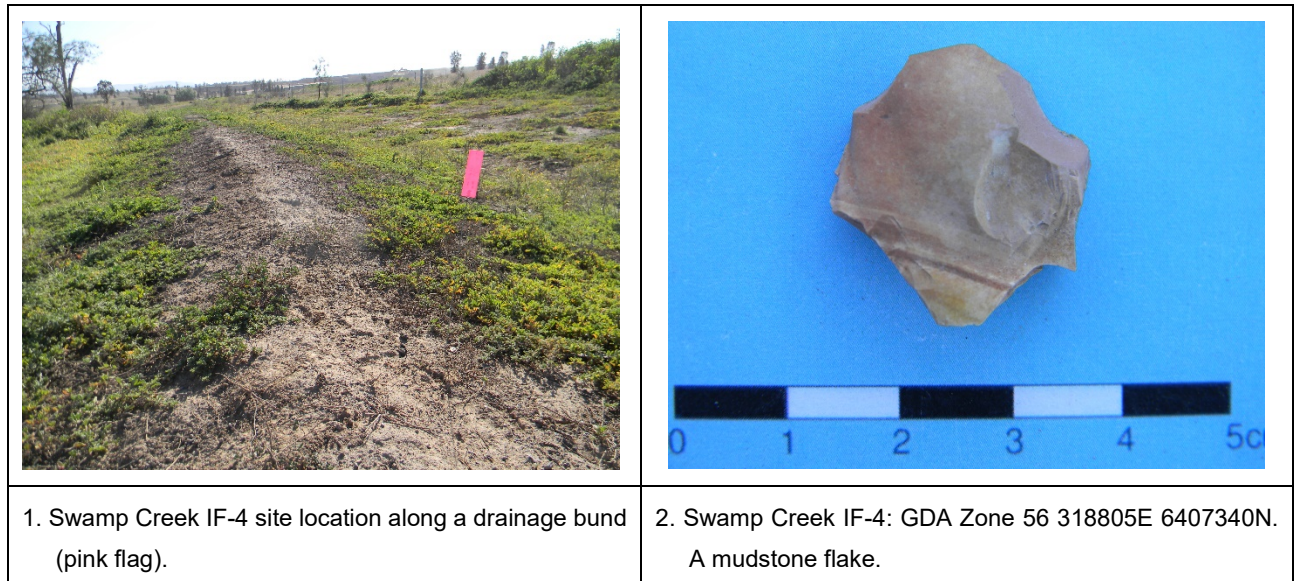
GPS Coordinates: GDA Zone 56 318805E 6407340N

Location of Site: Swamp Creek IF-4 is located along a drainage bund outside of the study area for the Proposed Modification (**Figure 6-5**). The site is 9 m north of Swamp Creek IF-3; 141 m northeast of Bettys Creek; and 300 m of northeast Swamp Creek.

Description of Site: The site consists of an isolated mudstone flake (**Table 6-5**). The flake is complete and retains approximately 40% cortex. The flake was recorded on a lower slope landform in an area of exposure along a drainage bund. The site is therefore in a secondary context and as a result, it is assessed that Swamp Creek IF-4 is not associated with further, intact, archaeological deposits.

Table 6-5: Swamp Creek IF-4. Recorded artefact attributes.

Artefact type	Material	Integrity	Reduction	Size (mm)
Flake	Mudstone	Complete	Secondary	20 x 23 x 6

Figure 6-5: Swamp Creek IF-4. View of site and the recorded artefact.

6.3 DISCUSSION

The predictive model (**Section 4.4**) suggested that landforms within the study area were favourable to Aboriginal occupation. The predictive model also stated that should Aboriginal sites be recorded in the study area they are likely to have a low artefact density and be within a disturbed context. Although four new Aboriginal sites, all isolated finds, were recorded, all conformed to the predictive model as they are isolated finds in disturbed contexts.

The assessment results also conform to previous assessments in the area (**Section 4.3**):

- Umwelt 2004 (**Section 4.3.1.1**) demonstrated that a clear majority of sites are closely associated with waterways. As there are no non-ephemeral waterways in the study area this explains the low artefact density of the recordings. Umwelt 2004 also demonstrated that lower slopes contained more sites when compared to crests or upper slope landforms. As the study area is located within lower slope landforms, this perhaps explains why sites were recorded during the assessment
- Umwelt 2013 demonstrated that occupation along Swamp Creek in the vicinity of the study area was less than occupation along nearby creek systems such as Bettys Creek (**Section 4.3.1.2**)
- OzArk 2014 (**Section 4.3.1.3**) demonstrated that sites were either isolated finds or low density artefact scatters without associated archaeological deposits in landforms away from watercourses. OzArk 2014 also showed that subsurface deposits are not common at the Mount Owen Complex and that there is evidence of widespread disturbance to the soil profile
- OzArk 2018 (forthcoming) (**Section 4.3.1.6**) showed that test excavation in the vicinity of the study area demonstrated a very low subsurface artefact density.

