Centennial Coal Company Ltd
Newstan Colliery Development Consent Modification
Environmental Assessment
September 2018

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Executive summary

Background and location

Newstan Colliery is an existing underground coal mine owned and operated by Centennial Newstan Pty Limited (Centennial Newstan). It is regionally located within the Lake Macquarie Local Government Area (LGA), approximately 25 kilometres south west of Newcastle and 140 kilometres north of Sydney, in New South Wales (NSW).

Newstan Colliery began mining operations in 1887, prior to the implementation of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and operated under existing use rights. On 14 May 1999 the (then) Minister for Urban Affairs and Planning granted development consent DA 73-11-98 under Part 4 of the EP&A Act for the Newstan Colliery Life Extension Project. DA 73-11-98 has since been modified 7 times.

In August 2014, Newstan Colliery underground operations were put on Care and Maintenance. Prior to being placed on Care and Maintenance, mining was undertaken in the West Borehole seam under the provisions of development consent DA 73-11-98.

Coal handling and distribution activities at the Newstan Colliery Surface Site continue to be undertaken as part of the Northern Coal Logistics Project in accordance with SSD -5145.

Proposed modification

On 26 February 2018, Centennial Newstan lodged an application to modify DA 73-11-98 pursuant to Section 75W of the EP&A Act under the savings provisions for former Part 3A projects and eligible Part 4 mining projects. The application was accepted by the NSW Department of Planning and Environment (DP&E), noting that formal Environmental Assessment Requirements would not be issued for the proposed modification. Notwithstanding this, the key matters to be addressed within the Environmental Assessment as part of the application were confirmed in written correspondence between Centennial Coal and DP&E in April 2018 (refer to Appendix A).

The proposed modification seeks approval to undertake investigations for the recommencement of mining in the southern portion of the Newstan Colliery Holding Boundary. As part of these investigations, Centennial Newstan propose to undertake first workings to determine the presence, throw and strike of the major fault projected from the historic Newstan workings (the proposed modification). Key elements of the proposed modification include:

- **Project life:** Extending the approval life of DA 73-11-98 for a further 12 months to 6 July 2021.
- **Mining method:** Undertaking first workings within the West Borehole seam utilising continuous miner development. The proposed first workings would not have any measurable surface-related subsidence and have been designed to be stable in the long-term.
- **Mining area:** The proposed first workings would be undertaken within the West Borehole seam throughout an area of approximately 229 hectares (ha), which is within the current Newstan Colliery Holding Boundary.
- **Coal production:** The proposed modification is seeking to extract up to 2 million tonnes (Mt) from the proposed first workings area. There would be no change to the approved annual extraction limit of 4 million tonnes per annum (Mtpa) for the Newstan Colliery as per DA 73-11-98.

The proposed modification would not result in any substantial change to the approved operations at Newstan Colliery. There would be no change to the approved maximum coal production, coal handling, coal transportation or water management.

Modification need

Centennial Coal has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery (Newstan Extension Project). The proposed modification would allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed consent life extension sought as part of the proposed modification would also enable operations at Newstan Colliery to continue until the determination of the Newstan Extension Project is made.

Furthermore, the proposed modification ensures optimised resource recovery while providing ongoing direct and indirect employment opportunities. It would also provide a number of positive flow-on effects to the local, regional and state economies through additional wages and royalties.

Key impact assessment findings

Subsidence predictions

Natural and built features are predicted to experience vertical subsidence of less than 20 millimetres (mm) due to the development of the first workings in the West Borehole seam associated with the proposed modification. As such, no adverse impacts to natural and built features are anticipated due to the development of the first workings in the West Borehole seam.

Further, the development of first workings in the West Borehole Seam is not expected to change the potential for ground movements and impacts due to existing subsidence associated with the old Awaba workings including pillar instability, pillar run and potential environmental impacts.

Due to the very low levels of predicted subsidence associated with the proposed modification, no additional mitigation or management measures are proposed. Existing subsidence monitoring and management measures at Newstan Colliery, including monitoring associated with the old Awaba workings, will continue to occur throughout the proposed modification.

Biodiversity

The proposed modification would not involve the clearing of native vegetation or the alteration of the land surface such that native vegetation cover and habitat would be directly or indirectly impacted. On this basis, it is considered that no habitat for threatened species or ecological communities would be impacted by the proposed modification.

The proposed modification is considered unlikely to result in a significant impact on Groundwater Dependent Ecosystems (GDEs), threatened species, ecological communities or their habitats. Further assessment or offsetting under the *Biodiversity Conservation Act 2016* (BC Act) is therefore not required. Referral of the proposed modification under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is also not required.

Due to the negligible impacts to diversity expected from the proposed modification, no additional mitigation or management measures are proposed. Implementation of the existing suite of environmental management plans approved under DA 73-11-98 is considered adequate for managing biodiversity impacts associated with the proposed modification.

Aboriginal cultural heritage

Due to the very low levels of vertical subsidence predicted, no impacts to Aboriginal objects and places or cultural heritage values are expected as a result of the proposed modification.

The Registered Aboriginal Parties raised no issues regarding the proposed modification as part of the consultation process.

No additional Aboriginal heritage mitigation or management measures are proposed. Implementation of the existing approved Centennial Northern Region Aboriginal Cultural Heritage Management Plan will be adequate for managing Aboriginal heritage impacts associated with the proposed modification.

Water resources

The proposed modification is not predicted to have a significant impact on the water and salt balance of Newstan Colliery or on licenced surface water discharges. It is also not expected to impact on flows, water quality, stream health, or watercourse stability. Furthermore, there are no downstream water users that would be impacted by the proposed modification.

The proposed first workings are not predicted to reactivate the existing overlying Awaba workings, nor are they expected to change the potential for longer-term subsidence above the Awaba workings. The risk of caving or fracturing creating a pathway for water from the Awaba workings into the proposed first workings is considered negligible.

The proposed first workings in the West Borehole seam are not predicted to result in any drawdown of alluvial groundwater. The predicted groundwater impacts from the proposed modification are expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable. No impacts on Groundwater dependent ecosystems are predicted.

The proposed modification is not expected to have a significant impact on a water resource, therefore referral of the proposed modification under the EPBC Act is not required.

With the implementation of appropriate mitigation and management measures, impacts on surface water and groundwater from the proposed modification are considered acceptable.

Air quality

The proposed modification would result in emissions of particulate matter and odour from the operation of existing ventilation fans at the Newstan Colliery Surface Site (NCSS). A review of air quality impacts associated with the proposed modification concluded that the additional emissions associated with the operation of the ventilation fans during first workings in the West Borehole seam would have a negligible impact on ambient air quality at the neighbouring sensitive receivers.

Existing air quality mitigation and management measures implemented at Newstan Colliery are adequate for the proposed modification given the negligible impact on ambient air quality.

Greenhouse gas

The predicted greenhouse gas emissions resulting from the proposed modification (Scope 1 and Scope 2 emissions) would represent a very small proportion of both the Australian and NSW total emissions, accounting for approximately 0.06 per cent of total Australian greenhouse gas production in 2016 and 0.26 per cent of total NSW production.

As such, the relatively small amount of greenhouse gas emissions generated by proposed modification would have an undetectable effect on global climate change.

Existing greenhouse gas mitigation and management measures implemented at Newstan Colliery such as the sealing up of old mine workings will continue to be applied for the proposed modification.

Conclusion

Impacts resulting from the proposed modification are not considered to be significant and would only result in a negligible change to impacts associated with the current operations at Newstan Colliery. There would be no change to the approved maximum coal production, coal handling, coal transportation, or water management managed by the Northern Coal Logistics Projects under SSD-5145. The life of Newstan Colliery would be extended by 12 months to ensure operations at Newstan Colliery until a determination on the Newstan Extension Project is made.

The adoption of appropriate management measures, generally in accordance with Newstan Colliery's current approved management plans, would minimise the potential for any residual impacts associated with the proposed modification.

It is therefore recommended that pursuant to Section 75W of the EP&A Act, the Minister approves the proposed modification.

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1. Introduction

1.1 Background

Newstan Colliery is an existing underground coal mine owned and operated by Centennial Newstan Pty Limited (Centennial Newstan). It is regionally located within the Lake Macquarie Local Government Area (LGA) approximately 25 kilometres south west of Newcastle and 140 kilometres north of Sydney in New South Wales (NSW) (Figure 1-1).

Newstan Colliery began mining operations in 1887, prior to the implementation of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and operated under existing use rights. On 14 May 1999 the (then) Minister for Urban Affairs and Planning granted development consent DA 73-11-98 under Part 4 of the EP&A Act for the Newstan Colliery Life Extension Project. Development consent DA 73-11-98 has since been modified 7 times.

Underground mining at Newstan Colliery has been undertaken in the Young Wallsend, Great Northern, Fassifern, Borehole and West Borehole coal seams and has extracted both a semi-soft coking coal and thermal coal product for domestic and export markets.

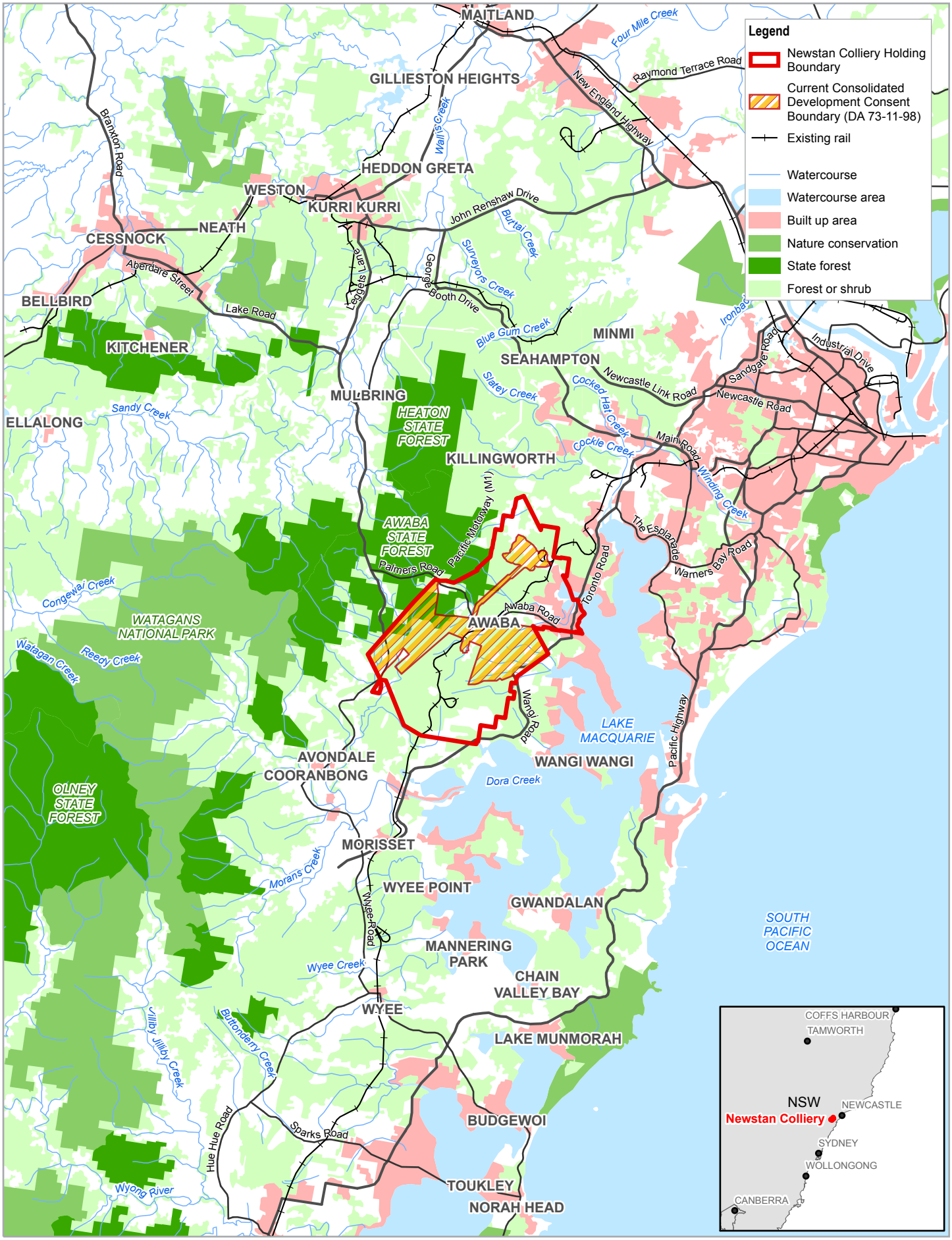
Centennial Newstan has approval to extract up to 4 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. In August 2014, Newstan Colliery underground operations were put on Care and Maintenance. Prior to being placed on Care and Maintenance, mining was undertaken in the West Borehole seam under the provisions of development consent DA 73-11-98.

Centennial Coal has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery (Newstan Extension Project). Centennial Newstan seek to modify DA 73-11-98 pursuant to Section 75W of the EP&A Act to undertake investigations for the Newstan Extension Project. As part of these investigations, Centennial Newstan propose to undertake first workings to determine the presence, throw and strike of the major fault projected from the historic Newstan workings (the proposed modification). The proposed modification would allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed mine life extension sought as part of the proposed modification would also enable operations at Newstan Colliery to continue until the determination for the Newstan Extension Project is made.

This Environmental Assessment (EA) has been prepared to support an application by Centennial Newstan to modify its existing development consent under Section 75W of Part 3A of the EP&A Act under the savings provisions for former Part 3A projects and eligible Part 4 mining projects. The proposed modification would constitute the eighth modification to DA 73-11-98. The primary components of the modification are summarised below in Section 1.4 and described in detail in Section 4.

In addition to describing the proposed modification, this EA contains a comprehensive and focused assessment of the matters pertinent to the modification to a level of detail commensurate with the scale of the proposed modification, industry standards and the legislative framework under which it is permissible.



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Newstan Colliery Mod 8
Environmental Assessment

Project No. **22-19526**
Revision No. **0**
Date **20/09/2018**

Site location

Figure 1-1

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1.2 The proponent

The proponent for the proposed modification is Centennial Newstan, a wholly owned subsidiary of Centennial Coal Company Limited (Centennial Coal). Centennial Coal is a wholly owned subsidiary of Banpu Public Company Limited (Banpu).

The proponent's address is:

Centennial Newstan Pty Limited
PO Box 1000
Toronto NSW 2283

1.3 Document purpose and structure

The (then) Minister for Urban Affairs and Planning granted development consent DA 73-11-98 to Newstan Colliery under Part 4 of the EP&A Act following the submission of the *Newstan Colliery Life Extension Project Environmental Impact Statement* (Umwelt, 1998). DA 73-11-98 has since been modified on seven occasions.

This EA has been prepared to support an application to modify development consent DA 73-11-98 pursuant to Section 75W of the EP&A Act. It has further been prepared in accordance with the relevant provisions of the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

In addition to describing the proposed modification, this EA contains an assessment of the key environmental, social and economic issues.

In summary, this EA is structured as follows:

Section 1: outlines the project background, the proponent, modification and approval pathway and the modification need.

Section 2: provides an overview of the proposed first workings area, including land ownership and existing land uses.

Section 3: describes the existing approved Newstan Colliery operations.

Section 4: describes the proposed modification being sought for approval.

Section 5: describes the approval pathway and legislative framework for the modification.

Section 6: presents an analysis of socio-economic factors relevant to the proposed modification.

Section 7: outlines the stakeholder consultation activities undertaken to identify and prioritise the issues to be addressed within the EA.

Section 8: outlines the key issues identified for assessment within the EA.

Section 9: contains an assessment of the potential environmental and socio-economic implications of the modification, including cumulative impacts.

Section 10: provides a justification for the proposed modification and outlines ecologically sustainable development considerations.

Section 11: lists the reference documents referred to within the EA.

Section 12: lists the abbreviations used within the EA.

1.4 Overview of the modification

Centennial Newstan seek to modify DA 73-11-98 pursuant to Section 75W of the EP&A Act to undertake first workings to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. This will further enable the first workings required to support the Newstan Extension Project to commence on schedule. Key elements of the proposed modification include:

- **Project life:** Extending the approval life of DA 73-11-98 for a further 12 months to 6 July 2021.
- **Mining method:** Undertaking first workings within the West Borehole seam utilising continuous miner development. The proposed first workings would not have any measurable surface-related subsidence and have been designed to be stable in the long-term.
- **Mining area:** The proposed first workings would be undertaken within the West Borehole seam throughout an area of approximately 229 hectares (ha), which is within the current Newstan Colliery Holding Boundary.
- **Coal production:** The proposed modification is seeking to extract up to 2 million tonnes (Mt) from the proposed first workings area. There would be no change to the approved annual extraction limit of 4 million tonnes per annum (Mtpa) for the Newstan Colliery as per DA 73-11-98.

1.5 Modification need

Centennial Coal has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery (Newstan Extension Project). Centennial Newstan propose to undertake first workings to determine the presence, throw and strike of the major faults projected from the historic Newstan workings.

The risk of unsafe operational conditions due to poorly understood structural features such as faulting has been assessed as a serious risk to the Newstan Extension Project in relation to both worker safety and financial viability. As such the presence of faulting must be characterised before mine design options, methods of extraction and infrastructure requirements are determined.

A total of eight north-west to south-east trending fault lines have been predicted to occur within the proposed first workings area (refer to Figure 2-4). Several of these lines are extrapolations of major fault zones which have been intersected in the adjacent workings. The proposed modification will assist in confirming whether these faults actually exist, in addition to determining their throw (i.e. extent of vertical movement) and strike (orientation relative to a horizontal plane).

Areas that traverse fault zones with large displacements often suffer from a physical weakening of the strata caused by fracturing, changes to the stress direction and an increased stress magnitude. In either longwall or full pillar extraction methods, this may require dramatically increased strata support requirements for both development and extraction, along with radical changes to the panel layout to keep the mine operational. These variables play an important role in determining mining areas and methods of extraction during the mine planning process.

In order to minimise the risk of strata failure, a reliable geological structural model for the area is required which incorporates a detailed understanding of the types of faults, their most likely orientation, continuity, frequency and associated mining impact. Additionally, a reliable geotechnical understanding of typical mining conditions and variable fault affected conditions is critical, which will depend on an understanding of the fault zone locations. Understanding the location and extent of these fault zones will allow Centennial Newstan to develop a safe and efficient mine layout that avoids unsafe areas where possible and maximises operational efficiency. The proposed modification would therefore allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed mine life extension sought as part of the proposed modification would also enable operations at Newstan Colliery to continue until the determination for the Newstan Extension Project is made.

Furthermore, the proposed modification ensures optimised resource recovery while providing ongoing direct and indirect employment opportunities. It would also provide a number of positive flow-on effects to the local, regional and state economies through wages and royalties.

The coal recovered from the proposed first workings would produce both a semi-soft coking coal product for the export market and a thermal coal product for both the domestic and export markets. The proposed modification would contribute to the ongoing supply of export coal products while meeting contractual coal supplies to the domestic markets.

1.5.1 Alternatives considered

The option of not proceeding with the proposed modification was considered by Centennial Coal during project inception. However, not proceeding was deemed infeasible as it would not enable a thorough assessment of the geological conditions associated with the Newstan Extension Project in order to potentially develop a suitable, efficient and safe mine plan. Furthermore, not proceeding with the proposed modification would constrain mine design options for the Newstan Extension Project and would constrain further development and employment opportunities more generally for Newstan Colliery. Centennial Coal has therefore opted to purse the proposed modification, as described in detail in Section 4.

2. Site description

2.1 Site location

Newstan Colliery is an existing underground coal mine located in the Lake Macquarie LGA, approximately 25 kilometres south west of Newcastle and 140 kilometres north of Sydney, NSW. Figure 1-1 shows Newstan Colliery in its regional setting on the western side of Lake Macquarie. The nearest major population settlements to Newstan Colliery are Toronto, Blackalls Park and Fassifern to the east, Wakefield to the north and Dora Creek to the south. Newstan Colliery is also bordered to the east by the Lake Macquarie foreshore, and the expanding urban areas of Rathmines and Buttaba. Newstan Colliery pit top and surface infrastructure (Newstan Colliery Surface Site (NCSS)) is located at Fassifern, approximately four kilometres north of Toronto.

2.2 Proposed first workings area

The current approved mining areas at Newstan Colliery are shown in Figure 2-1. The first workings area for the proposed modification encompasses approximately 229 ha and is illustrated on Figure 2-2. The consolidated development consent boundary for the proposed modification is shown on Figure 2-3. The projected faults from the Historic Newstan workings are shown on Figure 2-4.

2.3 Land use and ownership

The activities subject to the proposed modification are within the current Newstan Colliery Holding Boundary. Land use in the immediate vicinity of the proposed first workings area is generally undeveloped bushland, with some cleared areas accommodating unsealed access tracks and the Newstan-Eraring Private Haul Road. Surrounding land uses include underground mining and surface operations associated with Cooranbong Entry Site, Awaba Colliery (ceased operating as a producing mine in March 2012) and Mandalong Mine, residential and rural-residential, utility easements, power generation and transport corridors.

Infrastructure assets located within the proposed first workings area include:

- A 33 kV powerline owned by Ausgrid.
- A 33 kV substation owned by Ausgrid.
- A 33kV powerline owned by RailCorp.
- A telecommunications tower owned by Telstra.
- An optical fibre cable owned by Telstra.
- A private haul road (Eraring Haul Road), owned by Origin Energy.

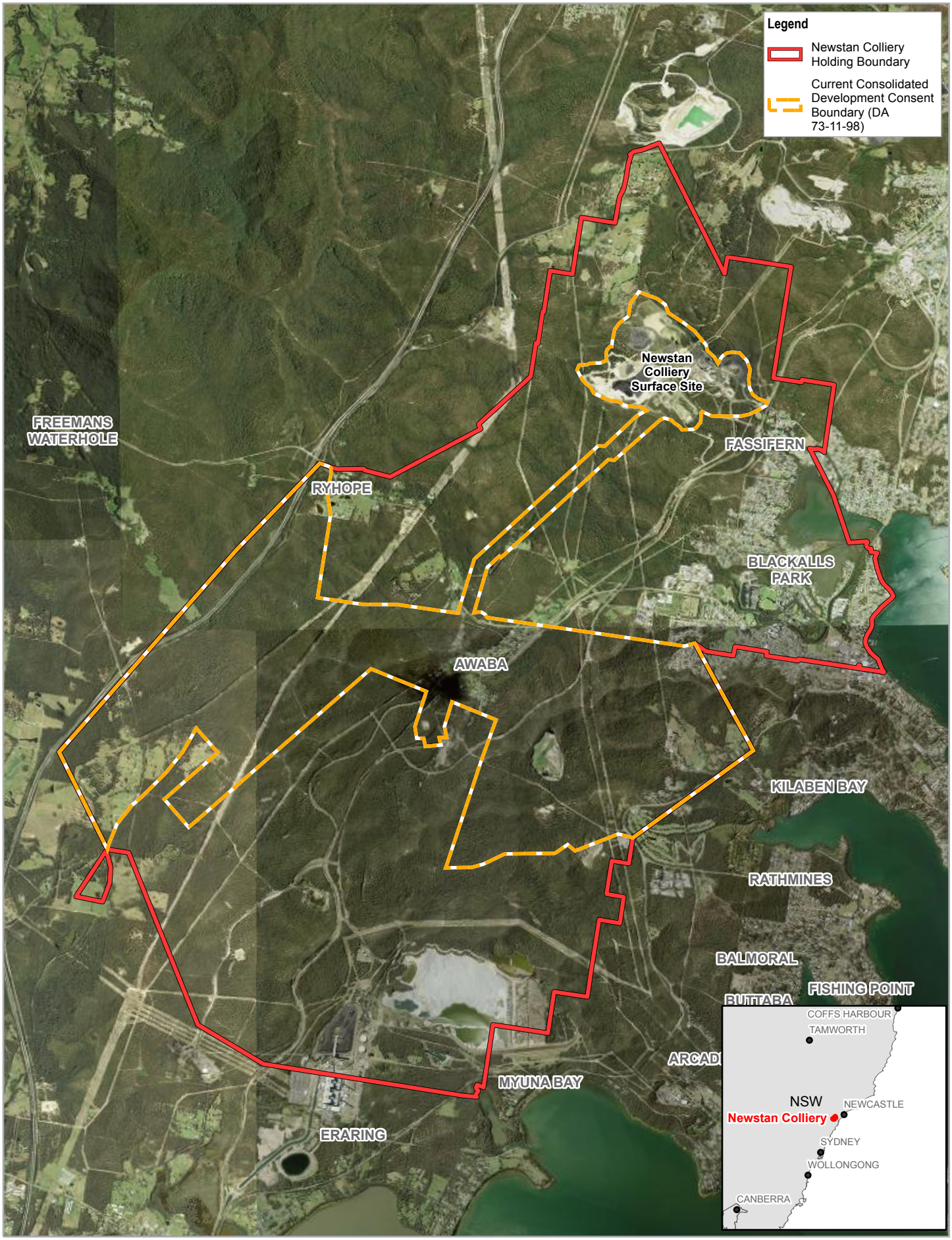
The location of these infrastructure assets relative to the proposed first workings area is shown on Figure 2-5.

Land within the proposed first workings area is owned by the State of NSW (Crown land, Crown roads, Crown waterway), with the exception of one privately owned lot and one lot owned by NSW Aboriginal Land Council, as shown in Table 2-1. Land ownership for the lots intersected by the proposed first workings area is shown on Figure 2-6.

A schedule of land for the proposed consolidated development consent boundary, which includes the proposed first workings area, is provided in Appendix B.

Table 2-1 Land ownership – proposed first workings area

Property description	Ownership
Lot 10 DP239629	Crown land
Lot 6 DP239629	Private land
Lot 9 DP239629	Crown land
Lot 212 DP755207	Crown land
Lot 110 DP755207	Crown land
Lot 213 DP755207	Crown land
Lot 214 DP755207	Crown land
Lot 1 DP585142	Crown land
Lot 102 DP755218	Crown land
Lot 1 DP582126	Crown land
Lot 153 DP755207	Crown land
Lot 215 DP755207	Crown land
Lot 216 DP755207	Crown land
Lot 462 DP1138964	Crown land
Lot 463 DP1138964	NSW Aboriginal Land Council
Lot 7305 DP1149082	Crown land
Lot 7304 DP1149082	Crown land
Lot 7309 DP1164559	Crown land
Lot 7321 DP1166295	Crown land
Lot 7320 DP1166295	Crown land
Lot 7336 DP1170023	Crown land
-	Crown road
-	Crown road
-	Crown road
-	Crown waterway



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Approved Newstan Colliery mining areas

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Figure 2-1

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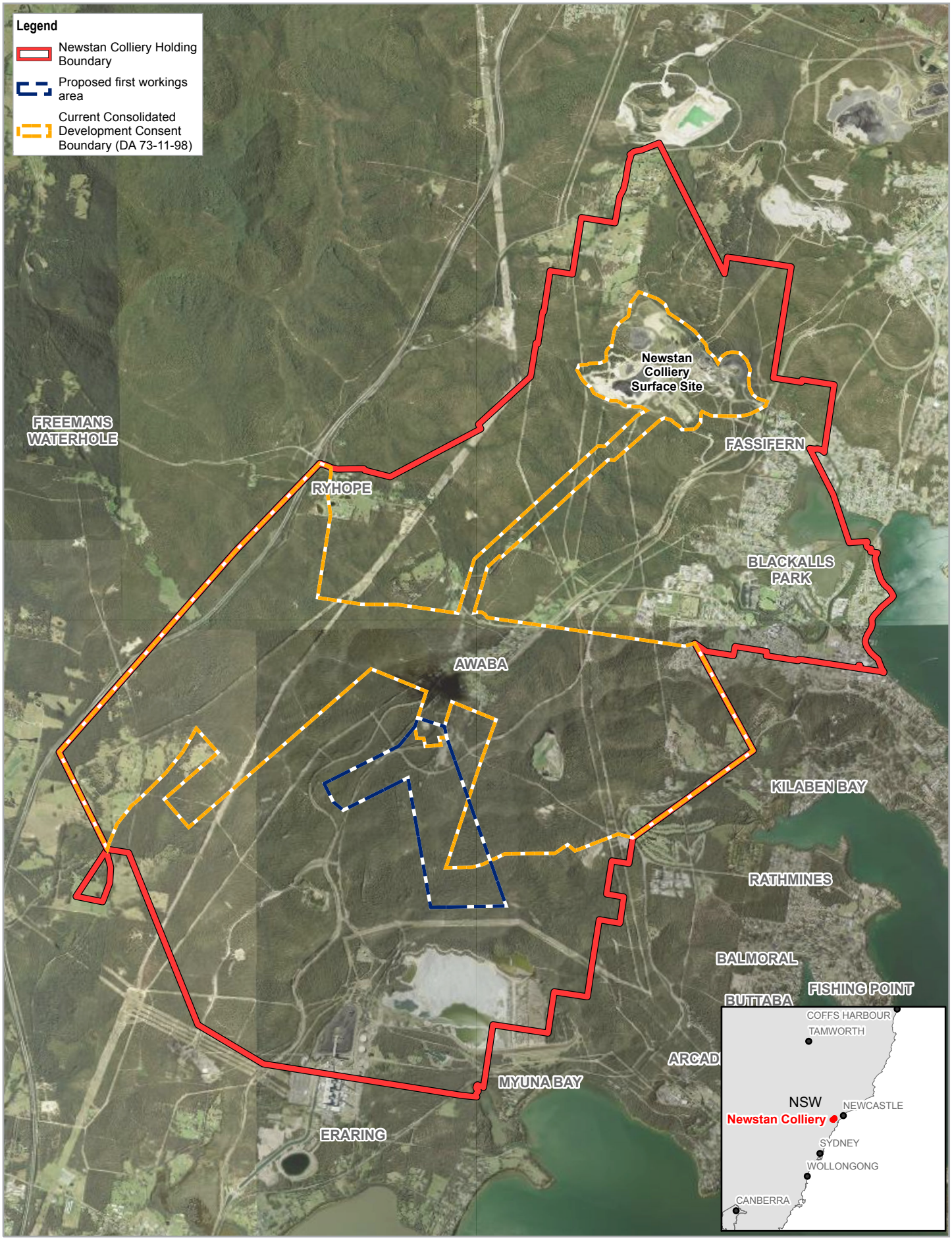

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Proposed first workings area

Figure 2-2

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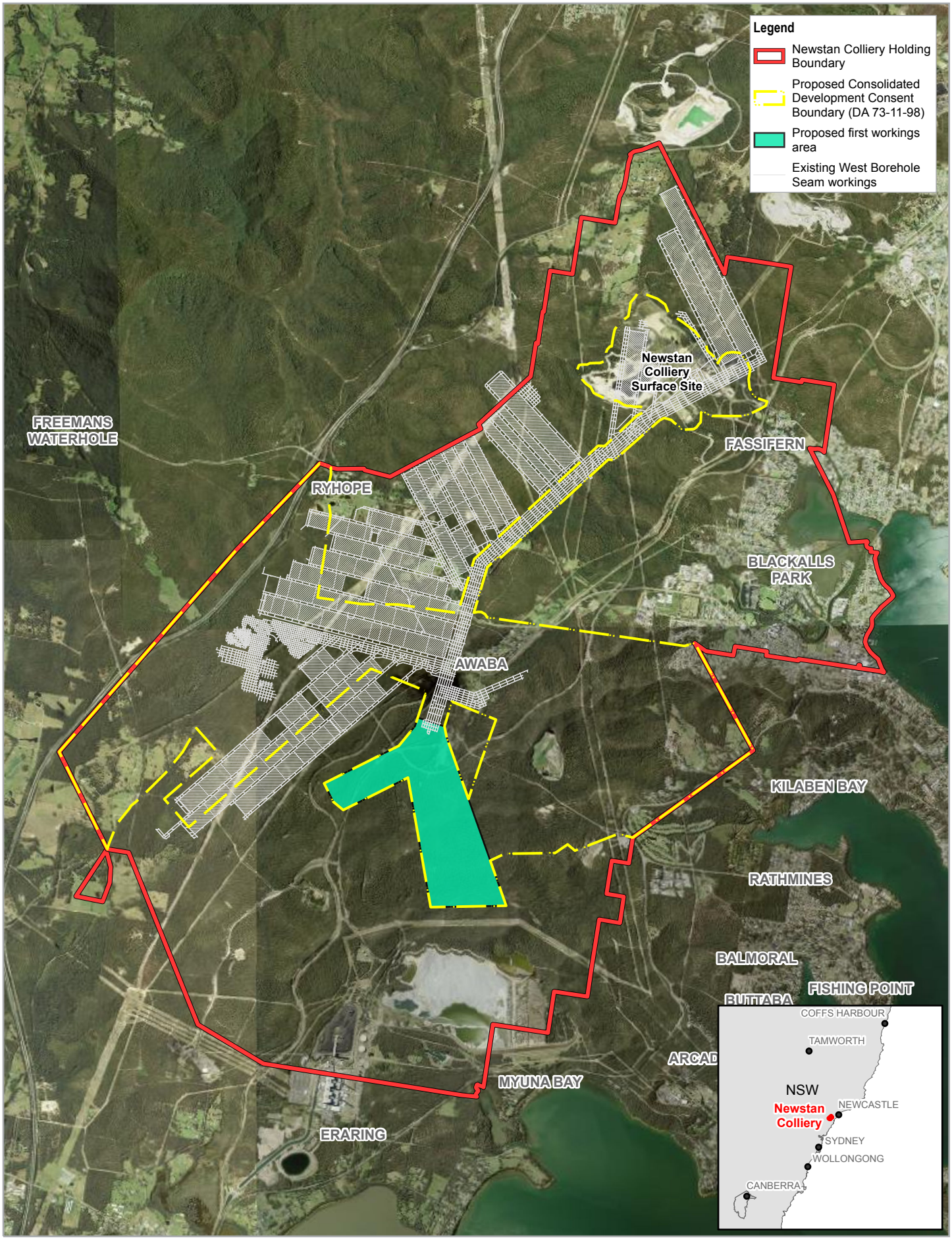

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Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Proposed Consolidated Development Consent Boundary (DA 73-11-98)

Project No. **22-19526**
Revision No. **0**
Date **20/09/2018**

Figure 2-3

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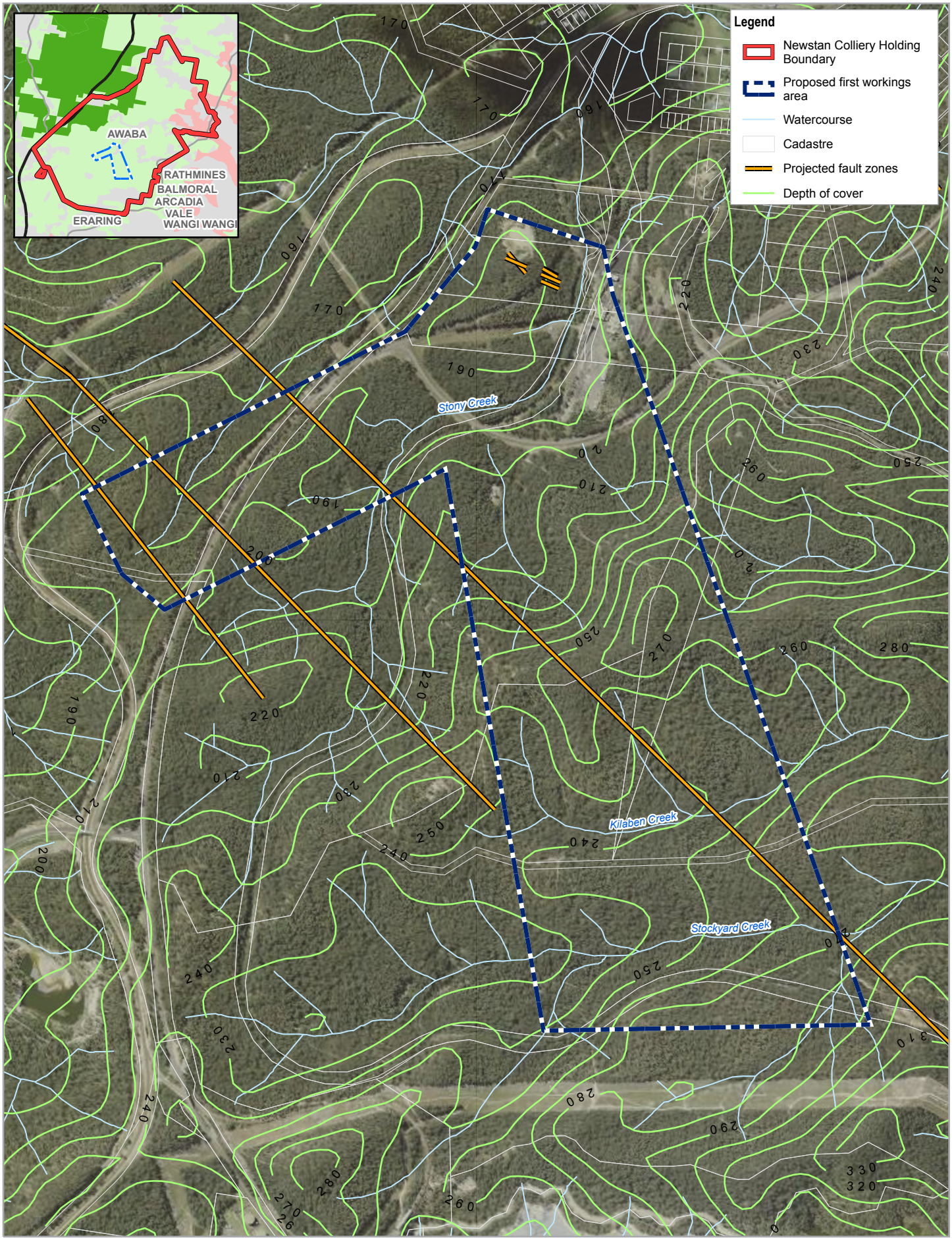

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Kilometers

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Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Projected faults within proposed first workings area

Project No. **22-19526**
Revision No. **0**
Date **20/09/2018**

Figure 2-4

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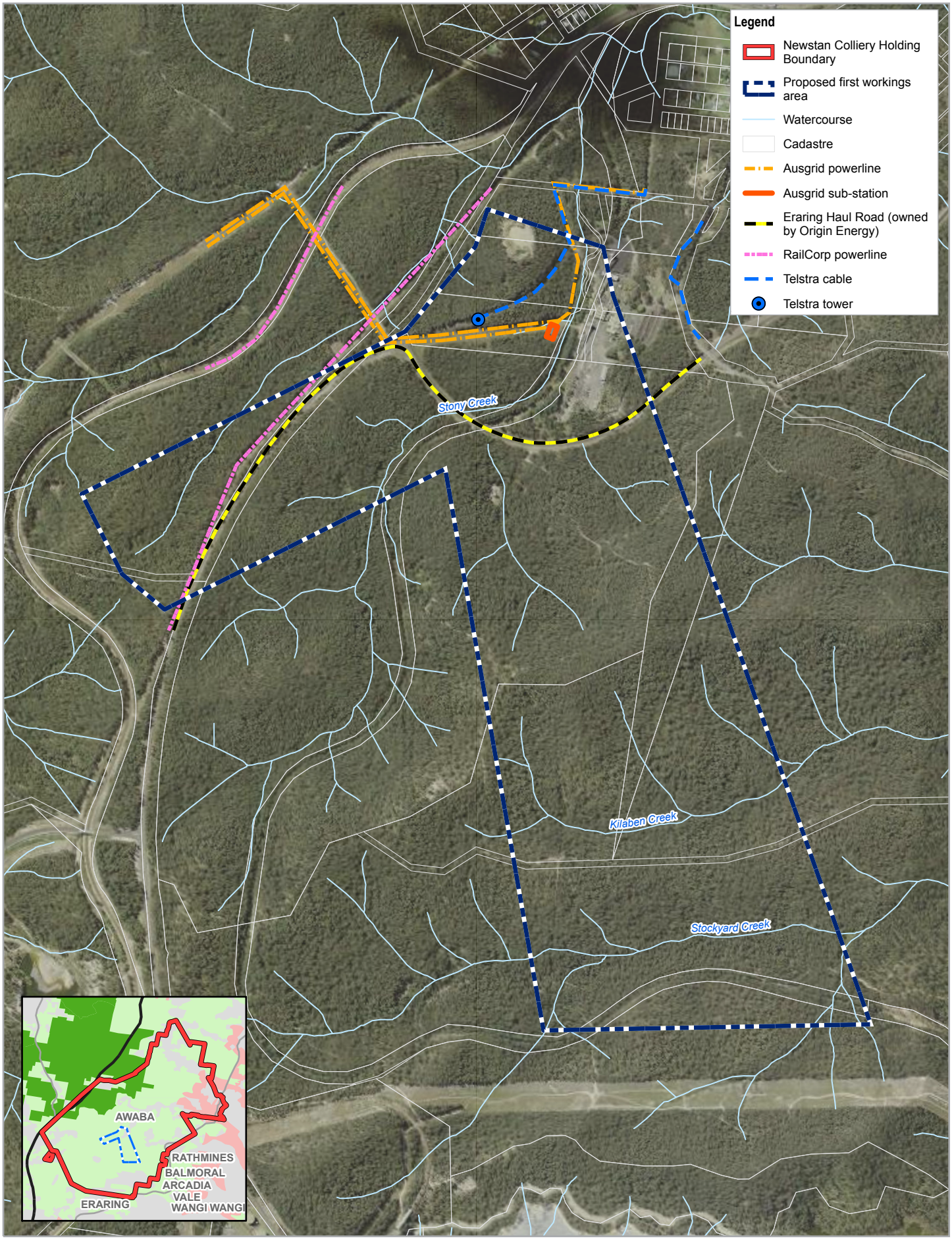
Print date: 20 Sep 2018 - 14:17

Data source: Centennial: Consent boundary, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by:



Paper Size ISO A4

0 0.1 0.2 0.3 0.4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Infrastructure within proposed first workings area

Project No. **22-19526**
Revision No. **0**
Date **24/09/2018**

Figure 2-5

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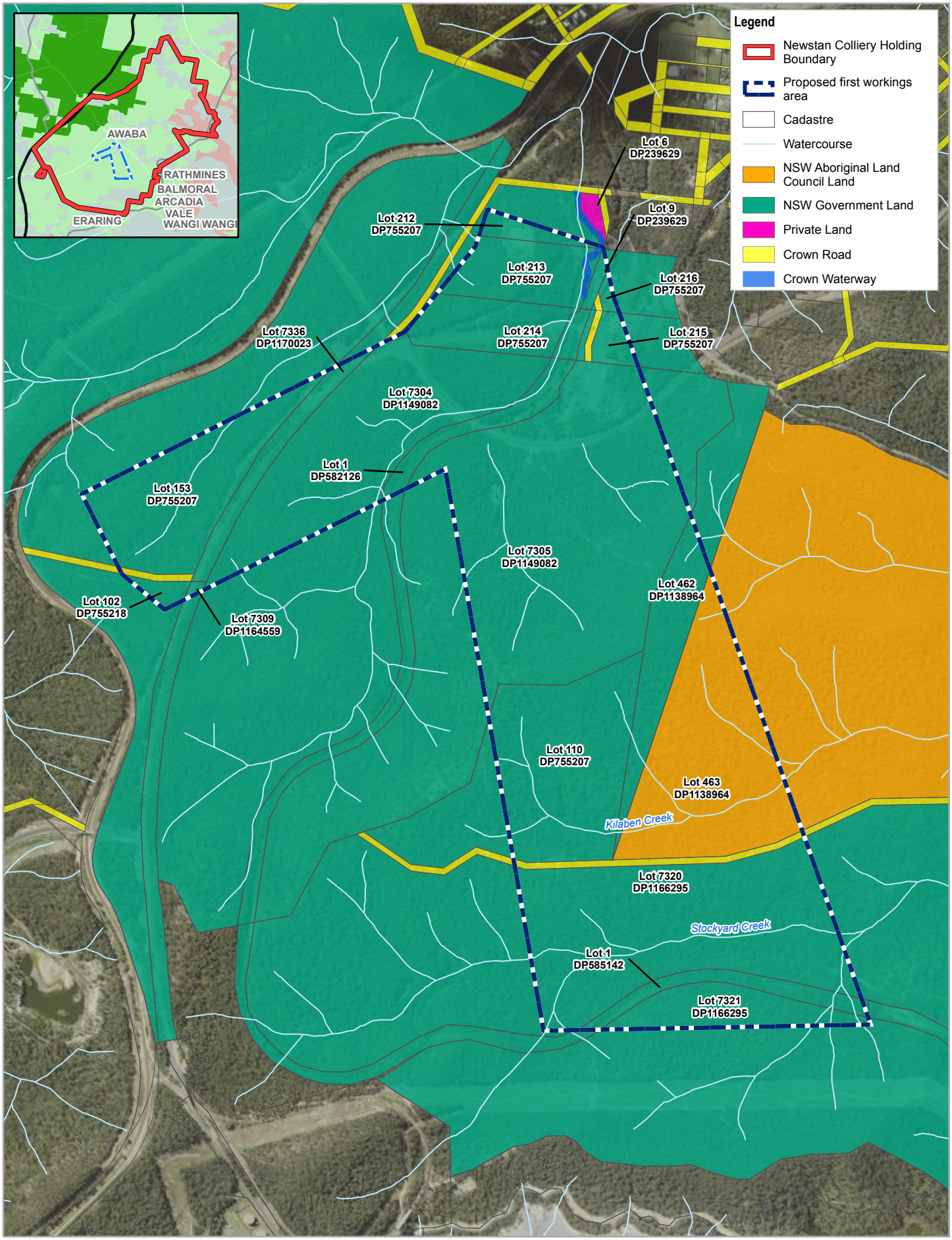
Print date: 24 Sep 2018 - 14:19

Data source: Centennial: Consent boundary, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by:



Paper Size ISO A4

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Land ownership in proposed first workings area

Project No. **22-19526**
Revision No. **0**
Date **24/09/2018**

Figure 2-6

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Print date: 24 Sep 2018 - 14:19

Data source: Centennial: Consent boundary, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by:

2.4 Geology, topography, hydrology and soils

2.4.1 Geology and soils

Newstan Colliery is located in the south-western part of the Newcastle Coalfield, which occupies the north-eastern portion of the Sydney Basin. The stratigraphy of the region consists of material from the Triassic and Permian periods.

The Young Wallsend, Great Northern, Fassifern, Borehole and West Borehole seams have been previously mined at Newstan Colliery. Most recently, mining was undertaken in the West Borehole seam within the Main West Mining Area.

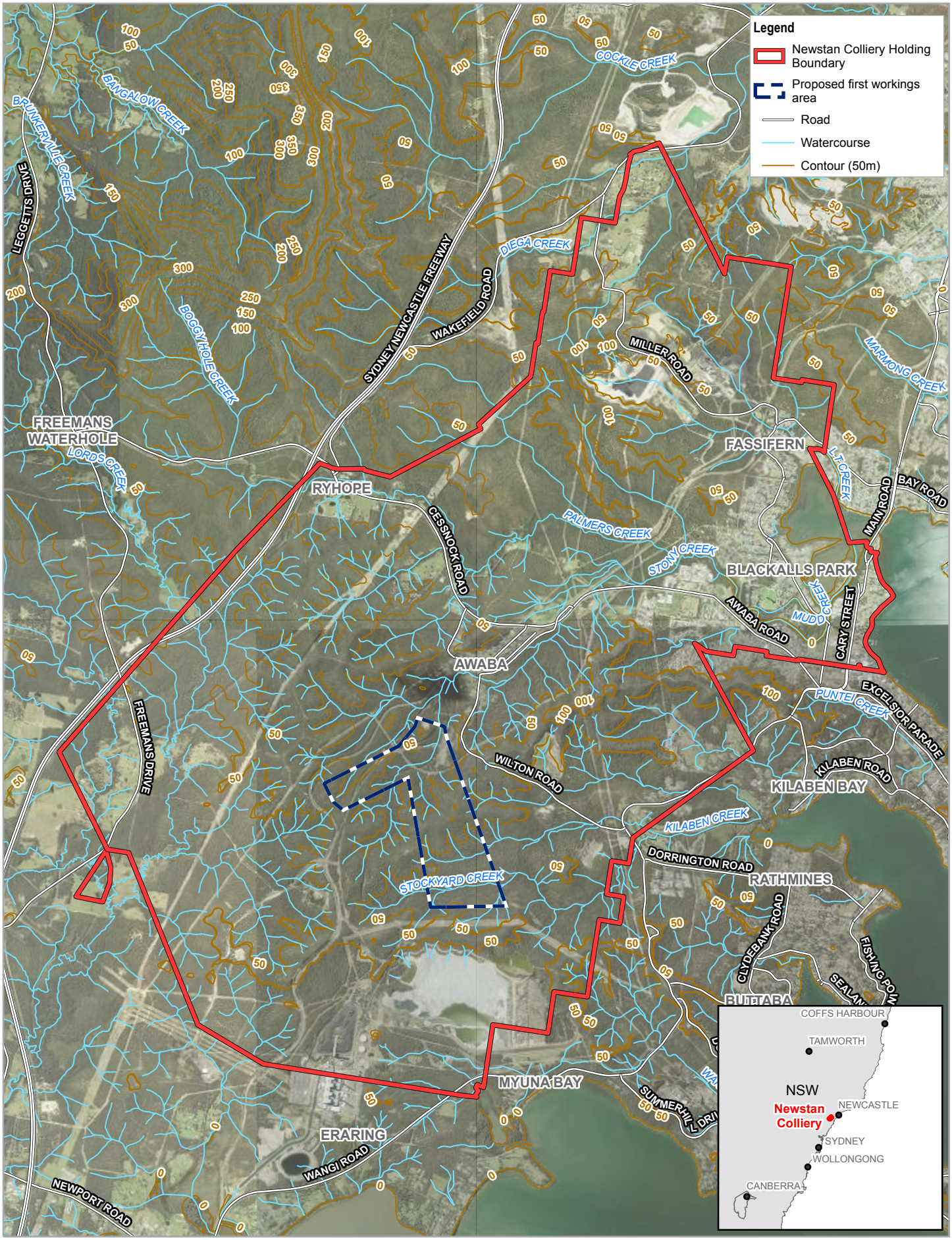
The soil landscapes within the proposed first workings area have been previously mapped by the former Department of Land and Water Conservation (DLWC) at a scale of 1:100,000 as Doyalson, Awaba and Awaba variant a soil landscapes.

2.4.2 Topography and hydrology

Figure 2-7 illustrates the topography and hydrology of the proposed first workings area. The area is characterised by several ridgelines and creek valleys. Site elevation ranges from approximately 20 metres Australian Height Datum (AHD) to 90 metres AHD.

The proposed first workings area is forested Crown land on a landform that is undulating with ridge tops at around 90 metres AHD elevation and valleys at around 10-20 metres AHD. Slope gradients are generally between 10-25 per cent.

As shown on Figure 2-7, ephemeral creeks and drainage lines traverse the proposed first workings area, which lies within the catchments of Stony Creek, Kilaben Creek and Stockyard Creek (a tributary of Kilaben Creek). Stony Creek flows in a generally north-easterly direction, flowing into Lake Macquarie in the vicinity of Blackalls Park and Fennell Bay, approximately 6 kilometres north of the proposed first workings area. Stockyard Creek and Kilaben Creek flow in a generally easterly direction, with Stockyard Creek joining Kilaben Creek, which flows into Lake Macquarie in the vicinity of Kilaben Bay, approximately 3.5 kilometres east of the proposed first workings area.



Paper Size ISO A4

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Topography and hydrology of proposed first workings area

Project No. **22-19526**
Revision No. **0**
Date **20/09/2018**

Figure 2-7

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Data source: Centennial: Consent boundary, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by:

2.5 Climate

The meteorological information presented in this section has been sourced from long-term data collected at the Bureau of Meteorology's (BoM) nearest operational weather stations, along with information provided in recent assessment reports commissioned by Centennial Coal.

2.5.1 Temperature

The proposed first workings area is located in a temperate climate zone with no designated wet season, although the area can be susceptible to occasional heavy showers and thunderstorms due to easterly troughs during warmer months. The local climate is characterised by warm to hot summers and cool to mild winters. Based on the long-term climate statistics sourced from the BoM between 1994 and 2012, mean monthly maximum temperatures in the area range between 15.1 degrees Celsius (°C) in July to 26.9 °C in January. Mean monthly minimum temperatures range between 6 °C in July to 17 °C in February. Autumn and spring are generally mild with sporadic temperature fluctuations.

2.5.2 Rainfall and evaporation

Continuous daily rainfall datasets were obtained from the BoM Cooranbong (Avondale) weather station (station number 061012), with missing data "patched" in from interpolations from nearby stations. The available rainfall data extended from January 1889 through to December 2017, with the representative statistics reported as:

- Minimum annual rainfall – 531 mm (in 1944).
- Average annual rainfall – 1,121 mm.
- Median annual rainfall – 1,076 mm.
- Maximum annual rainfall – 1994 mm (in 1950).

The average annual evaporation total was approximately 1,172 mm, compared to the annual average rainfall of 1,121 mm. This gives an annual deficit (difference between annual rainfall and annual evaporation) of approximately 51 mm.

2.5.3 Wind

The area predominantly experiences light to moderate winds (between 1.5 and 8 metres per second), with occasional high-speed winds (greater than 8 metres per second). Wind direction is seasonally dependent.

While winds occur reasonably evenly from all quadrants, summer winds appear to be generally from the east-northeast and winter winds appear to be predominately from the west-northwest. Calm wind conditions (less than 0.5 metres per second) generally occur just over 1 percent of the time.

3. Existing mine operations

3.1 Overview of operations

Mining operations at Newstan Colliery began on the western side of Lake Macquarie in 1887 and, upon the introduction of the EP&A Act, operated pursuant to continuing use rights in accordance with Part 4, Division 10 of the EP&A Act (continuing use rights).

On 14 May 1999 the (then) Minister for Urban Affairs and Planning granted Development Consent DA 73-11-98 under Part 4 of the EP&A Act for the Newstan Colliery Life Extension Area. This approval enabled mining to continue within the existing mining areas as well as the expansion into areas that had not previously been mined.

Development consent DA 73-11-98 has been modified on seven occasions, with the most recent modification approved on 1 December 2015.

The current Newstan Colliery consolidated development consent boundary is located within the localities of Awaba and Fassifern, as shown on Figure 2-2.

Newstan Colliery has at various times mined the upper coal seams (Great Northern and Fassifern seams) and lower coal seams (West Borehole, Borehole, Young Wallsend and Yard seams) and produced both semi-soft coking coal and thermal coal for the domestic and export markets. In the lower seams, workings to date have been limited to the western and north-eastern portions of the mining leases.

Mining at Newstan Colliery has been undertaken using a combination of first workings, bord and pillar (using continuous miner methods) and longwall mining.

In April 2009 Newstan Colliery was placed on Care and Maintenance. In July 2011, Newstan Colliery recommenced underground mining within the Main West area and the Main East area in response to the then strong export market and to allow Newstan Colliery to generate revenue while ongoing assessments for future mining as part of the Newstan Extension Project were being undertaken. In August 2014, the underground operations at Newstan Colliery were placed back onto Care and Maintenance due to poor market conditions.

Newstan Colliery is also integrated with the Northern Coal Logistics Project, under which Northern Coal Services Pty Ltd (Northern Coal Services) provides the coal handling, processing and transport facilities to deliver coal from Mandalong Mine and Newstan Colliery to domestic and export markets. These activities are approved under State Significant development consent SSD-5145, with facilities comprised of the NCSS, Cooranbong Entry Site, private haul roads and rail loading infrastructure. Whilst mining activities at Newstan Colliery are currently on Care and Maintenance, the coal preparation plant (CPP) and coal rail and loading facilities which now form part of the Northern Coal Logistics Project remain operational in accordance with SSD-5145.

3.2 Existing approvals and licences

3.2.1 Development consents

On 14 May 1999, development consent DA 73-11-98 was approved by the (then) Minister for Urban Affairs and Planning under Part 4 of the EP&A Act for the Newstan Colliery Life Extension Area. This approval enabled mining to continue within the existing mining areas as well as the expansion into areas that had not previously been mined. The approved Newstan Colliery Life Extension Area under development consent DA 73-11-98, filled in the gap between the Newstan Colliery and Awaba Colliery lease areas Figure 2-2).

The approved Newstan Colliery comprises the underground workings and some associated surface facilities, which are currently regulated by the original 1999 development consent (DA 73-11-98) and seven subsequent modifications, as outlined in Table 3-1.

The primary activities currently authorised under DA 73-11-98 are as follows:

- Extraction up to 4 Mtpa of ROM coal from within the consolidated development consent boundary, which includes the Main West mining area.
- Pumping water from underground workings to NCSS for recycling and reuse.
- Construction and operation of ventilation shafts, boreholes and associated overhead powerlines.
- Construction and operation of a men and materials drift to the underground workings from NCSS.
- Manning of up to 320 full time employees.
- Operating 24 hours per day, seven days a week.

Other activities that occur at NCSS, which are now regulated under SSD 5145-for the Northern Coal Logistics Project, include:

- Processing of ROM coal through the Newstan CPP
- Exporting product coal through the Newstan Colliery rail loading facilities by train to the Port of Newcastle
- Haulage of coal to the Vales Point Power Station
- Receiving coal from the Cooranbong Entry Site and Awaba Colliery by truck utilising the Cooranbong and Newstan-Eraring private haul roads
- Transporting reject material from the Newstan Colliery CPP to the Northern and Southern Reject Emplacement Areas and Hawkmount Quarry.

The inconsistencies and duplication of development consent requirements between Newstan Colliery (DA 73-11-98) and Northern Coal Logistics Project (SSD 5145) were rectified in the most recent modification to DA 73-11-98 (MOD 7).

The current approval expires on 6 July 2020.

Table 3-1 Newstan Colliery – DA 73-11-98, including associated modifications

Reference	Description	Issued by
DA 73-11-98	Approves the continuation of the existing mining operations and the extension of mining into the Newstan Colliery Life Extension Area, including the upgrade of associated surface facilities. DA 73-11-98 expires on 6 July 2020.	DUAP (May 1999)
DA 73-11-98 (MOD 1)	Modified DA 73-11-98 to allow: • Mining of one additional panel (longwall 24) located outside the approved mining area to extract a coal reserve of approximately 3 Mt. • Relocation of an approved, but not yet constructed, ventilation shaft, fans and associated service corridors (servicing the West Borehole Seam). This relocation was at the Awaba Colliery Surface Site from adjacent to the heliport to a disused quarry located to the west of the Awaba Colliery Surface Site.	DoP (Sept 2007)

Reference	Description	Issued by
DA 73-11-98 (MOD 2)	Modified DA 73-11-98 to allow: • Temporary increase of up to 400,000 tonnes in volume of coal to be delivered to Eraring Power Station from Cooranbong Entry Site by conveyor until Feb. 2010. • Temporary increase of up to 400,000 tonnes in the approved amount of coal to be handled and stored at the Eraring Power Station until Feb. 2010. • Loading of trucks with coal at the Eraring Power Station until Feb. 2010. • Transportation of coal by truck from the Eraring Power Station northwards to Newstan Colliery Surface Site, using the existing Newstan-Eraring Private Haul Road until Feb. 2010. • Delivery of the Mandalong Mine coal by trucks to the Newstan washery, instead of the Newstan rail loop facility. • Washing coal from Mandalong Mine at the Newstan Colliery washery and storing the washed coal at Newstan Colliery Surface Site. • Placement of the coarse and fine reject material generated from washing the Mandalong Mine coal in the Newstan Colliery reject emplacement. *(Note: Essentially MOD 2 facilitated the road transport of coal from Mandalong Mine to Newstan Colliery Surface Site for washing, with transport from Feb. 2010 involving the use of the Mandalong-Eraring conveyor. MOD 2 included modification of the Mandalong Mine development consent (DA 97/800).)*	DoP (Nov 2009)
DA 73-11-98 (MOD 3)	Modified DA 73-11-98 to allow: • Transport via internal haul roads and washing of 0.88 Mtpa of Awaba Colliery's ROM coal at the Newstan Colliery Surface Site. • Acceptance of Mandalong Mine's stone reject material at the Newstan Colliery Surface Site for capping the Northern Reject Emplacement Area tailings dam. • Establishing a 30,000 tonne emergency coal stockpile at the Newstan Colliery Surface Site.	DoP (Nov 2010)
DA 73-11-98 (MOD 4)	Modified DA 73-11-98 to allow: • The extraction of 3.2 Mt of ROM coal from an area partly outside the existing development consent boundary known as the "Main West" mining area. This involved bord and pillar extraction (i.e. first workings development only). • The restriction of mining operations within 100 metres of points in the coal seam directly below TransGrid Tension Tower #18.	DP&I (Mar 2012)

Reference	Description	Issued by
DA 73-11-98 (MOD 5)	Modified DA 73-11-98 to allow: • Receipt, handling and processing of up to 4 Mtpa of coal from the Cooranbong Entry Site at the Newstan Colliery Surface Site via private haul roads (up from the approved 2 Mtpa). • Transportation of excavated coal and stone material (not exceeding 0.8 Mtpa) produced from the construction of the two approved shafts at the Awaba Colliery to the Newstan REAs or the coal processing plant for processing via the private haul road (previously only the transportation of coal from Awaba Colliery to the Newstan Colliery Surface Site was approved).	DP&I (Nov 2012)
DA 73-11-98 (MOD 6)	The modification comprised a minor adjustment of the Newstan Colliery Consolidated Consent Boundary to include four small separate areas that adjoin the Main West Mining Area. The modification was predominantly an administrative change to the Development Consent DA 73-11-98 and did not require any other changes to the existing mine operation.	DP&E (Jan 2014)
DA 73-11-98 (MOD 7)	Administrative consent modification for Newstan Colliery to avoid inconsistency and duplication associated with SSD-5145 regarding Centennial Northern Coal Services.	DP&E (Dec 2015)

3.2.2 Environment protection licence

Newstan Colliery is a premises-based activity under Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). On this basis, the occupier of the premises must hold an Environment Protection Licence (EPL) administered by the Environment Protection Authority (EPA) under Section 43(b) of the POEO Act. Newstan Colliery operates under EPL 395, which covers coal works between 2 to 5 million tonnes handled per annum and coal mining between 2 to 3.5 million tonnes produced per annum.

3.2.3 Mineral authorities

Exploration, mining and mining-related operations at Newstan Colliery occur under the provisions of various mineral authorities, as detailed in Table 3-2.

Table 3-2 Centennial Newstan Mining Authorities

Lease	Mining area	Surface (ha)	Expiry
CCL 727	2,188.23	580.00	11/08/2027
CCL 746	3,169.00	2,525.00	31/12/2028
CCL 763	190.91	74.57	09/06/2022
CCL 764	108.80	9.33	18/05/2021
ML 1380	78.00	Nil	18/09/2037
ML 1452	1,587.00	Nil	06/07/2020
ML 1480	14.49	14.49	20/07/2023
ML 1586	449.10	Nil	31/10/2022
ML 1587	3.00	3.00	23/10/2027
MPL 304	Nil	0.0699	25/03/2035
MPL 305	Nil	0.4047	25/03/2035
MPL 327	Nil	1.041	05/08/2036
MPL 328	Nil	0.397	05/08/2036
PLL 497	20.23	Nil	24/08/2038

Lease	Mining area	Surface (ha)	Expiry
Lot C DP 381399	Nil	2.959	-
Lot 148 DP 728974	Nil	0.356	-
Portion 36	Nil	20.23	-
Lots 17 and 18 DP 1031778	Nil	0.35	-
Portion 194	Nil	1.73	-
Total	**7,492.00[1]**	**2,604.90**	

Note: [1] Some mining leases overlap.

The proposed first workings area is located within the boundaries of CCL 746 and ML 1452.

3.3 Approved operations

Key components of the approved operations at Newstan Colliery, and the current status of each, are summarised in Table 3-3.

Table 3-3 Approved and existing components of the Newstan Colliery

Aspect Approved	Approved Newstan Colliery	Existing Newstan Colliery
Life of operation	Development Consent expires on 6 July 2020	As approved
Operational hours	24 hours a day, seven days a week	As approved
Operational employment	245 full-time equivalent (FTE) personnel	Newstan underground operations were put on Care and Maintenance in August 2014. Newstan underground currently employs approximately 10 FTE personnel.
Mine access	Men and materials drift and winder for access to the underground workings from the Newstan Colliery Surface Site	As approved
Coal extraction	Up to 4 Mtpa of ROM coal from within the Life Extension Area and the Main West Mining Area using longwall mining and bord and pillar mining methods	No coal extraction is currently being undertaken as the site is on Care and Maintenance.
Mine Ventilation	Two surface ventilation fans at the Newstan Colliery Surface Site. One surface ventilation fan at the surface site for the Awaba Colliery	The two surface ventilation fans at the Newstan Colliery Surface Site are as approved. The Awaba Colliery surface ventilation fan is yet to be constructed.
Boreholes	Services borehole at the Forest Road Site	As approved
Water management	Underground mine water management system	As approved
General waste management	Systems are in place for the various non-production waste streams generated by the mining operation	As approved

Aspect Approved	Approved Newstan Colliery	Existing Newstan Colliery
Post Mining Closure and Rehabilitation	The primary objective for rehabilitation is to return areas to a natural land use that is consistent with the area's pre-mining land use and/or to some form of beneficial land use (for example, industry) that is acceptable to relevant stakeholders.	As approved
Environmental management	An established Environmental Management System (EMS) that has been developed in accordance with the Centennial Coal EMS Framework (2011). The EMS includes a comprehensive set of environmental management plans, which are backed by an environmental monitoring network.	As approved

4. Proposed modification

Centennial Coal has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery (Newstan Extension Project). Centennial Newstan seek to modify DA 73-11-98 pursuant to Section 75W of the EP&A Act to undertake investigations for the Newstan Extension Project. As part of these investigations, Centennial Newstan propose to undertake first workings to determine the presence, throw and strike of the major faults projected from the historic Newstan workings (the proposed modification). The proposed modification would allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed mine life extension sought as part of the proposed modification would also enable operations at Newstan Colliery to continue until the determination for the Newstan Extension Project is made.

Key elements of the proposed modification are listed as follows:

- **Project life:** Extending the approval life of DA 73-11-98 for a further 12 months to 6 July 2021.
- **Mining method:** Undertaking first workings within the West Borehole seam utilising continuous miner development. The proposed first workings would not have any measurable surface-related subsidence and have been designed to be stable in the long-term.
- **Mining area:** The proposed first workings would be undertaken within the West Borehole seam throughout an area of approximately 229 hectares (ha), which is within the current Newstan Colliery Holding Boundary.
- **Coal production:** The proposed modification is seeking to extract up to 2 Mt from the proposed first workings area. There would be no change to the approved extraction limit of 4 Million tonnes per annum (Mtpa) for the Newstan Colliery as per DA 73-11-98.

Other project elements, such as personnel, operating hours, ventilation, and water management would remain consistent with the current approved operation.

A comparison of the approved project and proposed modification is presented in Table 4-1.

Table 4-1 Overview of the proposed modification

Aspect	Description of existing operations	Proposed modification
Project life	DA 73-11-98 approves mining activities for a period of 21 years from the date of granting of a mining lease pursuant to this consent. ML 1452 was granted on 6 July 1999 hence the expiry date is 6 July 2020.	Extend the life of DA 73-11-98 for an additional 12 month period to 6 July 2021.
Development consent boundary	Covers a total area of approximately 2,065 ha. Refer to Figure 2-2.	Expand the development consent boundary to include an additional area of approximately 193 ha within the existing Newstan Colliery Holding Boundary. The proposed first workings would be undertaken within a 229 ha area, of which 193 ha is not within the current consolidated development consent boundary for DA 73-11-98. Refer to Figure 2-2.
Hours of operation	24 hours, seven days a week.	No change
Employment	Newstan is currently approved to have up to 320 full-time employees.	No change
Mining method	A combination of longwall and bord and pillar extraction.	Approval for first workings only is being sought which would not have any measurable surface related subsidence and would be designed to be stable in the long term.
Mining area	Defined existing mining area. Refer to Figure 2-2.	First workings into the proposed extension area. The first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Refer to Figure 2-3.
Coal production	Approved to extract up to 4 Mtpa	No change to upper coal extraction limit of 4 Mtpa. Seeking to extract up to 2 Mt from proposed first workings area.
Coal handling and preparation	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal stockpiles	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal transport	All ROM coal delivered to Northern Coal Logistics Project	No change
Waste/reject management	All ROM coal delivered to Northern Coal Logistics Project.	No change
Site access	Newstan pit top accessed via Miller Road	No change
Mine support facilities	Newstan pit top surface facilities	No change
Underground water management	Managed in accordance with Newstan Colliery water management system	No change

Aspect	Description of existing operations	Proposed modification
Mine ventilation	Managed in accordance with Newstan Colliery Ventilation Management System	No change
Construction	No construction activities occurring	No change
Rehabilitation	Progressive rehabilitation in accordance with Mining Operations Plan	No change

5. Regulatory framework

The proposed modification has been assessed with full consideration of the applicable legislative requirements of the Commonwealth and State, along with the local planning and environmental frameworks of the Lake Macquarie City Council LGA, where applicable. This section describes the relevant regulatory framework applicable to the modification.

5.1 Approval pathway and permissibility

Development consent DA 73-11-98 was granted by the (then) Minister for Urban Affairs and Planning. Centennial Newstan now seeks a modification to DA 73-11-98 pursuant to the provisions of Section 75W of Part 3A of the EP&A Act under the savings provisions for former Part 3A projects and eligible Part 4 mining projects.

Part 3A of the EP&A Act was repealed on 1 October 2011, however Schedule 6A of the EP&A Act provides savings provisions whereby Section 75W of Part 3A continues to apply to modifications of Part 4 development consents referred to in clause 8J(8) of the EP&A Regulation 2000. Clause 8J(8) provides a mechanism whereby projects approved under Part 4 of the EP&A Act can be modified under Section 75W in cases where the development would have been a Part 3A project but for the operation of clause 6(2)(a) of *State Environmental Planning Policy (State Significant Precincts) 2005 (SEPP State Significant Precincts 2005)*. Coal mining is a class of development listed in Schedule 1 of the SEPP State Significant Precincts 2005, and as such would be a project to which Part 3A applies.

Although Schedule 1 of the SEPP was repealed in March 2018, Schedule 6A of the EP&A Act allows for the continuation of the provisions of this relevant section of the SEPP.

On 26 February 2018, Centennial Newstan lodged an application to modify DA 73-11-98 pursuant to Section 75W of the EP&A Act under the savings provisions for former Part 3A projects and eligible Part 4 mining projects. The application was accepted by the NSW Department of Planning and Environment (DP&E), noting that formal Environmental Assessment Requirements would not be issued for the proposed modification.

The Minister for Planning (or their delegate) determines development applications under Section 75W of the EP&A Act. Accordingly, the Minister (or delegate) is the determining authority for the proposed modification.

5.2 Commonwealth legislation

5.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy (DotEE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES). An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance*" may not be undertaken without prior approval from the Commonwealth Minister, as provided under Part 9 of the EPBC Act. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

The proposed modification is not likely to have a significant impact on any MNES listed under the EPBC Act, including a water resource as described in the *Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (Department of the Environment, 2013). The proposed modification will also not affect Commonwealth land and its environment. Consequently, a referral to the DotEE has not been made.

5.2.2 Native Title Act 1993

The *Native Title Act 1993* recognises that Aboriginal people have rights and interests to land and waters which derive from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country. It can be negotiated through a Native Title Claim, an Indigenous Land Use Agreement (ILUA) or future Act agreements.

An ILUA is an agreement between a native title group and other parties who use or manage the land and waters. The ILUA process allows for negotiation between indigenous groups and other parties over the use and management of land and water resources, and the ability to establish a formal agreement. An ILUA is binding once it has been registered on the Native Title Tribunal's Register of Indigenous Land Use Agreements.

The land within the proposed first workings area is subject to an ILUA that was entered into on 28 May 1999 by the Wonnarua people (Wonnarua Nation Aboriginal Corporation) and Powercoal Pty Ltd (since acquired by Centennial Coal). As such, Centennial Coal is bound by the terms of the ILUA, which are set out in the Master Deed, in the use and management of the subject land. Clause 7 of the Master Deed outlines Centennial Coal's obligations, including provisions for compliance with an Aboriginal Heritage Protection Protocol (Clause 7.2 and Schedule 5).

The Deed is subject to a confidentiality clause and, as such, detailed commentary regarding the ILUA is not provided in this EA.

5.3 State legislation

5.3.1 Environmental Planning and Assessment Act 1979

Objects of the EP&A Act

The EP&A Act is the principal piece of legislation overseeing the assessment and determination of development proposals in NSW. It aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The objects of the EP&A Act generally seek to promote management and conservation of natural and artificial resources, while also permitting appropriate development to occur. The principles of ecologically sustainable development and public participation are also objectives of the EP&A Act. The consistency of the proposed modification with these objects is summarised in Table 5-1.

Table 5-1 Objects of the EP&A Act

Objects of the EP&A Act	Consistency of the proposed modification
a) *to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,*	The orderly and economic use of land is best served by development which is permissible under the relevant planning regime and predominantly in accordance with the prevailing planning controls. The proposed modification comprises a permissible development which is consistent with the statutory and strategic planning controls. The proposed modification would result in positive economic impacts. Appropriate mitigation measures and management strategies are provided to mitigate environmental impacts.
b) *to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,*	The proposed modification is consistent with the principles of ecologically sustainable development as outlined in Section 10.4, addressing both this object of the EP&A Act and clause 7(1)(f) in Schedule 2 of the EP&A Regulation.
c) *to promote the orderly and economic use and development of land,*	The orderly and economic use of land is best served by development which is permissible under the relevant planning regime and predominantly in accordance with the prevailing planning controls. The proposed modification comprises a permissible development which is consistent with the statutory and strategic planning controls. The proposed modification would result in positive economic impacts. Appropriate mitigation measures and management strategies are provided to mitigate environmental impacts..
d) *to promote the delivery and maintenance of affordable housing,*	Not applicable to the proposed modification.
e) *to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,*	Not applicable to the proposed modification.
f) *to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),*	The proposed modification would not impact built or cultural heritage. Further details are contained in Section 9.
g) *to promote good design and amenity of the built environment,*	Not applicable to the proposed modification.
h) *to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,*	Not applicable to the proposed modification.
i) *to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State,*	The proposed modification is subject to the provisions of Section 75W of the EP&A Act, where the Minister for Planning (or delegate) is the consent authority.

Objects of the EP&A Act	Consistency of the proposed modification
j) to provide increased opportunity for community participation in environmental planning and assessment.	As outlined in Section 7, Centennial Newstan has undertaken consultation with relevant stakeholders in relation to the proposed modification. This consultation process is continuing with respect to the progression towards obtaining development consent for the proposed modification. Any relevant public representations will need to be considered by the Minister for Planning (or delegate) during the assessment of the development application.

5.3.2 Other key State legislation

Existing approvals relevant to Newstan Colliery are described in Section 3.2.

In addition to the requirement for development consent under Part 4 of the EP&A Act, Newstan Colliery requires approvals, licences and/or authorities under various other pieces of State legislation. Table 5-2 lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the proposed modification.

Table 5-2 Relevant State legislation

NSW State legislation	Implications for proposed modification (approvals, licences and/or authorities)
POEO Act	Newstan Colliery is a premises-based "scheduled activity" under Schedule 1 of the POEO Act and currently operates under the provisions of EPL 395. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purposes of the Act. As EPL 395 permits coal works (between 2 to 5 million tonnes handled per annum) and mining for coal (between 2 to 3.5 million tonnes produced per annum), no variation to EPL 365 is required for the proposed modification.
Mining Act 1992	Centennial Newstan currently holds a number of mining leases (refer to Table 3-2). No change to existing mining tenements is required for the proposed modification. It is expected that the proposed modification will trigger the need for a revision to the currently approved Mining Operations Plan (MOP) for Newstan Colliery, which is a mining and rehabilitation planning document required under the Act.
Water Act 1912	The *Water Act 1912* governs access, trading and allocation of licences associated with surface water and groundwater sources where a Water Sharing Plan (WSP) is not in place. The study area for the proposed modification is covered by two WSPs, as such the *Water Act 1912* does not apply to the proposed modification.
Water Management Act 2000 (WM Act)	The WM Act is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. WSPs prepared in accordance with the WM Act include rules for protecting the environment and administrating water licencing and trading. The study area for the proposed modification is covered by the following two WSPs: • The North Coast Fractured and Porous Rock Groundwater Sources WSP, which commenced in July 2016 and regulates the interception and extraction of groundwater from the fractured

NSW State legislation	Implications for proposed modification (approvals, licences and/or authorities)
	and porous rock aquifer within the WSP boundary. Centennial Newstan is currently in consultation with Department of Industry – Lands and Water (DoI – Water) regarding the licensing of groundwater take from this source. Water license application were submitted by Centennial Newstan in 2015 and are awaiting determination. Follow-up consultation occurred in 2016, 2017 and 2018. • The Hunter Unregulated and Alluvial Water Sources WSP, which commenced in August 2009 and covers unregulated rivers and creeks and alluvial groundwater within the Hunter region. By the operation of Section 89J of the EP&A Act, the proposed modification would not trigger the requirement for water use approvals under Section 89, water management approvals under Section 90 or a controlled activity approval under Section 91 of the WM Act.
Work Health and Safety (Mines) Act 2013 (WHS (Mines) Act)	Centennial Newstan currently holds all necessary approvals under the WHS (Mines) Act, which aims to assist in securing and promoting the health, safety and welfare of people at work at coal operations. The proposed modification would not trigger the requirement for any further approvals under the Act.
Mine Subsidence Compensation Act 1961	The proposed first workings area is located within the West Lake Mine Subsidence District. As no surface improvements are proposed, the proposed modification would not trigger any requirement for approval from the Mine Subsidence Board (MSB).
Dams Safety Act 1978	The proposed modification would not involve any underground mining or surface disturbance on or in the vicinity of any dams prescribed under the *Dam Safety Act 1978*.
Crown Lands Act 1989	The proposed first workings area exists over Crown land. No surface infrastructure is proposed and as such Centennial Newstan does not need to obtain a licence to use the land under the provisions of the *Crown Lands Act 1989*.
Biodiversity Conservation Act 2016 (BC Act)	The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future. The BC Act lists threatened species, populations and ecological communities as well as critical habitat and key threatening processes that must be considered when assessing the effects of an activity. Natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the proposed first workings. As such, the proposed modification would not impact threatened species, populations and ecological communities, or critical habitat listed under the BC Act.
National Parks and Wildlife Act 1974 (NPW Act)	The NPW Act contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage. By operation of Section 89J of the EP&A Act, the proposed modification would not trigger the requirement for any additional approvals under the NPW Act.
Aboriginal Land Rights Act 1983	The *Aboriginal Land Rights Act 1983* provides for the establishment of local, regional and State Aboriginal Land Councils and a mechanism for Aboriginal Land Councils to claim Crown land. The NSW Aboriginal Land Council has been awarded a land claim over Lot 463 DP 1138964.

NSW State legislation	Implications for proposed modification (approvals, licences and/or authorities)
Heritage Act 1977	Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the *Heritage Act 1977*. There are no references to heritage items in the proposed first workings area within the World Heritage List, NSW Heritage Register, Australian Heritage Database or the relevant Local Environmental Plans. The proposed modification would not impact on any listed heritage items. In any event, approval is not required due to the operation of Section 89J of the EP&A Act.
Forestry Act 1916	No permits are required from the Forestry Corporation of NSW regarding the proposed modification.

5.3.3 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are Environmental Planning Instruments (EPIs) prepared by the Minister to address issues significant to NSW. The SEPPs outlined in the below sub-sections contain provisions that are relevant to the Project and therefore are matters to be taken into consideration by the consent authority.

SEPP (State and Regional Development) 2011

SEPP (State and Regional Development) 2011 (SRD SEPP) came into effect upon the repeal of Part 3A of the EP&A Act and identifies development to which the SSD assessment and determination process under Division 4.1 in Part 4 of the EP&A Act applies. However, pursuant to Clause 24 of the SEPP, the transitional Part 3A provisions outlined in Schedule 6A of the EP&A Act continue to apply.

The provisions of this SEPP do not apply to the proposed modification as it is to be considered under the savings provisions of the former Part 3A provisions of the EP&A Act (see Section 5.1).

SEPP (Mining, Petroleum Production & Extractive Industries) 2007

The Mining SEPP regulates the permissibility of mining and related development (see Section 5.1) and specifies matters that must be considered in assessing mining developments requiring consent under Part 4 of the EP&A Act.

Sub-clause 7(1)(a) of the Mining SEPP states that development for the purpose of underground mining (which includes mine related development) may be carried out on any land with development consent.

Clauses 12 to 17 (inclusive) require consideration to be given to the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The proposed modification would be consistent with the aims and objectives of the SEPP. The information presented in this EA (particularly Section 9) addresses each of the relevant matters for consideration prescribed in Clauses 12 to 17.

SEPP 44 – Koala Habitat Protection

SEPP No. 44 – Koala Habitat Protection provides for the protection of koala habitat by ensuring that areas subject to development proposals are considered for their value as habitat or potential habitat for koalas. The Lake Macquarie LGA is listed under Schedule 1 of SEPP 44 as an area to which the SEPP applies.

The proposed modification would not impact on any area of potential koala habitat, as no surface disturbance is proposed and the proposed first workings would result in <20 mm of measurable subsidence.

SEPP (Infrastructure) 2007

The *SEPP (Infrastructure) 2007* (ISEPP) aims to facilitate the effective delivery of infrastructure across NSW. Clause 45 of ISEPP provides that for a development application in respect of development carried out:

- Within or immediately adjacent to an easement for electricity purposes (whether or not the electricity infrastructure exists).
- Within 5 metres of an exposed overhead electricity power line.

The consent authority must give written notice to the electricity supply authority for the area and invite comments about potential safety risks (and take into consideration any response to that notice received within 21 days after the notice is given).

Centennial Newstan will continue to consult with TransGrid with respect to mining operations that have the potential to impact on their infrastructure, including those associated with the proposed modification. Potential impact to infrastructure from the proposed modification are assessed in Section 9.1.

SEPP No. 33 – Hazardous and Offensive Development

SEPP No. 33 - Hazardous and Offensive Development (SEPP 33) regulates, amongst other matters, the determination of development applications to carry out what is defined in SEPP 33 as development for the purposes of a "potentially hazardous industry" or "potentially offensive industry". The proposed modification will ensure the continued implementation of best management practices for hydrocarbons and explosives used within the proposed first workings area, as well as effective implementation of the approved EMS and occupation health and safety management systems. The proposed modification would not pose any significant risk, in relation to its locality, to human health, life or property or to the biophysical environment.

The proposed modification is not considered to comprise a "potentially hazardous industry" or a "potentially offensive industry" within the meaning of these expressions in SEPP 33, and therefore a preliminary hazard analysis was not prepared as required by clause 12 of SEPP 33 and nor does clause 13 of SEPP 33 apply to the consent authority's determination of the application to modify DA 73-11-98.

SEPP (Coastal Management) 2018

SEPP (Coastal Management) 2018 (Coastal Management SEPP) updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5 of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed. The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

There are no coastal management areas mapped under the Coastal Management SEPP in proximity to the proposed first workings area and the proposed modification would not impact any such areas.

5.3.4 Lake Macquarie Local Environmental Plan 2014

The objectives of the *Lake Macquarie Local Environmental Plan 2014* (Lake Macquarie LEP) are:

(a) to recognise the importance of Lake Macquarie City and its waterways and the coast as an environmental, social, recreational and economic asset to Lake Macquarie City and the Hunter and Central Coast regions,

(b) to implement a planning framework that protects areas of significant conservation importance, while facilitating development and public facilities in appropriate areas, that are accessible to a range of population groups, to accommodate Lake Macquarie City's social and economic needs,

(c) to promote the efficient and equitable provision of public services, infrastructure and amenities,

(d) to facilitate a range of accommodation types throughout Lake Macquarie City so that housing stock meets the diversity of community needs and is affordable to as large a proportion of the population as possible,

(e) to apply the principles of ecologically sustainable development,

(f) to encourage development that enhances the sustainability of Lake Macquarie City, including the ability to adapt to and mitigate against climate change.

The land zonings of the relevant components within the proposed first workings area pursuant to the Lake Macquarie LEP are E2 Environmental Conservation and SP2 Infrastructure.

Clause 8 of the Mining SEPP outlines its relationship to other environmental planning instruments:

8 Determination of permissibility under local environmental plans

(1) If a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if provisions of the plan are satisfied:

(a) development for that purpose may be carried out on that land with development consent without those provisions having to be satisfied, and

(b) those provisions have no effect in determining whether or not development for that purpose may be carried out on that land or on the determination of a development application for consent to carry out development for that purpose on that land.

(2) Without limiting subclause (1), if a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if the consent authority is satisfied as to certain matters specified in the plan, development for that purpose may be carried out on that land with development consent without the consent authority having to be satisfied as to those specified matters.

On this basis, any provision in the Lake Macquarie LEP that would otherwise operate to prohibit the proposed modification has no effect dur to Clause 8 of the Mining SEPP, and accordingly, the proposed modification is permissible with development consent on the land in which it would be carried out within the Lake Macquarie LGA.

5.3.5 Other considerations

Lake Macquarie City Council's Lifestyle 2030 Strategy

Lake Macquarie City Council's *Lifestyle 2030 Strategy* (LS2030) was adopted by LMCC on 11 March 2013. The LS2030 provides the long-term direction for the overall development of the City and describes LMCC's high level policies for managing private and public development in Lake Macquarie. LS2030 is the primary guiding document for the development of local plans, regulations and guidelines that control development of land. It is anticipated that major reviews of LS2030 will occur every five years.

Strategic Regional Land Use Policy

The NSW Government's *Strategic Regional Land Use Policy* was introduced in September 2012 and sets out a range of initiatives to better balance growth in the mining industry with the need to protect agricultural land and water resources.

The modification will not result in any impact to Biophysical Strategic Agricultural Land (BSAL) or changes to the land and soil capability classes.

Lower Hunter Regional Strategy 2006-31

The Department of Planning and Environment's (DP&E's) *Lower Hunter Regional Strategy 2006-31* (Lower Hunter Regional Strategy) identifies how the expected growth in the Lower Hunter Region (encompassing the five local government areas of Newcastle, Lake Macquarie, Port Stephens, Maitland and Cessnock) will be managed to provide for both economic development and the protection of environmental assets, cultural values and natural resources. The Lower Hunter Regional Strategy is implemented primarily through local environmental plans, development control plans, through the State Infrastructure Strategy and through funds collected as developer contributions. The Lower Hunter Regional Strategy is to be comprehensively reviewed every five years, so that it can adjust to any demographic and economic changes. This will assist local councils will their five-yearly review of local environmental plans, required under recent reforms to the planning system. In February 2010, the NSW Government announced it had re-endorsed the Lower Hunter Regional Strategy as a sound platform to guide the region's future growth.

6. Socio-economic analysis

A socio-economic analysis of Newstan Colliery was prepared by AIGIS Group (2018) and is presented as Appendix C of this EA. The analysis was not specific to the proposed modification, rather it provided a contemporary quantification of the local, regional and State economic contribution of the operating Newstan Colliery and a brief analysis of the associated social effects. A brief summary of the socio-economic analysis is presented below.

The socio-economic impacts from the existing mine are intrinsically linked to the proposed modification by virtue of the fact that, if approved, the proposed modification would involve the recommencement of operations at Newstan Colliery.

The two key elements of socio-economic contribution from the operation of Newstan Colliery are those related to the mine's commercial activities, and those resulting from the economic and social involvements of the mine and its employees.

The mine's operations entail both commercial/ economic elements and associated social impacts. Commercial engagement of locally and regionally-based suppliers and contractors supports those businesses and the consequent employment and extended economic benefits such transactions produce. This also has positive social impacts, through increasing the number of residents and households that have the resources to engage in the community on a variety of levels.

The role of employees as local and regional economic contributors is also significant. This is further supported by the number of household members who directly benefit from employment with Newstan Colliery during operations. This has short and longer term benefits for these households in terms of financial security and wealth creation. As is the case with Newstan Colliery's commercial partners, these households also have greater resources, permitting them to engage in the community and to form part of and/or contribute to the social fabric, functioning and cohesion of their communities.

A small number of households situated close to the mine may experience some negative impacts from operation of Newstan Colliery, along with the broader impact of Greenhouse gas (GHG) emissions, which are more difficult to quantify in terms of affected parties. The effects on these households will continue to be managed through appropriate avoidance, management and mitigation measures.

On balance, the contribution to the local, regional and State economies from operation of Newstan Colliery is highly likely to be positive.

7. Stakeholder consultation

This chapter provides a description of the government and community consultation activities undertaken in regard to the proposed modification, outlines the key issues identified and provides a reference to where each of the identified issues have been addressed in this document.

7.1 Government agency consultation

7.1.1 Department of Planning and Environment

A Section 75W application to modify DA 73-11-98 was made by Centennial Coal on 26 February 2018, which was accepted by DP&E, noting that formal Environmental Assessment Requirements would not be issued for the proposed modification. Centennial Coal personnel then met with DP&E representatives on 27 March 2018 to discuss the activities involved in the proposed modification and the environmental impact assessments proposed to be undertaken to support the application to modify DA 73-11-98.

Subsequent correspondence issued to DP&E by Centennial Coal on 16 April 2018 clarified the proposed modification and outlined the proposed environmental impact assessment studies to be undertaken to support the Section 75W application.

A response from DP&E was received by Centennial Coal on 24 April 2018. In the response, DP&E generally agreed with Centennial Coal's proposed approach to the assessment, subject to a number of comments. An outline of each of the specific comments made by DP&E, and a reference to where each one has been addressed within this EA, is presented in Table 7-1.

Table 7-1 DP&E comments regarding environmental impact assessment studies for the proposed modification

DP&E comment	Where addressed
Biodiversity: The Department understands that Centennial has sought confirmation from OEH regarding the application of the Biodiversity Assessment Methodology (BAM). The Department will await advice from OEH in this regard.	Section 7.1.2 and Section 9.2
Water resources: The Department notes that Centennial intends to review and update its hydrogeological model, and that this model will form the basis of a Water Resources Impact Assessment (WRIA) for Modification 8. This assessment should give particular consideration to: • Potential interactions with the existing underground workings at Awaba, and any associated impacts (particularly with respect to surface infrastructure and water resources). • Any need for referral to the Commonwealth.	Section 5.2.1 and Section 9.4
Subsidence: The EA should include an assessment of the likely conventional and non-conventional subsidence effects and impacts of the development, and the potential consequences of these effects and impacts on the natural and built environment, paying particular attention to those features that are considered to have significant economic, social, cultural or environmental value, including: • Infrastructure. • Heritage items/archaeological sites. • Watercourses and natural flow regimes. The EA should also include a detailed assessment of the potential interactions with the existing underground workings at Awaba, including consideration of pillar instability, pillar run and any potential environmental impacts.	Section 9.1

7.1.2 Office of Environment and Heritage

Centennial Coal provided to the Office of Environment and Heritage (OEH) a letter on 16 April 2018 outlining details of the proposed modification. The letter also sought in-principle support of Centennial Coal's proposed biodiversity survey and assessment approach for the proposed modification using the Biodiversity Assessment Method (BAM).

OEH issued a written response to Centennial Coal on 2 May 2018 recommending that the Biodiversity Offset Scheme (BOS) of the BC Act be applied to the proposed modification, and if triggered, the BAM be applied and a Biodiversity Development Assessment Report (BDAR) prepared.

Details of Centennial Coal's approach to the survey and assessment of biodiversity impacts for the proposed modification in accordance with OEH's requirements are presented in Section 9.2.

7.2 Aboriginal community engagement

Consultation with the local Aboriginal community in regard to the proposed modification was undertaken in accordance with reference to *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a). In accordance with these guidelines, a total of six (6) Registered Aboriginal Parties (RAPs) were consulted for the proposed modification.

Aboriginal heritage sub-committee

Centennial Newstan has been undertaking comprehensive consultation with registered Aboriginal parties (RAPs) on the status and progress of mining projects in the Lake Macquarie region since 2010. In 2016, Centennial Coal established an Aboriginal heritage sub-committee for the northern region. The Aboriginal heritage sub-committee includes representatives from the various RAPs from each of Centennial Coal's northern operations. The Aboriginal heritage sub-committee meet twice a year to discuss matters relating to cultural heritage including a review of any heritage related works carried out over the previous six months and any works proposed over the coming six months (including field surveys and site recording). On 9 May 2018 a presentation of the proposed modification was provided to the Aboriginal heritage sub-committee for the northern region.

Registered Aboriginal parties

In 2010 Centennial Coal sent requests to register an expression of interest in the consultation process for mining operations and projects associated with Newstan Colliery to eight RAPs. Of these, six registered an interest in being consulted, as follows:

- Awabakal Descendants Traditional Owners Aboriginal Corporation.
- Awabakal Traditional Owners Aboriginal Corporation.
- Biraban Local Aboriginal Land Council.
- Cacatua Culture Consultants.
- Wonnarua Nation Aboriginal Corporation.
- Wonn1.

The six RAPs listed above were consulted for the proposed modification. Consultation was also undertaken with Guringai Tribal Link Aboriginal Corporation, which is not a RAP for Newstan Colliery, but had expressed an interest in being consulted on the proposed modification. A number of consultees attended a site inspection and all were provided a draft copy of the Aboriginal cultural heritage impact assessment (RPS, 2018a) for review and comment. Wonn1 provided a response to Centennial Coal on 13 August 2018. The respondent indicated that they were generally in agreement with the contents and recommendations contained in the draft assessment and that they would like to be involved in the ongoing monitoring of the three identified Aboriginal heritage sites (refer to Section 9.3). No further comments were received on the draft assessment.

Full details of the consultation process undertaken in relation to the proposed modification are contained in Appendix F.

7.3 Community stakeholders

7.3.1 Newstan and Awaba Community Consultative Committee

The Newstan and Awaba Community Consultative Committee (CCC) comprises representatives from local government and the community, and is independently chaired. The CCC provides a forum for open discussion between representatives of Centennial Coal, the community, Lake Macquarie City Council and other stakeholders on issues directly relating to Newstan Colliery's operations, environmental performance and community relations. The CCC meets every two to three months.

The CCC was provided with a briefing regarding the proposed modification on 12 April 2018 and again on 26 July 2018. No issues or concerns were raised in relation to the proposed modification during or following these briefings.

7.3.2 Five bays sustainable neighbourhood group

The Five bays sustainable neighbourhood group is comprised of community members from the suburbs of Teralba, Booragul, Marmong-Point, Bolton Point, Fennell Bay, Fassifern, Blackalls Park and Woodrising.

The group was provided with a briefing regarding the proposed modification on 1 July 2018. No issues or concerns were raised in relation to the proposed modification during or following the briefing; however, the group requested they be kept up to date with progress in relation to the Environmental Impact Statement being prepared for the Newstan Extension Project.

7.3.3 Fassifern Public School parents and citizen's association

The Fassifern Public School parents and citizen's association (P&C) assists Fassifern Public School to support the local school children and community. The Fassifern Public School P&C meets on the second Thursday of every month.

The Fassifern Public School P&C were provided with a briefing regarding the proposed modification on Friday, 27 July 2018. No issues or concerns were raised in relation to the proposed modification during or following the briefing.

8. Identification of key environmental issues

Centennial Newstan utilises a risk-based approach to manage safety, environment and social issues as a result of its operations at Newstan Colliery. This process involves personnel identifying issues or recognising areas where further information is required in addition to recommending any necessary controls to address identified risks. This practice is guided by the overarching Centennial Environmental Policy, which requires continual improvement of environmental performance through risk management strategies based on clear science and valid data.

The compilation of this EA has been undertaken through a risk based and consultative approach. The key assessment issues warranting detailed investigation and discussion were identified through a range of measures including:

- The existing environmental context of the overall operation and its surrounding locality (see **Sections 2 and 3**).
- The regulatory framework applicable to the proposed modification (see **Section 5**).
- The outcomes of consultation undertaken with government agencies and other relevant stakeholders (see **Section 7**).
- Specialist assessments completed as part of the preparation of the EA (see **Section 9**).

The scope of the assessment was discussed and confirmed with DP&E and OEH. Where there was a knowledge gap in the information available, or where risks were considered unacceptable, a specialist assessment has been undertaken to support the EA.

Issues and aspects relating to the proposed modification with the potential to pose the greatest risk to the environment, assessed in the risk assessment and confirmed in consultation with DP&E and OEH, were as follows:

- Subsidence impacts on the built and natural environment. Specifically:
  - Infrastructure
  - Heritage items/archaeological sites
  - Watercourses and natural flow regimes.
- Biodiversity.
- Aboriginal cultural heritage.
- Water resources (surface water and groundwater).
- Air quality.
- Greenhouse gas.

In response to the risks identified, the following technical specialist assessments were carried out to inform this EA:

- Subsidence predictions and impact assessment.
- Biodiversity thresholds test.
- Aboriginal cultural heritage impact assessment.
- Water resources impact assessment.
- Air quality impact assessment.
- Greenhouse gas assessment.

Section 9 of this EA contains an assessment of all relevant environmental issues.

9. Assessment of key environmental impacts

9.1 Subsidence

This section addresses the subsidence impacts associated with the proposed modification and details the management measures proposed to mitigate these impacts.

The information presented below is drawn from the assessment titled *Newstan Colliery – Subsidence predictions and assessment of potential impact due to the development of first workings in the West Borehole Seam* (Mine Subsidence Engineering Consultants, 2018), a copy of which is provided in Appendix D.

9.1.1 Existing environment

Mine geology

The seam floor of the West Borehole seam is the Waratah Sandstone. The immediate seam roof is the Nobbys Tuff (generally less than 2 m thick), which is overlaid by the Adamstown Formation comprising many conglomerate and sandstone bands interbedded with shale, siltstone, tuffaceous claystone bands and high ash coal seams.

Natural and built features above proposed first workings area

Natural and built features located above the proposed first workings area include:

- Stony Creek, Kilaben Creek, Stockyard Creek and their tributaries.
- Steep slopes with natural gradients typically up to 1 in 2 (i.e. 50 per cent or 26.6^{o}).
- A private coal haul road.
- A 33kV substation.
- Two telecommunications towers.
- Aboriginal cultural heritage sites comprising one Open Site (AHIMS ID 38-4-1375) and two scarred trees (AHIMS IDs 45-7-0318 and 45-7-0319).

9.1.2 Predicted subsidence

Vertical subsidence

The maximum predicted vertical subsidence at the surface, due to the development of first workings in the West Borehole seam, is approximately 11 mm. The maximum predicted subsidence occurs near the middle and southern parts of the workings, where the depths of cover are greatest. The predicted vertical subsidence in the northern part of the workings reduces to approximately 7 mm, where the minimum depth of cover above the workings is 180 m.

Vertical subsidence less than 20 mm is generally considered to be insignificant. Natural ground movements due to wetting and drying of soils can result in similar levels of movement. The predicted vertical subsidence is unlikely to be measurable using standard surveying techniques.

Surface deformations

The strains at the surface due to the development of the first workings are predicted to be less than 0.1 mm/m. It is unlikely that the strains due to the development of the first workings would be measurable using standard surveying techniques.

Tensile cracking or compression heaving are not expected to develop above the proposed first workings in the West Borehole seam due to the very low levels of predicted vertical subsidence (i.e. less than 20 mm) and higher depths of cover (i.e. 180 m to 270 m). The development of the first workings is not expected to result in irregular or anomalous ground movements.

Multi-seam interaction with the existing workings

The existing Awaba workings in the Great Northern seam are located above the northern and central parts of the proposed first workings area in the West Borehole seam. These existing workings comprise areas of first workings, partial extraction and total extraction.

The development of the first workings in the West Borehole seam is not expected to reactivate the existing Awaba workings (including pillar run) due to the very low levels of predicted movement (i.e. vertical subsidence of less than 20 mm), the interburden thickness between the workings (i.e. 140 m to 210 m) and the high factors of safety for the proposed pillars (i.e. 2.1 to 3.4).

The development of the proposed first workings is not expected to change the potential for the longer-term subsidence above the existing Awaba workings.

Potential for sink holes

Sink holes have been previously observed above the existing Awaba workings. In each case, the sink holes have developed where: the depths of cover are very shallow (less than 30 m); above total extraction areas; and along the alignments of the streams.

The depth of cover above the proposed first workings in the West Borehole seam varies between 180 m and 270 m. Sink holes have not been previously observed above existing workings at the colliery at these higher depths of cover.

The streams located above the proposed first workings in the West Borehole seam comprise Stony Creek, Kilaben Creek, Stockyard Creek and tributaries to these creeks. The section of Stony Creek above the proposed first workings area in the West Borehole seam is also located above first workings only in the existing Awaba workings. The sections of Kilaben and Stockyard Creeks above the proposed first workings area are located outside the extents of the existing Awaba workings.

The development of the proposed first workings in the West Borehole seam is not expected to result in the potential for sink holes due to the high depths of cover and due to the larger streams being located above areas of first workings only in both the Great Northern and West Borehole seams.

9.1.3 Predicted subsidence impacts

Natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the first workings. At these very low levels of vertical subsidence, the surface features are not predicted to experience measurable tilts, curvatures or strains. It is not expected that visible surface deformations (i.e. tensile cracking or compression heaving) or irregular (i.e. anomalous) ground movements would occur.

No adverse impacts to the natural and built features identified above in Section 9.1.1 are expected due to the development of the first workings in the West Borehole seam.

Further, the development of first workings in the West Borehole seam is not expected to change to potential for ground movements and impacts due to the longer-term subsidence associated with the existing conditions of the Awaba workings.

9.1.4 Management and mitigation measures

There are no specific recommendations for ground monitoring or other management strategies associated with the development of the first workings in the West Borehole seam due to the very low levels of predicted ground movements. The predicted vertical subsidence (i.e. less than 20 mm) and the predicted strains (i.e. less than 0.1 mm/m) are not expected to be measurable.

There are existing ground monitoring lines used to measure the longer-term movements above the existing Awaba workings in the Great Northern seam. No changes to the existing monitoring regime are recommended due to the proposed development of the first workings in the West Borehole seam.

9.2 Biodiversity

This section addresses the biodiversity impacts associated with the proposed modification.

The information presented below is drawn from the report titled *Proposed Newstan Modification 8: Biodiversity Thresholds Test* (RPS, 2018b) which was prepared to assess the potential for impacts on biodiversity values as they related to relevant State and Commonwealth legislative requirements. A copy of the report is provided in Appendix E.

9.2.1 Methodology

The biodiversity impacts of the proposed modification were assessed by:

1. Establishing an understanding of the biodiversity values within and surrounding the proposed first workings area via desktop analysis and field surveys.
2. Completing an analysis of the likely impacts of the proposed modification on the identified biodiversity values.
3. Applying the three threshold tests prescribed under the BC Act, with consideration of likely impacts of the proposed modification and any potential interaction with the identified biodiversity values. The three tests applied asked the following questions:
   - Would the impacts of the proposed modification exceed the Biodiversity Offset Scheme (BOS) thresholds, as per Section 7.2 of the BC Act?
   - Would the impacts of the proposed modification be likely to significantly affect threatened species or ecological communities, or their habitats, as per Section 7.3 of the BC Act?
   - Would impacts from the proposed modification be expected on a declared area of outstanding biodiversity value?
4. Making a determination based on the outcomes of the threshold tests as to whether or not participation in the BOS, or referral under the EPBC Act, was required for the proposed modification.

Desktop analysis

A review of relevant information was performed to gain an understanding of the biodiversity values occurring or potentially occurring within and surrounding the proposed first workings area. Information sources reviewed for a 10 km radius of the proposed first workings area included:

- Biodiversity Assessment Methodology (BAM) Calculator candidate species output (accessed June 2018).
- Fauna and flora records contained in the OEH Atlas of NSW Wildlife (accessed June 2018).
- Fauna and flora records contained in the DotEE Protected Matters Search tool (accessed June 2018).

A preliminary 'likelihood of occurrence' assessment was completed to identify species that may be impacted by the proposed modification, and thus required consideration under Section 7.3 of the BC Act.

Flora survey

Flora surveys of the proposed first workings area were carried out over seven days (5-9 and 12-13 June 2018), in accordance with the BAM (2017), with the aim of identifying the vegetation communities present.

A total of 17 flora plots were performed to measure the composition, structure and functional components of the sites native vegetation cover. Preliminary plant community types (PCTs) were assigned to areas of relatively homogenous land cover (i.e. vegetation zones). Additional revisions were performed following the completion of field surveys (i.e. revision of boundaries and condition classes). PCT extent was calculated in a GIS to determine the number of BAM plots required and requirements for other survey methods. The assigning of PCTs to describe mapped vegetation cover was in accordance with the NSW Vegetation Information System (OEH, 2018).

Where possible, BAM plots were placed in a manner that best reflected the biological character of the vegetation zone being assessed (i.e. avoided placement of plots near ecotones and disturbed boundaries). The BAM plots were surveyed to cover the four mapped vegetation zones as outlined below:

- PCT 1588 Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast (three Plots)
- PCT 1619 Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (five Plots)
- PCT 1627 Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (four Plots)
- PCT 1636 Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast (five Plots)

The timing of field surveys was suitable for the detection/identification of the majority of threatened flora previously recorded or predicted to occur within 10 kilometres of the proposed first workings area.

Fauna survey

No targeted fauna surveys were undertaken. Opportunistic fauna records were collected during the flora surveys (5-9 and 12-13 June 2018).

9.2.2 Existing environment

Flora and fauna

A total of 15 threatened flora and 38 threatened fauna species were identified as having a greater than moderate likelihood of occurrence within the native vegetation cover present throughout the proposed first workings area.

Vegetation communities

The proposed first workings area is approximately 229 ha, of which approximately 210 ha is comprised of native vegetation. The following PCTs were identified within the proposed first workings area:

- PCT 1627: Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast.
- PCT 1588: Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast.
- PCT 1619: Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands.
- PCT 1636: Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast.

None of these PCTs have been identified as forming part of a threatened ecological community (TEC) listed under the BC Act or EPBC Act.

Groundwater dependent ecosystems

The potential for Groundwater Dependent Ecosystems (GDEs) was explored using the GDE Atlas (BoM, 2018). Seven GDEs were identified as potentially occurring within approximately 5 km of the proposed workings area (refer to Section 9.4.1). Within the proposed first workings area, dependent GDEs may be present in association with Stony Creek; Kilaben Creek and Stockyard Creek. Field validated vegetation mapping confirmed the following terrestrial PCTs within the proposed first workings area that may be associated with a terrestrial GDE:

- PCT 1636 Scribbly Gum –Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast.
- PCT 1619 Smooth-barked Apple –Red Bloodwood –Brown Stringybark –Hairpin Banksia heathy open forest of coastal lowlands.
- PCT 1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast.

Matters of national environmental significance

EPBC listed threatened species and ecological communities

The likelihood of occurrence analysis identified 11 threatened flora species and 10 threatened fauna species as having a moderate or greater likelihood of occurrence within the proposed first workings area.

No TECs listed under the EPBC Act were detected within the proposed first workings area. As such, no assessment for EPBC Act listed TECs was undertaken for the proposed modification.

Migratory species

Eighteen nationally listed migratory terrestrial and wetland species were either recorded on the DotE online database or were considered to have potential habitat available within 10 km of the proposed first workings area.

9.2.3 Impact assessment

The proposed modification does not involve:

- The clearing of native vegetation.
- Alteration of the land surface such that native vegetation cover and habitat would be either directly or indirectly impacted.

The proposed modification does not exceed any of the thresholds for the three biodiversity threshold tests that were applied in accordance with the BC Act. On this basis, it is considered that no habitat for a threatened species or ecological community would be impacted by the proposed modification.

The proposed modification is unlikely to result in a significant impact on BC Act or EPBC Act listed threatened species, ecological communities or their habitats. Participation in the BOS under the BC Act, or referral under the EPBC Act, is therefore not required for the proposed modification.

Groundwater dependent ecosystems

Despite the potential for GDEs to be present on site, impacts to these ecosystems are not expected to result from the proposed first workings. As described in Section 9.4, the predicted groundwater impacts are less than the NSW Aquifer Interference Policy's Level 1 minimal impact considerations, and as such are considered acceptable. No impacts to GDEs are therefore predicted.

9.2.4 Management and mitigation measures

Given that impacts on biodiversity are expected to be negligible, no specific management and mitigation measures are proposed. Implementation of the existing suite of environmental management plans approved under DA 73-11-98 is considered adequate for managing biodiversity impacts associated with the proposed modification.

9.3 Aboriginal cultural heritage

This section addresses the Aboriginal heritage impacts associated with the proposed modification and details the management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Aboriginal Cultural Heritage Impact Assessment, Proposed Modification 8, Newstan Colliery* (ACHIA) prepared by RPS (2018a), a copy of which is provided in Appendix F.

9.3.1 Methodology

Assessment approach

The ACHIA was prepared to satisfy the requirements of:

- The NPW Act and NPW Regulation.
- The principles of the Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013 (the Burra Charter) (Australia ICOMOS 2013).
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010a).
- *Due Diligence Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b).
- ILUA entered into on 28 May 1999 by the Wonnarua people (Wonnarua National Aboriginal Corporation) and Powercoal Pty Ltd (since acquired by Centennial).

The objectives of the ACHIA were to investigate and assess the potential impacts of the proposed modification on known and potential Aboriginal objects and places and cultural heritage values within the proposed first workings area and provide appropriate management and mitigation strategies.

Consultation

Consultation for the ACHIA was undertaken with reference to *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a). Further details regarding the consultation process are presented in Section 7.2.

Database searches

A search of the OEH Aboriginal Heritage Information Management System (AHIMS) was carried out on 25 April 2018 (refer to Appendix F). The search was completed for Aboriginal heritage sites recorded within an approximate six kilometre radius of the proposed first workings area. A total of 42 Aboriginal heritage sites were identified within the search area, including three within the proposed first workings area.

Site inspection

A site inspection of the proposed first workings area was conducted on 26 June 2018, with the involvement of Centennial Coal personnel and a number of RAPs. Whilst all RAPs were invited to attend the site inspection, only representatives from the following RAPs were in attendance on 26 June 2018:

- Awabakal Traditional Owners Aboriginal Corporation.
- Awabakal Descendants Traditional Owners Aboriginal Corporation.
- Wonn1.
- Guringai Tribal Link Aboriginal Corporation.

9.3.2 Existing environment

Cultural context

The study area is located in the traditional lands of the Awabakal people and in the administrative boundaries of the Biraban LALC. The exact traditional boundaries of the Awabakal tribes are unknown, but the broad geographical and cultural boundaries are relatively consistent between sources. The Awabakal appear to have been people of the coast, estuaries, lakes and wetlands, but also with attachment to the rugged sandstone country through the Sugarloaf and Watagan Ranges. The traditional country of the Awabakal people was bounded to the north by the Worimi, to the west by the Wonnarua, to the south west by the Darkinjung and to the south along the coast by the Kuring-gai people.

Historical records identify several different clans as occupying the region, with the Awabakal people being located in the Newcastle and Lake Macquarie area. There is limited information available regarding the Aboriginal occupation of the area given the impacts of European settlement. Abundant sources of marine and terrestrial resources were available in the Newcastle area. As such, the area was likely occupied both transiently, when ephemeral water sources were accessible, and more permanently where a continual water source, such as Lake Macquarie, approximately 4 kilometres to the east, was available. Both of these environments would have provided a variety of seasonal and annual floral and faunal resources.

Aboriginal heritage objects and places

All land within the proposed first workings area has been subject to previous archaeological survey (RPS, 2010; RPS, 2011; and RPS 2013). There are three (3) Aboriginal sites within the proposed first workings area, AHIMS #45-7-0318 (a scarred tree); AHIMS # 45-7-0319 (a scarred tree); AHIMS #38-4-1375 (an isolated find). No additional sites were identified during the site inspection completed on 26 June 2018.

9.3.3 Impact assessment

The subsidence assessment for the proposed modification (Appendix D) considered potential impacts to Aboriginal heritage as a result of mine subsidence. The assessment found:

The natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the first workings. At these very low levels of vertical subsidence, the surface features are not predicted to experience measurable tilts, curvatures or strains. It is not expected that visible surface deformations (i.e. tensile cracking or compression heaving) nor irregular (i.e. anomalous) ground movements would occur.

The natural and built features therefore are not expected to experience adverse impacts due to the development of the first workings in the West Borehole seam.

The ACHIA concluded that, based on the conclusions of the subsidence assessment (MSEC, 2018), there would be no adverse impact to the identified Aboriginal sites (refer to Table 9-1).

Table 9-1 Potential impacts on Aboriginal cultural heritage

AHIMS	Type of harm	Degree of harm	Consequence of harm
AHIMS #45-7-0318	None	None	No loss of value
AHIMS # 45-7-0319	None	None	No loss of value
AHIMS #38-4-1375	None	None	No loss of value

9.3.4 Management and mitigation measures

No additional Aboriginal heritage mitigation or management measures are proposed. Implementation of the existing approved Centennial Northern Region Aboriginal Cultural Heritage Management Plan is considered adequate for managing Aboriginal heritage impacts associated with the proposed modification.

9.4 Water resources

This section addresses the water resource impacts associated with the proposed modification and details the management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Newstan Colliery Modification 8: Water Resources Impact Assessment* prepared by GHD (2018), a copy of which is provided in Appendix G.

9.4.1 Existing environment

Newstan Colliery water management system

Newstan Colliery's main water management features are the Fassifern Underground storage and West Borehole seam workings. The Fassifern Underground Storage is the void formed by previous mining activity in the Fassifern and Great Northern seams at Newstan Colliery.

The West Borehole seam workings receive groundwater inflows and can be supplied with water for underground operations from NCSS. Water is collected in sumps and pumped to the Fassifern Underground Storage.

The Fassifern Underground Storage receives inflows as a result of infiltration from the surface catchment, groundwater inflows and transfers from NCSS. Water levels in the storage are managed by transferring water to NCSS. During wet periods when water within the Fassifern Underground Storage rises above 16.6 m below ground level (6.4 m AHD), the storage discharges water by gravity through two 600 mm diameter pipes into Stony Creek via Newstan LDP017.

A water management and monitoring station at Newstan LDP017 was commissioned in 2013 to allow for emergency discharges in a controlled manner in order to ensure the safety of personnel in the underground workings at Newstan Colliery.

Clean and dirty water management

Clean and dirty surface water at NCSS is managed by Northern Coal Services as part of the Northern Coal Logistics Project. Clean water is diverted around NCSS by a series of clean water diversions, while dirty water is captured and managed in a number of water storages to minimise the potential of dirty water discharges to the surrounding environment. Potable water and waste water for the workforce of Newstan Colliery and Northern Coal Services is managed at NCSS.

Dirty water is transferred from various surface water storages at NCSS to Newstan Colliery's Fassifern Underground Storage for temporary storage and management. NCSS can also provide water to Newstan Colliery for underground mining operations.

Environment Protection Licence

Newstan Colliery's EPL (395) includes both volumetric and concentration limits for the discharge of water off-site. The existing LDPs for EPL 395 include:

- LDP001 – Discharges into the upper reaches of the northern arm of LT Creek.
- LDP002 – Discharges into the upper reaches of the northern arm of LT Creek.
- LDP017 – Discharges into a tributary of Stony Creek.

EPL 395 permits discharge of up to 11 ML/day from LDP001; however, Centennial Coal has approval to discharge up to 14.5 ML/day from this LDP under SSD-5145 as part of the Northern Coal Logistics Project, subject to variation of EPL 395.

As part of the Northern Coal Logistics Project, it was also proposed to establish LDP003 at the outlet of the Clean Water Dam within the Southern Reject Emplacement Area at NCSS. This LDP would discharge into the southern arm of LT Creek. It is yet to be established.

Groundwater

Groundwater levels

Groundwater flow in the region is generally to the south-east towards Lake Macquarie.

Alluvial monitoring is undertaken within Lords Creek, Kilaben Creek, Stockyard Creek and Stony Creek alluvium. Alluvial groundwater levels fluctuate with rainfall and have not been impacted by previous mining at Newstan Colliery.

A groundwater monitoring network has been progressively established at Newstan Colliery since 2005 and consists of monitoring bores installed in alluvium, overburden rock and coal seam strata to monitor potential impacts of longwall mining on groundwater sources and/or provide baseline data for the assessment of impacts from future workings. The bores are generally monitored monthly or quarterly for groundwater levels and groundwater quality, although some alluvial bores also contain water level loggers. Coal seam monitoring previously consisted of vibrating wire piezometers (VWPs), ceasing operation in October 2009. The piezometric head data collected prior to this time indicates that the head of groundwater in the West Borehole seam is in the order of 0 – 20 m AHD.

Groundwater inflows

Based on Centennial Newstan's water transfer data, average groundwater inflow into the existing Newstan workings within the West Borehole seam was calculated to be approximately 1.4 ML/day during 2013, reducing over time to approximately 0.7 ML/day in 2018. This is based on the assumption that the workings are fully dewatered.

The groundwater model predicts existing groundwater inflows into the Newstan workings to be approximately 1.1 ML/day.

Groundwater quality

Alluvial groundwater quality monitoring indicates that historical mining activities have not impacted groundwater quality. Based on available monitoring data, no change or lowering of the beneficial use category is evident over the period 2006 to 2009 when longwall panels were being developed in the vicinity of these bores. It is considered that in most cases the variability in pH and EC is the result of rainfall and natural conditions.

Groundwater receptors

The search for registered groundwater bores identified 14 bores within a five kilometre radius of the approximate centre of the proposed first workings area. These bores are mapped in Appendix G. None are within the proposed first workings area.

Groundwater dependent ecosystems

The terrestrial GDEs identified within an approximate five kilometre radius of the proposed first workings area, based on publically available mapping (BOM, 2018), include:

- Narrow-leaved Apple/Parramatta Red Gum/Persoonia oblongata heathy woodland of the Howes Valley area.
- Scribbly Gum/Red Bloodwood/Angophora inopina heathy woodland on lowlands of the central coast.
- Smooth-barked Apple/Red Bloodwood/Brown Stringybark/Hairpin Banksia heathy open forest of the Central Coast.
- Spotted gum/Broad-leaved Mahogany/Grey Gum grass/shrub open forest on Coastal Lowlands of the Central coast.
- Spotted Gum/Broad-leaved Mahogany/Red Ironbark shrubby open forest.
- Swamp Mahogany/Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast.
- Sydney Blue Gum/Lilly Pilly mesic tall open forest of coastal ranges and tablelands escarpment.

Lake Macquarie, Muddy Lake, and Whiteheads Lagoon are mapped as aquatic GDEs. The GDEs in the vicinity of the proposed first workings area are shown in Appendix G.

Surface water

The proposed first workings area is located within the catchment area of Lake Macquarie. A number of watercourses traverse the proposed first workings area including:

- Stony Creek.
- Kilaben Creek.
- Stockyard Creek.
- Some unnamed creeks and tributaries.

The proposed first workings area encompasses a small proportion of the catchment areas associated with these watercourses.

LT Creek does not traverse the proposed first workings area, however it does traverse the NCSS, flowing in an easterly direction.

Downstream water users

Residential properties adjacent to the downstream freshwater reach of LT Creek are identified in Table 9-2. The search of the NSW Water Register completed in July 2018 indicated that there were no water access licences (WALs) for surface water use downstream of the proposed modification.

Table 9-2 Lots abutting the downstream freshwater reach of LT Creek

Deposited Plan (DP)	Lot	Existing water supply works approvals under the WM Act
592911	56	None
755207	257	None
	256	None
	254	None
1165945	100	None
1139078	259	None

Stream health

Aquatic ecology of LT Creek and Stony Creek

Instream aquatic ecology monitoring of LT Creek and Stony Creek is undertaken biannually as part of the Newstan Colliery aquatic ecology monitoring program. The monitoring program assesses the stream health of LT Creek and Stony Creek through the sampling of aquatic macroinvertebrates at five freshwater sites and three estuarine sites.

Results from recent sampling events have shown some influence of the LDP001 discharges on the community composition, but no evidence of impacts to the sensitivity and diversity of freshwater macroinvertebrates in LT Creek. Freshwater sites on Stony Creek have been dry during most recent aquatic ecology monitoring events. Estuarine macroinvertebrate samples have shown no patterns to suggest impacts due to discharges from Newstan Colliery.

Ecotoxicity of LDP001

Ecotoxicity has been assessed in accordance with EPL 395 for the LDP001 discharges and for the receiving environment of LT Creek (WMP03). Overall, the toxicity of the LDP001 discharges has been low since the commissioning of the Clean Water Plant (CWP) at NCSS in December 2013, with no acute effects observed in any of the samples tested to date. With the exception of the 2016 assessment, chronic toxicity has been negligible. The chronic toxicity observed in 2016 did not exceed EPL 365 condition L5.1 for toxicity to the cladoceran. Further details regarding the ecotoxicity of the LDP001 discharges are provided in Appendix G.

Watercourse stability

The majority of LT Creek was found to be in good geomorphic condition, with no watercourse stability threatening processes identified in LT Creek, with the exception of small (less than 0.5 m) head cuts in a reach of the creek downstream of Miller Road.

Newstan Colliery's LDP017 discharges into an unnamed tributary of Stony Creek. This tributary has a generally well vegetated channel set within alluvial sediments with a relatively low gradient of 0.0005 m/m. Existing instabilities are limited to localised sections of bank erosion that may be exacerbated by significant and prolonged discharge flows.

Existing water and salt balance

As part of the water impact assessment for the proposed modification, the water and salt balance at Newstan Colliery was updated for existing conditions. The annual average water balance is summarised in Table 9-3. Groundwater inflow into underground workings is divided into inflows into the West Borehole seam workings and all other groundwater inflows.

Table 9-3 and Table 9-4 show that the major inflows to the water and salt balance at Newstan Colliery are groundwater inflows and surface infiltration into the underground workings. The major outflow is due to transfers to the NCSS for discharge via LDP001.

Table 9-3 Forecast annual average water balance – existing conditions

Water management element	Annual average flow - existing conditions (2018) (ML/year)
Inputs	
Groundwater inflows into underground workings (West Borehole seam and Fassifern underground)	941
Surface infiltration into underground workings (Fassifern underground)	1160
Transfers from NCSS	671
Total inputs	**2772**
Outputs	
Transfers to NCSS (via Fassifern underground)	2747
Discharge to Stony Creek outlet (LDP017)	23
Total outputs	**2770**
Change in storage	
Underground water storages	2
Total change in storage	**2**
Balance	
Inputs – outputs – change in storage	0

Table 9-4 Forecast annual average salt balance – existing conditions

Water management element	Annual average salt flux - existing conditions (2018) (tonne/year)
Inputs	
Groundwater inflows into underground workings	1833
Surface infiltration into underground workings	1944
Transfers from NCSS	301
Total inputs	**4078**
Outputs	
Transfers to NCSS	4054
Discharge to Stony Creek outlet (LDP017)	31
Total outputs	**4085**
Change in storage	
Underground water storages	-7
Total change in storage	**-7**
Balance	
Inputs – outputs – change in storage	0

The forecast average annual discharges via EPL 395 are summarised in Table 9-5, which shows that discharges from LDP001 occur frequently and make up almost all discharges via EPL 395. Discharges from LDP002, LDP003 (planned) and LDP017 are forecast to occur infrequently and, in terms of average magnitude, be small compared to LDP001.

Table 9-5 Forecast EPL 395 discharges – existing conditions

EPL 395 discharges	Annual average flow - existing conditions (2018) (ML/year)	Annual average salt flux - existing conditions (2018) (tonne/year)	Annual probability of discharge
LDP001	2721	3990	100%
LDP002	24	12	45%
LDP003 (Planned)	1	0	10%
LDP017	23	31	10%

9.4.2 Proposed water management

The existing water management infrastructure will manage any additional water make generated by the proposed modification. Further, no increases to the current approved volumetric discharge limits are required. Therefore, there will be no change to the existing NCSS and Newstan Colliery water management systems.

9.4.3 Impact assessment

Water and salt balance impacts

The water and salt balance model was simulated from existing conditions to 6 July 2021 for both future and proposed conditions. The forecast annual average water balance is compared in Table 9-6 and the salt balance is compared in Table 9-7.

Table 9-6 Forecast annual average water balance – approved and proposed conditions

Water management element	Annual average flow - approved conditions (2021) (ML/year)	Annual average flow - proposed conditions (2021) (ML/year)
Inputs		
Groundwater inflows into underground	923	929
Surface infiltration into underground	1160	1160
Transfers from NCSS	671	671
Total inputs	**2754**	**2760**
Outputs		
Transfers to NCSS	2736	2741
Discharge to Stony Creek outlet (LDP017)	23.1	23.6
Total outputs	**2759**	**2765**
Change in storage		
Underground water storages	-5	-5
Total change in storage	**-5**	**-5**
Balance		
Inputs – outputs – change in storage	0	0

Table 9-6 shows that under proposed conditions, on average, groundwater inflows are forecast to be less than one per cent greater compared to future conditions (i.e. without the proposed modification). This increase is forecast to result in a slight increase in transfers to NCSS and discharge to Stony Creek outlet (about two per cent).

Table 9-7 Forecast annual average salt balance –approved and proposedconditions

Water management element	Annual average flux - approved conditions (2021) (tonne/year)	Annual average flux - proposed conditions (2021) (tonne/year)
Inputs		
Groundwater inflows into underground	1793	1808
Surface infiltration into underground	1944	1944
Transfers from NCSS	293	293
Total inputs	**4030**	**4045**
Outputs		
Transfers to NCSS	4017	4027
Discharge to Stony Creek outlet (LDP017)	31.1	31.8
Total outputs	**4048**	**4059**
Change in storage		
Underground water storages	-18	-14
Total change in storage	**-18**	**-14**
Balance		
Inputs – outputs – change in storage	0	0

Table 9-7 shows that the impact of the proposed modification on the salt balance is forecast to be very similar to the impact on the water balance. On average, groundwater inflows are forecast to be less than one per cent greater compared to approved conditions. This increase is forecast to result in a slight increase in transfers to NCSS and discharge to Stony Creek outlet (about two per cent).

EPL 395 discharges

The forecast discharges via EPL 395 are compared in terms of water volume, discharge frequency and salt mass in Table 9-8, Table 9-9 and Table 9-10, respectively. The licensed daily volume limit for LDP001 is presented in Table 9-8 along with the annual equivalent assuming the maximum licensed discharge per day.

Table 9-8 Forecast EPL 395 discharges – approved and proposed conditions

EPL 395 discharges	Annual average flow - approved conditions (2021) (ML/year)	Annual average flow - proposed conditions (2021) (ML/year)	EPL 395 discharge limits	
			(ML/day)	(ML/year equivalent)
LDP001	2710	2715	11	4015
LDP002	24.4	24.4	-	-
LDP003 (Planned)	1.1	1.1	-	-
LDP017	23.1	23.6	-	-

Table 9-9 Forecast EPL 395 discharge frequency – approved and proposed conditions

EPL 395 discharges	Annual discharge probability - approved conditions (2021)	Annual discharge probability - proposed conditions (2021)
LDP001	100%	100%
LDP002	45%	45%
LDP003 (Planned)	10%	10%
LDP017	10%	10%

Table 9-10 Forecast EPL 395 discharges (salt) – approved and proposed conditions

EPL 395 discharges	Annual average flux - approved conditions (2021) (tonne/year)	Annual average flux - proposed conditions (2021) (tonne/year)
LDP001	3953	3963
LDP002	12.3	12.3
LDP003 (Planned)	0.5	0.5
LDP017	31.1	31.8

Table 9-8, Table 9-9 and Table 9-10 show that discharges of water and salt through LDP001 are forecast to increase slightly from the approved conditions (less than one per cent) due to the proposed modification, while discharges from LDP002 and LDP003 (planned) are forecast to be unaffected.

The frequency of discharges through LDP017 is not forecast to change due to the proposed modification, although the forecast volume of water and mass of salt in the event of discharge is slightly higher (less than two per cent). This is because discharges through LDP017 are likely to occur as a result of prolonged periods of above average rainfall, resulting in high rates of infiltration into the underground workings. This process would not be affected by the proposed modification. However, in the event that discharges through LDP017 occur, the slightly higher groundwater inflows may mean that the volume of water required to be discharged for the safety of the underground operations may be slightly higher.

Overall, the proposed modification is not expected to have a significant impact on the water and salt balance of Newstan Colliery or on licenced discharges to LT Creek.

Surface water

As indicated by the water and salt balance modelling, the proposed modification is predicted to have a small impact on the amount of water and salt discharged from LDP001 and as water is treated at the CWP prior to discharge via LDP001, there is no change to water quality in LT Creek predicted.

The proposed modification is not predicted to have an impact on the likelihood of discharges through LDP017 to Stony Creek. As any discharges through LDP017 are in response to heavy rainfall, any change to the water quality of LDP017 is predicted to be negligible.

No measureable surface deformations are predicted as a result of the proposed modification (MSEC, 2018). As such, there are no predicted impacts to flows or water quality in the creeks which transect the proposed first workings area (Stony Creek, Kilaben Creek and Stockyard Creek).

There were no downstream water users identified which could be potentially impacted by the proposed modification.

Stream health

Aquatic ecology

The predicted increases in water and salt discharged from LDP001 as a result of the proposed modification are considered to be negligible (less than one per cent). Therefore, no impacts to stream health in LT Creek are predicted. No change in the likelihood of discharge through LDP017 to Stony Creek is predicted, and as any change the water quality of this discharge would be negligible, no change in macroinvertebrate community composition in Stony Creek is predicted as a result of the proposed modification.

Ecotoxity of LDP001

The proposed modification is not considered likely to result in a change in the quality of water discharged via LDP001. It is considered likely that existing conditions, where no acute toxicity and negligible chronic toxicity has been observed, will continue during the mining of the proposed first workings.

Watercourse stability

The minor (less than one per cent) increase in discharges through LDP001 predicted by the water balance modelling is unlikely to generate any geomorphic response in LT Creek. The stability of the watercourse is predicted to be maintained, as its wide and densely vegetated nature dissipates the majority of flows.

Water balance modelling predicted that there would be no greater probability of discharges through LDP017 to the Stony Creek catchment as a result of the proposed modification. As such, the extent and severity of bank erosion in the unnamed tributary of Stony Creek is not expected to be exacerbated by the proposed modification.

Groundwater impacts

The proposed workings are not predicted to result in any drawdown of alluvial groundwater. Therefore the predicted impacts on alluvial groundwater within the proposed first workings area are expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are considered to be acceptable. No impacts on GDEs are predicted.

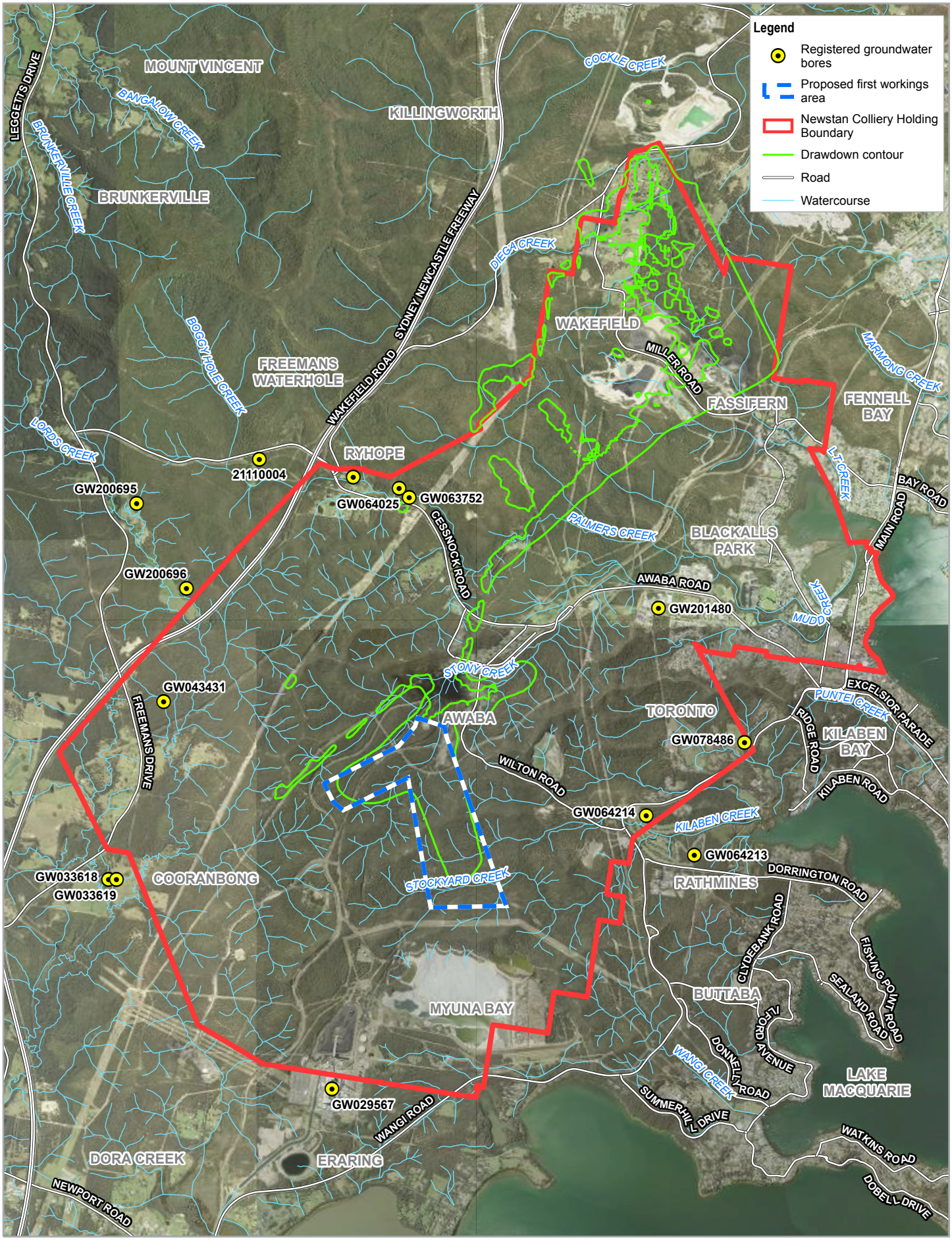
The groundwater model predicts some additional drawdown of porous and fractured rock groundwater within the Permian strata above the proposed first workings as well as above existing workings (due to the additional one year of dewatering). The zone of drawdown is shown on Figure 9-1. It is not expected that this drawdown will impact registered groundwater users, with the zone of drawdown generally being at least 2 km from registered bores; with the exception of GW064025 and GW063752 (however these are shallow bores (12 m deep) and not within the Permian strata). Therefore predicted impacts on porous and fractured rock groundwater are also expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable.

9.4.4 Management and mitigation measures

The measures described in Table 9-11 would be implemented in addition to those currently described in Newstan Colliery's surface water and groundwater management plans, to avoid or minimise water resource impacts.

Table 9-11 Water resources management and mitigation measures

Aspect/Impact	Management and mitigation measure	Timing
Trigger action response plan (TARP)	A Trigger Action Response Plan (TARP) will be developed to address the risk of any changes to the LDP001 discharge water quality and volume that have the potential to impact EPL compliance.	Pre-operation
Groundwater quality monitoring	The groundwater quality in the first workings will be monitored monthly. The proposed monitoring parameters are as follows: • Physicochemical parameters: pH, EC, turbidity, TSS, and Oil and Grease • Metals (dissolved and total): Al, B, Cd, Co, Fe, Pb, Mn, Ni, Se and Zn • Major anions: Alkalinity, sulfate and chloride • Major cations: Sodium, calcium, magnesium, potassium	Operation



Paper Size ISO A4

0 0.4 0.8 1.2 1.6 2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Centennial Coal
Newstan Colliery Mod 8
Environmental Assessment

Additional Permian drawdown due to proposed modification (1m contour)

Project No. **22-19526**
Revision No. **0**
Date **20/09/2018**

Figure 9-1

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Print date: 20 Sep 2018 - 13:05

Data source: NSWNRATLAS: Registered Bores, 2018; Centennial: Consent boundary, 2016; LPI: DTDB, 2016; sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. sixmaps/LPI_Imagery_Best: © Department of Finance, Services & Innovation 2017. Created by: fmackay

9.5 Air quality

This section addresses the air quality impacts associated with the proposed modification and details the management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Newstan Colliery Modification 8: Air Quality Impact Assessment* prepared by SLR (2018b), a copy of which is provided in Appendix H.

9.5.1 Methodology

The assessment of air quality impacts for the proposed modification was undertaken by comparing the predicted particulate matter and odour emissions from the proposed modification with those previously predicted for the same emission sources (SLR, 2014) as part of the SSD- 5145 application for the Northern Coal Logistics Project (approved in December 2017). The comparison was made to determine the influence that the proposed modification would have on the total air quality impacts previously assessed for the Northern Coal Logistics Project, and consequently, the scale of impacts expected from the proposed modification.

9.5.2 Emission sources

The elements of the proposed modification with potential for air quality impacts have been identified as the mine ventilation shafts and ventilation fans located within the NCSS. There are two ventilation fans which are owned and operated by Centennial Newstan to ventilate the underground workings of Newstan Colliery. These fans are operated such that only one fan is operated at any given time, with the other one used as a back-up.

The emissions from the ventilation fans include particulates (Total Suspended Particulates (TSP), Particulate matter less than 10 microns (PM10) and Particulate matter less than 2.5 microns (PM2.5)) and odour.

There are likely to also be some minor emissions of combustion gases from the ventilation shaft due to combustion of diesel in underground equipment used to mine the coal. However, any emissions from the combustion of fuel in equipment on site would not be emitted in high enough concentrations to have potential to result in any adverse off-site air quality impacts.

The location of the two ventilation fans at the NCSS is shown in Figure 9-2.

Figure 9-2 Location of ventilation fans at NCSS (SLR, 2018b)

Emission rates

Measurements of particulate and odour emissions from the ventilation fans at NCSS were not available. Instead, results from particulate and odour monitoring conducted on the ventilation fans at the Mandalong Mine Access Site were adopted for the assessment (SLR 2018b), which is consistent with the Northern Coal Logistics Project air quality impact assessment (SLR 2014).

The ventilation flow rate for the proposed modification has been estimated to be 180 m^3/s. This figure is based on historical fan flow rate data from Newstan Colliery when mining was occurring at a rate equivalent to 2 Mtpa.

The calculated particulate and odour emission rates for the proposed modification, based on measurements of emissions at the Mandalong Mine Access Site, and assuming a ventilation fan flow rate of 180 m^3/s, are shown in Table 9-12.

Table 9-12 Calculated particulate and odour emission rates for the proposed modification

Parameter	Value	Unit
TSP emission rate	1.3	g/s
PM10 emission rate	0.2	g/s
PM2.5 emission rate	0.2	g/s
Odour emission rate	41,580	$Ou.m^3$

9.5.3 Existing environment

Sensitive receptors

As part of the air quality impact assessment for the Northern Coal Logistics Project (SLR 2014), air quality impacts were assessed at a total of six (6) sensitive receptors around the NCSS. These sensitive receptors are considered to be relevant to the proposed modification. The locations of the sensitive receptors identified in the vicinity of NCSS are listed in Table 9-13 and shown on Figure 9-3.

Table 9-13 Sensitive receptors –air quality

Receptor ID	Type/Location	Coordinates (UTM))		Elevation (m, AHD)
		Easting	Northing	
NC1	Dwelling –Jefferson Road, Wakefield	365,779.7	6,351,882.4	40
NC2	Dwelling – Miller Road, Fassifern	365,720.1	6,351,115.5	58
NC3	Dwelling – Wallsend Road, Fassifern	367,462.9	6,349,487.1	12
NC4	Dwelling – Narara Street, Fassifern	367,399.3	6,348,880.4	27
NC5	Dwellling – Reynolds Street, Fassifern	366,904.1	6,348,625.7	72
NC6	Fassifern Primary School	367,580.8	6,349,693.9	11

9.5.1 Criteria

Particulate matter

The current air quality criteria for Newstan Colliery, as listed in development consent DA 73-11-98, are reproduced in Table 9-14.

Table 9-14 Current air quality criteria DA 73-11-98

Pollutant	Averaging period	Criterion	
Particulate matter <10 µm (PM10)	24 hour	[a] 50 µg/m^3	
	Annual	[a,d,e] 30 µg/m^3	
Total suspended particulates (TSP)	Annual	[a,d] 90 µg/m^3	
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a,d] 4 g/m^2/month

Notes:

[a] *Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).*

[b] *Incremental impact (i.e. increase in concentrations due to the development along, with zero allowable exceedances of the criteria over the life of the development).*

[c] *Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NCS 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 by the Secretary.*

[e] *SSD-5145 annual PM10 criterion is 25 µg/m^3.*

Figure 9-3 Sensitive air quality receptor locations (SLR, 2018b)

Since the most recent modification to development consent DA 73-11-98 (MOD 7) was granted on 15 December 2015, the National Clean Air Agreement (NCAA) was endorsed by Commonwealth, State and Territory Environment Ministers. Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles. All jurisdictions have agreed to implement strengthened standards for particles, as well as move to even tighter standards for annual average and 24-hour PM2.5 in 2025.

As such, in February 2016, a variation to the Ambient Air Quality National Environment Protection Measure (NEPM) was made to extend its coverage to PM2.5, setting reporting standards for PM2.5 with no allowable exceedances (NEPC 2016). In addition, the Ambient Air Quality NEPM revised the standard for annual average PM10 to be in line with the NCAA.

These standards have now been adopted by NSW Environment Protection Authority (EPA). The updated standards are outlined in the NSW EPA document titled *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA 2017) (Approved Methods).

The updated standards for particles are reflected in the current development consent for the Northern Coal Logistics Project SSD-5145 (as modified), granted in December 2017, which assessed air quality impacts from the Newstan Colliery ventilation fans. In particular, the criterion for annual average PM10 is updated from 30 µg/m^3 to 25 µg/m^3.

The air quality goals adopted for the assessment of air quality impacts from the proposed modification, which conform to current State and Federal air quality criteria, are summarised in Table 9-15.

Table 9-15 Air quality goals adopted for the proposed modification

Pollutant	Averaging period	Criterion	Source
PM10	24 hour	50 µg/m^3	EPA, 2017
	Annual	25 µg/m^3	EPA, 2017
PM2.5	24 hour	25 µg/m^3	EPA, 2017
	Annual	8 µg/m^3	EPA, 2017
TSP	Annual	90 µg/m^3	EPA, 2017
Deposited dust	Annual	2 g/m^2/month (maximum increase in deposited dust level) 4 g/m^2/month (maximum total deposited dust level)	EPA, 2017

Odour

The current odour compliance condition for Newstan Colliery, as listed under development consent DA 73-11-98, is reproduced as follows:

"The Applicant shall ensure that no offensive odours, as defined under the POEO Act, are emitted from the site."

The NSW EPA impact assessment criteria for complex mixtures of odours have been designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. Where a number of the factors simultaneously contribute to making an odour "offensive", an odour goal of 2 Odour Units (ou) at the nearest residence (existing or any likely future residences) is appropriate.

An odour criterion of 2 ou was therefore adopted for the assessment of odour impacts from the proposed modification.

9.5.2 Impact assessment

Potential off-site impacts are dependent on a range of input variables such as the meteorological conditions, regional topography, locations of the ventilation fans, operational conditions of the ventilation fans, relative location of the sensitive receptors and pollutant emission rates.

All the input variables are anticipated to be constant between the proposed modification operations and operations assessed as part of the air quality impact assessment completed for the Northern Coal Logistics Project (SLR 2014), with the exception of the operational conditions for the ventilation fans (i.e. exit velocity) and pollutant emission rates. A comparison of the particulate and odour emission rates estimated for the proposed modification operations and those assessed as part of the air quality impact assessment completed for the Northern Coal Logistics Project (SLR 2014) is shown in Table 9-16.

The emission rates estimated for the proposed modification operations are approximately 30% higher than those used in the air quality impact assessment completed for the Northern Coal Logistics Project (SLR 2014). The higher exit velocity of 9.9 m/s is based on historical operational data for Newstan Colliery.

Table 9-16 Estimated fan emission data for proposed modification compared with SLR 2014

Parameter	Proposed modification	Northern Coal Logistics Project air quality impact assessment (SLR 2014)
TSP emission rate (g/s)	1.30	0.99
PM10 emission rate (g/s)	0.22	0.16[2]
PM2.5 emission rate (g/s)	0.22	0.17[2]
Odour emission rate ($ou.m^3/s$)	41,580	30,282
Exit velocity (m/s)	9.9	7.5

A total of eight (8) operational scenarios were assessed as part of the Northern Coal Logistics Project air quality impact assessment (SLR, 2014), based on a range of coal movement and coal handling options.

The dispersion modelling results in the Northern Coal Logistics Project air quality impact assessment (SLR, 2014) showed that at the identified sensitive receptors, the predicted annual average dust deposition rates, annual average TSP concentrations, annual average PM10 concentrations, annual average PM2.5 concentrations and maximum 24-hour average PM2.5 concentrations were below the respective criteria across all the scenarios.

In regards to the maximum 24-hour average PM10 concentrations, exceedances were predicted at receptor R6 for scenarios 2a, 3a and 3b, with 3a being the highest. Scenario 3a assessed the air quality impacts from the following operations:

- Receipt of 6 Mtpa of coal from the Cooranbong Entry Site.
- Export of 8 Mtpa of coal by rail.
- Trucks dumping coal at ROM stockpile.
- Trucks dumping coal at rail loop stockpile.
- Manual train loading using FELs.

A source contribution analysis was conducted for predicted maximum 24-hour PM10 concentrations at receptor R6 for scenario 3a. This analysis showed that the contribution of emissions from the NCSS ventilation fans to the total predicted incremental impacts from the Northern Coal Logistics Project was less than 0.4%.

Given this negligible contribution, the 30% increase in the estimated emissions from the NCSS ventilation fans as a result of the proposed modification, compared to that assumed in the modelling during the assessment of air quality impacts for the Northern Coal Logistics Project, would not be expected to have any significant impact on the total offsite PM10 concentrations.

Further, the higher exit velocity from the ventilation fans estimated for the proposed modification operations (9.9 m/s) compared to that used in the Northern Coal Logistics air quality impact assessment (7.5 m/s) can be expected to facilitate the dispersion of plumes and would potentially result in lower ground level concentrations being predicted at the sensitive receptors for this source.

As discussed in Section 9.5.1, there has been a change in the EPA criterion for annual average PM10 concentrations since development consent DA 73-11-98 was originally granted in May 1999, reducing it from 30 µg/m^3 to 25 µg/m^3. The maximum cumulative annual average PM10 concentration predicted in the air quality impact assessment for the Northern Coal Logistics Project (SLR 2014) was 19.9 µg/m^3, at receptor R2. This was comprised of a background annual average concentration of 14.8 µg/m^3 and an incremental contribution from the Northern Coal Logistics Project of 5.1 µg/m^3. Given the contribution of emissions from the NCSS ventilation fans to the total predicted incremental impacts from the Northern Coal Logistics Project was found to be less than 0.4%, a 30% increase in ventilation fan emissions as a result of the proposed modification can be expected to increase the incremental PM10 concentrations at receptor R2 by a maximum of 0.12% (0.4% x 30%). This represents an increase of less than 0.01 µg/m^3 in incremental impacts from the proposed modification. Therefore, the resultant cumulative annual average PM10 concentration at receptor R2 will remain at 19.9 µg/m^3. Compliance with the revised criterion of 25 µg/m^3 would therefore continue to be achieved with the inclusion of the additional emissions predicted for the proposed modification.

In regard to the results predicted for odour in the air quality impact assessment for the Northern Coal Logistics Project (SLR 2014), the 99th percentile 1-hour average odour concentration was predicted to be less than 1 ou at all the identified sensitive receptors surrounding the NCSS for all modelled scenarios.

Based on the above, even though there is an increase in the estimated pollutant emission for the proposed modification, the impacts from the ventilation fans can be expected to still be negligible at the identified sensitive receptor locations compared to other sources at the NCSS.

9.5.3 Management and mitigation measures

Given that impacts on air quality are expected to be negligible, no specific management and mitigation measures are proposed. Existing air quality mitigation and management measures implemented at Newstan Colliery will continue to be applied for the proposed modification.

9.6 Greenhouse gas

A greenhouse gas assessment for the proposed modification was completed by SLR (2018b). A copy of the assessment is provided in Appendix I, with significant findings and recommendations summarised below.

9.6.1 Methodology

The greenhouse gas (GHG) assessment for the proposed modification was performed with reference to the Australian Department of Climate Change and Energy Efficiency's (DCCEEs) *National Greenhouse Accounts Factors* (DotEE, 2017), the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) and the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol Initiative (WRI, 2004).

The greenhouse gas emissions associated with the proposed modification were assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential, as detailed below.

Scope 1 Emissions

Scope 1 emissions refer to the direct emissions that occur as a result of a development's activities. The Scope 1 emissions for the proposed modification are:

- Transportation of materials, products, waste or people e.g. the combustion of diesel in mobile equipment, including on-road and off-road vehicles and stationary equipment.
- Generation of electricity, heat and/or steam, e.g. the combustion of diesel in generators.
- Fugitive emissions, both intentional and unintentional, e.g. through the use of switchgear, methane from exposed coal, land clearing etc.
- On-site waste management, e.g. solid and liquid waste management through landfill, sewage treatment, incineration etc.

Scope 2 Emissions

Scope 2 emissions refer to indirect emissions that are a consequence of a development's activities but are not from sources owned or controlled by the company. Scope 2 emissions for the proposed modification relate to indirect emissions associated with the generation of imported electricity for new infrastructure usage.

Scope 3 Emissions

Scope 3 indirect emissions are related to the upstream emissions generated in the extraction and production of fossil fuels and in the emissions from contracted/outsourced activities.

Scope 3 emissions are generally Scope 1 or 2 emissions for other companies. For example, in general, diesel use by contractors is a Scope 3 emission, yet is referred to as a Scope 1 emission in the GHG inventory of the contractor. Combustion of coal to produce electricity will result in a Scope 1 emission at the power station or a Scope 2 emission for industry or householders.

Scope 3 emissions may be, but are not required to be, reported as part of the GHG emissions assessment.

9.6.2 Emission sources

The potential greenhouse gas emission sources (Scope 1 to Scope 3) from the proposed modification include:

- Scope 1:
  - Diesel use in equipment used to mine 2 Mt of ROM coal over approximately 18 months (assuming the modification will commence on 1 January 2020 and run until expiry on 6 July 2021).
  - Fugitive CH_4 and CO_2 emissions from the ventilation system.
  - Consumption of oils during the 18 month period.
- Scope 2 – Electricity consumption associated with the underground mine during the 18 month period.
- Scope 3 – Emissions associated with the production and transport of diesel and oil consumed at the site during the 18 month period.

The projected activity data for the proposed modification and current 'Care and Maintenance' activities are shown in Table 9-17. The data for the proposed modification have been estimated based on historical operations at Newstan Colliery for the months of November 2008 and April 2009, when production was undertaken a rate equivalent to 2 Mtpa.

Table 9-17 Newstan Colliery activity data

Parameter	Approved project (historical data)	Approved project (Care and Maintenance)	Proposed modification	
	Average per month	Per annum	Per annum	Total
ROM throughput (tonnes)	167,536	0	1,335,000	2,000,000
Diesel consumption (kL)	29.03	12.2	232.5	351.6
Oil consumption (kL)	0	1.5	0	0
CO_2 emissions from vent (1,000 m^3)	324.0	406.3	2,594.9	3,924.4
CH_4 emissions from vent (1,000 m^3)	1,563.9	3,193.6	12,526.8	18,944.7
Electricity consumption (MWh)	-	5,587.1	13,178.7	19,930.4

9.6.3 Impact assessment

Calculated Scope 1, Scope 2 and Scope 3 greenhouse gas emissions resulting from the emissions sources for the approved project and the relative emissions contribution from each emission source as a result of the proposed modification are presented in Table 9-18.

Table 9-18 Summary of emissions from approved project and relative contributions from proposed modification

Activity/source	Estimated GHG Emissions (tonnes CO_2-e)		
	Approved project (Care and Maintenance)	Proposed modification	
	Per annum	Per annum	Total (18 months)
Scope 1			
Diesel consumption	33	630	953
Oil consumption	1	0	0
Fugitives – CH_4 and CO_2	54,920	217,284	328,605
Sub-total – Scope 1	***54,594***	***217,914***	***329,558***
Scope 2			
Electricity consumption	4,637	10,938	16,542
Scope 3			
Diesel and oil production	2	32	49
Total	**59,593**	**228,885**	**346,149**

The impacts of the proposed modification are as follows:

- Annual Scope 1 and Scope 2 GHG emissions are estimated to be 0.17 tonnes of CO_2-e per ROM tonne of coal produced. If only the incremental increase in annual emissions compared to keeping the mine in 'Care and Maintenance' mode are considered, the GHG intensity estimate reduces to 0.13 tonnes of CO_2-e per ROM tonne of coal.
- The main contributor to the estimated emissions is fugitive CH_4 and CO_2 emissions, which account for 94.9 per cent of the total combined Scope 1 and Scope 2 emissions.
- Electricity and diesel fuel consumption are estimated to account for only 4.8 per cent and 0.3 per cent respectively.

When compared with State and National greenhouse gas emissions from 2016, the predicted annual emissions represent 0.18 per cent and 0.04 per cent of total emissions for NSW and Australia respectively. As such, the relatively small amount of GHG emissions generated by proposed modification will have an undetectable effect on global climate change.

9.6.4 Mitigation and management

As part of Centennial Coal's Sustainability Strategy, the company has set its "Vision 2020", the platform to tangibly deliver the Company Vision and Values. Vision 2020 incorporates a target for greenhouse gas, being to reduce company greenhouse gas emissions by 25 per cent by 2020. An action plan and roadmap is in place to deliver this goal.

Existing greenhouse gas mitigation and management measures implemented at Newstan Colliery such as the sealing up of old mine workings will continue to be applied for the proposed modification.

9.7 Other impacts

A brief qualitative assessment of the impact of the proposed modification on other environmental aspects is presented in Table 9-19.

Table 9-19 Other impacts

Aspect	Potential impacts from proposed modification
Noise and vibration	Newstan Colliery is currently approved under DA 73-11-98 to extract up to 4 Mtpa. The proposed modification is seeking approval to extract the proposed first workings at a maximum rate of 2 Mtpa, which represents 50% of the maximum approved extraction rate for Newstan Colliery. Further, the proposed modification would neither involve the construction or operation of any infrastructure, nor the operation of any noise generating equipment, which is additional to that currently approved under DA 73-11-98. Therefore, noise impacts in addition to those currently approved under DA 73-11-98 are not expected as a result of the proposed modification.
Traffic and transport	The proposed modification is not proposing any changes to the current approved traffic and transportation activities or the current approved operational workforce (245 FTE employees) at Newstan Colliery. Access to Newstan Colliery for the proposed modification would continue to be off Miller Road, Fassifern. Transportation of the coal extracted as part of the proposed modification would continue to be undertaken in accordance with SSD 5145 as part of the Northern Coal Logistics Project. No impacts to traffic and transport additional to those currently approved under DA 73-11-98 and SSD-5145 are expected as a result of the proposed modification.
Visual amenity	The proposed modification is not proposing any changes to the current approved surface infrastructure at Newstan Colliery, nor is it proposing any surface disturbance activities. Landform changes as a result of the proposed first workings would be visually imperceptible. As such, there would be no visual amenity impacts as a result of the proposed modification.
Non-Aboriginal heritage	A review of the EIS for the Northern Coal Logistics Project (SLR, 2014) and a search of the State Heritage Register completed on 20 September 2018 indicates that there are no known items of Non-Aboriginal heritage within the proposed first workings area. Notwithstanding, given surface features are predicted to experience subsidence of less than 20 mm due to the development of the first workings, the potential for adverse impacts to any as yet unknown items of Non-Aboriginal heritage as a result of the proposed modification is very low.
Soils and land capability	The proposed modification would not involve any surface disturbance activities. Given surface features are predicted to experience subsidence of less than 20 mm due to the development of the first workings, soil and land capability impacts as a result of the proposed modification are expected to be negligible.
Bushfire	The proposed modification is not expected to increase the risk of bushfire impacts at Newstan Colliery. Bushfire management would continue to be undertaken in accordance with current management practices at Newstan Colliery.
Waste	No additional waste streams would be generated from the proposed modification. Waste management would continue to be undertaken in accordance with the approved waste management system at Newstan Colliery.
Closure and rehabilitation	The primary objective for rehabilitation of Newstan Colliery is to return areas to a natural land use that is consistent with the area's pre-mining land use and/or to some form of beneficial land use (for example, industry) that is acceptable to relevant stakeholders. There would be no change to the closure

Aspect	Potential impacts from proposed modification
	and rehabilitation requirements at Newstan Colliery as a result of the proposed modification.
Cumulative impacts	The proposed modification is anticipated to pose minimal environmental impacts beyond those previously assessed and approved under DA 73-11-98. Given the generally negligible impacts expected, and the location of Newstan Colliery within an established mining precinct, the contribution of the proposed modification towards the cumulative impacts experienced by sensitive receivers and the environment would be negligible.

10. Justification and conclusion

A description of the need and justification for the proposed modification is provided in this chapter with regard to environmental, social and economic factors. This includes consideration of alternatives, the principles of Ecologically Sustainable Development (ESD) and the consistency of the proposed modification with the objectives of the EP&A Act.

10.1 Modification justification and alternatives

Centennial Coal has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery (Newstan Extension Project). The proposed modification would allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed mine life extension sought as part of the proposed modification would also enable operations at Newstan Colliery to continue until the determination for the Newstan Extension Project is made.

Furthermore, the proposed modification ensures optimised resource recovery while providing ongoing direct and indirect employment opportunities. It would also provide a number of positive flow-on effects to the local, regional and state economies through additional wages and royalties.

The coal recovered from the proposed first workings would also produce both a semi-soft coking coal product for the export market and a thermal coal product for both the domestic and export markets. The proposed modification would enable the ongoing supply of export coal products while meeting contractual coal supplies to the domestic markets.

The proposed modification would not result in any substantial change to the approved operations at Newstan Colliery. There would be no change to the approved maximum coal production, coal handling, coal transportation, or water management. The life of Newstan Colliery would be extended by 12 months. As detailed in the EA, the proposed modification would have limited environmental impacts beyond those originally approved in Development Consent DA 73-11-98.

The option of not proceeding with the proposed modification is not considered feasible as it would not enable a thorough assessment of the geological conditions associated with the Newstan Extension Project in order to potentially develop a suitable, efficient and safe mine plan. Furthermore, not proceeding with the proposed modification would constrain mine design options for the Newstan Extension Project and would constrain further development and employment opportunities more generally for Newstan Colliery.

10.2 Modification impacts

This EA, which includes relevant technical specialist assessments, documents the various studies that have been undertaken to examine potential impacts that may occur as a result of the proposed modification.

The assessment of environmental issues has been multi-disciplinary and involved consultation with key stakeholders. The proposed modification is anticipated to pose minimal environmental impacts beyond those previously assessed and approved under DA 73-11-98.

10.3 Modification benefits

The propound modification would allow Centennial Coal to gain a more comprehensive understanding of mine design options, methods of extraction and infrastructure requirements for the Newstan Extension Project.

The proposed modification would allow for the optimisation of resource recovery while providing ongoing direct and indirect employment opportunities. In addition, the proposed modification would provide a number of positive flow-on effects to the local, regional and state economies through additional wages and royalties.

The coal recovered from the proposed first workings area during the proposed first workings would enable supply of export coal products while meeting contractual coal supplies to the domestic markets.

Approval of the proposed modification would also result in greater economic and related social returns for the State. This will also have a positive social impact over the life of the mine.

10.4 Ecologically Sustainable Development

ESD is a primary objective of environmental protection in NSW. The objects of the EP&A Act adopt the principles of ESD and it is defined under section 6(2) of the *Protection of the Environment Administration Act 1991* as:

6(2) For the purposes of subsection (1)(a), ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

a. ***the precautionary principle*** *- namely, that 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:*

   i. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

   ii. an assessment of the risk-weighted consequences of various options,

b. ***inter-generational equity*** *- namely, 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,*

c. ***conservation of biological diversity and ecological integrity*** *- namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,*

d. ***improved valuation, pricing and incentive mechanisms*** *- namely, 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.

The overall objectives of ESD are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future.

Centennial Newstan is committed to the principles of ESD and understands that social, economic and environmental objectives are interdependent. The company acknowledges that a well-designed and effectively managed operation will avoid significant and/or costly environmental impacts or degradation. Consideration has been given to appropriately identifying, avoiding, mitigating and managing environmental risks. This demonstrates environmental due diligence and will provide for on-going and adaptive monitoring and management of the operation in line with the ESD principles outlined in the below sub-sections.

10.4.1 The precautionary principle

The precautionary principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent the degradation.

This EA has enabled an understanding of the potential impacts of the proposed modification on environmental, social and economic factors. Existing management controls and mitigation strategies, as well as additionally proposed mitigation measures, will be implemented to effectively monitor, mitigate and/or manage the potential environmental and socio-economic impacts of the proposed modification should it be approved.

10.4.2 Intergenerational equity

Intergenerational equity is centred on the concept 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. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

Newstan Colliery undertakes ongoing environmental monitoring with mitigation measures to provide effective environmental management across its operations. This management is provided through planning, communication, documentation, review and feedback. These environmental management measures ensure that the health, diversity and productivity of the environment is maintained or enhanced for future generations.

10.4.3 Conservation of biological diversity and ecological integrity

The principle of "conservation of biological diversity and ecological integrity" holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals.

The potential environmental impacts of the proposed modification and existing measures to ameliorate these potential impacts are detailed in this report. The modification poses no significant impacts to biodiversity or ecological matters beyond those approved under DA 73-11-98.

10.4.4 Improved valuation, pricing and incentive mechanisms

The principle of "improved valuation, pricing and incentive mechanisms" deems that environmental factors should be included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to protect that resource. Newstan Colliery will optimise the valuation and pricing of the coal resource by efficiently achieving the extraction of additional coal resources by utilising existing approved infrastructure and identifying the sustainable and efficient recovery of a future coal resource associated with the Newstan Extension Project.

10.5 Conclusion

Environmental impacts resulting from the proposed modification are not considered to be significant and would only result in a negligible change to impacts associated with the current operations at Newstan Colliery. There would be no change to the approved maximum coal production, coal handling, coal transportation, or water management. The life of Newstan Colliery would be extended by 12 months to ensure operations at Newstan Colliery until a determination on the Newstan Extension Project is made.

The adoption of appropriate management measures, generally in accordance with Newstan Colliery's current approved environmental management plans, would minimise the potential for any residual impacts associated with the proposed modification.

It is therefore recommended that pursuant to Section 75W of the EP&A Act, the Minister approves the proposed modification.

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12. Abbreviations

Term	Definition
^{o}C	Degrees Celsius
ACHIA	Aboriginal Cultural Heritage Impact Assessment
AHD	Australian height datum
AIP	NSW *Aquifer Interference Policy*
Banpu	Banpu Public Company Limited
BC Act	NSW *Biodiversity Conservation Act 2016*
Biraban LALC	Biraban Local Aboriginal Land Council
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Scheme
BSAL	Biophysical strategic agricultural land
Burra Charter	*The principles of the Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*
CCC	Community Consultative Committee
Centennial Coal	Centennial Coal Company Limited
Centennial Newstan	Centennial Newstan Pty Limited
CPP	Coal preparation plant
CWP	Clean Water Plant
DCCEE	Department of Climate Change and Energy Efficiency
DLWC	Department of Land and Water Conservation
DotEE	Department of the Environment and Energy
DP	Deposited Plan
DP&E	Department of Planning and Environment
EA	Environmental Assessment
EMS	Environmental Management System
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EP&A Regulation	NSW *Environmental Planning and Assessment Regulation 2000*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPA	Environment Protection Authority
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FTE	Full-time equivalent
GDE	Groundwater dependent ecosystem
GHG	Greenhouse has

Term	Definition
ha	Hectares
ILUA	Indigenous Land Use Agreement
kL	Kilolitres
Lake Macquarie LEP	*Lake Macquarie Local Environmental Plan 2014*
LEP	Local Environmental Plan
LGA	Local government area
Lower Hunter Regional Strategy	DP&E's *Lower Hunter Regional Strategy 2006-31*
LS2030	Lake Macquarie City Council's *Lifestyle 2030 Strategy*
Mining SEPP	NSW *SEPP (Mining, Petroleum Production & Extractive Industries) 2007*
ML	Megalitre
MNES	Matters of national environmental significance
MOP	Mining Operations Plan
MSB	Mine Subsidence Board
MSEC	Mine Subsidence Engineering Consultants
Mtpa	Million tonnes per annum
NCSS	Newstan Colliery Surface Site
NGER Act	Commonwealth *National Greenhouse and Energy Reporting Act 2007*
NPW Act	NSW *National Parks and Wildlife Act 1974*
NPW Regulation	NSW *National Parks and Wildlife Regulation 2009*
NREA	Northern Reject Emplacement Area
NSW	New South Wales
OEH	Office of Environment and Heritage
PCT	Plant community types
POEO Act	NSW *Protection of the Environment Operations Act 1997*
RAPs	Registered Aboriginal Parties
ROM	Run-of-mine
RTO	Reverse thermal oxidiser
SEPP	State Environmental Planning Policy
SEPP 33	NSW *SEPP No. 33 - Hazardous and Offensive Development*
SRD SEPP	NSW *SEPP (State and Regional Development) 2011*
SREA	Southern Reject Emplacement Area
SSD	State significant development
TARP	Trigger action response plan
TEC	Threatened ecological community
VWPs	Vibrating wire piezometers
WAL	Water access licence

Term	Definition
WHS (Mines Act)	NSW *Work Health and Safety (Mines) Act 2013*
WM Act	NSW *Water Management Act 2000*
WRI/WBCSD	World Resources Institute/World Business Council for Sustainable Development
WSP	Water Sharing Plan

Appendices

Appendix A – Correspondence establishing environmental assessment requirements for the proposed modification

Centennial Coal
Newstan

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16 April 2018

BY Email

Mr. Howard Reed
Director, Resource Assessments
NSW Department of Planning and Environment
320 Pitt Street
SYDNEY NSW 2000

Dear Howard,

RE: Newstan Colliery (DA 73-11-98) – Modification 8 – Environmental Assessment Requirements.

Background and Purpose

Centennial Coal (Centennial) has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery located at Fassifern, NSW. The Newstan Extension Project will be assessed as a State Significant Development application in accordance with the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). At this time, the relevant background studies are being undertaken to understand the potential impacts on the environment including sensitive surface features.

Centennial intends to develop and lodge a scoping report regarding the Newstan Extension Project with the NSW Department of Planning and Environment (DP&E) in Quarter 3 2018 once the required information is available and preliminary stakeholder engagement has been undertaken. Based on the outcomes of the scoping report, it is expected that DP&E will issue Secretary's Environmental Assessment Requirements forming the basis of the Environmental Impact Statement. The project schedule regarding the assessment process indicates that determination is expected in Quarter 3 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed ahead of the State Significant Development application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021.

A Section 75W application was made on 26 February 2018 and was accepted by DP&E noting that formal Environmental Assessment Requirements will not be issued for the modification. As discussed during the meeting of 27 March 2018, the purpose of this letter is to seek confirmation from DP&E regarding the technical assessments required to support the 75W application. An update to the proposed site layout plan (dated 31/01/18) specifically the Project Application Area supplied with the 75W application on 26 February 2018 has be made to include areas of mining already approved under DA 73-11-98. This update is to ensure contemporary assessments are undertaken across all proposed first workings areas. A copy of this updated plan is attached to this letter (**Appendix A**).

The preliminary (draft) Subsidence Predictions and Impact Assessment Report (MSEC, 2018) has confirmed that the pillars are considered to be long-term stable and are not

Centennial Newstan Pty Limited ABN 68 101 508 865

expected to reactivate the existing Awaba workings due to the very low levels of predicted movement. Maximum predicted vertical subsidence at the surface, due to the first workings in the West Borehole Seam is expected to be around 11 mm. Based on the low level of risk associated with the first workings, the following assessments are proposed to be undertaken to support the Environmental Assessment.

Biodiversity

Please refer to the attached memorandum (**Appendix B**) which outlines the proposed approach to be undertaken with regard to the biodiversity surveys and assessment. A copy of this memorandum has been provided to the Office of Environment and Heritage seeking their feedback and in-principle support.

Aboriginal Heritage

An Aboriginal Heritage Impact Assessment will be prepared in consultation with the Registered Aboriginal Parties. Consultation with the Registered Aboriginal Parties will be undertaken in accordance with Centennial's Northern Region Aboriginal Cultural Heritage Management Plan.

Water Resources

The existing hydrogeological model will be reviewed and updated to reflect recent observed groundwater levels and inflow data. Once updated, the hydrogeological model will form the basis of a Water Resources Impact Assessment that considers the impact of the first workings on the groundwater and surface water environment.

Air Quality and Greenhouse Gas

An Air Quality and Greenhouse Gas assessment will be completed to update the emission estimates associated with the additional coal resource to be extracted by the proposed extent of first workings. In addition an assessment of the Scope 1, 2 and 3 emissions as a result of the first workings will be presented.

Closing Remarks

We would be grateful if you would confirm in writing that the above technical assessments are adequate to support the Modification 8 to DA 73-11-98. Should you need to discuss this matter please do not hesitate to contact me on (02) 4935 8901.

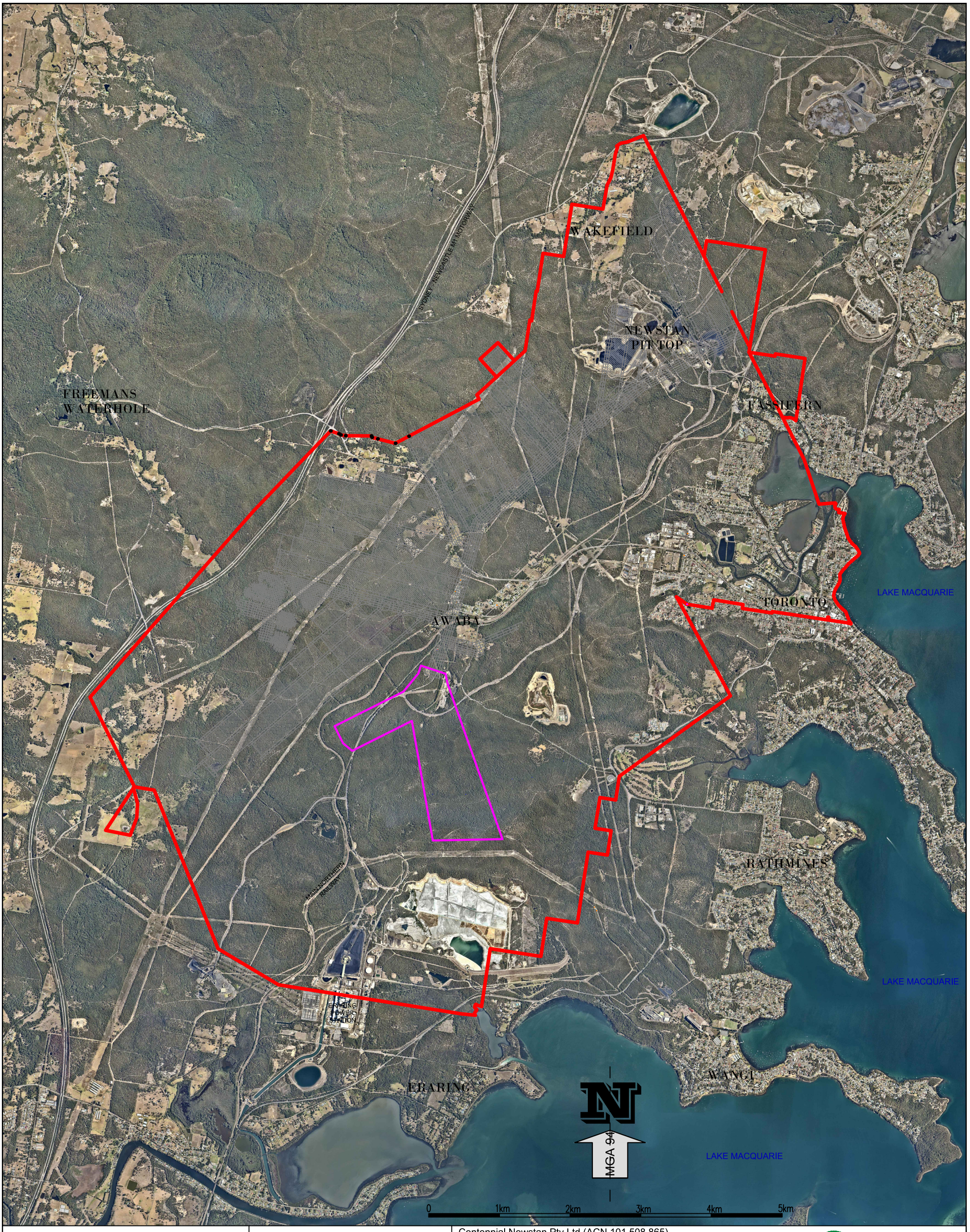
Yours sincerely

Iain Hornshaw
Approvals Coordinator

Encl: Appendix A: Mod 8 Project Application Area

Appendix B: RPS Memorandum Seeking in principle support for the Newstan Mod' 8 biodiversity assessment approach (14/04/18).

Appendix A: Mod 8 Project Application Area



LEGEND

- Newstan Colliery Holding
- Existing Seam Workings
- MOD 8 Project Application Area

ENDORSEMENTS

- *Aerial image referenced from NearMap dated 8th February 2018*
- *The co-ordinate system for all data shown on this plan is Map Grid of Australia 1994 (MGA94).*

nearmap

Centennial Newstan Pty Ltd (ACN 101 508 865)

NEWSTAN COLLIERY
Surface

Centennial Newstan

TITLE:

MOD 8 Project Application Area

DRAWN:	C.Cluderay	REVISION:		All Distances are in metres unless otherwise shown.	A3
DATE:	16/04/2018	DATE:			
CHECKED:	I.Hornshaw J.Boersma	PLOT FILE:	N:\Shared\Plots\Newstan\Projects\Newstan Extension\NS3382.pdf		NS3382
APPROVED:	G.Watson	SCALE:	1:50,000 (at A3 size)		

Appendix B: RPS Memorandum Seeking in principle support for the Newstan Mod' 8 biodiversity assessment approach (14/04/18)

Newcastle Office
Ground Floor, 241 Denison Street, Broadmeadow, NSW 2292
PO Box 428, Hamilton NSW 2303
T +61 2 4940 4200

Meeting Date:	13/04/2018
To:	Department of Planning and Environment
From:	Arne Bishop
Subject:	Seeking in principle support for the Newstan Mod' 8 biodiversity assessment approach

1 Introduction

Newstan Colliery is seeking an eighth modification to Development Consent DA 73-11-98 (Newstan Mod' 8). The modification is required to enable first workings to proceed on scheduled and determine the presence, throw and strike of the major fault projected from the historic Newstan workings. The modification will also seek to extend the life of DA 73-11-98 for an additional 12 months.

This memorandum seeks to gain in principle support with regards to the proposed biodiversity survey and assessment approach outlined herewith.

2 Regulatory context

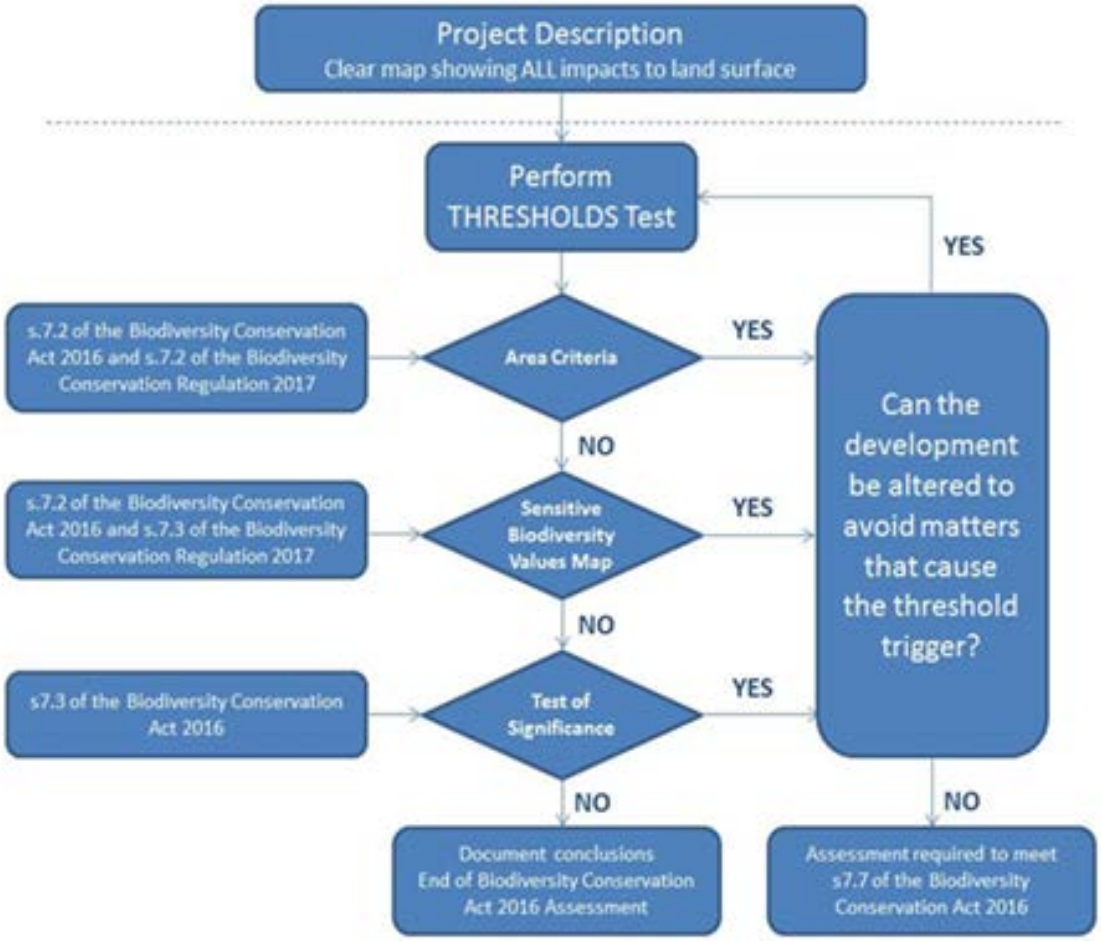
As of 25th August 2017, the NSW Government repealed the *Threatened Species Conservation Act* 1995 and replaced it with the *Biodiversity Conservation Act* 2016 (BC Act) and its regulation (2017). This change has resulted in a new approach to assessing biodiversity which is now termed the Biodiversity Assessment Methodology (BAM). The current proposal is a modification under Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act) to an existing Part 4 Development consent DA 73-11-98 for the Newstan Colliery.

Given the above, it is necessary to conduct a multiple test process in considering impacts on biodiversity to determine if there is a requirement for BAM to be conducted.

These steps are outlined in Section 7.2 of the BC Act, where tests are applied to determine if a development or activity is "likely to significantly affect threatened species". These are:

- Impacts are likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in Section 7.3 of the BC Act;
- Impacts exceed the biodiversity offsets scheme thresholds (thresholds test); or
- Impact on declared area of outstanding biodiversity value.

If the answer is 'yes' to any of the above, then an impact assessment is to be performed by an Accredited Person (Section 7.7 of the BC Act) in accordance with the Biodiversity Assessment Methodology (BAM); otherwise, evidence to the contrary is to be documented and preferably provided as part of the development application to show why assessment is not required. The process involved is outlined in the following flowchart.



The development site contains areas mapped as significant biodiversity on the significant biodiversity Values Map. Consequently, a BAM will be required to be prepared under the BC Act.

2.1 Biodiversity Assessment Methodology

The BAM requires the assessment to be prepared by an accredited assessor. The BAM will also be applied to identify reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity.

Utilising the BAM plot data gathered in the field and other GIS information, the BAM Credit Calculator will be populated and "run". Outputs generated from the initial run will be interim credit report from the BAM Credit Calculator relating to the impact site, clearly identifying the 'Ecosystem Credits' and the 'Species Credits' required to be retired to meet "no net loss", plus any other matters requiring consultation with OEH.

The field data and subsequent BAM credit calculations for both the development site and ordinarily the biodiversity stewardship (offset) site would be utilised to produce a Biodiversity Development Assessment Report (BDAR). Ultimately, reporting is required to be conducted for the formal project application in accordance with the BAM requirements, being:

Stage 1 – Biodiversity Assessment;

Stage 2 – Impact Assessment (biodiversity values); and

Stage 3 – Improving Biodiversity Values.

The BAM process requires consultation with OEH to ensure the Offsets and calculations are sufficient and appropriate.

RPS propose to conduct fieldwork, reporting and BAM requirements Stages 1 & 2 only. Consequently, no offset package is proposed by Centennial at this stage and it is not anticipated that a BAM Stage 3 – Improving Biodiversity Values assessment will be required for this project as a result of the minimal predicted impacts. The draft MSEC (2018) Subsidence Predications and Impact Assessment report predicts that the project is unlikely to have adverse impacts on the natural and built features as a result of the very low levels of predicted ground movement (i.e. less than 20 mm) associated with the proposed first workings. Furthermore, sink holes are not predicted to occur due to the high depth of cover (180m and 270m).

3 Field Survey Approach

At this stage it is proposed to conduct BAM plot data collection only across the development site which will result in an accurate delineation of the required Ecosystem Credits.

RPS propose to approach the development site assessment by assuming presence of species credit species which are likely to occur within the development site with only incidental observations of species credit species and their habitats being noted during surveys. This will be conducted in line with section 6.4.1 of the BAM by assuming presence of species credit species which are likely to use suitable habitat, on the subject land (or specific vegetation zones) in place of adequate surveys.

4 Summary of approach requiring comment

In principle support for the proposed approach is sought on the basis that MSEC (2018) predict very low levels of ground movement (i.e. less than 20 mm) associated with the proposed first workings. This is considered unlikely to result in impacts on potentially occurring biodiversity values.

1. Field surveys will only be conducted for the development site (Stages 1 & 2 only) with no offset package (Stage 3) proposed at this stage.
2. Surveys are conducted for ecosystem credits only and all species credit species are assumed present on the basis of suitable habitat occurring within the site.

If the proponent applies separately for secondary extraction at a later date, further BAM surveys and assessments would be required to be undertaken in line with the predicted impacts.

FW: Centennial Newstan Mod 8
Lauren Evans to: Iain Hornshaw 24/04/2018 03:24 PM
Cc: Colin Phillips, James Wearne
History: This message has been forwarded.

Dear Iain

Thank you for your letter dated 16 April 2018 regarding the Environmental Assessment (EA) for Newstan Colliery – Modification 8. The Department generally agrees with Centennial's proposed approach to assessment, subject to the following comments:

Biodiversity
The Department understands that Centennial has sought confirmation from OEH regarding the application of the Biodiversity Assessment Methodology (BAM). The Department will await advice from OEH in this regard.

Water Resources
The Department notes that Centennial intends to review and update its hydrogeological model, and that this model will form the basis of a Water Resources Impact Assessment (WRIA) for Modification 8. This assessment should give particular consideration to:

- potential interactions with the existing underground workings at Awaba, and any associated impacts (particularly with respect to surface infrastructure and water resources); and
- any need for referral to the Commonwealth.

Subsidence
The EA should include an assessment of the likely conventional and non-conventional subsidence effects and impacts of the development, and the potential consequences of these effects and impacts on the natural and built environment, paying particular attention to those features that are considered to have significant economic, social, cultural or environmental value, including:

- infrastructure;
- heritage items/archaeological sites; and
- watercourses and natural flow regimes.

The EA should also include a detailed assessment of the potential interactions with the existing underground workings at Awaba, including consideration of pillar instability, pillar run and any potential environmental impacts.

If you need any further information or clarification, please feel free to contact me.

Kind Regards

Lauren Evans
Senior Planning Officer
Resource Assessments | Planning Services
320 Pitt Street | GPO Box 39 | Sydney NSW 2001
T 02 9274 6311 E lauren.evans@planning.nsw.gov.au

NSW GOVERNMENT Planning & Environment

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From: Lauren Evans
Sent: Tuesday, 24 April 2018 1:49 PM
To: Jessie Evans <Jessie.Evans@planning.nsw.gov.au>
Subject: FW: Centennial Newstan Mod 8

From: Iain Hornshaw [mailto:Iain.Hornshaw@centennialcoal.com.au]
Sent: Monday, 16 April 2018 2:02 PM
To: Howard Reed <Howard.Reed@planning.nsw.gov.au>
Cc: Colin Phillips <Colin.Phillips@planning.nsw.gov.au>; James Wearne <James.Wearne@centennialcoal.com.au>
Subject: Centennial Newstan Mod 8

Dear Howard,

Please find attached a letter as follow up to our meeting of 27 March 2018.

I look forward to the Department's feedback.

Regards

Iain Hornshaw
Approvals Coordinator

p: +61 (0) 2 4935 8901 | m: +61 (0) 435 030 438

Centennial Coal

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Appendix B – Schedule of land within the proposed consolidated development consent boundary

Schedule of land within proposed consolidated development consent boundary	
LOT SP50017	LOT 320 DP857889
LOT 1 DP1139314	LOT 321 DP857889
LOT 1 DP1147459	LOT 322 DP857889
LOT 1 DP121470	LOT 323 DP857889
LOT 1 DP130632	LOT 324 DP857889
LOT 1 DP239629	LOT 325 DP857889
LOT 1 DP34358	LOT 326 DP857889
LOT 1 DP502590	LOT 327 DP857889
LOT 1 DP561528	LOT 328 DP857889
LOT 1 DP626824	LOT 329 DP857889
LOT 1 DP659579	LOT 33 DP755207
LOT 1 DP729932	LOT 33 DP835633
LOT 1 DP758041	LOT 330 DP857889
LOT 1 DP815846	LOT 331 DP857889
LOT 1 DP817297	LOT 332 DP857889
LOT 1 DP833614	LOT 333 DP857889
LOT 1 DP835263	LOT 334 DP857889
LOT 1 DP873289	LOT 335 DP857889
LOT 10 DP1031778	LOT 336 DP857889
LOT 10 DP1146201	LOT 337 DP857889
LOT 10 DP239629	LOT 338 DP857889
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LOT 11 DP249535	LOT 390 DP1064199

Schedule of land within proposed consolidated development consent boundary	
LOT 11 DP623972	LOT 391 DP1064199
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LOT 11 DP758041	LOT 397 DP821668
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LOT 12 DP758041	LOT 409 DP1006267
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LOT 14 DP249535	LOT 419 DP1006267
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LOT 14 DP835633	LOT 42 DP804985

Schedule of land within proposed consolidated development consent boundary	
LOT 140 DP755218	LOT 42 DP835633
LOT 141 DP755207	LOT 420 DP1006267
LOT 142 DP755207	LOT 421 DP1006267
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LOT 167 DP755207	LOT 46 DP835633
LOT 168 DP755207	LOT 462 DP1138964
LOT 169 DP755207	LOT 463 DP1138964
LOT 17 DP1031778	LOT 464 DP1138964

Schedule of land within proposed consolidated development consent boundary	
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LOT 17 DP875748	LOT 471 DP860305
LOT 170 DP755207	LOT 472 DP860305
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LOT 172 DP755207	LOT 475 DP1138964
LOT 173 DP755207	LOT 48 DP835633
LOT 174 DP755207	LOT 49 DP835633
LOT 175 DP755207	LOT 4A DP376807
LOT 18 DP1031778	LOT 4B DP376807
LOT 18 DP755218	LOT 4C DP376807
LOT 180 DP755207	LOT 5 DP1031778
LOT 183 DP755207	LOT 5 DP239629
LOT 184 DP755207	LOT 5 DP46737
LOT 185 DP755207	LOT 5 DP738276
LOT 186 DP755207	LOT 5 DP758041
LOT 187 DP755207	LOT 5 DP758041
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LOT 192 DP755207	LOT 5 DP835263
LOT 194 DP755207	LOT 5 DP845676
LOT 195 DP755207	LOT 50 DP835633
LOT 196 DP755207	LOT 51 DP622344
LOT 2 DP1031778	LOT 51 DP700659
LOT 2 DP1139314	LOT 51 DP835633
LOT 2 DP233639	LOT 52 DP622344
LOT 2 DP239629	LOT 52 DP700659
LOT 2 DP516039	LOT 52 DP835633
LOT 2 DP561528	LOT 53 DP835633
LOT 2 DP615264	LOT 54 DP755218
LOT 2 DP755218	LOT 54 DP835633
LOT 2 DP758041	LOT 55 DP835633
LOT 2 DP758041	LOT 56 DP835633
LOT 2 DP815846	LOT 57 DP835633
LOT 2 DP835263	LOT 58 DP792783
LOT 2 DP873289	LOT 58 DP835633
LOT 20 DP1031778	LOT 6 DP1031778
LOT 20 DP835633	LOT 6 DP239629
LOT 203 DP844413	LOT 6 DP46737

Schedule of land within proposed consolidated development consent boundary	
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LOT 205 DP844413	LOT 6 DP835633
LOT 206 DP844413	LOT 60 DP835633
LOT 207 DP755207	LOT 61 DP569340
LOT 207 DP844413	LOT 61 DP603232
LOT 208 DP755207	LOT 61 DP615460
LOT 208 DP844413	LOT 62 DP569340
LOT 209 DP755207	LOT 62 DP603232
LOT 209 DP755218	LOT 62 DP615460
LOT 209 DP844413	LOT 64 DP755207
LOT 21 DP532058	LOT 65 DP1126625
LOT 21 DP835633	LOT 66 DP755207
LOT 210 DP755207	LOT 7 DP1031778
LOT 210 DP844413	LOT 7 DP239629
LOT 211 DP755207	LOT 7 DP738276
LOT 211 DP844413	LOT 7 DP758041
LOT 212 DP755207	LOT 7 DP835633
LOT 212 DP844413	LOT 7 DP845676
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LOT 213 DP844413	LOT 7014 DP93169
LOT 214 DP755207	LOT 7019 DP1050414
LOT 214 DP844413	LOT 702 DP1030918
LOT 215 DP755207	LOT 702 DP516825
LOT 215 DP844413	LOT 7047 DP1125954
LOT 216 DP755207	LOT 7052 DP1057169
LOT 216 DP844413	LOT 7053 DP1052818
LOT 217 DP844413	LOT 7059 DP1060424
LOT 218 DP844413	LOT 7060 DP1060424
LOT 219 DP755207	LOT 7061 DP1060425
LOT 219 DP844413	LOT 7062 DP1060425
LOT 22 DP1076675	LOT 7062 DP1060426
LOT 22 DP755207	LOT 7063 DP1060426
LOT 22 DP835633	LOT 7064 DP1060437
LOT 220 DP844413	LOT 7065 DP1077182
LOT 221 DP548001	LOT 7066 DP1077182
LOT 221 DP755207	LOT 7067 DP1077182
LOT 221 DP844413	LOT 7068 DP1077183

Schedule of land within proposed consolidated development consent boundary	
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LOT 223 DP844413	LOT 7072 DP1077184
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LOT 243 DP844413	LOT 7329 DP1166478
LOT 244 DP844413	LOT 7336 DP1170023
LOT 245 DP844413	LOT 7337 DP1170022
LOT 246 DP844413	LOT 7338 DP1170024
LOT 247 DP844413	LOT 78 DP755207
LOT 248 DP1154986	LOT 8 DP1031778
LOT 248 DP844413	LOT 8 DP758041
LOT 249 DP844413	LOT 8 DP835633
LOT 25 DP835633	LOT 81 DP519603

Schedule of land within proposed consolidated development consent boundary	
LOT 250 DP844413	LOT 82 DP519603
LOT 251 DP844413	LOT 85 DP1070146
LOT 259 DP1139078	LOT 85 DP755207
LOT 26 DP835633	LOT 861 DP528641
LOT 266 DP755207	LOT 862 DP528641
LOT 27 DP755207	LOT 87 DP755207
LOT 27 DP835633	LOT 88 DP755218
LOT 277 DP755207	LOT 89 DP755207
LOT 281 DP755207	LOT 89 DP755218
LOT 3 DP1031778	LOT 9 DP1031778
LOT 3 DP239629	LOT 9 DP239629
LOT 3 DP516039	LOT 9 DP758041
LOT 3 DP758041	LOT 9 DP835633
LOT 3 DP815846	LOT 90 DP755218
LOT 3 DP835263	LOT 91 DP755207
LOT 301 DP755207	LOT 91 DP755218
LOT 301 DP857889	LOT 91 DP825387
LOT 302 DP857889	LOT 92 DP755207
LOT 303 DP857889	LOT 92 DP755218
LOT 304 DP857889	LOT 92 DP825387
LOT 305 DP857889	LOT 93 DP1131485
LOT 306 DP857889	LOT 93 DP755218
LOT 307 DP857889	LOT 94 DP755207
LOT 308 DP857889	LOT 94 DP755218
LOT 309 DP857889	LOT 95 DP755207
LOT 31 DP557456	LOT 95 DP755218
LOT 31 DP858764	LOT 96 DP755207
LOT 310 DP857889	LOT 96 DP755218
LOT 311 DP857889	LOT 97 DP755207
LOT 312 DP857889	LOT 98 DP755207
LOT 313 DP857889	LOT 98 DP755218
LOT 314 DP857889	LOT 99 DP755207
LOT 315 DP857889	LOT A DP357869
LOT 316 DP857889	LOT A DP361988
LOT 317 DP857889	LOT A DP371352
LOT 318 DP857889	LOT B DP357869
LOT 319 DP857889	LOT B DP361988

Schedule of land within proposed consolidated development consent boundary	
LOT 32 DP557456	LOT B DP371352
LOT 32 DP835633	LOT C DP381399
LOT 32 DP858764	

Appendix C – Socio-economic analysis

Socioeconomic Profile
Newstan Colliery

Centennial Newstan Pty Limited

February 2018

AIGIS GROUP

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
EDS	Economic Development Strategy
FTE	Full Time Equivalent
GHG	Greenhouse gas (emissions)
GRP	Gross Regional Product
LGA	Local Government Area
LMCC	Lake Macquarie City Council
LMWSA3	Lake Macquarie West Statistical Area Level 3 (ABS)
p.a.	per annum
PT	Part Time
SA3	Statistical Area Level 3 (ABS)
SUA	Significant Urban Area (ABS)

1. INTRODUCTION

This report provides an overview of the socioeconomic impacts of Newstan Mine, located in the Lake Macquarie City Council (LMCC) Local Government Area (LGA). Comparisons with other relevant populations, most notably the immediate area in which the operations are located, the Newcastle – Maitland area are also included. Various quantitative and qualitative measures are presented to describe these populations, communities and economies, and the role of Newstan Mine in respect of these.