As such, the current results support the general archaeological context that has been built up at the Mount Owen Complex in that: occupation along Swamp Creek is likely to indicate short-term

or sporadic use; numbers of sites away from waterways is greatly reduced; lower slope landforms are likely to record sites; there is unlikely to be subsurface deposits associated with sites; and sites are likely to have been disturbed.

Given that only isolated finds in a secondary context were recorded, and that a high degree of land-use disturbance was noted, there is a low likelihood of intact sub-surface archaeological deposits being present within the study area.

6.4 ASSESSMENT OF SIGNIFICANCE

6.4.1 Introduction

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Social or Cultural Value

This area of assessment concerns the importance of a site or features to the relevant cultural group: in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

Archaeological/Scientific Value

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of value relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

Aesthetic Value

This refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (Australia ICOMOS 2013).

Historic Value

Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have 'shared' historic values with other (non-Aboriginal) communities.

Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage. Consequently the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives. This means it is often necessary to collect oral histories along with archival or documentary research to gain a sufficient understanding of historic values.

6.4.2 Assessed significance of the recorded sites

Social or Cultural Value

Aboriginal heritage is of great value to many people and the site therefore has social value. Any assessment of social or cultural value is typically determined through consultation with the Aboriginal community. As community consultation has not been completed as part of the current assessment, all newly recorded sites have been provisionally assigned high social/cultural value.

Archaeological/Scientific Value

The scientific significance of Swamp Creek IF-1 to Swamp Creek IF-4 is assessed as extremely low as all sites represent artefacts in secondary contexts. These sites are described as having low scientific / archaeological significance based on the following factors:

- Few formal tool types
- Located in areas where there has been a complete or near complete loss of A-Horizon soils by erosion
- Widespread past and current erosion creating high landform modification
- Not possible to determine the original or primary context of the recorded artefacts.

Aesthetic Value

None of the newly recorded sites does contain any features that are likely to be appreciated on aesthetic grounds, either as individual objects or in terms of setting as it is within a heavily disturbed landscape which has been impacted by mining and agricultural activities. Therefore, the sites are considered to have low aesthetic value.

Historic Value

None of the Aboriginal sites recorded have an apparent direct relationship to known historical Aboriginal sites (such as missions or massacre sites). It is possible that the area saw some of the earliest contact between Aboriginals and non-Aboriginal settlers, however, none of the recorded Aboriginal sites display evidence that they constitute 'contact' or 'post-contact' Aboriginal sites. To that end, all recorded sites are assessed as having no historic value.

Table 6-6 tabulates the assessment of significance for the recorded sites.

Table 6-6: Significance assessment of recorded sites.

Site Name	Social or Cultural Value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
Swamp Creek IF-1 (37-3-1491)	High	Low	Low	None
Swamp Creek IF-2 (37-3-1492)	High	Low	Low	None
Swamp Creek IF-3 (37-3-1493)	High	Low	Low	None
Swamp Creek IF-4 (37-3-1490)	High	Low	Low	None

6.5 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE PROPOSED MODIFICATION

The assumption in this report is that all landforms within the study area are liable to be impacted should the Proposed Modification be approved. While all sites recorded as part of the visual inspection of the study area in August 2017 are outside of the study area, three sites recorded subsequent to the August 2017 inspection are either wholly within the study area or partially within the study area (Swamp Creek OS1: 37-3-1499; Glendell North OS28: 37-3-1508; Glendell North OS31: AHIMS pending).

Regarding the two sites that are partially within the study area it will be a recommendation here that the entirety of the sites be salvaged should the Proposed Modification be approved. The reason for this is that both sites are highly disturbed with all artefacts in a secondary context along a drainage bund. It therefore serves no purpose to leave a portion of the site intact. Indeed, there are benefits to the full salvage of these sites as it will allow the artefacts to be moved to a safe location and prevent inadvertent impacts to the remainder of these sites as they would be in close proximity to impacts arising from the Proposed Modification. As three of the isolated finds recorded during the August 2017 inspection (Swamp Creek IF-2: 37-3-1492; Swamp Creek IF-3: 37-3-1493; Swamp Creek IF-4: 37-3-1490) are now part of a larger artefact scatter (Swamp Creek OS1: 37-3-1499) that will be recommended for salvage, the three isolated finds will also be

recommended for salvage. **Table 6-7** sets out the impact assessment arising from the Proposed Modification.