It is noted that Newstan Mine was placed in care and maintenance on 1 August 2014. As such, current financial data for the mine when operating at full capacity are unavailable. This being the case, data for the most recent complete operating year (FY2013-2014) are used to develop certain aspects of this profile. Where more recent assumptions are used (e.g. assessment of wage/salary impacts), this is noted in the report.

2. LOCAL AND REGIONAL POPULATIONS

2.1. Demographic profile

Key demographic data for the following Australian Bureau of Statistics (ABS) statistical geography units in which the mine is located are examined in this section. These are:

- Lake Macquarie City Council (LMCC) LGA;
- Lake Macquarie West Statistical Area Level 3 (SA3);
- Newcastle-Maitland Significant Urban Area (SUA).

The geographic extents of these areas are displayed in Figures 1 through 4.

Figure 1: Lake Macquarie West SA3

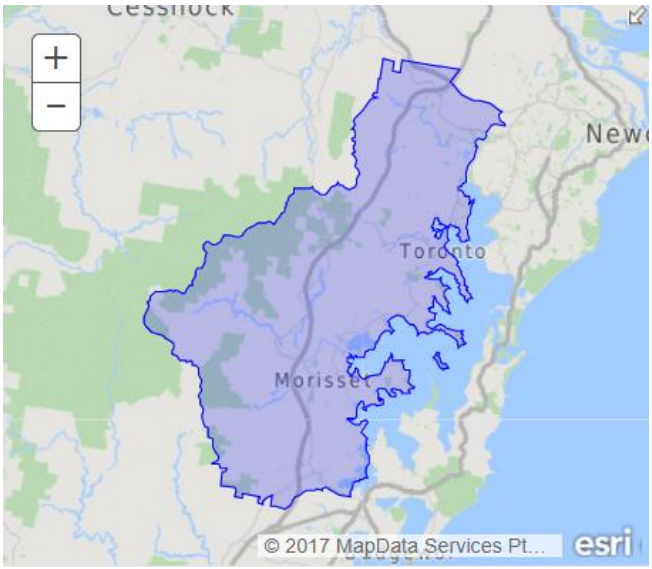


Figure 2: Lake Macquarie LGA

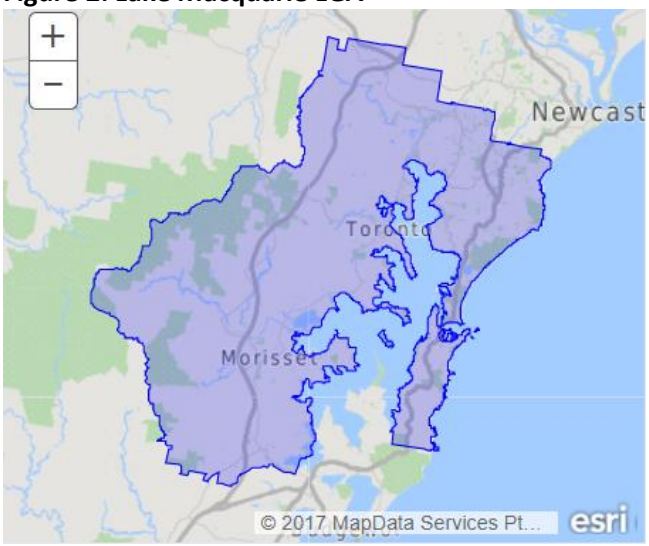
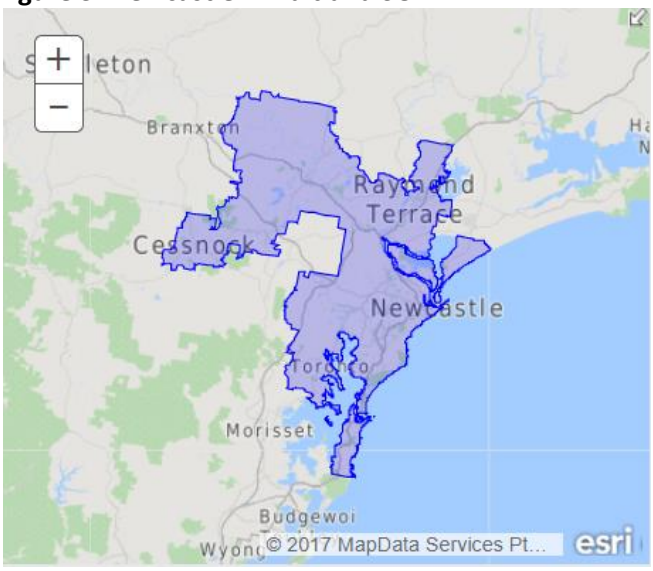


Figure 3: Newcastle – Maitland SUA



Source: ABS Census Data 2016

2.1.1. Personal characteristics

Table 1: Demographic profile; personal characteristics

	LMWSA3 (%[1])	LMCC (%)	SUA (%)	NSW (%)
Population	**75,205**	**197,371**	**463,052**	**7,480,228**
Male	48.8	48.8	49.1	49.3
Female	51.2	51.2	50.9	50.7
Median Age	**43 years**	**42 years**	**39 years**	**38 years**
< 15 years	18.2	18.2	18.6	18.5
15-29 years	17.0	17.0	19.6	19.5
30- 44 years	17.3	17.8	19.1	20.6
45-64 years	26.1	26.4	25.3	25
≥ 65 years	21.4	20.6	17.4	15.9
Ancestry (top responses)[2]				
Australian	32.3	31.9	31.0	22.9
English	32.2	32.0	31.0	23.3
Irish	8.0	8.3	8.8	7.5
Scottish	8.4	8.6	8.4	5.9
German	3.1	3.1	3.1	-
Chinese	-	-	-	5.2
Aboriginal/Torres Strait Islander	4.9	4.1	4.6	2.9
Born in Australia	84.5	85.3	84.5	65.5
Parents' country of birth				
Both parents born overseas	13.0	12.7	13.1	37.0
Father only born overseas	6.3	6.4	6.0	6.1
Mother only born overseas	4.5	4.5	4.2	4.3
Both parents born in Australia	70.3	71.1	70.5	45.5
Language				
English (only spoken at home)	91.3	91.3	88.9	68.5
Non-English language (spoken at home)	6.1	6.5	7.8	26.5
Legally registered relationship status				
Married	50.0	50.0	45.7	48.7
Separated	3.4	3.3	3.4	3.1
Divorced	9.7	9.5	9.6	8.4
Widowed	6.9	6.8	6.2	5.4
Never married	30.0	30.4	35.1	34.4
Religious affiliation				
Catholic	19.1	20.8	22.4	24.7
No religion (so described)	27.6	28.9	29.3	25.1
Anglican	22.3	21.3	21.0	15.5
Not stated	7.6	7.2	7.8	9.2
Uniting Church	5.7	5.9	5.2	-
Islam	-	-	-	3.6

Key observations

[1] Highlighted data excepted.
[2] Census form included option of reporting two (2) ancestries, therefore responses do not reconcile with population counts.

- The SA3 population is approximately 38% of the LGA population, and approximately 16% of the regional (SUA) population.
- The balance of male and female residents is relatively consistent across all populations.
- The SA3 population is older than each of the other populations, based on median age.
- The local and regional populations are relatively less ethnically diverse than for NSW, with around 85% of people born in Australia, compared to approximately 66% for NSW. Local and regional residents are also more likely to have parents born in Australia.
- All smaller populations have markedly larger proportions of Aboriginal and/or Torres Strait Islander residents than NSW in total.
- The larger proportions of widowed residents is consistent with the older populations for the local and regional populations.
- Generally, differences between the local and regional populations and NSW are also apparent for language and religious affiliation data. These further emphasise the relative homogeneity of the SA3, LGA and SUA populations.

2.1.2. Household composition characteristics

Table 2: Demographic profile: families & household composition

	LMWSA3 (%[3])	LMCC (%)	SUA (%)	NSW (%)
Couple without children	40.6	39.5	37.9	36.6
Couple with child(ren)	41.0	42.0	41.9	45.7
One parent with child(ren)	17.3	17.4	18.6	16.0
Other family	1.2	1.2	1.6	1.7
Family households	74.7	73.5	70.2	72.0
Single/lone person households	22.9	24.1	25.8	23.8
Group households	2.4	2.4	4.0	4.2
Average people/household (count)	2.6	2.5	2.5	2.6

Key observations

- The SA3 and LGA, have larger proportions of couple *without* children families, consistent with their older age profiles, with presumed larger proportions of 'empty-nester' households. These conclusions are also consistent with the registered relationship status data (Table 1).
- Higher proportions of single parent families and single/lone person households are also consistent with higher proportions of divorced persons (Table 1).
- Household size is relatively consistent across all populations.

[3] Highlighted data excepted.

2.1.3. Income & housing-related data

Table 3: Demographic profile: income data & housing-related data

	LMWSA3 (%)	LMCC (%)	SUA (%)	NSW (%)
Income	**$**	**$**	**$**	**$**
Median weekly personal income	582	609	623	664
Median weekly household income	1,499	1,610	1,641	1,780
Median weekly family income	1,276	1,313	1,324	1,486
% households < $650 gross p.w.	21.2	21.4	21.8	19.7
% households > $3000 gross p.w.	10.9	13.1	13.2	18.7
Housing tenure	**%**	**%**	**%**	**%**
Owned outright	36.1	37.7	32.9	32.0
Owned with a mortgage	37.1	35.8	34.3	32.3
Rented	22.6	23.0	29.5	31.8
Dwelling structure	**%**	**%**	**%**	**%**
Separate house	89.8	85.4	80.6	66.4
Semi-detached, row or terrace house, townhouse etc.	6.8	9.7	11.7	12.2
Flat or apartment	2.0	3.8	6.5	19.9
Other dwelling	1.2	0.9	0.6	0.9
Housing costs	**$**	**$**	**$**	**$**
Median monthly mortgage repayment	1,733	1,733	1,733	1,986
Median weekly rent	320	320	320	380

Key observations

- Incomes in the SA3 and LGA are lower than for the SUA and NSW. Housing costs, which represent a significant element of cost of living, are reported as being the same for the local and regional communities, and lower than for NSW.
- Home ownership (outright and under mortgage) is higher for the LMWSA3 and LGA, and rented accommodation lower. These higher rates of home ownership are interpreted as being consistent with the older populations in these areas.

2.1.4. Population growth projections

NSW Government Department of Planning and Environment (DPE) population projections for Lake Macquarie LGA, compared with regional NSW and the entire State, are presented in Table 4.

Table 4: NSW DPE average annual population change projections 2011-2036

Average Annual Population Growth	2011-16	2016-21	2021-26	2026-31	2031-36
Lake Macquarie	0.6%	0.6%	0.6%	0.5%	0.6%
Regional NSW	0.90%	0.80%	0.71%	0.62%	0.54%
NSW	1.00%	1.00%	1.00%	1.00%	1.00%

Projected population growth is likely to be lower for Lake Macquarie than for the larger comparators. Considering land availability and other constraints on a particular LGA in such a comparison, these outcomes are to be expected to some extent.

3. REGIONAL ECONOMIC PROFILE DATA

3.1. Economic and employment metrics

3.1.1. Headline economic data

Table 5: Headline economic indicators LMCC LGA[4]

Economic metric	LMCC value
Gross Regional Product (GRP)	≈ $9.244 billion
Population (2016 Census)	197,371
Local businesses	13,911
Employed residents	51,584
Mining employment (# jobs)	1,565
Unemployment rate	5.3%

3.1.2. Industry structure – employment by industry

Table 6: Employment by industry: ABS Census 2016 (% of total)[5]

Industry	LMWSA3 (%)	LMCC (%)	SUA (%)	NSW
Agriculture, forestry & fishing	0.7	0.4	0.6	2.2
Mining	3.1	2.6	3.6	0.9
Manufacturing	7.5	6.6	6.5	5.9
Electricity, gas, water & waste services	1.8	1.6	1.4	0.9
Construction	10.7	10.4	8.8	8.4
Wholesale trade	2.3	2.2	2.1	3.1
Retail trade	10.6	10.4	10.3	10.0
Accommodation & food services	6.1	6.8	7.9	7.1
Transport, postal & warehousing	4.6	4.2	4.1	4.7
Information media & telecommunications	0.9	0.9	0.9	2.2
Financial and insurance services	2.6	3.3	3.1	5.0
Rental, hiring & real estate services	1.4	1.4	1.4	1.8
Professional, scientific & technical services	4.4	5.3	5.6	8.1
Administrative & support services	3.5	3.3	3.3	3.5
Public administration & safety	5.2	5.9	6.5	5.9
Education & training	8.0	8.9	8.7	8.3
Health care & social assistance	16.6	16.8	16.4	12.5
Arts & recreation services	1.1	1.2	1.2	1.5
Other services	4.8	4.3	4.2	3.7

[4] Data sources: Dantia 2017: http://www.economyprofile.com.au/dantia/ . Dantia is the economic development company for Lake Macquarie City.

[5] ABS advises that small random adjustments are made to all cell values in source data to protect confidentiality. Classifications 'Inadequately described' and 'Industry of Employment not stated' excluded from this table.

Key observations

- The data demonstrate the importance of the mining industry in the Lower Hunter Region, with the SA3, LGA and SUA all having significantly greater proportions of mining employees than NSW.
- Additional ABS Census data report *coal mining* specifically as being the second largest industry of employment in the SUA (3.0%) and the fifth largest in the LMWSA3 (2.5%) (ABS 2017).
- Electricity gas, water and waste services are also comparatively over-represented compared with NSW. This emphasises the interdependencies between the regional mining and electricity generation industries which are co-located in the Lake Macquarie area.
- When supporting industries are considered in addition to these data, the importance of coal mining to the regional economies is further emphasised (refer to Sections 5.3 and 5.4).

3.1.3. Industry structure – occupation

Table 8: Comparison of mining & local/regional occupational groups 2016 Census

Occupation	LMWSA3	LMCC	SUA	NSW
	%	%	%	%
Managers	9.3	9.9	9.7	13.5
Professionals	17.2	20.1	21.2	23.6
Technicians & Trades Workers	17.1	16.1	15.2	12.7
Community & Personal Services Workers	11.6	11.5	11.9	10.4
Clerical & Administrative Workers	13.7	14.3	13.4	13.8
Sales Workers	9.9	10.1	9.9	9.2
Machinery Operators & Drivers	8.3	6.8	7.3	6.1
Labourers	11.2	9.8	10	8.8

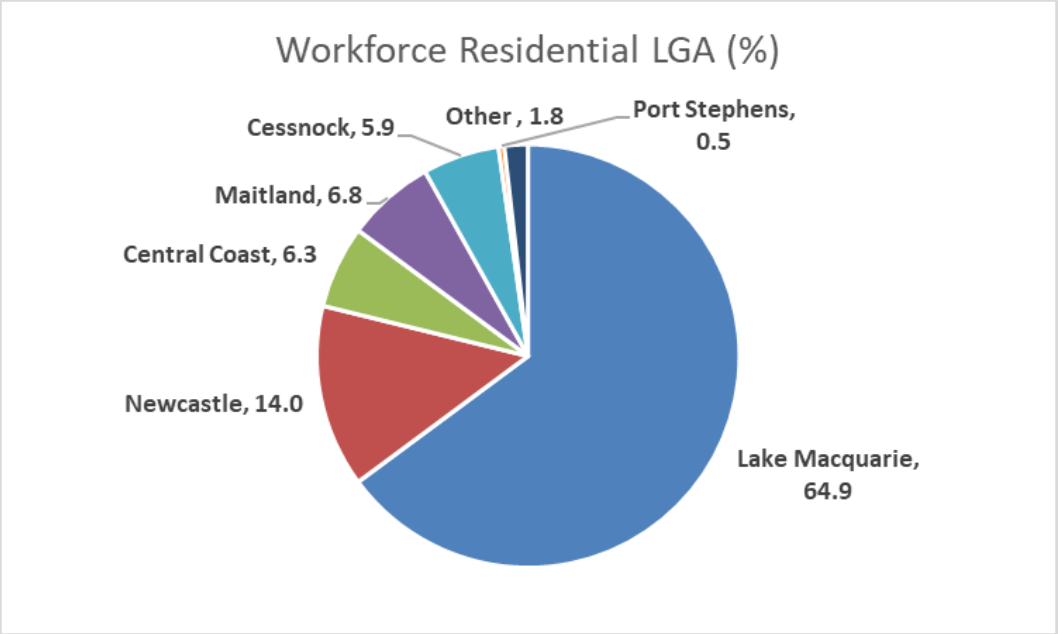
Key observations

- There are larger representations of technicians and trades workers, and machinery operators and drivers in the SA3, when compared with general workforce data for the larger populations. These are employment categories typically associated with mining.

3.1.4. Residential distribution of Newstan Mine's workforce

Figure 5 illustrates the residential distribution of the workforce as at 2014, based on internal data.

Figure 5: Residential LGAs of Newstan Mine workforce



Key observations

Summarising Figure 5:

- Approximately 65% of the workforce resides in the Lake Macquarie LGA, in which operations are based;
- In relative terms, much lower proportions of Newstan's workforce reside in other individual LGAs. However, approximately 92% of the workforce resides in the Newcastle – Maitland SUA[6].
- Although not included in Figure 5, approximately 40% of the workforce resides in the Lake Macquarie West SA3, being the parts of the LGA most immediate to Newstan.
- The data demonstrate that the mining workforce is regionally-based. As a consequence, much of the social and economic activity of the workforce takes place in the local and regional areas, further contributing to the socioeconomic functioning of these areas.
- The retention of mining employee incomes in the region is economically significant, as emphasised by comparison of mining employee incomes with overall median personal and employee incomes for the LGA, SA3 and SUA (Table 9) and LMCC economic performance data (Table 10). The higher incomes in mining employment

[6] Port Stephens LGA is only partially within the SUA, however the one employee resident in the LGA resides in a suburb located within the SUA.

encourage increased expenditure in the local and regional economies in which these employees live, when compared to population medians and measures for the regional workforce.

Table 9: Weekly gross personal income data comparison

Description	Income ($/week)
Median personal income - Lake Macquarie LGA – Census 2016	$609
Median personal income - Lake Macquarie West SA3– Census 2016	$582
Median personal income – Newcastle – Maitland SUA – Census 2016	$623
Median employee income (Lake Macquarie LGA, 2015)[7]	$906
Drillers, Miners, Shotfirers (Dept. of Employment Job Outlook 2015 data)[8]	$2,102
Earthmoving Plant Operators	$1,489
Geologists, Geophysicists and Hydrogeologists	$2,133
Mining Engineers	$2,037
Safety Inspectors	$2,121

3.2. Discussion of regional economic effects

3.2.1. LMCC Economic Profile (Dantia)

As noted in Section 4.1.1., Dantia is the economic development company of LMCC. The following comparison between mining industry and overall economic performance for the LGA is based on the most recent data published by Dantia (2017). The data also include an estimate of average employee income, based on the Dantia employment and income data.

Table 10: Economic performance indicators – LMCC LGA

Indicator	Mining Industry	LGA Economy	% mining contribution
Employment (number)	1,565	51,584	3.0
Average income ($)	$143,070	$81,960	-
	$M	***$M***	***%***
Wages & salaries	223.9	4,227.8	5.6
Output	1,475.4	18,502.6	8.0
Exports	1,312.9	5,189	25.3
Imports	370.3	5,057.8	7.3
Value added	580	8,274.7	7.0

Data source: Dantia (2017)

Adopting total employment as a measure of industry size, the mining industry makes a relatively large contribution to the regional economy. As indicated in Table 9 and demonstrated in Table 10, incomes for mining employees are comparatively large, with the associated economic on-flows that this supports. Other measures of relative productivity (output and value added) are also larger than the industry's employment measure, in terms of their proportional share of the LGA totals. As may be expected given the trade-based

[7] ABS Data by Region – derived as median employee income ($47,108)/ 52 weeks = $905.92.
[8] Selected occupational examples for brevity.

nature of the industry, exports are much higher. Imports are also higher, which is likely to be related to the value of capital investment associated with mining.

3.2.2. LMCC Economic Development Strategy (EDS) 2014-2018

The following material from the current LMCC EDS explains local government's perspective on the mining industry and its regional economic role.

Table 11: LMCC Economic Development Strategy 2014-2018.

Reference	EDS content
P.2	[LMCC's strategic] platform will also support other industries integral to the City's economy: mining, power generation and construction.
P.17	Lake Macquarie City has a diversity of industries and a broadly qualified and experienced workforce. Dantia will support other industries, such as coal mining and power generation, that are integral to the City's economy.
P.25	The City has a proud coal mining history and coal remains a robust and significant contributor to the state and national economies. Coal mines are a major direct employer and the industry generates employment and economic growth in integrated support industries such as engineering, manufacturing, service and logistics.
P.25	Lake Macquarie has access to abundant natural coal and quarrying resources, which has driven local mining since the 1800s. Similarly, local coal supplies provide thermal coal for Eraring Power Station. Connection to world-class rail, road and port infrastructure provides for low-cost operational and export and import advantages.

The EDS recognises the role of the mining industry in creating and sustaining employment and supporting a range of industries along the supply chain.

4. ASSESSMENT OF SOCIOECONOMIC EFFECTS OF NEWSTAN MINE OPERATIONS

4.1. Description of approach to assessment

The assessment presented in this section draws on internal operational data for Newstan Mine. These data are then assessed using relevant economic assessment tools to provide a quantified description of the economic contribution of the mine in the local and regional economies in particular. Additionally, qualitative measures are also presented and discussed for appropriate measures of activity and associated impacts.

4.2. Employment effects

Based on the FY2014 data for the most recent full operating year, Newstan employed 222 FTE employees, including contractors. In order to assess the contribution of this employment to the regional economy, the most recently reported average income for Mandalong Mine employees was compared with the average incomes derived in Table 10. Mandalong Mine was selected as a proxy for Newstan, as the mines are of comparable scale when in full production. The method applied produces a labour surplus, which may be interpreted as the additional (and to some extent, disposable) income component of employee incomes, compared with broader employee levels. Much of this surplus is

disbursed in the local and/or regional economies. An explanation of the method is included in Annexure 1.

The assumed annual labour surplus per employee which would result from employment with Newstan (based on Mandalong Mine data) ranges between **$36,020** (average mining employment income in the LGA [Estimate 1]) and **$62,665** (average employment income in the broader mining industry [Estimate 2]).

Table 12: Estimates of labour surplus/regional employment contribution (p.a.)

	Labour surplus @ 222 employees $M
Estimate 1	8.0
Estimate 2	13.9

These estimates may be considered as the upper and lower bounds of a range which allows for differences in the behaviours of individual employees and/or their households. Similarly, as the estimates are based on gross earnings, this allows some provision for economic 'leakages', including income taxes (part of which are returned as public expenditures) and other financial commitments beyond the regional area/economy.

In raw terms, the average Newstan employee income would be around 21% and 110% higher than the implied average wage for mining employees and all employees respectively in the LGA (Table 10). These estimates provide an indication of the extent of additional economic stimulus that employment at Newstan may represent in the local and regional economies.

A further qualitative measure of these effects is the application of household size assessments to the number of positions with Newstan Mine. This results in an estimate of the *total* number of LGA residents who are likely to directly benefit from this employment, when employees' families and/or other household members are factored in. The estimate is based on the average household size for the LGA derived from ABS Census 2016 Census data (refer to Table 2), of 2.5 people per household. On this basis, full employment at Newstan would support an estimated 555 residents in the region. This estimate is conservative, as average household size for the LGA population includes older residents' households that typically comprise one or two people, and some of which may not be in the workforce (e.g. retirees). This is likely to apply to a lesser proportion of employee households. For example, internal recent internal research on a Centennial operation in the Western Coalfield identified an average household size for the workforce of 3.1 persons per household, against an overall regional household size of 2.5 persons. Applied to a Newstan workforce as an indicative measure, this would increase the total number of beneficiaries to 689 residents.

4.3. Contractor & supply chain effects

As is identified in the LMCC EDS, the regional coal mining industry 'generates employment and economic growth in integrated support industries such as engineering, manufacturing, service and logistics.' (2014:25). This recognises additional economic activity among regional businesses that provide labour, goods and services to Newstan Mine. Table 13 provides a summary of indicators of the extent of this additional activity in the local, regional and state economies. The assessments are based on internal data for the most recent corporate financial year. The data also include transactions with businesses in adjacent Central Coast LGA for the regional estimate.

Table 13: Regional & NSW supplier transaction & contractor engagement data

Measure	Local	Regional	NSW
Supplier transactions			
Number of firms/entities	62	200	298
Total transaction value	$2.9 million	$17.7 million	$32.1 million

The data provide some quantitative context to the qualitative assessment in the LMCC EDS. This also emphasises the extent to which local industry is geared towards the mining industry, with around 67% of firms engaged and 55% of total transaction value being concentrated in the regional economy.

4.4. Multiplier effects analysis of additional economic stimulus

When the downstream impacts on those regional participants in these firms' supply chains are also considered, the effects are further amplified. An indication of the scale of these effects can be estimated using input/output (I/O) multipliers. It is noted that there are limitations on the extent to which multipliers can provide an accurate assessment of the extent of economic on-flows. These limitations principally relate to the applicability of the multipliers at regional levels, given their basis in national-level economic data, and the inability of the data and multipliers to capture certain economic flows and changes.

Table 8: Type 2A Multipliers – mining and services

Description	Multiplier value
Output Multiplier – mining & services	2.136
Gross Value Added Multiplier – mining & services	4.099
Income Multiplier – mining & services	2.839
Employment Multiplier – mining & services	3.977

Bearing in mind the limitations outlined, economic effects may increase by 2.1 to 4.1 times the initial stimulus, depending on the measure adopted. Additional employment of almost four times may also result. An alternative assessment of likely multipliers from within Government (Treasury)[9] is that mining-related multiplier effects are likely to be in the range of 1.1 to 1.4 times the initial stimulus. These clearly predict lower level economic on-flows.

[9] Verbal advice provided by Treasury representatives January 2015.

The practical demonstration of these effects is provided by the summary internal data on contractor and supplier engagement, and the further employment this supports.

4.5. Direct community contributions & community participation

As noted on the mine's webpage, Newstan Mine supports the following local community organisations:

- Wangi Lions Club and the Dobell Arts and Craft Festival;
- Wangi RSL Amateur Sailing Club and the Australia Day Regatta;
- Sponsorship of the Wangi Arcadia Netball Club;
- Sponsorship of the Wangi Lions Club Beautifying Wangi Project;
- Toronto Learning Community Band through the Arcadia Vale School;
- Rathmines Scouts.

In addition to this corporate support, it is considered likely that individual employees also make financial and in-kind contributions to the community, particularly through activities such as volunteering with organisations in the region. Although equivalent internal workforce data cannot be generated for Newstan while it remains under care and maintenance, recent workforce research at one of Centennial's Western Operations provides an indication of these community contributions. The research found that 161 respondents (approximately 62 percent of respondents) reported a total 288 involvements with various service, community, school, sports, social and cultural organisations in the areas in which they reside.

Considered together, these company and employee contributions contribute positively to the local and regional communities. Although a quantified assessment is possible for donations, labour surplus etc., these other qualitative contributions are also of significant importance in contributing to community welfare and cohesion.

4.6. Royalties, taxes, rates and other charges.

When fully operational, Newstan Mine also returns a range of payments to various levels of government. For example, corporate income taxes are paid at federal level, royalties and payroll taxes at state level, and rates and other charges to local government. In the most recent corporate financial year, State royalties paid amounted to approximately $9.1 million. Rates and charges paid to Lake Macquarie City Council were around $80,000. Centennial Coal assesses it income tax liabilities at total group level (including all of Centennial's Northern and Western and corporate operations). Therefore, a separate estimate for Newstan cannot be practically presented. In each instance, the sums returned to government contribute to the provision of public goods and services that benefit communities locally, regionally and more broadly.

As is the case with the local and regional economic stimulus provided by employment at the various operations, Centennial's employees also remit personal income taxes to the federal government, which fund further public goods and services.

5. OPERATIONAL IMPACTS

There are a range of impacts associated with Newstan during operations, that may affect a relatively limited number of households and residents located in the near vicinity of the mine. These impacts include:

- Air quality (dust etc.);
- Noise;
- Visual impacts;
- Water resources;
- Subsidence.

Centennial has in place an appropriate balance of avoidance, management and mitigation strategies which are continuously deployed to address such impacts. Centennial also has structures in place for ongoing stakeholder engagement, with a strong focus on residents and/or community representatives residing within areas immediate to the mine.

6. CONCLUSION

The material presented in this socioeconomic profile focuses on the contribution of Centennial Coal's Newstan MIne to the local, regional and state economies and communities. The two key elements of socioeconomic contribution are those related to the mine's commercial activities, and those resulting from the economic and social involvements of the mine and its employees. These must be considered in the context of valuations of operational impacts.

The mine's operations entail both commercial/economic elements and associated social impacts. Commercial engagement of locally and regionally-based suppliers and contractors supports those businesses and the consequent employment and extended economic benefit such transactions produce. This also has positive social impacts, through increasing the number of residents and households that have the resources to engage in the community on a variety of levels.

The role of employees as local and regional economic actors is also significant. This is perhaps best illustrated by the estimates of the number of household members who directly benefit from employment with Newstan during operations. This has short and longer term benefits for these households in terms of financial security and wealth creation. As is the case with the Newstan's commercial partners, these households also have greater resources, permitting them to engage in the community and to form part of and/or contribute to the social fabric, functioning and cohesion of their communities.

Section 6 of the report identified a small number of households situated close to the mine, the occupants of which may experience some negative impacts, along with the broader impact of GHG emissions, which are more difficult to quantify in terms of affected parties. As stated, the effects on these households are managed directly by the relevant operations, through appropriate avoidance, management and mitigation activities, to the extent practicable, and ongoing consultation with these parties.

A number of different measures of socioeconomic impact are examined in this report. On balance, the contribution to the local, regional and state economies is strongly likely to be positive.

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ANNEXURE 1:

LABOUR SURPLUS ESTIMATION

As was demonstrated in Sections 4.1.4 and 4.2.1, mining industry workers in the region have significantly higher incomes than the regional workforce in general. This results in a greater capacity for economic contribution on the part of mining workers, due to their implied higher disposable incomes. This excess component comprises the 'labour surplus' element of mining incomes. The approach taken to estimating labour surplus is to calculate a 'reservation wage' for mining workers, which essentially accounts for three employment status possibilities: employment at estimated current income level, employment at average industry income level, and receipt of transfer payments (unemployment benefits) in the event that alternative work cannot be obtained. This is then compared with regional workforce measures to determine the labour surplus/increased economic contribution of Northern Operations employees. The reservation wage is derived as:

$$RW = (1 – p)AW + pB$$

Where:

RW = reservation wage;

p = probability of a worker remaining unemployed and thus claiming unemployment (Newstart Allowance) benefit. The Australian Government JobSearch website was referenced to obtain information to inform an assumption on this probability. Findings for relevant occupations for the five-year period 2013 to 2018 are included in Table A3.

Table A1.1: Job outlook information – mining industry

Occupation	Unemployment level (%)[10]	Employment growth	Job openings
Drillers, Miners & Shot Firers	average	declining	average
Mine Deputies[11]	above average	slight growth	average
Mining Engineers	average	relatively steady	low
Other Construction and Mining Labourers	above average	moderate growth	below average
Geologists & Geophysicists	average	declining	low
Production Managers	below average	relatively steady	above average

As the numerical majority of the Northern Operations workforce would fall into the first category (miners) this group is used as a basis for assessing probability of unemployment. As unemployment is assessed as average, the unemployment rate for the region may be considered as reflecting the likelihood of a displaced employee being unable to find work. Most recent Australian Government Department of Employment data reported

[10] At November 2013

[11] Included in the occupational group 'Other Building and Engineering Technicians

unemployment in the LMCC LGA at 5.2% (September 2017) and at 5.6% in the Newcastle – Lake Macquarie SA4 (October 2017). On the basis of conservatism, the latter is adopted in the subsequent assessment.

AW = assumed alternate wage. In this instance the alternate wage is assumed as the median wage for the mining sector (2013) as determined by ABS (2014), which was $2,071 per week ($107,692 annualised). This was escalated by the Wage Price Index (ABS 2017), being 2.5 percent, 2.1 percent and 1.9 percent for 2014, 2015 and 2016 respectively. The assumed wage was therefore $114,844.
B = Newstart Allowance. The benefit is assumed at partnered level, $486.50 per fortnight (each)[12] annualised ($25,298). Therefore the reservation wage is:

$$(0.944 \times \$114,844) + (0.056 \times \$25,298) \quad \therefore$$
$$\$108,413 + \$1,417 = \mathbf{\$109,830}$$

A second estimate is derived using the average mining wage calculated from LMCC data (Table 10):

$$(0.944 \times \$143,070) + (0.056 \times \$25,298) \quad \therefore$$
$$\$135,058 + \$1,417 = \mathbf{\$136,475}$$

The assumed wage rate at the time of preparation of the economic impact assessment was the average wage (including assumed overtime and bonuses) at Mandalong Mine (as a proxy for Newstan), which is has the largest workforce of the various Northern Operations sites. This was **$172,495**[13]. The assessed labour surplus resulting from employment with Newstan when fully operational therefore ranges between **$36,020** (average mining employment income in the LGA) and **$62,665** (average employment income in the broader mining industry).

[12] Australian Government Department of Human Services website (2017). Rate current from 20 September 2017.
[13] Includes budgeted ordinary wages, bonus and overtime.

Appendix D – Subsidence predictions

msec
mine subsidence
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30th April 2018

Centennial Coal Australia Limited
Newstan Colliery
PO Box 1000
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For the attention of Mr. Iain Hornshaw

Dear Iain,

Newstan Colliery – Subsidence predictions and assessments of potential impacts due to the development of first workings in the West Borehole Seam

Centennial Coal (Centennial) has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery. The Newstan Extension Project will be assessed as a State Significant Development application in accordance with the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). At this time, the relevant technical assessments are being undertaken to understand the potential impacts on the environment including sensitive surface features.

Centennial intends to develop and lodge a scoping report regarding the Newstan Extension Project with the NSW Department of Planning and Environment (DP&E) in Quarter 3 2018 once the required information is available and preliminary stakeholder engagement has been undertaken. Based on the outcomes of the scoping report, it is expected that DP&E will issue Secretary's Environmental Assessment Requirements forming the basis of the Environmental Impact Statement.

The project schedule regarding the assessment process indicates that determination is expected in Quarter 3 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed ahead of the State Significant Development application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021.

The DP&E has provided initial comments on the Modification Application in their email to Newstan Colliery on the 24th April 2018. The comments in relation to subsidence are:

> *"The EA should include an assessment of the likely conventional and non-conventional subsidence effects and impacts of the development, and the potential consequences of these effects and impacts on the natural and built environment, paying particular attention to those features that are considered to have significant economic, social, cultural or environmental value, including:*
>
> - *infrastructure;*
> - *heritage items/archaeological sites; and*
> - *watercourses and natural flow regimes.*
>
> *The EA should also include a detailed assessment of the potential interactions with the existing underground workings at Awaba, including consideration of pillar instability, pillar run and any potential environmental impacts."*

The layout of the proposed first workings is shown in Figure 1 (Source: Centennial, 2018).

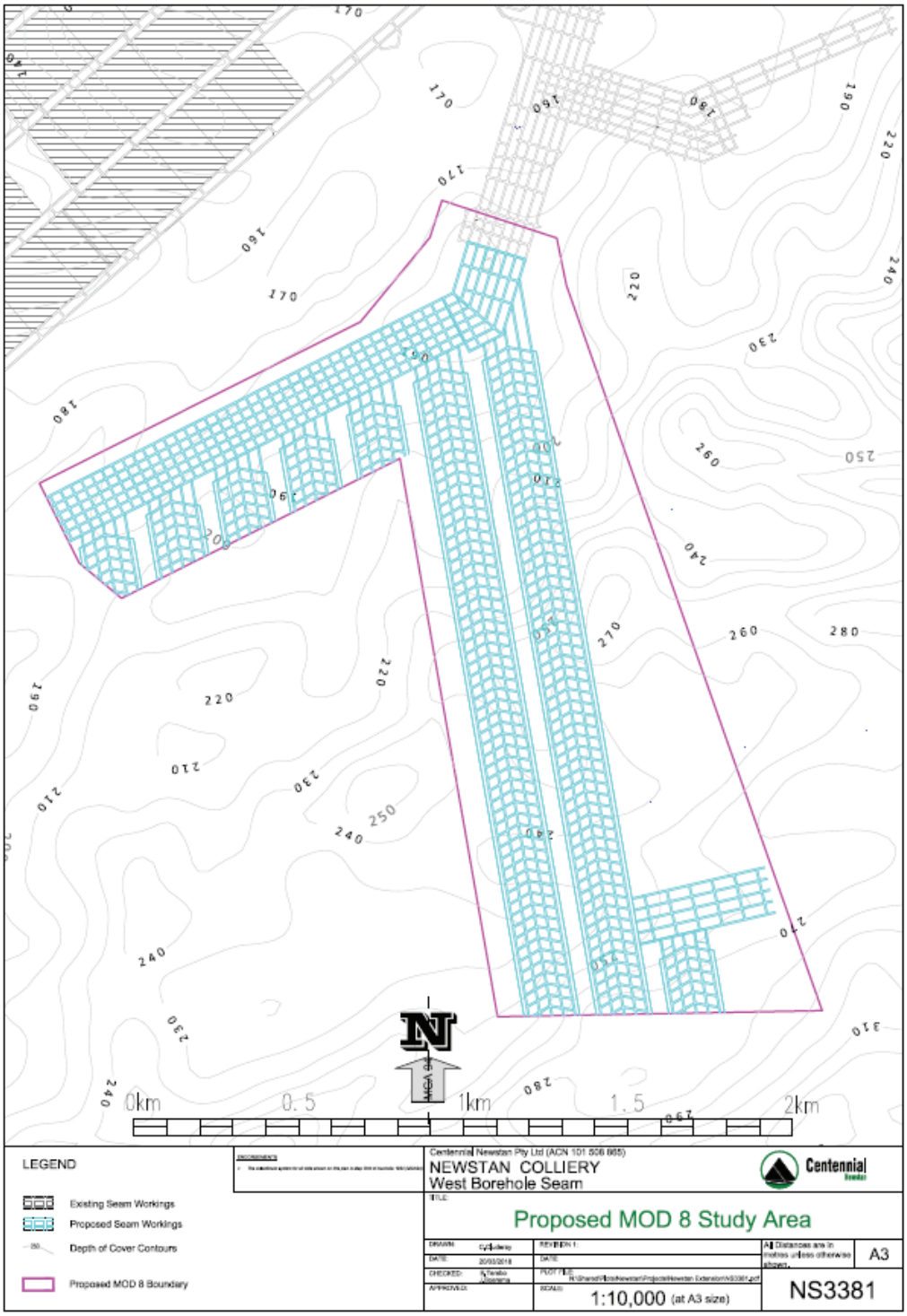

Figure 1 Proposed first workings in the West Borehole Seam (Source: Centennial, 2018)

The Main Headings comprise square pillars with dimensions of 35 m by 35 m. The Panels comprise four parallelepiped pillars at 70° with dimensions of 35 m by 35 m. The roadways for the Main Headings and Panels are 5.5 m wide and 3.4 m high. The width-to-height ratio of the pillars therefore is 10.3.

The first workings will be developed in the West Borehole Seam. The depth of cover above the proposed first workings area varies between 180 m and 270 m. The existing Awaba workings in the Great Northern Seam are located above the northern and central parts of the proposed first workings area. These existing bord and pillar workings comprise areas of first workings only, partial extraction and total extraction. The interburden thickness between the existing and proposed workings varies between 140 m and 210 m.

Pillar design

The pillars have been designed by Centennial (2018) using the UNSW Rectangular Pillar Strength Formula Method (UNSW, 1998). The factors of safety for the parallelepiped pillars vary between 2.1 at a depth of cover of 270 m and 3.1 at a depth of cover of 180 m. The factors of safety for the square pillars vary between 2.3 and 3.4 over this range of depths of cover.

The probability of failure using the UNSW power formulae is 1 in 1,000,000 based on a factor of safety of 2.1. The pillars have therefore been considered to be long-term stable.

Predicted subsidence at the surface

The development of first workings results in the increase in stress within the chain pillars and barrier pillars, as well as in the seam floor and seam roof. The vertical subsidence at the surface results from the compression of the pillars and the strata within the floor and roof. The prediction has been based on the methodology outlined by Das (1986).

The compression of the pillar is provided by:

Equation 1 $$P_{pillar} = \frac{\sigma_c h}{E}$$

where σ_c = vertical stress change (MPa)
h = height of pillar (m)
E = elastic modulus of coal (MPa)

The vertical stress at the seam roof is equal to the unit weight of the overburden times the depth of cover. The unit weight of overburden has been taken as 25 kN/m^3 and the maximum stress occurs at the highest depth of cover of 270 m. The initial vertical stress in the coal prior to the development of first workings is:

Equation 2 $$\sigma_{v.initial} = 25 \times 270 = 6.8\ MPa$$

The final vertical stress in the pillars is equal to the unit weight of the overburden times the depth of cover times the tributary area of the pillar divided by the solid area of the pillar:

Equation 3 $$\sigma_{v.final} = 25 \times 270 \times \frac{(35+5.5)(35+5.5)}{35 \times 35} = 9.0\ MPa$$

The change in stress due to the development of the first workings, taking the difference between Equation 2 and Equation 3, therefore, is 2.2 MPa.

The height of the pillars (h) is 3.4 m. The elastic modulus of coal has been taken as 3000 MPa based on core testing results from Newstan Colliery (STS, 2009) and the Newcastle Coalfield (Holt, 1998). The compression of the pillar therefore is:

Equation 4 $$P_{pillar} = \frac{2.2 \times 3.4}{3000} = 2\ mm$$

The compression of the floor and roof is provided by:

Equation 5 $$P_{floor/roof} = \frac{\sigma_c w_m (1-\upsilon^2)}{E}$$

where σ_c = vertical stress change (MPa)
w_m = width of pillar (m)
υ = Poisson's ratio of the floor and roof
E = elastic modulus of the floor and roof (MPa)

The seam floor is the Waratah Sandstone. The immediate seam roof is the Nobbys Tuff (generally less than 2 m thick) which is overlaid by the Adamstown Formation comprising many conglomerate and sandstone bands interbedded with shale, siltstone, tuffaceous claystone bands and high ash coal seams. The elastic moduli (E) of these units have been taken as 20 000 MPa for the Waratah Sandstone and 15 000 MPa for the combined Nobbys Tuff and Adamstown Formation based on the available core testing results (Holt, 1998 and STS, 2009). The Poisson's ratio has been taken as 0.25 for both the seam floor and seam roof.

The compression in the roof and floor based is:

Equation 6 $$P_{floor} = \frac{2.2 \times 35 \times (1 - 0.25^2)}{20000} = 4\ mm$$

Equation 7 $$P_{roof} = \frac{2.2 \times 35 \times (1 - 0.25^2)}{15000} = 5\ mm$$

The predicted total compression of the pillar, floor and roof is:

Equation 8 $$P = 2 + 4 + 5 = 11\ mm$$

The maximum predicted vertical subsidence at the surface, due to the development of first workings in the West Borehole Seam, therefore, is approximately 11 mm. The maximum subsidence occurs near the middle and southern parts of the workings, where the depths of cover are greatest. The predicted vertical subsidence in the northern part of the workings reduces to approximately 7 mm, where the minimum depth of cover above the workings is 180 m.

Vertical subsidence less than 20 mm is generally considered to be insignificant. Natural ground movements due to wetting and drying of soils can result in similar levels of movement. The predicted vertical subsidence due to the development of the first workings is similar to the order of survey tolerance for absolute level and, therefore, it is unlikely to be measurable using standard surveying techniques.

Potential for surface deformations

The strains at the surface due to the development of the first workings are predicted to be less than 0.1 mm/m. It is unlikely that the strains due to the development of the first workings would be measurable using standard surveying techniques.

Tensile cracking or compression heaving are not expected to develop above the proposed first workings in the West Borehole Seam due to the very low levels of predicted vertical subsidence (i.e. less than 20 mm) and due to the higher depths of cover (i.e. 180 m to 270 m). The development of the first workings themselves is not expected to result in irregular or anomalous ground movements.

Multi-seam interaction with the existing workings

The existing Awaba workings in the Great Northern Seam are located above the northern and central parts of the proposed first workings area in the West Borehole Seam. These existing workings comprise areas of first workings, partial extraction and total extraction. These existing workings do not form part of the Modification Application; however, they have been considered since the first workings in the West Borehole Seam are proposed to be developed directly beneath them.

The development of the first workings in the West Borehole Seam is not expected to reactivate the existing Awaba workings (including pillar run) due to the very low levels of predicted movement (i.e. vertical subsidence of less than 20 mm), the interburden thickness between the workings (i.e. 140 m to 210 m) and the high factors of safety for the proposed pillars (i.e. 2.1 to 3.4).

Some areas of the existing Awaba workings have two to four rows of pillars that have been extracted. The overlying Teralba Conglomerate is capable of spanning up to approximately 100 m (SG, 2010) where the unit is continuous and where there are no geological structures. The floor of the Great Northern Seam comprises the Awaba Tuff. This unit loses strength when wetted and can result in the remnant pillars punching into the seam floor or lateral movement resulting in spalling and stripping of the pillars.

Ongoing ground monitoring above the existing Awaba workings has measured the development of subsidence above the Teralba Conglomerate spanning areas well after the completion of mining. It is considered that this long-term subsidence has resulted from the failure of the existing pillars supporting the spanning conglomerate roof.

Whilst it not expected that the development the first workings in the West Borehole Seam would reactivate the existing Awaba workings, further development of subsidence could occur above the existing Teralba Conglomerate spanning areas due to their existing conditions, similar to that previously observed at the colliery. That is, the development of the proposed first workings is not expected to change the potential for the longer-term subsidence above the existing Awaba workings.

Potential for sink holes

Sink holes have been previously observed above the existing Awaba workings. In each case, the sink holes have developed where: the depths of cover are very shallow (less than 30 m); above total extraction areas; and along the alignments of the streams.

The depth of cover above the proposed first workings in the West Borehole Seam varies between 180 m and 270 m. Sink holes have not been previously observed above existing workings at the colliery at these higher depths of cover.

The streams located above the proposed first workings in the West Borehole Seam comprise Stony Creek, Kilaben Creek, Stockyard Creek and tributaries to these creeks (refer to Figure 2). The section of Stony Creek above the proposed first workings area in the West Borehole Seam is also located above first workings only in the existing Awaba workings. The sections of Kilaben and Stockyard Creeks above the proposed first workings area are located outside the extents of the existing Awaba workings.

The development of the proposed first workings in the West Borehole Seam is not expected to result in the potential for sink holes due to the high depths of cover and due to the larger streams being located above areas of first workings only in both the Great Northern and West Borehole Seams.

Assessment of potential impacts on surface features

The natural and built features located above the proposed first workings in the West Borehole Seam are shown in Figure 2.

The natural and built features located above the first workings area comprise:

- Stony Creek, Kilaben Creek, Stockyard Creek and their tributaries;
- steep slopes with natural gradients typically up to 1 in 2 (i.e. 50% or 26.6°);
- a private coal haul road;
- a 33 kV substation;
- two telecommunications towers (Site Nos. 2283003 and 9009652); and
- Archeological sites comprising one Open Site (Ref. 38-4-1375) and two scarred trees (Refs. 45-7-0318 and 45-7-0319).

The natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the first workings. At these very low levels of vertical subsidence, the surface features are not predicted to experience measurable tilts, curvatures or strains. It is not expected that visible surface deformations (i.e. tensile cracking or compression heaving) nor irregular (i.e. anomalous) ground movements would occur.

The natural and built features therefore are not expected to experience adverse impacts due to the development of the first workings in the West Borehole Seam.

As discussed previously, longer-term subsidence could develop above the existing Awaba workings due to their existing conditions, as has been previously observed at the colliery. Surface deformations could therefore develop above these existing workings based on their existing conditions. However, the development of first workings in the West Borehole Seam is not expected to change to potential for ground movements and impacts due to the longer-term subsidence associated with the existing conditions of the Awaba workings.

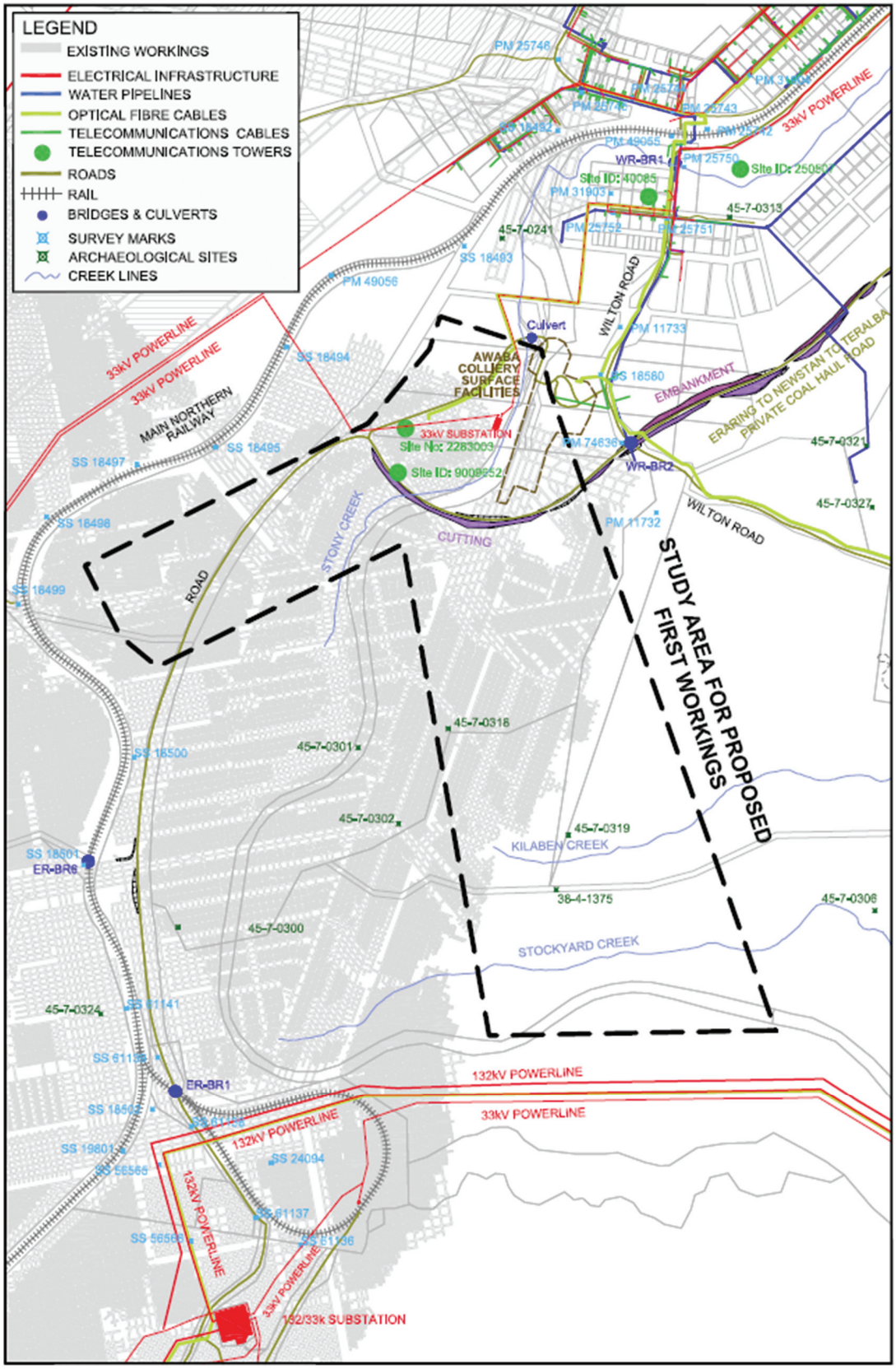

Figure 2 Natural and built features above the proposed first workings area

Recommended monitoring and management strategies

There are no specific recommendations for ground monitoring or other management strategies associated with the development of the first workings in the West Borehole Seam due to the very low levels of predicted ground movements. The predicted vertical subsidence (i.e. less than 20 mm) and the predicted strains (i.e. less than 0.1 mm/m) are similar to the order of survey tolerance and, therefore, are not expected to be measurable.

There are existing ground monitoring lines used to measure the longer-term movements above the existing Awaba workings in the Great Northern Seam. No changes to the existing monitoring regime are recommended due to the proposed development of the first workings in the West Borehole Seam.

I trust that this report is of assistance and that it provides the necessary information on the subsidence predictions and impact assessments for the proposed development of first workings in the West Borehole Seam. If you have any questions or would like further information, please do not hesitate to email or call me on (02) 9413-3777.

Yours sincerely,

James Barbato

Dr James Barbato
Mine Subsidence Engineering Consultants

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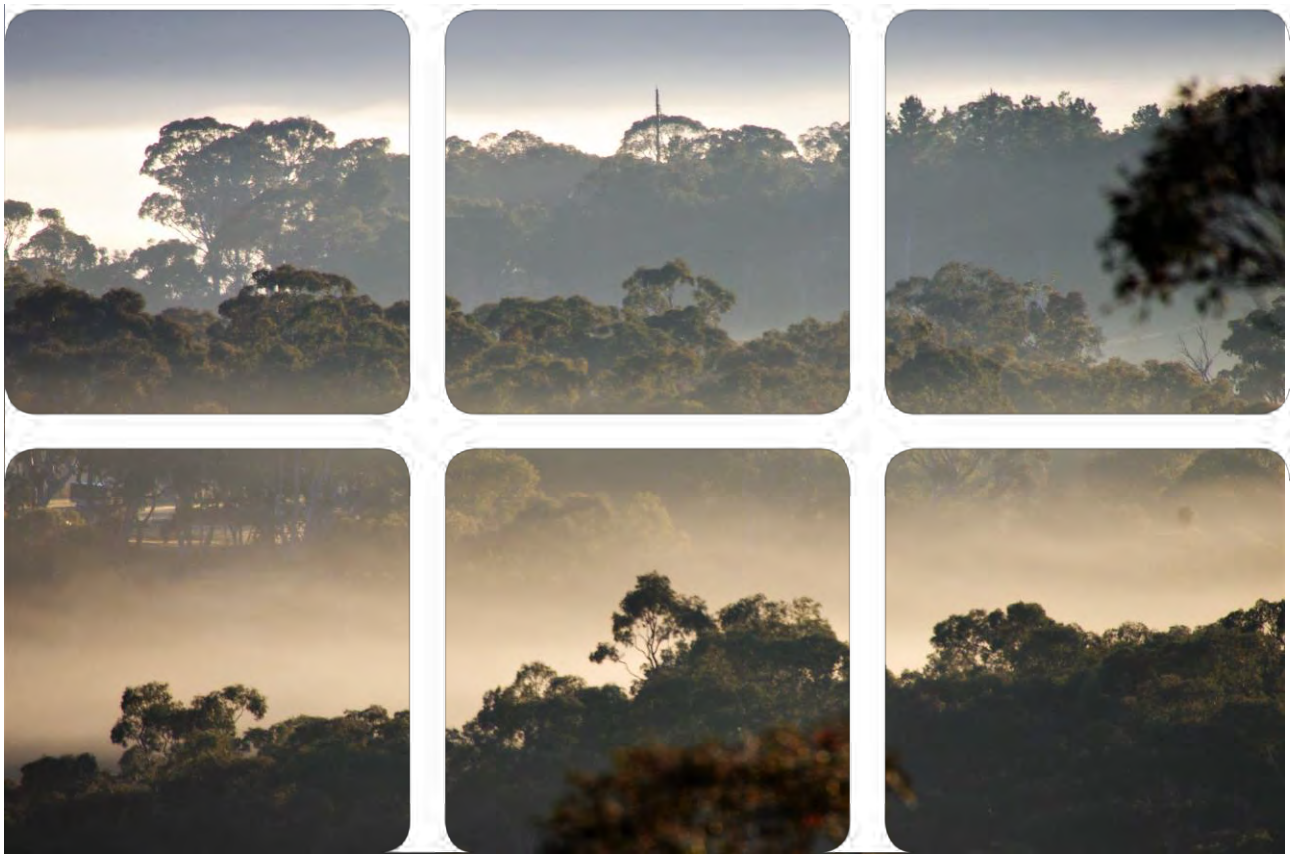
Appendix E – Biodiversity threshold test

PROPOSED NEWSTAN MODIFICATION 8
Biodiversity Thresholds Test

Prepared for ***Centennial Coal***

24 AUGUST 2018



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Report Number: PR139881
Version / Date: R2 | 24/08/2018

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
R0	Draft for Client review	Arne Bishop	Mark Aitkens	20/7/2018
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Approval for Issue

Name	Signature	Date
Mark Aitkens		24/8/2018

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Appendix 1 Biodiversity Inventory Report

1.0 Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Coal to prepare a Biodiversity Thresholds Test (BTT) as a supporting technical document for Newstan Colliery's eighth modification to Development Consent DA 73-11-98 (hereafter referred to as Newstan Mod 8). This BTT focuses on the assessment of matters listed under the NSW *Biodiversity Conservation Act* 2016 (BC Act) to determine if the Newstan Mod 8 project requires participation in the Biodiversity Offset Scheme (BOS).

The Biodiversity Inventory Report (BIR) provided in **Appendix 1** describes the survey methods performed and results for the Newstan Mod 8 project area. It also provides assessment for matters not addressed under the *Biodiversity Assessment Method Order 2017* (BAM) as listed below:

- Threatened species and ecological communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act);
- Relevant State Environmental Planning Policies (SEPPs); and
- Relevant parts of the NSW Aquifer Interference Policy (i.e. groundwater development ecosystems).

1.1 Project Description and Location

The Newstan Mod 8 project, as shown in **Figure 1**, is to enable first workings to proceed and determine the presence, throw and strike of the major fault projected from the historic Newstan workings. The modification will also seek to extend the life of DA 73-11-98 for an additional 12 months. The site is 229.04 hectares in total comprising 209.99 ha of native vegetation.

1.2 Regulatory Context

1.2.1 *Environmental Planning and Assessment Act 1979*

Section 1.7 of the EP&A Act requires the application of Part 7 of the BC Act (i.e. Biodiversity Assessment and Approvals under the Planning Act) to determine if a development is likely to significantly affect threatened species, ecological communities or their habitats. Part 7, Division 2 of the BC Act describes the biodiversity assessment requirements for Part 4 developments (i.e. Section 7.7).

Centennial Coal is the proponent with the Project being assessed by the Department of Planning and Environment (DP&E) as a Part 3A modification under Section 75W of the EP&A Act. In this instance the DP&E has not issued formal Environmental Assessment Requirements and, following consultation with the Office of Environment and Heritage (OEH), it is understood that the biodiversity assessment is to be initially performed in accordance with Section 7.2 of the BC Act to determine if the Project is "*likely to significantly affect threatened species*".

1.2.2 *Biodiversity Conservation Act 2016*

The BC Act and supporting *Biodiversity Conservation Regulation* 2017 (BC Regs) establish a modern and integrated legislative framework for land management and conservation in NSW. The purpose of the BC Act is:

> *(k) to establish a framework to avoid, minimise and offset the impacts of proposed development and land use change on biodiversity;*
>
> *(l) to establish a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values; and*
>
> *(m) to establish market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales.*

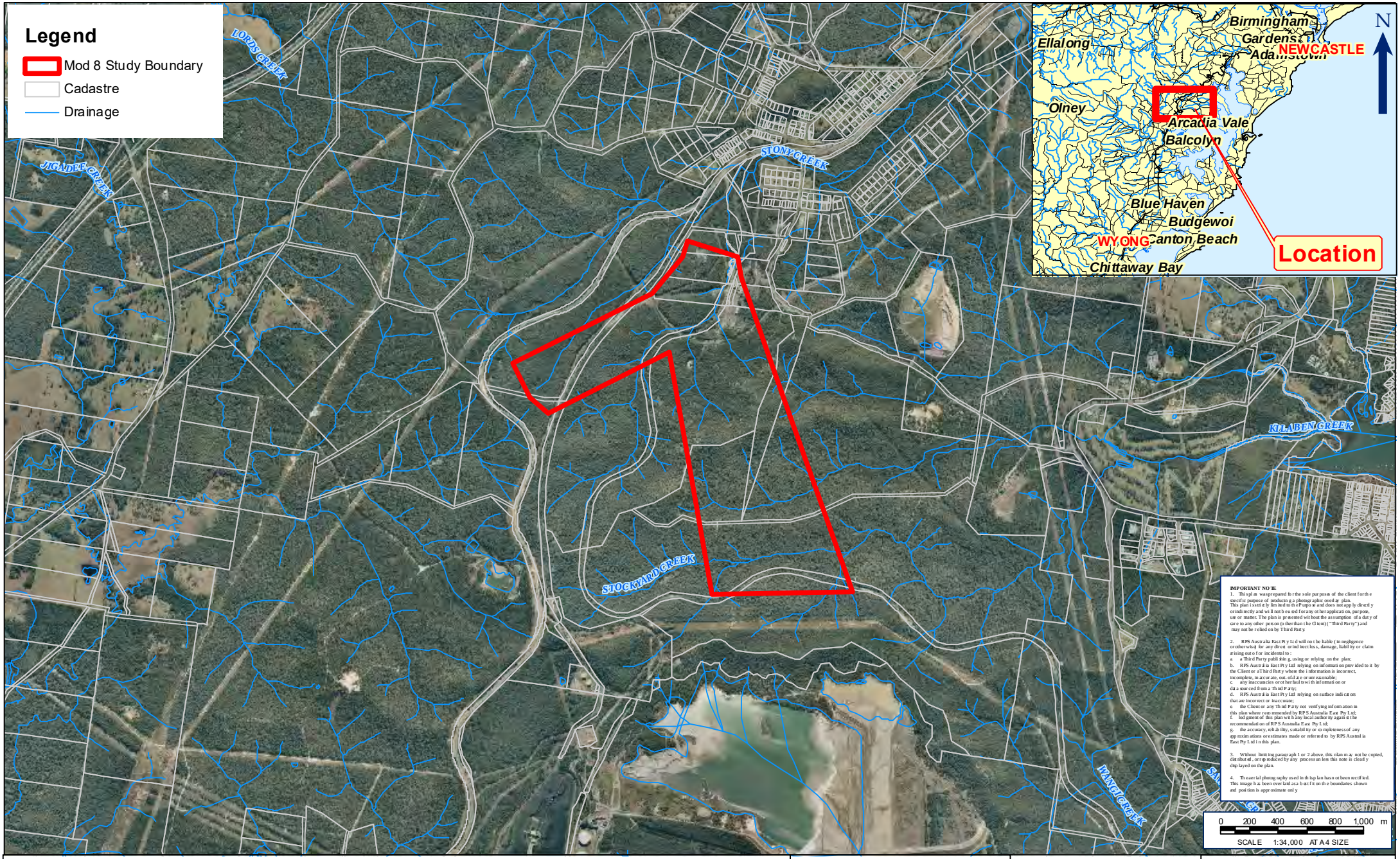

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Figure 1: The Study Area

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: mark.aitkens Date: 20/07/2018

Path: S:\Centennial\All Jobs\141016 Ecological Due Diligence For Wolgan 1 Site\10 - Drafting\Arcgis Map Documents\Eco\BTT Report\139881 Figure 1 SA A4L

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL
JOB REF: PR139881

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Proponents acting under transitional Part 3A s75W of the EP&A Act are to assess a Project's impacts on biodiversity via tests prescribed under Section 7.2 of the BC Act (i.e. Thresholds tests including Assessment of Significance or 5-Part Test of Significance). These tests are performed to determine if the activity is likely to significantly affect threatened species or ecological communities, or their habitats. Three tests are performed as indicated in the flowchart below (**Figure 2**).

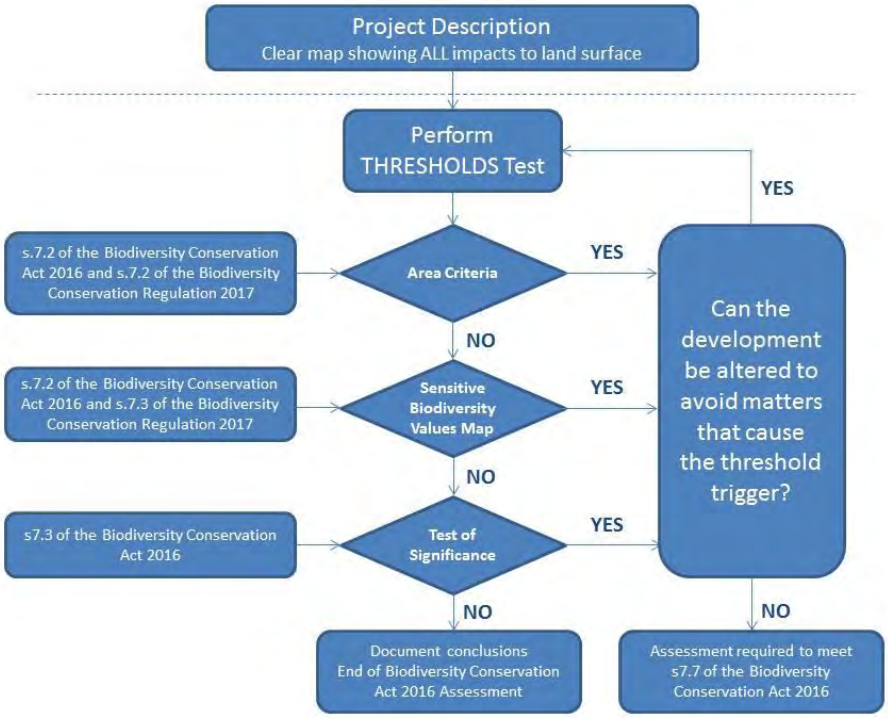

Figure 2 Biodiversity Offset Scheme Threshold Test flowchart

Threshold tests, as listed below, are applied to determine if a development or activity is "likely to significantly affect threatened species":

- Impacts exceed the biodiversity offsets scheme thresholds (Section 7.2 of the BC Act); or
- Impacts are likely to significantly affect threatened species or ecological communities, or their habitats (Section 7.3 of the BC Act); or
- Impact on declared area of outstanding biodiversity value.

'Yes' to any of the above thresholds tests triggers a requirement for an impact assessment performed in accordance with the BAM, which is to be performed by an Accredited Person (Section 7.7 of the BC Act). Otherwise, evidence to the contrary is to be documented and preferably provided as part of the development application to show why the second tier of assessment is not required.

1.2.2.1 Area Criteria

An area criteria threshold determines the clearing limit for native vegetation before triggering a requirement for assessment in accordance with the BAM. These thresholds are defined in Clause 7.2 of the BC Regs and reproduced in **Table 1**.

Table 1 Area Criteria Thresholds

Minimum lot size associated with the property	Thresholds for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
Greater than 1 ha and less than 40 ha	0.5 ha or more
Greater than 40 ha and less than 1000 ha	1 ha or more
Greater than 1000 ha	2 ha or more

If the native vegetation clearing does not exceed the relevant area criteria threshold, then it is deemed that the project is not "*likely to significantly affect threatened species*" for this test.

1.2.2.2 Biodiversity Values Map

Development involving the clearing of native vegetation within lands identified on the Biodiversity Values Map (BVM) is a trigger for assessment in accordance with the BAM. If the project is wholly located outside areas mapped on the BV Map, or there is no requirement to clear native vegetation within an area indicated on the BVM, then it is deemed that the project is not "*likely to significantly affect threatened species*" for this test.

1.2.2.3 Assessment of Significance

A '5-part test of significance' is to be performed in accordance with Section 7.3 of the BC Act to determine if assessment in accordance with the BAM is required (i.e. 'Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats'). The 5-Part Test is applied to listed threatened biota identified as likely to be impacted by the proposed works (i.e. all direct and indirect impacts on listed threatened species). Entry into the BOS is not required if the Project is not '*likely to have a significant affect on threatened species*' identified as having the potential to be impacted by the project.

1.2.2.4 Biodiversity Offset Scheme

Participation in the BOS is required where it is determined that an activity is likely to significantly affect threatened species or ecological communities, or their habitats. A Biodiversity Assessment Development Report (BDAR) prepared under Section 7.13 of the BC Act and in accordance with the BAM is to be submitted to the consent authority in circumstances where the Project is "likely to significantly affect threatened species".

1.3 Assessment Scope

This BTT has the purpose of determining if the Project is "likely to significantly affect threatened species" and therefore requires participation in the BOS. This will be determined through application of the thresholds tests prescribed in Clause 7.2 and 7.3 of the BC Regs and the 5-Part Test of Significance as prescribed in Section 7.3 of the BC Act.

1.4 Definitions

Cleared – Section 60J of the *Local Land Services Act* 2013 (LLS Act) has been adopted in this assessment as the definition for native vegetation comprising grasslands or other non-woody vegetation that is taken to have been cleared.

Clearing – Section 60C of the LLS Act has been adopted in this assessment as the definition for 'clearing' native vegetation.

Derived native vegetation – Clauses 110 and 114 of the *Local Land Services Regulation* 2014 has been considered in this assessment for determining the conservation value of grasslands or other groundcover and whether or not the native vegetation has been significantly disturbed or modified.

Native Vegetation – Section 60B of the LLS Act has been adopted in this assessment as a definition for 'native vegetation'.

2.0 Method

2.1 Biodiversity Values

The biodiversity values of the Newstan Mod 8 project area are summarised in the attached BIR (**Appendix 1**). The BIR includes:

- Desktop analysis;
- Description of field methods and effort;
- Native vegetation mapping and plant community type (PCT) descriptions; and
- Likelihood of occurrence analysis for threatened species and ecological communities.

The likelihood of occurrence analysis has been used to identify species that may be impacted by the Project; thus require consideration under Section 7.3 of the BC Act.

2.2 Impact Analysis

The impact of the Newstan Mod 8 project has been estimated through a review of relevant technical documents, these being:

- MSEC (2018) Newstan Colliery – Subsidence predictions and assessment of potential impacts due to the development of first workings in the West Borehole Seam ; and
- GHD (2018) Newstan Colliery Modification 8. Water Resources Impact Assessment.

The nature and extent of impacts that may affect a listed threatened species, ecological community or its habitat has been mapped for comparison against the occurrence of habitat for such matters.

2.3 Thresholds Tests

Thresholds tests described in **Section 1.2.2** were applied following consideration of the impact analysis and any potential interaction with relevant matters identified in the BIR. A determination as to whether or not the Project is required to participate in the BOS is made as a conclusion for each thresholds test.

2.4 Limitations

This assessment is based on BAM Plots and Rapid Data Points (RDPs) only, with the potential for threatened flora and fauna detection limited to opportunistic surveys and habitat analysis.

Due to survey limitations, the likelihood of occurrence analysis has relied on an evaluation of existing habitat value and its importance in lifecycle process (e.g. differentiating between fauna activity associated with a specific home range from non-habitat dependant transient/ vagrant movements). In this respect, habitat value was assessed on the basis of habitat surrogates (i.e. PCTs) and condition, with the importance of this habitat determined by an analysis of micro habitat features necessary for lifecycle processes (e.g. hollow-bearing trees, surface rock, water bodies, fallen logs etc.).

Given the above, the precautionary principle has been applied in circumstances where scientific uncertainty exists (i.e. assumed presence for a threatened flora or fauna species which is likely to occur).

3.0 Results

3.1 Biodiversity Values

The site is 229.04 hectares in total comprising 209.99 ha of native vegetation. The following PCTs were identified within the site (see Appendix 1):

- Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast (PCT 1627).
- Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast (PCT 1588).
- Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (PCT 1619).
- Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coast (PCT 1636).

None of these PCTs have been identified as forming part of a listed threatened ecological community. A total of 15 threatened flora and 38 threatened fauna species were identified as having a greater than moderate likelihood of occurrence within the native vegetation at the site.

3.2 Impact Analysis

The proposed works will not involve any clearing of native vegetation and threatened species habitat from within the Newstan Mod 8 project area.

With regard to the proposed workings, MSEC (2018) predicted:

- *The depth of cover above the proposed first workings in the West Borehole Seam varies between 180 m and 270 m. Sink holes have not been previously observed above existing workings at the colliery at these higher depths of cover.*
- *The maximum predicted vertical subsidence at the surface, due to the development of first workings in the West Borehole Seam, therefore, is approximately 11 mm. The maximum subsidence occurs near the middle and southern parts of the workings, where the depths of cover are greatest. The predicted vertical subsidence in the northern part of the workings reduces to approximately 7 mm, where the minimum depth of cover above the workings is 180 m.*
- *Vertical subsidence less than 20 mm is generally considered to be insignificant. Natural ground movements due to wetting and drying of soils can result in similar levels of movement. The predicted vertical subsidence due to the development of the first workings is similar to the order of survey tolerance for absolute level and, therefore, it is unlikely to be measurable using standard surveying techniques.*
- *The strains at the surface due to the development of the first workings are predicted to be less than 0.1 mm/m. It is unlikely that the strains due to the development of the first workings would be measurable using standard surveying techniques.*
- *Tensile cracking or compression heaving are not expected to develop above the proposed first workings in the West Borehole Seam due to the very low levels of predicted vertical subsidence (i.e. less than 20 mm) and due to the higher depths of cover (i.e. 180 m to 270 m). The development of the first workings themselves is not expected to result in irregular or anomalous ground movements.*
- *The natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the first workings. At these very low levels of vertical subsidence, the surface features are not predicted to experience measurable tilts, curvatures or strains. It is not expected that*

visible surface deformations (i.e. tensile cracking or compression heaving) nor irregular (i.e. anomalous) ground movements would occur.

GHD (2018) has identified that the Newstan Mod 8 project area is not likely to have an impact on groundwater resources otherwise accessed by surface biodiversity values. GHD (2018) predicted:

The proposed modification is predicted to have negligible impacts on both surface and groundwater environments. The changes to the water volume and the salt load discharged through Newstan Colliery's are predicted to be less than one percent. The impact of this on water quality and stream health in watercourses which receive licensed discharges from Newstan Colliery is predicted to be negligible.

A numerical groundwater model has been developed to predict groundwater take and drawdown as a result of the Project. The predicted groundwater impacts are less than the NSW Aquifer Interference Policy's Level 1 minimal impact considerations, and as such are considered as acceptable. No impacts on groundwater receptors, including the registered groundwater bores identified in the proximity of the Study Area and groundwater dependent ecosystems, are predicted. Groundwater take from the North Coast Fractured and Porous Rock Groundwater Sources is predicted to be higher in years 2020 and 2021 (compared to approved conditions). Centennial Newstan is currently in consultation with DoI – Water regarding the licensing of groundwater take from this source.

On this basis, it is considered that the Newstan Mod 8 project is not likely to have any measurable impact on native vegetation and/ or habitat for a listed threatened species or ecological community.

3.3 Thresholds Tests

3.3.1 Area Criteria

As stated in **Section 3.2**, the Newstan Mod 8 project will not involve the clearing of native vegetation. Therefore, the Newstan Mod 8 project will not exceed the clearing thresholds applicable to this project. Participation in the BOS is not required as a consequence of this threshold.

3.3.2 Biodiversity Values Map

As shown in **Figure 2**, the site is located within an area mapped on the Biodiversity Values Map (OEH, June 2018). Any surface disturbance on lands within the orange mapped area involving the clearing of native vegetation or that would impact matters identified in Clause 6.1 of the BC Regs trigger a requirement for an assessment performed in accordance with the BAM.

As stated in **Section 3.2**, the Newstan Mod 8 project will not involve the clearing of native vegetation. Therefore, the Newstan Mod 8 project will not clear any native vegetation within an area included in the Biodiversity Values Map (OEH, June 2018). Participation in the BOS is not required as a consequence of this threshold.

3.3.3 Assessment of Significance

MSEC (2018) and GHD (2018) both concluded that the Newstan Mod 8 project will not:

- Involve the clearing of native vegetation; and/ or
- Alteration of surface abiotic values such that native vegetation cover and habitat would be either directly or indirectly impacted.

On the basis of these impact assumptions it is considered that no habitat for a threatened species or ecological community would be impacted by the Project. It is considered that the proposed works are unlikely to result in a significant impact on threatened species, ecological communities or their habitats.

No 5-Part Tests of Significance have been prepared on this basis and, as such, participation in the BOS is not required as a consequence of this threshold.

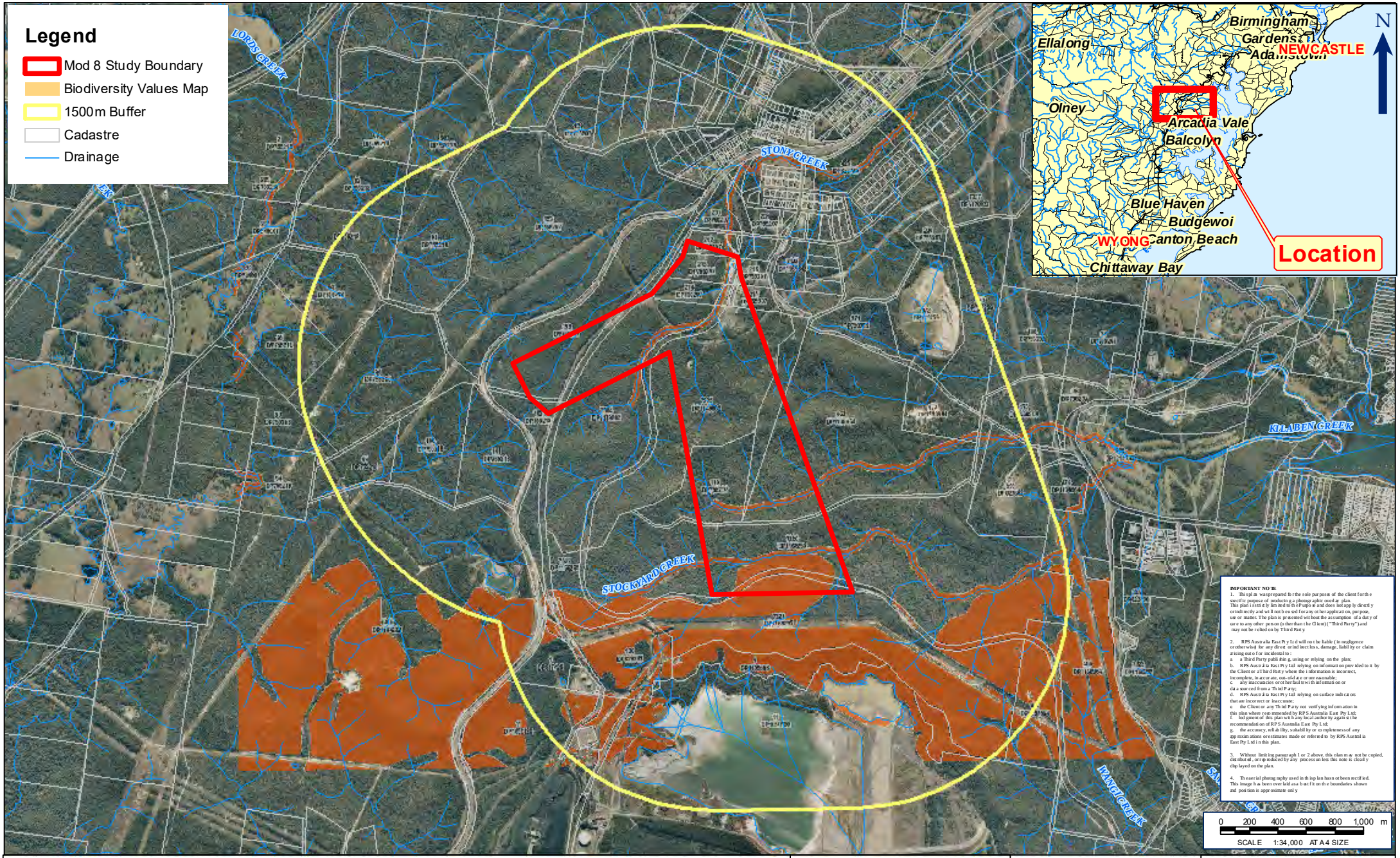

Figure 1: Site Location

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: mark.aitkens Date: 20/07/2018

Path: S:\Centennial\All Jobs\141016 Ecological Due Diligence For Wolgan 1 Site\10 - Drafting\Arcgis Map Documents\Eco\BTT Report\139881 Figure 3 BVM A4L

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94

PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL

JOB REF: PR139881

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4.0 Conclusions

4.1 BC Act

The Newstan Mod 8 project has demonstrated an impact avoidance outcome and, as such, has not breached any of the thresholds tests. Therefore, it is considered that the Newstan Mod 8 project is not required to participate in the BOS.

4.2 Other Matters

As concluded in **Appendix 1**, the Newstan Mod 8 project is not expected to have an adverse impact on:

- Relevant matters listed under Section 198 and 18A of the EPBC Act; or
- Terrestrial GDEs is expected within the site (GHD 2018).

5.0 References

GHD (2018) Newstan Colliery Modification 8. Water Resources Impact Assessment. Unpublished Report Prepared for Centennial Coal, Fassifern NSW.

MSEC (2018) Newstan Colliery – Subsidence predictions and assessment of potential impacts due to the development of first workings in the West Borehole Seam. Unpublished Report Prepared for Centennial Coal, Fassifern NSW.

Office of Environment and Heritage [OEH] (2018). Biodiversity Values Map – extract for the Newstan Mod 8 project area. (Accessed June 2018 https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap)

6.0 Acronyms and Units

E	Endangered
EP	Endangered Population
EEC	Endangered Ecological Community
OEH	Office of Environment and Heritage
TEC	Threatened Ecological Community
BOS	Biodiversity Offset Scheme
BC Act	Biodiversity Conservation Act 2016

Appendix 1
Biodiversity Inventory Report

REPORT

Newstan MOD 8

Biodiversity Inventory Report

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Author:	Hayden Beck
Reviewed:	Arne Bishop
Approved:	Arne Bishop
No.:	139881
Version:	3
Date:	30/07/2018

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Document Status

Version	Purpose of Document	Approved by	Reviewed by	Review Date
R1	Draft for client review	Arne Bishop	Arne Bishop	18/07/2018
R2	FINAL	Mark Aitkens	Mark Aitkens	30/07/2018
R3	FINAL (minor amendments)	Mark Aitkens	Mark Aitkens	24/08/2018

Approval for issue

Name	Signature	Date
Mark Aitkens		24/08/2018

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Summary

Context

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Coal to prepare a Biodiversity Inventory Report (BIR) (this document) as supporting technical information for Newstan Colliery's eighth modification to Development Consent DA 73-11-98 (hereafter referred to as Newstan Mod 8). This BIR includes the results of relevant desktop and field investigations of the site.

The overarching Biodiversity Threshold Test (BTT), which this BIR is appended to, focuses on matters listed under the NSW *Biodiversity Conservation Act* 2016 (BC Act). The BTT assesses whether the threshold for requiring a Biodiversity Development Assessment Report (BDAR) is required to be produced in line with the *Biodiversity Assessment Method Order 2017* (BAM). The BTT concluded that a BDAR is not required.

This BIR focuses on the surveys methods, results and assesses matters not addressed in the BTT such as; Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and relevant State Environmental Planning Policies (SEPPs).

As Newstan Mod 8 is expected have a negligible impact on biodiversity, no targeted flora or fauna surveys were undertaken. Nevertheless, floristic surveys were undertaken using BAM methodology to determine the pre-mining Plant Community Type (PCT) condition and extent, should unexpected impacts result from the proposed first workings.

Key Results – Plant Community Types

Four PCTs were identified within the site, none of which are considered to be commensurate with a State or Commonwealth listed threatened ecological community (TEC).

Key Results – Flora

Fifteen Candidate Species Credit Species were identified based on PCTs or likelihood of occurrence based on Office of Environment and Heritage (OEH) sighting records and EPBC Protected Matters Search results. *Corybas dowlingii* (Red Helmet Orchid; BC Act: Endangered) and *Grevillea parviflora subsp. parviflora* (Small Flower Grevillea; BC Act: Vulnerable; EPBC Act: Vulnerable) were opportunistically detected.

Key Results – Fauna

Thirty-six Candidate Species Credit Species were listed based on PCTs or likelihood of occurrence based on OEH sighting records and EPBC Protected Matters Search results. *Calyptorhynchus lathami* (Glossy Black Cockatoo; BC Act: Endangered) was opportunistically detected.

EPBC Act Assessment

The Project is not considered likely to result in a significant impact on any listed threatened species, ecological or communities.

State Environmental Planning Policy 44 – Koala Habitat

The site does not constitute 'Core Koala Habitat' as defined under SEPP 44 and no further provisions of this policy apply to the site.

Conclusions and Recommendations

Impacts on threatened biodiversity values are expected to be negligible given that very low levels of ground movement (<20mm of vertical subsidence) are predicted, and that no vegetation would be removed. RPS recommends that the existing Flora and Fauna Management Plan be reviewed and if necessary updated to address Newstan Mod 8.

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1 Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Centennial Coal to prepare a Biodiversity Inventory Report (BIR) (this document) as supporting technical information for Newstan Colliery's eighth modification to Development Consent DA 73-11-98 (hereafter referred to as Newstan Mod 8). This BIR includes the results of relevant desktop and field investigations of the Site.

The overarching Biodiversity Threshold Test (BTT) which this BIR is appended to focuses on matters listed under the NSW *Biodiversity Conservation Act* 2016 (BC Act). The BTT assesses whether the threshold for requiring a Biodiversity Development Assessment Report (BDAR) is required to be produced in line with the Biodiversity Assessment Method (BAM). The BTT concluded that a BDAR is not required.

This BIR focuses on the surveys methods, results and assesses matters not addressed in the BTT such as; Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and relevant State Environmental Planning Policies (SEPPs).

1.1 The Project

The Newstan Mod 8 project is to enable first workings to proceed and determine the presence, throw and strike of the major fault projected from the historic Newstan workings. The modification will also seek to extend the life of DA 73-11-98 for an additional 12 months. The location of the site is shown in **Figure 1**.

1.2 Purpose

The purpose of this report is to describe the biodiversity values of the site as a basis for assessing the Project's impacts on threatened biodiversity listed under the BC Act and the EPBC Act.

The following documents and guidelines have been considered when preparing the BIR:

- Threatened Species Assessment Guidelines (OEH);
- NSW State Groundwater Dependent Ecosystem Policy (NOW);
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW);
- State Environmental Planning Policy No. 44 – Koala Habitat Protection; and
- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013).

In relation to the above, the BIR has focused on evaluating the likelihood of occurrence and incidence of threatened biodiversity (i.e. threatened species, populations, ecological communities) listed under the BC Act and/ or EPBC Act using methods and guidance specified in the BAM and project brief. In addition to providing technical information for the preparation of the BTT, the BIR also contains an assessment of the Project's impact on relevant Matters of National Environmental Significance (MNES) listed under the EPBC Act. MNES relevant to this report are those listed under Section 18 and 18A of the EPBC Act (i.e. threatened species and ecological communities) and relevant SEPPs.

1.3 Investigation Scope

As Newstan Mod 8 is expected to have a negligible impact on biodiversity, no targeted flora or fauna surveys were undertaken. Nevertheless, floristic surveys were undertaken using BAM methodology to determine the pre-mining Plant Community Type (PCT) condition and extent, should unexpected impacts result from the proposed first workings.

The investigation scope of this BIR includes:

- Identify and map the extent of PCTs within the site, including any threatened ecological communities (TECs) listed under the BC Act and/ or EPBC Act;
- Report datasets necessary for performing computations in the online Biodiversity Accredited Assessor System (BAAS); and
- Assess the likely impact of the Project on threatened biodiversity listed under the EPBC Act that are relevant to the Project.

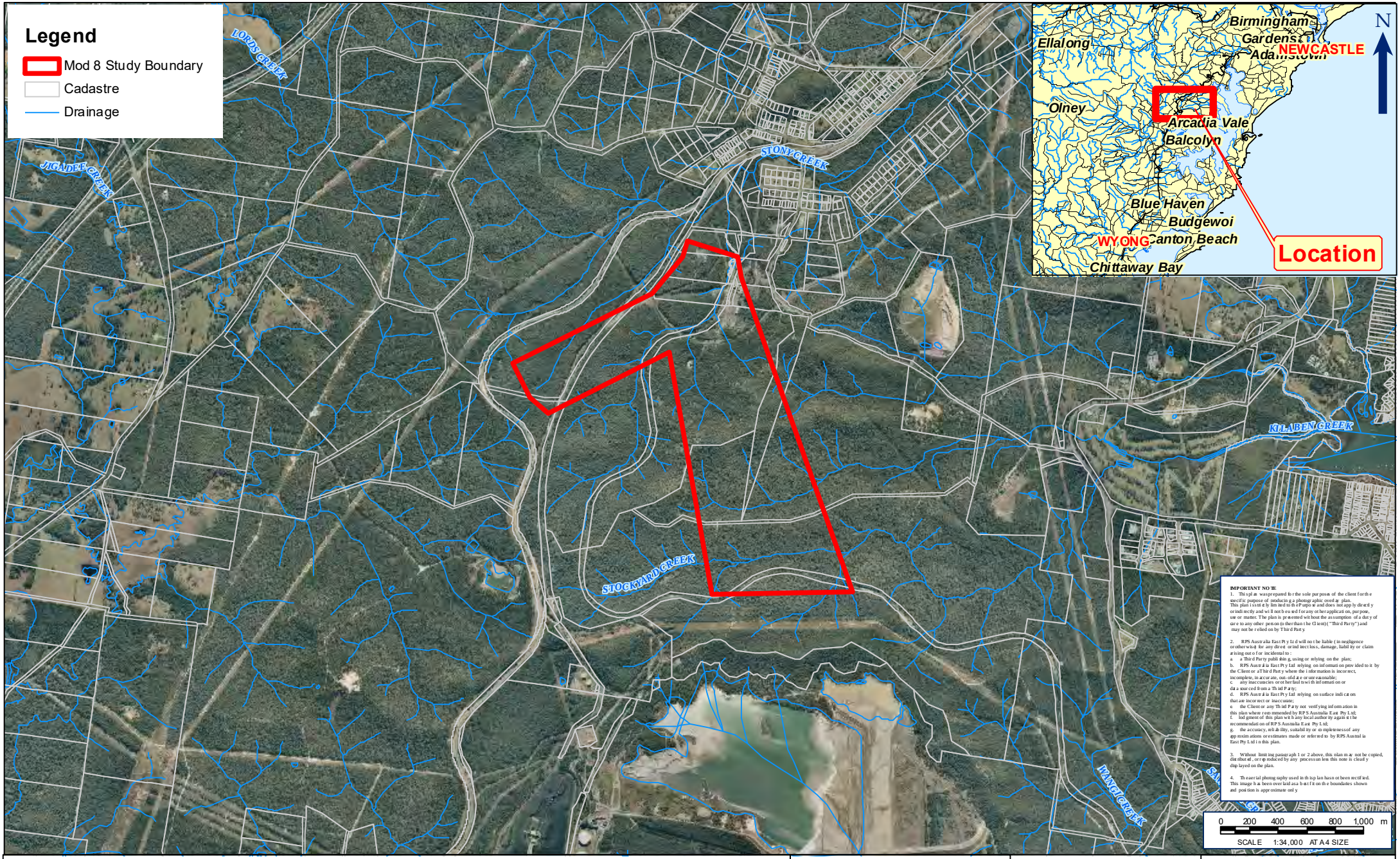

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Figure 1: The Study Area

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: mark.aitkens Date: 20/07/2018

Path: S:\Centennial\All Jobs\141016 Ecological Due Diligence For Wolgan 1 Site\10 - Drafting\Arcgis Map Documents\Eco\BTT Report\139881 Figure 1 SA A4L

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL
JOB REF: PR139881

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1.4 Site Description

The site is broadly described in **Table 1**.

Table 1 Site Description

Feature	Description
Site	The Newstan Mod 8 site boundary is shown in **Figure 1**. The site is 229.04 hectares in total of which 209.99 hectares is native vegetation and is bound by bushland.
Local Government Area	Lake Macquarie City Council Local Government Area.
Current Land Use	Bushland makes up the majority of the site, with no discernible anthropogenic land use. Other land uses are: • Awaba colliery surface facilities; • coal haul road; • 33 kV substation; and • two telecommunications towers (Site Nos. 2283003 and 9009652).
Topography	The site is characterised by an undulating terrain, incised by three creeks that create a series of gullies. Site elevations range from approximately 30 m to 100 m Australian Height Datum (AHD).
Hydrology	Three major catchments drain the site, which are Stony Creek; Kilaben Creek and Stockyard Creek. All three creeks discharge into Lake Macquarie, located approximately 4 km to the east. Stony Creek constitutes a Key Fish Habitat (DPI 2007) within the site.
Vegetation	Apart from the listed infrastructure above and clearing for tracks and powerline easements, the remainder of the site is covered by native vegetation. In total, there are 1,722.7 ha of native vegetation within 1500 m of the site, constituting 81.09% of the corresponding assessment area.

1.5 Regulatory Context

The regulatory context that defines the assessment framework for the Project is outlined in **Table 2**.

Table 2 Relevant Legislation, Policy and Guidelines

Legislation, Policy and Guidelines	Jurisdiction	Comment
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth	Provides lists of MNES such as threatened species and ecological communities (Section 18 and 18A). Outlines circumstances where a Proponent is required to refer a proposed action for assessment under the EPBC Act (i.e. Section 68).
Significant Impact Guidelines 1.1 – Matters of National Environmental Significance	Commonwealth	These Significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a MNES. Consideration of survey methods for specific MNES required where potential impacts are identified.
Biodiversity Conservation Act 2016	NSW	Provides lists of species, populations and ecological communities with a legal threatened status in NSW. Introduces the Biodiversity Offsets Scheme (BOS) and BAM.
Biosecurity Act 2015	NSW	Prescribes the statutory requirements for managing pests, diseases, weeds and contaminants in NSW. Applies to construction activities and occupation of the Project area.
Environmental Planning and Assessment Act 1979	NSW	This Act has effect subject to the provisions of Part 7 of the BC Act and Part 7A of the *Fisheries Management Act* 1994 that relate to the operation of this Act in connection with the terrestrial and aquatic environment. Biodiversity impact assessments in terrestrial settings to be performed in accordance with BAM and BOS.
National Parks and Wildlife Act 1974	NSW	Requires consideration of any impacts on the conservation reserve network.
Fisheries Management Act 1994	NSW	Provides lists of species, populations and ecological communities with a legal threatened status in NSW. One of the objectives of this act is to 'conserve key fish habitats', which includes Stoney Creek.
Coastal Management State Environmental Planning Policy 2018	NSW	Sets the land use planning framework for coastal management and ensures implementation of the planning objectives of the proposed Coastal Management Act in NSW. This policy repeals and consolidates SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection).
State Environmental Planning Policy No. 44 – Koala Habitat Protection	NSW	In addressing SEPP 44, there are two questions to be considered: Is the land "Potential Koala Habitat"? and; Is the land "Core Koala Habitat"?

1.6 Qualifications and Licensing

1.6.1 Qualifications

This report was written by Dr Hayden Beck and reviewed by Mr Arne Bishop (BSc) of RPS. Academic qualifications and professional experience of RPS staff involved are documented in **Appendix A**.

1.6.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Scientific Investigation Licence S100536 (Valid 31 December 2018);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2018);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2019); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2020).

2 Methodology

Investigation methods, including desktop information sources and survey methods, are detailed in the following sections.

2.1 Desktop Assessment

2.1.1 Databases

A review of relevant information was performed to gain an understanding of the biodiversity values occurring or potentially occurring within the site. Information sources reviewed for a 10 km radius of the site (i.e. locality) included:

- BAM Calculator candidate species output (accessed June 2018);
- Fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (accessed June 2018); and
- Fauna and flora records contained in the Department of the Environment and Energy (DoEE) Protected Matters Search tool (accessed June 2018).

A preliminary 'likelihood of occurrence' assessment was produced from this information to provide a framework for determining investigation methods necessary for performing adequate site investigations.

2.1.2 Spatial Datasets

Desktop analysis of vegetation cover including a review of the resources listed below:

- Lake Macquarie Native Vegetation Community Map (Bell and Driscoll 2015);
- Mitchell Landscapes (NPWS 2003);
- IBRA Region and subregion mapping (IBRA7); and
- Recent aerial imagery of the site.

2.1.3 Literature

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring on the site and locality (i.e. within 10 Kilometres of the site). Previous reports prepared for the site have been reviewed for the purpose of assessing the likelihood of threatened species or ecological communities occurring within the site. Information sources reviewed included:

- RPS (2017) Annual fauna monitoring report; and
- RPS (2016) Newstan Mine Extension EIS.

The following sections provide additional detail on the methods employed during surveys.

2.1.4 Likelihood of Occurrence

The list of threatened species, populations and ecological communities (threatened biodiversity) identified as potentially occurring was determined through a likelihood of occurrence analysis. A preliminary likelihood of occurrence was performed prior to field surveys to guide investigation methods and effort. This was subsequently refined following the completion of field survey.

Table 3 Likelihood of Occurrence criteria

Likelihood Rating	Description
None	Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Low	Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction.
Moderate	Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat.
High	Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes.
Known	Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population).

Note that regardless of the outcome of the Likelihood of Occurrence, BAM Candidate species still require to be surveyed for within the prescribed timeframe. BAM Candidate Species may only be dismissed from requiring survey when:

- presence is assumed;
- an expert report is prepared; or
- more appropriate local data is gained.

2.2 Flora Surveys

Flora surveys were conducted in accordance with the Fee Proposal, issued 1 May 2018. These surveys were conducted in accordance with BAM (2017), with the aim to identify the vegetation communities existing on site. Species detected are summarised in **Appendix B**.

2.2.1 Vegetation Mapping

The Lake Macquarie Vegetation Community Mapping (Bell and Driscoll 2015) was used as the basis for a preliminary analysis of vegetation patterns within the site. Bell and Driscoll (2015) was updated following re-interpretation of mapped vegetation boundaries using the latest aerial photography (i.e. Google 2018) prior to survey stratification. PCTs were assigned to Bell and Driscoll (2015) using the conversion table by Bell (2006). Updates also included the assigning of notional condition classes, which took into consideration findings presented in RPS (2016 and 2017). Preliminary plant community types (PCTs) were assigned to areas of relatively homogenous land cover (i.e. vegetation zones). Additional revisions were performed following the completion of field surveys (i.e. revision of boundaries and condition classes). PCT extent was

calculated in a GIS to determine the number of BAM plots required and implementation of other survey methods.

2.2.2 BAM Plots

A total of 17 flora plots were performed in accordance with BAM to measure the composition, structure and functional components of the sites native vegetation cover. Where possible, BAM plots were placed in a manner that best reflected the biological character of the vegetation zone being assessed (i.e. avoided placement of plots near ecotones and disturbed boundaries).

Each plot included:

- One standard 20 x 20 m plot, to assess the composition and structure attributes, including trees, shrubs, grasses, forbs, ferns and other growth forms;
- One standard 20 x 50 m plot (1000 m^2) to assess the function attributes: number of large trees (i.e. > 50cm DBH), stem size class, tree regeneration, length of fallen logs, high threat exotic vegetation cover and hollow-bearing trees; and
- Five 1 m^2 sub-plots to assess average litter cover for the plots.

The methods for collecting data from within a BAM plot are described in OEH (2017). Survey timing, effort and locations are outlined in **Section 2.4**.

2.2.3 Flora Inventory

2.2.3.1 Rapid Data Points

Data collected from 'rapid data points' (RDPs) was used to assist vegetation classification and determining the floristic inventory. Data collected at each RDP include:

- Dominant canopy species;
- Main associated species;
- Landscape position;
- Characteristic mid-storey species;
- Characteristic groundcover species; and
- Other diagnostic features.

2.2.3.2 Quadrats

Native and exotic plant species were recorded within the 400 m^2 plot. Percent cover was estimated for each plant species and recorded with reference the guidance outlined in BAM (2017). Plant abundance was recorded for species with less than 5% cover.

2.3 Fauna Surveys

As Newstan Mod 8 requires no vegetation removal, and impacts on fauna are expected to be negligible given the very low levels of predicted ground movement, no targeted fauna surveys were undertaken. As such, the BTT was prepared assuming presence of species credit species occur within the development site with only incidental observations of species credit species and their habitats being noted during surveys.

2.4 Survey Details

2.4.1 Flora

Flora field surveys were conducted over seven days (5-9 and 12-13 June 2018). Seventeen BAM plots were surveyed to cover the five mapped vegetation zones as outlined below:

- PCT 1588 Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast (3 Plots);
- PCT 1619 Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (5 Plots);
- PCT 1627 Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands (4 Plots); and
- PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast (5 Plots).

Locations of biometric plots and rapid data points, used to identify vegetation community boundaries, are shown on **Figure 3**.

2.4.2 Fauna

Opportunistic fauna records were collected during flora surveys (5-9 and 12-13 June 2018).

2.4.3 Data recording

A hand-held Trimble differential global positioning system (DGPS), accurate to less than one metre, was used to record the location of survey methodologies along with notable results including the location of threatened flora and/or fauna species.

2.4.4 Dates and Weather Conditions

Surveys were conducted in June 2018. Survey dates, methods and weather conditions are provided in **Table 4**. Climatic data was attained for Lake Macquarie (station number 061412), located approximately 9.8 km west of the site (BOM, 2018).

Table 4 Weather Conditions over survey period

Date	Min-Max Temperature (°C)	Rain (24 hrs to 9am; mm)	Sunrise to Sunset
5/6/18	11.2-17.0	24.2	10 hrs 3 min
6/6/18	9.0-17.1	2.6	10 hrs 2 min
7/6/18	9.0-20.2	6.0	10 hrs 2 min
8/6/18	5.7-17.7	0	10 hrs 1 min
9/6/18	9.0-16.3	2.6	10 hrs 1 min
12/6/18	3.3-18.9	0	10 hrs
13/6/18	3.5-19.4	0.2	9 hrs 59 min

2.5 Nomenclature

2.5.1 Plant Taxonomy

Plant taxonomy used was consistent with the nomenclature of the Flora of NSW (Harden 1990-1993; 2002), except where more recent revisions have been published in recognised scientific journals and accepted by the National Herbarium of New South Wales (as per PlantNet web site http://plantnet.rbgsyd.nsw.gov.au/).

2.5.2 Fauna Taxonomy

Taxonomy and common names of fauna in this report were from the following sources:

- Mammals: Menkhorst and Knight (2010), Churchill (2008), Pennay et al. (2004);
- Birds: Christidis and Boles (2008);
- Reptiles: Wilson and Swan (2010); and
- Frogs: Tyler and Knight (2009).

2.5.3 Native Plant Community Types (PCTs)

The assigning of PCTs to describe mapped vegetation cover was in accordance with the NSW Vegetation Information System (OEH 2018). Published scientific literature, where available, was used to aid in the interpretation of this database (e.g. referenced source documents).

2.6 Limitations

This assessment is based on BAM Plots and RDPs only, with the potential for threatened flora and fauna detection limited to opportunistic surveys and habitat analysis.

Due to survey limitations, the likelihood of occurrence analysis has relied on an evaluation of existing habitat value and its importance in lifecycle process (e.g. differentiating between fauna activity associated with a specific home range from non-habitat dependant transient/ vagrant movements). In this respect, habitat value was assessed on the basis of habitat surrogates (i.e. PCTs) and condition, with the importance of this habitat determined by an analysis of micro habitat features necessary for lifecycle processes (e.g. hollow-bearing trees, surface rock, water bodies, fallen logs etc.).

Given the above, the precautionary principle has been applied in circumstances where scientific uncertainty exists (i.e. assumed presence for a threatened flora or fauna species which is likely to occur).

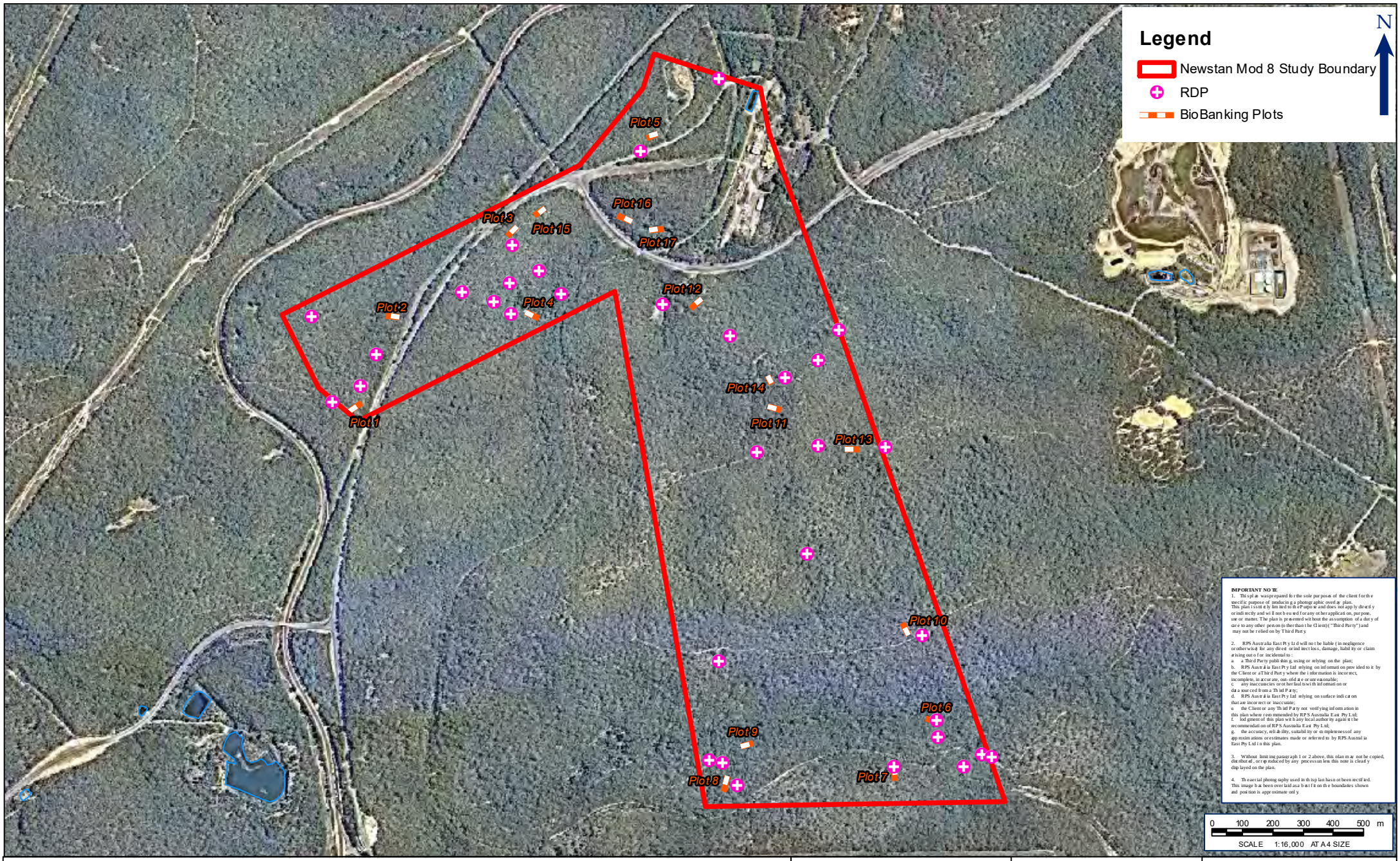

Figure 2: Flora Survey Effort

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: mark.aitkens Date: 30/07/2018

Path: S:\Centennial\All Jobs\139881 Newstan Mod Ecology Assessment\10 - Drafting\Arcgis Map Documents\Eco\Report Figures\BIR\139881 Figure 2

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94

PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL

JOB REF: PR139881

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3 Results

3.1 Desktop Assessment

3.1.1 Databases

Database search results (OEH 2018a; DoEE 2018) identified 17 threatened flora and 53 threatened fauna species with potential to occur within the locality (i.e. 10 km radius of the site). A comprehensive list of threatened species, including their habitat types, is provided in **Appendix C**. A summary comprising those with a moderate or greater likelihood of occurrence is provided in **Table 5**.

Table 5 Threatened Species with 'Moderate' or Greater Likelihood of Occurrence

Scientific name	Common name	BC Act	EPBC Act
Fauna			
Litoria brevipalmata	Green-thighed Frog	V	-
Crinia tinnula	Wallum Froglet	V	-
Mixophyes iteratus	Giant Barred Frog	E	E
Hoplocephalus stephensii	Stephens' Banded Snake	V	-
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-
Lophoictinia isura	Square-tailed Kite	V	-
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-
Burhinus grallarius	Bush Stone-curlew	E	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-
Anthochaera phrygia	Regent Honeyeater	CE	CE
Daphoenositta chrysoptera	Varied Sittella	V	-
Glossopsitta pusilla	Little Lorikeet	V	-
Lathamus discolor	Swift Parrot	E	CE
Ninox connivens	Barking Owl	V	-
Ninox strenua	Powerful Owl	V	-
Tyto novaehollandiae	Masked Owl	V	-
Tyto tenebricosa	Sooty Owl	V	-
Cercartetus nanus	Eastern Pygmy-possum	V	-
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E
Phascogale tapoatafa	Brush-tailed Phascogale	V	-

Scientific name	Common name	BC Act	EPBC Act
Planigale maculata	Common Planigale	V	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-
Mormopterus norfolkensis	Eastern Freetail-bat	V	-
Pseudomys novaehollandiae	New Holland Mouse	-	V
Petaurus australis	Yellow-bellied Glider	V	-
Petaurus norfolcensis	Squirrel Glider	V	-
Phascolarctos cinereus	Koala	V	V
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V
Petauroides volans	Greater Glider	-	V
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-
Kerivoula papuensis	Golden-tipped Bat	V	-
Miniopterus australis	Little Bentwing-bat	V	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-
Flora			
Rutidosis heterogama	Heath Wrinklewort	V	V
Acacia bynoeana	Bynoe's Wattle	E	V
Maundia triglochinoides		V	-
Angophora inopina		V	V
Callistemon linearifolius		V	-
Eucalyptus camfieldii		V	V
Melaleuca biconvexa	Biconvex Paperbark	V	V
Syzygium paniculatum	Magenta Lilly Pilly	E	V
Caladenia tessellata	Thick-lip Spider Orchid	E	V
Corybas dowlingii		E	-
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V
Genoplesium insignis	Variable Midge Orchid	E	-
Rhizanthella slateri		V	E
Grevillea parviflora subsp. parviflora	Small-flowered Grevillea	V	V
Tetratheca juncea	Black-eyed Susan	V	V

In addition to the Candidate species identified by the BAM Calculator, the following Credit Species were considered in the BIR as they had been recorded within 10 km of the site and a moderate or greater likelihood of occurrence based on the habitat at the Site:

- *Anthochaera phrygia* (Regent Honeyeater);
- *Caladenia tessellata* (Thick Lip Spider Orchid);
- *Corybas dowlingii* (Red Helmet Orchid);
- *Genoplesium insigne* (Variable Midge Orchid);
- *Maundia triglochinoides*;
- *Melaleuca biconvexa* (Biconvex Paperbark);
- *Mixophes iteratus* (Giant Barred Frog);
- *Rhizanthella slateri* (Eastern Australian Underground Orchid); and
- *Syzygium paniculatum* (Magenta Lilly Pilly).

It should be noted that even if BAM Species Credit Species are not considered likely to occur, these species still need to be assessment in the BTT if they cannot be discounted using the prescribed Geographic and Habitat Constraints assigned within the BAM calculator. A list of Candidate Species requiring consideration in the BTT is further discussed in **Section 3.1.5**.

3.1.2 Literature Review

The following threatened species as being previously detected on site or nearby the site are shown in **Table 6**.

Table 6 Previously detected threatened species (as adapted from RPS 2011)

Scientific Name	Common Name	BC Act	EPBC Act	Source
Flora				
Acacia bynoeana	Bynoe's Wattle	E	V	Umwelt (2005), Cumberland Ecology (2007, 2008); HunterEco (2008a, 2008b, 2009b); RPS 2011
Angophora inopina	Charmhaven Apple	V	V	Cumberland Ecology (2007, 2008); HunterEco (2008a, 2009b); RPS (2011)
Callistemon linearifolius	Crimson Bottlebrush	V		Umwelt (2004)
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Umwelt (2005); EcoBiological (2005); Cumberland Ecology (2007, 2008); HunterEco (2008a, 2008b, 2010); RPS (2011)
Tetratheca juncea	Black-eyed Susan	V	V	Umwelt (1998, 2004, 2005); EcoBiological (2005); Cumberland Ecology (2007, 2008); HunterEco (2008a, 2008b, 2010); RPS (2011, 2016)
Fauna				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Gunninah (1998); RPS (2011; 2015; 2016)

Scientific Name	Common Name	BC Act	EPBC Act	Source
Miniopterus australis	Little Bent-wing Bat	V		Gunninah (1998); RPS (2011, 2015; 2016; 2018)
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V		Gunninah (1998); RPS (2011, 2015; 2018)
Mormopterus norfolkensis	East Coast Freetail-bat	V		Cumberland Ecology (2007); RPS (2011, 2018)
Petaurus norfolcensis	Squirrel Glider	V		Gunninah (1998)
Pteropus poliocephalus	Grey-headed Flying - fox	V	V	Cumberland Ecology (2007); RPS (2011)
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V		Cumberland Ecology (2007)
Tyto novaehollandiae	Masked Owl	V		Cumberland Ecology (2007)
Tyto tenebricosa	Sooty Owl	V		Cumberland Ecology (2007)
Daphoenositta chrysoptera	Varied Sittella	V		RPS (2015)

3.1.3 Spatial Datasets

The site is located within the Sydney Basin IBRA region and Wyong subregion (SYB06) and Gosford – Cooranbong Coastal Slopes Mitchell Landscape (NPWS 2003). This is described as:

> *"Coastal fall of the Sydney Basin, rolling hills and sandstone plateau outliers of Triassic Narrabeen sandstones, extensive rock outcrop and low cliffs along ridge margins, general elevation 0 to 75m. Texture-contrast soils on lithic sandstones and shales. Loamy sand alluvium along creeks. Organic sand and mud in lagoons and swamps. Open forest and woodland of smooth-barked apple (Angophora costata), red bloodwood (Corymbia gummifera), brown stringybark (Eucalyptus capitellata), Sydney peppermint (Eucalyptus piperita), spotted gum (Corymbia maculata), bastard mahogany (Eucalyptus carnea), northern grey ironbark (Eucalyptus siderophloia) and grey gum (Eucalyptus punctata) on hills and slopes. Small areas of closed forest with; turpentine (Syncarpia glomulifera), lilly pilly (Acmena smithii), mountain cedar wattle (Acacia elata), coachwood (Ceratopetalum apetalum), sassafras (Doryphora sassafras) and water gum (Tristaniopsis laurina) in gullies under high escarpments Prickly-leaved tea-tree (Melaleuca stypheliodes) and other shrubs with swamp mahogany (Eucalyptus robusta), swamp oak (Casuarina glauca), sedges and common reed (Phragmites australis) on swampy creek flats. Coastal heath subject to salt spray on headlands (NPWS 2003)."*

Vegetation mapping and inspection of recent aerial photography indicates a limited amount of vegetation clearing within the locality resulting in a continuous native vegetation patch size of approximately 2300 ha. Boundaries assumed to create a barrier for connectivity were the rail corridor to the north and west, Eraring PowerStation to the south and Wangi Road to the east.

Locally, the clearing of native vegetation has occurred because of transport (i.e. roads and access tracks), mining, Awaba Waste Management Facility and easements for utilities, including electricity and rail.

3.1.4 Literature

A review of previous vegetation mapping by RPS (2016 and 2017) and Bell and Driscoll (2015) for the site was undertaken. This vegetation mapping identified four vegetation types within the site, which are described in **Section 3.2**.

Mapping by Bell and Driscoll (2015) was consistent with Rapid Data Points (RDPs), which were used to ground truth these mapping units, except for MU42. Bell and Driscoll (2015) mapped MU42 Red Mahogany-Apple Paperbark Forest as occurring at the southern extent of the site, associating with gullies in this location. However, RDPs confirmed that MU42 was not present, and that this vegetation was consistent with MU11 Coastal Sheltered Apple-Peppermint Forest.

3.1.5 Candidate Species Survey Matrix – BAM Calculator

Sub-bioregion, landscape and regional vegetation mapping outlined in **Section 3.1.3** was entered in the NSW BAM Calculator to produce a survey matrix for State listed threatened species identified as having a likelihood of occurrence within the site. Species and appropriate survey periods (i.e. blue shading) is provided in **Table 7**. Survey adequacy has also been assessed in terms of the survey timing and methods used, as described in **Section 2.** It should be noted that as Newstan Mod 8 is first working only and is expected to have a negligible impact on terrestrial ecosystems, surveys for these candidate species were not undertaken. However, if an impact is suspected as a result of Newstan Mod 8, or later stages have a greater potential to impact biodiversity, targeted surveys for these Candidate Species would be required.

Table 7 Candidate Species List

Species Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acacia bynoeana Bynoe's Wattle												
Angophora inopina Charmhaven Apple												
Anthochaera phrygia[1] *Regent Honeyeater*												
Asperula asthenes Trailing Woodruff												
Burhinus grallarius Bush Stone-curlew												
Caladenia tessellata[1] Thick Lip Spider Orchid												
Callistemon linearifolius Netted Bottle Brush												
Callocephalon fimbriatum Gang-gang Cockatoo												

[1] Candidate species not identified by BAM calculator but has a moderate or greater likelihood of occurrence

RPS

Species Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calyptorhynchus lathami Glossy Black-Cockatoo												
Cercartetus nanus Eastern Pygmy-possum												
Chalinolobus dwyeri Large-eared Pied Bat												
Corybas dowlingii[1] Red Helmet Orchid												
Crinia tinnula Wallum Froglet												
Cryptostylis hunteriana Leafless Tongue Orchid												
Cynanchum elegans White-flowered Wax Plant												
Diuris praecox Rough Doubletail												
Dromaius novaehollandiae - Endangered population												
Eucalyptus camfieldii Camfield's Stringybark												
Genoplesium insigne Variable Midge Orchid												
Grevillea parviflora subsp. parviflora Small-flower Grevillea												
Haliaeetus leucogaster White-bellied Sea-Eagle												
Hieraaetus morphnoides Little Eagle												
Hoplocephalus bitorquatus Pale-headed Snake												
Hoplocephalus stephensii Stephens' Banded Snake												
Lathamus discolor Swift Parrot												

RPS

Species Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Litoria aurea Green and Golden Bell Frog												
Litoria brevipalmata Green-thighed Frog												
Lophoictinia isura Square-tailed Kite												
Maundia triglochinoides[1]												
Melaleuca biconvexa[1] Biconvex Paperbark												
Melaleuca groveana Grove's Paperbark												
Miniopterus australis Little Bentwing-bat												
Miniopterus schreibersii oceanensis Eastern Bentwing-bat												
Mixophyes iteratus[1] Giant Barred Frog												
Myotis macropus Southern Myotis												
Ninox connivens Barking Owl												
Ninox strenua Powerful Owl												
Pandion cristatus Eastern Osprey												
Petaurus norfolcensis Squirrel Glider												
Petrogale penicillata Brush-tailed Rock-wallaby												
Phascogale tapoatafa Brush-tailed Phascogale												
Phascolarctos cinereus Koala												

Species Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planigale maculata Common Planigale												
Prostanthera cineolifera Singleton Mint Bush												
Pseudophryne australis Red-crowned Toadlet												
Pteropus poliocephalus Grey-headed Flying-fox												
Rhizanthella slateri[1] Eastern Australian Underground Orchid*												
Rutidosis heterogama Heath Wrinklewort												
Syzygium paniculatum[1] Magenta Lilly Pilly												
Tetratheca juncea Black-eyed Susan												
Tyto novaehollandiae Masked Owl												
Tyto tenebricosa Sooty Owl												
Uperoleia mahonyi Mahony's Toadlet												
Vespadelus troughtoni Eastern Cave Bat												

3.2 Vegetation Cover

3.2.1 Plant Community Types (PCTs)

Ground truthing of the site identified four native PCTs totalling an estimated 209.99 ha of native vegetation cover. Vegetation communities are mapped in **Figure 3**. **Table 8** lists the PCTs occurring within the site.

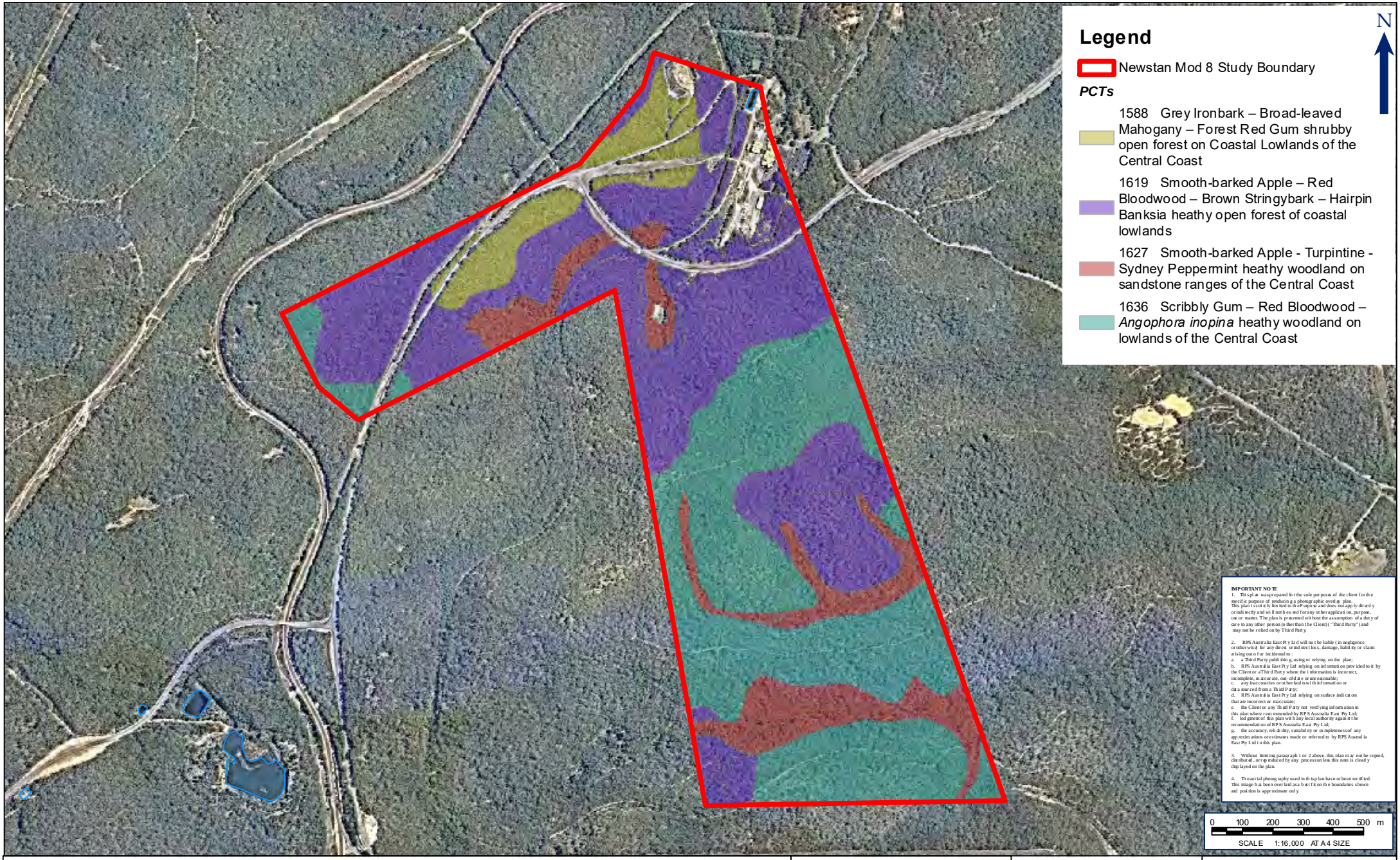

Figure 3: PCTs of the Site

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: mark.aitkens Date: 30/07/2018

Path: S:\Centennial\All Jobs\139881 Newstan Mod Ecology Assessment\10 - Drafting\Arcgis Map Documents\Eco\Report Figures\BIR\139881 Figure 3

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94

PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL

JOB REF: PR139881

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Table 8 Regional Vegetation Types, Area, PCT and TEC Equivalents for the Site

Regional Vegetation Type (LMCC Map; Bell and Driscoll 2015)	Likely PCT equivalent (OEH 2018)	Likely TEC Equivalents (OEH 2018)	Area (ha)
MU11 Coastal Sheltered Apple-Peppermint Forest	PCT 1627 Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Nil	28.38
MU15 Spotted Gum-Ironbark-White Mahogany - Grey Gum Forest	PCT 1588 Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	Nil	13.50
MU30 Smooth-barked Apple-White Mahogany-Sydney Peppermint Forest & Woodland	PCT 1619 Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands	Nil	86.43
MU31 Scribbly Gum-Red Bloodwood Woodland	PCT 1636 Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast	Nil	81.68

Vegetation classifications presented in this report recognise the overstorey canopy as a key identifying determinant. Summary descriptions for these PCTs are provided in **Tables 9-12**.

Table 9 Summary description for PCT 1627

Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	
Plate 1 PCT 1627: BAM Plot # 17	
Description:	Open Forests to Woodlands with a generally well developed and distinctly two-layered mid-stratum. The ground cover is characterised by graminoids; sub-shrubs and forbs. Sandstone ranges of the Central Coast hinterland from Wisemans Ferry to Pearl Beach and north to about Wyong Creek, including Dharug National Park. Elevation is 50 to 300m.
BAM Plots:	4,6,9 and 17
Diagnostic upper stratum species:	*Angophora costata* (smooth-barked apple; Plots 4,6,9 and 17); *Eucalyptus piperita* (Sydney Peppermint; Plots 4,6,9 and 17); and *Corymbia gummifera* (Red Bloodwood; Plot 9).
Diagnostic middle stratum species:	*Persoonia linearis* (Narrow-leaved Geebung; Plot 6)
Species ground stratum species:	*Dianella caerulea* (Blue-flax Lilly; Plots 4,6,9 and 17); *Lomandra longifolia* (Plot 17); *Lepidosperma laterale* (Variable sword-edge; Plot 9)
Classification Status:	This vegetation community does not correspond with any BC Act and/or EPBC Act listed EEC.

Table 10 Summary description for PCT 1619

Smooth-barked Apple – Red Bloodwood – Brown Stringybark – Hairpin Banksia heathy open forest of coastal lowlands	
Plate 2 PCT 1619: BAM Plot # 16	
Description:	Open forests with a canopy dominated by *Angophora costata* and *Corymbia gummifera*. The mid-storey is typically shrubby and commonly includes grass trees and scrambling climbers. The ground layer is typically dominated by grasses along with graminoids and scattered forbs. Coastal lowlands and low ranges of the lower North Coast and Central Coast; mainly on sandy substrates.
BAM Plots:	2,8,12,13 and 16
Diagnostic upper stratum species:	*Angophora costata* (Smooth-barked Apple; Plots 2,8,13 and 16); *Corymbia gummifera* (Red Bloodwood; Plots 2,8,12 and 13); *Eucalyptus capitellata* (Brown Stringybark; Plots 2,8 and 13).
Diagnostic middle stratum species:	*Banksia spinulosa* (Hairpin Banksia; Plots 2 and 8); *Allocasuarina littoralis* (Black She-Oak; Plot 2); *Leptospermum polygalifolium* (Tantoon; Plots 8 and 16); Persoonia levis (Broad-leaved Geebung; Plot 12); *Persoonia linearis* (Narrow-leaved Geebung; Plot 2); Billardiera scandens (Hairy Apple Berry; Plots 2,12,13 and 16).
Species ground stratum species:	*Themeda triandra* (Kangaroo Grass: Plots 2, 12 and 16); *Aristata vagans* (Threeawn Speargrass; Plots 12 and 16); *Dianella caerulea* (Blue Flax-lily; Plots 8, 12 and 16); *Lepidosperma laterale* (Variable Sword-sedge; Plots 2, 8, 12, 13); *Lomandra oblique* (Plots 2,12,13 and 16) and *Goodenia heterophylla* (Variable Leaved Goodenia; Plot 12.).
Classification Status:	This vegetation community does not correspond with any BC Act and/or EPBC Act listed EEC.

RPS

Table 11 Summary description for PCT 1588

Grey Ironbark – Broad-leaved Mahogany – Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	
Plate 3 PCT 1588: BAM Plot # 15	
Description:	Open forests characterised by *Eucalyptus paniculata*. The understorey is typically shrubby with sparse climbers. The ground layer is characteristically grassy with various graminoids and forbs. Coastal lowlands of the Central Coast mainly on sandstones.
BAM Plots:	3, 5 and 15
Diagnostic upper stratum species:	*Eucalyptus umbra* (Broad-leaved White Mahogany; Plots 3,5 and 15).
Diagnostic middle stratum species:	*Breynia oblongifolia* (Large Mock-olive; Plot 15); *Dodonaea triquetra* (Large-leaf Hop-bush; Plots 5 and 15); *Eustrephus latifolius* (Wombat Berry; Plots 3,5 and 15); *Pandorea pandorana* (Wonga Wonga Vine; Plots 3,5 and 15).
Species ground stratum species:	*Themeda triandra* (Kangaroo Grass: Plots 3, 5 and 15); *Imperata cylindrica* (Blady Grass; Plots 3, 5 and 15); *Dianella caerulea* (Blue Flax-lily; Plots 3, 5 and 15); *Lomandra longifolia* (Spiny-headed Mat-rush; Plots 5 and 15); *Pratia purpurescens* (Whiteroot; Plot 5) and *Glycine clandestine* (Twining glycine; Plots 3,5 and 15).
Classification Status:	This vegetation community can correspond with 'Endangered - Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion', which is BC Act listed. However, as the site is outside of the North Coast Bioregion, it does not correspond with this EEC.

RPS

Table 12 Summary description for PCT 1636

Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast	
Plate 4 PCT 1636: BAM Plot # 14	
Description:	Eucalypt dominated Woodlands with a shrubby mid-stratum and a graminoid ground cover. This community occurs on coastal lowlands from northern Tuggerah Lake to the northern end of Lake Macquarie. The substrate is sandstone with moist sandy soils. Elevation is usually under 100m.
BAM Plots:	1,7,10,11 and 14
Diagnostic upper stratum species:	*Eucalyptus haemastoma* (Broad-leaved Scribbly Gum; Plots 1,7,10,11 and 14); *Corymbia gummifera* (Red Bloodwood; Plots 1,7,10 and 11).
Diagnostic middle stratum species:	*Banksia oblongifolia* (Fern-leaved Banksia; Plot 10); *Leptospermum trinervium* (Slender Tea-tree; Plots 1,7,10,11 and 14); *Lambertia Formosa* (Mountain Devil; Plots 1,7,10,11 and 14); Xanthorrhoea spp. (A grass tree; Plots 1,7,10,11 and 14) and *Hakea dactyloides* (Finger Hakea; Plot 10).
Species ground stratum species:	*Epacris pulchella* (Wallum Heath; Plots 1 and 7); *Ptilothrix deusta* (Plots 1,7,10,11 and 14*); Lomandra obliqua* (Plots 1,7,10 and 14); and *Themeda triandra* (Kangaroo Grass: Plots 1 and 14).
Classification Status:	This vegetation community does not correspond with any BC Act and/or EPBC Act listed EEC.

3.2.2 Threatened Flora

Although targeted surveys for threatened flora were not undertaken as part of the scope, the following threatened species were detected:

- *Corybas dowlingii* (Red Helmet Orchid; BC Act: Endangered; EPBC Act: Not Listed; Plate 5) was found in Plot 16 (PCT 1619); and
- *Grevillea parviflora* subsp. *parviflora* (Small Flower Grevillea; BC Act: Vulnerable; EPBC Act: Vulnerable).

Plate 5 *Corybas dowlingii*

3.3 Fauna observations

Opportunistic observations made throughout the flora surveys resulted in detection of *Calyptorhynchus lathami* (Glossy Black Cockatoo; BC Act: Endangered; EPBC Act: Not Listed). No other threatened fauna species were observed.

4 Impact Assessment

This section addresses regulatory matters not relevant to the prescribed content of the BTT.

4.1 NSW State Groundwater Dependent Ecosystems

The potential for Groundwater Dependent Ecosystems (GDEs) was examined using the Groundwater Dependent Ecosystems Atlas (GDE Atlas) (BOM 2018). The GDE Atlas was developed as a national dataset of Australian GDEs to inform groundwater planning and management (BOM 2018). GHD (2018) identified the following terrestrial GDEs as potentially occurring within 5km of the site:

- Narrow-leaved Apple/Parramatta Red Gum/Persoonia oblongata heathy woodland of the Howes Valley area;
- Scribbly Gum/Red Bloodwood/Angophora inopina heathy woodland on lowlands of the central coast;
- Smooth-barked Apple/Red Bloodwood/Brown Stringybark/Hairpin Banksia heathy open forest of the Central Coast;
- Spotted gum/Broad-leaved Mahogany/Grey Gum grass/shrub open forest on Coastal Lowlands of the Central coast;
- Spotted Gum/Broad-leaved Mahogany/Red Ironbark shrubby open forest;
- Swamp Mahogany/Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast; and
- Sydney Blue Gum/Lilly Pilly mesic tall open forest of coastal ranges and tablelands escarpment

The primary source of groundwater in the region, owing the underlying sandstone, is likely to be a sedimentary rock groundwater system. Terrestrial GDEs (i.e. facultatively dependent) may be present and, if so, most likely associated with Stony Creek, Kilaben Creek and Stockyard Creek.

Field validated vegetation mapping confirmed the following terrestrial PCTs within the site that may be partly associated with a terrestrial GDE:

- PCT 1636 (see Table 12);
- PCT 1619 (see Table 10); and
- PCT 1627 (see Table 9).

GDE extent (BOM 2018), riparian corridors and field validated PCTs are shown in **Figure 4**.

In relation to the impacts of the Newstan Mod 8 impacts, GHD (2018) states the following:

"*The proposed workings are not predicted to result in any drawdown of alluvial groundwater. Therefore the predicted impacts on alluvial groundwater within the Study Area are expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable. No impacts on GDEs are predicted*."

On this basis, it is considered that Newstan Mod 8 impacts are not likely to have an impact on GDEs that may occur within the site.

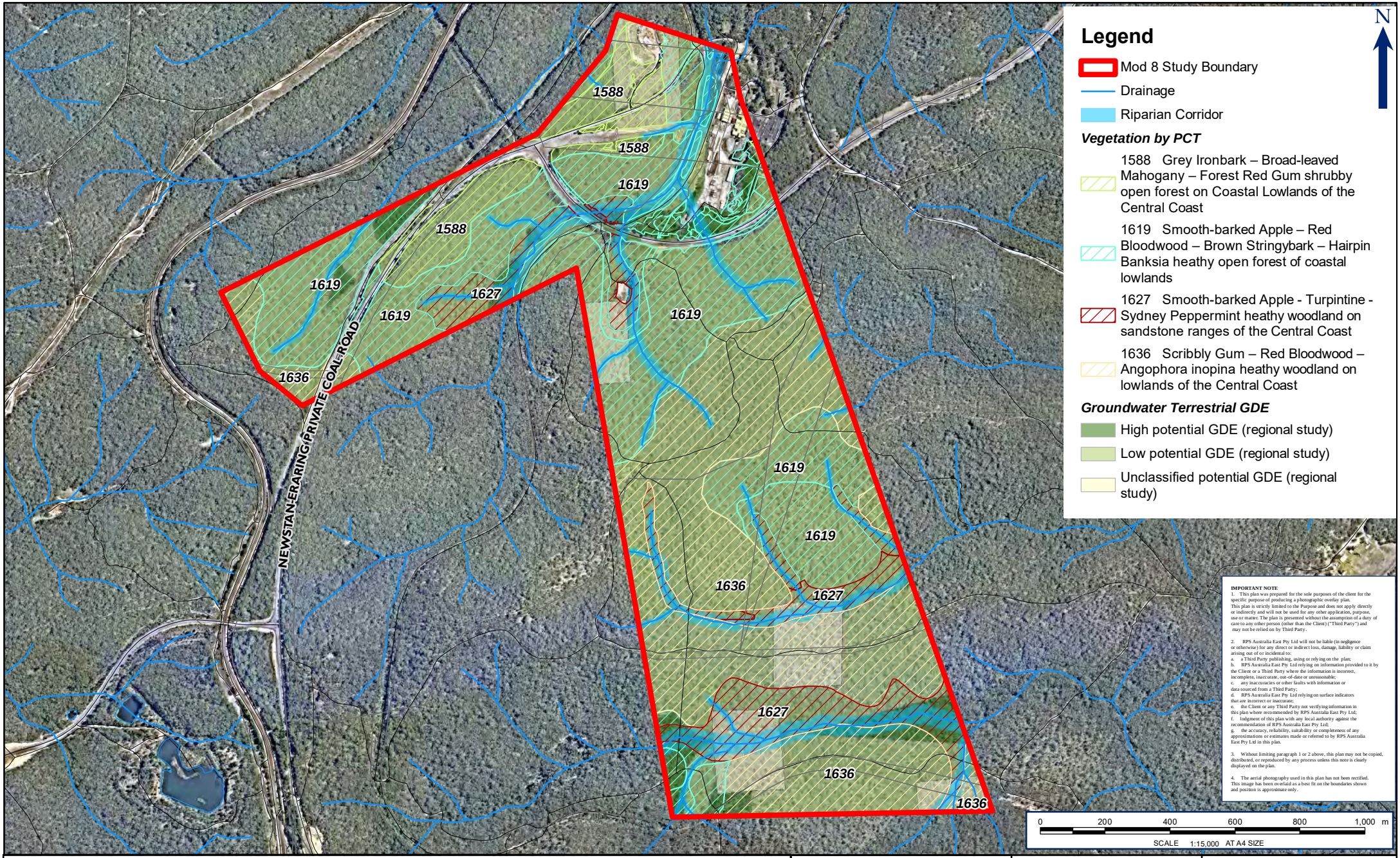

Figure 4: Groundwater Dependent Ecosystems for Newstan MOD 8

LOCATION: NEWSTAN

PURPOSE: ECOLOGY

Technician: Natalie.Wood Date: 6/07/2018

Path: S:\Centennial\All Jobs\139881 Newstan Mod Ecology Assessment\10 - Drafting\Arcgis Map Documents\Eco\Report Figures\139881 Figure 4 Veg

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL
JOB REF: PR139881

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4.2 State Environmental Planning Policy No.44 – Koala Habitat Protection

An assessment of koala habitat under SEPP 44 is provided below. In addressing SEPP44, there are two criteria to be considered as provided in **Table 13**.

Table 13 SEPP 44 Koala Habitat Protection Criteria

SEPP 44 Criteria	Comment
Is the land "Potential Koala Habitat"?	'Potential Koala Habitat' is defined in SEPP 44 as, "...an area of native vegetation where trees of the type listed in Schedule 2 (Koala feed tree species) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component"
Is the land "Core Koala Habitat"?	"Core Koala habitat" is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population."

E. microcorys (Tallowwood; Primary 'Koala Feed Tree') and *E. resinifera* (Red Mahogany; Secondary 'Koala Feed Tree'), were recorded within PCT 1627, and composed over 15% of the canopy cover at Plot 17. During the site survey, no Koalas or signs thereof (e.g. scats and scratches on boles of trees) were observed. Moreover, there have been no reported sightings of Koalas nearby the proposed works site (OEH, 2013) (see **Figure 4**), with the closest reported sighting made of an individual koala 3 km southeast of the site. Given the low levels of Koala activity evidenced on site, the site is not considered to constitute 'Core Koala Habitat' as defined under SEPP 44 and no further provisions of this policy apply to the site.

4.3 *Environmental Protection and Biodiversity Conservation Act 1999*

4.3.1 Migratory Species

Eighteen nationally listed migratory terrestrial and wetland species were recorded on the DoEE online database or are considered to have potential habitat available within 10km of the site (**Table 14**).

Table 14 Migratory birds listed under EPBC Act

Scientific Name	Common Name
Migratory Terrestrial Species	
Cuculus optatus	Oriental Cuckoo
Hirundapus caudacutus	White-throated Needletail
Monarcha melanopsis	Black-faced Monarch
Monarcha trivirgatus	Spectacled Monarch
Motacilla flava	Yellow Wagtail
Myiagra cyanoleuca	Satin Flycatcher
Rhipidura rufifrons	Rufous Fantail
Migratory Wetlands Species	
Actitis hypoleucos	Common Sandpiper

Scientific Name	Common Name
Calidris acuminata	Sharp-tailed Sandpiper
Calidris canutus	Red Knot
Calidris ferruginea	Curlew Sandpiper
Calidris melanotos	Pectoral Sandpiper
Gallinago hardwickii	Latham's Snipe
Limosa lapponica	Bar-tailed Godwit
Numenius madagascariensis	Eastern Curlew
Pandion haliaetus	Osprey
Pluvialis fulva	Pacific Golden Plover
Tringa nebularia	Common Greenshank

The proposed works are unlikely to impact on any area considered to be 'important habitat' for the above migratory species or are likely to impact a significant proportion of a migratory population.

4.3.2 Threatened Species

The likelihood of occurrence analysis identified 11 threatened flora species and 10 threatened fauna species as having a moderate or greater likelihood of occurrence within the site (**Table 15**; **Appendix C**).

Table 15 EPBC Act listed flora identified likelihood to occurrence

Scientific name	Common name	EPBC Act Listing
Flora		
Rutidosis heterogama	Heath Wrinklewort	vulnerable
Acacia bynoeana	Bynoe's Wattle	vulnerable
Angophora inopina	Charmhaven Apple	vulnerable
Eucalyptus camfieldii		vulnerable
Melaleuca biconvexa	Biconvex Paperbark	vulnerable
Syzygium paniculatum	Magenta Lilly Pilly	vulnerable
Caladenia tessellata	Thick-lip Spider Orchid	vulnerable
Cryptostylis hunteriana	Leafless Tongue-orchid	vulnerable
Rhizanthella slateri	Eastern Underground Orchid	vulnerable
Grevillea parviflora subsp. parviflora	Small-flowered Grevillea	vulnerable
Tetratheca juncea	Black-eyed Susan	vulnerable
Fauna		
Mixophyes iteratus	Giant Barred Frog	endangered
Anthochaera phrygia	Regent Honeyeater	critically endangered

Scientific name	Common name	EPBC Act Listing
Lathamus discolour	Swift Parrot	critically endangered
Dasyurus maculatus maculatus	Spotted-tailed Quoll	endangered
Pseudomys novaehollandiae	New Holland Mouse	vulnerable
Phascolarctos cinereus	Koala	vulnerable
Potorous tridactylus tridactylus	Long-nosed Potoroo	vulnerable
Petauroides volans	Greater Glider	vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	vulnerable
Chalinolobus dwyeri	Large-eared Pied Bat	vulnerable

Impacts on fauna are expected to be negligible given that no vegetation would be removed, whilst very low levels of predicted ground movement are expected (< 2cm; MSEC 2018). Consequently, no significant impacts are predicted to result from the Project.

4.3.3 Threatened Ecological Communities

No threatened ecological community (TEC) listed under the EPBC Act were detected on site. As such, no assessment for EPBC Act Listed Threatened Ecological Communities is provided in this report.

4.3.4 Summary

No significant impacts are predicted to result from the Project. Therefore, it is unlikely that the proponent would consider lodging a referral to the Commonwealth Minister for the Environment on this basis.

5 Recommendation

MSEC (2018) and GHD (2018) have concluded that due to the impact predictions no monitoring is required. RPS recommend that the existing Flora and Fauna Management Plan be reviewed and if necessary updated to address the Newstan Mod 8.

6 Conclusions

This BIR details the methods and results of flora surveys conducted for first workings in the West Borehole Seam. As the project requires no vegetation removal, and very low levels of predicted ground movement are expected, impacts on biodiversity are expected to negligible. Hence, biodiversity offset requirements are not required and no targeted surveys for threatened flora or fauna species were undertaken. Nevertheless, floristic surveys were undertaken to determine a baseline for vegetation integrity at the site.

None of the PCTs identified on site form part of a BC Act and/or EPBC Act listed EEC. No adverse impacts on terrestrial GDEs is expected within the site (GHD 2018).

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RPS (2015) Annual Fauna Monitoring Report Newstan Colliery

RPS (2016) Newstan Colliery Extension Project Ecological Assessment

RPS (2017) Annual Fauna Monitoring Report Newstan Colliery

Appendix A
Staff CVs

RPS

Mark Aitkens

Principal Ecologist

Project role: Principal Ecologist

Location: Newcastle, NSW, Australia

Qualifications: B.Sc. (Environmental Biology)

Memberships: Ecological Society of Australia (ESA)

How Mark can add value

Mark is a Principal Ecologist with 22+ years experience in the delivery of terrestrial and aquatic ecology services to the private and public sectors. As a consulting ecologist, he is experienced in all aspects of project delivery including design and implementation of seasonally based flora and fauna surveys, identification of terrestrial and aquatic species and ecological communities, impact assessments prepared under State and Commonwealth legislation, provision of biodiversity offsetting outcomes and design and implementation of monitoring programs.

Mark is accredited to apply the Biodiversity Assessment Method (BAM) for projects that are to be assessed under the *Biodiversity Conservation Act* 2016 and previously as a BioBanking Assessor under the *Threatened Species Conservation Act* 1995. He has performed BBAM and BAM assessments for Major Projects (State Significant Infrastructure and State Significant Developments). He has also conducted EPBC offset calculations under the EPBC Act Environmental Offsets Policy (SEWPAC 2012).

Relevant projects

Springvale Coal, Centennial Coal, 2018

Preparation and implementation of Biodiversity Management Plans (BMP) and Swamp Monitoring Programs (SMP) as subplans of Longwall Extractions Plans for the Springvale Coal Extension Project. BMPs and SMPs are reviewed by the Independent Monitoring Panel and State/ Commonwealth regulators prior to the approval of secondary coal extraction. Works involved the synthesis of a growing knowledge base on best practice monitoring and management of endangered upland peat swamps listed on State and Commonwealth legislation.

Mandalong Coal, Centennial Coal, 2018

Preparation and implementation of a BMP as a subplan for Extractions Plans prepared for longwalls 25-31 of the Mandalong Coal Project. BMPs are reviewed by the relevant State regulator prior to the approval of secondary coal extraction.

Mary's Mount Blue Metal Quarry, Gunnedah Quarry Products, 2013-2014

Project managed and prepared Preliminary Documentation for a 'controlled action' declared under the EPBC Act (significant impact on Semi-evergreen Vine Thicket EEC and the Koala). Calculated biodiversity offset requirements in accordance with Commonwealth Offsets Policy and incorporated into a Biodiversity Offset Strategy. Prepared Biodiversity Offset Management Plan for residual values including a site specific Koala Plan of Management prepared in accordance with SEPP 44 and approved by the Department of Planning and Environment.

Northern Coal Logistics Project, Centennial Coal, 2018

Preparation of a BioBanking compliant assessment for the Northern Coal Logistics Project including assessment of complimentary biodiversity offset sites for inclusion in the biodiversity offset strategy for the Project.

Pacific Highway Upgrade: Oxley Highway to Kempsey, RMS, 2012-2014

Assisted in the procurement of approvals under State and Commonwealth legislation including the performed of risk assessments, field surveys, reporting, project design and impact assessments. Performed monitoring surveys for the State listed *Maundia triglochinoides* and the State and Commonwealth listed Giant Barred Frog (*Mixophyes iteratus*) in accordance with a Before Impact Control After monitoring design. Analysed results and reported findings including an evaluation of Project impacts and performance of mitigation measures.

Western Region Biodiversity Offset Strategy, Centennial Coal, 2018

Preparation of a biodiversity offset strategy for multiple approved coal mining operations in the NSW 'Western Coal Fields' near Lithgow. Involved a post hoc assessment of Project impacts and comparable offsets using the repealed Framework for Biodiversity Offsets (Major Projects) and Part 7A of the *Threatened Species Conservation Act* 1995. Demonstrated a suitable offset strategy for approved projects by gaining approval through the NSW Department of Planning and Environment and Office of Environment and Heritage.

Arne Bishop

National Ecology Discipline Leader, Newcastle Ecology Manager

Areas of expertise

Arne has over 16 years' experience in the environmental sector. As the National Discipline Leader for both Terrestrial and Aquatic Ecology Arne focuses on the national growth of our core services and on marketing our capability. He is accountable for: thought leadership for the Ecology discipline; driving our services to the leading edge of industry best practice; and for growing our business nationally. In his position as Ecology Manager, Arne manages the Newcastle environment department including the day to day running of projects, verification of reports and other outputs and ensures clients and other stakeholders are well informed of project progress, key findings and any pertinent issues which require resolution.

Arne's current and previous roles have provided him with an extensive knowledge of a plethora of exotic and endemic NSW flora, fauna, ecological communities and migratory species. He conducts ecological impact assessments and monitoring programs on a daily basis, which aim to identify appropriate performance indicators for monitoring and managing potential impacts upon threatened entities through Trigger Action Response Plans. Threatened entities include; threatened flora, fauna, populations and communities listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act).

Arne is an accredited person under the Biodiversity Assessment Methodology (BAM). Prior to the introduction of the BAM, Arne was a BioBanking Assessor and has conducted BioBanking assessments for Major Projects (State Significant Infrastructure and State Significant Developments) under the Framework for Biodiversity Assessment (OEH 2014) and assessments for smaller developments under the *BioBanking Assessment Methodology* (OEH 2014). He has also conducted EPBC offset calculations under the *EPBC Act Environmental Offsets Policy* (SEWPAC 2012).

During his career, Arne has project managed and/or participated in numerous large-scale land development, mining, energy and infrastructure projects. He subsequently possesses a firm understanding and working knowledge of local, state and federal government legislation and policies that underpin environmental assessments, environmental mitigation, management and offsetting techniques.

Location:

Newcastle, NSW
Australia

Education:

Bachelor of Environmental Science, University of Canberra

Bachelor of Landscape Architecture, University of Canberra

Cert IV Horticulture (Landscape), Canberra Institute of Technology

Cert II Australian Land Conservation and Restoration, Conservation Volunteers Australia

Memberships:

Ecological Consultants Association, Royal Zoological Society NSW

Sectors:

Urban Growth

Infrastructure

Energy

Natural Resource Management

https://www.linkedin.com/in/arne-bishop-7b53723a/

Selected project experience

Newcastle Light Rail, Downer and TfNSW

Arne is currently project managing a team undertaking pre-clearance surveys and the identification of tree species and fauna species within the Newcastle Light Rail alignment and immediate surrounds, to accommodate the Newcastle Light Rail.

Newcastle Urban Transformation and Transport Program - Rezoning of Surplus Corridor Lands, UrbanGrowth NSW C/- Elton Consulting

Arne was involved in the provision of a Flora and Fauna Assessment to inform the rezoning of lands for the Project. The proposed zoning amendments applying to the rail corridor land will form part of the delivery of urban transformation, comprising a package of transport, built form and public domain improvements in and around the rail corridor lands.

NBN Projects

Biodiversity due diligence analysis to identify the presence of '*areas of environmental significance*'. Service Area Modules previously investigated include 2DAP-20 (Dapto), 2CAL-20 (Callala Bay), 2MVI-02 (Mt Victoria), 2CAH-20 (Camden Haven), 2KMS-20 (Kempsey), 2TER-20 (Terranora), 2WAU-20 and 2WAU-21 (Wauchope), 2PTM-23 (Port Macquarie), 2ULL-04 (Ulladulla), 2MAC-20 2MAC-21 2MAC-22 (Macksville), 2NLT-05 (New Lambton), 2BYB-21 (Byron Bay), 2GOS-20 (Gosford), 2NRN-07Narellan, 2SUX-01 (Sussex Inlet) and 2NWR-20 (Nowra). All projects have involved the identification and development of impact avoidance solutions for '*areas of environmental significance'* such as SEPP 14 coastal wetlands, SEPP 26 Littoral Rainforest, SEPP 44 Koala Habitat, threatened biodiversity (species, populations and ecological communities) listed under the *Threatened Species Conservation Act* 1995 and/ or *Environment Protection and Biodiversity Conservation Act* 1999.

Gunnedah Basin, Santos

Conducted multiple projects over approximately two years. These projects included; ecological works for Santos within the Gunnedah Basin covering gas exploration and provision of infrastructure, including, gas pipelines and access tracks. Works included field survey, preparation of advice, impact assessments, EPBC referrals, preparation and implementation of well lease rehabilitation plans, liaison and negotiations with regulators and agencies.

Bells Line of Road Corridor – Chifley Rd Upgrade, RMS

Conducted targeted threatened species field surveys and assisted in the preparation of a biodiversity assessment for the proposed Chifley Road upgrade located on the Bells Line of Road between Bell and Scenic Hill.

Westmead Hospital Upgrade, Price Waterhouse Coopers and Johnstaff

Ecological surveys and reporting. Ecological opportunities and constraints were assessed in relation to the relevant state and federal legislation to inform the concept design.

Finley Solar Farm EIS, ESCO

Arne is currently involved in RPS' preparation of an Environmental Impact Statement (EIS) for the Finley Solar Farm Project. The Finley Solar Farm would produce 170MW over 500 hectares of land. The project is currently ongoing with numerous RPS service lines working together to prepare the document. To date RPS have successfully liaised with the NSW Department of Planning and Environment, as well as the client, to progress the project smoothly in line with the desired outcomes.

Springvale Coal (Newnes Plateau Shrub Swamp EEC)

Performed complex seasonal and annual monitoring programs for this State and Commonwealth listed threatened ecological community. Monitoring includes flora based repeated measures sampling within a BACI monitoring design and Soil Adjusted Normalised Vegetation Index (SANDVI) analysis of remotely sensed imagery (7cm resolution RGBI imagery) over four seasons.

Huntlee Ecological works, LWP Property Group

Undertook Ecology works to inform Major Project Approval and negotiations under the EPBC Act for the new Hunter Valley town at Huntlee. This project involved critically endangered species, offsets and presentations to stakeholder groups.

Reticulated Water, Sewer and Recycled Water

(Glossodia, Huntlee new town and Cooranbong), Flow Systems - RPS has prepared a number of REF's to enable licences to be sought by the client for the provision of reticulated water, sewer and recycled water across large urban release areas in accordance with the *Water Industry Competition Act 2006*. Conducted notional BioBanking calculations to quantify biodiversity impacts and potential offset requirements.

Appendix B

Flora List

Family	Scientific Name	Common Name
Mimosoideae	*Acacia brownii*	Heath Wattle
Mimosoideae	*Acacia falcata*	
Mimosoideae	*Acacia linifolia*	White Wattle
Mimosoideae	*Acacia longifolia*	
Mimosoideae	*Acacia parramattensis*	Sydney Green Wattle
Mimosoideae	*Acacia spp.*	Wattle
Mimosoideae	*Acacia suaveolens*	Sweet Scented Wattle
Mimosoideae	*Acacia ulicifolia*	Prickly Moses
Orchidaceae	*Acianthus fornicatus*	Pixie Caps
Orchidaceae	*Acianthus spp.*	Mosquito Orchid
Myrtaceae	*Acmena smithii*	Lillypilly
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Asteraceae	*Ageratina riparia**	Mist Flower
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Loranthaceae	*Amyema spp.*	Mistletoe
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Poaceae	*Aristida vagans*	Three-awn Speargrass
Aspleniaceae	*Asplenium aethiopicum*	Shredded Spleenwort
Poaceae	*Austrostipa spp.*	A Speargrass
Proteaceae	*Banksia marginata*	Silver Banksia
Proteaceae	*Banksia oblongifolia*	Fern-leaf Banksia
Proteaceae	*Banksia paludosa*	Swamp Banksia
Proteaceae	*Banksia serrata*	Old Man Banksia
Proteaceae	*Banksia spinulosa*	Hairpin Banksia
Proteaceae	*Banksia spinulosa var. collina*	Hairpin Banksia
Cyperaceae	*Baumea rubiginosa*	Twig Rush
Pittosporaceae	*Billardiera scandens*	Hairy Appleberry
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern
Fabaceae (Faboideae)	*Bossiaea obcordata*	Spiny Bossiaea

Family	Scientific Name	Common Name
Fabaceae (Faboideae)	*Bossiaea spp.*	
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Cunoniaceae	*Callicoma serratifolia*	Black Wattle
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern
Cyperaceae	*Carex longebrachiata*	Bergalia Tussock
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Lauraceae	*Cassytha spp.*	
Apiaceae	*Centella asiatica*	Swamp Pennywort
Cunoniaceae	*Ceratopetalum apetalum*	Coachwood
Orchidaceae	*Chiloglottis spp.*	
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Ranunculaceae	*Clematis glycinoides var. glycinoides*	Headache Vine
Polygalaceae	*Comesperma ericinum*	Pyramid Flower
Orchidaceae	*Corybas dowlingii*	
Orchidaceae	*Corybas spp.*	
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Corymbia maculata*	Spotted Gum
Orchidaceae	*Cryptostylis subulata*	Large Tongue Orchid
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Goodeniaceae	*Dampiera stricta*	Blue Dampiera
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*	
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil
Phormiaceae	*Dianella caerulea var. caerulea*	Flax Lily
Phormiaceae	*Dianella caerulea var. producta*	Blue Flax Lily
Phormiaceae	*Dianella revoluta*	Blueberry Lily
Poaceae	*Dichelachne spp.*	A Plumegrass
Convolvulaceae	*Dichondra repens*	Kidney Weed

Family	Scientific Name	Common Name
Fabaceae (Faboideae)	*Dillwynia retorta*	Eggs and Bacon
Fabaceae (Faboideae)	*Dillwynia spp.*	
Dioscoreaceae	*Dioscorea transversa*	Native Yam
Sapindaceae	*Dodonaea spp.*	A Hopbush
Sapindaceae	*Dodonaea triquetra*	Hop-bush
Doryanthaceae	*Doryanthes excelsa*	Gymea Lily
Droseraceae	*Drosera spp.*	
Eleocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Restionaceae	*Empodisma minus*	
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Epacridaceae	*Epacris microphylla*	Coral Heath
Epacridaceae	*Epacris paludosa*	Swamp Epacris
Epacridaceae	*Epacris pulchella*	Wallum Heath
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark
Myrtaceae	*Eucalyptus globoidea*	White Stringybark
Myrtaceae	*Eucalyptus haemastoma*	Broad-leaved Scribbly Gum
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Myrtaceae	*Eucalyptus piperita*	Sydney Peppermint
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus siderophloia*	Northern Grey Ironbark
Myrtaceae	*Eucalyptus spp.*	
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry
Cyperaceae	*Gahnia aspera*	Saw Sedge
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge
Cyperaceae	*Gahnia spp.*	
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily

Family	Scientific Name	Common Name
Orchidaceae	*Genoplesium spp.*	
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree
Fabaceae (Faboideae)	*Glycine clandestina*	Twining Glycine
Fabaceae (Faboideae)	*Glycine tabacina*	Twining Glycine
Fabaceae (Faboideae)	*Gompholobium latifolium*	Broad-leaf Wedge-pea
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge-pea
Fabaceae (Faboideae)	*Gompholobium spp.*	
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia
Goodeniaceae	*Goodenia heterophylla subsp. eglandulosa*	
Goodeniaceae	*Goodenia heterophylla subsp. heterophylla*	Variable Leaved Goodenia
Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea
Proteaceae	*Grevillea sericea*	Pink Spider Flower
Araceae	*Gymnostachys anceps*	Settlers Flax
Proteaceae	*Hakea bakerana*	
Proteaceae	*Hakea dactyloides*	Broad-leaved Hakea
Proteaceae	*Hakea laevipes*	
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsparilla
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower
Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea Flower
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower
Dilleniaceae	*Hibbertia spp.*	
Fabaceae (Faboideae)	*Hovea linearis*	
Fabaceae (Faboideae)	*Hovea longifolia*	Rusty Pods
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort
Pittosporaceae	*Hymenosporum flavum*	Native Frangipani
Poaceae	*Imperata cylindrica*	Blady Grass
Proteaceae	*Isopogon anemonifolius*	Flat-leaved Drumsticks

Family	Scientific Name	Common Name
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral Pea
Asteraceae	*Lagenophora stipitata*	
Proteaceae	*Lambertia formosa*	Mountain Devil
Verbenaceae	*Lantana camara**	Lantana
Sterculiaceae	*Lasiopetalum spp.*	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Cyperaceae	*Lepidosperma neesii*	
Cyperaceae	*Lepidosperma spp.*	
Myrtaceae	*Leptospermum polyanthum*	
Myrtaceae	*Leptospermum polygalifolium*	Tantoon
Myrtaceae	*Leptospermum polygalifolium subsp. cismontanum*	Tantoon
Myrtaceae	*Leptospermum spp.*	Tea-tree
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree
Epacridaceae	*Leucopogon juniperinus*	Prickly Beard-heath
Epacridaceae	*Leucopogon lanceolatus*	Lance-leaf Beard-heath
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge-fern
Lomandraceae	*Lomandra confertifolia*	Mat-rush
Lomandraceae	*Lomandra cylindrica*	
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush
Lomandraceae	*Lomandra glauca*	Pale Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Lomandraceae	*Lomandra spp.*	Mat-rush
Proteaceae	*Lomatia silaifolia*	Crinkle Bush
Asclepiadaceae	*Marsdenia rostrata*	Common Milk Vine
Asclepiadaceae	*Marsdenia suaveolens*	Scented Marsdenia
Celastraceae	*Maytenus silvestris*	Orange Bush

Family	Scientific Name	Common Name
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca stypheloides*	Prickly-leaved Tea Tree
Epacridaceae	*Melichrus procumbens*	Jam Tarts
Poaceae	*Microlaena stipoides*	Weeping Grass
Fabaceae/faboideae	*Mirbelia speciosa*	
Epacridaceae	*Monotoca scoparia*	Prickly Broom-heath
Rubiaceae	*Morinda jasminoides*	Sweet Morinda
Oleaceae	*Notelaea longifolia*	Mock Olive, Large Mock-olive
Oleaceae	*Notelaea venosa*	Veined Mock Olive
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant
Rubiaceae	*Opercularia diphylla*	
Poaceae	*Oplismenus aemulus*	Basket Grass
Poaceae	*Oplismenus imbecillis*	
Oxalidaceae	*Oxalis sp.*	
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Panicum sp.*	
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Iridaceae	*Patersonia glabrata*	Leafy Purple-flag
Iridaceae	*Patersonia sericea*	Wild Iris
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Phyllanthaceae	*Phyllanthus spp.**	
Euphorbiaceae	*Phyllanthus tenellus**	Hen and Chicken
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum
Apiaceae	*Platysace ericoides*	Heathy Platysace
Apiaceae	*Platysace linearifolia*	Narrow-leafed Platysace
Apiaceae	*Platysace spp.*	

Family	Scientific Name	Common Name
Poaceae	*Poa spp.**	
Fabaceae (Faboideae)	*Podolobium ilicifolium*	Prickly Shaggy Pea
Convolvulaceae	*Polymeria calycina*	Bindweed
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax
Phyllanthaceae	*Poranthera spp.*	
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Lamiaceae	*Prostanthera incana*	Velvet Mint-bush
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Rubiaceae	*Psychotria loniceroides*	Hairy Psychotria
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Orchidaceae	*Pterostylis sp.*	Greenhood
Cyperaceae	*Ptilothrix deusta*	
Fabaceae (Faboideae)	*Pultenaea euchila*	
Fabaceae (Faboideae)	*Pultenaea paleacea*	
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea
Poaceae	*Rytidosperma pallidum*	
Goodeniaceae	*Scaevola ramosissima*	Purple Fan Flower
Fabaceae (Caesalpinioideae)	*Senna pendula var. glabrata**	
Fabaceae (Caesalpinioideae)	*Senna spp.**	
Smilacaceae	*Smilax australis*	Lawyer Vine
Smilacaceae	*Smilax glyciphylla*	Sarsaparilla
Smilacaceae	*Smilax spp.*	
Solanaceae	*Solanum nigrum**	Black Nightshade, Black-berry Nightshade
Asteraceae	*Solenogyne bellioides*	
Caryophyllaceae	*Stellaria spp.**	Prickly Starwort
Menispermaceae	*Stephania japonica*	Snake vine
Proteaceae	*Telopea speciosissima*	Waratah
Poaceae	*Themeda triandra*	Kangaroo Grass
Violaceae	*Viola betonicifolia*	Native Violet
Violaceae	*Viola hederacea*	Ivy-leaved Violet

Family	Scientific Name	Common Name
Xanthorrhoeaceae	*Xanthorrhoea media*	Forest Grass Tree
Xanthorrhoeaceae	*Xanthorrhoea spp.*	

Appendix C
Likelihood of Occurrence

RPS

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Litoria aurea (Green and Golden Bell Frog)	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	1	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Litoria brevipalmata (Green-thighed Frog)	V	-	This species is distributed from south-east Queensland to the NSW Central Coast. It occurs in a range of habitat types including rainforest, moist eucalypt forest, dry eucalypt forest and heath, but is most closely associated with wetter forest types in the southern part of its range. Calling and breeding is highly correlated with heavy rainfalls that lead to the formation of large ephemeral pools in a range of sites, but always in association with some native vegetation. Calling occurring only for one or two nights at a time anywhere between September and May.	2	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Crinia tinnula (Wallum Froglet)	V	-	Wallum Froglets are found in acid paperbark swamps and sedge swamps of the coastal 'wallum' country. Their tadpoles are adapted to acid conditions and may be outcompeted by the	3	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			Common Froglet. Males call from the base of vegetation in and around the breeding site and are almost impossible to locate. Calling occurs from Autumn to Spring, being most strongly associated with flooding following rainfall. Its range extends from SE QLD to the Kurnell Peninsular of Sydney.		'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Heleioporus australiacus (Giant Burrowing Frog)	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Mixophyes balbus (Stuttering Frog)	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundres of metres from water	2	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).

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Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Mixophyes iteratus (Giant Barred Frog)	E	E	This species is found along larger streams of the coast and adjacent ranges of NSW and SE QLD. It inhabits rainforest and wet sclerophyll forest, but is also found within cleared farmland where fringing vegetation is retained, including lantana beds. Many sites where the Giant Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Pseudophryne australis (Red-crowned Toadlet)	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Uperoleia mahonyi (Mahony's Toadlet)	CE	CE	0	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Caretta caretta (Loggerhead Turtle)	E	-	Loggerhead turtles have a worldwide tropical and subtropical distribution. In Australia, they occur in coral reefs, bays and estuaries in tropical and warm temperate waters off the coast of Queensland, Northern Territory, Western Australia and New South Wales.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Chelonia mydas (Green Turtle)	V	V	Green turtles occur in seaweed-rich coral reefs and inshore seagrass pastures in tropical and subtropical areas of the Indo-Pacific region.	2	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Eretmochelys imbricata (Hawksbill Turtle)	V	V	Found mainly throughout the world's tropical oceans, predominantly in coral reefs	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Natator depressus (Flatback Turtle)	V	V	Found only in the waters around Australia, Papua New Guinea and Timor, hence it is also known as the Australian flatback	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Dermochelys coriacea (Leathery Turtle)	V	E	Occurs in inshore and offshore marine waters. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional breeding records from NSW coast, including between Ballina and Lennox Head in northern NSW.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Hoplocephalus bitorquatus (Pale-headed Snake)	V	-	The Pale-Headed Snake has a patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah and out to the western plains. It is found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest where it favours streamside areas, particularly in drier habitats. They shelter during under loose bark or in hollows and have a preference for frogs as prey, although lizards and small mammals are also taken. This species breeds and shelters in hollows in live and dead trees and in and under fallen timber. It is best detected from mid spring to mid autumn and is mostly nocturnal.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).

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Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Hoplocephalus bungaroides (Broad-headed Snake)	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Hoplocephalus stephensii (Stephens' Banded Snake)	V	-	The Stephens Banded Snake is found through the coast and adjacent ranges of NSW from the Central Coast northwards and into SE Queensland. It is most commonly found living in wet sclerophyll and rainforest areas, but can be found in taller dry forest areas and even in some areas of dry forest where there is significant rock outcropping. They spend most of the time in tree tops, either in large hollows or in dense vegetation, coming to the ground for forage for a range of vertebrates.	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Erythrotriorchis radiatus (Red Goshawk)	C E	-	The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					such as reproduction. Species recently observed in the locality (NSW BioNet records).
Haliaeetus leucogaster (White-bellied Sea-Eagle)	V	M	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	9	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Hieraaetus morphnoides (Little Eagle)	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Lophoictinia isura (Square-tailed Kite)	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata* or *E. smithii*. Individuals appear to occupy large hunting ranges of more than 100km^2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			generally located along or near watercourses, in a tree fork or on large horizontal limbs.		modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Pandion cristatus (Osprey)	V	-	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	5	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Oxyura australis (Blue-billed Duck)	V	-	Widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Stictonetta naevosa (Freckled Duck)	V	-	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Botaurus poiciloptilus (Australasian Bittern)	E	E	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

RPS

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	V	-	The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris (Higgins and Peter 2002). Birds are also often observed in farm land, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber."	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Burhinus grallarius (Bush Stone-curlew)	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands,	4	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.		important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Calyptorhynchus lathami (Glossy Black-Cockatoo)	V	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	10	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Dromaius novaehollandiae (Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area)	E P	-	The species was formerly widespread in north-eastern NSW, but that population is now isolated and largely restricted to coastal and near-coastal areas between Ballina - Evans Head and Red Rock, extending west to the Bungawalbin area. There have also been recent records from the Port Stephens area. On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Climacteris picumnus victoriae (Brown Treecreeper)	V	-	Found in eucalypt woodlands (including box-gum woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			species; also found in mallee and river red gum forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.		(i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Diomedea antipodensis (Antipodean Albatross)	V	V	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. The Antipodean Albatross breeds biennially in colonies on ridges, slopes and plateaus of isolated subantarctic islands, usually in vegetation such as grass tussocks. This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Diomedea antipodensis gibsoni (Gibson's Albatross)	V	-	The species is regularly encountered on trans-Tasman shipping routes and at seas off Sydney, and regularly occurs off the NSW coast usually between Green Cape and Newcastle. This species is known only to breed on the Adams, Disappointment and Auckland Islands in the subantarctic Auckland Island group. Potential forage in NSW waters during the winter is considered significant for the species.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Diomedea epomophora (Southern Royal Albatross)	V	V	Breeding occurs on Adams, Enderby and Auckland Islands (Auckland Islands group), Campbell Island, and on Taiaroa Head (Otago Peninsula, South Island), New Zealand. This otherwise pelagic species is most commonly recorded in New Zealand and South American waters in the non-breeding season, but may circumnavigate all the way around the Southern Ocean	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Diomedea exulans (Wandering Albatross)	E	-	The Wandering Albatross is marine, pelagic and aerial.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

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Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
Diomedea sanfordi (Northern Royal Albatross)	E	E	Marine, subtropical to sub-Antarctic oceans; occasionally further south into the Antarctic.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche bulleri (Pacific Albatross)	V	V	Inhabits tropical to sub-Antarctic waters, shelf edge and pelagic, preferring warmer waters, of south seas where currents from the north make it warmer.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche bulleri platei (Northern Buller's Albatross)	0	V	Marine, pelagic species that occurs in subtropical and subantarctic waters of the South Pacific Ocean. In Australia, the species occurs over inshore, offshore and pelagic waters (Blaber 1986; Carter 1977; Rogers 1969) and off the coast of south-east Tasmania. Prefers waters of the East Australia Current where sea surface-temperatures are greater than 16.5 °C.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche cauta cauta (Shy Albatross)	V	V	The Shy Albatross is a marine species occurring in subantarctic and subtropical waters, reaching the tropics in the cool Humboldt Current off South America.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche cauta steadi (Black-browed Albatross)	V	V	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. Inhabits antarctic, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche eremita (Chatham Albatross)	E	E	Breeds solely on a small, precipitous rock in the Chatham Islands called 'The Pyramid', to the east of New Zealand. When not breeding, the Chatham albatross migrates across the South Pacific and can be found off the coast of Peru and Chile	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche impavida (Campbell Albatross)	-	V	While most of its time is spent at sea, the Campbell albatross returns to land to breed, nesting on ledges and steep slopes which are covered with short grasses, tussocks and mud.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area.

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche melanophris (Black-browed Albatross)	-	V	Uses wide range of marine habitats from inshore shallows, bays and channels to the edge of the continental shelf and beyond to pelagic ocean environs.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thalassarche salvini (Salvin's Albatross)	-	V	Breeds on just a few small barren and rocky islands, and otherwise occupies the open oceans	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Anthochaera phrygia (Regent Honeyeater)	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Epthianura albifrons (White-fronted Chat)	V	-	Low vegetation in salty coastal and inland areas and crops. Runs along ground and is found in local flocks in Winter.		None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Grantiella picta (Painted Honeyeater)	V	-	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.		this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Melithreptus gularis (Black-chinned Honeyeater)	V	-	Eucalypt woodlands within an approximate annual rainfall range of 400-700mm.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Daphoenositta chrysoptera (Varied Sittella)	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	8	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Dasyornis brachypterus (Eastern Bristlebird)	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of

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					occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Pyrrholaemus sagittatus (Speckled Warbler)	V	-	The Speckled Warbler lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Stagonopleura guttata (Diamond Firetail)	V	-	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).

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Melanodryas cucullata cucullata (Hooded Robin)	V	-	Occupy a wide range of eucalypt woodlands, Acacia shrublands and open forests.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Petroica boodang (Scarlet Robin)	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Pomatostomus temporalis (Grey-crowned Babbler (eastern subspecies))	V	-	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open box-gum woodlands on the slopes, and box-cypress-pine and open box woodlands on alluvial plains.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Macronectes giganteus (Southern Giant Petrel)	E	E	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20 S and is a common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Macronectes halli (Northern Giant-petrel)	V	V	Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Pachyptila turtur subantarctica (Fairy Prion)	V	V	The fairy prion is the smallest prion and it measures between 23 and 28 cm (9.1–11.0 in) long. Its plumage is blue-grey on its upperparts, and white underneath. They have a dark "M" on their upperparts extending to their wingtips, and their tail is wedge-shaped with a dark tip. They have a blue bill and feet. The diet consists mainly of planktonic crustaceans and other tiny sea animals, which they feed at night from the water's surface. They breed colonially and prefer small islands. The nest is situated in soil, hidden by vegetation and is dug with the bill or feet, or it is in a hollow in a crevice. When coming back to their nest at night, they will coo softly and listen for their mate. The fairy prion is found throughout oceans and coastal areas in the Southern Hemisphere. Their colonies can be found on Chatham, Snares and Antipodes Islands of New Zealand, Bass Strait Islands of Australia, Falkland Islands, Marion Island, the Crozet Islands and Macquarie Island. Outside of the breeding season, the fairy prion is most often found feeding over deep waters, far from shore. During stormy weather it may come towards coastal habitats. It breeds on oceanic islands, where it nests in crevices on cliffs and	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

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			rock falls or in burrows in soil, although it may also nest in scrub, herblands, tussock or pasture.		
Glossopsitta pusilla (Little Lorikeet)	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	5	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Lathamus discolor (Swift Parrot)	E	C E	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Neophema pulchella (Turquoise Parrot)	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Rostratula australis (Australian Painted Snipe)	E	E	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Calidris canutus (Red Knot)	-	E	The Red Knot is common in all the main suitable habitats around the coast of Australia. Very large numbers are regularly recorded in north-west Australia, with 80 Mile Beach and Roebuck Bay being particular strongholds. The only places it is not found in significant numbers are the northern part of the Great Australian Bight in South Australia and Western Australia, and along much of the NSW coast, where wader habitat is rather scarce (excluding the Hunter Estuary). It is widespread along the coast south of Townsville and along the coasts of NSW and Victoria. In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Calidris ferruginea (Curlew Sandpiper)	E	-	The Curlew Sandpiper is distributed around most of the coastline of Australia. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

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Limosa lapponica (Bar-tailed Godwit)	-	M	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Numenius madagascariensis (Eastern Curlew)	-	C E	The Eastern curlew spends its breeding season in northeastern Asia, including Siberia to Kamchatka, and Mongolia. Its breeding habitat is composed of marshy and swampy wetlands and lakeshores. Most individuals winter in coastal Australia, with a few heading to South Korea, Thailand, Philippines and New Zealand, where they stay at estuaries, beaches, and salt marshes. It uses its long, decurved bill to probe for invertebrates in the mud. It may feed in solitary but it generally congregates in large flocks to migrate or roost. Its call is a sharp, clear whistle, cuuue-reee, often repeated.	2	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Ninox connivens (Barking Owl)	V	-	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Ninox strenua (Powerful Owl)	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red	34	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of

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			turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.		2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Tyto novaehollandiae (Masked Owl)	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Tyto tenebricosa (Sooty Owl)	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161cm in diameter.	3	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Cercartetus nanus (Eastern Pygmy-possum)	V	-	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest. Because of its small size it is able to utilise a range of	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of

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			hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period .		2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Dasyurus maculatus maculatus (Spotted-tailed Quoll)	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	3	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Phascogale tapoatafa (Brush-tailed Phascogale)	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occassional records west ot the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Planigale maculata (Common Planigale)	V	-	Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. The female builds a nest lined with grass, eucalypt leaves or shredded bark.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence

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					(i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Mormopterus norfolkensis (Eastern Freetail-bat)	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	19	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is

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					likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Pseudomys novaehollandiae (New Holland Mouse)	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Petaurus australis (Yellow-bellied Glider)	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	1	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Petaurus norfolcensis (Squirrel Glider)	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow	29	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
			stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.		life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Phascolarctos cinereus (Koala)	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	12	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Potorous tridactylus tridactylus (Long-nosed Potoroo)	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Petauroides volans (Greater Glider)	-	V	The Greater Glider occurs in eucalypt forests and woodlands. Utilise tree hollows	4	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	11	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	9	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	4	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for important life cycle processes; however, the

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					importance of this habitat would depend on additional factors (e.g. size and extent of local population). Not recently observed in the locality (NSW BioNet records).
Kerivoula papuensis (Golden-tipped Bat)	V	-	Distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW. Found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Miniopterus australis (Little Bentwing-bat)	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	72	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	17	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors

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					(e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Myotis macropus (Southern Myotis)	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	4	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Nyctophilus corbeni (South-eastern Long-eared Bat)	V	V	The South-eastern Long-eared Bat has a limited distribution that is restricted around the Murray-Darling Basin in south-eastern Australia. Even in this region its distribution is scattered and it is rarely recorded. It occurs in far eastern South Australia, in areas north of the Murray River, east of Canegrass Station and south of the Barrier Highway. These areas include the Riverland Biosphere Reserve, Danggali Conservation Park and the Birds Australia Gluepot Reserve. It is distributed throughout inland NSW except in the north-west area which is dominated by treeless plains. It can be found in the Hunter Valley, extending from central NSW to the eastern Hunter Valley coast. Considered Nyctophilus timorensis south eastern form under TSC Act.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Scoteanax rueppellii (Greater Broad-nosed Bat)	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	2	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the habitat it occurs within for

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					important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Vespadelus troughtoni (Eastern Cave Bat)	V	-	The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	1	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Not recently observed in the locality (NSW BioNet records).
Epinephelus daemelii (Black Cod)	-	V	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the single specimen recorded from South Australian waters is considered a vagrant. The NSW coastline forms the species' main range, both in Australia and internationally. Black cod are known to occur to some degree in all six NSW Marine Parks – Lord Howe, Cape Byron, Solitary Island, Port Stephens, Jervis Bay and Batemans Bay	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Cynanchum elegans (White-flowered Wax Plant)	E	E	Recorded from rainforest gullies scrub and scree slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random

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					and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Rutidosis heterogama (Heath Wrinklewort)	V	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Acacia bynoeana (Bynoe's Wattle)	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.	0	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Pultenaea maritima	V	-	The species occurs in grasslands, shrublands and heath on exposed coastal headlands.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random

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					and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Pelargonium sp. Striatellum (Omeo's Stork's-bill)	0	E	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Maundia triglochinoides	V	-	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Diaspore is the seed and root tubers, which are probably dispersed by water.	2	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the identified habitat values for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Prostanthera cineolifera (Singleton Mint Bush)	V	V	Grows in open woodlands on exposed sandstone ridges. Usually found in association with shallow or skeletal sands.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Angophora inopina (Charmhaven Apple)	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. Occurs most frequently in red bloodwood – scribbly gum woodland, wet heath, red mahogany – paperbark sedge woodland and stringybark – red bloodwood forest.	76	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of

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					this habitat would depend on additional factors (e.g. size and extent of local population). Species recently observed in the locality (NSW BioNet records).
Callistemon linearifolius (Netted Bottle Brush)	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	29	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Eucalyptus camfieldii Camfield's Stringybark	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Eucalyptus parramattensis subsp. decadens	V	V	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural

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					occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Eucalyptus parramattensis subsp. parramattensis	E P	-	Occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments, on sandy alluvium within a floodplain community which also supports swamp mahogany, forest red gum, red bloodwood as well as paperbarks.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Melaleuca biconvexa (Biconvex Paperbark)	V	V	Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	2	High. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). If present, the species is likely to depend on the identified habitat values for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Melaleuca groveana (Grove's Paperbark)	V	-	Grows in heath and shrubland, often in exposed sites, at high elevations, on rocky outcrops and cliffs. It also occurs in dry woodlands.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with

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					modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Caladenia tessellata (Thick-lip Spider Orchid)	E	V	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Corybas dowlingii (Red Helmet Orchid)	E	-	Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m.	2	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Cryptostylis hunteriana (Leafless Tongue-orchid)	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).

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Diuris praecox (Rough Doubletail)	V	V	Occurs between Ourimbah and Nelson Bay. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	1	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Genoplesium insignis (Variable Midge Orchid)	E	-	Grows in patches of kangaroo grass amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by scribbly gum, red bloodwood, smooth-barked apple and black she-oak.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Species recently observed in the locality (NSW BioNet records).
Pterostylis gibbosa (Illawarra Greenhood)	E	E	Grows in open forest or woodland, on flat or gently sloping land with poor drainage. Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes

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					such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Rhizanthella slateri	V	E	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	0	Moderate. Typical habitat types, important habitat features and/ or known habitat surrogates (e.g. PCTs) are present within the study area. Habitat is located within known 'extent of occurrence'; however, is outside its known area of occurrence (i.e. standard grid size of 2x2km (IUCN 2001). Incidence may be supplementary to proximal incidence in higher value habitat or associated with modified or degraded habitat. Not recently observed in the locality (NSW BioNet records).
Grevillea parviflora subsp. parviflora (Small-flowered Grevillea)	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	30	Known. Habitat values generally consistent with description provided in the OEH TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001). The species is likely to depend on the habitat it occurs within for important life cycle processes; however, the importance of this habitat would depend on additional factors (e.g. size and extent of local population). Species not recently observed in the locality (NSW BioNet records).
Asperula asthenes (Trailing Woodruff)	V	V	This small herb occurs only in NSW. It is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens-Wallis Lakes area. Damp sites, often along river banks	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes

Scientific name (Common name)	BC Act	EPBC Act	Habitat	Recent records (< 5 years; OEH 2018)	Likelihood of Occurrence
					such as reproduction. Species not recently observed in the locality (NSW BioNet records).
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest.	0	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.
Thesium australe (Austral Toadflax)	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	0	Low. Typical habitat types are absent from the study area; however, formation level vegetation habitat surrogates are present. Irrespective of proximity to the species known 'extent of occurrence' and 'area of occurrence' (i.e. standard grid size of 2x2km (IUCN 2001), the presence of this species would likely be incidental or random and generally inconsistent with natural occurrences. The species is unlikely to depend on available habitat for important life cycle processes such as reproduction. Species recently observed in the locality (NSW BioNet records).
Tetratheca juncea (Black-eyed Susan)	V	V		1046	None. Suitable formation level vegetation habitat surrogates are absent from the study area. Species incidence is not expected and, if present, would represent atypical habitat usage.

Appendix F – Aboriginal cultural heritage impact assessment

REPORT

Aboriginal Heritage Impact Assessment, Proposed Modification 8, Newstan Colliery

Centennial Newstan

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Approval for issue

Name	Signature	Date
D. Rigby		20/08/2018

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RPS

Statements of Aboriginal Cultural Significance

Statements of Aboriginal cultural significance has been prepared by the Registered Aboriginal Parties who expressed desire to have these included in the report. The cultural significance statements were provided on a volunteer basis and should not be interpreted as an indicator of participation or interest in the project. All registered stakeholder groups have a strong cultural and spiritual connection to Country, but their manner of expressing their involvement in the project varies. As a result, this report has sought to cater for the different ways in which the RAPs wished to participate and contribute to the understanding of Aboriginal culture, knowledge and spiritual connection to the land.

Although only some statements have been provided, the purpose is to acknowledge and recognise the cultural heritage, value and importance of the Lake Macquarie region to the Traditional Custodians, which includes the area of proposed underground mining works relevant to this assessment report. Centennial Newstan Pty Limited (Centennial) and RPS Australia East Pty Limited (RPS) recognise the primary role of the Aboriginal parties registered for this project in confirming the Aboriginal cultural significance of the region and the Aboriginal cultural features and sites contained within the Project Area.