Table 6-7: Impact assessment.

Site Name	AHIMS Id	Degree of disturbance	Scientific significance	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)
Swamp Creek IF-1 (37-3-1491)	37-3-1491	High	Low	None	None	No loss of value
Swamp Creek IF-2 (37-3-1492)	37-3-1492	High	Low	Direct	Total	Total loss of value
Swamp Creek IF-3 (37-3-1493)	37-3-1493	High	Low	Direct	Total	Total loss of value
Swamp Creek IF-4 (37-3-1490)	37-3-1494	High	Low	Direct	Total	Total loss of value
Swamp Creek OS1 (37-3-1499)	37-3-1499	High	Low	Direct	Total	Total loss of value
Glendell North OS28 (37-3-1508)	pending	High	Low	Direct	Total	Total loss of value
Glendell North OS31 (AHIMS pending)	pending	High	Low	Direct	Total	Total loss of value

7 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

7.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. **Section 6.4.2** and **Section 6.5** describe, respectively, the significance / potential of the recorded sites and the likely impacts of the Proposed Modification. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- Avoid impact by altering the development proposal or in this case by avoiding impact to a recorded Aboriginal site. If this can be done, then a suitable curtilage around the site must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.
- If impact is unavoidable then approval to salvage the sites under the authority of an approved ACHMP should be undertaken.

7.2 MANAGEMENT AND MITIGATION OF RECORDED ABORIGINAL SITES

As all sites liable to be harmed by the Proposed Modification are in highly disturbed contexts and have a low scientific value, an appropriate mitigation would be to undertake a recording and collection of all low density surface artefacts.

It has been argued here (**Section 6.5**) that the entirety of the two sites partially within the study area should be salvaged, not just those portions physically within the study area, as all sites are in highly disturbed contexts. As such, six sites will be impacted by the Proposed Modification: three isolated finds; and three low density artefact scatters (Swamp Creek OS1: 37-3-1499; Glendell North OS28: 37-3-1508; Glendell North OS31: AHIMS pending; and the three isolated finds contained within Swamp Creek OS1: Swamp Creek IF-2: 37-3-1492; Swamp Creek IF-3: 37-3-1493; Swamp Creek IF-4: 37-3-1490).

The protocol for the collection of surface artefacts at these sites should follow the Mount Owen Complex ACHMP Section 6.2.1.1.

8 RECOMMENDATIONS

Under Section 89A of the NPW Act it is mandatory that all newly-recorded Aboriginal sites be registered with OEH AHIMS. As a professional in the field of cultural heritage management it is the responsibility of OzArk to ensure this process is undertaken.

To this end it is noted that four Aboriginal sites were recorded during the assessment.

The following recommendations are made on the basis of these impacts and with regard to:

- Legal requirements under the terms of the NPW Act whereby it is illegal to damage, deface or destroy an Aboriginal place or object without the prior written consent of OEH;
- The findings of the current investigations undertaken within the study area; and
- The interests of the Aboriginal community.

To ensure that Aboriginal cultural heritage values are protected in the study area, the following recommendations are made:

- 1) Should the Proposed Modification be approved, the Mount Owen Complex ACHMP should be updated to include the management recommendations contained in this report. In order to update the ACHMP, consultation with the Aboriginal community is required as set out in Section 8.1 of the Mount Owen Complex ACHMP.
- 2) The updated ACHMP should stipulate that the recording and collection of surface artefacts occur at six sites: Swamp Creek IF-2 (37-3-1492); Swamp Creek IF-3 (37-3-1493); Swamp Creek IF-4 (37-3-1490); Swamp Creek OS1 (37-3-1499); Glendell North OS28 (37-3-1508); and Glendell North OS31 (AHIMS pending). The collection of surface artefacts should follow the procedure set out in the Mount Owen Complex ACHMP Section 6.2.1.1.
- 3) Should Aboriginal artefacts or human skeletal material be uncovered during works within the study area, all work should cease and the Mount Owen Complex ACHMP Sections 6.1 or 6.2 should be followed.
- 4) Work crews should undergo cultural heritage induction to ensure they recognise Aboriginal artefacts and are aware of the legislative protection of Aboriginal objects under the NPW Act and the contents of the Mount Owen Complex ACHMP.

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