Awabakal Traditional Owners Aboriginal Corporation (ATOAC)

> *"The Awabakal iconic landmarks feature prominently within its surrounding landscape. This regions mythology, mystery and organic presence that are quite simply, uniquely Awabakal still to this day has an undeniable amount of fascination and attention regarding its cultural value and purpose. The Centennial Coal Mining Project areas are also included within the Awabakal landscape.*
>
> *The Awabakal Traditional Owners have a personalised and ever-revitalised bond with our ancestors' culture, tradition & heritage. This inexplicable connection is reverberated within the surrounding landscape of the Awabakal region.*
>
> *Additionally, we appreciate our unique role and responsibility for the care and protection of the integrity of this landscape, for and on behalf of its original First Peoples and their descendants.*
>
> *We would like to take this opportunity to assert our focus on the critical flow of intergenerational equity and aim to ultimately safeguard the immeasurable life-changing impact to this and future generations. Intergenerational equity lays the foundation for identifying, assessing, protecting and maintaining the important cultural and heritage values of landscapes, resources, places, objects, customs and traditions so that we, and generations to come, can enjoy, learn from them, and appropriately manage these values*
>
> *We believe that the principles of the Awabakal tradition and culture still exist today to keep intact the moral and spiritual fibre of this land. Equally, we also believe it is essential to nurture new visions that are inspired by the cultural integrity of our ancestral family and we are encouraged that so many people in the region are focused on gaining an ever growing respect and understanding for the Awabakal Peoples, this land and environment.*
>
> *This land has had a wealth of knowledge walk over it, with each one of us deepening the footprints of our ancestral family, the Awabakal People"*

(Quote from statements by Awabakal Traditional Owners Aboriginal Corporation and speeches by Nola Hawken, Awabakaleen Elder. Copyright, 2010).

Awabakal Descendants Traditional Owners Aboriginal Corporation (ADTOAC)

"This area, as part of what is the Traditional Awabakal Country, is considered by our People to be of great importance within our Cultural Heritage. There are a variety of reasons our People have benefited from using this location over thousands of years.

One of the earliest documented accounts of the importance of the areas around Lake Macquarie for the Awabakal is attributed to the Rev. L.E. Threlkeld. For us, this area has not just a physical presence within the Cultural Heritage of our People but it is part of our oral history and incorporates places of spiritual significance. The landforms and resources of this locale fulfilled not just the basic needs that underpinned our Peoples subsistence but also satisfied the many other aspects that made up what can only be described here as being part of the very cultural foundations of our People.

Needless to say, our People have had a long history within this area which is unsurpassed. Our apical Ancestor, Mahrahkah, an Awabakal woman and her two daughters were recorded by the Reverend L.E.Threlkeld and Jonathan Warner as living in and around these areas which all formed part of their Traditional Country. This apart from everything else makes it a very important location for our family, knowing that Mahrahkah walked these areas before any white man was ever seen in the Newcastle and Lake Macquarie region. She was intrinsically acquainted with her Land and she has left a legacy for us to carry on in this day and age and to pass onto our Descendants.

This area is of very high significance to the Awabakal and therefore it would be expected that after many generations of our People that have walked the pathways of their Ancestors it should be obvious there would be many areas that contain evidence of this connection resulting from thousands of years of occupation on varying levels by our People. Traditionally these areas were the supply of rich resources of which our People have depended on over millennia. There are physical reminders left by our Ancestors, some in the form of middens, scarred trees or stone tools (artefacts) and grinding grooves which provide us as Descendants of the Awabakal People an opportunity to make a connection through time with our Ancestors. This connection is manifest in a variety of ways; one is through the physical senses such as knowing we are seeing where they lived or touching what they used. By holding or touching something our Ancestors handled, something they made, possibly many thousands of years previously, gives rise to a sense of perception, appreciation, familiarity and recognition of who we are and reinforces where we belong and our birthright as Awabakal Descendants".

(Shane Frost, Managing Director – Awabakal Descent Traditional Owner Aboriginal Corporation March 2012)

Westlakes Aboriginal Community (WLAC)

"*The area in which the Aboriginal Heritage Assessment is to be conducted is located in the Tribal Country of our people. The area is significant because our people have been the custodians of this Country for thousands of years, our people have hunted the land and fished the waters in the traditional way that has been passed down through the centuries. The area is in close proximity to significant sites that were used by our people. There are many sites located within the surrounding area which proves our spiritual connection to Country".*

(Margaret Harvey, CEO Awabakal Local Aboriginal Land Council 2012)

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Executive Summary

RPS has been engaged by Centennial Newstan to prepare an Aboriginal Cultural Heritage Impact Assessment to support the lodgement of a modification to Newstan's development consent DA 73-11-98. Centennial Newstan has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery. The Newstan Extension Project will be assessed as a State Significant Development application in accordance with the EP&A Act. At this time Centennial Newstan is currently focusing investigations for the recommencement of mining in the southern portion of the Colliery Holding Boundary. Centennial Newstan is evaluating mine design options, methods of extraction, and surface infrastructure requirements to support the Newstan Extension Project. In addition, the relevant environmental assessments are being undertaken to understand the potential impacts on the environment including sensitive surface features.

The project schedule regarding the assessment process indicates that determination is expected in Quarter 3 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed in the West Borehole Seam ahead of the State Significant Development application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021.

The purpose of this impact assessment is to assess the potential for the proposed development to impact Aboriginal cultural heritage and to provide recommendations in relation to the requirement for additional assessment and consultation with the Registered Aboriginal Parties.

In 2010 the NSW Office of Environment and Heritage (OEH) released the Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCRs) (2010). These guidelines are designed to establish the requirements for consultation with the Registered Aboriginal Parties (RAPs) as part of the heritage assessment process. The RAPs associated with Centennial Newstan have been identified in accordance with the ACHCRs with ongoing consultation and engagement undertaken in accordance with the Northern Holdings Aboriginal Cultural Heritage Management Plan (ACHMP). This assessment was prepared in accordance with the ACHMP which specifies the requirements for ongoing consultation, monitoring, site management and, where applicable, implementing offsets.

RPS undertook an analysis of previous archaeological assessments for the Project Area in April 2018. The analysis identified that the Project Area had been subject to previous archaeological assessments and pedestrian surveys completed with the RAPs in accordance with the ACHMP and ACHCRs.

Due to the first workings resulting in negligible subsidence and being stable in the long term (MSEC, 2018) the proposed modification is predicted to have a negligible impact on Aboriginal Cultural Heritage. Regardless, the following management recommendations have been formulated with consideration to all the available information.

In accordance with the Northing Holdings ACHMP it is recommended:

Recommendation 1

The three-phase monitoring program be implemented for AHIMS #45-7-0318, AHIMS #45-7-0319 and AHIMS #38-4-1375 in accordance with the monitoring program detailed within the approved Northern Holdings Aboriginal Cultural Heritage Management Plan

Recommendation 2

If during monitoring, a risk of harm to AHIMS #45-7-0318, AHIMS #45-7-0319 or AHIMS #38-4-1375 is identified, a Section 90 AHIP must be applied for in consultation with RAPs in accordance with the Northern Holdings ACHMP.

Recommendation 3

If, during mining, additional cultural heritage is identified, work must cease in that area immediately, the area cordoned off, and the nominated Centennial Environmental Coordinator notified. The Centennial Environmental Coordinator must contact the OEH and monitoring and management strategies must be implemented in accordance with the Northern Holdings ACHMP.

Recommendation 4

If human remains are located, work must cease in the immediate area. Centennial must contact the NSW Police immediately. If the skeletal remains are identified as Aboriginal, Centennial must contact OEH's Enviroline (131 555) and the RAPs. Centennial must not continue work until OEH provides written notification to Centennial about the action plan for the management of the remains and formulated management plan if required.

1 Introduction

RPS has been engaged by Centennial Newstan to prepare an Aboriginal Cultural Heritage Impact Assessment to support the lodgement of a modification to Newstan Colliery's development consent DA 73-11-98. The purpose of the cultural heritage assessment is to assess the potential for the proposed modification to affect Aboriginal cultural heritage and to provide recommendations in relation to requirements for additional assessment and consultation with the Aboriginal community.

This report was prepared by RPS Heritage Consultant, Jo Nelson. This report was reviewed by RPS Senior Heritage Consultant, Georgia Wright. Technical Assistance was provided by RPS Draftsperson, Natalie Wood.

1.1 The Proposed Project

The Newstan Colliery began mining operations in 1887. After the introduction of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), mining operations continued on the basis of existing use rights pursuant to the provisions of Part 4, Division 10 of the EP&A Act. Newstan Colliery is currently approved under DA 73-11-98 which was originally granted in May 1999. The original approval enabled mining to continue within the existing mining areas as well as the expansion into areas that had not previously been mined. The approved Newstan Colliery Life Extension Area under Development Consent DA 73-11-98 essentially filled in the gap between the Newstan Colliery and Awaba Colliery lease areas. Since the initial approval of DA 73-11-98, the progressive history of mining approvals for Newstan Colliery has resulted in a patchwork of approved areas from the originally approved mining area (under existing use rights) to the current approved mining areas (comprising the Consolidated Consent Boundary under Development Consent DA 73-11- 98 as modified). DA 73-11-98 has since been modified 7 times; most recently in December 2015.

The project schedule regarding the assessment process indicates that determination is expected in Quarter 3 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed in the West Borehole Seam ahead of the State Significant Development application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021. It is proposed to modify the Newstan Colliery Development Consent DA 73-11-98 pursuant to Section 75W of the EP&A Act. A Section 75W application was made on 26 February 2018 and was accepted by the NSW Department of Planning and Environment noting that formal Environmental Assessment Requirements will not be issued for the modification.

1.2 Project Area

Newstan Colliery is located at Fassifern, NSW. The Project Area is illustrated on Figure 1.

1.2.1 Previous assessments of the Modification Area

RPS undertook an analysis of previous archaeological assessments for the proposed Modification 8 (MOD 8) Newstan Mine Extension area in April 2018 to ascertain if additional archaeological assessment was required.

The analysis identified that the Project Area has been subject to previous archaeological assessments:

- RPS (2010) Heritage Assessment Impact Newstan Colliery modification, Centennial Newstan Pty Ltd.
- RPS (2011) Section 75W Modification Aboriginal and Non-Aboriginal Heritage Impact Assessment, Newstan Colliery, Centennial Newstan Pty Ltd.
- RPS (2013) Cultural Heritage Impact Assessment for Newstan Extension of Mining Projects.

Three Aboriginal Cultural Heritage sites were identified during an archaeological assessment undertaken in 2010 (RPS 2010): AHIMS #45-7-0318; AHIMS # 45-7-0319; AHIMS #38-4-1375.

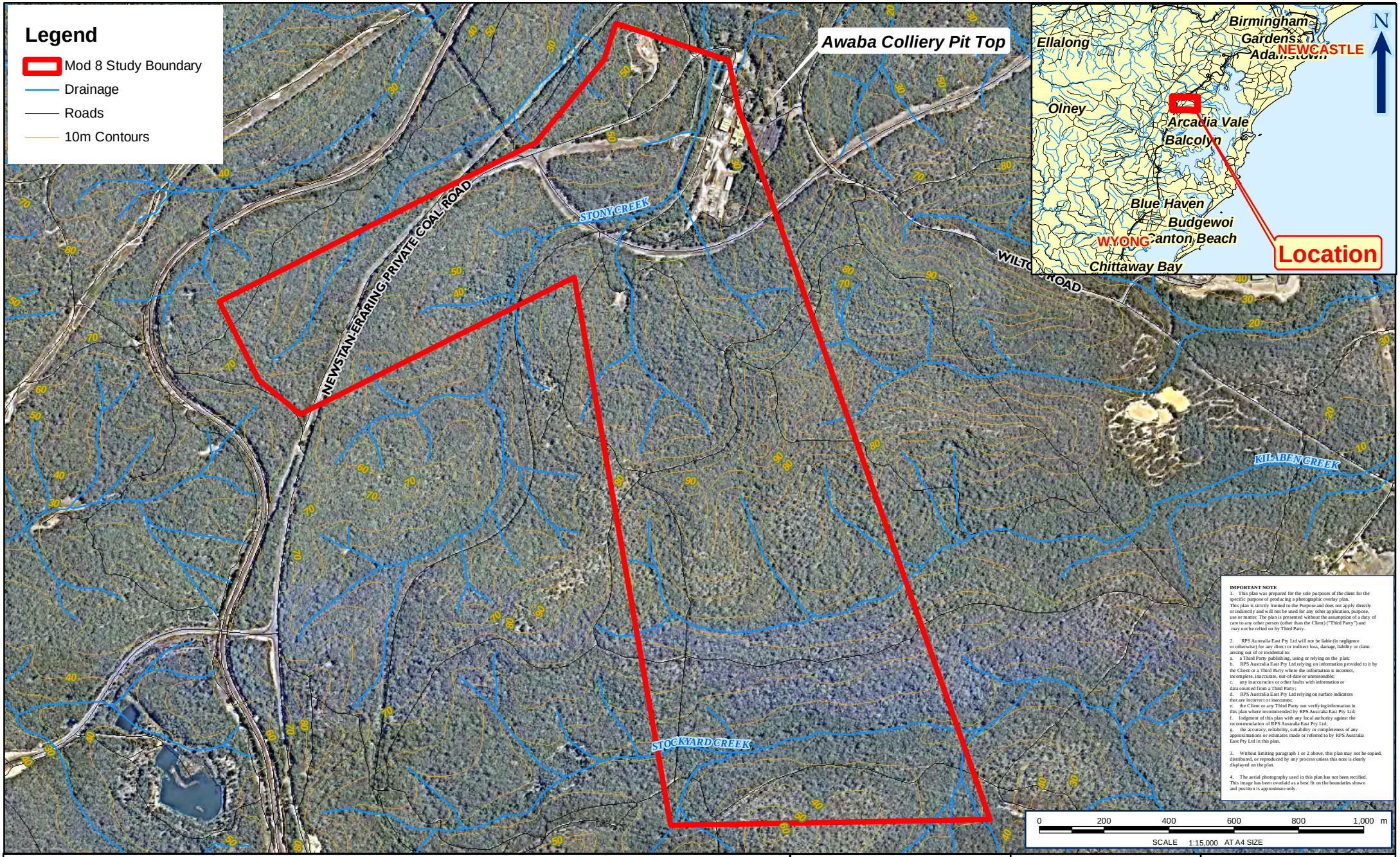

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Figure 1: Project Area Location

LOCATION: NEWSTAN

PURPOSE: HERITAGE

Technician: Natalie.Wood Date: 20/08/2018

Path: S:\Centennial\All Jobs\139866 Newstan Colliery\10 - Drafting\Arcgis Map Documents\Arch\139866 Figure 1 Location A A4L 20180319.mxd

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL
JOB REF: PR139866

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2 Statutory Context

The proposed project is an application for a proposed modification to Development Consent DA 73-11-98 under Section 75W of the EP&A Act.

2.1 *Environmental Planning and Assessment Act 1979*

The EP&A Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal cultural heritage. Within the EP&A Act, Parts 3, 4 and 5 relate to Aboriginal heritage.

Part 3 regulates the preparation of planning policies and plans. Part 4 governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part 5 regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part 5 authority under the EP&A Act.

The EP&A Act ensures that Aboriginal and historic heritage is properly assessed in land use planning and development.

It is proposed to modify the Newstan Colliery Development Consent DA 73-11-98 pursuant to Section 75W of the EP&A Act. A Section 75W application was made on 26 February 2018 and was accepted by the NSW Department of Planning and Environment noting that formal Environmental Assessment Requirements will not be issued for the modification.

2.2 *National Parks and Wildlife Act 1974* (as amended)

The *National Parks and Wildlife Act 1974* (as amended) (NPW Act) protects Aboriginal heritage (places, sites and objects) within NSW. Protection of Aboriginal heritage is outlined in s86 of the NPW Act, as follows:

- "A person must not harm or desecrate an object that the person knows is an Aboriginal object" s86(1),
- "A person must not harm an Aboriginal object" s86(2)
- "A person must not harm or desecrate an Aboriginal place" s86(4).

Penalties apply for harming an Aboriginal object or place. The penalty for knowingly harming an Aboriginal object (s86[1]) and/or an Aboriginal place (s86[4]) is up to $550,000 for an individual and/or imprisonment for 2 years; and in the case of a corporation the penalty is up to $1.1 million. The penalty for a strict liability offence (s86[2]) is up to $110,000 for an individual and $220,000 for a corporation.

Harm under the NPW Act is defined as any act that; destroys defaces or damages the object, moves the object from the land on which it has been situated, causes or permits the object to be harmed. However, it is a defence from prosecution if the proponent can demonstrate 1) that harm was authorised under an Aboriginal Heritage Impact Permit (AHIP) (and the permit was properly followed), or 2) that the proponent exercised due diligence in respect to Aboriginal heritage.

The 'due diligence' defence (s87(2)), states that if a person or company has exercised due diligence to ascertain that no Aboriginal object was likely to be harmed as a result of the activities proposed for the Project Area; then liability from prosecution under the NPW Act will be removed or mitigated if it later transpires that an Aboriginal object was harmed. If any Aboriginal objects are identified during the activity,

then works should cease in that area and Office of Environment and Heritage (OEH) notified (DECCW 2010:13). The due diligence defence does not authorise continuing harm.

Notification of Aboriginal Objects

Under section 89A of the NPW Act Aboriginal objects (and sites) must be reported to the Director-General of OEH within a reasonable time (unless it has previously been recorded and submitted to AHIMS). Penalties of $11,000 for an individual and $22,000 for a corporation may apply for each object not reported.

2.3 National Parks and Wildlife Regulation 2009

The *National Parks and Wildlife Regulation 2009* (NPW Regulation) provides a framework for undertaking activities and exercising due diligence in respect to Aboriginal heritage. The NPW Regulation outlines the recognised due diligence codes of practice which are relevant to this report, but it also outlines procedures for Aboriginal Heritage Impact Permit (AHIP) applications and Aboriginal Cultural Heritage Consultation Requirements (ACHCRs) (DECCW 2010); amongst other regulatory processes.

2.4 Native Title Act 1993

The Commonwealth Government enacted the *Native Title Act (1993)* to formally recognise and protect native title rights in Australia following the decision of the High Court of Australia in Mabo & Ors v Queensland (No. 2) (1992) 175 CLR 1 ("Mabo").

Although there is a presumption of native title in any area where an Aboriginal community or group can establish a traditional or customary connection with that area, there are a number of ways that native title is taken to have been extinguished. For example, land that was designated as having freehold title prior to 1 January 1994 extinguishes native title, as does any commercial, agricultural, pastoral or residential lease. Land that has been utilised for the construction or establishment of public works also extinguishes any native title rights and interests for as long as they are used for that purpose. Other land tenure, such as mining leases, may be subject to native title, depending on when the lease was granted.

2.5 Aboriginal Land Rights Act 1983

The purpose of this legislation is to provide land rights for Aboriginal people within NSW and to establish Local Aboriginal Land Councils (LALCs). The land able to be claimed by LALCs, on behalf of Aboriginal people, includes Crown Land that (s36):

- Is able to be lawfully sold, leased, reserved or dedicated;
- Is not lawfully used or occupied;
- Does not comprise lands which, in the opinion of the Crown Lands Minister, are needed or are likely to be needed for residential purposes;
- Are not needed, nor likely to be needed for an essential public purpose;
- Does not comprise land under determination by a claim for native title; and
- Is not the subject of an approved determination under Native Title.

Claims for land are by application to the Office of the Registrar*, Aboriginal Land Rights Act (1983).*

3 Environmental Context

An understanding of environmental context is important for the interpretation of Aboriginal cultural context. The nature of Aboriginal occupation and resource procurement is directly related to their local environment and as such is an important component of the assessment of Aboriginal cultural heritage. Reporting of the environmental context is also a requirement of NPW Regulation.

3.1 Geology and Soils

The geological formation of the Project Area comprises the Narrabeen Group and Newcastle Coal Measures, predominantly the Clifton Subgroup and Singleton Subgroup (Matthei 1995). These formations include sandstone, interbedded sandstone and siltstone, claystone, tuff and coal. The presence of sandstone and tuff in the Project Area is important for Aboriginal occupation of the area as some types of silicified tuff have been used by Aboriginal people for manufacturing flaked stone tools and sandstone was used for grinding grooves, shelters (if rockshelters present) and engravings, amongst other uses.

The majority of the Project Area consists of the Awaba soil landscape, with the southern section in the Doyalson soil landscape (eSpade NSW).

The Awaba Soil landscape is generally comprised of five dominant soil materials (aw1, aw2, aw3, aw4 and aw5) (Matthei 1995). Topsoil in this landscape is comprised of gravelly brown loam. Gravelly, hardsetting bleached sandy loam to sandy clay loam (aw2) underlies the topsoil as a shallow subsoil. The B horizon comprises gravelly, earthy, bright yellowish sandy clay loam (aw3). Gravelly grey clay (aw4) occurs as a B2 horizon and a well-structured sticky plastic clay (aw5) is found beneath it (Matthei 1995).

The Doyalson soil landscape is characterised by five dominant soil materials (do1, do2, do3, do4 and do5) (Matthei 1995). The topsoil consists of brown loose loamy sand (do1) with an A1 Horizon comprising hardsetting, bleached yellowish-brown clayey sand (do2). An earthy bright, yellowish-brown sand clay loam underlies the A2 Horizon (do3) and underlying this is earthy light grey clay subsoil (do4). Strongly pedal clay (do5) occurs at the B Horizon (Matthei 1995).

3.2 Topography and Hydrology

The topography of the Project Area is characterised by undulating rises and low hills with broad drainage lines and ridges. In small sections of the Project Area the topography consists of steep low hills featuring uneven surfaces with many cobbles, stones and boulders(Matthei 1995). Elevation of the Project Area extends between 40 and 90 metres Australian Height Datum (AHD).

Three creeks and their tributaries cross the Project Area; Stony Creek in the north, and Kilaben and Stockyard Creeks in the south. Stony Creek and Kilaben Creeks are a third-order streams of Lake Macquarie, and Stockyard Creek is a second-order stream of Kilaben Creek.

3.3 Floral and Faunal Resources

Floral species identified in and around the region of the Project Area are associated with the Sydney Coastal Dry Sclerophyll Forest which comprises of several Eucalyptus species, such as Sydney peppermint, scribbly gum, and brown stringy gum (Keith 2006:146). Common understorey in the Project Area includes Tea tree, flax- leaved wattle, sunshine wattle and hairpin banksia (Keith 2006:146). The Forest would also have provided numerous herbal plants and grasses which would have been managed and utilised by Aboriginal people.

The Sydney Coastal Dry Sclerophyll Forest would have provided habitat for macropods, emu, koala, kangaroo and wallaby, possums and bird species (National Parks and Wildlife Service NSW 2003). Lake Macquarie would have also provided an abundance of marine and coastal resources, such as fish and shell fish, water birds and reptiles. These resources provided an important source of food but also raw material used for manufacturing and other processes.

3.4 Climate

Approximately 18,000 years ago, climatic conditions began to alter, affecting the movement and behaviour of past populations within their environs. During this time, notably at the start of the Holocene (more than 11,000 years ago), the melting of the ice sheets in the Northern Hemisphere and Antarctica caused the sea levels to rise, with a corresponding increase in rainfall and temperature. The change in climatic conditions reached its peak about 6,000 years ago (Short, 2000:19-21). Up until 1,500 years ago, temperatures decreased slightly and then stabilised about 1,000 years ago, which is similar to the temperatures currently experienced. Consequently, the climate of the Project Area for the past 1,000 years would probably have been much the same as present day, providing a year-round habitable environment.

The Project Area experiences a temperate climate that is affected by its proximity to the coast, swamps and mountain ranges. Summer and autumn are the wettest seasons with an average rainfall of approximately 840 millimetres and the temperatures can range between 6 degrees and 30 degrees Celsius (Bureau of Meteorology 2010). The temperate climate would be suitable for occupation for most of the year, providing suitable shelter could be obtained during the wet periods.

4 Aboriginal Cultural Heritage Context

This section summaries ethnohistorical information for the Lower Hunter. This information is considered as part of the assessment of the significance of the Project Area.

It is important to acknowledge that early historical documents were produced for a number of reasons and thus may contain inaccuracies and/or bias in their reporting of events or other aspects of Aboriginal culture (L'Oste Brown 1998). Nonetheless, some historical documents provide important information and insights into local Aboriginal customs and material culture

4.1 Ethnohistorical Records of Aboriginal Land Use

4.1.1 Awabakal

Gunson (1974:30) identified Awabakal as the largest clan in the Lake Macquarie region, but because of Threlkeld's (an early missionary) well-known studies in the area, Awabakal became the name which represented a number of clans: the Awabakal (Lake Macquarie and Newcastle region), the Five Islands clan, the Ash Island clan, the Kurungbong clan (Cooranbong) and the Pambalong clan (Swamps district and near Newcastle). Tindale (1974) presented the Awabakal as one independent group in 'Aboriginal Tribes of Australia'.

While the details of the clan boundaries are unclear, the broad geographical and cultural boundaries are relatively consistent between sources. The Awabakal appear to have been people of the coast, estuaries, lakes and wetlands, but also with attachment to the rugged sandstone country through the Sugarloaf and Watagan Ranges. The traditional country of the Awabakal people was bounded to the north by the Worimi, to the west by the Wonnarua, to the south west by the Darkinjung and to the south along the coast by the Kuring-gai people.

Threlkeld (Turner 1997) documented interaction between Aboriginal people across a wider area, noting that the 'natives here are connected in kind of a circle extending to the Hawkesbury and Port Stephens'.

4.1.2 Implements for the Production and Harvest of Food and Utensils

Threlkeld (in Gunson 1974) observed the use of stone hatchets ('baibai' 'pukko'). Dawson (1830) observed grooved heads with a handle fastened by adhesive gum. He stated that gum obtained from wattle (Acacia spp.) and grass trees was used in the manufacture of many utensils. The stone was often basalt or diorite and ground on sandstone platforms to form a bevelled cutting edge. There was evidence that shell scrapers were used to sharpen edges, but with the introduction of glass, that material quickly became preferred (Dawson 1830).

Threlkeld (in Gunson 1974) recorded many important aspects of the material culture of Aboriginal people:

> "*Their canoes were made of the bark of a tree about 12 or 14 feet long, and from 3 to 4 feet in width. They procure the limb of a tree and set it up against the standing trunk, as a ladder, on which they ascend and cut around the whole circumference of the tree in the same manner as done at the bottom. They then chop down a perpendicular line, when they insert their throwing-stick, which is of a wedgelike make at one end, betwixt the bark and the tree, and choosing the season when the sap is either ascending or descending…they proceed to separate the sheet of bark from the tree whilst it is most carefully allowed to slide down and then is laid flat on the ground, the rough outside of the bark being upward. A fire is then made upon the bark and being heated, the steam of the sap*

softens it so that they can crumble up each end like a folded fan, then which they tie securely with vines from the bush…' (Threlkeld in Gunson 1974).”

He also described the manufacture of fishing, hunting, and fighting spears that were made from the flowering stem of the grass tree with one or more pieces of hardwood attached to the end, within which was set a barb of bone or quartz (or glass in post-contact times) (Gunson 1974:66). The resin from the grass tree or Acacia was used as the fixative. The spears were thrown using a throwing stick, the woomera. Woomeras were generally about four feet long, half an inch thick and tapered to a point at one end where a barb was affixed (Threlkeld in Gunson 1974:67). Threlkeld observed that spears were traded with groups inland for possum skin cloaks and 'hanks of line, spun by hand from the fur of animals of the opossum tribe' (Threlkeld in Gunson 1974:61).

4.1.3 Food and Useful Plants

The red ironbark was used as a resource plant and smooth barked apple was used as a medicinal and resource plant. The black wattle had gum that was used for food. The leaves were crushed and soaked to waterproof nets and its wood used for boomerangs, clubs and digging sticks. The false sarsaparilla was both a medicinal and a resource plant.

Brayshaw (1986) noted that shells were shaped for fish hooks and also used to sharpen or shape wooden implements. Kangaroo bones were made into awls to sew kangaroo and possum skin cloaks, belts and headbands.

4.1.4 Clothing

Summer weather and the milder days of autumn and spring required little in the way of protective clothing; winter however, saw the use of animal skins for both clothing and as blankets. Tench (Tench 1996(1789):52) described Aboriginal people using opossum skin cloaks with a “girdle of spun opossum hair next to the skin” with their principal ornament a nautilus shell suspended around the neck on a string.

4.1.5 Campsites and Shelters

Campsites and shelters the Lower Hunter were described by Tench (Tench 1996 (1798)) as consisting: *only of pieces of bark laid together in the form of an oven, open at one end, and very low, though long enough for a man to lie at full length in...they depend less on them for shelter, than on the caverns with which the rocks abound' (Tench 1996 (1789) :80).*

Collins observed that the houses were 'often large enough to hold six to eight people' (Collins 1802:555). These shelters were often grouped together.

5 Archaeological Context

This section summarises previous archaeological information for the Project Area. This information is used to understand the nature of cultural material associated with Aboriginal land use within the landscape context of the Project Area. This information is used to understand the significance and cumulative impact to Aboriginal cultural heritage in the Project Area.

5.1 Aboriginal Heritage Information Management System (AHIMS)

A search of the Aboriginal Heritage Management Information System (AHIMS) was undertaken 25 April 2018 using the following search co-ordinates (Appendix A):

Datum: GDA, Zone: 56,

Co-ordinates: Eastings: 360286 – 366286, Northings: 6341493 – 6347493

Buffer: 0 meters

Number of Aboriginal Sites: 42

The search revealed 42 registered Aboriginal sites within the above co-ordinates, with three Aboriginal sites within the Project Area. The three AHIMS sites are summarised in the Table 1 below and Figure 2.

Site cards for the three registered Aboriginal sites are at Appendix B.

Table 1 Three Aboriginal registered sites in the Project Area

AHIMS ID	Site Type	Eastings : Northings
45-7-0318	Scarred Tree	362999 : 6344235
45-7-0319	Scarred Tree	363423 : 6343924
38-4-1375	Isolated Find	363381 : 6343735

Source: AHIMS 25 April 2018. ID:341165

5.1.1 AHIMS #45-7-0318

Scarred Tree AHIMS #45-7-0318 was recorded on the 16 April 2010 by RPS with the assistance of Aboriginal Stakeholders Mr Shane Frost (ADTOAC) and Mr Arthur Fletcher (WNAC). The Scarred Tree was located on a crest of a hill within open woodland, approximately 150 metres from Kilaben Creek. Bush fire had affected the condition of Scarred Tree AHIMS #45-7-0318, which was poor (Appendix B).

5.1.2 AHIMS #45-7-0319

Scarred Tree AHIMS #45-7-0319 was recorded on the 16 April 2010 by RPS with the assistance of Aboriginal Stakeholders Mr Shane Frost (ADTOAC) and Mr Arthur Fletcher (WNAC). The Scarred Tree was located on a lower slope within open woodland, approximately 90 metres from Kilaben Creek. Bush fire had affected the condition of Scarred Tree AHIMS #45-7-0319. The condition of the tree was considered fair(Appendix B).

5.1.3 AHIMS #38-4-1375

Isolated find AHIMS #38-4-1375 was recorded on the 16 April 2010 by RPS with the assistance of Aboriginal Stakeholders Mr Shane Frost (ADTOAC) and Mr Arthur Fletcher (WNAC). The isolated find was located on a mid-slope within an open woodland. The nearest permanent water source was Kilaben Creek, located approximately 90 metres away. The area had been disturbed by vehicle movement and surface water movement (Appendix B).

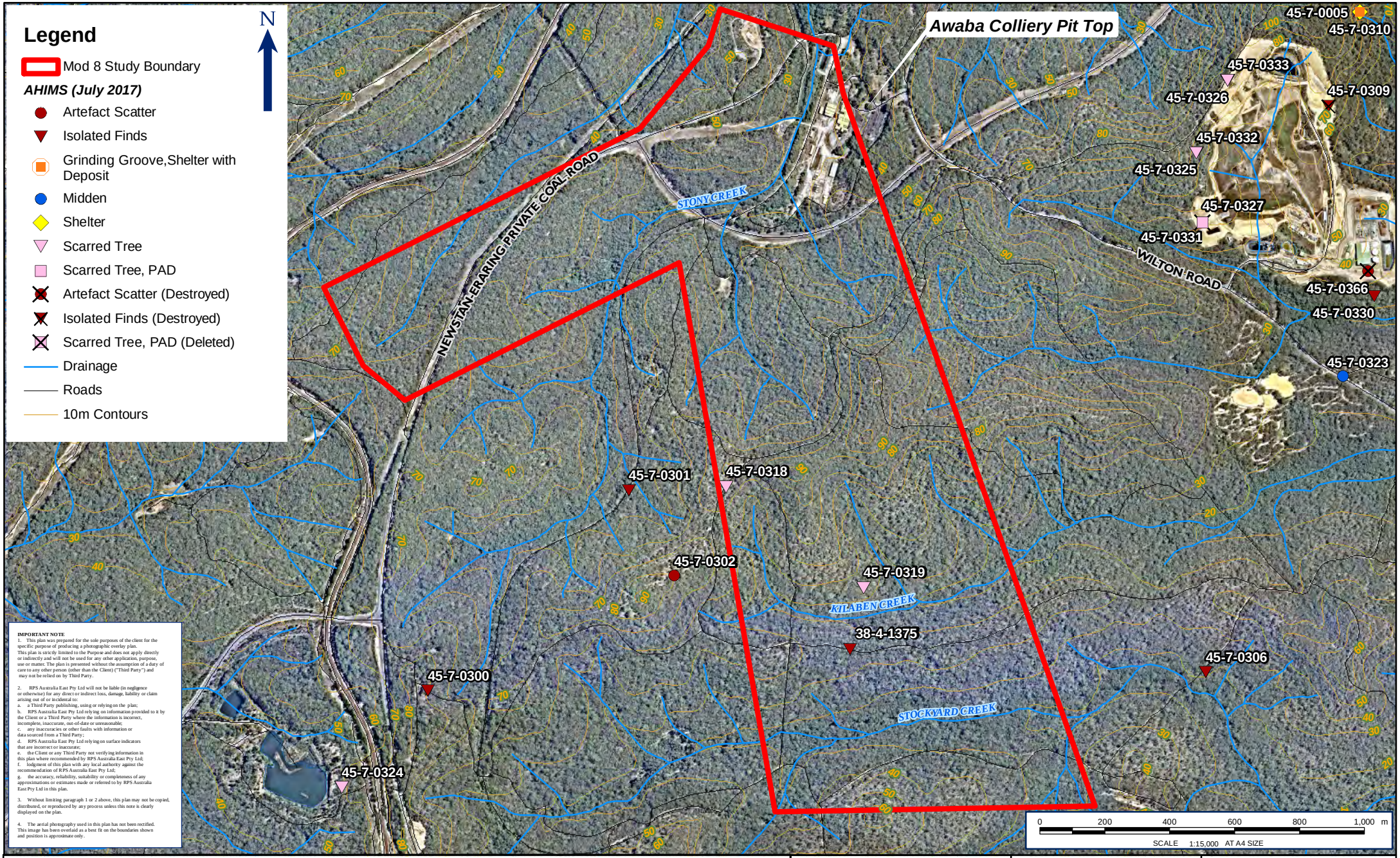

Figure 2: Project Area with AHIMS

LOCATION: NEWSTAN

PURPOSE: HERITAGE

Technician: Natalie.Wood Date: 20/08/2018

Path: S:\Centennial\All Jobs\139866 Newstan Colliery\10 - Drafting\Arcgis Map Documents\Arch\139866 Figure 2 AHIMS B A4L 20180622.mxd

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL

JOB REF: PR139866

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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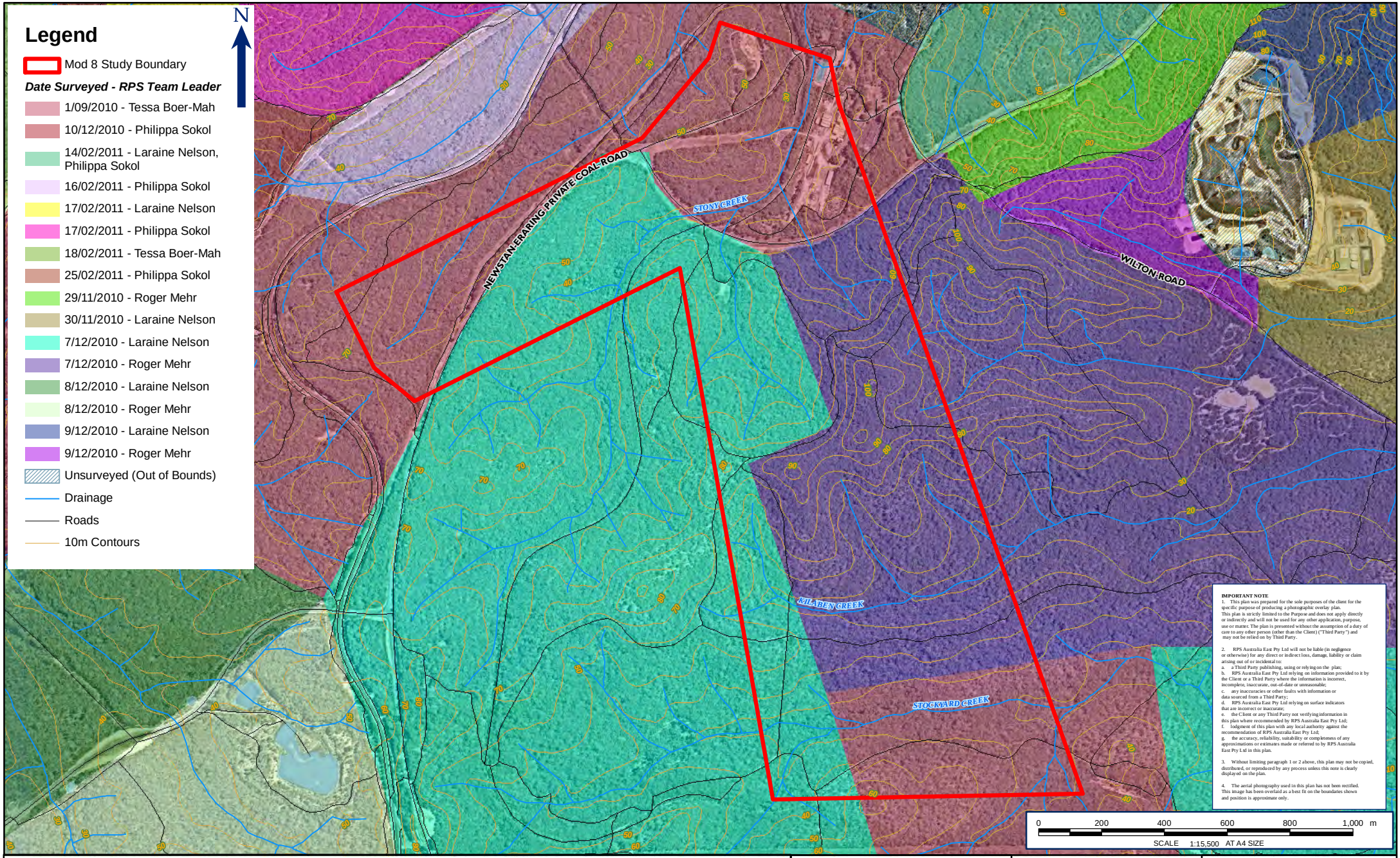

Figure 3: RPS Areas Surveyed

LOCATION: NEWSTAN

PURPOSE: HERITAGE

Technician: Natalie.Wood Date: 6/07/2018

Path: S:\Centennial\All Jobs\139866 Newstan Colliery\10 - Drafting\Arcgis Map Documents\Arch\139866 Figure 3 RPS Area Surveyed B A4L 20180706.mxd

VERSION (PLAN BY): A A4 (NW)

DATUM: GDA94
PROJECTION: MGA Zone 56

Data Sources:
RPS
Land and Property 2015

CLIENT: CENTENNIAL COAL
JOB REF: PR139866

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5.2 Previous Archaeological Assessment – Regional and Local

Numerous archaeological assessments have been undertaken within the Project Area and region. The following assessments have identified that the majority of sites in the Newstan Mine region are stone artefacts, located on elevated landforms at or near permanent water courses, and scarred trees where mature, native trees are still present.

5.2.1 Local Archaeological Assessments

Umwelt (1998) Environmental Impact Statement, Newstan Colliery Life Extension Project

In 1998 Umwelt was engaged by Powercoal to provide an Environmental Impact Statement (EIS) for the Newstan Colliery Life Extension Project. The report focused on impacts from underground mining to shelters, axe-grinding grooves and scarred trees whilst also conducting an archaeological survey throughout the lower slopes in the Lords Creek area. The survey was assisted by representatives of Koompahtoo Local Aboriginal Council. The study area was located approximately 2kms east, north and west of the current Project Area.

No Aboriginal sites were identified in the Lords Creek area. Of the previously recorded rock shelters, five were considered to have potential to contain archaeological material of value with the remaining four holding very shallow deposits, were disturbed and no artefacts recorded within them. Axe grinding groove sites re-visited were found to have low archaeological significance due to their small number and poorly defined grooves. Few mature trees were found in the survey area and none had evidence of cultural scarring.

Umwelt (2004) Archaeological survey for Centennial Newstan Longwalls 22 and 23

This survey focussed on the tributaries of Lords and Stony Creeks, as well as a sample of other landforms (Umwelt 2004). The landscape was considered to be heavily disturbed and no Aboriginal heritage objects or places were identified.

Indigenous Outcomes (2007) Archaeological Survey Newstan Colliery Area

This survey included the area to the west of the Newstan pit top and SMP Study Area. One Aboriginal site (AA4 isolated find) had been previously recorded but no artefactual material associated with this site was identified during the survey. One potential scarred tree was identified (AA3) which has since been confirmed by Shane Frost of ADTOAC as an actual scarred tree.

RPS (2009) The Olstan Project, Cultural Heritage Assessment, Newstan Colliery

RPS was commissioned to undertake an Aboriginal and European cultural heritage assessment as part of a Part 3A application for the Olstan Study Area. The field survey that formed part of the overall assessment was conducted to check for the presence of Aboriginal sites and also confirm or refute the predictive model for the area. No Aboriginal sites were identified during the surveys.

RPS (2010) Aboriginal Heritage Assessment Impact Newstan Colliery modification, Centennial Newstan Pty Ltd.

RPS was engaged by Centennial Coal to prepare an Aboriginal heritage assessment for Stage 1 Newstan colliery modification.

The project area was approximate 7 kilometres east of Lake Macquarie. The project area was surveyed on foot with no Aboriginal objects or places being identified. Under a predicted subsidence level of 20 millimetres, is was considered that the potential for impact to potential Aboriginal sites would be low.

RPS (2011) Section 75W Modification Aboriginal and Non-Aboriginal Heritage Impact Assessment, Newstan Colliery, Centennial Newstan Pty Ltd.

RPS prepared a Heritage Impact Assessment (HIA) for a modification to the Newstan Colliery Development Consent (DA 73-11-98). The HIA compiled results from a number of previous studies which have been undertaken within the proposed Main West mining area (Project Area). All land within the Project Area had been previous surveyed and no Aboriginal heritage sites had been identified.

The report recommended an updated archaeological survey be undertaken over the Project Area with the participation of the relevant Aboriginal stakeholders, prior to the commencement of proposed works, with an aim to locate any Archaeological sites within the Project Area not identified during previous archaeological investigations.

RPS (2013) Cultural Heritage Impact Assessment for Newstan Extension of Mining Projects

RPS undertook a Cultural Heritage Impact Assessment (CHIA) as part of an Environmental Impact Statement (EIS) for the proposed Newstan Colliery Extension of Mining Project (the Project). The Project Application Area (PAA) was approximately 12.6 km (north-south) by 9.0 km (east-west) and covered approximately 7453 hectares.

The search of the AHIMS over a 5 kilometre radius around the PAA identified 45 sites. The most common site type was isolated finds (n=17; 37.78%) followed by scarred trees (n=9; 20.00%) and artefact scatters (n=6; 13.33%). Sites occurring with moderate frequency included shell middens (n=3; 6.67%) and sandstone platforms containing grinding grooves (n=4; 8.89%). Ceremonial sites were observed twice, one of which is a restricted ceremonial site (n=1; 2.22%), and the other an unrestricted ceremonial site (n=1; 2.22%).

The results indicated a high percentage of artefact scatters and artefact scatters with PADs are in lowlands, particularly along fluvial beds and creek lines, with a higher percentage of isolated finds near the fluvial creek beds in the lowlands. Rockshelters and rockshelters with PADs were all restricted to steep ridges and escarpments because this is where suitable sandstone was outcropping and had developed sufficient cavities in the rock which could be used as occupation sites.

The report recommended monitoring and management of all Aboriginal sites with the PAA in accordance with the Northern Region ACHMP.

RPS (2015) Heritage Due Diligence Letter Report for the Newstan Colliery Sinkhole

In 2015 RPS was engaged by Newstan Colliery to conduct an Aboriginal archaeological due diligence assessment report at Fassifern. A visual inspection was undertaken in May 2015 for the area located approximately 700 metres east of the current Project Area.

Ground visibility was poor due to heavy grass coverage and leaf litter with exposed areas limited to tracks and eroded areas. The due diligence assessment identified no risk of harm to Aboriginal objects.

5.3 Regional Archaeological Assessments

RPS HSO (2009) Archaeological Assessment Awaba East Exploration Area Stage 2 Drilling Area

This study involved a desktop assessment for the for Awaba East Exploration Area Stage 2 Drilling area, located within 2 kilometres east of the current PAA. It identified the locations which had been previously surveyed, areas which had previously been mined, as well as, areas which had neither been mined or subject to archaeological survey. This allowed heritage management zones for the exploration area to be

defined, for which a set of heritage management protocols were developed (RPS HSO 2009c). No Aboriginal sites were identified as a result of this study.

RPS HSO (2009) Aboriginal Cultural Heritage Assessment for Proposed Road Intersection Upgrade, Rathmines, NSW

RPS Harper Somers O'Sullivan were engaged by Maunsell AECOM Australia on behalf of the NSW Roads and Traffic Authority (RTA) to carry out a cultural heritage assessment to be included in a Review of Environmental Factors (REF) for the Intersection Upgrade of Wangi and Dorrington Roads, Rathmines, NSW.

The predictive model that was developed for the area indicated the most common site type for the was shell middens, at the shoreline of Lake Macquarie, and isolated finds. Grinding grooves were also identified as likely to appear in areas of reasonably low disturbance close to a reliable water source.

No Aboriginal sites were identified during the archaeological pedestrian survey. The potential to identify Aboriginal sites during works associated with the upgrade of the intersection at Wangi and Dorrington Roads was deemed unlikely due to the extremely disturbed nature of the study area resulting from the current road infrastructure. The Aboriginal archaeological sensitivity of the study area was assessed as low to nil.

Streat Archaeological Services and AMAC (2013) Aboriginal Cultural Heritage Assessment, Proposed F3 Service Station Development (Northbound), 266 Newport Road, Cooranbong, NSW

Streat Archaeological Services Pty Ltd (SAS) and Archaeological Management and Consulting Group (AMAC) were commissioned to undertake an Aboriginal archaeological and cultural heritage assessment for a proposed Service station facility (Northbound) at Cooranbong, NSW.

The area had been subject to grazing of livestock, construction of services, construction of dwellings and outbuildings, construction of water storage facilities (dams) and infrequent vehicle traffic which had resulted in minor disturbance of top soil (A horizon).

No previously recorded Aboriginal sites were located within the area assessed. A predictive model expected artefact scatters and isolated finds to be the most likely identified Aboriginal site. No raw material was identified in the study area. Reliable fresh water was present in the study area. Due to the presences of A horizon soils and background context, the potential for Aboriginal objects was considered moderate to high and as such the assessment recommended further investigation in the form of test excavation, to the parts of the study area under potential impact.

5.4 Local and Regional Character of Aboriginal Land Use

The review of previous local and regional archaeological work suggests the area was occupied both transiently, when ephemeral water sources were accessible and, more permanently where a continual water source, such as Lake Macquarie, approximately four kilometres to the east, was available. Both of these environments would have provided a variety of seasonal and annual floral and faunal resources. The local region still retains forested areas with occasional mature trees, which provides mature trees with cultural scarring.

RPS

6 Aboriginal Community Consultation

The purpose of Aboriginal community consultation is to provide an opportunity for the relevant Aboriginal parties to have input into the heritage management process. The NSW Office of Environment and Heritage (OEH) encourages consultation with Aboriginal people for matters relating to Aboriginal heritage. Guidelines for Aboriginal community consultation have been developed to be implemented in accordance with the relevant sections of the EP&A Act (1979), where applicable, and the NPW Act (1974).

In 2010 Centennial Newstan implemented the Office of Environment and Heritage (OEH) Aboriginal Cultural Heritage Consultation Requirements (ACHCR) for Proponents (2010). The details of consultation undertaken to identify potential relevant Aboriginal parties who may be interested in the consultation process for mining operations and projects associated with the Newstan Colliery is provided in Table 2.

Table 2 Consultation undertaken to identify relevant Aboriginal parties for Newstan Colliery mining operations and projects

Date	Correspondence to/from	Method	Purpose
29 June 2010	Department of Aboriginal Affairs	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	Native Title Services Corporation Limited	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	National Native Title Tribunal	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	Lake Macquarie City Council	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	West Lakes Aboriginal Community (Koompahtoo LALC)	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	Hunter Central River Catchment Management Authority	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
29 June 2010	Department of Environment, Climate Change and Water (now NSW Office of Environment and Heritage)	Mail	Identification of interested Aboriginal groups for land in the East Lake Macquarie region
2 July 2010	National Native Title Tribunal	Email	Native title search results response-No Aboriginal people identified
7 July 2010	Department of Aboriginal Affairs	Mail	Search result response-No Aboriginal people identified
15 July 2010	Department of Environment, Climate Change and Water (now NSW Office of Environment and Heritage)	Mail	DECCW sent their search results and 7 groups were identified as having a potential interest in the study area being:

Date	Correspondence to/from	Method	Purpose
			• Awabakal Newcastle Aboriginal Co -op • Awabakal Descendants Traditional Owners Aboriginal Corporation • Awabakal Traditional Owners Aboriginal Corporation • Awabakal Local Aboriginal Land Council * • Yamuloong Group Initiatives Ltd • Arwarbukarl Cultural Resources Association • Cacatua Culture Consultants

**The Koompahtoo Local Aboriginal Land Council, representing the Aboriginal community of western Lake Macquarie, was formally dissolved by the Minister for Aboriginal Affairs in March 2010. Following this the community was represented by West Lakes Aboriginal Community administered in the first instance by the NSW Aboriginal Land Council and later by the Awabakal Local Aboriginal Land Council. In 2013, the new Biraban Local Aboriginal Land Council was appointed.*

As an outcome of this consultation, a request to register an expression of interest in the consultation process for mining operations and projects associated with the Newstan Colliery were sent on 16 July 2010 to:

- Awabakal Newcastle Aboriginal Co-op
- Awabakal Descendants Traditional Owners Aboriginal Corporation
- Awabakal Traditional Owners Aboriginal Corporation
- Awabakal Local Aboriginal Land Council on behalf of the West Lakes Aboriginal Community (now Biraban Local Aboriginal Land Council)
- Yamuloong Group Initiative Ltd
- Arwarbukarl Cultural Resource Association
- Cacatua Culture Consultants
- Wonnarua Nation Aboriginal Corporation

In addition, a notice was placed in the Lakes Mail on 8 July 2010 requesting registrations of interest from any potential relevant Aboriginal Party not previously identified.

As a result of this process, six aboriginal parties registered their interest in the consultation process for mining operations and projects associated with the Newstan Colliery being

- Awabakal Descendants Traditional Owners Aboriginal Corporation
- Awabakal Traditional Owners Aboriginal Corporation
- Biraban Local Aboriginal Land Council
- Cacatua Culture Consultants
- Wonnarua Nation Aboriginal Corporation
- Wonn1

Centennial Newstan have been undertaking comprehensive consultation with the registered Aboriginal parties on the status and progress of mining projects in the Lake Macquarie region since 2010. In 2016 Centennial established an Aboriginal Heritage Sub-Committee for the northern region. The Aboriginal Heritage Sub-Committee includes representatives from the various registered Aboriginal parties from each of Centennial's northern operations. The Aboriginal Heritage Sub-Committee meet twice a year to discuss matters relating to cultural heritage including a review of any heritage related works carried out over the previous 6 months and any works proposed over the coming 6 months (including field surveys and site recording).

On 9 May 2018 a presentation of the proposed modification was provided to the Northern Region Aboriginal Heritage Sub-Committee. This was followed by a site visit on 26 June 2018 to the Project Area with representatives of the various Registered Aboriginal Parties including:

- Guringai Tribal Link Aboriginal Corporation
- Awabakal Traditional Owners Aboriginal Corporation
- Awabakal Descendants Traditional Owners Aboriginal Corporation; and
- Wonn1

This draft report (RPS 2018) was sent to the RAPs for a 28 day review, with responses due 13 August 2018. One response was received by Centennial Newstan (Table 3) (Appendix C).

Table 3 RAPs who received the draft report and response

Date of response	Correspondence to/from	Method	Response
13 August 2018	Wonn1	Email	We wish to advise that we are generally in agreement with the contents and recommendations within the draft report and would like to be involved in the continued monitoring of the three sites as detailed in the document.

7 Significance Assessment

7.1 Aboriginal Cultural Significance Assessment

Archaeological field investigations are an effective way of determining the location of Aboriginal sites in the landscape. However, the cultural significance of the sites and landscape can only be assessed by the cultural knowledge holders because they draw on knowledge from their ancestors and their own experiences. Understanding the cultural significance of the landscape is an integral part of undertaking cultural heritage impact assessment in any study Area because the information can identify areas deemed more culturally significant to the Aboriginal community and assist in the development of appropriate management strategies taking into consideration any cultural sensitivities.

7.1.1 Cultural Significance Workshop

A cultural mapping and significance assessment workshop was conducted on the 23rd March 2012 at Newstan. All Aboriginal stakeholders who have registered their interest to participate in the consultation process for the Newstan mining projects were invited to participate. In addition, as the process is to be rolled out to all of Centennial's Northern operations, all other Aboriginal groups who have registered their interest in any of Centennial's other northern operations projects were invited to attend as observers.

Representatives of the ATOAC (Ms Kerrie Brauer, Mr Dene Hawken & Amanda Hawken) and ADTOAC (Mr Shane Frost) participated in the cultural significance workshop. Ms Sharon Hodgetts (Darkinjung LALC) attended the workshop as an observer and Ms Jane Delaney-John acted as a mediator. Representatives of Wonn 1 Contracting (Mr Arthur Fletcher), Cacatua Culture Consultants (Mrs Donna Sampson), Guringai Tribal Link (Ms Tracey Howie) and Bahtabah Local Aboriginal Land Council (Mr Michael Green and Mr Toby Whaleboat) expressed their apologies because they were not able to attend the workshop.

The workshop identified areas of cultural sensitivity that could not be determined through standard archaeological methods.

7.1.2 Methodology behind Cultural Significance Assessment

The ICOMOS Burra Charter defines cultural significance as the aesthetic, historic, scientific or social value of an item for past, present and future generations. The assessment of cultural significance has also been adopted by the NSW NPWS Guidelines (2011: 9). In order to rank the cultural significance value of Aboriginal sites in the Newstan Study Area, ADTOAC and ATOAC developed a ranking process, which was based on the criteria listed in the Burra Charter (1999).

It is important to note that the process for ranking the cultural significance of an Aboriginal site is a matter for Aboriginal people. This assessment can only be made by the appropriate Aboriginal representatives of the relevant communities. This process for identifying the cultural significance of an Aboriginal site has been adopted by Centennial to assist in understanding what sites hold a higher significance to the Aboriginal community and understand the impacts of its operations on Aboriginal cultural heritage. The cultural significance assessment does not represent the true cultural values placed on these sites by the Aboriginal community. The results of the ranking of cultural significance are a result of the views held only of those Aboriginal people/groups participating in the process and are not representative of the cultural values placed on Aboriginal sites by all Aboriginal people/groups.

The aspects considered during the cultural significance assessment of the Aboriginal sites within and surrounding the Newstan Study Area are detailed below.

Historic/ Social/Ceremonial/Spiritual/Dreaming Connection:

This criterion refers to any historic, social, ceremonial, spiritual or dreaming connection that the site may have to the registered Aboriginal stakeholder/group. This criterion also considers its past teaching potential.

Rarity:

This criterion refers to how rare the site is in reference to location, site type, site integrity on a local and regional scale. Rarity is also assessed on its archaeological potential.

Inter-relatedness:

This criterion refers to whether the site is believed to be related or associated another site in the landscape.

Teaching Potential:

This criterion refers to any potential future and/or present use for educational purposes in the teaching of culture and history.

Aesthetics:

This criterion refers to the sites aesthetic qualities. Please note that the notion of visual appeal is subjective.

Outlook:

Outlook refers to whether the site has an extensive outlook over the landscape and/or if the area of the site has an attractive perspective to the Aboriginal stakeholders.

Table 4 is a summary of the significance of the three registered Aboriginal sites within the MOD 8 Project Area, based on the Cultural Significance Ranking formulated as an outcome from the Cultural Significance Workshop, 23rd March 2012 (Table 5)

Table 4 Summary of Cultural Significance for the three Aboriginal sites in the Mod 8 Project Area

AHIMS	Site Type	Ceremonial/ Spiritual Dreaming Connection	Rarity	Inter-relatedness	Teaching Potential/Research Potential	Aesthetics of site	Outlook	Overall Ranking per RAP group	Overall Cultural Ranking (Ave)
45-7-0318	Scarred Tree	5	5	4	5	4	5	28	**28**
45-7-0319	Scarred Tree	3	4	4	4	3	2	20	**20**
38-4-1375	Isolated Find	Not Assessed (NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)

Table 5 Overall Cultural Significance Ranking

Significance	Ranking
High Cultural Significance	1 to 6 Points
High to Very High Cultural Significance	7 to 13 Points
Very High Cultural Significance	14 to 20 Points
Very High to Extremely High Cultural Significance	21 to 27 Points
Extremely High Cultural Significance	28 to 30 Points

8 Impact Assessment

This section assesses the archaeological impact of the proposed project.

8.1 The Proposed Project

The proposed project is an application for a modification to DA 73-11-98 pursuant to Section 75W of the EP&A Act. The proposed modification is required to enable first workings to proceed and determine the presence, throw and strike of the major fault projected from the Newstan workings. Due to the consent expiry date of 6 July 2020, the proposed modification is in addition seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021.

8.2 Impact Assessment

All land within the Project Area has been subject to previous archaeological survey, RPS (2010), RPS (2011) and RPS (2013). There are three Aboriginal sites within the Project Area, AHIMS #45-7-0318; AHIMS # 45-7-0319; AHIMS #38-4-1375.

Mine Subsidence Engineering Consultants (MSEC) have developed a Subsidence Predictions and Impact Assessment report (MSEC, 2018) which considers impacts to heritage items/archaeological sites. This was a requirement raised in correspondence from the NSW Department of Planning and Environment received by Centennial Newstan on 24 April 2018. MSEC (2018) report the following:

The maximum predicted vertical subsidence at the surface, due to the development of first workings in the West Borehole Seam, therefore, is approximately 11 mm. The maximum subsidence occurs near the middle and southern parts of the workings, where the depths of cover are greatest. The predicted vertical subsidence in the northern part of the workings reduces to approximately 7 mm, where the minimum depth of cover above the workings is 180 m.

Vertical subsidence less than 20 mm is generally considered to be insignificant. Natural ground movements due to wetting and drying of soils can result in similar levels of movement. The predicted vertical subsidence due to the development of the first workings is similar to the order of survey tolerance for absolute level and, therefore, it is unlikely to be measurable using standard surveying techniques.

The strains at the surface due to the development of the first workings are predicted to be less than 0.1 mm/m. It is unlikely that the strains due to the development of the first workings would be measurable using standard surveying techniques.

Tensile cracking or compression heaving are not expected to develop above the proposed first workings in the West Borehole Seam due to the very low levels of predicted vertical subsidence (i.e. less than 20 mm) and due to the higher depths of cover (i.e. 180 m to 270 m). The development of the first workings themselves is not expected to result in irregular or anomalous ground movements.

The natural and built features are predicted to experience vertical subsidence of less than 20 mm due to the development of the first workings. At these very low levels of vertical subsidence, the surface features are not predicted to experience measurable tilts, curvatures or strains. It is not expected that visible surface deformations (i.e. tensile cracking or compression heaving) nor irregular (i.e. anomalous) ground movements would occur.

The natural and built features therefore are not expected to experience adverse impacts due to the development of the first workings in the West Borehole Seam.

The proposed project is a modification to enable first workings to be undertaken which will be long-term stable and non-subsiding with no adverse impacts to Aboriginal sites AHIMS #45-7-0318, AHIMS # 45-7-0319 or AHIMS #38-4-1375 (Table 7).

Table 6 Impact assessment

AHIMS	Type of harm	Degree of harm	Consequence of harm
AHIMS #45-7-0318	None	None	No loss of value
AHIMS # 45-7-0319	None	None	No loss of value
AHIMS #38-4-1375	None	None	No loss of value

9 Monitoring and Management

Centennial's northern region mining operations operate in accordance with the approved Northern Holdings Aboriginal Cultural Heritage Management Plan (ACHMP). The Northern Holdings ACHMP is designed to provide Centennial with a consistent approach consultation with the local Aboriginal communities regarding Aboriginal cultural heritage matters as well as identifying consistent minimum standards and processes for Aboriginal cultural heritage identification, monitoring and management across Centennial's northern operations including the Newstan Colliery.

The Northern Holdings ACHMP was prepared in consultation with various Aboriginal parties who registered an interest to participate in the consultation processes for projects across Centennial's northern operations including:

- Awabakal Traditional Owners Aboriginal Corporation;
- Awabakal Descendants Traditional Owners Aboriginal Corporation;
- Bahtabah Local Aboriginal Land Council;
- Biraban Local Aboriginal Land Council;
- Darkinjung Local Aboriginal Land Council;
- Guringai Tribal Link;
- Wonn1;
- Yula-Punnal Aboriginal Education and Healing Centre

All sites subject to subsidence as a result of the proposed Project must be monitored in accordance with the Northern Holdings ACHMP. The aim of the monitoring program is to identify the potential for harm to Aboriginal sites as a result of mining activities and to identify appropriate mitigation strategies to be implemented, if required. This monitoring program has been developed in accordance with the principles of due diligence as defined by the NP&W Regulation 2009. While the broad principles of the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (DECCW 2010) and the NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects (Minerals Council 2010) have been adopted; additional (and more specific heritage) management protocols have been developed to manage the complexities of mining activities, the nature of the Aboriginal sites present and the assessment of harm. The monitoring program involves a staged assessment of potential impacts, as well as providing a framework for implementation of mitigation measures. Due to the staged nature of the monitoring program, the effectiveness and reliability of measures can be assessed during the latter stages of monitoring to ensure that any residual impacts are addressed after mitigation measures have been implemented.

The monitoring program requires the recording of the condition of the site before mining (baseline survey and baseline check) and the condition of the site after mining (post mining initial condition and post mining secondary condition check) with the program separated into three phases:

- Phase 1: Baseline recording (prior to site being undermined)
- Phase 2: Post mining initial condition (within a reasonable time-frame following undermining)
- Phase 3: Post mining secondary condition (approximately 8 months after undermining)

- Phase 3a: (Longwall Mining) - In instances where final subsidence is not achieved until after a number of longwall extractions have taken place, then additional inspections by a qualified cultural heritage consultant may be required to assess any further risks to Aboriginal sites.

The monitoring program for Aboriginal cultural heritage sites within the Project Area is detailed below.

9.1 Monitoring Protocols for Scarred Trees/Carved Trees

Phase 1: A baseline recording of the site's condition must be ascertained and tabulated for future monitoring purposes. The baseline assessment will involve recording the position and tilt of the tree prior to sub-surface mining. The baseline recording requires the following measurements to be recorded:

- Level of the tree (base);
- V-notch (top) tilt measurement (as an easting and northing location);
- V-notch (top) level;
- V-notch (bottom) tilt measurement (as an easting and northing location);
- V-notch (bottom) level; and
- Degree of tilt.

Phase 2: The tilt and condition of the scarred/carved tree must be re-assessed immediately post mining. During the monitoring, if it is identified that the tilt of the tree exceeds 10° from the baseline recording, Centennial Newstan must endeavour to protect the tree from further tilting by erecting a non-invasive framework which may be in the form of bracing or other exterior supports. In this instance, Centennial Newstan must inform and notify the OEH (Environmental Line: 131 555) that there is a potential for harm to the site.

Phase 3: The post mining secondary check must be undertaken approximately 8 months after the mining activity has finished. The inspection is required to make an assessment on whether the ground surface conditions have stabilised. If ground conditions have stabilised and no change to the site's condition is observed, then no further monitoring should be required.

If it is identified that the tilt of the tree exceeds 10° from the baseline recording, Centennial Newstan must endeavour to protect the tree from further tilting by erecting a non-invasive framework to prevent further tilt to the tree where possible. Centennial Newstan must also inform and notify the OEH (Environment Line: 131 555) that there is a potential for harm to the site and follow the advice given by OEH.

9.2 Monitoring Protocols for Artefact Scatters and Isolated Finds

Once an open site has been assessed to be at risk of harm and it is not feasible for Centennial Newstan to modify the mining footprint to eliminate the risk, then irrespective of whether the risk is related to surface facilities and/or ground surface subsidence the following protocol must be adopted.

Phase 1: Immediately before the commencement of mining activity, a baseline check of the site's condition must be undertaken. The purpose of this exercise is to document the condition of the site immediately before mining related activities take place and gauge whether there are impacts to the site related to natural processes rather than mining activities. Monitoring of the site should be undertaken using the following documentation methods:

- Digital photography (scaled as appropriate);
- Field notes to record the current condition and status of the site;
- GPS (using differential, preferably) to locate and confirm site location; and

- Produce a site plan using baseline and offsets (tape measure), or GPS plotted polygons, as appropriate.

During the due diligence inspection and baseline recording, the location of the site must be verified using a GPS and the site dimensions and content must be confirmed. Photos of the site need to be taken so that the overall condition can be documented.

If the site is determined by the archaeologist and representatives of the Aboriginal Parties to be at an inappropriate risk of harm, consideration should be given to salvage the artefacts with the aim of returning the objects to their original location after the completion of mining following notification of OEH.

Phase 2: Within a reasonable timeframe after the completion of undermining, the condition of the site must be reinspected and the condition of the site compared to the last documented results. If the level of harm to the site becomes evident immediately post-mining, Centennial Newstan must endeavour to protect the site from further harm for example, by using non-invasive barrier fencing to prevent erosion. The Centennial Newstan Environmental Team must notify and inform OEH (Environment Line: 131 555) if that there is a potential for harm to the site and follow the advice given by OEH.

Phase 3: The post mining secondary check must be undertaken approximately 8 months after the mining activity has finished. The inspection is required to make an assessment on whether the ground surface conditions have stabilised. If ground conditions have stabilised and no changes to site condition is observed, then no further monitoring should be required. If noticeable amounts of erosion or disturbance is identified, the Centennial Newstan Environmental Team must also notify and inform OEH (Environment Line: 131 555) that there is a potential for harm to the site and follow the advice given by OEH.

10 Conclusions and Recommendations

The proposed project is an application for a proposed modification to DA 73-11-98 pursuant to Section 75W of the EP&A Act. The modification is required to enable first workings to proceed and extend the expiry date of DA 73-11-98 from 6 July 2020 for a further 12 months to 6 July 2021.

The Project Area was subject to previous archaeological assessment in 2010, 2011 and 2013, with the three Aboriginal sites recorded within the Project Area as part of the 2010 assessment (AHIMS #45-7-0318; AHIMS #45-7-0319; AHIMS #38-4-1375).

The proposed first workings which will be long-term stable and non-subsiding will not adversely impact Aboriginal sites AHIMS #45-7-0318, AHIMS # 45-7-0319 or AHIMS #38-4-1375.

In accordance with the Northern Holdings ACHMP it is recommended:

Recommendation 1

The three-phase monitoring program be implemented for AHIMS #45-7-0318, AHIMS #45-7-0319 and AHIMS #38-4-1375 in accordance with the monitoring program detailed within the approved Northern Holdings Aboriginal Cultural Heritage Management Plan

Recommendation 2

If during monitoring, a risk of harm to AHIMS #45-7-0318, AHIMS #45-7-0319 or AHIMS #38-4-1375 is identified, a Section 90 AHIP must be applied for in consultation with RAPs in accordance with the Northern Holdings ACHMP.

Recommendation 3

If, during mining, additional cultural heritage is identified, work must cease in that area immediately, the area cordoned off, and the nominated Centennial Environmental Coordinator notified. The Centennial Environmental Coordinator must contact the OEH and monitoring and management strategies must be implemented in accordance with the Northern Holdings ACHMP.

Recommendation 4

If human remains are located, work must cease in the immediate area. Centennial must contact the NSW Police immediately. If the skeletal remains are identified as Aboriginal, Centennial must contact OEH's Enviroline (131 555) and the RAPs. Centennial must not continue work until OEH provides written notification to Centennial about the action plan for the management of the remains and formulated management plan if required.

11 References

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Appendix A
AHIMS Searches

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : PR139866 Newstan JN

Client Service ID : 341165

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0295	RPS NEWST 2	GDA	56	365245	6345771	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0296	RPS NEWST 3	GDA	56	365499	6344513	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0297	RPS NEWST 4	GDA	56	365501	6344486	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Roger Mehr,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0298	RPS NEWST 5	GDA	56	365524	6344433	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Roger Mehr,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0299	RPS NEWST 6	GDA	56	365445	6344870	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0300	RPS NEWST 7	GDA	56	362080	6343607	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0301	RPS NEWST 8	GDA	56	362700	6344225	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0302	RPS NEWST 9	GDA	56	362839	6343963	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0303	RPS NEWST 10	GDA	56	365471	6344111	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0070	Eraring;Crooked Creek;	AGD	56	363454	6341759	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Len Dyall					**Permits**		
45-7-0005	Awaba Railway Stn;Toronto; same as 45-7-0310	GDA	56	364953	6345699	Closed site	Valid	Artefact : -, Grinding Groove : -	Axe Grinding Groove,Shelter with Deposit	102458
	Contact	**Recorders**	Australian Museum,RPS - Echuca					**Permits**		
45-7-0241	Awaba 1	AGD	56	363091	6345787	Open site	Valid	Artefact : 3		
	Contact S Scanlon	**Recorders**	Umwelt (Australia) Pty Limited					**Permits**		
45-7-0260	LEA 10 (Swansea)	GDA	56	365425	6345450	Open site	Valid	Grinding Groove : 5		102458
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0261	Stockyard Creek AS with PAD (Swansea)	GDA	56	365653	6343871	Open site	Valid	Potential Archaeological Deposit (PAD) : 0, Artefact : 41		102458
	Contact	**Recorders**	Doctor.Alan Williams					**Permits**	3095,3199	

Report generated by AHIMS Web Service on 25/04/2018 for Jo Nelson for the following area at Datum :GDA, Zone : 56, Eastings : 360286 - 366286, Northings : 6341493 - 6347493 with a Buffer of 0 meters. Additional Info : for Report. Number of Aboriginal sites and Aboriginal objects found is 42

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-7-0335	AWMF Pipeline PAD2	GDA	56	365839	6344029	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,Niche Environment and Heritage,Ms.Alison Lamon					**Permits**		
45-7-0336	AWMF Pipeline PAD 1	GDA	56	365304	6344358	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,Niche Environment and Heritage,Ms.Alison Lamon					**Permits**		
45-7-0324	RPS COALLOG1	GDA	56	361815	6343309	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-7-0327	AWTF_ST1, TP7	GDA	56	364468	6345051	Open site	Deleted	Modified Tree (Carved or Scarred) : -, Potential Archaeological Deposit (PAD) : -, Artefact : -		
	Contact Mr.Shane Frost	**Recorders**	Ms.Elizabeth Wyatt					**Permits**		
45-7-0330	AWABA AWT IF1	GDA	56	364997	6344822	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Niche Environment and Heritage					**Permits**		
45-7-0331	AWTF ST1 TP7	GDA	56	364468	6345051	Open site	Partially Destroyed	Artefact : 1, Potential Archaeological Deposit (PAD) : 1, Modified Tree (Carved or Scarred) : 1		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,Insite Heritage Pty Ltd,Mr.Kirwan Williams					**Permits**		
45-7-0332	AWTF ST2	GDA	56	364449	6345264	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	**Recorders**	Insite Heritage Pty Ltd					**Permits**		
45-7-0333	AWTF ST3	GDA	56	364546	6345488	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	**Recorders**	Insite Heritage Pty Ltd					**Permits**		
45-7-0328	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-7-0329	RPS NEWST 24A	GDA	56	365657	6343846	Open site	Valid	Water Hole : 1		

Report generated by AHIMS Web Service on 25/04/2018 for Jo Nelson for the following area at Datum :GDA, Zone : 56, Eastings : 360286 - 366286, Northings : 6341493 - 6347493 with a Buffer of 0 meters. Additional Info : for Report. Number of Aboriginal sites and Aboriginal objects found is 42

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : PR139866 Newstan JN

Client Service ID : 341165

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-7-0288	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact Awabakal LALC	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0312	RPS NEWST 19	GDA	56	361062	6341692	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Roger Mehr,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0313	RPS NEWST 20	GDA	56	363978	6346050	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0314	RPS NEWST 21	GDA	56	361985	6346530	Open site	Valid	Habitation Structure : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0315	RPS NEWST 22	GDA	56	361364	6346170	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0304	RPS NEWST 11	GDA	56	365537	6343813	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0305	RPS NEWST 12	GDA	56	365658	6343764	Open site	Valid	Artefact : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0306	RPS NEWST 13	GDA	56	364478	6343664	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Roger Mehr,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0307	RPS NEWST 14	GDA	56	365155	6343126	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0309	RPS NEWST 16	GDA	56	364857	6345409	Open site	Destroyed	Artefact : -		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,RPS Australia East Pty Ltd -Hamilton,Mr.Kirwan W					**Permits**		
45-7-0310	RPS NEWST 17, same as 45-7-0005	GDA	56	364953	6345699	Open site	Valid	Habitation Structure : -		
	Contact	**Recorders**	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					**Permits**		
45-7-0318	RPS ST01	GDA	56	362999	6344235	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	**Recorders**	Ms.Tessa Boer-Mah,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0319	RPS ST02	GDA	56	363423	6343924	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	**Recorders**	Ms.Tessa Boer-Mah,RPS Australia East Pty Ltd -Hamilton					**Permits**		
45-7-0294	RPS NEWST 1	GDA	56	366193	6342431	Open site	Valid	Modified Tree (Carved or Scarred) : -		

Report generated by AHIMS Web Service on 25/04/2018 for Jo Nelson for the following area at Datum :GDA, Zone : 56, Eastings : 360286 - 366286, Northings : 6341493 - 6347493 with a Buffer of 0 meters. Additional Info : for Report. Number of Aboriginal sites and Aboriginal objects found is 42

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : PR139866 Newstan JN

Client Service ID : 341165

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	Contact	**Recorders**	RPS - Echuca					**Permits**		
45-7-0323	AWMF Pipeline Midden 1	GDA	56	364901	6344577	Open site	Valid	Shell : 50		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,Niche Environment and Heritage,Ms.Clare Anderso					**Permits**		
45-7-0325	AWTF_ST2	GDA	56	364449	6345264	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	**Recorders**	Ms.Elizabeth Wyatt					**Permits**		
45-7-0326	AWTF_ST3	GDA	56	364546	6345488	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	**Recorders**	Ms.Elizabeth Wyatt					**Permits**		
45-7-0366	Awaba Waste Treatment Facility 1	GDA	56	364979	6344901	Open site	Destroyed	Artefact : -		
	Contact	**Recorders**	Umwelt (Australia) Pty Limited,Mr.Kirwan Williams					**Permits**		

Report generated by AHIMS Web Service on 25/04/2018 for Jo Nelson for the following area at Datum :GDA, Zone : 56, Eastings : 360286 - 366286, Northings : 6341493 - 6347493 with a Buffer of 0 meters. Additional Info : for Report. Number of Aboriginal sites and Aboriginal objects found is 42

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Appendix B

AHIMS Site Cards #45-7-0318; #45-7-0319; #38-4-1375

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Department of Environment & Climate Change NSW

Office Use Only

Site Number 38-4-1375

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name RPS IF01

Easting 363381 Northing 6343735 AGD/GDA GDA

Mapsheet

Zone 56 Location Method Differential GPS

Other Registration

Primary Recorder

Title | Surname | First Name | Initials

MS | Tessa | Boer-Mah

Organisation RPS

Address PO BOX 428 HAMILTON NSW 2303

Phone number 02 4940 4200 Fax 02 4961 6794

Date recorded

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [ ] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [ ] Lower slope
- [x] Mid slope
- [ ] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

0 degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [ ] Open forest
- [ ] Open woodland
- [ ] Scrub
- [x] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [x] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

Water

Distance to permanent water source _____ metres

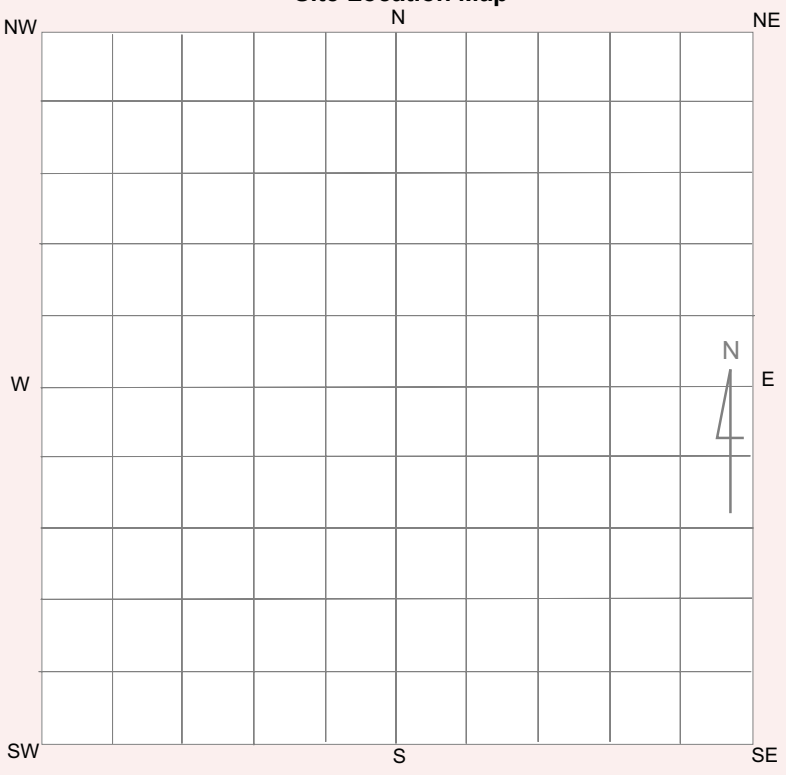
Distance to temporary water source 90 metres

Name of nearest permanent water source _____

Name of nearest temporary water Kilaben Ck Upp.trb

Directions for Relocation

Site Location Map



Current Land Tenure

- [ ] Public — National Park / other Government Dept.
- [ ] Private — Crown leased to Centennial

Primary report **I.D.** _____ (I.D. Office Use only)

NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

Site Orientation

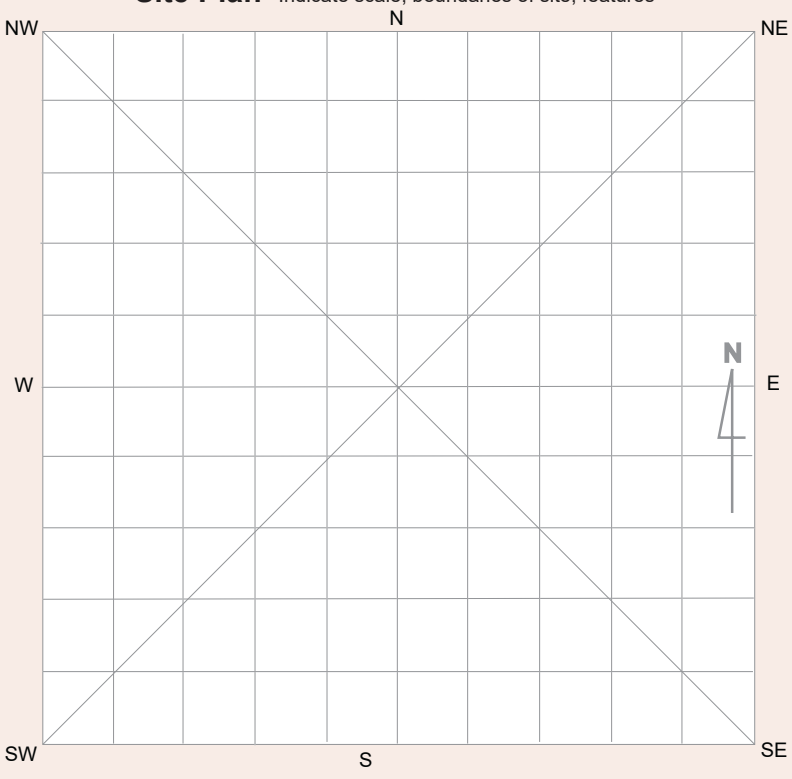
- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☐ SE-NW
- ☑ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☑ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☐ 17. Shell
- ☐ 18. Stone Arrangement
- ☐ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- _____ Internal length
- _____ Internal width
- _____ Shelter height
- _____ Shelter floor area

Open Site Dimensions (m)

- _____ Total length of visible site
- _____ Average width of visible site
- _____ Estimated area of visible site
- _____ Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC), agreed with management recommendation to leave the artefact in -situ beside the track.

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC) indicated the isolated find was evidence of Aboriginal occupation of the area, but it did not have specific cultural impotance

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☐ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. RPS IF01

Site Name

First recorded date 16/04/2010

Importance Cannot be presently determined

No. of instances

Recorded by TBM

	Yes	No
Stone artefacts only	Yes	
Artefacts collected		No
Permit issued		No

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-59% | 60-69% | 70-79% | 80-89% | 90-100%

0-9%

Feature Context & Condition

Scatter No.

Easting

Northing

Density (Artefact count per square metre) 1

Dimensions 1 Length (m) 1 Width (m) Depth (m)

	Yes	No
In situ		No
Stratified		No

Feature Condition

- [ ] Very good
- [ ] Good
- [x] Poor

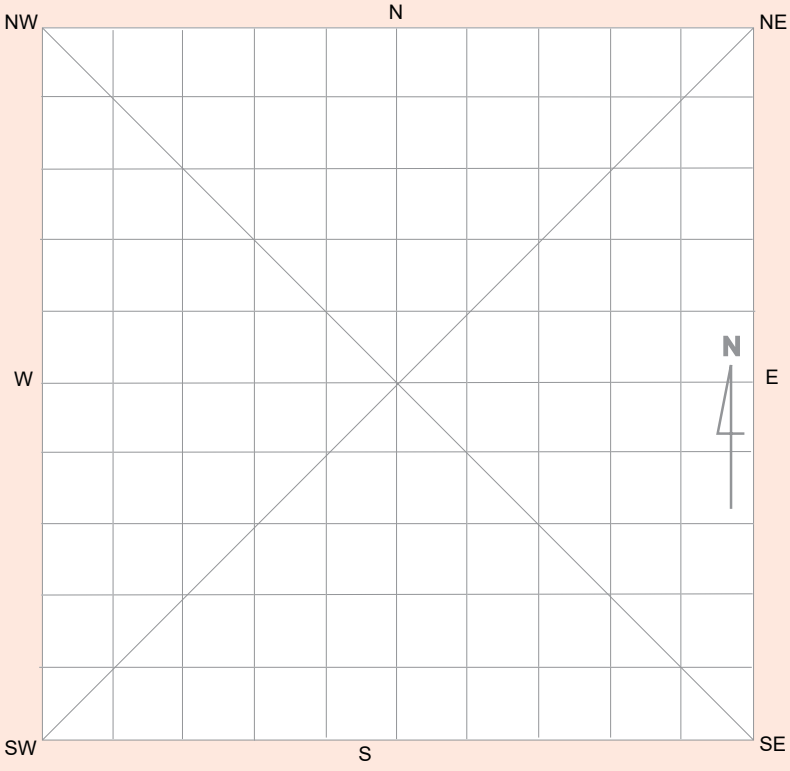
General Condition

- [ ] Weathered
- [x] Vehicle damage
- [ ] Surface water wash
- [ ] Fire damage
- [ ] Erosion
- [ ] Stock damage
- [ ] Exposed archaeological material

Recommended Action

- [ ] Boardwalk
- [ ] Fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Fire hazard reduction
- [ ] Expert assessment
- [ ] Meeting with land manager
- [ ] Revegetation
- [ ] Signage
- [ ] Soil erosion control
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

Lower Slope — Land form

Land form unit

Slope

Vegetation

Underground mine — Land use

Water

Distance to permanent water source metres

Distance to temporary water source 90 metres

Name of nearest permanent water source

Name of nearest temporary water

Upper tributary of Kilaben Creek

NPWS FEATURE RECORDING TABLE - ARTEFACT

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)
1	16/4/10	Chert	Debitage					51	45	40

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

Basalt
Chert
Fine grained siliceous
Granite
Quartz
Quartzite
Sandstone
Silcrete
Green glass
Amber glass
Amethyst glass
Clear glass
Ceramic
Porcelain
Tin can
Wire
Nail
Button
Shell
Bone
Wood
Resin

Artefact Description

Adze
Anvil
Axe
Backed blade
Blade
Core
Core tool
Cyclon
Distal fragment
Eloura
Flake
Flake tool
Flaked piece
Hammerstone
Manuport
Milling slab
Mortar
Muller
Nuclear tool
Pirri
Proximal fragment
Tula
Other diagnostic type
Modified
Unworked

Platform Surface

Cortex
Flake scar
More than one flake scar
Faceted
Ground
Indeterminate
Bipolar

Platform Type

Wide
Focal
Shattered
Indeterminate
Bipolar

Termination

Feather
Hinge
Step
Outrepasse
Bipolar

Cross Section

High/strong
High/weak
Low/weak
Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. | Site Name | First recorded date | **Importance** | **Aboriginal Information Recorded?** | No. of instances | Recorded by

Feature description

No. of scars

No. of carved panels

Easting | Northing

Feature Condition

- Very good
- Good
- Poor

Condition

- Weathered
- Ringbarked
- Fire damage
- Vehicle damage
- Insects/termites
- Rot
- Limb fall
- Stock damage

Recommended Action

- Fencing
- Closure to public
- Continued inspection
- Expert assessment
- Fire hazard reduction
- Insect removal
- Meeting with land manager
- Rubbish removal
- Signage
- Tree health assessment
- Track closure/re-routing
- Additional recording

Feature environment

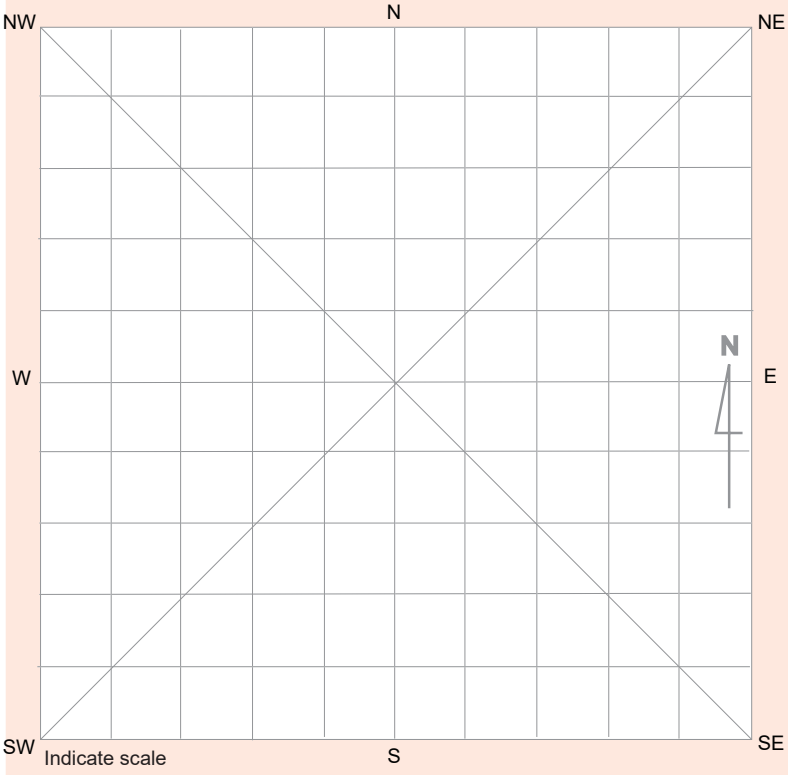
(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

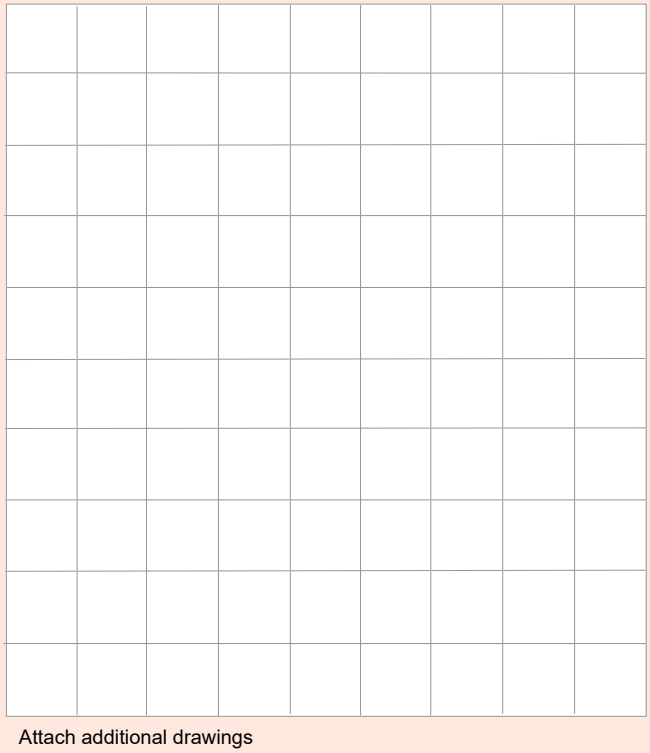
Water

- Distance to permanent water source — metres
- Distance to temporary water source — metres
- Name of nearest permanent water source
- Name of nearest temporary water

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____ / ____ / ____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Description

Recording date ____ / ____ / ____

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present

Groove Function

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Dimensions

Smallest		**Largest**			
Length (mm)		Length (mm)		Groove count	
Width (mm)		Width (mm)		Cluster count	
Depth (mm)		Depth (mm)			

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

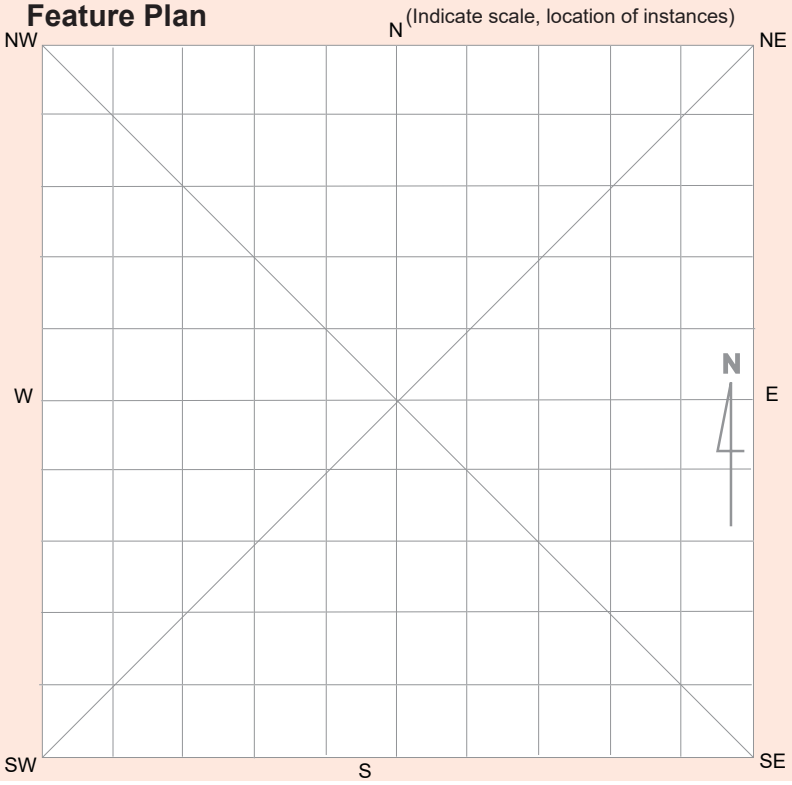
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

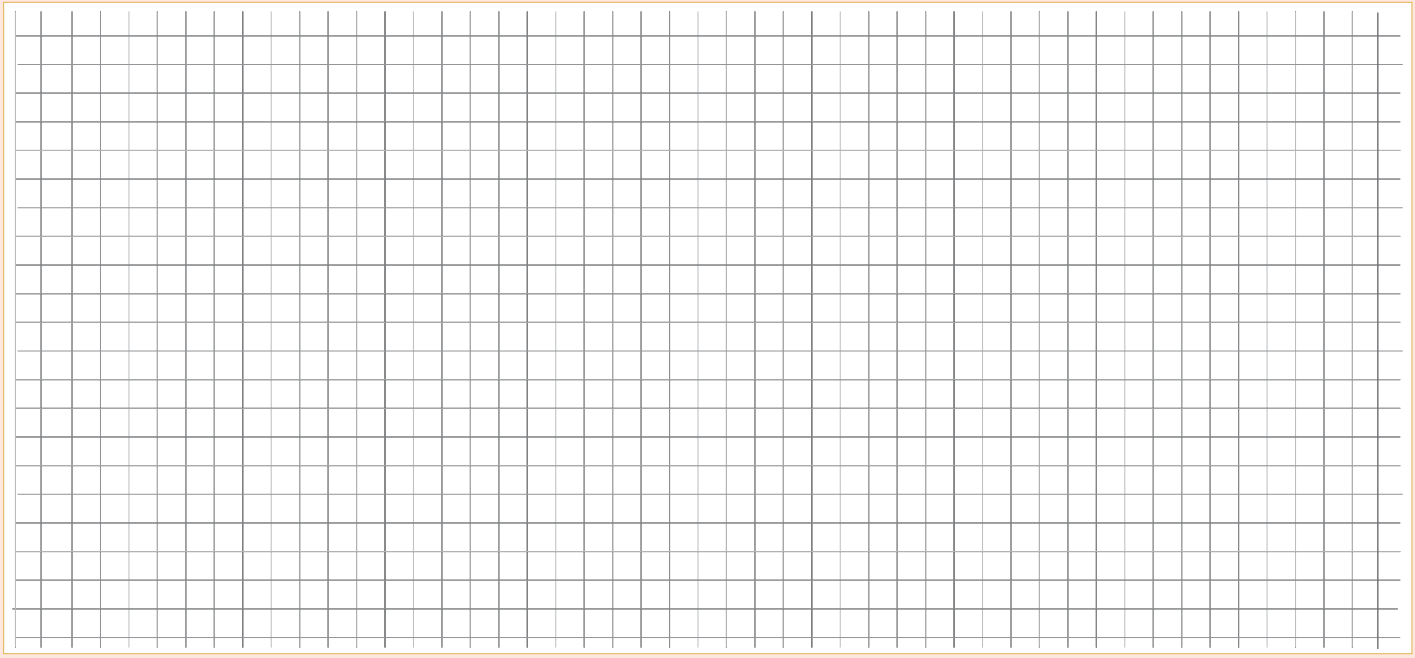
Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups



NPWS FEATURE RECORDING TABLE - ART MOTIF

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature

____ Length (m) ____ Width (m) ____ Depth (m)

Shell Distribution

- ☐ Surface scatter
- ☐ Stratified deposit
- ☐ Mounded

____ Distance to high water mark (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti

General Condition ctd

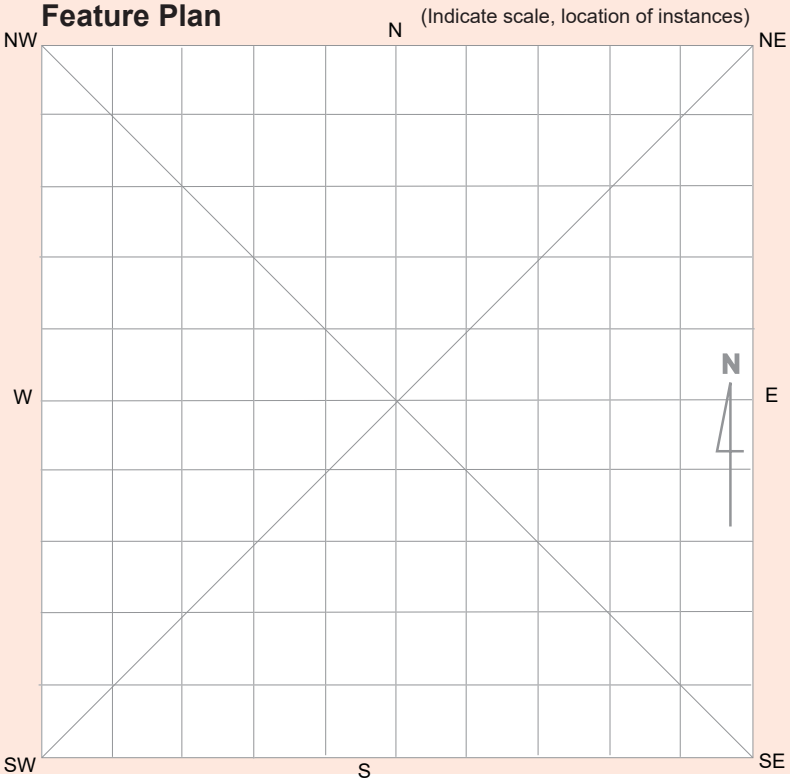
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock damage
- ☐ Unstable structure
- ☐ Exposed bone material
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Insect/bird nest removal
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

____ Land form

____ Land form unit

____ Slope

____ Vegetation

____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING TABLE - SHELL

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Department of Environment & Climate Change NSW

Office Use Only

Site Number 45-7-0318

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name RPS ST01

Easting 362999 Northing 6344235 AGD/GDA GDA

Mapsheet

Zone 56 Location Method Differential GPS

Other Registration

Primary Recorder

Title | Surname | First Name | Initials

MS | Tessa | Boer-Mah

Organisation RPS

Address PO BOX 428 HAMILTON NSW 2303

Phone number 02 4940 4200 Fax 02 4961 6794

Date recorded

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [ ] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [x] Crest
- [ ] Flat
- [ ] Lower slope
- [ ] Mid slope
- [ ] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

0 degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [ ] Open forest
- [ ] Open woodland
- [ ] Scrub
- [x] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [x] Forestry
- [ ] Industrial
- [x] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

Water

Distance to permanent water source	metres
Distance to temporary water source	150 metres
Name of nearest permanent water source	
Name of nearest temporary water	Kilaben Ck Upp.trb

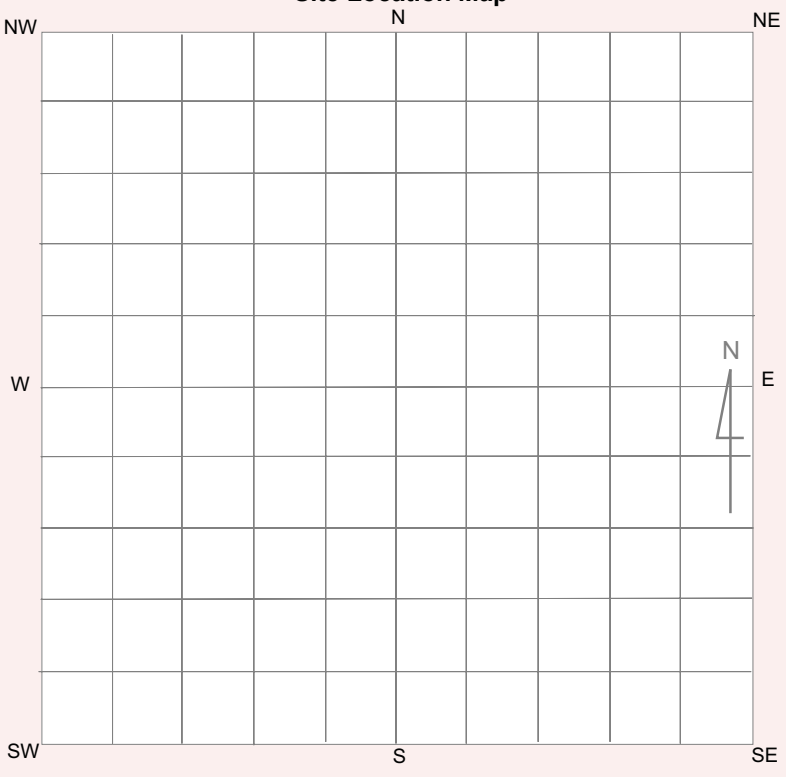
Directions for Relocation

Current Land Tenure

- [ ] Public — National Park / other Government Dept.
- [ ] Private — Crown leased to Centennial

Primary report **I.D.** (I.D. Office Use only)

Site Location Map



NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- [ ] Boulder
- [ ] Wind erosion
- [ ] Water erosion
- [ ] Rock collapse

Rock Surface Condition

- [ ] Boulder
- [ ] Sandstone platform
- [ ] Silica gloss
- [ ] Tessellated
- [ ] Weathered
- [ ] Other platform

Condition of Ceiling

- [ ] Boulder
- [ ] Sandstone platform
- [ ] Silica gloss
- [ ] Tessellated
- [ ] Weathered
- [ ] Other platform

Shelter Aspect

- [ ] North
- [ ] North East
- [ ] East
- [ ] South East
- [ ] South
- [ ] South West
- [ ] West
- [ ] North West

Open Site

Site Orientation

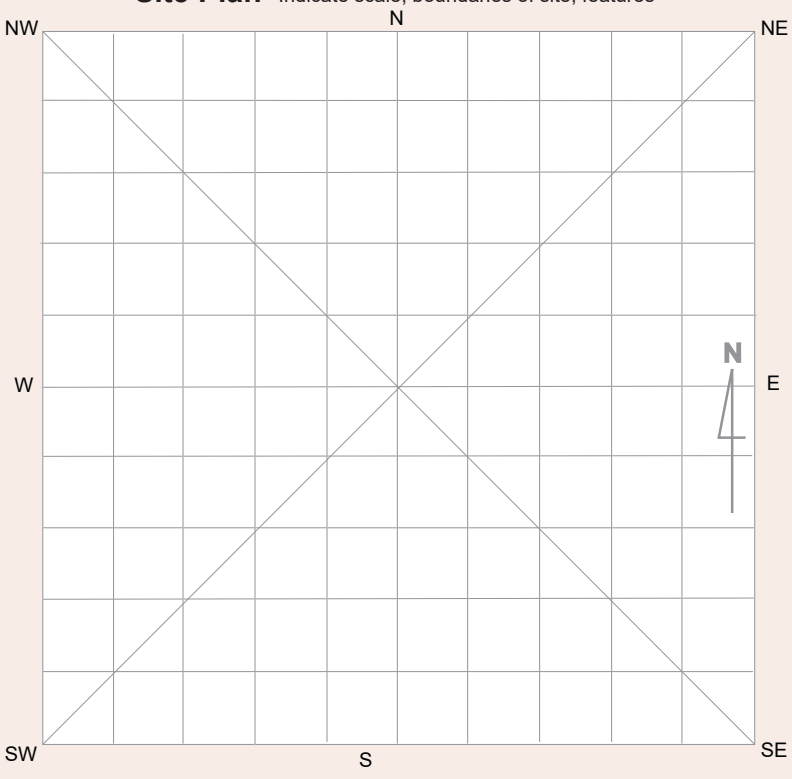
- [ ] N-S
- [ ] NE-SW
- [ ] E-W
- [x] SE-NW
- [ ] N/A

Features

- [ ] 1. Aboriginal Ceremony & Dreaming
- [ ] 2. Aboriginal Resource & Gathering
- [ ] 3. Art
- [ ] 4. Artefact
- [ ] 5. Burial
- [ ] 6. Ceremonial Ring
- [ ] 7. Conflict
- [ ] 8. Earth Mound
- [ ] 9. Fish Trap
- [ ] 10. Grinding Groove
- [ ] 11. Habitation Structure
- [ ] 12. Hearth
- [ ] 13. Non Human Bone & Organic Material
- [ ] 14. Ochre quarry
- [ ] 15. Potential Archaeological Deposit
- [ ] 16. Stone Quarry
- [ ] 17. Shell
- [ ] 18. Stone Arrangement
- [x] 19. Modified Tree
- [ ] 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- [ ] Internal length
- [ ] Internal width
- [ ] Shelter height
- [ ] Shelter floor area

Open Site Dimensions (m)

- [ ] Total length of visible site
- [ ] Average width of visible site
- [ ] Estimated area of visible site
- [ ] Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC), present

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC) indicated the scarred tree was of high significance

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☐ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. | Site Name

First recorded date

No. of instances

Recorded by

Importance Cannot be presently determined

	Yes	No
Stone artefacts only		No
Artefacts collected		No
Permit issued		No

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-59% | 60-69% | 70-79% | 80-89% | 90-100%

0-9%

Feature Context & Condition

Scatter No. | Easting | Northing

Density (Artefact count per square metre)

Dimensions Length (m) | Width (m) | Depth (m)

	Yes	No
In situ		No
Stratified		No

Feature Condition

- Very good
- Good
- Poor

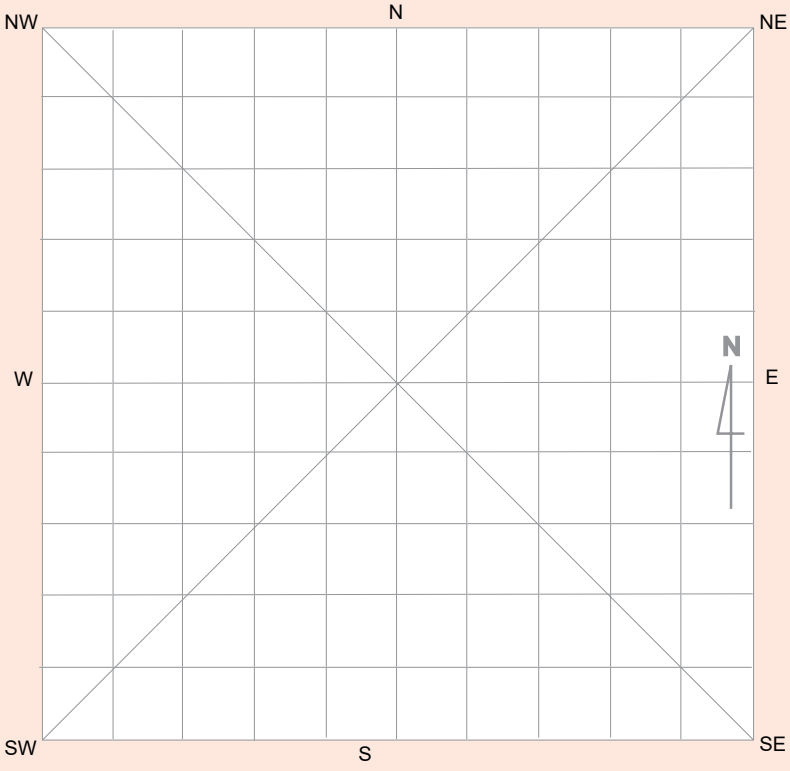
General Condition

- Weathered
- Vehicle damage
- Surface water wash
- Fire damage
- Erosion
- Stock damage
- Exposed archaeological material

Recommended Action

- Boardwalk
- Fencing
- Closure to public
- Continued inspection
- Fire hazard reduction
- Expert assessment
- Meeting with land manager
- Revegetation
- Signage
- Soil erosion control
- Track closure/re-routing
- Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

Water

Distance to permanent water source metres

Distance to temporary water source metres

Name of nearest permanent water source

Name of nearest temporary water

NPWS FEATURE RECORDING TABLE - ARTEFACT

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

- Basalt
- Chert
- Fine grained siliceous
- Granite
- Quartz
- Quartzite
- Sandstone
- Silcrete
- Green glass
- Amber glass
- Amethyst glass
- Clear glass
- Ceramic
- Porcelain
- Tin can
- Wire
- Nail
- Button
- Shell
- Bone
- Wood
- Resin

Artefact Description

- Adze
- Anvil
- Axe
- Backed blade
- Blade
- Core
- Core tool
- Cyclon
- Distal fragment
- Eloura
- Flake
- Flake tool
- Flaked piece
- Hammerstone
- Manuport
- Milling slab
- Mortar
- Muller
- Nuclear tool
- Pirri
- Proximal fragment
- Tula
- Other diagnostic type
- Modified
- Unworked

Platform Surface

- Cortex
- Flake scar
- More than one flake scar
- Faceted
- Ground
- Indeterminate
- Bipolar

Termination

- Feather
- Hinge
- Step
- Outrepasse
- Bipolar

Platform Type

- Wide
- Focal
- Shattered
- Indeterminate
- Bipolar

Cross Section

- High/strong
- High/weak
- Low/weak
- Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. RPS ST01 | Site Name RPS Scarred Tree 01

First recorded date 16/4/2010 | **Importance** Contributes to primary site importar | **Aboriginal Information Recorded?** Yes

No. of instances 2

Recorded by Tessa Boer-Mah

Feature description

Easting | Northing

No. of scars 1

No. of carved panels 0

Feature Condition

- [ ] Very good
- [ ] Good
- [x] Poor

Condition

- [ ] Weathered
- [x] Ringbarked
- [x] Fire damage
- [ ] Vehicle damage
- [ ] Insects/termites
- [ ] Rot
- [ ] Limb fall
- [ ] Stock damage

Recommended Action

- [ ] Fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Expert assessment
- [ ] Fire hazard reduction
- [ ] Insect removal
- [ ] Meeting with land manager
- [ ] Rubbish removal
- [ ] Signage
- [ ] Tree health assessment
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

Crest — Land form

Land form unit

Slope

Mainly regrowth — Vegetation

Land use

Water

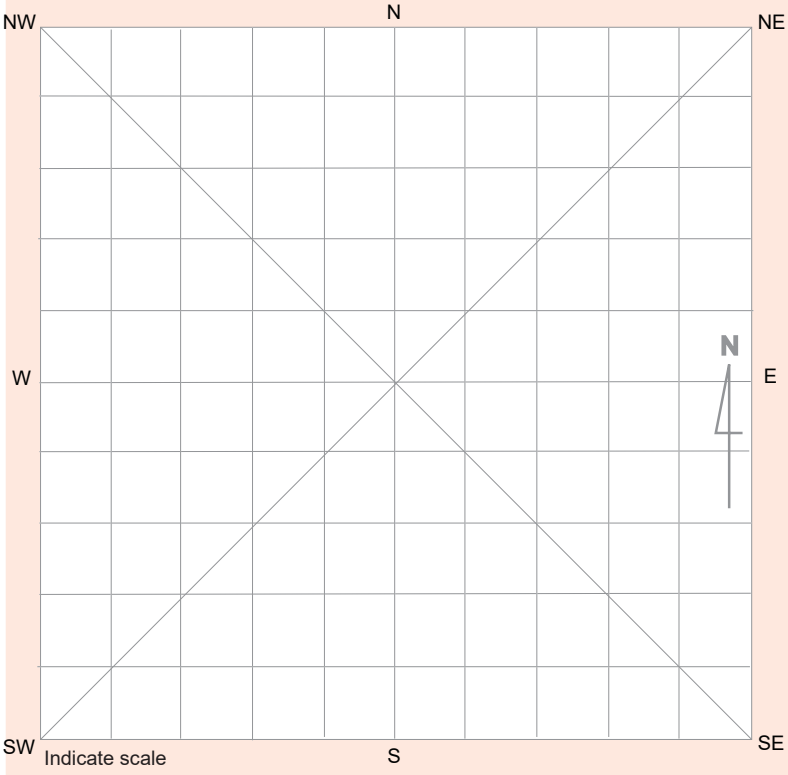
Distance to permanent water source — metres

Distance to temporary water source 150 metres

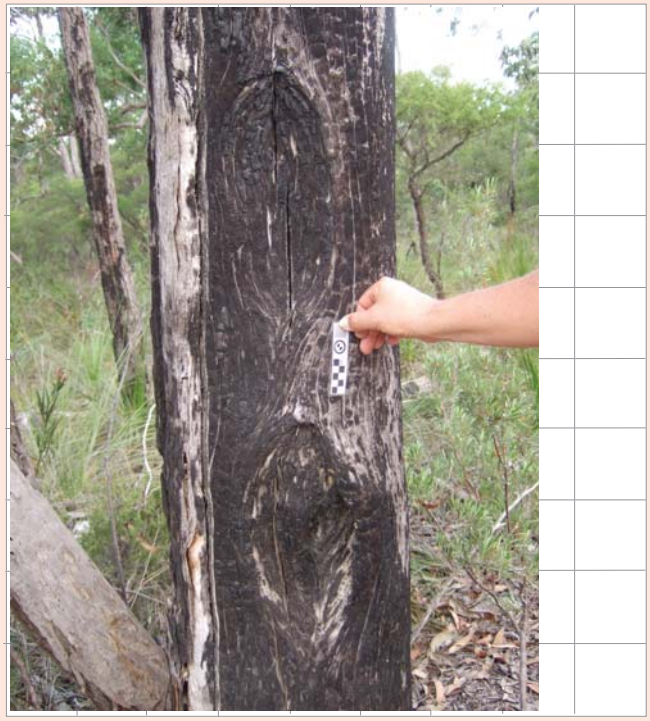
Name of nearest permanent water source

Name of nearest temporary water upper trib. Kilaben Creek

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks
1	16-4-10	Scarred	Eucalypt	Dying	Standing	No	33	15	2		1	Oval			North We	
2	16-4-10	Scarred	Eucalypt	Dying	Standing	No	40	15	2		1	Oval			North We	

Type of Tree	**Tree Species**	**Living Status**	**Tree Status**	**Regrowth**
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	**Carving Type**	**Axe Marks**	**Orientation**
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:

Two scars on tree, penetrated into heartwood, much of the bark around the tree has been removed and metal axe marks around the base suggest it was ringbarked, likely during the original clearing of this area. Scar dimensions in millimetres. Girth (circumference) of tree was 1.22m, approximately 6m in height

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____ / ____ / ____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Description

Recording date ____ / ____ / ____

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present

Groove Function

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Dimensions

Smallest		**Largest**			
Length (mm)		Length (mm)		Groove count	
Width (mm)		Width (mm)		Cluster count	
Depth (mm)		Depth (mm)			

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

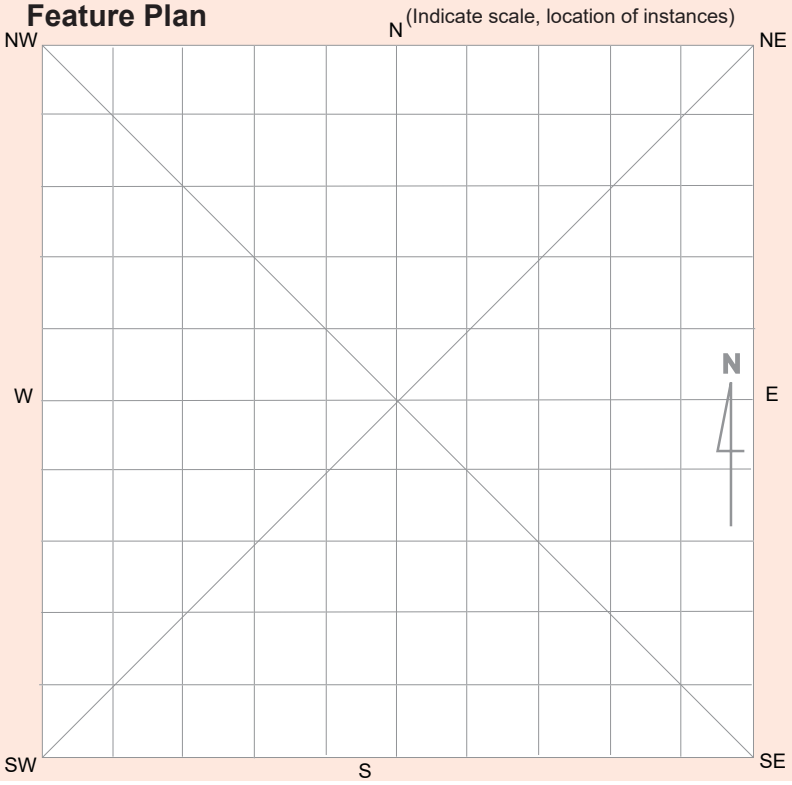
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

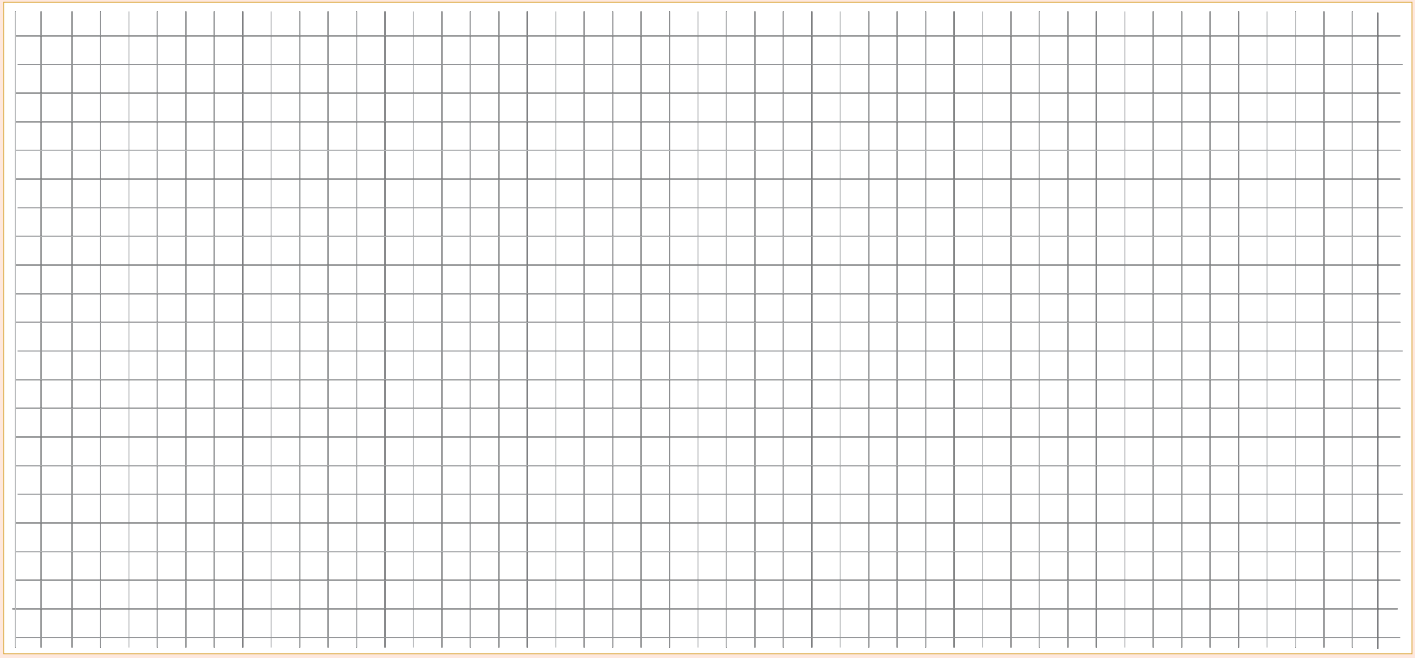
Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups



NPWS FEATURE RECORDING TABLE - ART MOTIF

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature

____ Length (m) ____ Width (m) ____ Depth (m)

Shell Distribution

- ☐ Surface scatter
- ☐ Stratified deposit
- ☐ Mounded

____ Distance to high water mark (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti

General Condition ctd

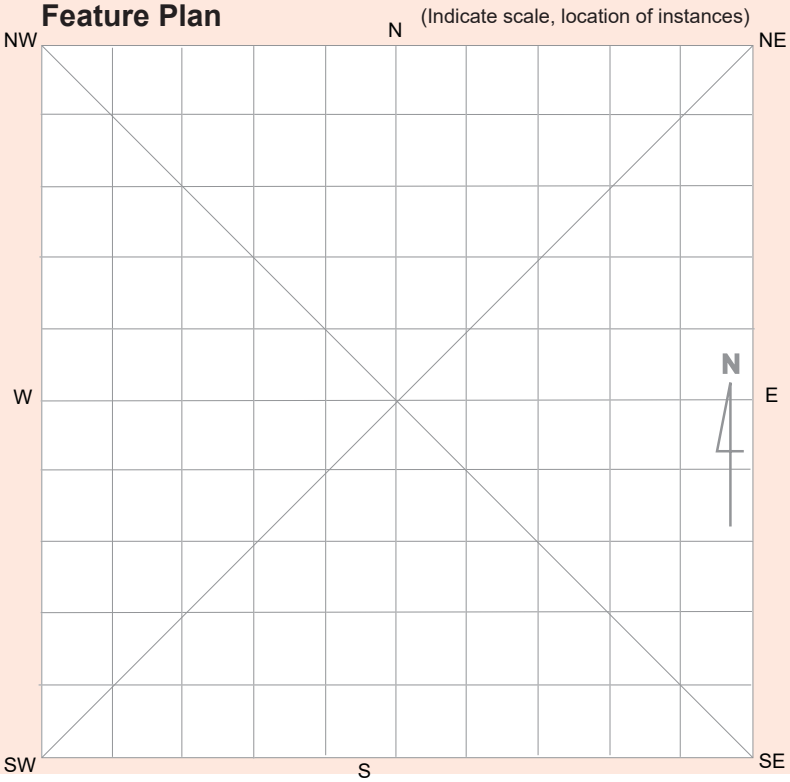
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock damage
- ☐ Unstable structure
- ☐ Exposed bone material
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Insect/bird nest removal
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

____ Land form

____ Land form unit

____ Slope

____ Vegetation

____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING TABLE - SHELL

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Department of Environment & Climate Change NSW

Office Use Only

Site Number 45-7-0319

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name RPS ST02

Easting 363423 Northing 6343924 AGD/GDA GDA

Mapsheet

Zone 56 Location Method Differential GPS

Other Registration

Primary Recorder

Title | Surname | First Name | Initials

MS | Tessa | Boer-Mah

Organisation RPS

Address PO BOX 428 HAMILTON NSW 2303

Phone number 02 4940 4200 Fax 02 4961 6794

Client on system ☐

Date recorded

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [ ] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [x] Lower slope
- [ ] Mid slope
- [ ] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

0 degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [ ] Open forest
- [ ] Open woodland
- [ ] Scrub
- [x] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [x] Forestry
- [ ] Industrial
- [x] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

Water

Distance to permanent water source _____ metres

Distance to temporary water source 90 metres

Name of nearest permanent water source _____

Name of nearest temporary water Kilaben Ck Upp.trb

Directions for Relocation

_____

_____

_____

_____

_____

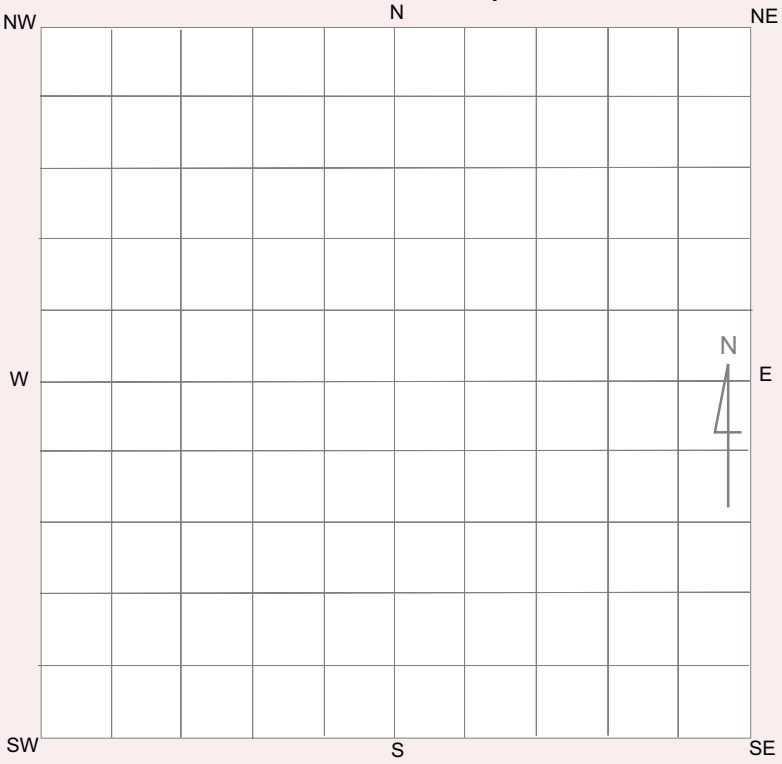
_____

Current Land Tenure

- [ ] Public — National Park / other Government Dept.
- [ ] Private — Crown leased to Centennial

Primary report **I.D.** _____ (I.D. Office Use only)

Site Location Map



NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

Site Orientation

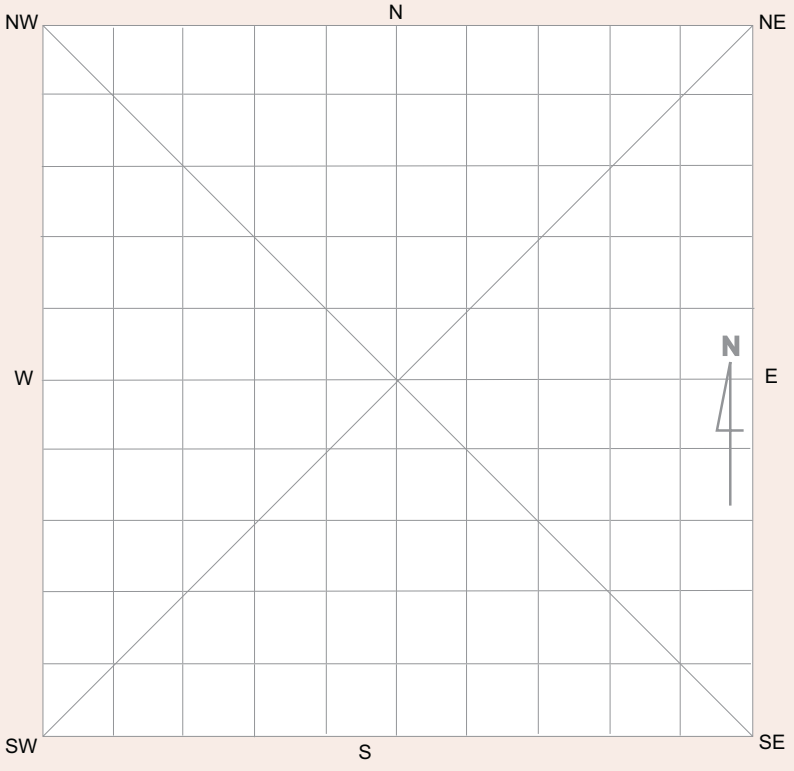
- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☑ SE-NW
- ☐ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☐ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☐ 17. Shell
- ☐ 18. Stone Arrangement
- ☑ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- ☐ Internal length
- ☐ Internal width
- ☐ Shelter height
- ☐ Shelter floor area

Open Site Dimensions (m)

- ☐ Total length of visible site
- ☐ Average width of visible site
- ☐ Estimated area of visible site
- ☐ Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC) indicated area site was culturally important

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

Shane Frost (Awabakal Descendents Traditional Aboriginal Owners Corporation-ADTOAC) and Arthur Fletcher (Wonnarua Nation Aboriginal Corporation WNAC) indicated the scarred tree was of high significance

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☐ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. | Site Name

First recorded date

No. of instances

Recorded by

Importance Cannot be presently determined

	Yes	No
Stone artefacts only		No
Artefacts collected		No
Permit issued		No

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-59% | 60-69% | 70-79% | 80-89% | 90-100%

0-9%

Feature Context & Condition

Scatter No. | Easting | Northing

Density (Artefact count per square metre)

Dimensions Length (m) | Width (m) | Depth (m)

	Yes	No
In situ		No
Stratified		No

Feature Condition

- Very good
- Good
- Poor

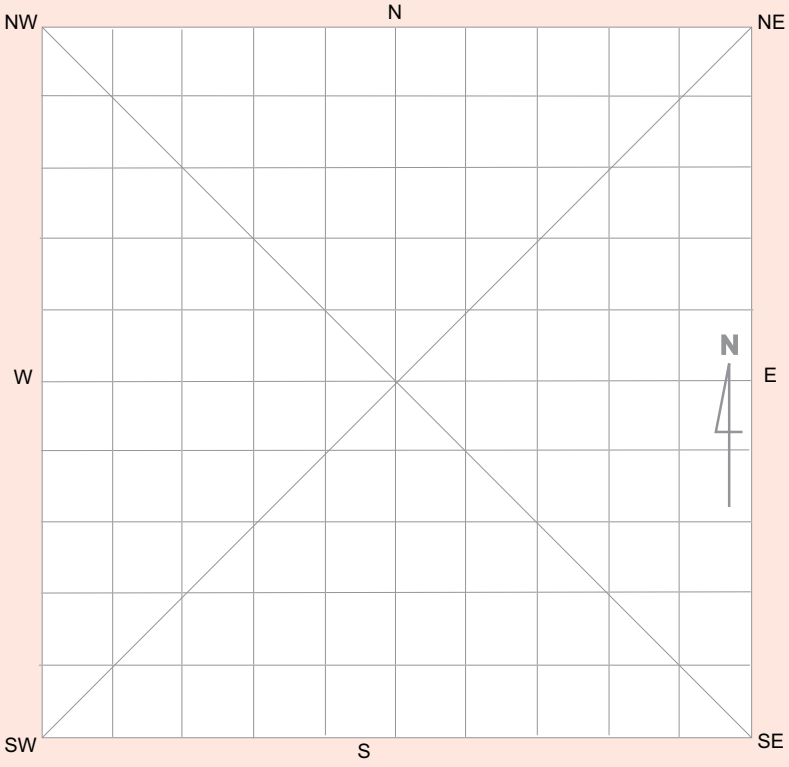
General Condition

- Weathered
- Vehicle damage
- Surface water wash
- Fire damage
- Erosion
- Stock damage
- Exposed archaeological material

Recommended Action

- Boardwalk
- Fencing
- Closure to public
- Continued inspection
- Fire hazard reduction
- Expert assessment
- Meeting with land manager
- Revegetation
- Signage
- Soil erosion control
- Track closure/re-routing
- Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

Water

Distance to permanent water source metres

Distance to temporary water source metres

Name of nearest permanent water source

Name of nearest temporary water

NPWS FEATURE RECORDING TABLE - ARTEFACT

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

Basalt
Chert
Fine grained siliceous
Granite
Quartz
Quartzite
Sandstone
Silcrete
Green glass
Amber glass
Amethyst glass
Clear glass
Ceramic
Porcelain
Tin can
Wire
Nail
Button
Shell
Bone
Wood
Resin

Artefact Description

Adze
Anvil
Axe
Backed blade
Blade
Core
Core tool
Cyclon
Distal fragment
Eloura
Flake
Flake tool
Flaked piece
Hammerstone
Manuport
Milling slab
Mortar
Muller
Nuclear tool
Pirri
Proximal fragment
Tula
Other diagnostic type
Modified
Unworked

Platform Surface

Cortex
Flake scar
More than one flake scar
Faceted
Ground
Indeterminate
Bipolar

Termination

Feather
Hinge
Step
Outrepasse
Bipolar

Platform Type

Wide
Focal
Shattered
Indeterminate
Bipolar

Cross Section

High/strong
High/weak
Low/weak
Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. RPS ST02 | Site Name RPS Scarred Tree 02

First recorded date 16/4/2010 | **Importance** Contributes to primary site importar | **Aboriginal Information Recorded?** Yes

No. of instances 1

Recorded by Tessa Boer-Mah

Feature description

Easting 3 6 3 4 2 3 | Northing 6 3 4 3 9 2 5

No. of scars 1

No. of carved panels 0

Feature Condition

- [ ] Very good
- [x] Good
- [ ] Poor

Condition

- [ ] Weathered
- [ ] Ringbarked
- [x] Fire damage
- [ ] Vehicle damage
- [ ] Insects/termites
- [ ] Rot
- [ ] Limb fall
- [ ] Stock damage

Recommended Action

- [ ] Fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Expert assessment
- [ ] Fire hazard reduction
- [ ] Insect removal
- [ ] Meeting with land manager
- [ ] Rubbish removal
- [ ] Signage
- [ ] Tree health assessment
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

Lower Slope — Land form

Land form unit

Slope

Mainly regrowth — Vegetation

Land use

Water

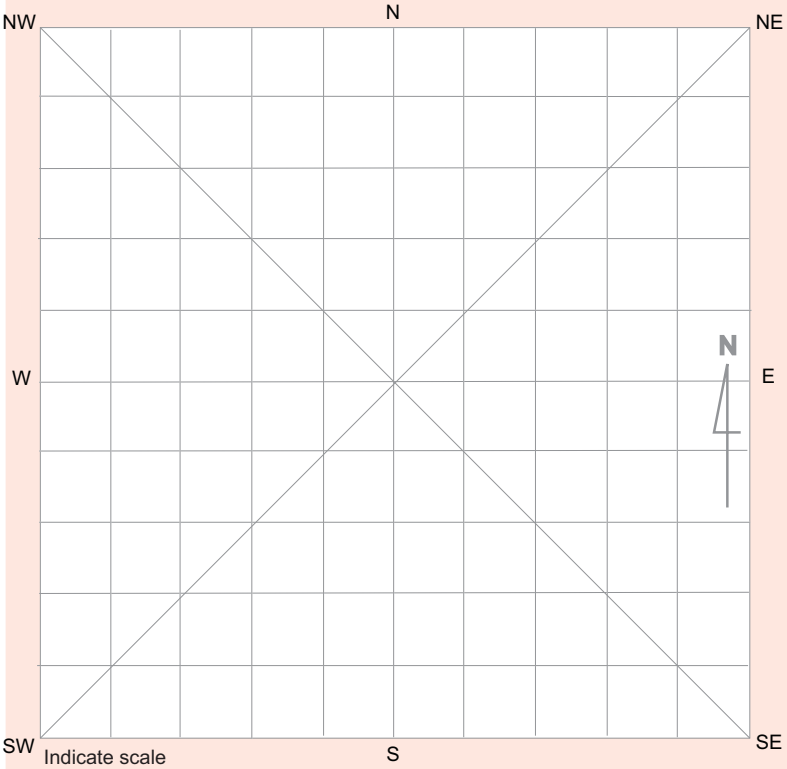
Distance to permanent water source — metres

Distance to temporary water source 90 metres

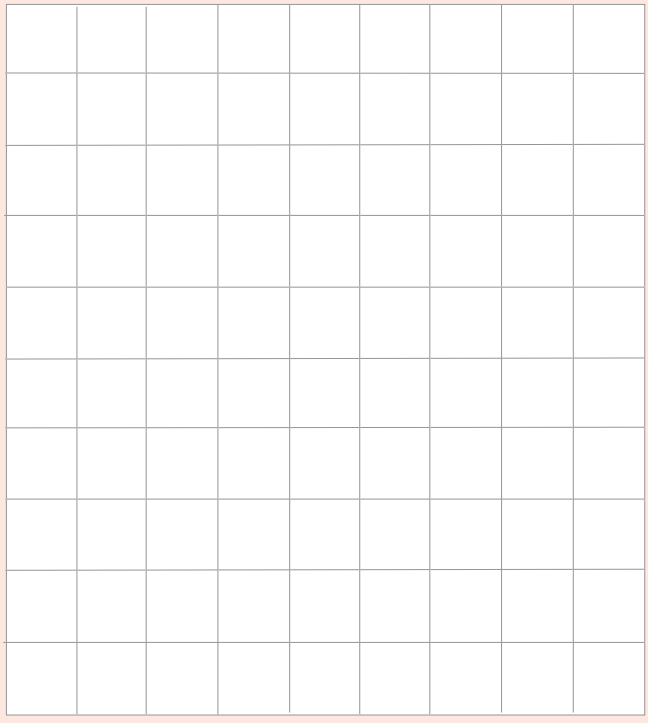
Name of nearest permanent water source

Name of nearest temporary water upper trib. Kilaben Creek

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks
1	16-4-10	Scarred	Eucalypt	Alive	Standing	No	100	12	5		1	Oval			South	
						No									North We	

Type of Tree	Tree Species	Living Status	Tree Status	Regrowth
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	Carving Type	Axe Marks	Orientation
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:

Scar is 1m from ground surface and regrowth is 10 cm, tree girth is 1.2m and tree height is approximately 20m

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D.

Site Name

First recorded date / /

Importance

Aboriginal Information Recorded?

No. of instances

Recorded by

Feature Description

Type of Grinding Feature

- Broad
- Narrow/point
- Hollow
- Flat

Profile Shape

- 'U' shaped
- 'V' shaped
- Flat

Seed Species Present

Recording date / /

Groove Function

Dimensions

Smallest		Largest			
Length (mm)		Length (mm)		Groove count	
Width (mm)		Width (mm)		Cluster count	
Depth (mm)		Depth (mm)			

Feature Context & Condition

Easting

Northing

Dimensions of Whole Feature Length (m) Width (m)

Feature Condition

- Very good
- Good
- Poor

General Condition

- Weathered
- Vandalised

General Condition ctd

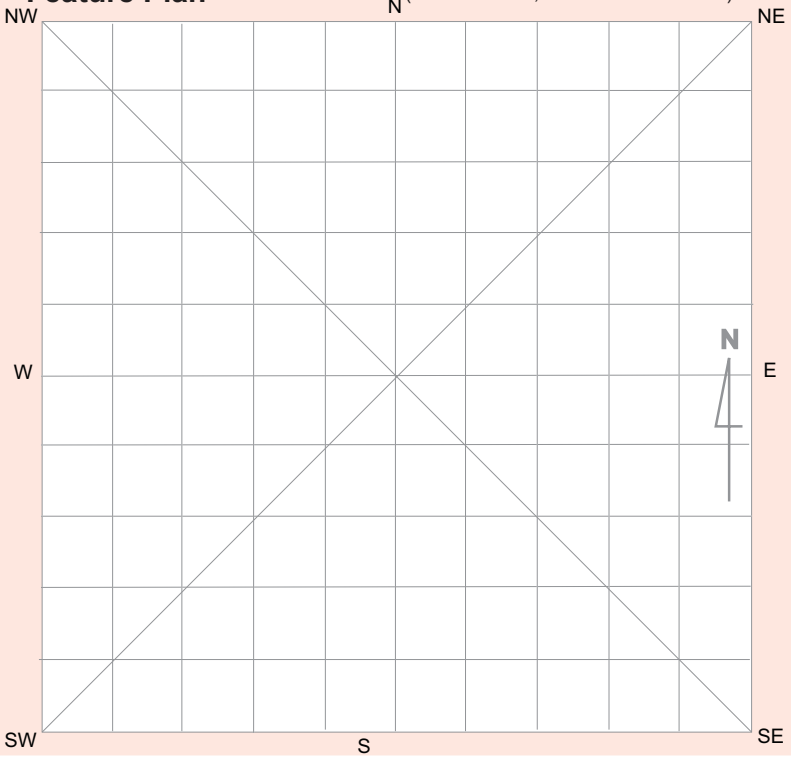
- Fire damage
- Surface water wash
- Graffiti
- Vehicle damage
- Erosion
- Stock damage

Recommended Action

- Boardwalk
- Cage/barrier/fencing
- Closure to public
- Continued inspection
- Expert assessment
- Graffiti removal
- Meeting with land manager
- Revegetation
- Rubbish removal
- Signage
- Erosion control
- Track closure/re-routing
- Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

Water

Distance to permanent water source metres

Distance to temporary water source metres

Name of nearest permanent water source

Name of nearest temporary water

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature

____ Length (m) ____ Width (m) ____ Depth (m)

Shell Distribution

- ☐ Surface scatter
- ☐ Stratified deposit
- ☐ Mounded

____ Distance to high water mark (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti

General Condition ctd

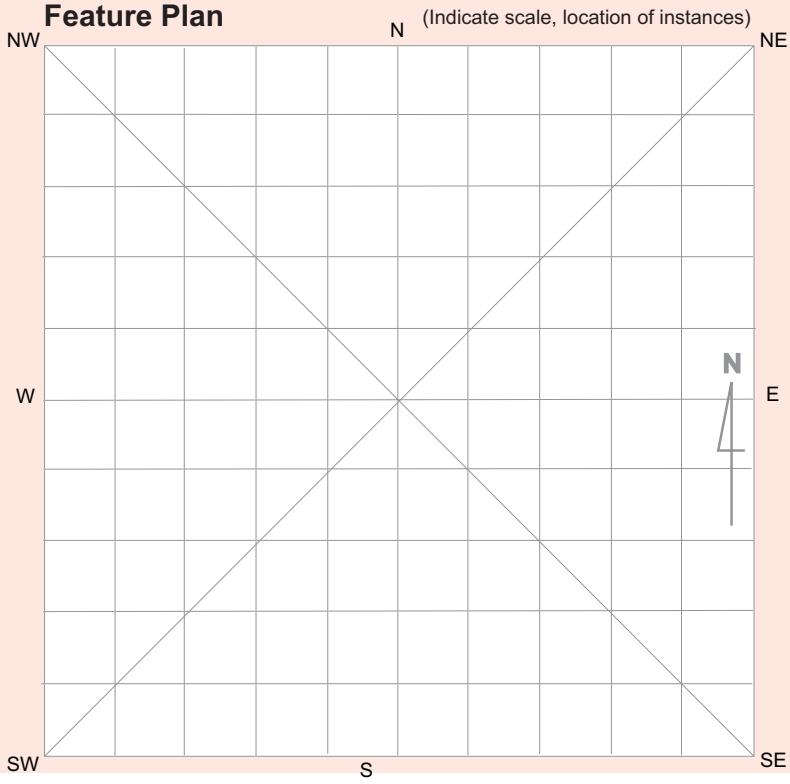
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock damage
- ☐ Unstable structure
- ☐ Exposed bone material
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Insect/bird nest removal
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

____ Land form

____ Land form unit

____ Slope

____ Vegetation

____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING TABLE - SHELL

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

Appendix C

Draft Report RAP Response

Wonn1
Entity of Kauwul Pty Ltd

619 Main Road Glendale, 2285

PHONE: 0249547751 Mobile: 0402146193

ABN: 27 153 953 363

13 August 2018

Mr J Marshall
Group Manager Stakeholder Engagement
Centennial Coal
PO Box 1000
TORONTO NSW 2283
Email: James.Marshall@centennialcoal.com.au

Dear James

RE: NEWSTAN MODIFICATION 8 DRAFT CULTURAL HERITAGE IMPACT ASSESSMENT

Thank you for this opportunity to review the above draft report.

We wish to advise that we are generally in agreement with the contents and recommendations within the draft report and would like to be involved in the continued monitoring of the three sites as detailed in the document.

We look forward to continuing the consultation process with your organisation.

Kind regards

Suzie Worth
For Arthur C Fletcher
Wonn1 (Kauwul Pty Ltd)

Appendix G – Water resources impact assessment

Centennial Newstan Pty Ltd

Newstan Colliery Modification 8

Water Resources Impact Assessment

August 2018

Executive summary

Centennial Newstan Pty Ltd is seeking to modify DA 73-11-98 under Section 75W of the NSW *Environmental Planning and Assessment Act 1979*. This modification is required to enable first workings to proceed as per the mine's schedule in addition to determining the presence, throw and strike of the major fault projected from the historical Newstan workings. A Water Resources Impact Assessment has been undertaken to determine the potential impacts of mining these first workings on surface water and groundwater environments. The assessment investigated the regional hydrogeology, water management at Newstan Colliery, and the environment specific to LT Creek, which receives regular discharges from one of Newstan Colliery's Licensed Discharge Points.

Water and salt balance modelling indicated that the proposed modification would result in a negligible increase in the amount of water and salt discharged from Newstan Colliery to LT Creek (less than one percent), and that no change in the frequency of discharges through the Licensed Discharge Point to Stony Creek was likely. As such, the proposed modification is predicted to have a negligible impact on the surface water environment, and the stream health of watercourses which receive licensed discharges from Newstan Colliery.

Groundwater sources throughout the area are of low yield and limited beneficial use. Numerical groundwater modelling predicts no drawdown of alluvial or Triassic groundwater sources as a result of the proposed modification. Some drawdown of groundwater within Permian strata is predicted, however overall groundwater impacts are predicted to be less than the Level 1 minimum impact considerations defined in the NSW Aquifer Interference Policy. No impacts on registered groundwater users or Groundwater Dependent Ecosystems are predicted. Groundwater take from the North Coast Fractured and Porous Rock Groundwater Source is predicted to be slightly higher in years 2020 and 2021 (compared to approved conditions). Centennial Newstan is currently in consultation with the Department of Industry – Water regarding the licensing of existing and proposed groundwater take from this source.

As no significant impact as per the *Environment Protection and Biodiversity Conservation Act 1999* is predicted, referral to the Commonwealth Environment Minister is not required. No change to the Environment Protection Licence for Newstan Colliery is required.

This report is subject to, and must be read in conjunction with, the limitations, assumptions and qualifications contained throughout the Report.

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Appendix B – Height of Fracturing report and peer review

Appendix C – Groundwater hydrographs

Glossary

Alkalinity	A measure of the ability of an aqueous solution to neutralise acids. Alkalinity of natural waters is due primarily to the presence of hydroxides, bicarbonates and carbonates. It is expressed in units of calcium carbonate ($CaCO_3$).
Alluvial	Deposition from running waters.
Ambient	Pertaining to the surrounding environment or prevailing conditions.
Aquifer	An underground layer of permeable material from which groundwater can be usefully extracted.
Australian Height Datum	A common national surface level datum approximately corresponding to sea level.
Bore	Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular location.
Dewatering	The removal or pumping of water from an above or below ground storage, including the mine water within the water collection system of mine workings. Water removed from mine workings is regarded as dewatering unless the workings are flooded and at equilibrium with the surrounding strata (in which case the removal is considered groundwater extraction).
Discharge	The quantity of water per unit of time flowing in a stream, for example cubic metres per second or megalitres per day.
Electrical conductivity	A measure of the concentration of dissolved salts in water.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Floodplain	Area of land that is periodically inundated by floods up to the probable maximum flood event.
Geomorphology	Scientific study of landforms, their evolution and the processes that shape them. In this report relates to the form and structure of waterways.
Groundwater	Water occurring naturally below ground level.
Groundwater extraction	For the purposes of this assessment, groundwater extraction has been defined as the removal of groundwater from a groundwater source or aquifer, either via direct removal for use via a production bore or via incidental flow of groundwater from the aquifer into the mine workings during and after mining. Groundwater extraction includes the pumping of underground water from flooded mine workings in equilibrium with the surrounding strata as well as the removal of water from perched aquifers recharged directly from rainfall infiltration.
Guideline	A numerical concentration or narrative statement that provides appropriate guidance for a designated water use or impact.
Guideline value	The concentration or load of physicochemical characteristics of an aquatic ecosystem, below which there exists a low risk that adverse ecological effects will occur. They indicate a risk of impact if exceeded, which should result in action to conduct further investigations or to implement management or remedial processes.

Hardness	The concentration of multivalent cations present in water. Generally, hardness is a measure of the concentration of calcium and magnesium ions in water and is expressed in units of calcium carbonate ($CaCO_3$) equivalent. Hardness may influence the toxicity and bioavailability of substances in water.
Ion	Electrically charged atom.
Licensed discharge point	A location where the premises discharge water in accordance with conditions stipulated within the site Environmental Protection License.
Median	The middle value, such that there is an equal number of higher and lower values. Also referred to as the 50th percentile.
Newstan Colliery	Newstan Colliery is an existing underground coal mine owned and operated since 2002 by Centennial Newstan Pty Limited. Newstan Colliery operates a conventional water treatment plant which used clarification and filtration process technologies to treat mine dewatering volumes suitable for environmental discharge.
Percentile	The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80 percent of values are found.
pH	The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
Potable water	Water of a quality suitable for drinking.
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Run of mine	Raw coal production (unprocessed).
Sediment	Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters.
Surface water	Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines.
Topography	Representation of the features and configuration of land surfaces.
Toxicity	The inherent potential or capacity of a substance to cause adverse effects in a living organism.
Tributary	A stream or river that flows into a main river or lake.
Turbidity	A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

Abbreviations

AHD	Australian height datum
AIP	Aquifer Interference Policy
bgl	below ground level
BOM	Bureau of Meteorology
Centennial Coal	Centennial Coal Pty Limited
Centennial Newstan	Centennial Newstan Pty Limited
CRD	Cumulative rainfall departure
CWP	Clean water plant
DoI	Department of Industry
DP	Development Plan
DPE	Department of Planning and Environment
DSITI	Department of Science, Information Technology and Innovation
EC	Electrical conductivity
EC_{XX}	Effective concentration for XX percent of the test species.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment protection licence
GDE	Groundwater dependent ecosystem
GHD	GHD Pty Ltd
ha	Hectare
HUA WSP	Hunter Unregulated and Alluvial Water Sources Water Sharing Plan
km	Kilometre
L/s	Litre per second
LC_{XX}	Lethal concentration for XX percent of the test species
LDP	Licensed discharge point
m	Metre
m/s	Metre per second
ML	Megalitre
ML/day	Megalitre per day
ML/year	Megalitre per year
mm	Millimetre
MNES	Matters of national environmental significance
MSEC	Mine Subsidence Engineering Consultants
Mtpa	Million tonnes per annum
NCFPR WSP	North Coast Fractured and Porous Rock Groundwater Sources Water Sharing Plan
NCSS	Newstan Coal Surface Site
NOEC	No observable effect concentration

NTU	Nephelometric turbidity units
NWQMS	National Water Quality Management Strategy
OEH	Office of Environment and Heritage
POEO Act	*Protection of the Environment Operations Act 1997*
REA	Reject emplacement area
ROM	Run of mine
SEPP	State Environment Planning Policy
SILO	Scientific Information for Land Owners
SSD	State Significant Development
SSGV	Site-specific guideline values
TARP	Trigger, Action, Response Plan
t/year	Tonnes per year
TDS	Total dissolved solids
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids
VWP	Vibrating Wire Piezometer
WAL	Water access licence
WM Act	Water Management Act 2000
WRIA	Water Resources Impact Assessment
WSP	Water sharing plan
µS/cm	Microsiemens per centimetre

1. Introduction

Centennial Newstan Pty Ltd (Centennial Newstan) commissioned GHD Pty Ltd (GHD) to prepare a Water Resources Impact Assessment (WRIA) to support Modification 8 to DA 73-11-98. This assessment forms part of an Environmental Assessment (EA) to support a modification application under Section 75W of Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Background

Newstan Colliery is an existing underground coal mine operation located on the western side of Lake Macquarie. Newstan is located approximately 25 km south-west of Newcastle in New South Wales (NSW) and is located within the Lake Macquarie Local Government Area (LGA).

Underground mining operations commenced at Newstan approximately 125 years ago, with longwall mining commencing in 1984. Various seams have been mined, including the upper seams (Great Northern and Fassifern Seams) and lower seams (West Borehole, Borehole, Young Wallsend and Yard Seams) of the Newcastle Coal Measures. The mine moved to a care and maintenance phase in August 2014. Mining operations have ceased during this time, however safety management, including dewatering of the underground workings, is ongoing.

Newstan Colliery is currently approved under DA 73-11-98 which was originally granted in May 1999. The original approval enabled mining to continue within the existing mining areas that had not previously been mined. DA 73-11-98 has since been modified seven times; most recently in December 2015. Newstan has approval to extract up to 4 million tonnes per annum (Mtpa) of run of mine (ROM) coal.

1.2 Project description

Centennial Newstan has initiated feasibility investigations into the recommencement of mining at Newstan Colliery and proposes to modify DA 73-11-98 under Section 75W of the EP&A Act (the Project). This modification is required to enable first workings to proceed as per the mine's schedule in addition to determining the presence, throw and strike of the major fault projected from the historical Newstan workings. Proposed changes to the approved project include:

- **Project life**: Extend DA 73-11-98 for a further 12 months to 6 July 2021.
- **Development consent boundary**: Modification to include the first workings as per Figure 1-1.
- **Mining method**: First workings only being sought, which would not have any measurable surface related subsidence and would be designed to be long term stable.
- **Mining area**: First workings into the proposed extension area.
- **Coal production**: No change to upper coal extraction limit of 4 million tonnes per annum (Mtpa). The modification is seeking to extract up to 2 Mt from the proposed first workings area.

A Section 75W application was made on 26 February 2018 and was accepted by the NSW Department of Planning of Environment (DPE), noting that formal Environmental Assessment Requirements will not be issued for the modification. In email correspondence to Centennial Newstan on 24 April 2018, DPE noted: "that Centennial intends to review and update its hydrogeological model, and that this model will form the basis of a Water Resources Impact Assessment (WRIA) for Modification 8. This assessment should give particular consideration to: potential interactions with the existing underground workings at Awaba, and any associated impacts (particularly with respect to surface infrastructure and water resources); and any need for referral to the Commonwealth." These comments have been addressed in the following sections of this WRIA:

- Section 6.4.1 – Hydrogeological model predictions
- Section 4.1 discusses the potential interactions of the Project with the existing Awaba Colliery underground workings
- Section 2.1.1 and Appendix A address whether or not referral to the Commonwealth is required

1.3 Study area

The Study Area for the WRIA is shown in Figure 1-1. This WRIA also considers impacts on surface water and groundwater environments that extend beyond this Study Area.

1.4 Related projects

Northern Coal Services (as approved under development consent SSD 5145) integrates the coal processing, handling and transport operations from Mandalong Mine and Newstan Colliery. Northern Coal Services utilises existing infrastructure at the Cooranbong Entry Site and the Newstan Colliery Surface Site (NCSS), along with private haul roads and rail loading infrastructure. A reject emplacement area (REA) is also approved for Hawkmount Quarry, a disused quarry located between the Cooranbong Entry Site and NCSS.

1.5 Objectives of the Water Resources Impact Assessment

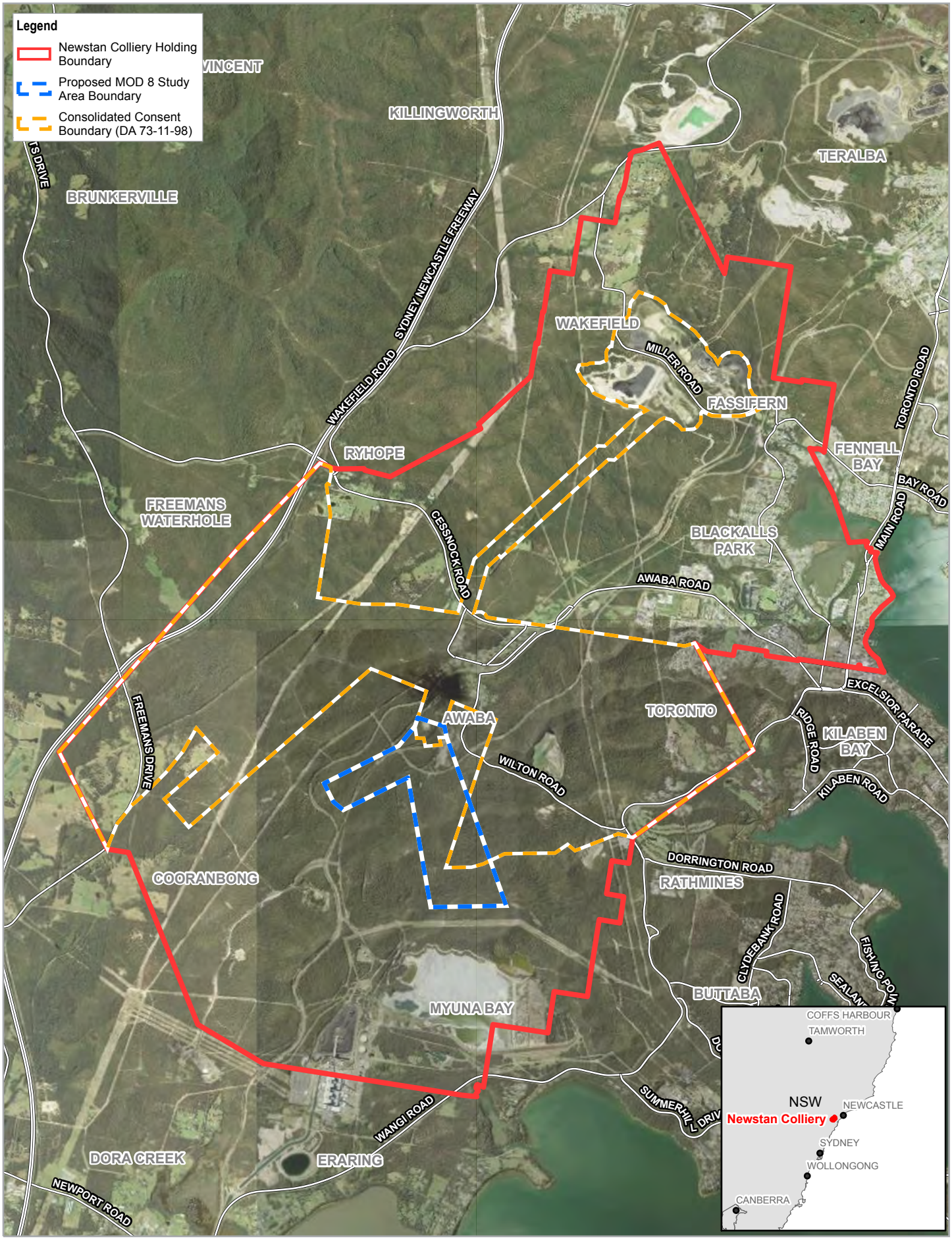
The primary objective of the WRIA is to determine the potential impacts of the Project on the surface water and groundwater environments, including sensitive receptors, in the vicinity of the Project and the broader regional environment. This involves an assessment of surface water and groundwater in terms of hydrology, hydrogeology, water quality and impacts on water users.

1.6 Scope of work

The scope of work for the WRIA includes:

- Review existing assessments and data relevant to the Project
- Review relevant statutory requirements
- Establish the existing conditions for surface water and groundwater environments
- Identify components of the Project with the potential to impact surface water and groundwater environments
- Undertake an assessment of the potential impacts of the Project on:
  - Water and salt balance
  - Surface water quality

  - – Groundwater levels and quality
  - – Stream health (aquatic ecology and geomorphology)
  - – Downstream water users, including licensed water users and basic landholder rights
- Develop measures to avoid, minimise and mitigate the identified potential impacts and provide recommended management, monitoring and reporting requirements



Paper Size ISO A4

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Centennial Coal
Newstan Colliery Mod 8
Water Resources Impact Assesssment

Project No. **22-19545**
Revision No. **0**
Date **18/07/2018**

Proposed MOD 8 Study Area

Figure 1-1

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Print date: 19 Jul 2018 - 11:19

Data source: Centennial: Consent boundary, 2016; LPI: DTDB, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. sixmaps/LPI_Imagery_Best: © DFSI Spatial Services 2017. Created by: tmorton

2. Legislation, policies and guidelines

2.1 Legislation

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy and provides a legal framework to protect and manage nationally and internationally significant flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES). Any action that "has, will have or is likely to have a significant impact on a matter of national environmental significance" is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Commonwealth Environment Minister, as provided under Part 9 of the EPBC Act. Approval is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

The EPBC Act identifies MNES as:

- World heritage properties
- National heritage places
- Wetlands of international importance (Ramsar wetlands)
- Threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining)
- Great Barrier Reef Marine Park
- A water resource in relation to coal seam gas development and large coal mining development

The EPBC Act is also relevant to the determination of the ecological value of a groundwater dependent ecosystem (GDE). If a GDE contains a threatened species as listed under the EPBC Act, the GDE is then taken to have a higher ecological value.

Potential impacts on any MNES are subject to assessments of significance pursuant to the EPBC Act *Significant Impact Guidelines 1.1* (Department of the Environment, 2013a). If a significant impact is considered likely, a referral under the EPBC Act must be submitted to the Commonwealth Environment Minister.

The *Significant Impact Guidelines 1.3* (Department of the Environment, 2013b) includes general criteria for whether an action is likely to have a significant impact on water resources, which are for the possibility for direct or indirect changes to:

- The hydrology of a water resource
- The water quality of a water resource

According to the *Significant Impact Guidelines 1.3* (Department of the Environment, 2013b), the value of the water resource needs to be confirmed such that impacts from actions can be evaluated on their significance. The guidelines indicate that key factors for evaluating a water resource's value include its utility for all third party users. Third party user categories specific to the Project include:

- Provisioning services (e.g. use by other industries and use as drinking water)

- Cultural services (e.g. recreation and tourism, science and education)
- Supporting services (e.g. maintenance of ecosystem function)

If evidence can be provided that proposed actions would not materially affect the availability and quality for third party users, then the likelihood of an action having a significant impact would be reduced (Department of the Environment, 2013b).

The modification of the Centennial Newstan development consent has the potential to impact on MNES with respect to water resources, through changes to hydrology and water quality of a water resource (LT Creek).

The significant impact guideline was completed for the modification and has been provided in Appendix A.

The significant impact guideline completed for the modification (Appendix A) indicated that a significant impact is not considered likely, and as such no referral to the Commonwealth Environment Minister is required for the proposed modification.

2.1.2 Environmental Planning and Assessment Act 1979

The EP&A Act, administered by the NSW Department of Planning and Environment, is the core legislation relating to planning and development activities in NSW and provides the statutory framework under which development proposals are assessed. The EP&A Act aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

This WRIA forms part of an EA to support an application to modify DA 73-11-98 under Part 3A, Division 5, Section 75W of the EP&A Act for the Project. The Minister for Planning (or their delegate) determines development applications under Section 75W of the EP&A Act.

2.1.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the NSW Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include programs to reduce pollution at the source and monitoring and reporting on environmental quality. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution.

Under the POEO Act, an Environment Protection Licence (EPL) is required for premises at which a ‘scheduled activity’ is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purpose of the act. Licence conditions relate to pollution prevention and monitoring and can control the air, noise, water and waste impacts of an activity.

Newstan Colliery is a premises-based ‘scheduled activity’ and current operations under the provisions of EPL 395. EPL 395 is held by Centennial Newstan Pty Ltd for coal mining at Newstan Colliery and coal processing at NCSS. The parts of the EPL relevant to this impact assessment are described in Section 5.2.2.

No variation to EPL 395 is required.

2.1.4 Water Management Act 2000

The *Water Act 1912* has historically been the main legislation for managing water resources in NSW, however it is currently being progressively phased out and replaced by water sharing plans (WSPs) under the *Water Management Act 2000* (WM Act). Once a WSP commences, existing licences under the *Water Act 1912* are converted to water access licences (WALs) and to water supply works and use approvals under the WM Act.

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

The Study Area is covered by the following two WSPs made under Section 50 of the WM Act. Each WSP consists of several water sources that are regulated by a water extraction entitlement:

- The WSP for the North Coast Fractured and Porous Rock Groundwater Sources Water Sharing Plan (NCFPR WSP) commenced on 1 July 2016 and regulates the interception and extraction of groundwater from the fractured and porous rock aquifer within the WSP boundary. Centennial Newstan is currently in consultation with the Department of Industry – Lands and Water (DoI – Water) regarding the licensing of groundwater take from this source. Water licence applications were submitted by Centennial Newstan in 2015 and are awaiting determination. Follow up consultation has occurred in 2016 and 2017 and throughout 2018.
- The Hunter Unregulated and Alluvial Water Sources Water Sharing Plan (HUA WSP), which commenced in August 2009, covers unregulated rivers and creeks and alluvial groundwater within the Hunter region. The HUA WSP includes four extraction management units which are further broken down into water sources. Northern Coal Services currently holds WAL 18735 under this WSP to pump water from the Main By-Wash Dam at the NCSS to supplement water supply at the site. Extractions from the Main By-Wash Dam occur occasionally during dry periods or when other supplies are compromised due to infrastructure failures and are limited to 750 ML/year.

Section 91 of the WM Act details activity approvals to be considered with regards to developments proposed within a WSP. The two activity approvals stipulated under Section 91, namely controlled activity approvals and aquifer interference approvals, will not be required for the Project.

2.2 Policies

2.2.1 State Environmental Planning Policy

State Environmental Planning Policies (SEPPs) are Environmental Planning Instruments prepared by the Minister to address issues significant to NSW. The SEPPs outlined in the below sub-sections contain provisions that are relevant to the Project and this WRIA.

SEPP (Coastal Management) 2018

SEPP (Coastal Management) 2018 updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5 of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed. The Coastal Management SEPP gives effect to the objectives of the *Coastal Management Act 2016* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

The NSW Government Sharing and Enabling Environmental Data (SEED) Portal (available at https://www.seed.nsw.gov.au/) indicates that there are coastal management areas mapped under SEPP (Coastal Management) 2018 within the Newstan Colliery Holding boundary, but not within one kilometre of the Study Area. The Project therefore is not required to be assessed following SEPP (Coastal Management) 2018.

2.2.2 NSW Aquifer Interference Policy

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

The Level 1 minimal impact considerations for less productive groundwater sources are relevant to the groundwater sources in the Study Area, as water yield rates are generally below 5 L/sec. The impact considerations are as follows:

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

2.3 Guidelines

2.3.1 Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The National Water Quality Management Strategy (NWQMS) provides a national framework for improving water quality in Australia's waterways. The main policy objective of the NWQMS is to achieve sustainable use of the nation's water resources, protecting and enhancing their quality, while maintaining economic and social development.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) is a benchmark document of the NWQMS which provides a guide for assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values, such as aquatic ecosystems, primary industries, recreation and drinking water. ANZECC (2000) provide a framework for determining appropriate guideline values or performance criteria to evaluate the results of water quality monitoring programs.

The ANZECC (2000) guidelines adopt a risk-based approach to assessing ambient water quality by providing the framework to tailor water quality guidelines to local environmental conditions. Guideline values provided by ANZECC (2000) can be modified into regional, local or site-specific guideline values (SSGVs) by taking into account factors such as the variability of the particular ecosystem, soil types, rainfall and level of exposure to contaminants. It should be noted that guideline values are applied to the receiving environment at the edge of the mixing zone and do not apply to mine water discharges.

The ANZECC (2000) guidelines are applicable for the receiving environments of LT Creek and Stony Creek, and also for creeks which traverse the Study Area.

2.3.2 Approved Methods for the Sampling and Analysis of Water Pollutants in NSW

The document Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA 2004) lists the sampling and analysis methods to be used when acquiring water samples for compliance with environmental protection legislation, a relevant licence or relevant notice. The water sampling and analysis required by EPL 395 must be undertaken using the methods listed in EPA (2004).

3. Site description

3.1 Land use

The Newstan Holding Boundary encompasses areas previously disturbed by mining and associated activities, including the Newstan Colliery Surface Site, Awaba Colliery, Hawkmount Quarry and various private haul roads.

Lake Macquarie and the low to medium density residential areas of Fassifern, Toronto, Rathmines and Myuna Bay are located east of the Study Area. Unpopulated areas within the vicinity of the Study Area consist primarily of medium density bushland, including State Forest areas, and partially or completely cleared agricultural land used for grazing of stock. Major surface infrastructure surrounding the study area includes Eraring Power Station and associated infrastructure, the M1 Pacific Motorway and the Main Northern Railway line.

3.2 Topography

Figure 3-1 presents the topography and watercourses in the vicinity of the Study Area. The area is characterised by several ridgelines and creek valleys. Site elevations within the Mod 8 Study Area ranges from around 20 m AHD to around 100 m AHD.

3.3 Climate

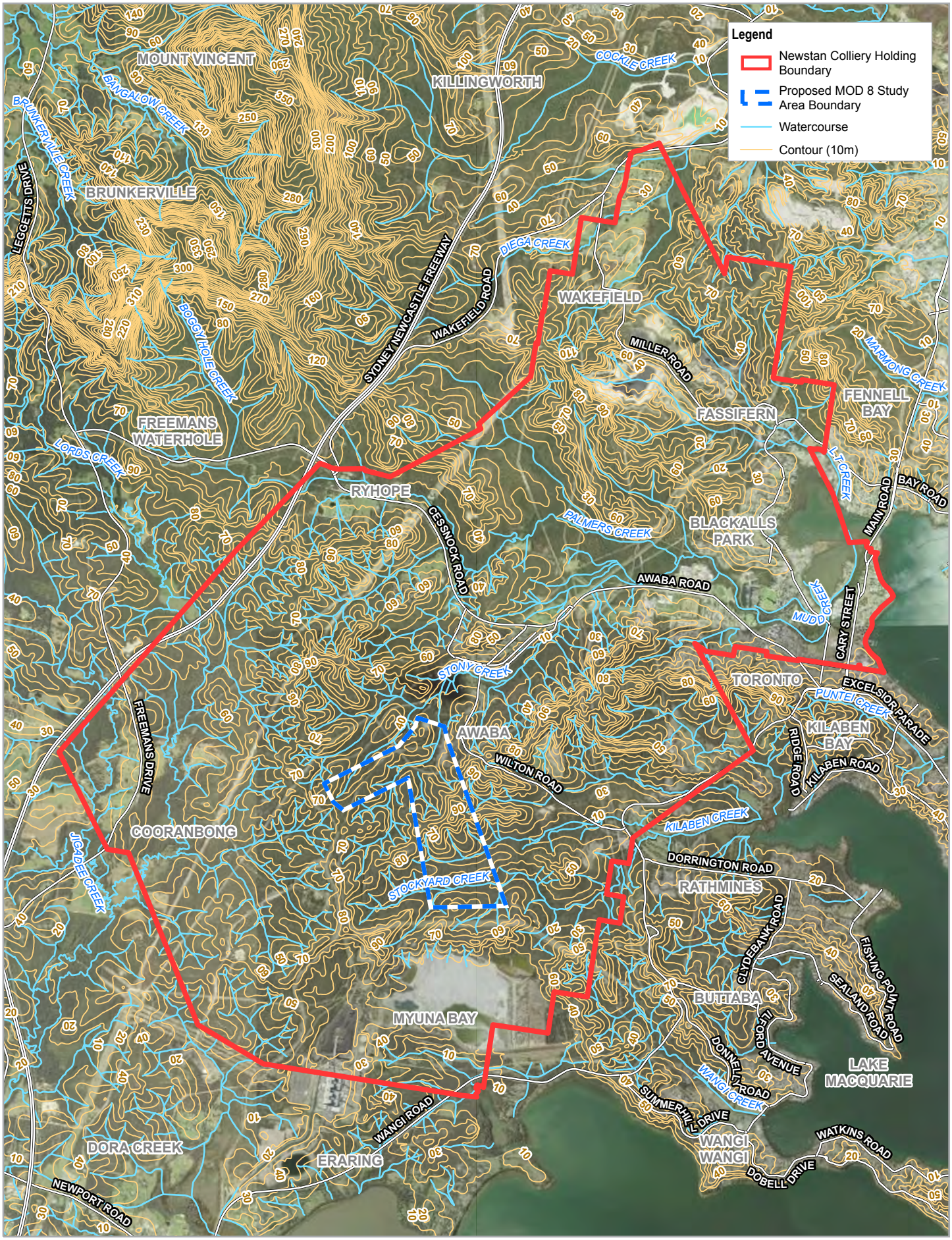
A historical record of daily rainfall and evaporation depths was obtained in the form of a patched point data set from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation (DSITI). SILO patched point data is based on observed historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolating with data from nearby stations (DSITI, 2017).

For this assessment, SILO data was obtained for the Cooranbong (Avondale) station (station number 061412), which is located approximately 14 km south-west of the NCSS. This station was chosen based on proximity to the site and similarity of elevation. The period of rainfall data used for this assessment extended from 1 January 1889 to 1 January 2018 (a total of 129 years).

Figure 3-2 shows the distribution of annual rainfall and evaporation totals near Newstan Colliery. Annual rainfall totals near Newstan Colliery have varied between 584 mm (1944) to 2059 mm (1990), with an average of about 1135 mm. Annual potential evaporation totals are about 1370 mm, resulting in an average net annual evaporation of about 235 mm.

Figure 3-3 shows the average monthly rainfall and evaporation totals near Newstan Colliery. On average, more rainfall occurs in late summer and early autumn than in late winter and early spring. Evaporation is highest in summer and lowest in winter.

Figure 3-4 shows the average distribution of daily rainfall totals near Newstan Colliery. On average, daily rainfall totals exceeding 0.1 mm occur on about 40 % of days, while daily rainfall totals exceeding 50 mm occur on less than 1 % of days.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Newstan Colliery Mod 8
Water Resources Impact Assesssment

Topography and watercourses in the study area

Project No. **22-19545**
Revision No. **0**
Date **18/07/2018**

Figure 3-1

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Data source: Centennial: Consent boundary, 2016; LPI: DTDB, 2016; sixmaps/LPI_Imagery_Best: © DFSI Spatial Services 2017. Created by: tmorton

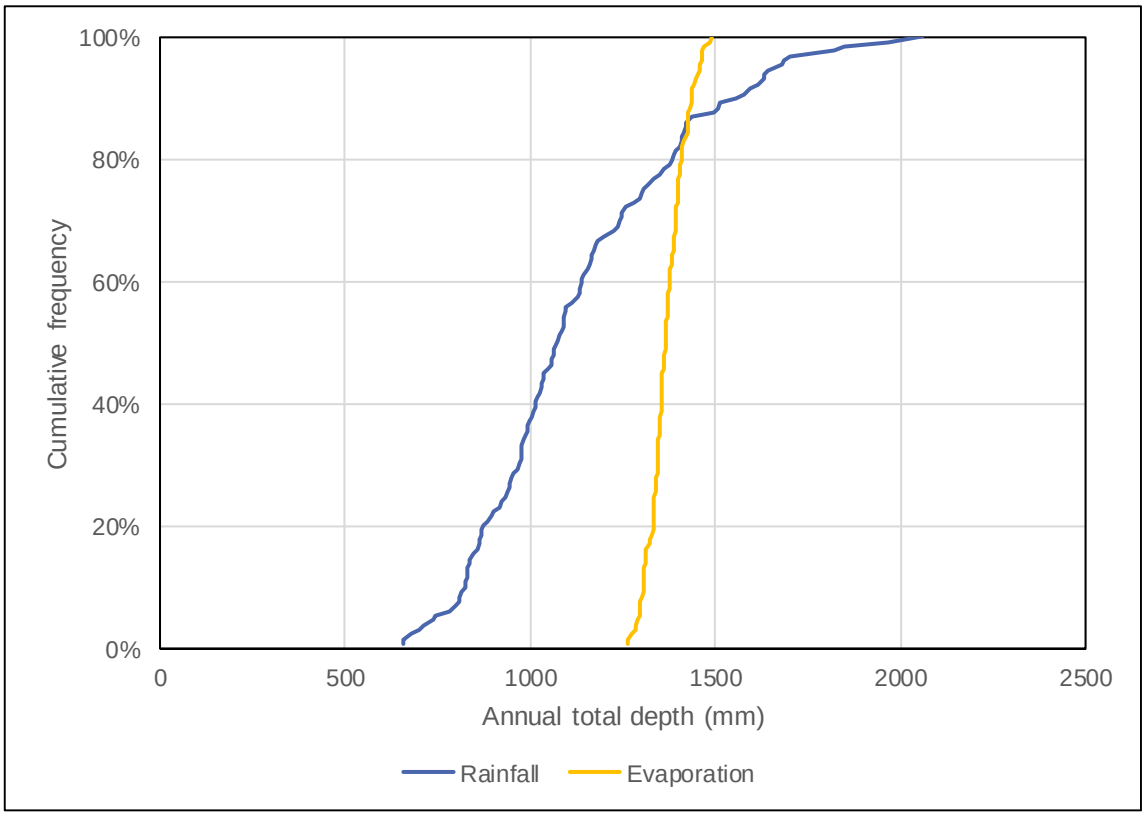


Figure 3-2 Annual rainfall and evaporation totals

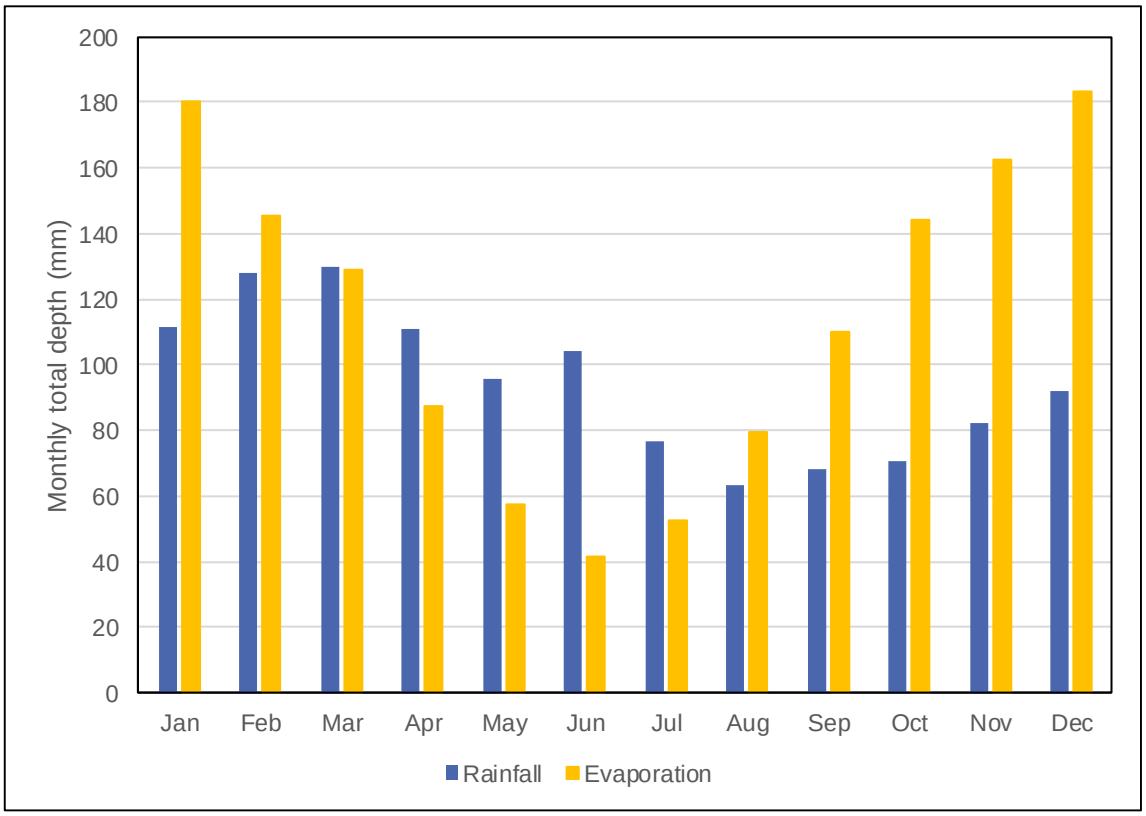


Figure 3-3 Monthly rainfall and evaporation totals

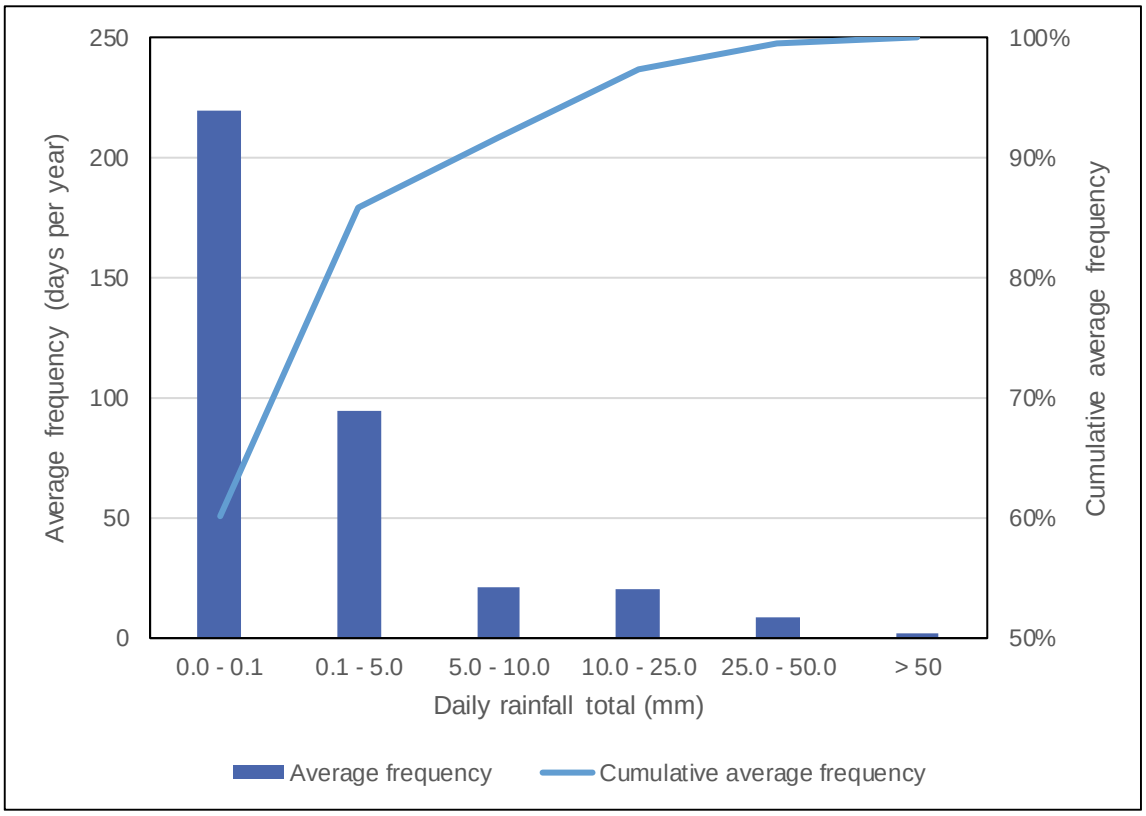


Figure 3-4 Daily rainfall totals

The SILO Patched Point Data was also used to generate a cumulative rainfall departure (CRD) curve over the period from 1901 to 2018, presented in Figure 3-5. CRD is a monthly accumulation of the difference between the observed monthly rainfall and long-term average monthly rainfall. Any increase in the CRD curve reflects above average rainfall while a decrease in CRD curve reflects below average rainfall. The CRD shows that recent years have been average in general, but rainfall has been below average in the last 12 months.

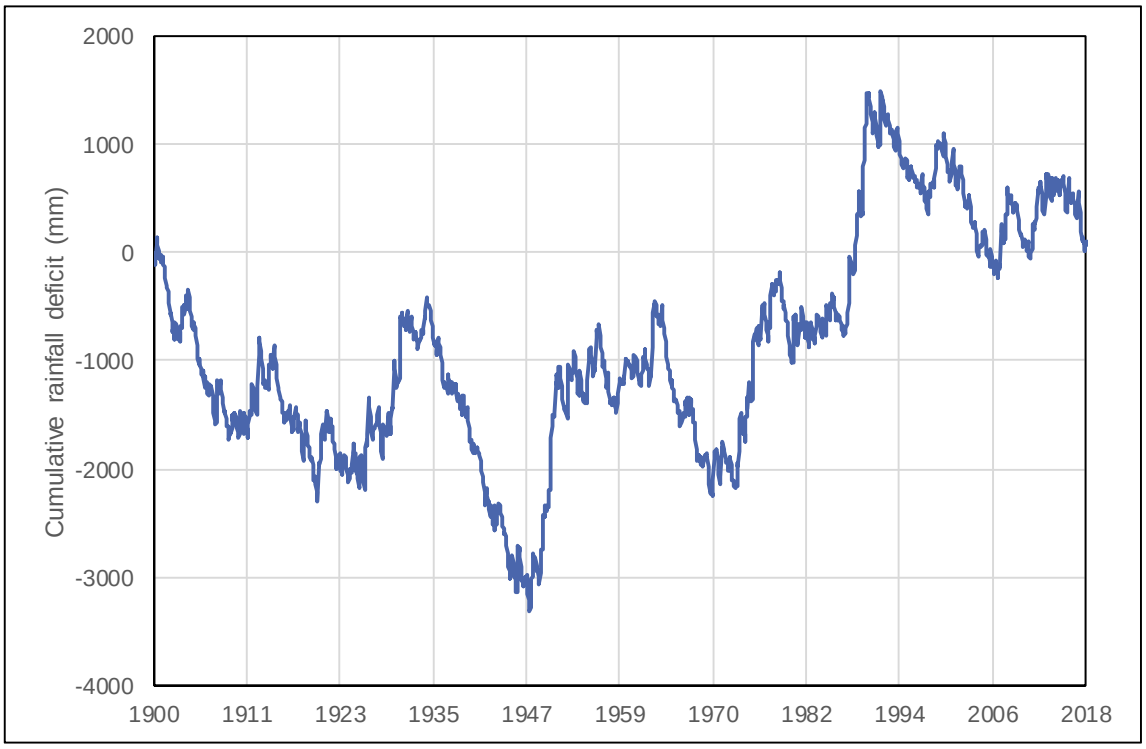


Figure 3-5 Cumulative rainfall departure curve

3.4 Geology

The Study Area is located in the south-western part of the Newcastle Coalfield, which occupies the north-eastern portion of the Sydney Basin. The stratigraphy of the region consists of rocks from the Triassic and Permian periods.

The proposed first workings are contained within the Lambton Formation, the earliest formation of the Newcastle Coal Measures. The stratigraphy at Newstan is listed and described in Table 3-1. This information has been sourced from the Newcastle Coalfields Regional Geology 1:100,000 map (Edition 1 1995) and the Newstan Colliery Life Extension Project Overburden Groundwater Study (Pacific Power International, 1997).

Table 3-1 Site stratigraphy

Period	Stratigraphy		Unit/Lithology	Coal Seams
	Group	Subgroup		
Quaternary			Alluvium	
Triassic	Narrabeen	Clifton	Conglomerate, sandstone, siltstone, claystone	
Permian	Newcastle Coal Measures	Moon Island Beach	Conglomerate, sandstone, siltstone, tuff, coal	Vales Point, Wallarah, Great Northern
		Awaba Tuff		
		Boolaroo	Sandstone, conglomerate, siltstone, coal, tuff	Fassifern, Upper Pilot, Lower Pilot, Hartley Hill
		Warners Bay Tuff		
		Adamstown	Conglomerate, sandstone, siltstone, coal, tuff	Australasian Montrose, Wave Hill, Fern Valley, Victoria Tunnel
		Nobby's Tuff		
		Lambton	Sandstone, siltstone, claystone, coal, tuff	Young Wallsend, Yard, Borehole
	Waratah Sandstone			

Based on a review of the Newcastle Coalfields Regional Geology map and exploration logs, the surface lithology in the vicinity of the Study Area comprises shallow Quaternary alluvium (associated with the major watercourses) as well as bedrock and surface deposits from the Narrabeen Group and the Moon Island Beach Group of the Newcastle Coal Measures, which dip gently at approximately 1 to 2 degrees to the south-west. The Triassic and Permian rocks that comprise the surface lithology include conglomerate, sandstone, siltstone, claystone, tuff and coal.

The target coal seams are the Young Wallsend, Yard and Borehole Seams (referred to collectively as the West Borehole Seam). Centennial Newstan has previously developed 32 longwall panels within the West Borehole Seam. This Seam subcrops to the west of the Study Area. The depth of cover above the proposed first workings ranges from approximately 180 m to 270 m and the Seam thickness ranges from 3.5 m to over 5.0 m.

The existing Awaba Colliery workings within the Great Northern Seam are located over 140 m above the proposed workings within the West Borehole Seam.

3.5 Soils

A number of soil landscapes exist throughout the Study Area as identified by NSW Office of Environment and Heritage's eSPADE version 2.0 (OEH 2018). These are primarily the Awaba, Doyalson, Gateshead, Warners Bay and Wyong soil landscapes.

Awaba Soils are characterised by steep and low rolling hills on predominantly coarse-grained or hard setting soils. The Awaba soils consist of shallow Lithosols on the steeper slopes and transition to moderate to deep Soloths on the gentler slopes. In the drainage lines Yellow and Gleyed Podzolic soils are formed on fine-grained substrates. These soils are considered to be a very high erosion hazard and are prone to rill and sheet erosion with a moderate erodibility for non-concentrated flows and a high erodibility for concentrated flows. The soils are strongly acidic with typically a low fertility.

Doyalson Soils have similar properties to the Awaba soil landscape but are located on the higher elevations in the area. The Doyalson soils are moderately deep Yellow Earths, Yellow Podzolic and Soloths overlaying the Conglomerate Sandstone and Yellow Leached Earths, Grey Earths and Gleyed Podzolic soils. These soils occur on the drainage lines and they typically have a high erosion hazard with a high erodibility for both non-concentrated and concentrated flows. The soils are strongly acidic and have low fertility and are prone to seasonal waterlogging.

Gateshead Soils are generally stable when disturbed and of low fertility due to low pH. The soils are generally located within cleared woodland, open forest and are dominated by Yellow Podzolic Soils, Yellow Soloths, Tenosols and Red Podzolic Soils. The soil unit is a well to moderately drained soil dependent upon the position vertically within the unit (SLR, 2014). Gateshead Soils are typical of the Newstan Colliery Surface Site only.

Warners Bay Soils are moderately deep to deep Grey and Yellow Podzolic soils and structured loams. The soils are predominantly located on steep slopes and have potential for mass movement. These soils are considered a high erosion hazard which is prone to rill and sheet erosion with a moderate erodibility for non-concentrated flows and a moderate to high erodibility for concentrated flows. They are strongly acidic with low fertility.

Wyong Soils are poorly drained deltic soils of the floodplain and alluvial flats. The soils are predominately deep Yellow Podzolic, Brown Podzolic soils with Soloths and Humus Podzols around the lake edges. The soils are prone to waterlogging and are strongly acidic with low fertility.

3.6 Surface water environment

The Study Area is located within the catchment area of Lake Macquarie. Watercourses traverse the Study Area; however the Study Area encompasses a small proportion of the catchment areas associated with these watercourses. The main creek systems that traverse the Study Area are:

- Stony Creek
- Kilaben Creek
- Stockyard Creek
- Some unnamed creeks and tributaries

LT Creek does not traverse the area of proposed first workings, however it does traverse the NCSS flowing in an easterly direction with the entire site draining to the creek. Newstan's licensed discharge point 1 (LDP001) discharges into LT Creek.

Newstan's other LDPs under EPL 395 are:

- LDP002, which discharges from the Final Pollution Control Dam into LT Creek
- LDP017, which discharges into a tributary of Stony Creek

These LDPs are for emergency use only, with discharges occurring only as a result of heavy rainfall.

The Clean Water Plant (CWP) at NCSS commenced operations in late 2013. The plant employs coagulation, flocculation, sedimentation, filtration and ultra-violet treatment to reduce the concentrations of total suspended solids (TSS) and total (unfiltered) metals before water is discharged to LT Creek via an LDP.

3.7 Groundwater environment

The groundwater sources in the vicinity of the Study Area are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams. They would be classified as 'less productive', in accordance with the NSW Aquifer Interference Policy.

3.7.1 Alluvial water sources

The alluvium forms an unconfined shallow aquifer with groundwater ranging in depth from less than 1 m to about 5 m below ground level (bgl), and aquifer thickness generally less than 15 m. Due to the clay content of the alluvium, yields and beneficial use of this groundwater are generally low. The alluvial groundwater is generally fresh to brackish and slightly acidic.

3.7.2 Porous and fractured rock water sources

The piezometric head within the Permian coal seams tend to reflect the natural topography and the orientation and dip of the seams, with reduced pressures at major surface drainage areas (i.e. Lake Macquarie) and in areas of coal extraction. Where coal seam groundwater has not been depressurised, the groundwater head tends to be in the order of 0 m AHD due to the coastal environment. Recharge of coal seams occurs in areas of seam subcrop.

Packer testing undertaken as part of previous exploration drilling at Newstan indicates that the hydraulic conductivities of the West Borehole and overlying seams are generally in the order of 10^{-8} to 10^{-7} m/s.

Monitoring by Centennial Newstan indicates that the existing workings within the West Borehole Seam currently receive groundwater inflow of approximately 1-2 ML/day. This water is brackish and slightly alkaline, and sodium bicarbonate-chloride dominant. Underground water within the existing workings flows under gravity to underground dams, where it is transferred to the 19 cut through dam and pumped to the Fassifern underground water storage at Newstan Colliery.

The overburden and interseam strata within the Newcastle Coalfield tend to have very low hydraulic conductivities (in the order of 10^{-11} to 10^{-9} m/s), unless joints or fracturing creates a secondary permeability (Pacific Power International, 1997).

3.8 Sensitive receptors

The following sensitive surface and groundwater receptors have been identified:

- GDEs in the vicinity of the Study Area
- Aquatic ecology maintained in local waterbodies, including macroinvertebrate fauna, frogs, macrophytes and algae, fish, semi-aquatic invertebrate species and semi-aquatic mammals

- Waterways of Stony Creek, Kilaben Creek, Stockyard Creek, LT Creek and Lake Macquarie
- Users of surface water and groundwater, including licensed water users and basic landholder rights

Further detail on the existing condition of these sensitive receptors is provided in Section 5.

4. Assessment methodology

4.1 Potential impacts

The objective of the WRIA is to determine the potential impact of the Project on surface water and groundwater environments. The identification of potential impacts enables the development of measures to avoid or mitigate impacts and the provision of the framework of monitoring programs that may be required for the Project. The following potential impacts to surface water and groundwater systems were identified:

- Changes to the local water cycle
- Changes to geomorphological condition of waterways
- Altered surface water and groundwater quality downstream of the Project
- Altered availability of surface and groundwater downstream of the Project

The assessment of these potential impacts was dependent on the findings of the following reports:

- Subsidence predictions and assessments of potential impacts due to the development of first workings in the West Borehole Seam (MSEC 2018)
- Geotechnical report on the expected height of fracturing associated with first workings (Centennial Coal 2018)

MSEC (2018) calculated the maximum predicted vertical subsidence at the surface associated with the development of the proposed first workings to be 11 mm, and noted that vertical subsidence less than 20 mm is generally considered to be insignificant, and unlikely to be measurable using standard surveying techniques. Tensile cracking or compression heaving were not predicted by MSEC (2018) due to the low level of predicted subsidence and the higher depths of cover in the area. The development of the proposed first workings is not predicted to reactivate the existing Awaba workings, and is not expected to change the potential for longer-term subsidence above the Awaba workings (MSEC 2018).

Centennial Coal's geotechnical report on the expected height of fracturing associated with the first workings (Centennial Coal 2018) predicted the proposed first workings to be stable, with any potential caving being confined to the immediate roof. As the interburden thickness between these workings and the flooded Awaba workings is greater than 140 metres, the risk of caving creating a pathway for water from the Awaba workings into the proposed workings was classified as negligible.

Centennial Coal commissioned a peer review of the height of fracturing report, which was undertaken by Dr Ismet Canbulat of the University of New South Wales, Sydney. Canbulat (2018) confirmed that the overall risk associated with fracture connectivity between the proposed workings and overlying Awaba workings is insignificant.

The Centennial Coal height of fracturing report (2018) and the Canbulat (2018) review have been provided as Appendix B.

4.2 Water and salt balance

A site water and salt balance model was developed for Northern Coal Services as part of the Northern Coal Logistics Project (GHD, 2014) to quantify water transfers within the site under existing and approved operational conditions using various rainfall patterns. This model included Newstan Colliery, Mandalong Mine, NCSS, Cooranbong Entry Site and Hawkmount Quarry. A subset of this model was used to assess the impact on the water and salt balance at Newstan Colliery and discharges to LT Creek and Stony Creek as licensed by EPL 395.

At Newstan Colliery, water from site operations and groundwater inflows is recycled and treated at the Clean Water Plant (CWP). Most of this water is discharged via LDP001, but some is reused for site operations. GHD (2014) showed that, under average conditions, approximately seven times more water is discharged via LDP001 than is used in site operations. In net marginal terms, coal mining, handling and processing result in water losses via evaporation and moisture entrained in product and reject coal. Therefore, at Newstan Colliery, higher coal mining, handling or processing rates (within the approved limits) correspond to higher losses and therefore decreased discharges via LDP001.

No increases to coal mining, handling or processing are proposed, only an extension of first workings, which is expected to result in a minor increase in groundwater inflows and a corresponding increase in discharges via LDP001 within the approved daily volume limit as per EPL 395. In order to conservatively estimate the absolute potential impact to discharges via LDP001, the water and salt balance assessment assumes no losses of water due to coal mining, handling or processing. This approach maximises the modelled discharges at LDP001.

The water and salt balance assessment compared the approved conditions with the proposed (MOD 8) conditions to evaluate the potential impacts of the modification.

4.3 Surface water quality

A surface water quality assessment was undertaken to establish the existing conditions in terms of the volume and the quality of the LDP001 discharge. The water quality assessment has been undertaken in accordance with the assessment framework and methodologies outlined by ANZECC (2000). Surface water quality data for LDP001 for the period January 2016 to April 2018 were statistically summarised, and minima, median and maxima values were compared to the EPL discharge limits and the ANZECC (2000) default GVs for lowland rivers in south east Australia.

The potential impact of the Project on the water quality of licensed discharges LDP002 and LDP017 was considered negligible, as both LDPs discharge only in response to heavy rainfall. As such, the water quality of these discharges was not assessed.

4.4 Groundwater environment

4.4.1 Groundwater model

The hydrogeology at Newstan Colliery has been modelled by GHD to predict groundwater inflow into the proposed first workings within the West Borehole Seam (GHD 2018a). Drawdown of groundwater sources has also been predicted by the model.

The hydrogeological model has been developed with reference to the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The purpose of the model is to estimate groundwater seepage into the proposed workings and predict drawdown in groundwater sources. Based on the model objectives, the availability of existing data and the value of the groundwater sources, the model is considered to have a Class 2 level of confidence, as defined under the Guidelines. Class 2 models are considered to be suitable for the prediction of impacts of proposed developments in medium value aquifers.

Hydrogeological domain

The spatial extent of the model to the north and west is defined by the extent of the Newcastle Coal Measures. The eastern extent is defined by Lake Macquarie while the southern extent is defined by the Newstan Colliery Holding Boundary. The groundwater model covers an area of 13.9 km x 19.7 km, divided into grid cells of size 50 m x 50 m.

The model has been divided into seven layers:

- Alluvium and outcropping areas (Layer 1)
- Triassic sandstone and conglomerate (Layer 2)
- Great Northern seam (Layer 3)
- Interbedded Permian strata (Layer 4)
- Interbedded Permian strata containing potentially fractured strata (Layer 5)
- West Borehole Seam (Layer 6)
- Waratah Sandstone (Layer 7)

A fractured material zone has been established in model Layer 5, and covers the strata located above the existing longwalls at Newstan Colliery as well as West Wallsend Colliery to the north. This zone has been used to represent increases in horizontal and vertical hydraulic conductivity that develop due to continuous and discontinuous cracking above longwalls and secondary workings. Continuous and discontinuous cracking is not expected to develop above the proposed first workings and therefore the fractured material zone does not extend above this area of mining. In addition, there is no increased hydraulic conductivity in the strata between the existing Awaba Colliery void and the proposed workings.

Model software

Numerical modelling was undertaken using the MODFLOW-NWT solver with the Upstream Weighting flow package. MODFLOW-NWT is a version of MODFLOW 2005 that provides a different formulation of the groundwater flow equation (Newton formulation) designed to solve models that are non-linear due to unconfined cells or non-linear boundary conditions. MODFLOW 2005 is a three-dimensional finite difference groundwater flow model from the United States Geological Survey (USGS) and is one of the industry standard codes for numerical groundwater modelling. The model was built using the Groundwater Modelling System version 10 (GMS) graphical user interface. GMS is a three-dimensional user interface that supports the MODFLOW groundwater modelling code.

Calibration

The hydrogeological model was initially run under steady state conditions to ensure that the groundwater levels and flow direction were realistic. Rainfall recharge and the hydraulic conductivities of each hydrogeological unit were adjusted as part of this process.

Modelled steady state groundwater levels were then used as the starting head levels for the transient model. The model was calibrated under transient conditions using groundwater level data as well as observed groundwater inflow data into the existing Newstan workings within the West Borehole Seam. Storage properties as well as the hydraulic conductivity of the fractured strata above existing workings were adjusted as part of the transient calibration. The transient model was run with annual stress periods from 2012 to 2018 for transient calibration.

Predictive simulations

A basecase was run to simulate existing and approved conditions. Under this scenario, the existing West Borehole Seam workings remained dewatered until mid-2020 when the existing approval expires. No additional first workings within the Study Area were included in this scenario.

The proposed scenario included mining of the additional first workings area between January 2020 and July 2021. In addition, the existing West Borehole Seam workings remained dewatered for an additional year (until July 2021). The model was run at monthly stress periods throughout 2020 and 2021 and at annual stress periods for other years. Based on advice from Centennial Newstan, first workings were modelled to progress at 310 m per month with an overall development width of 168 m.

Both scenarios were run to the end of year 2029 to cover a period of groundwater recovery.

Model assumptions and limitations

Since the hydrogeological model is based on limited data and a simplified conceptualisation of the hydrogeological system, it is necessary to make assumptions. Assumptions and limitations are outlined as follows:

- The water level of Lake Macquarie (a General Head Boundary within the model) is constant since tidal variations are likely to have little effect on inflows into the deep underground workings or on shallow groundwater levels in the vicinity of the Study Area.
- Material properties are homogeneous throughout each hydrogeological unit, with the exception of the fractured zone. Material properties do not change with the degree of saturation.
- Since groundwater utilisation in the area is low with relatively few registered bores, it is reasonable to assume that groundwater extractions from registered bores within the hydrogeological domain are negligible and are assumed to have a negligible effect on model results.
- No direct flow pathways will develop between the proposed workings and the ground surface, Awaba Colliery workings or alluvium.
- Horizontal hydraulic conductivity is ten times the vertical hydraulic conductivity for each hydrogeological unit. This is a typical relationship for essentially horizontal strata.
- The West Wallsend Colliery workings remained drained until the end of 2016, after which time the drains (model element representing a dewatering activity) were turned off.

Impact assessment

Predicted groundwater drawdown was assessed against the impact criteria from the NSW Aquifer Interference Policy (defined in Section 2.2.2). As part of this assessment, it was necessary to identify registered groundwater bore users and GDEs.

Groundwater bore information was obtained using the Bureau of Meteorology 'Australian Groundwater Explorer' (BoM 2018) on 29 June 2018. The map was searched for all registered groundwater bores within a five kilometre radius of the approximate centre of the proposed first workings.

The potential GDEs in the vicinity of the study area have been mapped by Bureau of Meteorology in the Groundwater Dependent Ecosystem Atlas (BOM 2017). They include ecosystems that rely on the surface presence of groundwater and ecosystems that rely on the subsurface presence of groundwater.

4.4.2 Groundwater quality

Existing water quality data for groundwater sampled in the West Borehole Seam at cut through 19 have been reviewed and statistically summarised to provide a range of likely water quality that will be encountered in the proposed first workings. The approximate location of the cut through 19 sampling point is shown in Figure 5-3.

Based on the likely interaction between alluvial groundwater and GDEs within the Study Area, it is considered that the beneficial use category (or environmental value) of the alluvial groundwater is 'aquatic ecosystem' protection.

4.5 Stream health

Stream health of LT Creek is assessed annually based on biannual aquatic ecology monitoring and annual ecotoxicology monitoring. These studies have been considered in the context of the potential impacts of the Project on the water quality and volume of the LDP001 discharge.

A detailed geomorphology assessment of the water courses in the Study Area was undertaken by GHD (2013). This study established the existing geomorphic conditions of the watercourses potentially impacted by the Project. These findings have been used in Section 5.6.3. The assessment of the potential impacts of the project to watercourse stability was based on the findings from GHD (2013) and the changes to licensed discharges predicted by the water and salt balance modelling. As MSEC (2018) predicted that there would be no measureable subsidence as a result of the Project, the potential impacts of subsidence on watercourse stability have not been assessed in this WRIA.

4.6 Downstream surface water users

The potential impacts of the project on licensed surface water users and basic landholder rights under the WM Act were assessed by identifying the downstream users along the freshwater reach of LT Creek. All lots in this area were searched in the NSW Water Register (WaterNSW 2018).

5. Existing and approved conditions

5.1 Site operations

Newstan Colliery began mining operations in 1887. In 2014, the Northern Coal Logistics project was approved, which effectively transferred the management of the Newstan Colliery surface site (NCSS) to Northern Coal Services. Therefore, Newstan Colliery now refers to the underground mine in the upper seams (Great Northern and Fassifern seams) and the lower seams (West Borehole, Borehole, Young Wallsend and Yard seams) within the consolidated consent boundary of DA 73 11 98.

Newstan Colliery is currently in care and maintenance, with approval to extract up to 4 million tonnes per annum of ROM coal until 6 July 2020.

NCSS currently receives, handles, processes and transfers coal from Mandalong Mine for domestic use at Vales Point Power Station and export via rail. NCSS is also approved to receive coal from Newstan Colliery. The facilities at NCSS include the CHP, CPP, stockpile area, rail loop, haulage roads, NREA and SREA and water management structures.

5.2 Existing water management

Newstan Colliery's main water management features are the Fassifern Underground storage and West Borehole seam workings. The Fassifern Underground Storage is the void formed by previous mining activity in the Fassifern and Great Northern Seam at Newstan Colliery. The workings in the West Borehole seam are in care and maintenance.

The West Borehole seam workings receive groundwater inflows and can be supplied with water for underground operations from NCSS. Water is collected in sumps and pumped to the Fassifern Underground Storage.

The Fassifern Underground Storage receives inflows as a result of infiltration from the surface catchment, groundwater inflows and transfers from NCSS. Water levels in the storage are managed by transferring water to NCSS. During wet periods when water within the Fassifern Underground Storage rises above 16.6 m below ground level (6.4 m AHD), the storage discharges water by gravity through two 600 mm diameter pipes into Stony Creek via Newstan LDP017.

A water management and monitoring station at Newstan LDP017 was commissioned in 2013 to allow for emergency discharges in a controlled manner in order to ensure the safety of personnel in the underground workings at Newstan Colliery. The water management and monitoring station allows for:

- The control of the instances of discharge via the pipeline.
- The continuous monitoring of discharge water quality.
- In the event of poor water quality, discharges can be contained within the station and treated or extracted as required in a controlled manner.

5.2.1 Interaction with Newstan Colliery surface site

Clean and dirty surface water at NCSS is managed by Northern Coal Services. Clean water is diverted around NCSS by a series of clean water diversions, while dirty water is captured and managed in a number of water storages to minimise the potential of dirty water discharges to the surrounding environment. NCSS manages potable water and waste water for the workforce of Newstan Colliery and Northern Coal Services.

Dirty water is transferred from various surface water storages at NCSS to Newstan Colliery's Fassifern Underground Storage for temporary storage and management. NCSS can also provide water to Newstan Colliery for underground mining operations.

Water levels in Newstan Colliery's Fassifern Underground Storage are managed by transferring water to NCSS's Clean Water Plant, which commenced operation at the NCSS in late 2013. The Clean Water Plant employs coagulation, flocculation, sedimentation, filtration and ultra-violet treatment to reduce the concentrations of total suspended solids (TSS) and metals in water that was previously transferred directly from the Fassifern Underground Storage to Newstan LDP001. Water treated by the Clean Water Plant is either used to supply mining processes and the CPP, or is discharged through Newstan LDP001.

5.2.2 Environment Protection Licence

As discussed in Section 2.1.3, EPLs are issued by the EPA under the POEO Act. EPL 395 includes both volumetric and concentration limits for the discharge of water off-site. The existing LDPs for EPL 395 include:

- LDP001 – Discharges into the upper reaches of the northern arm of LT Creek
- LDP002 – Discharges into the upper reaches of the northern arm of LT Creek
- LDP017 – Discharges into a tributary of Stony Creek

As part of the Northern Coal Logistics project, it was proposed to establish LDP003 at the outlet of the Clean Water Dam within the SREA at the Newstan Colliery Surface Site. Overflows from the Clean Water Dam are directed into the southern arm of LT Creek and are expected to occur infrequently as a result of heavy rainfall.

5.2.3 Historical pumping to Awaba underground workings

Awaba Colliery is a former underground coal mine operation owned by Centennial Newstan. Bord and pillar mining operations commenced at Awaba Colliery in 1947 and coal production ceased in March 2012. Awaba mine is now closed with all coal reserves exhausted. The mine is sealed and there is no access to the underground workings, which have become flooded following the cessation of mine dewatering.

There is existing pumping infrastructure linking the underground storages at Newstan and Awaba via an area within the West Borehole Seam underground workings known as the 80 cut through. This infrastructure was previously used to transfer water from Newstan to Awaba. Water from 80 cut through was pumped to the surface via a borehole and then along a 200 mm surface pipeline to the Awaba surface site. This pipeline was reported to have a length of approximately 1 km and a typical operating flow rate of 40 L/s (3.4 ML/day). This pipeline is now disused and the associated pump has been removed. Approval for this transfer has also since been removed from EPL 395.

5.3 Water and salt balance

The water and salt balance at Newstan Colliery was updated for existing conditions. Annual totals are reported for year ending 30 June. The annual water balance is summarised in Table 5-1 and Figure 5-1. As shown in Figure 5-1, groundwater inflow into underground workings is divided into inflows into the West Borehole seam workings and all other groundwater inflows.

Annual salt transfers are summarised in Table 5-2 and Figure 5-2. The forecast average annual discharges via EPL 395 are summarised in Table 5-3.

Table 5-1 Forecast annual average water balance – existing conditions

Water management element	Annual average flow Existing conditions (2018) (ML/year)
INPUTS	
Groundwater inflows into underground workings (West Borehole seam and Fassifern underground)	941
Surface infiltration into underground workings (Fassifern underground)	1160
Transfers from NCSS	671
TOTAL INPUTS	**2772**
OUTPUTS	
Transfers to NCSS (via Fassifern underground)	2747
Discharge to Stony Creek outlet (LDP017)	23
TOTAL OUTPUTS	**2770**
CHANGE IN STORAGE	
Underground water storages	2
TOTAL CHANGE IN STORAGE	**2**
BALANCE	
Inputs – outputs – change in storage	0

Table 5-2 Forecast annual average salt balance – existing conditions

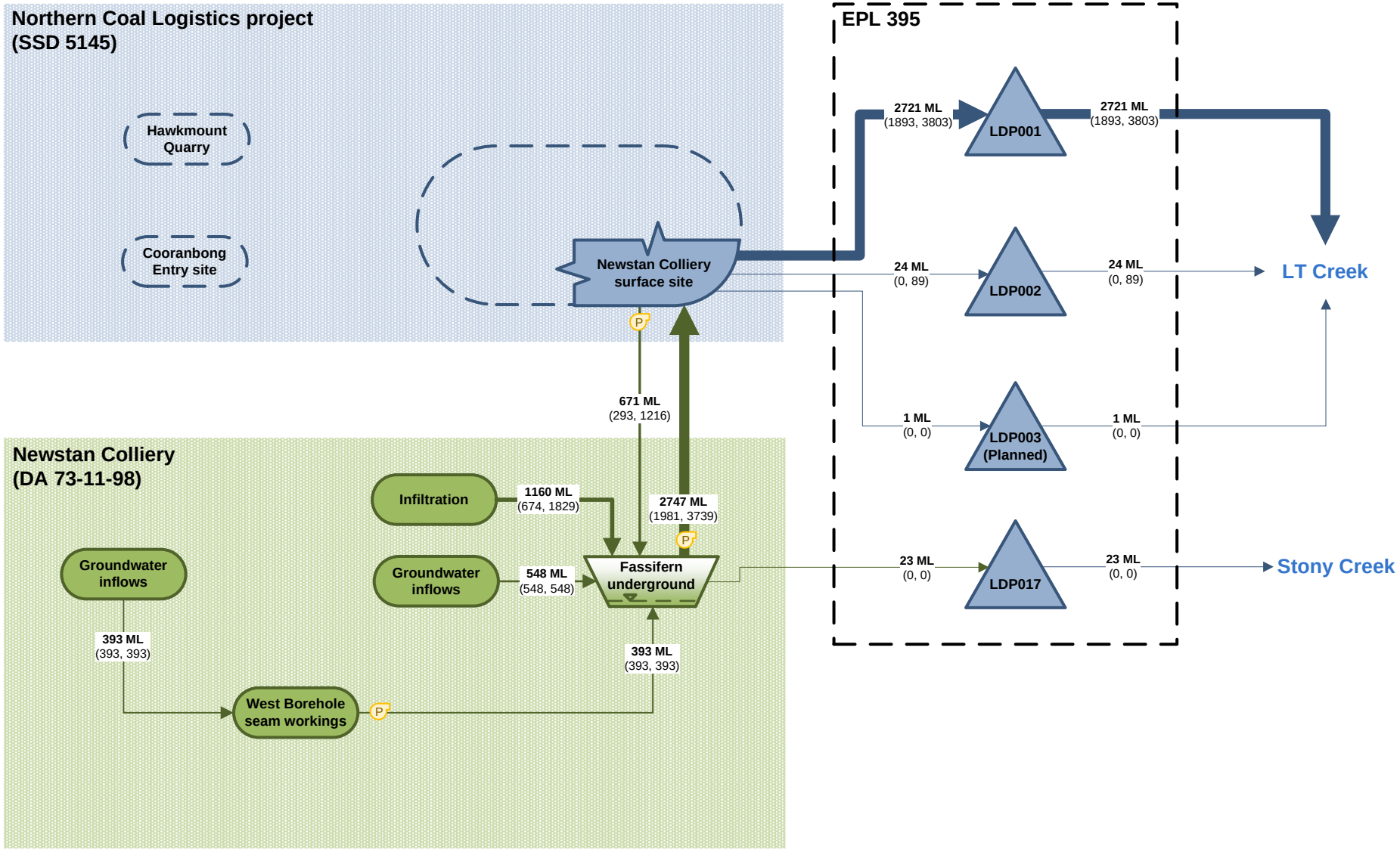
Water management element	Annual average salt flux Existing conditions (2018) (tonne/year)
INPUTS	
Groundwater inflows into underground workings	1833
Surface infiltration into underground workings	1944
Transfers from NCSS	301
TOTAL INPUTS	**4078**
OUTPUTS	
Transfers to NCSS	4054
Discharge to Stony Creek outlet (LDP017)	31
TOTAL OUTPUTS	**4085**
CHANGE IN STORAGE	
Underground water storages	-7
TOTAL CHANGE IN STORAGE	**-7**
BALANCE	
Inputs – outputs – change in storage	0

Table 5-1 and Table 5-2 show that the major inflows to the water and salt balance at Newstan Colliery are by the groundwater inflows and surface infiltration into the underground workings. The major outflow is transfers to the NCSS for discharge via LDP001.

Table 5-3 Forecast EPL 395 discharges – existing conditions

EPL 395 discharges	Annual average flow Existing conditions (2018) (ML/year)	Annual average salt flux Existing conditions (2018) (tonne/year)	Annual probability of discharge
LDP001	2721	3990	100%
LDP002	24	12	45%
LDP003 (Planned)	1	0	10%
LDP017	23	31	10%

Table 5-3 shows that discharges from LDP001 occur frequently and make up almost all discharges via EPL 395. Discharges from LDP002, LDP003 (planned) and LDP017 are forecast to occur infrequently and, in terms of average magnitude, be small compared to LDP001.



Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) Mean (10^{th} percentile, 90^{th} percentile)

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NEWSTAN COLLIERY MOD8
WATER RESOURCES IMPACT ASSESSMENT

WATER MANAGEMENT SCHEMATIC ANNUAL WATER TRANSFERS EXISTING CONDITIONS (2019)

Project No. 2219545
Revision No. 0
Date 26/07/2018

FIGURE 5-1

Created by: Tyler Tinkler

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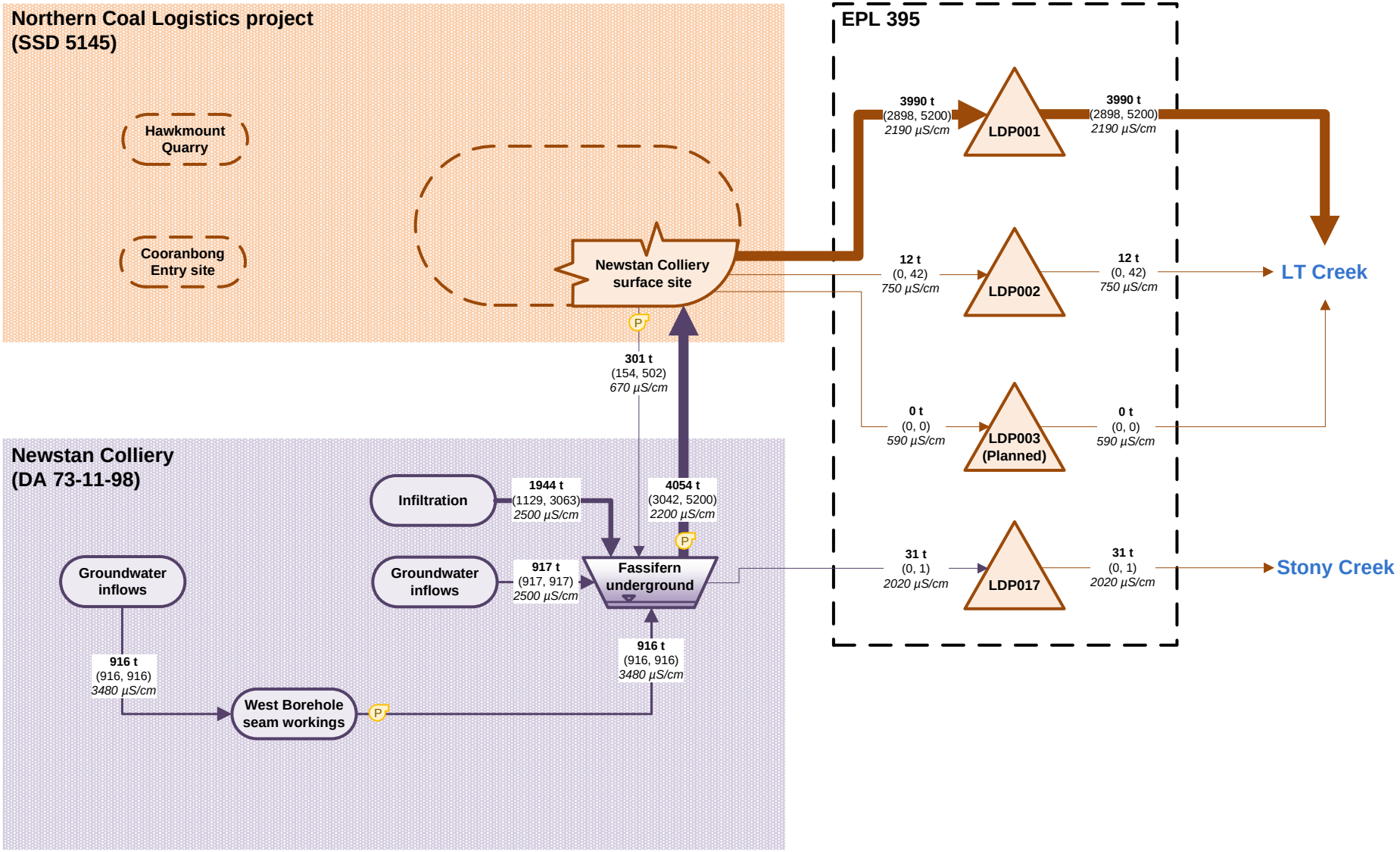

Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) Mean (10^{th} percentile, 90^{th} percentile)

CENTENNIAL NEWSTAN PTY LTD
NEWSTAN COLLIERY MOD8
WATER RESOURCES IMPACT ASSESSMENT

WATER MANAGEMENT SCHEMATIC ANNUAL SALT TRANSFERS EXISTING CONDITIONS (2019)

Project No. 2219545
Revision No. 0
Date 26/07/2018

FIGURE 5-2

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5.4 Surface water environment

A statistical summary of the water quality results for LDP001 between January 2016 and April 2018 is provided in Table 5-4. Median values for water quality parameters were all within the applicable EPL limits. Maximum values for EC, pH, TSS, bicarbonate alkalinity, nitrate and nitrite, and total nitrogen exceeded the relevant EPL limits, or the ANZECC (2000) GV where no EPL limit applies. For pH and EC, it is noted that these results are measured in situ, and are interpreted to inform water management decisions at NCSS, such as to cease discharges from LDP001 until such a time that the results can be confirmed by laboratory measurement, or further treatment allows discharge of the water under the conditions of EPL 395. The exceedances for other parameters were recorded in 2016 and were reported in the annual return provided to the EPA on 27 February 2017. The details for EPL 395 available on the POEO public register (available at: https://www.epa.nsw.gov.au/licensing-and-regulation/public-registers/about-prpoeo) identify that the appropriate actions were taken by the licensee (Centennial Newstan).

The summary of metals data in Table 5-4 indicates that there have been no potentially ecotoxic metal concentrations observed in the LDP001 discharge between January 2016 and April 2018. Similarly, no potentially ecotoxic ammonia concentrations were observed during this period. Nutrient concentrations in the discharge are generally low, though an elevated nitrite and nitrate concentration was observed in February 2016. This concentration exceeded the ANZECC (2000) GV for nitrite and nitrate as chemical stressors, however considering the substantial algal and macrophyte present in the By-Wash dam, which receives the LDP001 discharge, it is likely that these nutrients were readily absorbed, and did not result in eutrophication in LT Creek.

Table 5-4 Statistical summary of LDP001 water quality, January 2016 to April 2018

Analyte	Unit	LOR	Count	Median	Min	Max	EPL limit	ANZECC (2000) GV
Physicochemical parameters								
EC	µS/cm	1	145	2137	1.838	**3370**	3250	2200
pH	pH unit	0.01	151	8.25	6.84	**8.74**	6.5-8.5	6.5-8.0
TSS	mg/L	1	143	5	1	**81**	50	50
Turbidity	NTU	0.1	75	0.3	0.1	2.3	NA	50
Hardness as $CaCO_3$	mg/L	1	61	116	64.2	177	NA	NA
Major ions								
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	83	595	210	**750**	711	NA
Carbonate Alkalinity as $CaCO_3$	mg/L	1	51	5	1	74	NA	NA
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	51	1	1	5	NA	NA
Total Alkalinity as $CaCO_3$	mg/L	1	52	597.5	210	750	NA	NA
Chloride	mg/L	1	63	359	130	635	NA	NA
Sulfate as SO_4	mg/L	1	63	93	25	135	NA	NA
Calcium	mg/L	1	63	30	15	48	NA	NA
Magnesium	mg/L	1	63	11	5	17	NA	NA

Analyte	Unit	LOR	Count	Median	Min	Max	EPL limit	ANZECC (2000) GV
Sodium	mg/L	1	63	499	219	766	NA	NA
Potassium	mg/L	1	63	4	2	5.8	NA	NA
Dissolved metals								
Aluminium	mg/L	0.01	63	<0.01	<0.01	0.01	0.15	0.055
Antimony	mg/L	0.001	63	<0.001	<0.001	0.002	NA	NA
Arsenic	mg/L	0.001	63	<0.001	<0.001	0.003	NA	0.013
Barium	mg/L	0.001	63	0.09	0.058	0.174	0.25	NA
Beryillium	mg/L	0.001	62	<0.001	<0.001	<0.001	NA	NA
Boron	mg/L	0.001	63	0.2	0.016	0.39	1.3	0.37
Cadmium	mg/L	0.0001	63	<0.0001	<0.0001	0.0002	0.0008	0.0002
Chromium	mg/L	0.001	63	<0.001	<0.001	0.001	NA	0.001
Cobalt	mg/L	0.001	63	<0.001	<0.001	0.001	NA	NA
Copper	mg/L	0.001	63	0.0018	<0.001	0.004	0.005	0.0014
Iron	mg/L	0.05	63	<0.05	<0.05	5	NA	NA
Lead	mg/L	0.001	63	0.001	<0.001	0.002	0.038	0.0034
Lithium	mg/L	0.001	63	0.134	0.005	0.191	0.4	NA
Manganese	mg/L	0.001	63	<0.001	<0.001	0.002	NA	1.9
Mercury	mg/L	0.0001	63	<0.0001	<0.0001	<0.0001	0.0006	0.0006
Molybdenum	mg/L	0.001	63	0.021	0.004	0.0369	0.04	NA
Nickel	mg/L	0.001	63	0.007	0.004	0.0116	0.0425	0.011
Selenium	mg/L	0.01	63	<0.01	<0.01	0.0013	0.011	0.011
Silver	mg/L	0.001	63	<0.001	<0.001	<0.001	NA	NA
Tin	mg/L	0.001	63	<0.001	<0.001	<0.001	NA	NA
Titanium	mg/L	0.01	63	<0.01	<0.01	0.005	NA	NA
Vanadium	mg/L	0.01	63	<0.01	<0.01	<0.01	NA	NA
Zinc	mg/L	0.005	63	<0.005	<0.005	0.022	0.04	0.008
Nutrients								
Ammonia as N	mg/L	0.01	44	<0.01	<0.01	0.06	NA	0.9
Nitrite and nitrate as N	mg/L	0.01	61	0.16	0.02	**5.42**	NA	0.04
TKN as N	mg/L	0.1	63	<0.01	<0.01	0.8	2.6	NA
Total nitrogen as N	mg/L	0.1	63	0.2	<0.01	**6.0**	2.7	0.5
Phosphorous as P	mg/L	0.01	63	<0.01	<0.01	0.017	0.41	0.05
Other parameters								
Oil & Grease	mg/L	1	43	<1	<1	3	6	NA
Cyanide	mg/L	0.004	16	<1	<1	<1	NA	NA
Fluoride	mg/L	0.1	16	0.5	0.4	0.7	NA	NA

Note: **Bold yellow** highlight indicates that the value exceeds the EPL 395 concentrations limits for LDP001, or, if there is no EPL limit for the parameter, the ANZECC (2000) GV, if applicable.

5.5 Groundwater environment

The groundwater monitoring program is outlined in this section. Details regarding groundwater receptors are included in Section 5.8.

5.5.1 Groundwater levels

A groundwater monitoring network has been progressively established at Newstan since 2005 and consists of monitoring bores installed in alluvium, overburden rock and coal seam strata to monitor potential impacts of longwall mining on groundwater sources and/or provide baseline data for the assessment of impacts from future workings. The bores are generally monitored monthly or quarterly for groundwater levels and groundwater quality, although some alluvial bores also contain water level loggers. Coal seam monitoring previously consisted of vibrating wire piezometers (VWPs).

Existing monitoring locations are shown in Figure 5-3. Hydrographs are presented in Appendix C. Groundwater flow in the region is generally to the south-east towards Lake Macquarie.

Alluvial monitoring is undertaken within Lords Creek, Kilaben Creek, Stockyard Creek and Stony Creek alluvium. Alluvial groundwater levels fluctuate with rainfall and have not been impacted by previous mining at Newstan.

Note that the coal seam VWPs have not been in operation since October 2009. The piezometric head data collected prior to this time indicates that the head of groundwater in the West Borehole Seam is in the order of 0 – 20 m AHD.

5.5.2 Groundwater inflows

Based on Centennial Newstan's water transfer data, average groundwater inflow into the existing Newstan workings within the West Borehole Seam was calculated to be approximately 1.4 ML/day during 2013, reducing over time to approximately 0.7 ML/day in 2018. This is based on the assumption that the workings are fully dewatered.

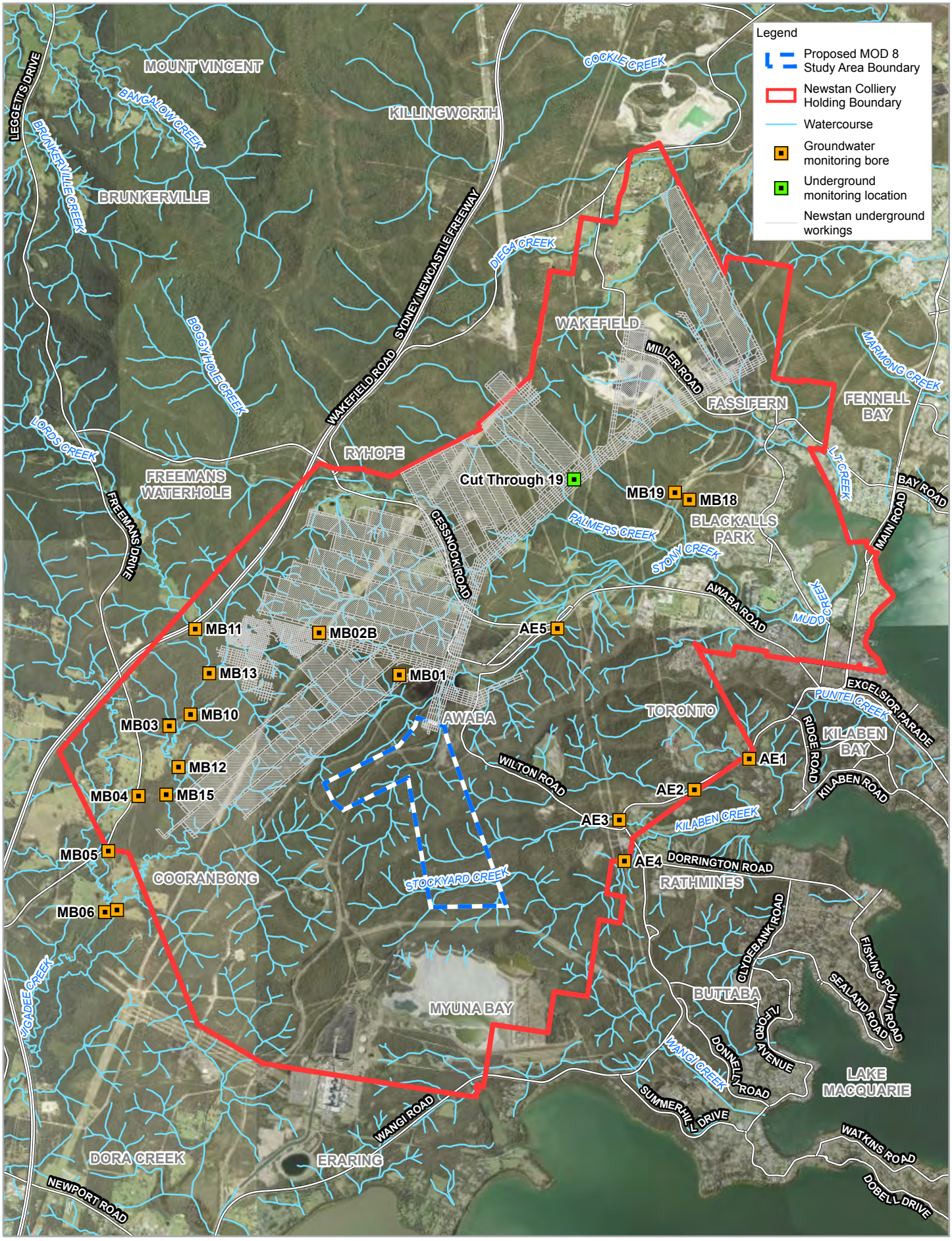
The groundwater model predicts existing groundwater inflows into the Newstan workings to be approximately 1.1 ML/day.

Note that this is separate to groundwater inflows into the Fassifern underground storage, which are predicted to be 548 ML/year on average as shown in Figure 5-1.

5.5.3 Groundwater quality

A statistical summary of the water quality results for the groundwater in the West Borehole Seam at the 19 cut through dam is provided in Table 5-5. The median, minimum and maximum values for water quality parameters have been compared to the EPL 395 limits for LDP001 and the ANZECC (2000) GVs as dewatering of the West Borehole seam supplies water to the CWP. The median values for EC, TSS and bicarbonate alkalinity exceed the EPL limits for LDP001. For the case of EC, this indicates that other influent water to the CWP is of lower salinity, and dilutes the water pumped from the West Borehole seam, as none of the treatment methods employed at the CWP result in a significant reduction in salinity. The effect of dilution likely also explains the lower alkalinity of the LDP001 discharge compared to the median result presented in Table 5-5.

Median concentrations of barium, chromium, molybdenum, and nitrite and nitrate in groundwater at 19 cut through also exceeded the EPL/ANZECC (2000) GVs, though it is noted that only one sample was analysed for each of these parameters. Maximum observed concentrations of aluminium, copper, zinc and oil and grease exceeded the respective EPL concentration limits.



Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Existing groundwater monitoring locations

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Figure 5-3

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Data source: NSWNRATLAS: Registered Bores, 2018; Centennial: Consent boundary, 2016; LPI: DTDB, 2016; sixmaps/LPI_Imagery_Best: © Land and Property Information (a division of the Department of Finance and Services) 2012. Created by: tmorton

Table 5-5 Statistical summary of water quality in the West Borehole seam at 19 cut through dam, January 2013 to December 2014

Analyte	Unit	LOR	Count	Median	Min	Max	EPL	ANZECC (2000) GV
Physicochemical parameters								
EC	µS/cm	1	19	**3480**	3030	**3700**	3250	2200
pH	pH unit	0.01	19	8.32	8.16	8.44	6.5-8.5	6.5-8.0
TSS	mg/L	1	19	**83**	7	**1800**	50	50
Turbidity	NTU	0.1	19	**79.1**	6.5	**1150**	NA	50
Hardness as $CaCO_3$	mg/L	1	1	39	39	39	NA	NA
Major ions								
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	19	**789**	685	**917**	711	NA
Carbonate Alkalinity as $CaCO_3$	mg/L	1	19	22	1	45	NA	NA
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	19	1	1	1	NA	NA
Total Alkalinity as $CaCO_3$	mg/L	1	19	811	716	956	NA	NA
Chloride	mg/L	1	19	618	482	682	NA	NA
Sulfate as SO_4	mg/L	1	19	12	0	76	NA	NA
Calcium	mg/L	1	19	10	7	16	NA	NA
Magnesium	mg/L	1	19	4	3	5	NA	NA
Potassium	mg/L	1	19	6	4	8	NA	NA
Sodium	mg/L	1	19	774	588	896	NA	NA
Dissolved metals								
Aluminium	mg/L	0.01	19	<0.01	<0.01	**0.32**	0.15	0.055
Antimony	mg/L	0.001	1	0.001	0.001	0.001	NA	NA
Arsenic	mg/L	0.001	19	0.002	0.001	0.004	NA	0.013
Barium	mg/L	0.001	1	**0.308**	**0.308**	**0.308**	0.25	NA
Beryllium	mg/L	0.001	1	<0.001	<0.001	<0.001	NA	NA
Boron	mg/L	0.001	19	0.35	0.24	0.46	1.3	0.37
Cadmium	mg/L	0.0001	1	<0.0001	<0.0001	<0.0001	0.0008	0.0002
Chromium	mg/L	0.001	1	**0.004**	**0.004**	**0.004**	NA	0.001
Cobalt	mg/L	0.001	1	<0.001	<0.001	<0.001	NA	NA
Copper	mg/L	0.001	19	0.001	<0.001	**0.007**	0.005	0.0014
Iron	mg/L	0.05	19	<0.05	<0.05	0.52	NA	NA
Lead	mg/L	0.001	19	<0.001	<0.001	<0.001	0.038	0.0034
Lithium	mg/L	0.001	1	0.32	0.32	0.32	0.4	NA
Manganese	mg/L	0.001	19	0.007	<0.001	0.024	NA	1.9
Mercury	mg/L	0.0001	1	<0.0001	<0.0001	<0.0001	0.0006	0.0006
Molybdenum	mg/L	0.001	1	**0.05**	**0.05**	**0.05**	0.04	NA
Nickel	mg/L	0.001	1	0.012	0.012	0.012	0.0425	0.011
Selenium	mg/L	0.01	1	<0.01	<0.01	<0.01	0.011	0.011
Silver	mg/L	0.001	1	<0.001	<0.001	<0.001	NA	NA

Analyte	Unit	LOR	Count	Median	Min	Max	EPL	ANZECC (2000) GV
Tin	mg/L	0.001	1	<0.001	<0.001	<0.001	NA	NA
Titanium	mg/L	0.01	1	<0.01	<0.01	<0.01	NA	NA
Vanadium	mg/L	0.01	1	<0.01	<0.01	<0.01	NA	NA
Zinc	mg/L	0.005	19	0.022	<0.005	**0.116**	0.04	0.008
Nutrients								
Nitrite and nitrate as N	mg/L	0.01	1	**0.9**	**0.9**	**0.9**	NA	0.04
TKN as N	mg/L	0.1	1	0.4	0.4	0.4	2.6	NA
Total nitrogen as N	mg/L	0.1	1	1.3	1.3	1.3	2.7	0.5
Phosphorous as P	mg/L	0.01	1	0.03	0.03	0.03	0.41	0.05
Other parameters								
Oil & Grease	mg/L	1	20	<1	<1	**21**	6	NA

Note: Bold yellow highlight indicates that the value exceeds the EPL 395 concentrations limits for LDP001, or, if there is no EPL limit for the parameter, the ANZECC (2000) GV, if applicable.

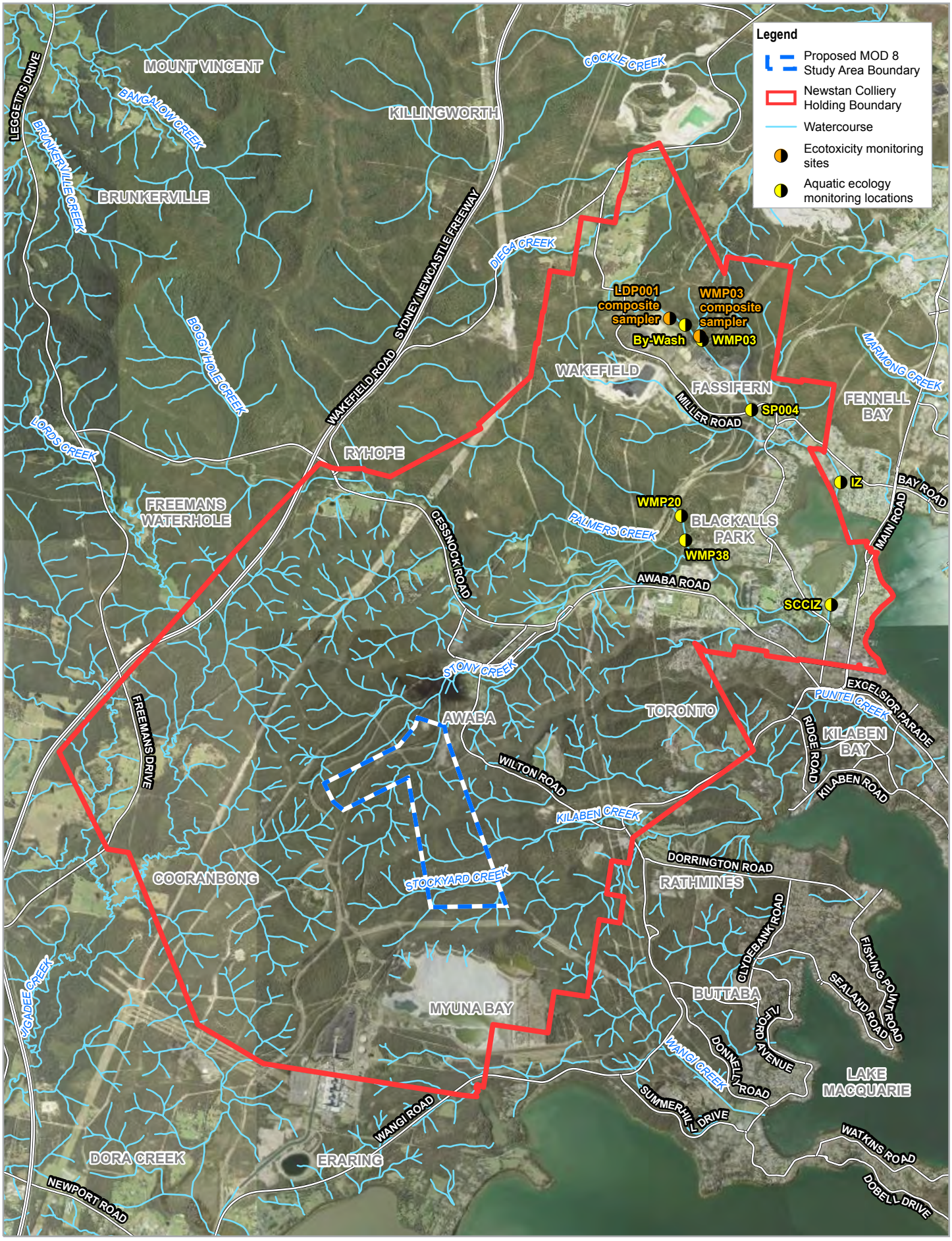
Alluvial groundwater quality monitoring indicates that historical mining activities have not impacted groundwater quality. Based on available monitoring data, no change or lowering of the beneficial use category is evident over the period 2006 to 2009 when longwall panels were being developed in the vicinity of these bores. It is considered that in most cases the variability in pH and EC is the result of rainfall and natural conditions.

5.6 Stream health

5.6.1 Aquatic ecology of LT Creek and Stony Creek

Instream aquatic ecology monitoring of LT Creek and Stony Creek is undertaken biannually as part of the Newstan aquatic ecology monitoring program. Results from this program were most recently reported on in GHD (2018b). The monitoring program assesses the stream health of LT Creek and Stony Creek through the sampling of aquatic macroinvertebrates at five freshwater sites and three estuarine sites. The existing condition of the aquatic ecology of LT Creek and Stony Creek based on this monitoring program is summarised below. The locations of the sites sampled as part of the Newstan aquatic ecology monitoring program are provided in Figure 5-4.

Results from recent sampling events have shown some influence of the LDP001 discharge on the community composition of freshwater macroinvertebrates in LT Creek, but no evidence of impacts to the sensitivity and diversity of macroinvertebrates found in LT Creek. Freshwater sites on Stony Creek have been dry during most recent aquatic ecology monitoring events. Estuarine macroinvertebrate samples have shown no patterns to suggest impacts due to discharges from Newstan mine.



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Metres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

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Stream health monitoring locations

Figure 5-4

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Data source: Centennial: Consent boundary, 2016; LPI: DTDB, 2016; sixmaps/LPI_Imagery_Best: © DFSI Spatial Services 2017. Created by: tmorton

5.6.2 Ecotoxicity of LDP001

Ecotoxicity has been assessed in accordance with the EPL 395 for the LDP001 discharge and for the receiving environment at WMP03 (refer Figure 5-4). A summary of the chronic and acute toxicity of the LDP001 discharge, expressed as concentration of the discharge where 50% of test organisms exhibited an inhibition effect (EC50) or lethal effect (LC50), is shown in Figure 5-5.

In 2015, the ecotoxicity of the LDP001 discharge was assessed using a suite of 5 bioassays which used cladoceran, microalgae, shrimp, duckweed and fish species. Screening tests were undertaken using the WMP03 sample using the cladoceran species with the cladoceran species. No chronic or acute toxicity was observed for any of the test species for both the LDP001 and WMP03 samples.

In 2016, the ecotoxicity assessment was undertaken using the cladoceran and microalga bioassays. No acute toxicity was observed, though chronic toxicity was observed for both the cladoceran and microalga, for both the LDP001 and WDP03 samples. The EPL limit for toxicity was not exceeded, as the chronic EC50 for the cladoceran was higher than 50 percent of the LDP001 discharge by volume.

In 2017 the LDP001 discharge showed no acute toxicity and low chronic toxicity, which was observed only in the undiluted sample. The WMP03 sample was not acutely or chronically toxic.

Overall, the toxicity of the LDP001 discharge has been low since the commissioning of the CWP in December 2013, with no acute effects observed in any of the samples tested to date. With the exception of the 2016 assessment, chronic toxicity has been negligible. The chronic toxicity observed in 2016 did not exceed EPL 365 condition L5.1 for toxicity to the cladoceran.

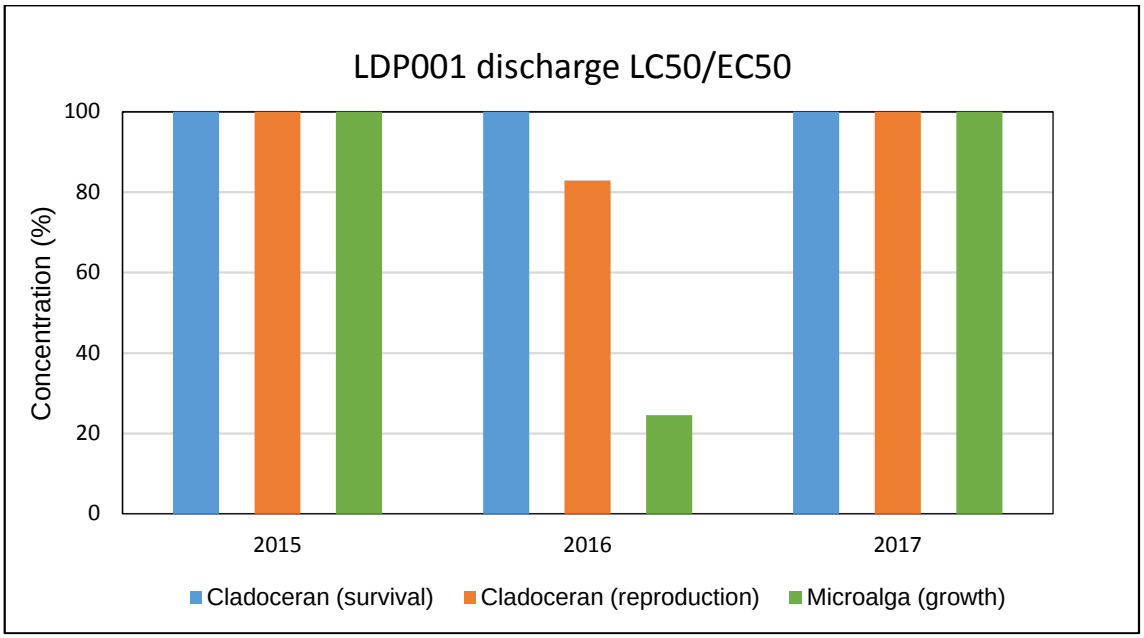


Figure 5-5 LDP001 discharge toxicity, 2015-2017 (higher LC50/EC50 reflect lower toxicity)

5.6.3 Watercourse stability

The majority of LT Creek was found to be in good geomorphic condition by GHD (2013). The creek is generally well vegetated and stable, although it is highly modified in places due to road and rail crossings and past mining disturbances. There were no watercourse stability threatening processes identified by GHD (2013) in LT Creek, with the exception of small (less than 0.5 m) head cuts in a reach of the creek downstream of Miller Road.

Newstan Colliery's LDP017 discharges into an unnamed tributary of Stony Creek. This tributary has a generally well vegetated channel set within alluvial sediments with a relatively low gradient of 0.0005 m/m. Existing instabilities are limited to localised sections of bank erosion that may be exacerbated by significant and prolonged discharge flows. This tributary travels approximately 600 metres before it flows into the main channel of Stony Creek, at which location the creek is tidal.

5.7 Downstream water users

The residential lots which abut the downstream freshwater reach of LT Creek were identified and have been presented in Table 5-6. The search of the NSW Water Register indicated that there were no WALs for surface water use downstream of the project.

Table 5-6 Lots abutting the downstream freshwater reach of LT Creek

Development Plan (DP)	Lot	Existing water supply works approvals under the WM Act
592911	56	None
755207	257	None
	256	None
	254	None
1165945	100	None
1139078	259	None

5.8 Groundwater receptors

5.8.1 Groundwater bores

The search for registered groundwater bores indicated 14 bores within a five kilometre radius of the approximate centre of the proposed first workings. The available information for each of these bores is presented in Table 5-7. The location of each of these bores is shown in Figure 5-6.

Table 5-7 Registered groundwater bores within 5 km of the study area

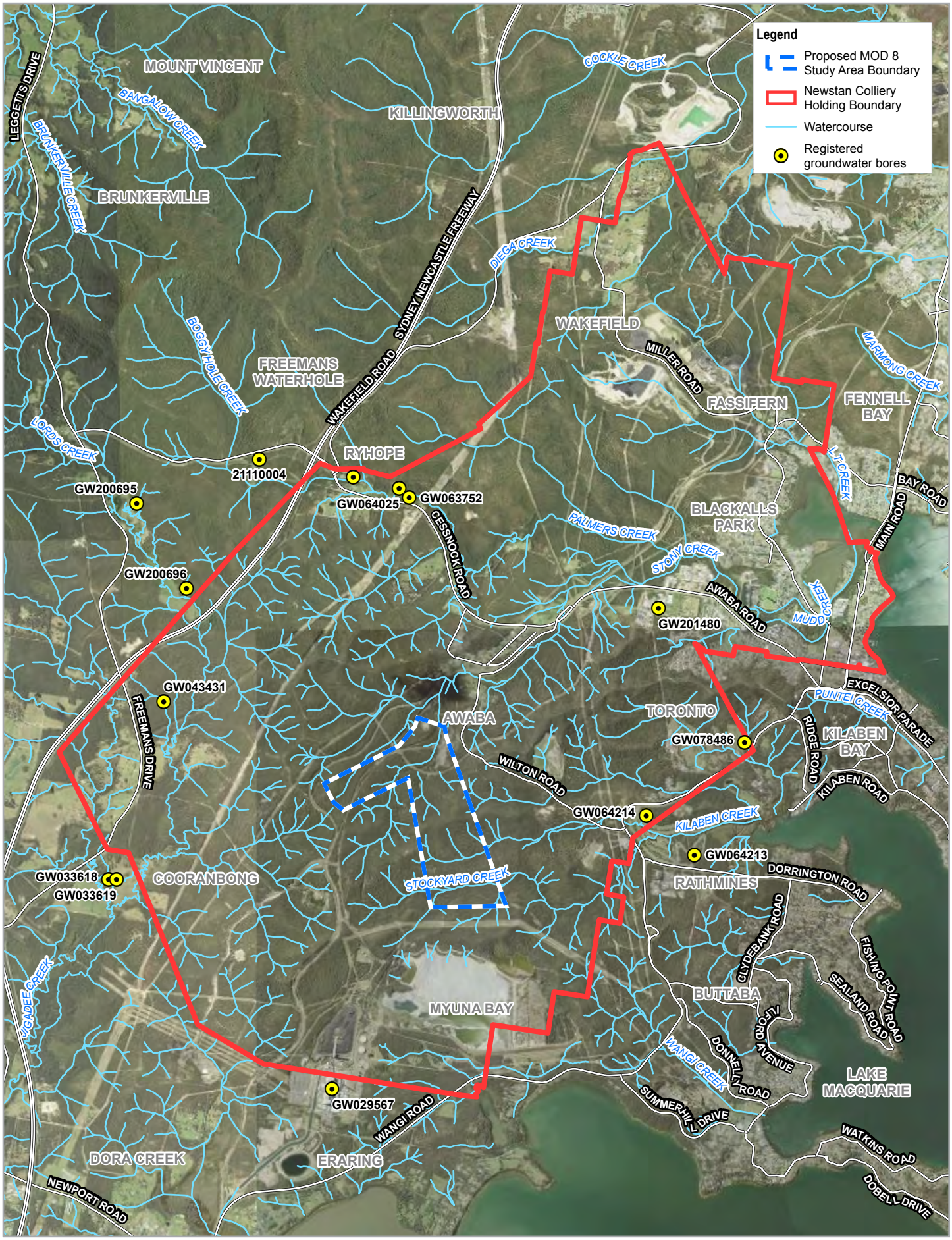
Bore ID	Bore Depth (m)	Drilled Date	Purpose	Status
GW200695	66	2008-05-20	Exploration	Unknown
21110004	-	-	Unknown	Unknown
GW200696	66	2008-10-31	Exploration	Unknown
GW043431	38.1	-	Irrigation	Functioning
GW078486	5.73	1940-01-01	Water Supply	Unknown
GW064025	12.2	1986-10-01	Water Supply	Unknown
GW064214	45.7	1987-05-01	Exploration	Unknown
GW029567	3	1968-01-01	Irrigation	Functioning
GW033618	30.4	-	Stock and Domestic	Unknown
GW064067	12.1	1987-02-01	Water Supply	Unknown
GW201480	11.6	2011-01-31	Exploration	Functional
GW064213	45.7	1987-05-01	Exploration	Unknown
GW063752	12.2	1986-11-01	Water Supply	Unknown
GW033619	21.3	-	Stock and Domestic	Unknown

5.8.1 Groundwater dependent ecosystems

The GDEs mapped by BOM (2018) in the vicinity of the study area are shown in Figure 5-7, which identifies general ecosystem types. The following terrestrial GDEs are present within an approximately five kilometre radius of the northern extent of the proposed first workings:

- Narrow-leaved Apple/Parramatta Red Gum/Persoonia oblongata heathy woodland of the Howes Valley area
- Scribbly Gum/Red Bloodwood/Angophora inopina heathy woodland on lowlands of the central coast
- Smooth-barked Apple/Red Bloodwood/Brown Stringybark/Hairpin Banksia heathy open forest of the Central Coast
- Spotted gum/Broad-leaved Mahogany/Grey Gum grass/shrub open forest on Coastal Lowlands of the Central coast
- Spotted Gum/Broad-leaved Mahogany/Red Ironbark shrubby open forest
- Swamp Mahogany/Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast
- Sydney Blue Gum/Lilly Pilly mesic tall open forest of coastal ranges and tablelands escarpment

Lake Macquarie, Muddy Lake, and Whiteheads Lagoon are mapped as “Aquatic” GDEs.



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Registered groundwater bores

Figure 5-6

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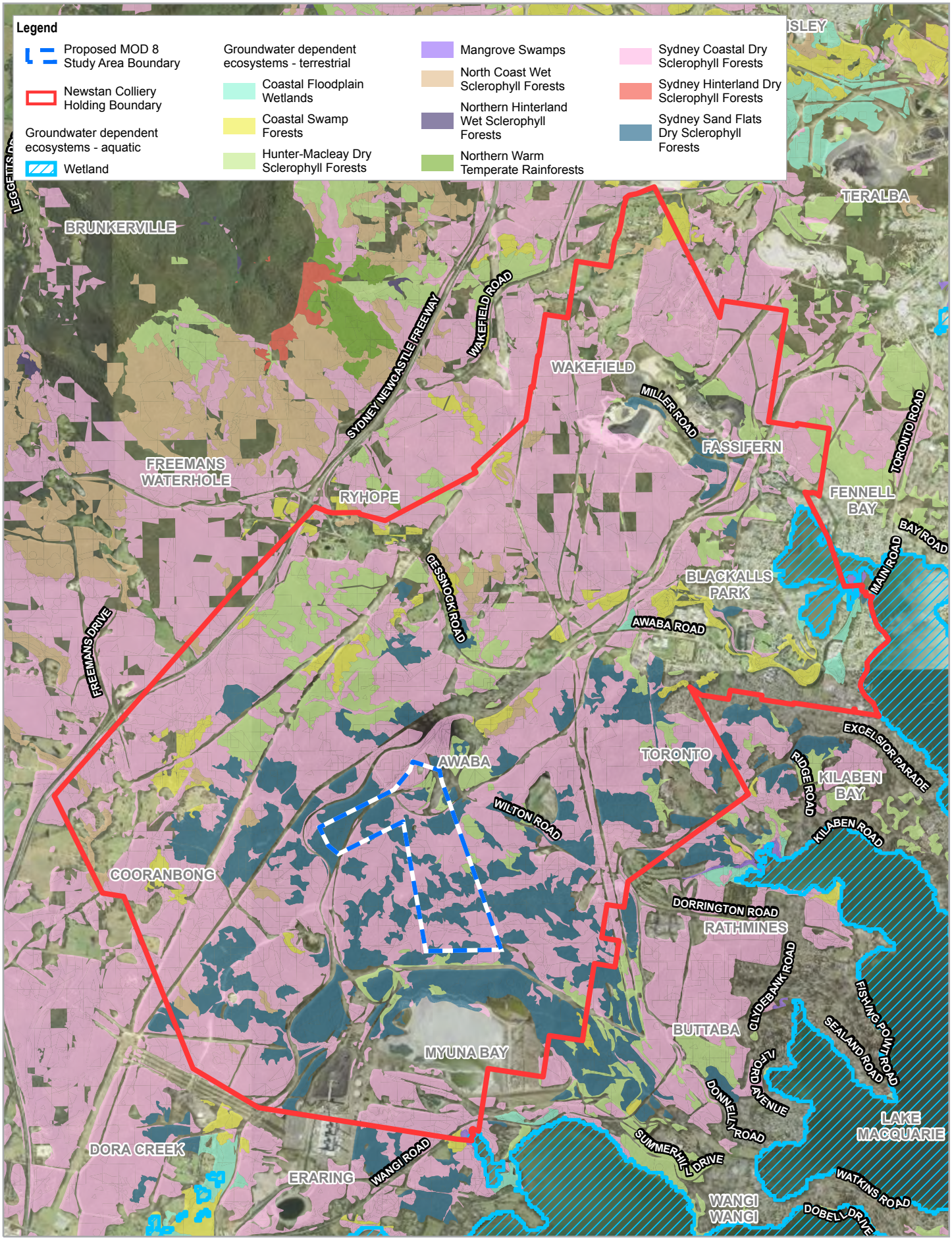

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Groundwater dependent ecosystems

Figure 5-7

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6. Impact assessment

6.1 Proposed water management

There will be no change to the existing surface and groundwater management, which are in accordance with the NCSS and Newstan Colliery water management systems.

6.2 Water and salt balance

The water and salt balance model was simulated from existing conditions to 6 July 2021 for both approved and proposed conditions. The forecast annual average water balance is compared in Table 6-1 and the salt balance in Table 6-2.

Table 6-1 Forecast annual average water balance – approved and proposed conditions

Water management element	Annual average flow Approved conditions (2021) (ML/year)	Annual average flow Proposed conditions (2021) (ML/year)
INPUTS		
Groundwater inflows into underground	923	929
Surface infiltration into underground	1160	1160
Transfers from NCSS	671	671
TOTAL INPUTS	**2754**	**2760**
OUTPUTS		
Transfers to NCSS	2736	2741
Discharge to Stony Creek outlet (LDP017)	23.1	23.6
TOTAL OUTPUTS	**2759**	**2765**
CHANGE IN STORAGE		
Underground water storages	-5	-5
TOTAL CHANGE IN STORAGE	**-5**	**-5**
BALANCE		
Inputs – outputs – change in storage	0	0

Table 6-1 shows that under proposed conditions, on average, groundwater inflows are forecast to be less than 1% greater compared to approved conditions. This increase is forecast to result in a slight increase in transfers to NCSS and discharge to Stony Creek outlet (about 2%).

Table 6-2 Forecast annual average salt balance – approved and proposed conditions

Water management element	Annual average flux Approved conditions (2021) (tonne/year)	Annual average flux Proposed conditions (2021) (tonne/year)
INPUTS		
Groundwater inflows into underground	1793	1808
Surface infiltration into underground	1944	1944
Transfers from NCSS	293	293
TOTAL INPUTS	**4030**	**4045**
OUTPUTS		
Transfers to NCSS	4017	4027
Discharge to Stony Creek outlet (LDP017)	31.1	31.8
TOTAL OUTPUTS	**4048**	**4059**
CHANGE IN STORAGE		
Underground water storages	-18	-14
TOTAL CHANGE IN STORAGE	**-18**	**-14**
BALANCE		
Inputs – outputs – change in storage	0	0

Table 6-2 shows the impact of the Project of the salt balance is forecast to be very similar to the impact on the water balance. On average, groundwater inflows are forecast to be less than 1% greater compared to approved conditions. This increase is forecast to result in a slight increase in transfers to NCSS and discharge to Stony Creek outlet (about 2%).

The forecast discharges via EPL 395 are compared in terms of water volume, discharge frequency and salt mass in Table 6-3, Table 6-4 and Table 6-5, respectively. The licensed daily volume limit for LDP001 is presented in Table 6-3 along with the annual equivalent assuming the maximum licensed discharge per day.

Table 6-3 Forecast EPL 395 discharges – approved and proposed conditions

EPL 395 discharges	Annual average flow Approved conditions (2021) (ML/year)	Annual average flow Proposed conditions (2021) (ML/year)	EPL 395 discharge limits	
			(ML/day)	(ML/year equivalent)
LDP001	2710	2715	11	4015
LDP002	24.4	24.4	-	-
LDP003 (Planned)	1.1	1.1	-	-
LDP017	23.1	23.6	-	-

Table 6-4 Forecast EPL 395 discharge frequency – approved and proposed conditions

EPL 395 discharges	Annual discharge probability Approved conditions (2021)	Annual discharge probability Proposed conditions (2021)
LDP001	100%	100%
LDP002	45%	45%
LDP003 (Planned)	10%	10%
LDP017	10%	10%

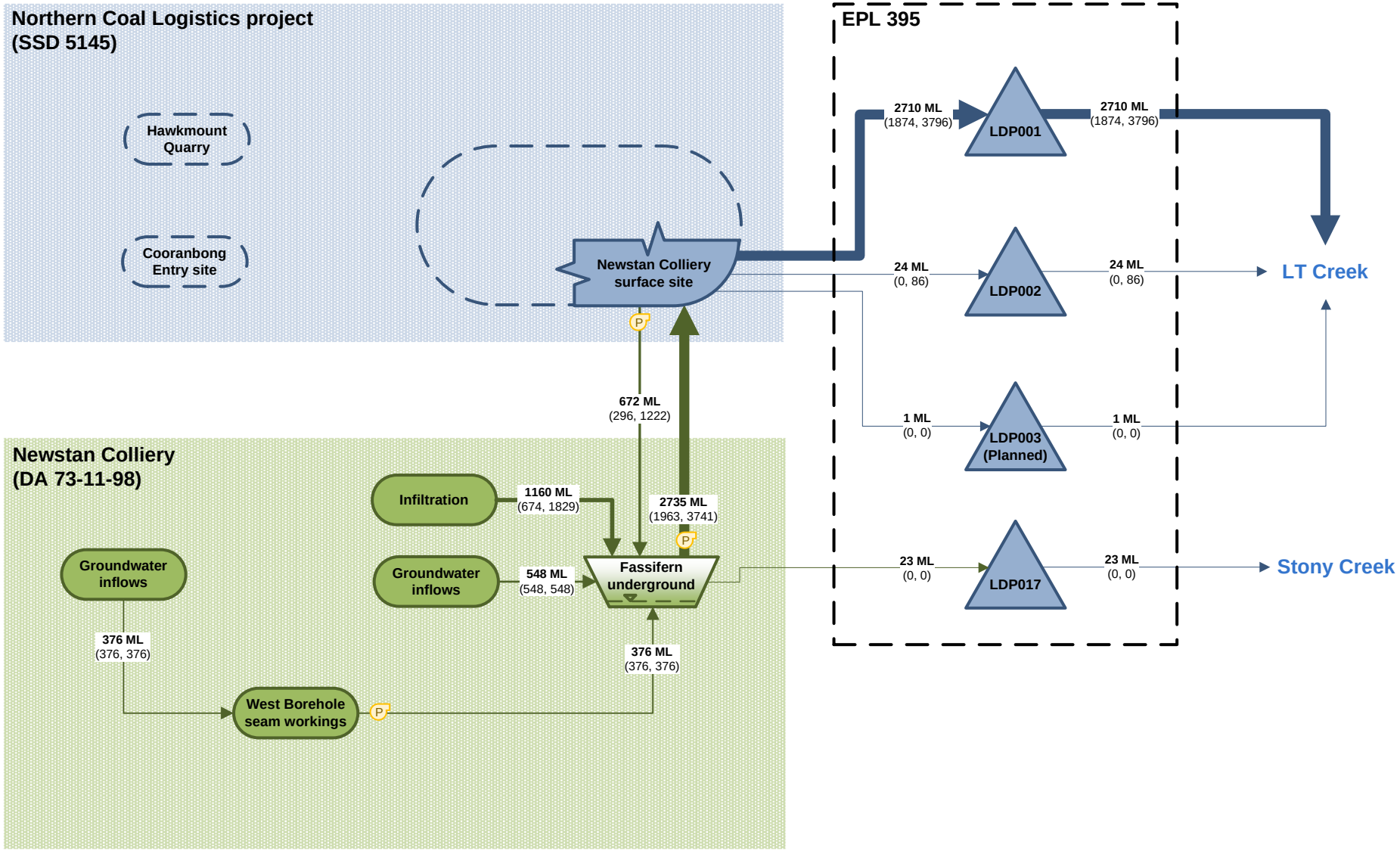
Table 6-5 Forecast EPL 395 discharges (salt) – approved and proposed conditions

EPL 395 discharges	Annual average flux Approved conditions (2021) (tonne/year)	Annual average flux Proposed conditions (2021) (tonne/year)
LDP001	3953	3963
LDP002	12.3	12.3
LDP003 (Planned)	0.5	0.5
LDP017	31.1	31.8

Table 6-3, Table 6-4 and Table 6-5 show that discharges of water and salt through LDP001 are forecast to increase slightly from the approved conditions (less than 1%) due to the Project. Discharges through LDP002 and LDP003 (planned) are forecast to be unaffected by the Project. The frequency of discharges through LDP017 is not forecast to change due to the Project, although the forecast volume of water and mass of salt in the event of discharge is slightly higher (less than 2%). This is because discharges through LDP017 are likely to occur as a result of prolonged periods of above average rainfall, resulting in high rates of infiltration into the underground workings and this process is not affected by the Project. However, in the event that discharges through LDP017 occur, the slightly higher groundwater inflows may mean that the volume of water required to be discharged for the safety of the underground operations may be slightly higher.

As a result of extending the life of the development consent by 1 additional year to 6 July 2021, an additional 340 ML of water (approx.) and 500 tonnes of salt (approx.) are predicted to be discharged via LDP001.

Overall, the Project is not expected to have a significant impact on the water and salt balance of Newstan Colliery or on discharges via EPL 395.



Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) — Mean (10^{th} percentile, 90^{th} percentile)

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WATER MANAGEMENT SCHEMATIC ANNUAL WATER TRANSFERS APPROVED CONDITIONS (2021)

Project No. 2219545
Revision No. 0
Date 20/08/2018

FIGURE 6-1

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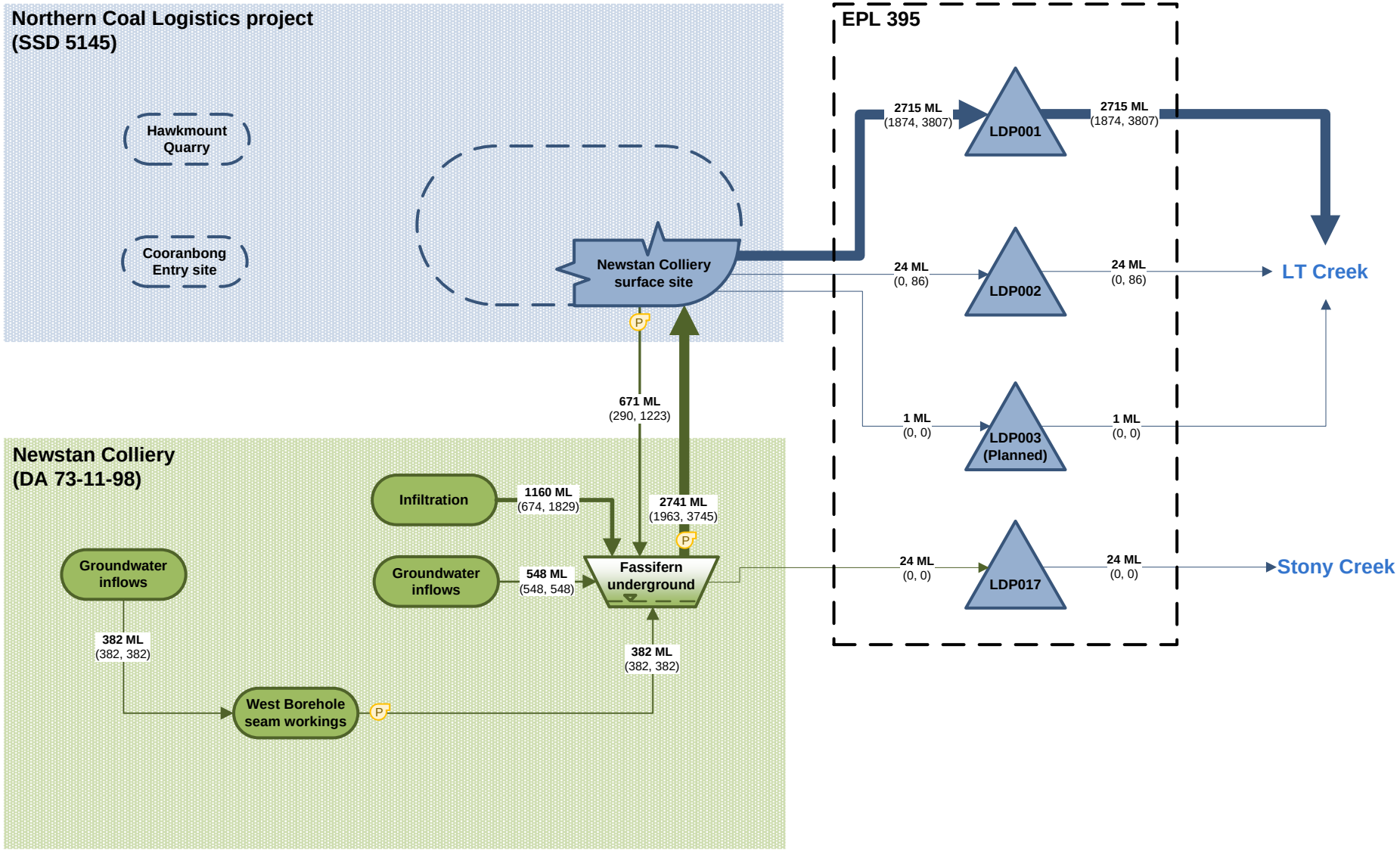

Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) Mean (10^{th} percentile, 90^{th} percentile)

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WATER RESOURCES IMPACT ASSESSMENT

WATER MANAGEMENT SCHEMATIC ANNUAL WATER TRANSFERS PROPOSED CONDITIONS (2021)

Project No. 2219545
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FIGURE 6-2

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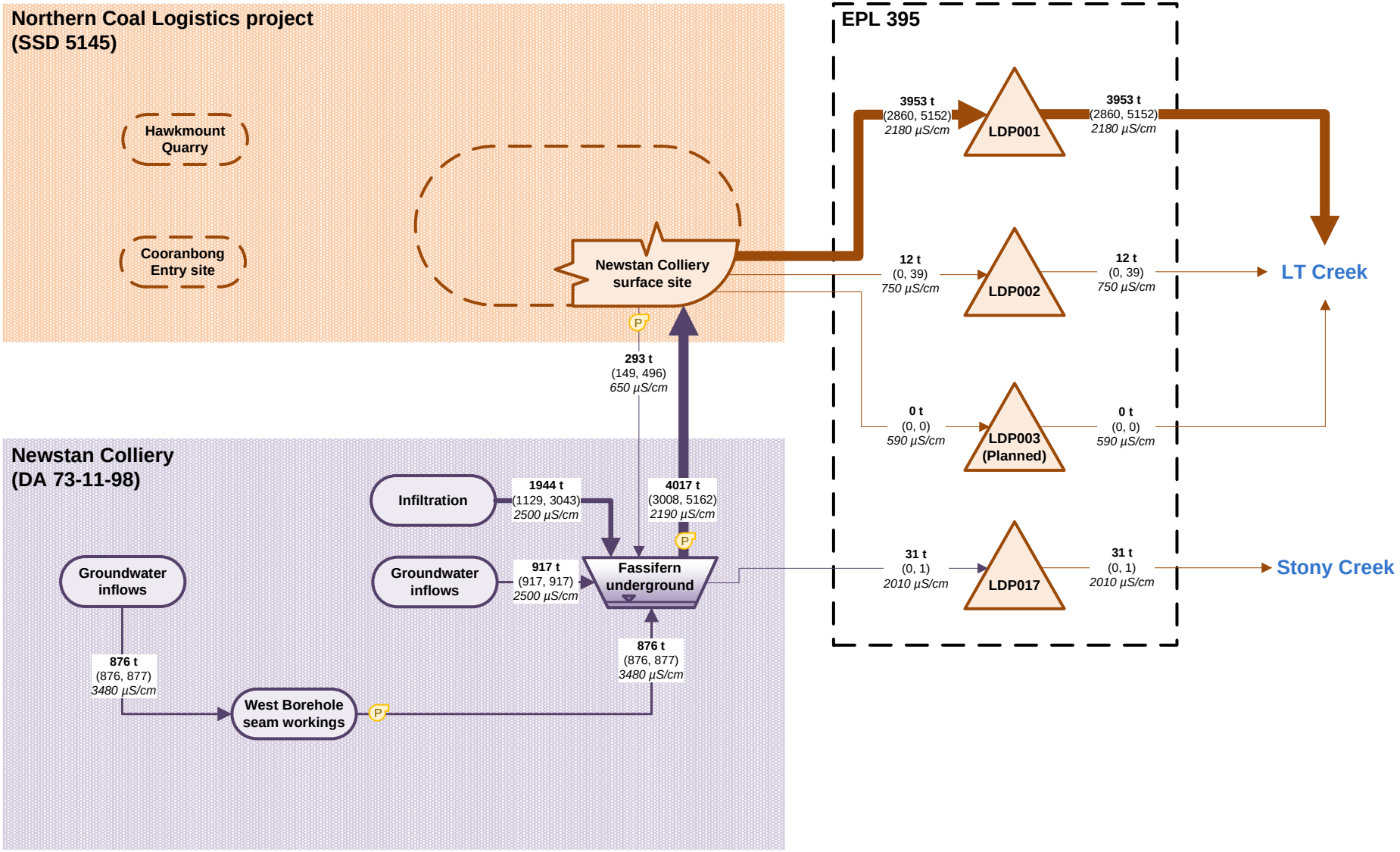

Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) Mean (10^{th} percentile, 90^{th} percentile)

CENTENNIAL NEWSTAN PTY LTD
NEWSTAN COLLIERY MOD8
WATER RESOURCES IMPACT ASSESSMENT

WATER MANAGEMENT SCHEMATIC ANNUAL SALT TRANSFERS APPROVED CONDITIONS (2021)

Project No. 2219545
Revision No. 0
Date 20/08/2018

FIGURE 6-3

Created by: Tyler Tinkler

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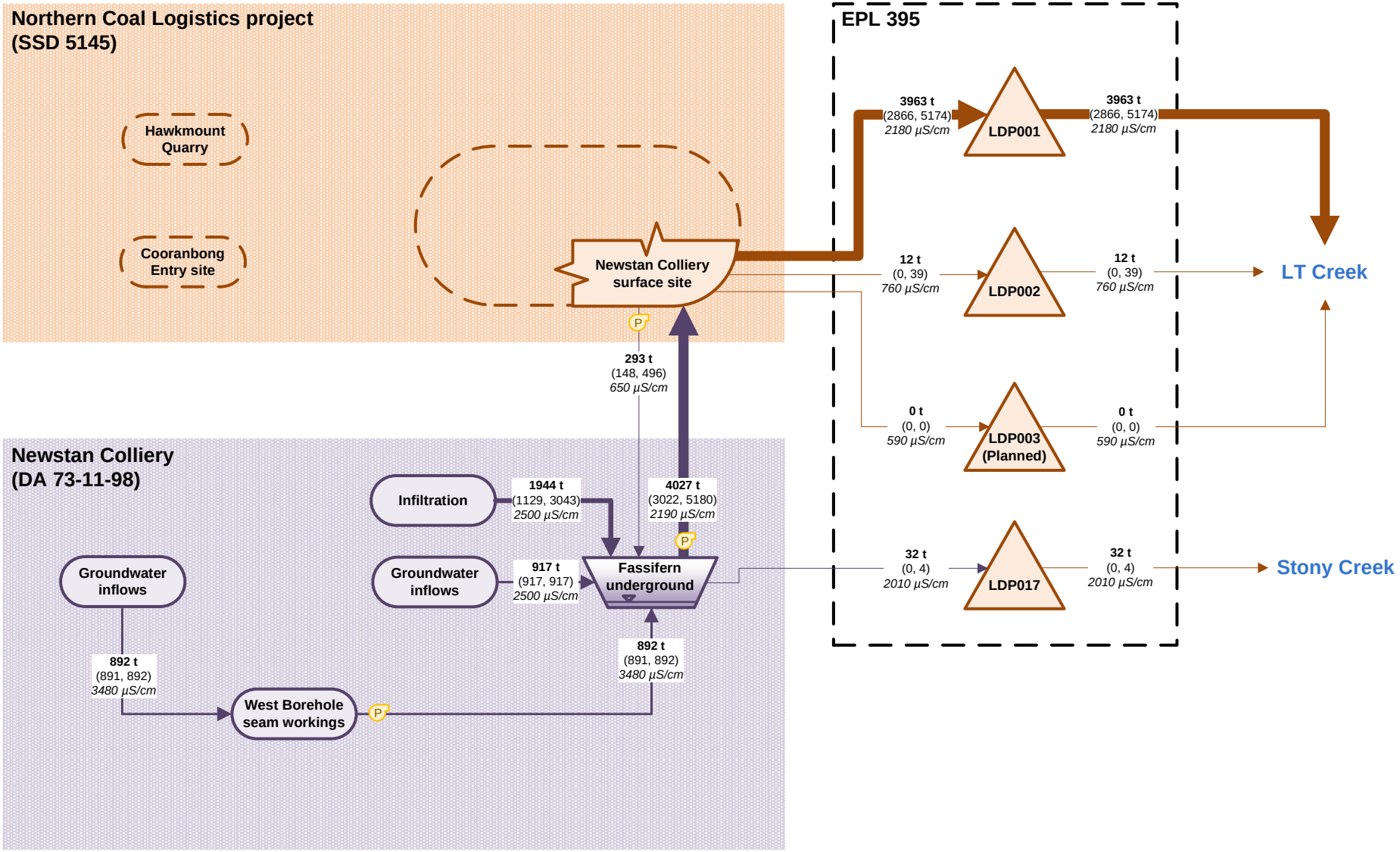

Legend

- Underground storage
- Underground process
- Surface process
- Non-impacted operations
- Licensed discharge point
- Pump
- Surface water flow
- Groundwater flow
- $\bar{X}$ (X, X) Mean (10^{th} percentile, 90^{th} percentile)

CENTENNIAL NEWSTAN PTY LTD
NEWSTAN COLLIERY MOD8
WATER RESOURCES IMPACT ASSESSMENT

WATER MANAGEMENT SCHEMATIC ANNUAL SALT TRANSFERS PROPOSED CONDITIONS (2021)

Project No. 2219545
Revision No. 0
Date 26/07/2018

FIGURE 6-4

Created by: Tyler Tinkler

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Print date: 26/07/2018 17:07

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6.3 Surface water environment

As the water and salt balance modelling has indicated (Section 6.2), the Project is predicted to have a small impact on the amount of water and salt discharged from LDP001. As water is treated at the CWP prior to discharge via LDP001, there is no change to water quality in LT Creek predicted.

The proposed modification is predicted to have no impact on the likelihood of discharges through LDP017 to Stony Creek. As any discharges through LDP017 are in response to heavy rainfall, any change to the water quality of LDP017 is predicted to be negligible.

No measureable surface deformations are predicted as a result of the project (MSEC 2018). As such, there are no predicted impacts to flows or water quality in the creeks which transect the Study Area (Stony Creek, Kilaben Creek and Stockyard Creek).

The additional year of licensed discharges from LDP001 to LT Creek would result in the existing conditions in terms of water flow and quality in the creek to continue.

6.4 Groundwater environment

6.4.1 Model predictions

Predicted groundwater inflows into the Newstan workings for the basecase (approved) and proposed scenarios are shown in Figure 6-5. Groundwater inflows into the Fassifern underground storage are also shown and are predicted to remain unchanged.

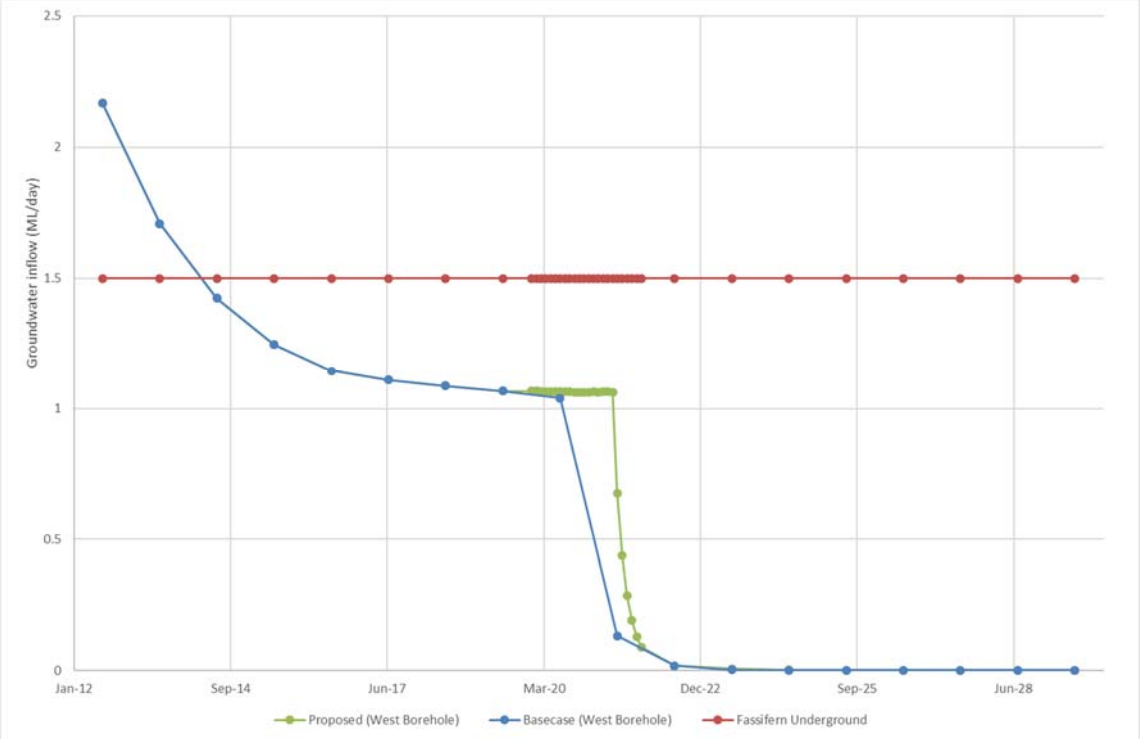


Figure 6-5 Predicted groundwater inflows for basecase (approved) and proposed conditions

Groundwater inflows into the West Borehole Seam are predicted to be slightly higher in years 2020 and 2021 under proposed conditions as a result of the proposed first workings and dewatering of the existing Newstan workings for an additional year. Annual groundwater take in 2020 is predicted to be approximately 6 ML higher under proposed conditions. In year 2021, annual groundwater take is predicted to be approximately 340 ML higher.

From year 2022 onwards, groundwater take during the recovery phase is negligible under both scenarios. Note that the additional groundwater take is from the Permian strata (not alluvium) which forms part of the North Coast Fractured and Porous Rock Groundwater Sources.

The groundwater model predicts that the proposed workings are unlikely to result in any drawdown of groundwater within the alluvium or Triassic strata. Some drawdown of Permian strata directly above the proposed mine workings is predicted as well as additional drawdown within Permian strata as a result of the additional one year of dewatering. The 1 m drawdown contour within the Permian strata above the mine workings is shown in Figure 6-6. Drawdown beyond this contour is less than 1 m.

6.4.2 Groundwater quality

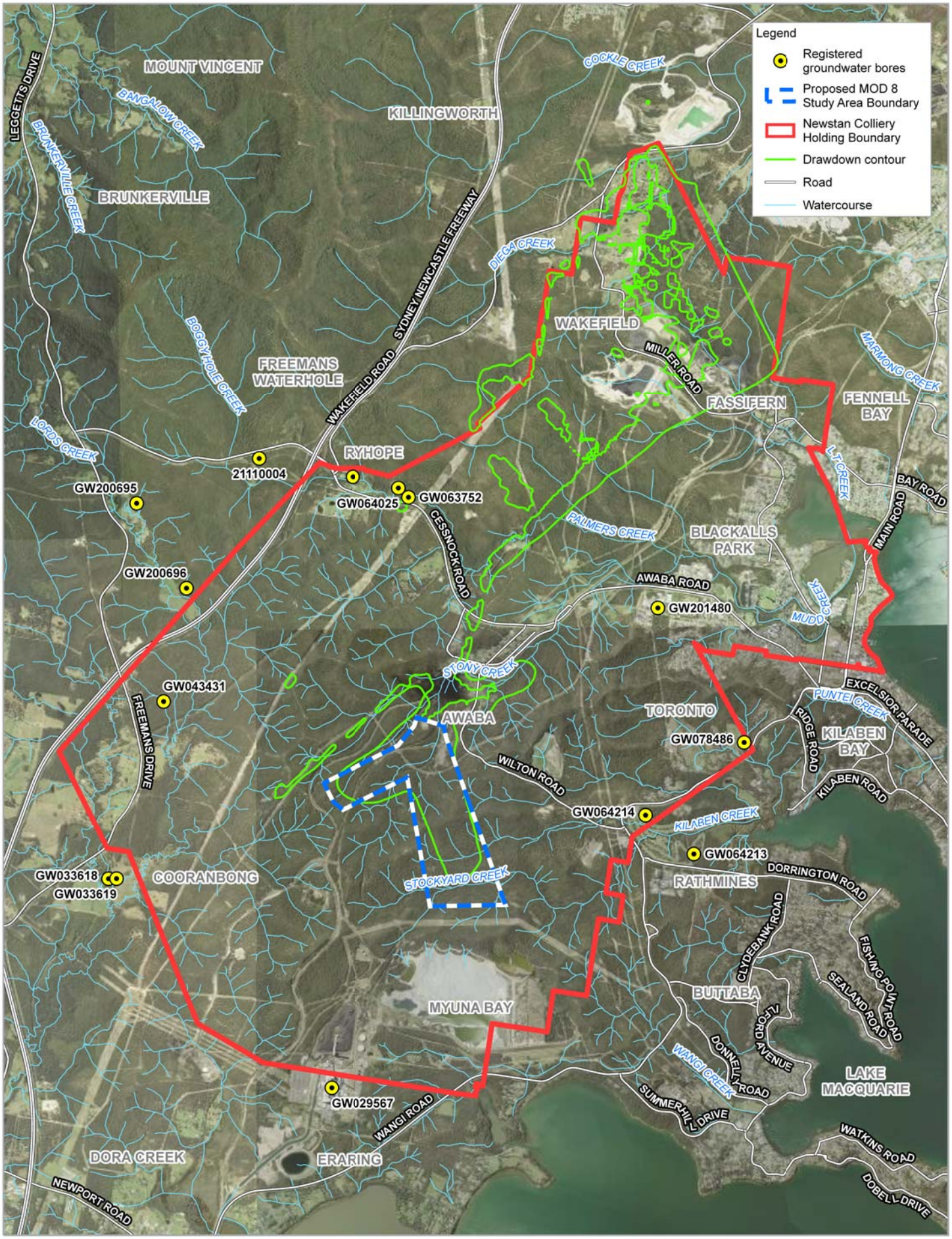
There is no change to groundwater quality predicted as a result of the Project. Groundwater encountered in the first workings is predicted to be similar in quality to that which has been monitored in the existing Newstan workings in the West Borehole Seam at cut through 19 (refer Section 5.5.3). There is no geological features within the proposed mining area that would suggest a change in groundwater quality will be encountered.

Minor temporal variability in groundwater quality is expected due to the nature of the porous and fractured rock groundwater sources however is expected to be within the bounds of variability currently observed. All groundwater extracted from the West Borehole Seam will be transferred to the Fassifern underground storage and the Clean Water Plant prior to discharge via LDP001.

6.4.3 Impact assessment

The proposed workings are not predicted to result in any drawdown of alluvial groundwater. Therefore the predicted impacts on alluvial groundwater within the Study Area are expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable. No impacts on GDEs are predicted.

The groundwater model predicts some additional drawdown of porous and fractured rock groundwater within the Permian strata above the proposed first workings as well as above existing workings (due to the additional one year of dewatering). The zone of drawdown is shown in Figure 6-6. It is not expected that this drawdown will impact registered groundwater users. The zone of drawdown is generally at least 2 km from registered bores with the exception of GW064025 and GW063752, however these are shallow bores (12 m deep) and not within the Permian strata. Therefore predicted impacts on porous and fractured rock groundwater are also expected to be less than the Level 1 minimal impact considerations from the NSW Aquifer Interference Policy and are therefore considered to be acceptable.



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0 400 800 1,200 1,600 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Cenetnnial Coal
Newstan Colliery Mod 8
Water Resources Impact Assesssment

Additional Permian drawdown due to Project (1 m contour)

Project No. **22-19545**
Revision No. **0**
Date **27/07/2018**

Figure 6-6

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Data source: NSWNRATLA

Data source: NSWNRATLAS: Registered Bores, 2018; Centennial: Consent boundary, 2016; LPI: DTDB, 2016; sixmaps/LPI_Imagery_Best: © DFSI Spatial Services 2017. Created by: tmorton

6.5 Stream health

6.5.1 Aquatic ecology

As the predicted increases in water and salt discharged from LDP001 as a result of the proposed modification are predicted to be negligible (less than 1%), no impacts to stream health in LT Creek, as assessed through macroinvertebrate sampling and analysis of the taxa presence/absence results, are predicted. Substantial seasonal variability has been observed in the macroinvertebrate communities sampled in LT Creek, and this variability is predicted to continue to be observed.

No change in the likelihood of discharge through LDP017 to Stony Creek is predicted, and as any change the water quality of this discharge would be negligible, no change in macroinvertebrate community composition in Stony Creek is predicted as a result of the proposed modification. These conditions are predicted to continue for an additional year as a result of the modification.

6.5.2 Ecotoxicity of LDP001

As no change in the quality of water discharged via LDP001 is predicted, it is likely that the existing conditions, where no acute toxicity and negligible chronic toxicity has been observed, will continue during the mining of the proposed first workings. The LDP001 discharge is therefore predicted to remain complaint with EPL 365 condition L5.1. These conditions are predicted to continue for an additional year as a result of the modification.

6.5.3 Watercourse stability

The minor (less than 1%) increase in discharges through LDP001 predicted by the water balance modelling is unlikely to generate any geomorphic response in LT Creek. The stability of the watercourse is predicted to be maintained, as its wide and densely vegetated nature dissipates the majority of flows. Headward migration of the headcuts which have been observed downstream of Miller Road is unlikely as these headcuts are small and relatively stable due to binding of channel sediments by tree roots. Additionally, any headward migration would be limited in its extent to the culvert at Miller Road. The additional year of licensed discharges from LDP001 is not predicted to have any impact on the stability of LT Creek.

Water balance modelling predicted that there would be no greater probability of discharges through LDP017 to the Stony Creek catchment as a result of the Project. In the event of a discharge from LDP017, which occurs in response to heavy rainfall, the slightly increased volume of water pumped from the West Borehole Seam to the Fassifern Seam is predicted to have a negligible impact on the volume which would be discharged from LDP017. As such, the extent and severity of bank erosion in the unnamed tributary of Stony Creek is not expected to be exacerbated by the Project.

6.6 Downstream water users

There were no downstream water users identified (refer Section 5.7) which could be potentially impacted by the Project.

6.7 Legislative considerations

The significant impact guideline completed for the modification (Appendix A) indicated that a significant impact is not considered likely, and as such no referral to the Commonwealth Environment Minister is required for the proposed modification.

As the impact of the proposed modification on the volume and quality of water discharged through LDP001 is predicted to be negligible, no change to EPL 395 will be required.

The predicted increase in groundwater take from the North Coast Fractured and Porous Rock Groundwater Sources is temporary and minor. As stated in Section 2.1.4, Centennial Newstan is currently in consultation with DoI – Water regarding the licensing of groundwater take from this source for existing operations. As part of the proposed modification additional licensing volumes will be acquired or existing volumes will be utilised from the regional share.

7. Avoidance, mitigation and management measures

7.1 Monitoring and management requirements

Approval of the project will result in a revision of the existing NCSS and Newstan Water Management Plans. A Trigger Action Response Plan (TARP) will be developed to address the potential risk of changes to LDP001 discharge quality and volume with the potential to impact EPL compliance

In addition to the current surface and groundwater monitoring programs, which are proposed to continue, the groundwater quality in the first workings is proposed to be monitored monthly at cut through 19 (assuming that dewatering of the first workings would be to the cut through 19 dam). The proposed monitoring parameters are as follows:

- Physicochemical parameters: pH, EC, turbidity, TSS, and Oil and Grease
- Metals (dissolved and total): Al, B, Cd, Co, Fe, Pb, Mn, Ni, Se and Zn
- Major anions: Alkalinity, sulfate and chloride
- Major cations: Sodium, calcium, magnesium, potassium

Groundwater level monitoring is proposed to continue at the locations detailed in Figure 5-3. Additionally, monitoring of water levels within the Awaba underground workings as per the Awaba Colliery Water Management Plan (GHD 2018c) will allow for the detection of any connectivity between the first workings and the Awaba void, noting that the risk of which is considered negligible (refer Section 4.1).

7.2 Review

The review of the outcomes predicted within this WRIA will be required to validate the assessment of impacts from the Project on surface and groundwater environments.

At a minimum, these impacts should be reviewed annually, or specifically as a result of:

- Any statutory or regulatory requirements
- Any significant change to water management practices
- Continual exceedances of the concentration limits for LDP001
- Any incident which requires reporting

8. Conclusions

The proposed modification is predicted to have negligible impacts on both surface and groundwater environments. The changes to the water volume and the salt load discharged through Newstan Colliery's licensed discharges as a result of the additional mining area and one year extension of the dewatering of the West Borehole Seam workings are predicted to be minor and temporary. The impact of this on water quality and stream health in watercourses which receive licensed discharges from Newstan Colliery is predicted to be negligible. The extension of the existing development consent for an additional year is predicted to have no impact on water quality and stream health apart from the continuation of the existing conditions.

A numerical groundwater model has been developed to predict groundwater take and drawdown as a result of the Project. The predicted groundwater impacts are less than the NSW Aquifer Interference Policy's Level 1 minimal impact considerations, and as such are considered as acceptable. No impacts on groundwater receptors, including the registered groundwater bores identified in the proximity of the Study Area and groundwater dependent ecosystems, are predicted. Groundwater take from the North Coast Fractured and Porous Rock Groundwater Sources is predicted to be higher in years 2020 and 2021 (compared to approved conditions). Centennial Newstan is currently in consultation with DoI – Water regarding the licensing of groundwater take from this source.

No significant impact, as per the EPBC Act, is predicted, and therefore referral to the Commonwealth Environment Minister is not required. No change to the Environment Protection Licence for Newstan Colliery is required.

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Appendices

Appendix A – Significant Impact Test

Element	Result	Triggers an impact	Reasoning
Changes to Hydrology			
Flow regimes (volume, timing, duration, frequency)	Negligible	No	Changes to the LDP001 discharge regime are negligible and of minimal consequence.
Recharge rates	No	No	No changes to surface conditions.
Aquifer pressure or pressure relationships between aquifers	Minor	No	Minor drawdown in Permian strata above workings predicted by model.
Groundwater table levels	No	No	No drawdown of groundwater table predicted by model.
Groundwater/surface water interactions	No	No	Connectivity exists between surface and groundwater environments however these are existing with no change predicted in relation to these interactions.
River/floodplain connections	No	No	Changes to the LDP001 discharge regime are negligible and of minimal consequence.
Inter-aquifer connectivity	No	No	No groundwater interactions.
Changes to Water Quality			
Creates risks to human or animal health or to the condition of the natural environment	No	No	No change to LDP001 water quality predicted.
Substantially reduce the amount of water available for human consumptive uses or for other uses, including environmental, which are dependent on water of a particular quality	No	No	No reduction in the amount of water available is predicted.
Cause persistent organic chemicals, heavy metals, salts or other potentially harmful substances to accumulate in the environment	No	No	No accumulation of potentially harmful substances predicted.
ANZECC Water Quality Assessment undertaken	Yes	No	Applied to LDP001 discharge.
Changes to Ecosystem Function and Integrity			
Areas of the water resource being destroyed or substantially modified in a way that has an adverse effect on a water-dependent ecosystem	No	No	

Element	Result	Triggers an impact	Reasoning
An adverse change to the benefits or services provided by a water resource	No	No	No change to beneficial use categories.
A change in the biological diversity or species composition of a water resource or its ecological connectivity to other water resources	No	No	See Section 6.5
The habitat or lifecycle of native species which are ecologically associated with the water resource or which are important determinants of the water resource's character being seriously affected	No	No	No change to stream health is predicted.
An invasive or pest species that is harmful to the ecosystem functioning or integrity of the water resource becoming established (or an existing invasive or pest species being spread) in the water resource.	No	No	The modification is not expected to have any impact on invasive/pest species establishment.
Cumulative Impacts			
An assessment of the cumulative impacts of all other known projects in the surface or groundwater source area	Completed	No	Standard cumulative assessment approach down to the LT Creek intertidal zone.
Timing, Scale and Value			
An assessment of the impacts in both the short and long term. The long term will at a minimum be 100 years, unless otherwise defined by a peer reviewed hydrogeological model	Yes	No	Modelling predicts that additional groundwater recovery is negligible.
Timing of the activities that are likely to impact water resources	Short timeframe	No	Additional mining for only one year. First workings only.
A robust water balance that identifies when in the project timing water impacts are likely to be greater than the existing situation	Refer Section 6.2	No	No impacts greater than the existing situation predicted.
A complete or revised existing local and regional water balance and hydrogeological model	Regional	No	Regional model has been updated and calibrated.
A statement as to the value of the water resource must be included in the significant impact test. This statement must be in the context of the services provided by the resource as well as the connectivity of the resource to other water resources. Services include provisioning to other industries or potable water supplies, cultural services and supporting ecosystem services.	See rightmost column.	No	The value of LT Creek is relatively low as it supports only ecosystem services and recreational uses in Lake Macquarie.

Appendix B – Height of Fracturing report and peer review

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NEWSTAN PROJECT - MOD 8 STUDY AREA

GEOTECHNICAL REPORT ON THE EXPECTED HEIGHT OF FRACTURING ASSOCIATED WITH FIRST WORKINGS

BY ELLIOT TEMBO

10th August 2018

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1.0 Introduction

This report is an assessment of the geotechnical stability issues associated with the proposed First Workings layouts in the section of the Newstan Project referred to as Mod 8 (see figure below).

This assessment seeks to indicate or estimate the height of fracturing associated with the first workings. The assessment is required as a contribution to the hydrogeological study for the Mod 8 First Workings layout and does not include the fracturing impact associated with secondary extraction which is proposed for sections of the panels.

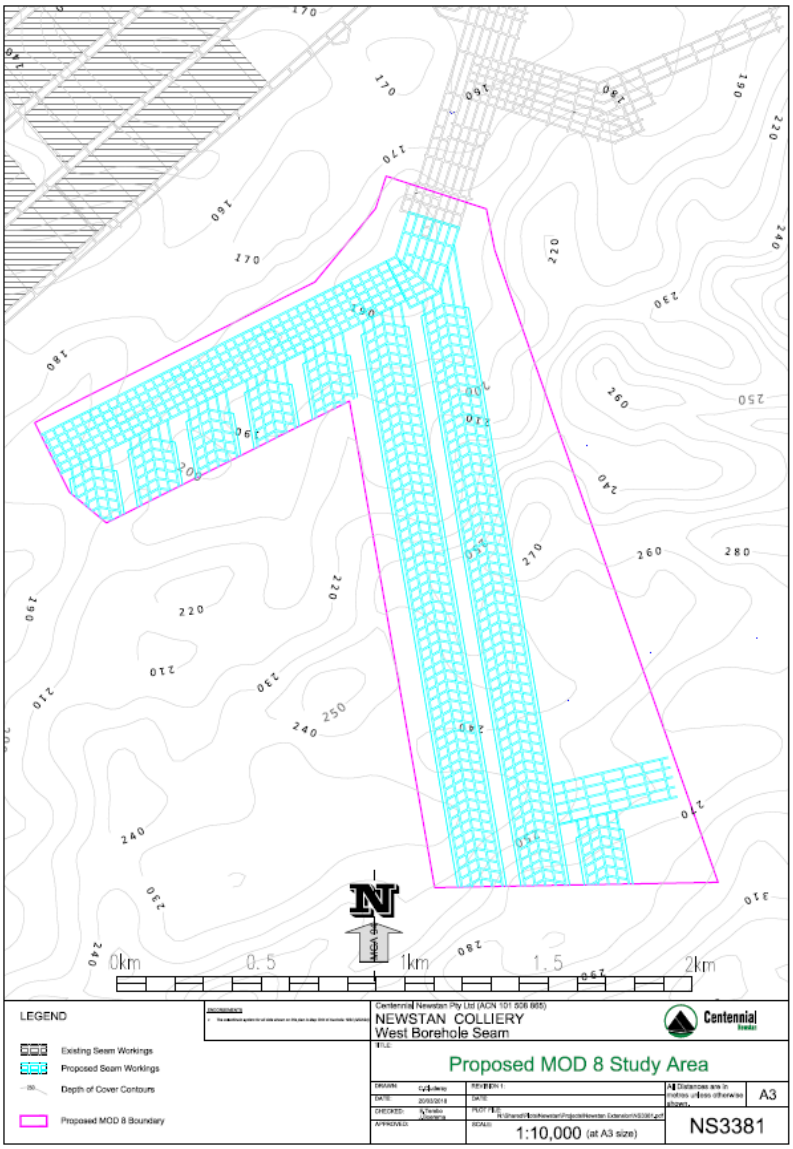

Figure 1 – Newstan Extension - Mod 8 Project Area

2.0 Geological Setting

The section under review is part of the western zone of the project area. This is characterised by the presence of the full West Borehole Seam, and is bounded by the existing Newstan workings in the north and west, an igneous sill at the seam level in the south-west and the seam split line in the east.

2.1 Seam

The West Borehole Seam generally ranges in thickness from 3.5m in the West to over 5.0m in the east.

A feature of the seam with respect to the cutting horizon and stability is the presence of the Dudley Clay that can be correlated across the entire project area. It is located in the upper part of the West Borehole Seam with a thickness of generally around 0.1m. This is used as a marker horizon for development with a considerable thickness of coal above being left in the roof to provide a buffer against the overlying relatively incompetent units. The thickness of the coal seam above the Dudley clay ranges from 1 to 1.3m and the plan is to mine up to 0.4m above the Dudley Clay leaving coal tops of up to 0.9m.

The seam is generally competent with UCS of around **26MPa** being quoted in previous analyses of adjacent Newstan workings

2.2 Roof

The West Borehole Seam is overlain by the **Nobbys Tuff** which typically exceeds 1m in thickness in this section of the project area.

The Nobbys tuff is directly overlain by the **Victoria Tunnel** and **Fern Valley Seams**, which combine to form a thick sequence of interbedded coal and tuff layers. This is very similar to the roof strata above the adjacent Newstan longwall.

The roof strengths derived from sonic velocity general formula and laboratory tests range from **11 to 207MPa** with the typical sonic velocity derived values of around **50MPa** for the 2m of immediate roof.

2.3 Floor

Across the western zone of the project area the floor material immediately below the West Borehole Seam is the **Waratah Sandstone**. This is a high

strength competent medium to coarse grained sandstone with strengths consistently around **60 and 70MPa** in the project area. In some sections however, a carbonaceous mudstone and siltstone of up to **0.3m** forms the immediate floor section of the West borehole Seam. Where present this mudstone/siltstone layer has been observed to break down causing boggy conditions during mining.

3.0 Mining Layout Configuration

The mining Layout configuration is indicated in figure below and consists of:

- Square Pillars in Mains
- Parallelepiped Pillars in the Panels with cut throughs angled at 70^{o}
- The Mains are separated from the panels by Barrier Pillars and similarly the panels are separated by inter-panel barrier pillars. These barrier pillars are not part of this assessment. However they are designed with an appropriately high factor of safety as required of barrier pillars

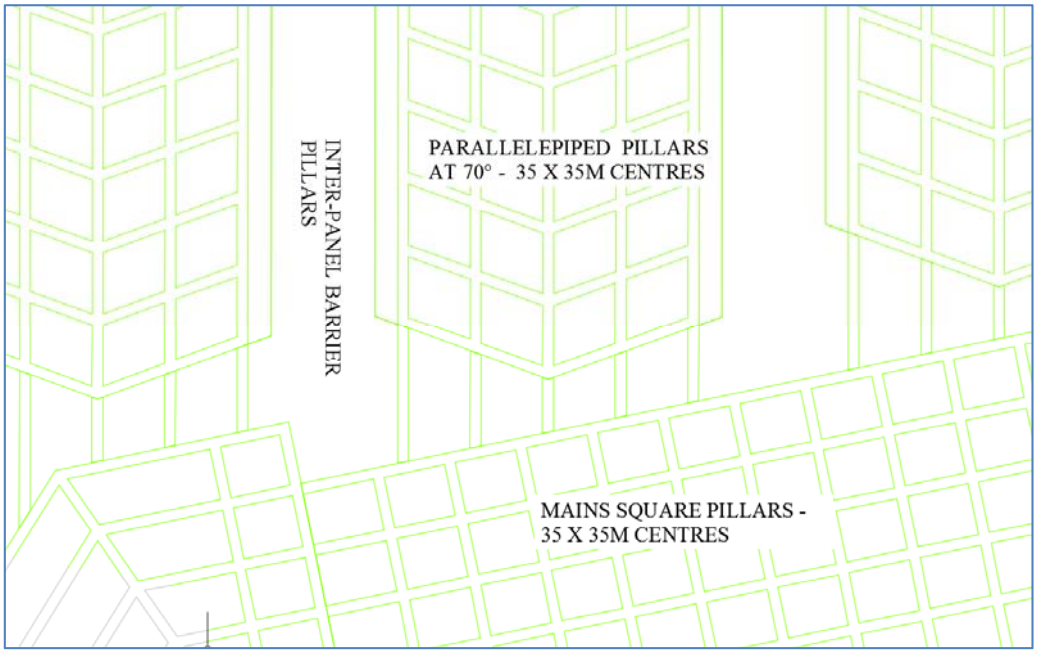

Figure 2 – Schematic Layout of Proposed First Workings in Mod 8 Section

To determine the potential **Height of Fracturing**, the report needs to determine the following:

- Determine the stability of the pillars which will give assurance that the development profile will remain stable after mining.
- Assess the potential height of fracturing on the basis of the designed roadway widths and the stability around the roof and ribs dimensions.

4.0 Pillar Stability Assessment of the Proposed First Workings

The stability assessment was done utilising the University of New South Wales (UNSW) Pillar stability procedure.

The Factor of Safety (FOS) and thus probability of failure was assessed for the pillar configurations at varying depths of cover across the study area.

Assumptions and Methodology of Pillar Stability Assessment

- Bord and Pillar Workings.
- UNSW Rectangular Pillar Strength Formula used
- Full Tributary Loading

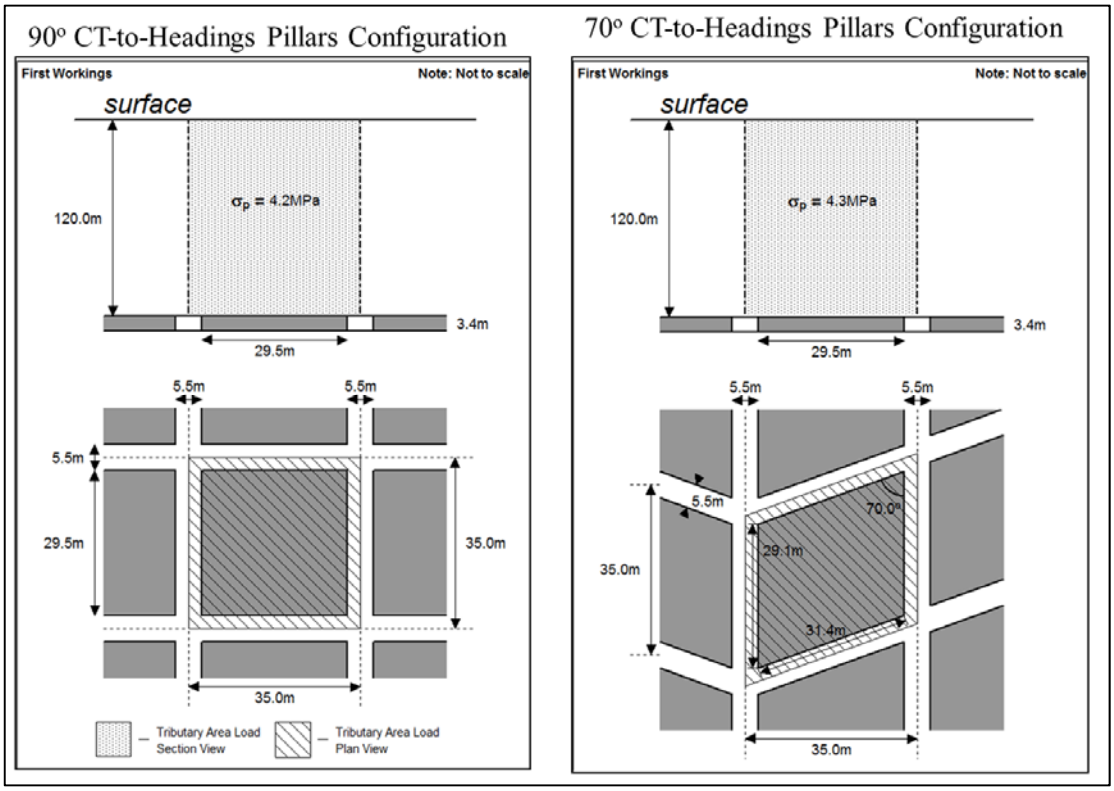

Figure 3 – Schematic Representation of the 35 x 35m Pillars Configurations and Loading Characteristics

The Resulting Factors of Safety (FOS) for the pillars with the changing depths of cover are tabulated in Table **1** below

Table 1 –FOS against Changing Depth of Cover for the 35 x 35m Pillar Configurations

Depth of Cover (m)	Factor of Safety	
	Parallelepiped Pillars (70^o)	Square Pillars (90^o)
180	3.10	3.39
200	2.79	3.05
220	2.54	2.77
240	2.33	2.54
260	2.15	2.35
270	2.07	2.26

Based on the above assessment the pillars in the Mod 8 area are designed to be long term stable with the probability of failure being less than **1 in 10,000,00 (FOS>2.11).**

5.0 Height of Fracturing Impact Associated with First Workings

The first Workings are proposed to be mined at a nominal width of 5.5m and height of 3.2m with intersections to be as tight as possible, typically around 8m effective width.

Previous studies and experience in the Bord-and-Pillar Panels in the Main West section of the mine with similar geology have shown that a 5.5m wide roadway with a height of 3.2m mined to 200 - 500mm above the Dudley Clay yields a stable coal ply of around 0.3m above the seam height. Assuming a minimum Factor of Safety of 2 against compression and that the coal top is the primary support unit, the developments with widths ranging from 5 to around 8m will be self-supporting.

However long term stability is achieved in reinforcing the coal tops and the overlying Nobbys tuff with appropriate roof bolts to give an adequate thick beam of either a natural coal tops/Nobbys tuff or the coal tops/Nobbys tuff reinforced with bolts. Studies have shown that for a typical span of 5.5m and potential intersection spans of around 8m, a thickness of 0.35 – 0.75m of competent Nobbys tuff is required for long term stability.

As indicated in section 2.2 the average tuff thickness in the project area is greater than 1 and therefore the requirement for long term stability is achieved by the combination of the coal tops and the overlying Nobbys tuff with an appropriate bolt length to reinforce the beam.

Therefore the height of fracturing will be confined to the immediate environment around the development and not extend beyond the primary support horizons of the coal tops and Nobbys tuff.

5.1 Numerical Modelling For Height of Fracture

Based on the geomechanical parameters obtained from boreholes within the Mod 8 section of the project area the following numerical analysis of roof stability was undertaken using the RS2 (Phase2 9.0) software.

RS2* (*Phase2* 9.0)** is a program for 2D finite element analysis of geotechnical structures for civil and mining applications. Applicable for both rock and soil (RS2* = Rock** and **Soil 2-dimensional** analysis program), the *RS2* software is a general purpose finite element analysis program for civil and mining analyses and support designs.

The program has many benefits including provision to have a wide range of geomechanical material parameters inputs for the different strata units.

A section indicated below represents a cross section Profile across the project area capturing parameters such as:

- Strata units thicknesses and related strengths properties
- Simulation of development of the five headings across one Panel
- Analysis of the expected displacement /convergence resulting from stress redistribution around the excavations. This can be related to whether or not caving will occur.
- How far into the roof will the caving extend should it occur
- Will this caving have any impact on the overlying Awaba workings?

Table 2 – Geometric Parameters Used in the Stability Assessment

Depth of Cover	180 – 270m	180m is used for assessment due to the fact that the potential impact on the overburden would be in shallower section of the mine
Seam Cutting Height	3.2m	Proposed development height of 3.2m
Development Width	5.5m	Nominal
Mains Pillar Dimensions	35 x 35m Centres – forming Square pillars	
Panels Pillar Dimensions	35 x 35m Centres – with cut throughs at 70^{o} forming Parallelepiped pillars	

Table 3 - Geomechanical Properties utilised in the Analysis are indicated in table

Material Name	Color	Initial Element Loading	Unit Weight (MN/m3)	Elastic Type	Shear Modulus (MPa)	E2 (MPa)	V12	Failure Criterion	Intact Compressive Strength (MPa)	mb (peak)	s (peak)	a (peak)	Jointed?
Conglomerate		Field Stress and Body Force	0.027	Transversely Isotropic	5442.3	13061.6	0.2	Generalized Hoek-Brown	50	6.23536	0.022873	0.501834	Yes
Coal		Field Stress and Body Force	0.015	Transversely Isotropic	267	4000	0.2	Generalized Hoek-Brown	10	1.29181	0.008415	0.503516	Yes
Tuff		Field Stress and Body Force	0.027	Transversely Isotropic	267	4000	0.2	Generalized Hoek-Brown	25	2.10333	0.003459	0.506143	Yes
Sandstone		Field Stress and Body Force	0.027	Transversely Isotropic	800	12000	0.2	Generalized Hoek-Brown	35	7.21434	0.069483	0.500838	Yes
Interbedded SS_ST		Field Stress and Body Force	0.027	Transversely Isotropic	800	12000	0.2	Generalized Hoek-Brown	30	2.31243	0.010509	0.503051	Yes
Siltstone/Shale		Field Stress and Body Force	0.027	Transversely Isotropic	800	12000	0.2	Generalized Hoek-Brown	35	0.397514	0.000215	0.533437	Yes

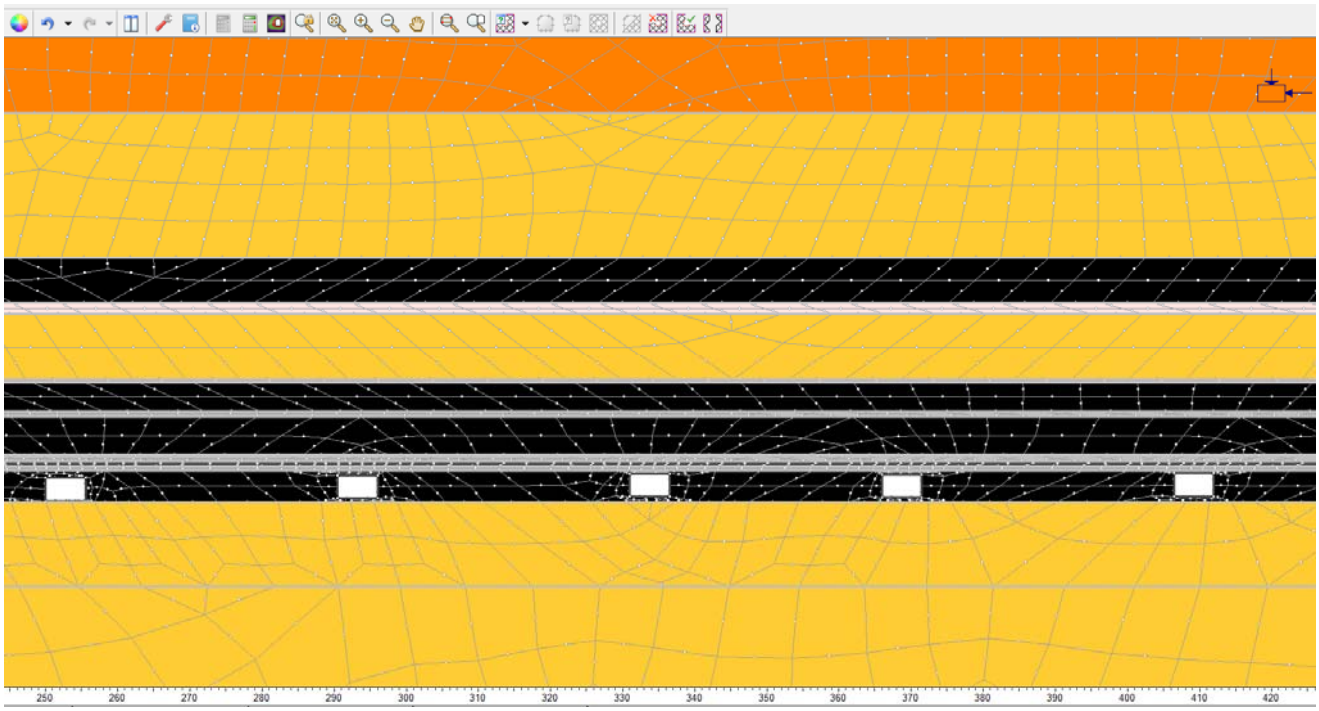

Figure 4 – Schematic representation of a Section of the RS2 Finite Element Mesh design for the Stability analysis

5.2 Results of the Analysis

Determination of the potential height of softening which indicates the potential height of fracturing was made using the **Strength Factor Parameter**.

The **Strength Factor** is a ratio of the Strength of the strata units against the induced stress due to mining. The induced stress is the result of the interaction of the excavations with all the components of the stress vector. In simple terms where the Strength Factor is less than 1, the strata will fail, either in tension or compression or shear. Where the Strength Factor is greater than 1, the strata will not fail.

By setting the maximum strength Factor of 1, the outline of the failure /caving arch can be determined.

Figure 5 below shows the generalised response of first workings mining where the failure or caving zone is confirmed to the strata in the immediate roof of the workings.

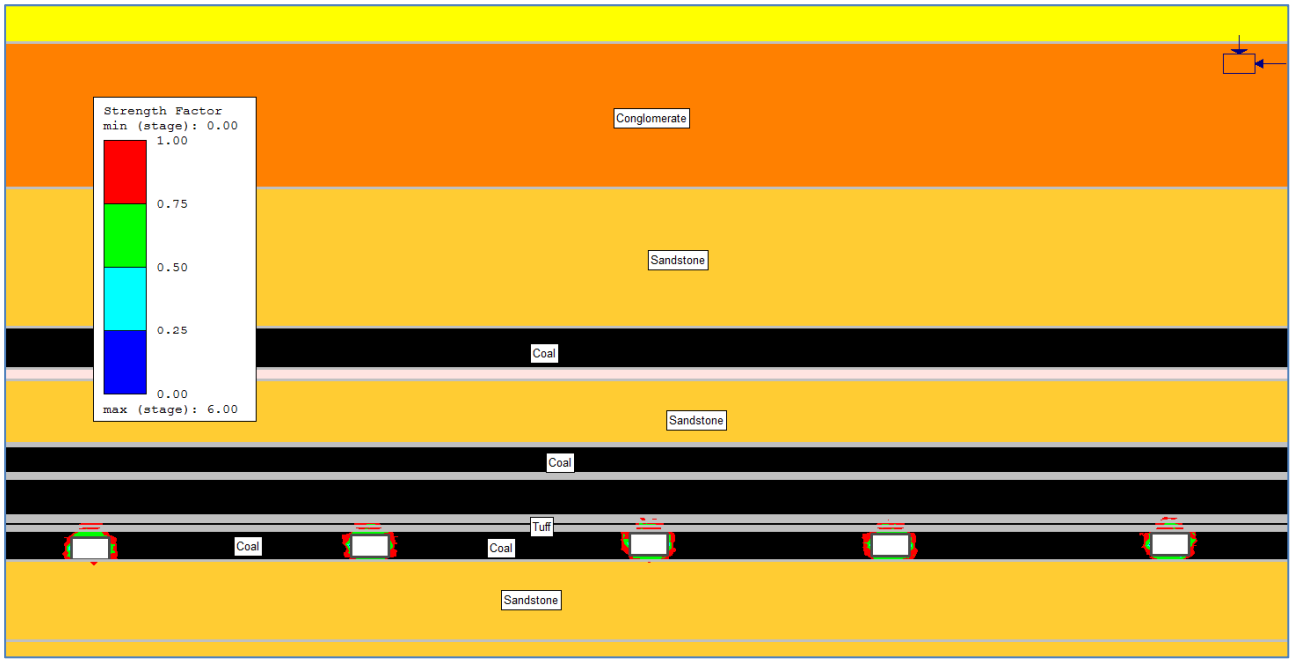

Figure 5 – Showing the scaled section across the five headings with the height of fracturing indicated around the development.

The section beneath the outer limit of the Red Colour represents a zone where caving/fracturing may occur to the extent that the stress exceeds the strength. As indicated

that zone is very localised and confined to the section in the immediate roof. A more detailed representation of the same is indicated in **Figure 6** below**.**

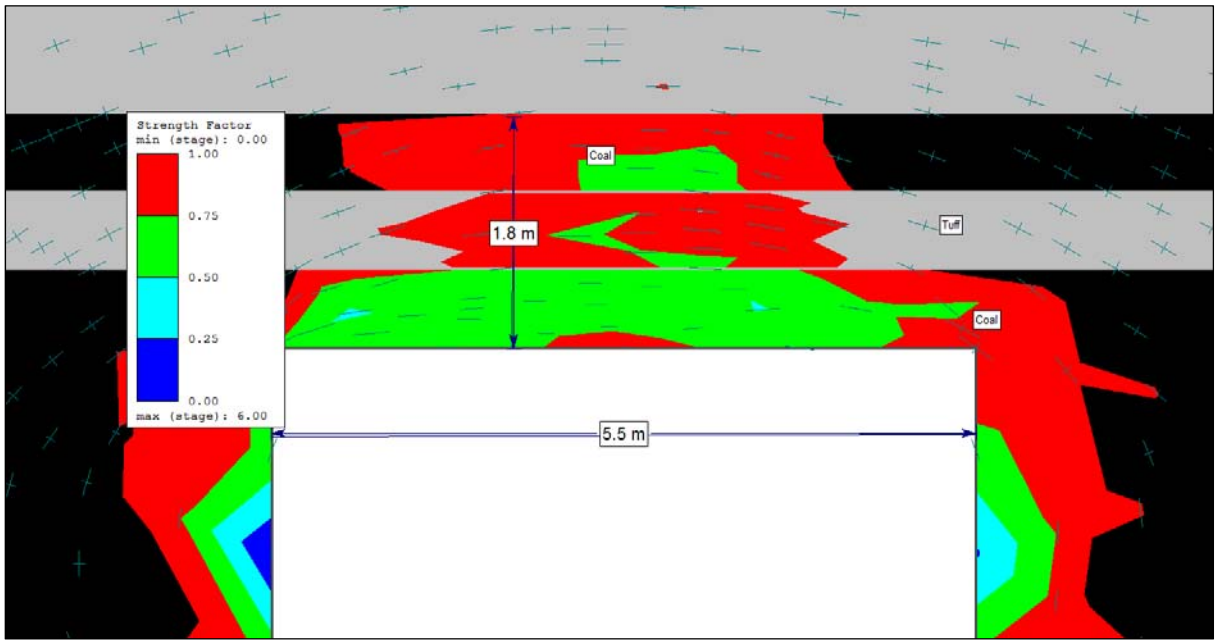

Figure 6 – Detailed presentation of the potential height of softening.

With regards to response to this softening the model indicates total displacement of less than 20mm in the centre of the roadway (see figure 7 below).

It is worth noting that while coal is a good roof support and most mines in practice leave a coal roof for the purpose of good roof conditions, the reduced lateral stress means that it may fail suddenly without obvious signs. However the overlying Nobbys Tuff remains a stable spanning unit that spans across the headings.

Therefore the combination of an adequate coal top layer and a tuff layer of at least 1m means that the first workings developments will remain largely stable.

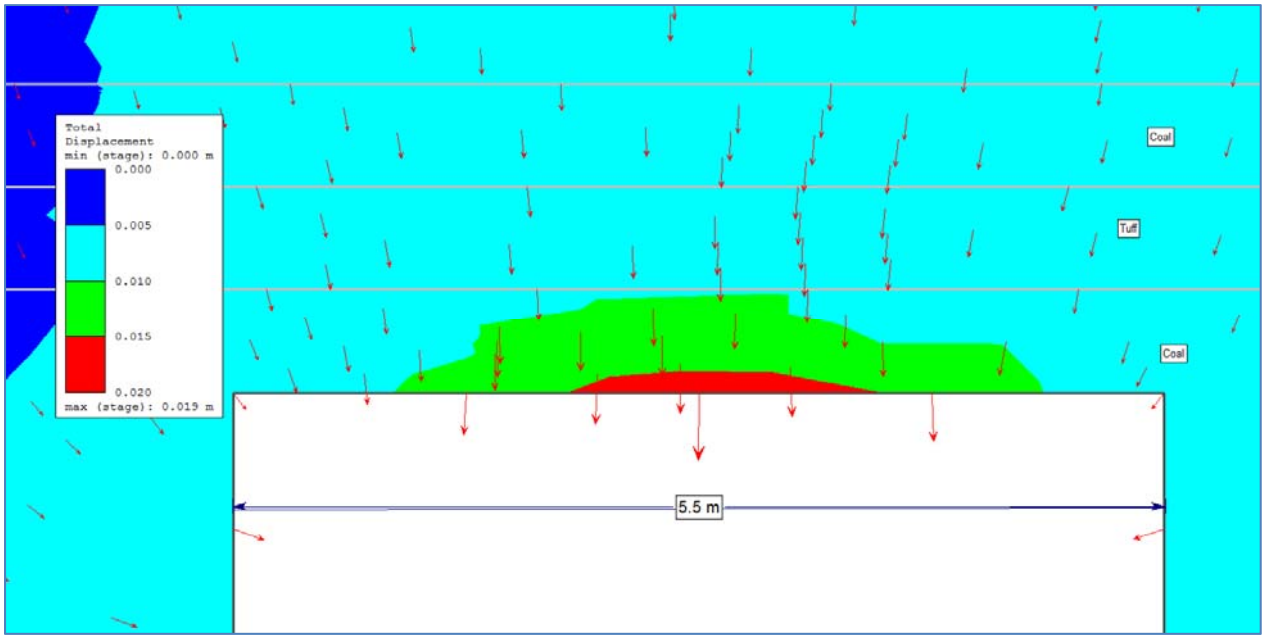

Figure 7 – Shows Potential deflection or displacement around the excavation with a maximum displacement of around 20mm in the centre of the roadway.

6.0 Conclusion

Based on the above, the following conclusion is made:

1) First workings in the Mod 8 are expected to be stable with any potential caving being confined to the immediate roof.
2) The design of leaving around coal tops coupled with at least **1m of the relatively competent Nobbys tuff** means that the developments will largely span across the 5.5m wide workings and associated intersections.
3) However given the potential for natural variations in strength, particularly in the Nobbys tuff, an appropriate roof support using 1.8m bolts will allow for reinforcement of the immediate roof and long term stability of the first workings.
4) With regards to the overlying aquifers and the flooded Awaba Workings located more than 140m above at the shallowest location of this section, the risk of caving creating a pathway for water into the workings is negligible.
5) Note that a separate assessment of the caving profile for second workings will be made as required.

Date: 18 July 2018

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From: Dr Ismet Canbulat

RE: **Assessment of height of fracturing in MOD 8 Study Area and the review of the report compiled by Newstan, entitled "Newstan Project – Mod 8 Study Area – Geotechnical report on the expected height of fracturing associated with first workings".**

1. BACKGROUND

At the request of Jason Boersma (Operations Projects Engineer, Newstan Colliery), an assessment of the potential height of fracturing in the proposed Mod 8 Study Area has been conducted. An internal report on the subject compiled by the mine has also been reviewed. This report is entitled "Newstan Project – Mod 8 Study Area – Geotechnical report on the expected height of fracturing associated with first workings".

The proposed first workings only mine layout is provided in Figure 1.

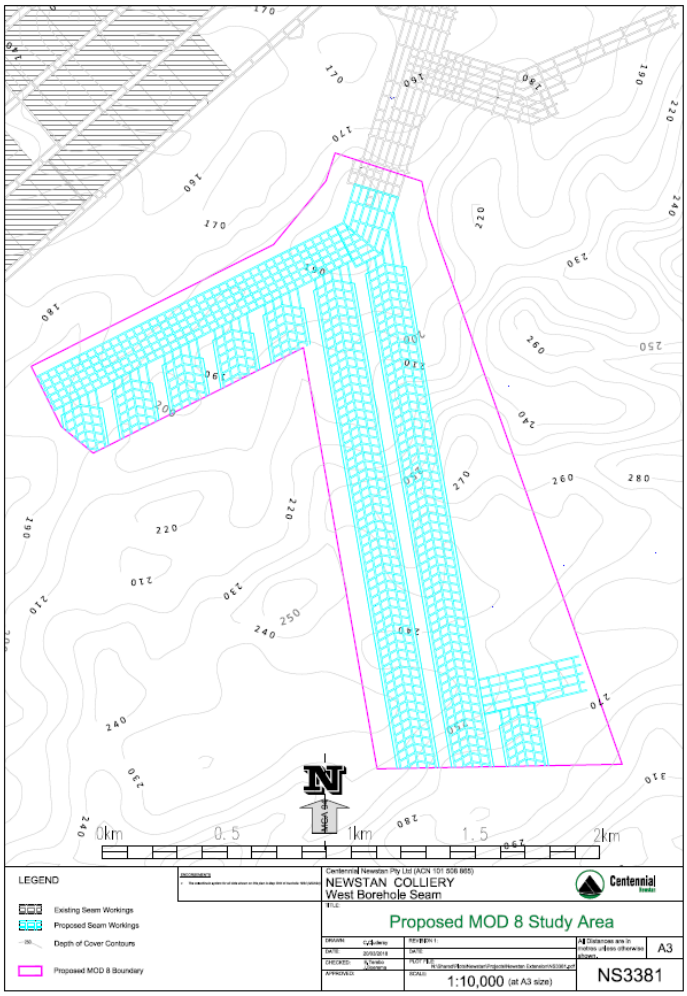

Figure 1. Plan showing the proposed first workings in MOD 8 Area

1.1 Site information

As part of this review, the following report has been provided:

- "Newstan Project – Mod 8 Study Area – Geotechnical Report on the Expected Height of Fracturing Associated with First Workings". Dated 16 May 2018. By Elliot Tembo.

For the sake of completeness, information regarding the geological and mining layout settings are taken directly from the above-mentioned report.

1.1.1 Geological setting

The proposed mining area is part of the western zone of the project area. This area is characterised by the presence of the full West Borehole Seam. It is bound by existing Newstan workings in the north and west, an igneous sill at seam level in the south-west and the seam split line to the east.

Target Seam

The West Borehole Seam generally ranges in thickness from 3.5m in the west to over 5.0m in the east. The marker horizon is the Dudley Clay, which is located consistently in the upper part of the West Borehole Seam and has a thickness of approximately 0.1m. The thickness of coal remaining in the roof is approximately 0.9m (i.e., it is planned to cut up to 0.4m above the Dudley Clay).

The UCS of the coal is approximately 26MPa, as quoted in a previous assessment of the adjacent Newstan workings.

Roof

The West Borehole Seam is overlain by the Nobbys Tuff which, in this section of the project area typically exceeds 1m in thickness. The Nobbys Tuff is directly overlain by the Fern Valley Seam, which is a thick sequence of interbedded coal and tuff layers.

The roof strengths derived from sonic velocity and laboratory tests range between 11 and 207MPa. Considering the interbedded coal and tuff layers, relatively weak roof conditions are expected in this part of the mine.

Floor

The floor material immediately below the West Borehole Seam (in the western part of the project area) is the Waratah Sandstone. This is a competent, medium to coarse grained sandstone with a strength between 60 and 70MPa. However, in some sections carbonaceous mudstone of up to 0.3m in thickness forms in the basal portion of the West Borehole Seam. This has been observed to break down, causing boggy conditions during mining.

1.1.2 Proposed Mining Layout

The proposed layout is indicated in Figure 2 and consists of the following features:

- First workings only (i.e., no secondary extraction).
- 35mx35m (centres) square pillars in mains.
- 35x35m (centres) parallelepiped pillars in the panels with cut throughs angled at 70^{o}.
- The mains are separated from the panels by barrier pillars. Similarly, the panels are separated by inter-panel barrier pillars. These barrier pillars are not part of this assessment. It is understood that the barrier pillars are designed with an appropriately high factor of safety, as required for barrier pillars.

The workings are proposed to be mined at a nominal width of 5.5m and height of 3.2m.

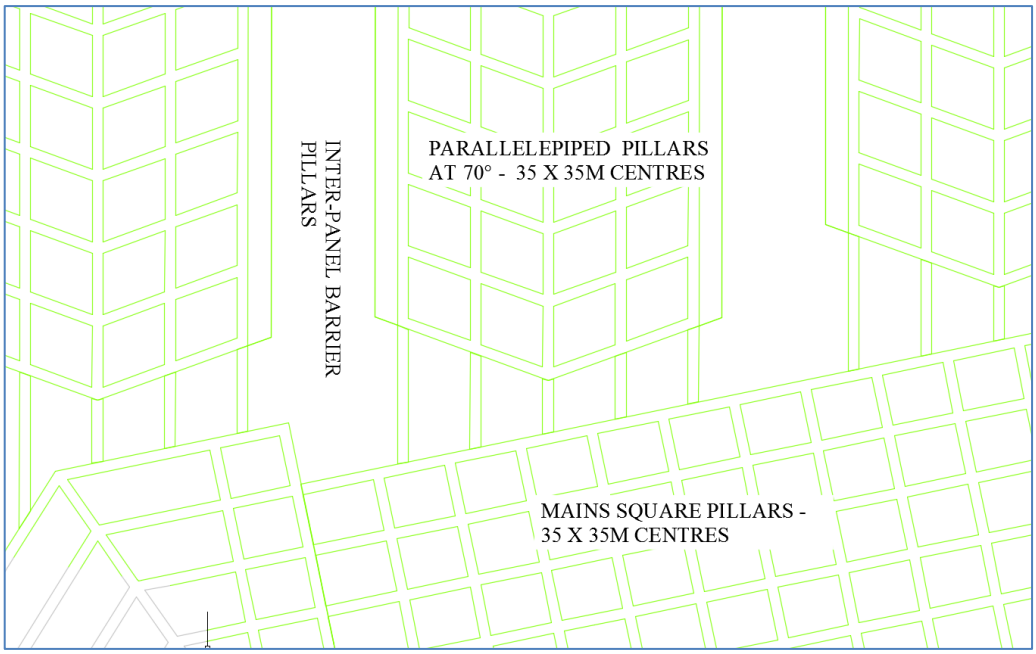

Figure 2. Schematic layout of the proposed first workings in the Mod 8 Area

2. PURPOSE AND SCOPE

The purpose and scope of this study is to assess the potential height of fracturing in the MOD 8 study area and the review of the report compiled by Newstan, entitled "Newstan Project – Mod 8 Study Area – Geotechnical Report on the Expected Height of Fracturing Associated with First Working".

It is understood that the primary consideration of this review is to determine; "will there be a hydraulic connectivity to the overlying aquifers and the flooded Awaba workings, which are located more than 140m above at the shallowest location of the proposed workings?".

3. GENERAL REMARKS ON HEIGHT OF FRACTURING

There are a number of definitions of height of fracturing used by different disciplines (e.g., geology, hydrogeology, structural, geotechnical and mining engineering). In the context of this study, the height of fracturing is defined as "the height of continuous or connective vertical fracturing" (Galvin, 2016b). As suggested by such a definition, there needs to be vertical (or interconnected) fracturing (or fracture networks) in the overburden caused by mining to provide connectivity between the proposed workings and the groundwater and/or Awaba workings.

The caving mechanisms vary between high extraction mining methods (i.e., longwall and pillar extraction) and the bord and pillar mining method (i.e., first workings). Compiled below is a short summary of the differences in caving mechanisms in longwall and bord and pillar mining methods.

3.1 Overburden caving characteristics in longwall mining

It is not the intention of this report to explain the detailed principles of caving mechanism in longwall mining, but rather to present simple models which demonstrate that longwall mining is usually associated with caving of the immediate strata in the overburden followed by further fracturing up to the surface.

Figure 3 shows a generalised conceptual model (Forster and Enever, 1991) illustrating the caving behaviour of longwall mining, which can be expected within the overburden due to subsidence above a full extraction panel. This model divides the overburden into four ground deformation zones.

These four broad zones are:

1. **Caved Zone**, in which the roof rock is completely disrupted and disintegrated as it falls into the goaf. Can extend up to 10 times the extracted seam height.

2. **Fractured Zone**, within which the subsidence strains are great enough to cause new fracturing in the rock and create direct hydraulic connections to the lower seam. The top of this zone can be as high as 21 to 33 times the extracted height.

3. **Constrained Zone**, where the permeability is enhanced but little new fracturing is created. The thickness of this zone is variable based on the local geology.

4. **Surface Zone**, where subsidence normally causes no change in strata properties other than occasional bed slippage.

The dimensions of these zones vary from mine to mine and even panel to panel due to differences in geology and panel geometries; therefore, this proposed model is not complete or universally accepted Galvin (2016a).

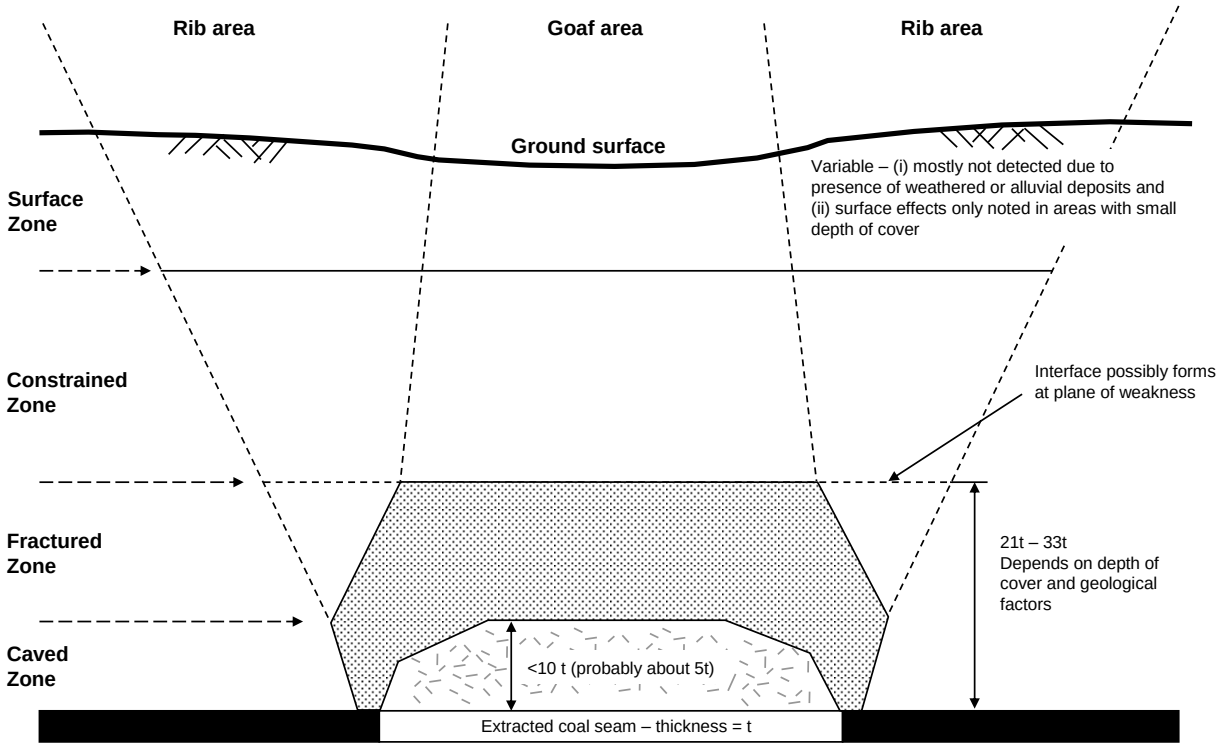

Figure 3. Schematic illustration of hydrogeological model proposed for use in the Central Coast area of the Newcastle Coalfield (After Forster and Enever 1991)

Galvin (2016a) summarises a selection of proposals for the thickness of zones associated with hydrogeological models (extended and modified from Forster 1995), as shown in Table 1.

Table 1. A selection of proposals for the thickness of zones associated with hydrogeological models (extended and modified from Forster 1995), after Galvin 2016a

Author	Country	Thickness of deformation				Remarks
		Caved zone	Fractured zone+	Constrained zone*	Surface zone	
Kenny (1969)	UK	2–4 t	–	–	–	Caving observations
Silitsa and Vasilenko (1969)	USSR	–	16 t	4 t	–	Measured results using dyes
Kapp and Williams (1972)	Australia	–	<30 m (assumed by authors to be 100 ft)	–	15 m (50 ft – adopted by authors from Orchard, 1969)	Zone thicknesses are only estimates (assumptions)
Ropski and Lama (1973)	Poland	1.5–2 t	3–3.5 t	–	–	Borehole observations
Orchard (1974)	UK	6–9 m	18–36 m	30 m	<30 m	Constrained zone should contain 50 % shale
Morton (1975, 1976)	Australia (Wongawilli and Kemira)	<30 m	34 t (94 m)	–	12 m	Based on measurements of permeability and piezometric pressure
Wardell (1975)	Australia (Newcastle) NSW	<5 t	<10 t	50 t-S	S	S = assumed surface zone thickness
Wardell (1973, 1976)	Australia (NSW South Coast)		10 t	60 m	12–15 m	Recommendations based on overseas experience
Singh & Kendorski (1981)	UK	3–6 t	30–58 t	9–27 m	<15 m	Constrained zone thickness depend on lithology
Holla and Armstrong (1986)	Australia (NSW Hunter Valley)	2 t	10–13 t (36–45 m)	–	–	Borehole anchors used to determine strains
Singh (1986)	UK	3 t	100t/ (3.1t + 5)	8 t	<15 m	Weak strata
		5 t	100t/ (1.2t + 2)	15 t	15 m	Strong strata
Kesseru (1984)	Hungary	–	20–40 m	15–25 m	–	Field experience
Kesseru et al. (1987)						

t seam thickness *includes caved zone thickness + recommended safe distance for subaqueous mining

3.2 Overburden caving characteristics in bord and pillar mining

In bord and pillar mining, provided that the pillars are design to be long-term stable, no caving is associated with mining. When bords are excavated, the compression of pillars causes some low level of elastic subsidence in the roof, pillar and floor. The amount of subsidence can vary depending on the pillar sizes and be calculated using the elasticity theory.

In the case of failure of pillars, surface and subsurface subsidence are different to those where high extraction mining methods are used. Since the pillars provide some form of resistance to the overlying rock mass, there is no free collapse of overburden. The entire rock mass sits down on the failing pillars, as shown schematically in Figure 4 (van der Merwe and Madden, 2010). Whilst the failure could still cause differential fracturing and movement between the bedding planes and different units, this differential movement is likely to be less than what would be expected in the high extraction mining method, depending on cover depth and overburden characteristics.

Van der Merwe and Madden (2010) state that since there is no goaf (i.e., failed, disintegrated material) to compress in pillar failures, the rate of subsidence is governed by the rate at which the pillars fail and the rate at which the sliding between the jointed blocks can occur, which is significantly greater than the rate of goaf compression. Thus, a meaningful amount of subsidence often occurs almost immediately and always within 24 hours.

Van der Merwe and Madden (2010) also state that due to the absence of a voided goaf, the total volume of subsidence is very close to the total volume of mining underground at shallow depths (e.g., ~80m). As the depth increases, the ratio gradually reduces.

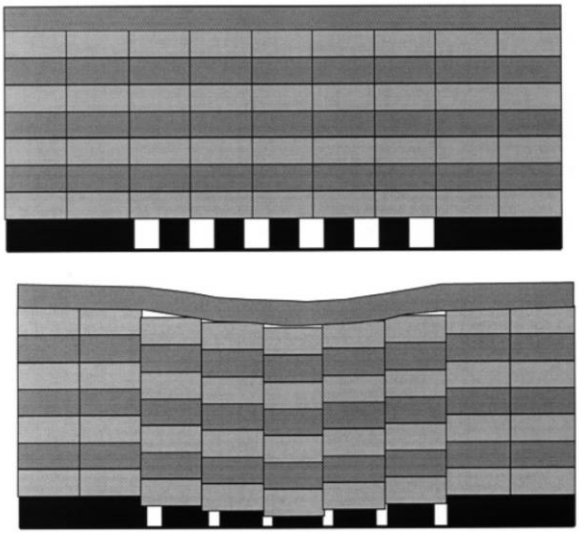

Figure 4. Simplified schematic drawing illustrating the basics of the subsidence mechanism in case of pillar failure (after van der Merwe and Madden, 2010)

Another failure type in bord and pillar mining which can potentially cause connectivity to the aquifers and/or previous workings is chimney failures. Chimney failures can occur during mining or many years after mining in bord and pillar working intersections. Most failures develop due to the progressive collapse of roof strata. The pillar factor of safety formula developed for bord and pillar mining gives no indication as to the stability of intersections or roadways, particularly over a long period of time. Collapse of intersections can result in connectivity to aquifers or previous workings. At shallow depths, these types of failures are referred to as sinkholes when they reach surface.

Since the intersections are approximately 40% wider (diagonally) than the roadways, these failures are more common in intersections. The height of failure in intersections is a function of the stability of the immediate layer in the roof, the dimensions of workings and the geology of the overburden strata. The bulking factor (defined as the ratio of total volume to solid volume) of the caved material, the mining height and the intersection width determine the amount of material that will spill into the workings when the strata fails. This type of failure is referred to as a bulking controlled failure.

The bulking controlled failure is illustrated in Figure 5. Ignoring the shape of the crown, the maximum height (z) of a potential collapse in large pillar widths above the roof line, based on an equilibrium volume between the in-situ rock in the "chimney" and the caved (and bulked) material in a 4-way intersection can be expressed by the following equation:

$$z = \frac{2(hb^2 + 2bh^2 \cot \alpha)}{(B-1)\pi b^2} \qquad [1]$$

where w = pillar width (m)
h = mining height (m)
α =angle of repose of the caved rock (°)
B = bulking factor
b = roadway width (m)

Due to the potential for unconsolidated wet material to flow into the mine, if the caving chimney intersects an aquifer within the overburden, a critical consideration in this type of failure is the groundwater. It is also of note that the height of the goaf in the bulking factor analysis is only valid where water does not wash away or decompose the fallen material.

When a competent unit exists in the overburden, it will arrest the failure. The stability of competent units can be assessed using currently available methods by assuming the unit as a crown pillar.

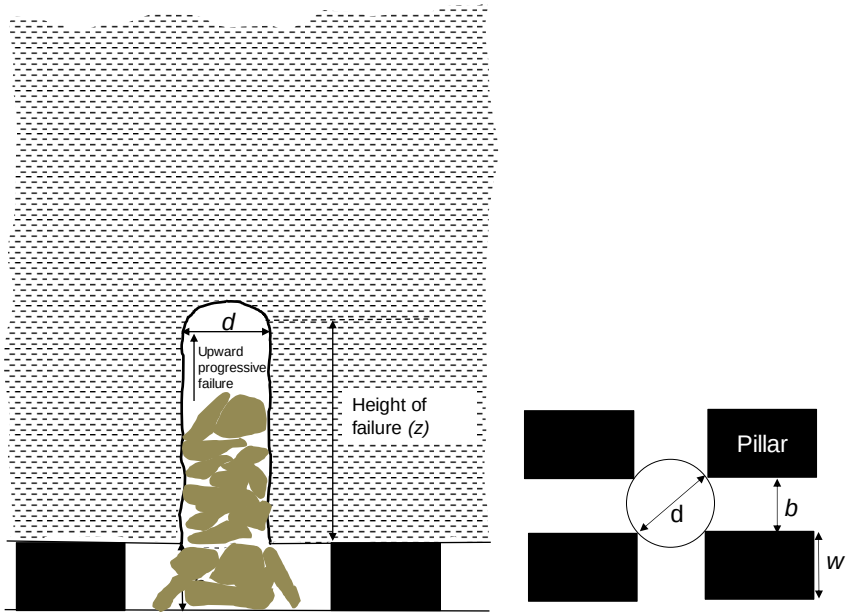

Figure 5. Mechanism of progressive failure in intersections

As the essential parameter in this type of failure is the bulking factor, an understanding of bulking factors in coal measure rocks needs to be established. Canbulat et al. (2017) reviewed 14 relevant studies to establish that the bulking factor of coal measure rocks varies from 1.1 to 1.9, with an average of approximately 1.42. This data can be best represented by a Pert distribution using the following parameters.

Table 2. Statistical parameters established for bulking factor in coal measure rocks (Canbulat et al. 2017)

Continuous mode parameters	1.08
Boundary parameter 1	1.31
Boundary parameter 2	2.16

The density distribution of bulking factor using the statistical parameters above are presented in Figure 6.

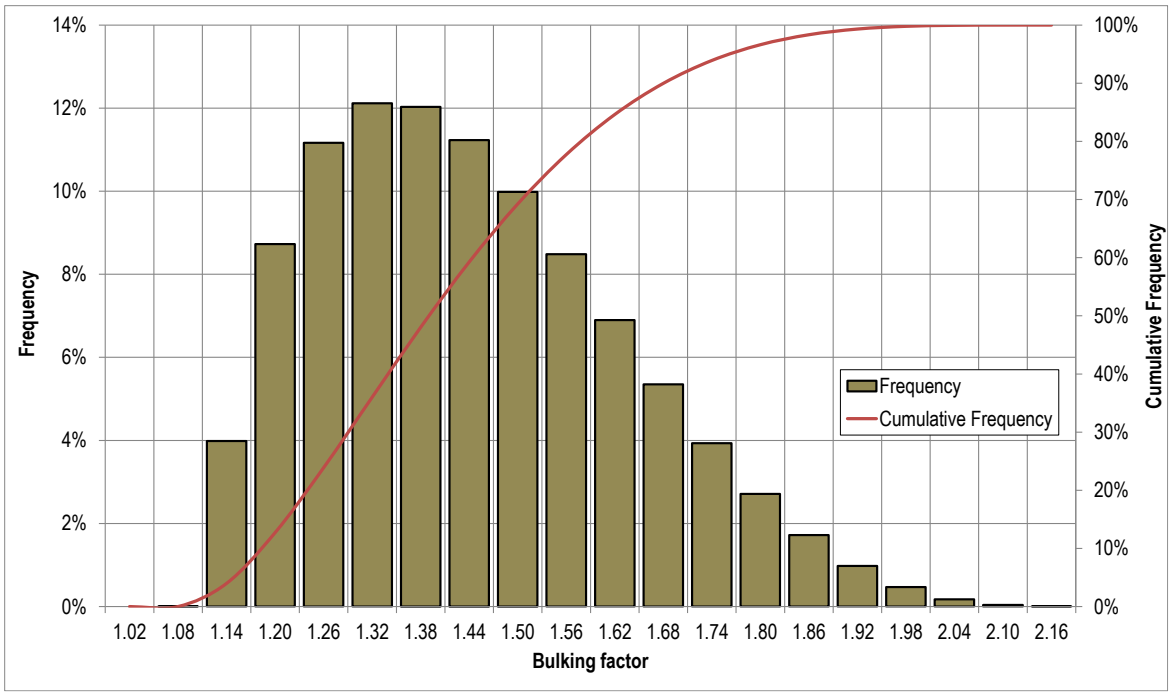

Figure 6. Distribution of bulking factor data obtained from the literature

From the preceding summary, it is evident that caving mechanisms in the proposed first workings will be entirely different to those in high extraction mining methods. Therefore, two critical assessments in the case of Newstan Colliery are the pillar stability and height of chimney failures that may create connectivity to the aquifers and the previous Awaba workings.

In the following sections, the risk of these two failure types is assessed for the proposed workings.

4. ASSESSMENT OF PILLAR STABILITY AND CHIMNEY HEIGHT

4.1 Pillar stability

The stabilities of the proposed pillars have been assessed by Tembo (2018) in his internal report to Newstan Colliery. The methodology and results presented in his report are considered to be sound and acceptable (with some minor variations between the author's and Tembo's calculations).

The results indicate that the factors of safety of all pillars are >2.1 with a minimum pillar width to mining height (w/h) ratio of 8.5. Based on these results, it is concluded that it is highly likely that the proposed pillars will be long-term stable. Therefore, hydraulic connectivity between the aquifers and the previous Awaba workings due to pillar failure is unlikely.

Note that a further assessment of the long-term stability of the pillars can also be assessed using the methodologies proposed by Salamon et al (1998) and Canbulat (2010). However, considering the size and the stiffness of the proposed pillars, it is deemed unnecessary to conduct a detailed assessment in this case.

4.2 Intersection failure height

An assessment of the caving height in the intersections are conducted in this review. In this assessment it is assumed that there are no competent units in the immediate overburden (i.e., at least within the first 50m) that can arrest complete chimney failure. The potential cavity height is calculated using Equation 1 and the bulking factor input parameters as presented in Table 2.

Figure 7 shows the cumulative and density distributions of intersection failures. Note that a nominal 10m intersection width and an angle of repose of 35^{o} are assumed in this assessment. It is evident from this figure that the potential

height of caving in intersections will reach approximately 37m, with an average of approximately 10m. Therefore, it is unlikely that an intersection failure will create a hydraulic connective.

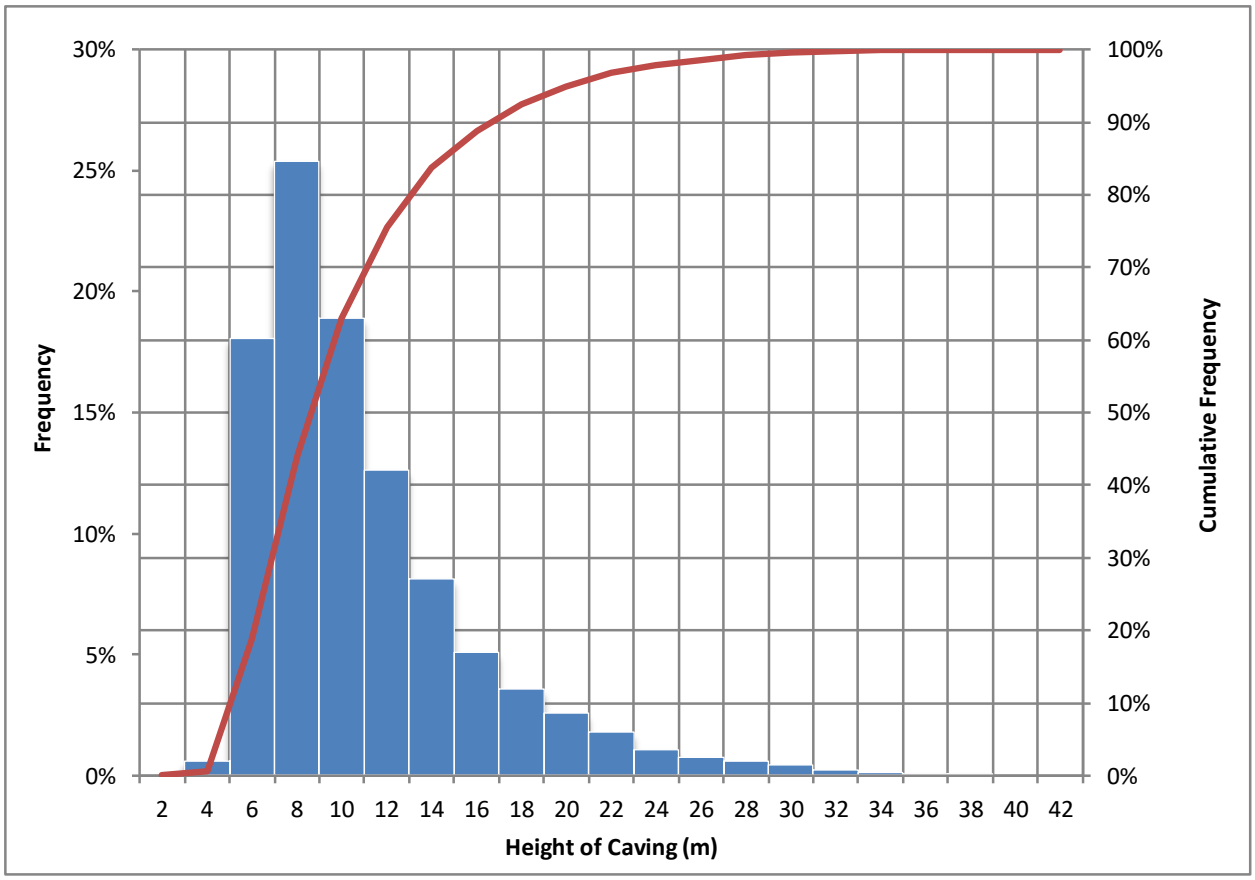

Figure 7. Cover depth versus pillar FoS for mining height of 4.5m

5. CONCLUSIONS

Caving mechanisms in longwall and bord and pillar mining are different. While a disintegrated goaf exists in longwall mining, there is no free collapse of the overburden in the case of pillar failure in first workings. Nevertheless, failure of pillars could still cause differential fracturing and movement between the bedding planes and different units, which could, in turn, create a fracture network that can provide hydraulic connectivity to the aquifers and the flooded Awaba workings. Although this is a low likelihood event, the long-term stability of pillars is critical. An assessment of pillar stabilities indicates that it is likely that the proposed pillars will be long-term stable. Therefore, the risk of hydraulic connectivity between the proposed panels, aquifers and the flooded Awaba workings is very low.

Another failure type in bord and pillar mining which can potentially cause connectivity to the aquifers and/or previous workings is the chimney failure of the intersections. Most failures develop due to the progressive collapse of the roof strata. The pillar factor of safety formula developed for bord and pillar mining gives no indication as to the stability of intersections or roadways, particularly over a long period of time. Therefore, an assessment of the likely height of chimney failures has been conducted. These results indicate that the maximum height of chimney failures is 37m, with an average of approximately 10m.

Based on these results, it is concluded that the overall risk associated with fracture connectivity in the proposed workings is very low.

Note that the results and the conclusions presented in this report are based on the fact that the overlying aquifers and the flooded Awaba workings are located more than 140m above the shallowest part of the proposed workings. This information is provided by the mine; if this dimension happens to be different, a further assessment is recommended.

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Title:	Assessment of height of fracturing in MOD 8 Study Area and the review of the report compiled byvNewstan, entitled "Newstan Project – Mod 8 Study Area – Geotechnical report on the expected height of fracturing associated with first workings".
Report No:	NST-2018/1
Author:	Ismet Canbulat, FIEAust, FAusIMM, RPEQ
Date:	18 July 2018
Purchase Order No:	JBO29
Signature:	

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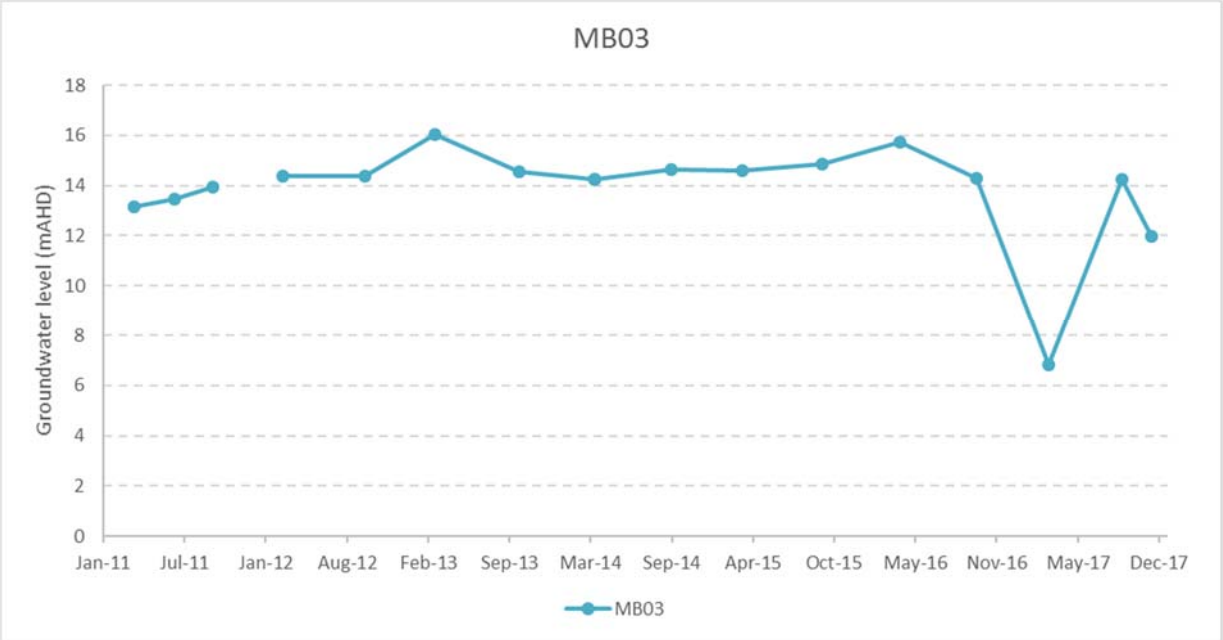
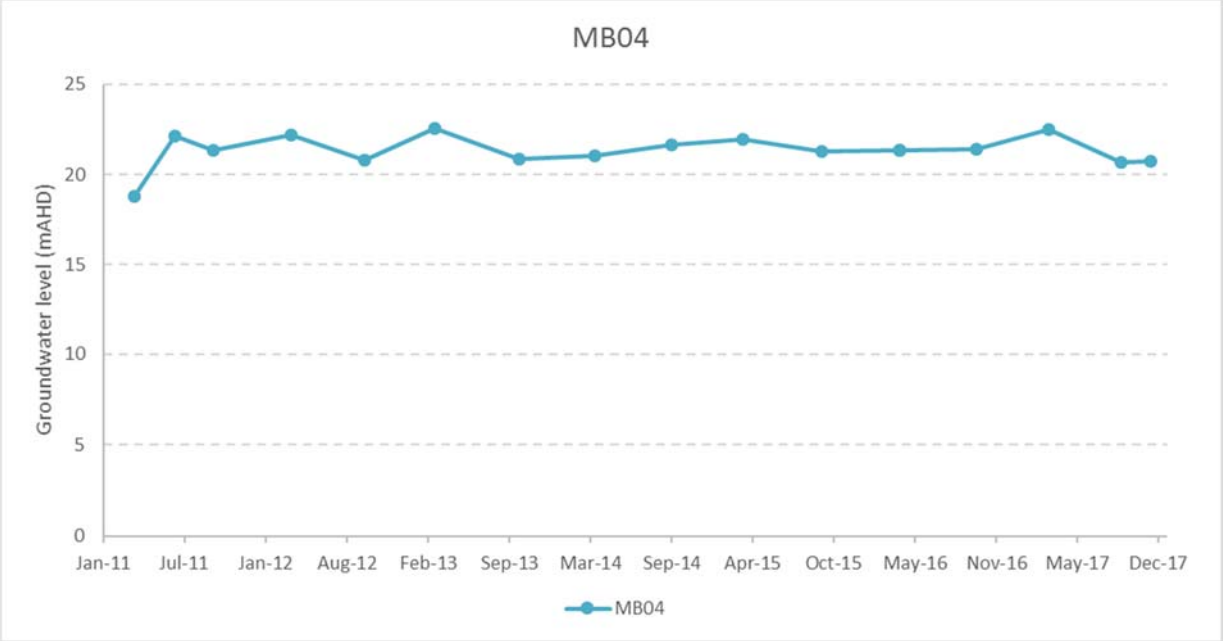
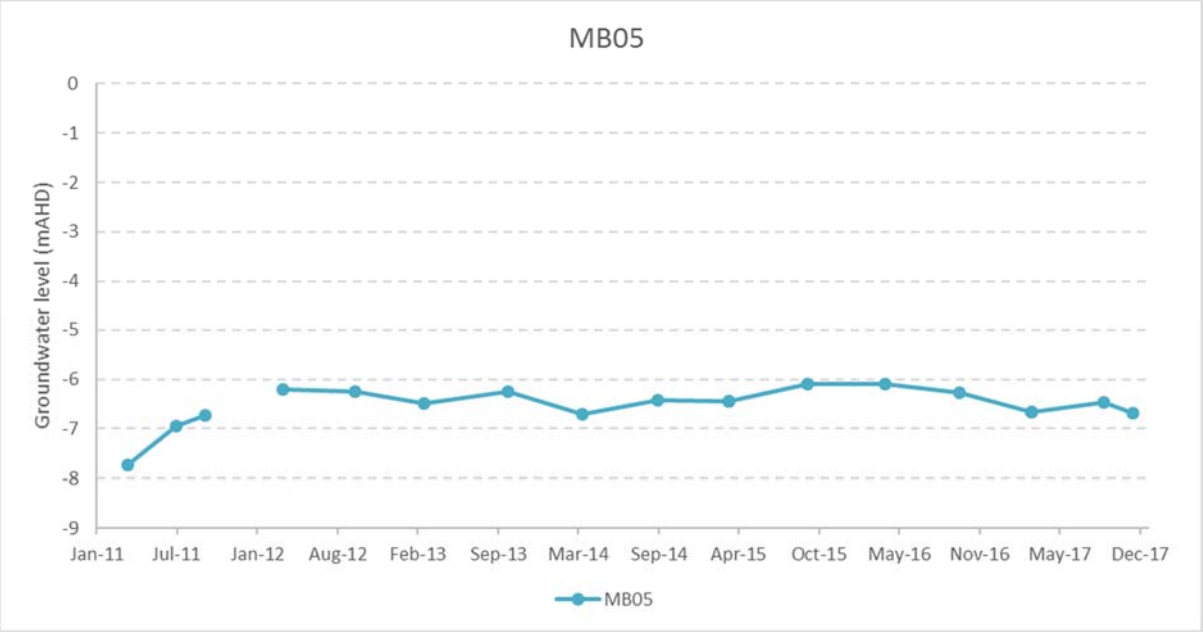
Ismet Canbulat is employed as Professor and Kenneth Finlay Chair of Rock Mechanics at The University of New South Wales (UNSW) Sydney. In accordance with policy regulations of UNSW regarding external private consulting, it is recorded that this report has been prepared by the author in his private capacity as an independent consultant, and not as an employee of UNSW. The report does not necessarily reflect the views of UNSW, and has not relied upon any resources of UNSW.

Appendix C – Groundwater hydrographs



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-3
-4
-5
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-7
-8
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Jan-11
Jul-11
Jan-12
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Mar-14
Sep-14
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Nov-16
May-17
Dec-17
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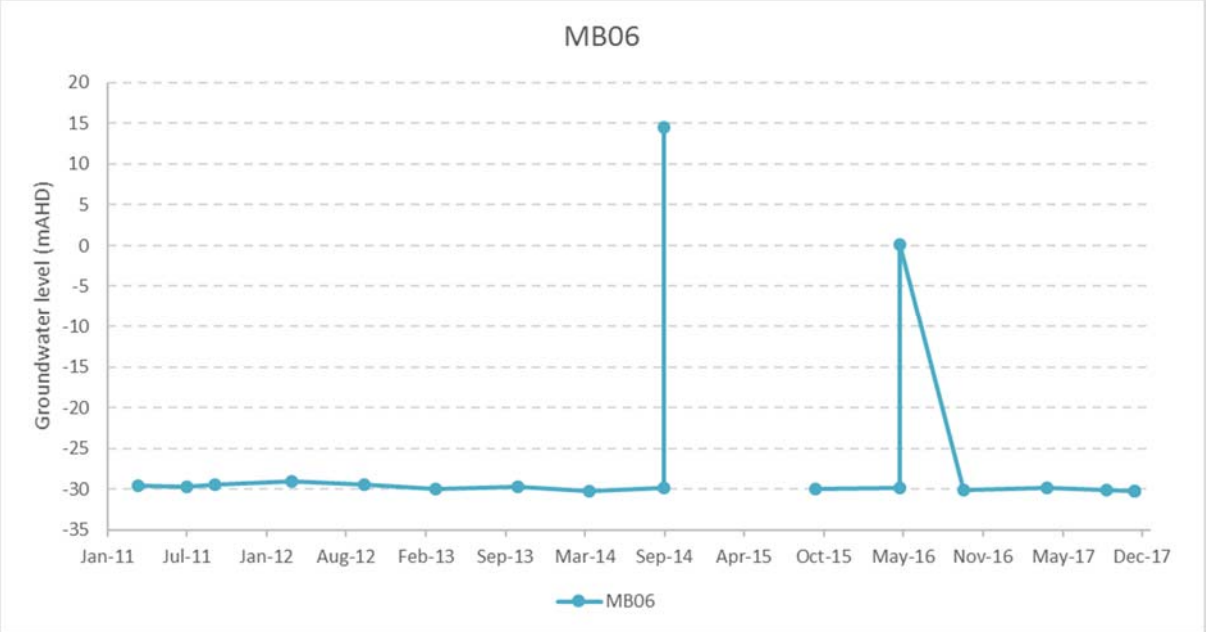
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Groundwater level (mAHD)
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15
10
5
0
-5
-10
-15
-20
-25
-30
-35
Jan-11
Jul-11
Jan-12
Aug-12
Feb-13
Sep-13
Mar-14
Sep-14
Apr-15
Oct-15
May-16
Nov-16
May-17
Dec-17
MB06

MB09
Groundwater level (mAHD)
25
24.5
24
23.5
23
22.5
22
21.5
21
20.5
Jan-11
Jul-11
Jan-12
Aug-12
Feb-13
Sep-13
Mar-14
Sep-14
Apr-15
Oct-15
May-16
Nov-16
May-17
Dec-17
MB09

MB10
Groundwater level (mAHD)
24.6
24.4
24.2
24
23.8
23.6
23.4
23.2
23
22.8
22.6
Jan-11
Jul-11
Jan-12
Aug-12
Feb-13
Sep-13
Mar-14
Sep-14
Apr-15
Oct-15
May-16
Nov-16
May-17
Dec-17
MB10

MB11
Groundwater level (mAHD)
30.4
30.2
30
29.8
29.6
29.4
29.2
29
28.8
28.6
Jan-11
Jul-11
Jan-12
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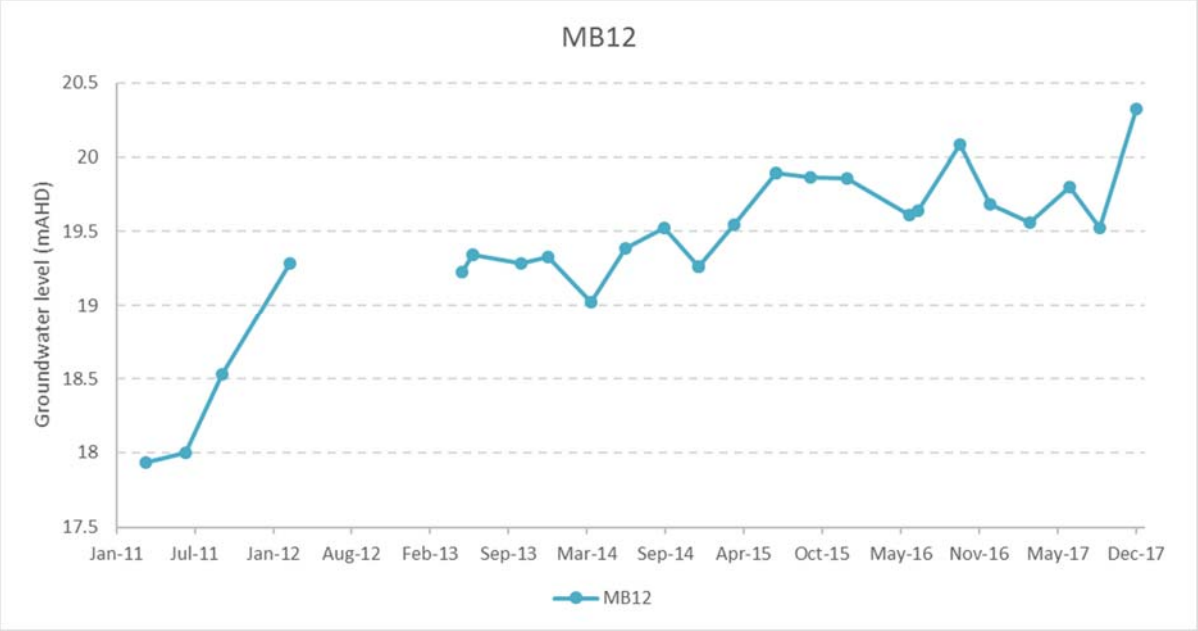
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19.5
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18.5
18
17.5
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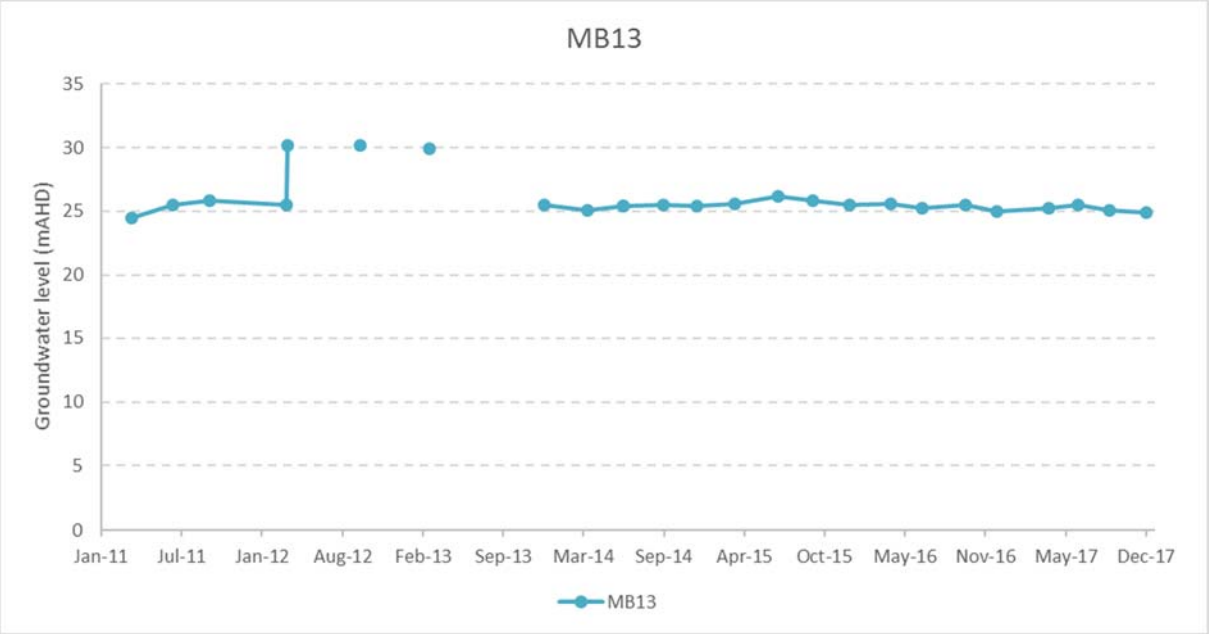
May-17
Dec-17
MB12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Groundwater level (mAHD)
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20
15
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5
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Jan-11
Jul-11
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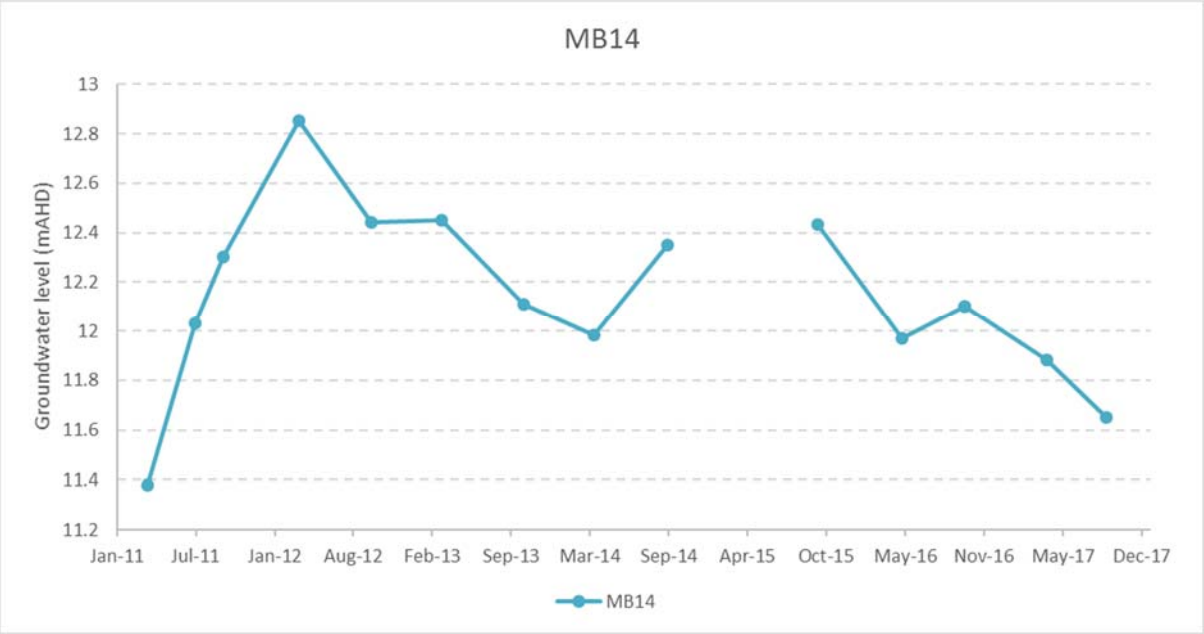
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Groundwater level (mAHD)
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12.4
12.2
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Jul-11
Jan-12
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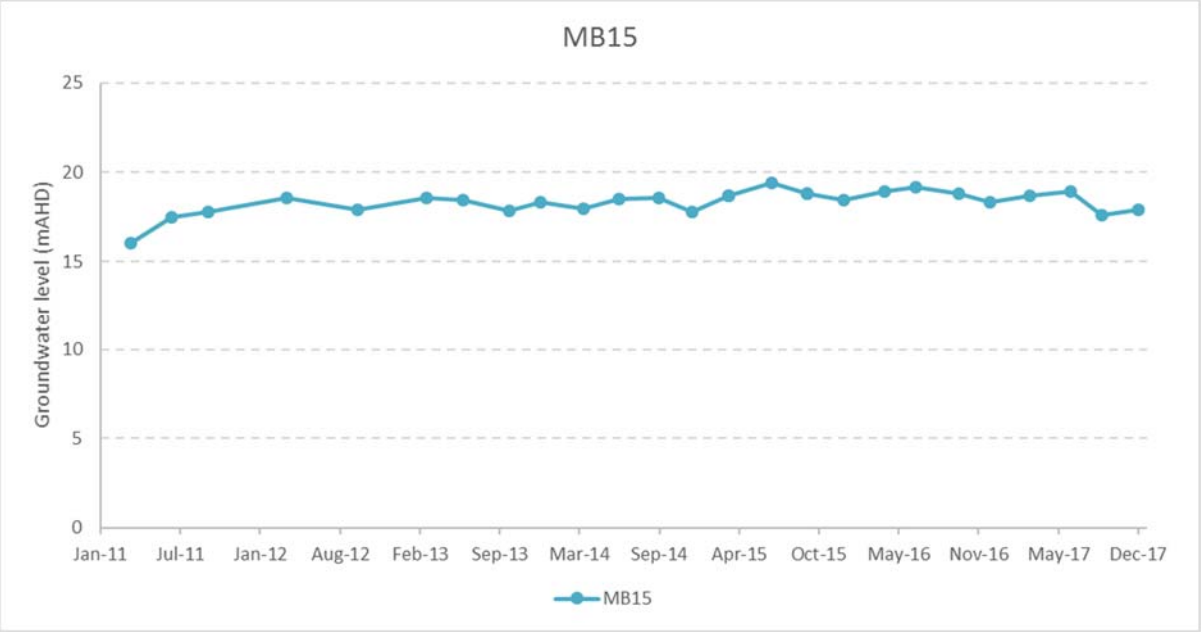
Dec-17
MB14


MB15
Groundwater level (mAHD)
25
20
15
10
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0
Jan-11
Jul-11
Jan-12
Aug-12
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Sep-14
Apr-15
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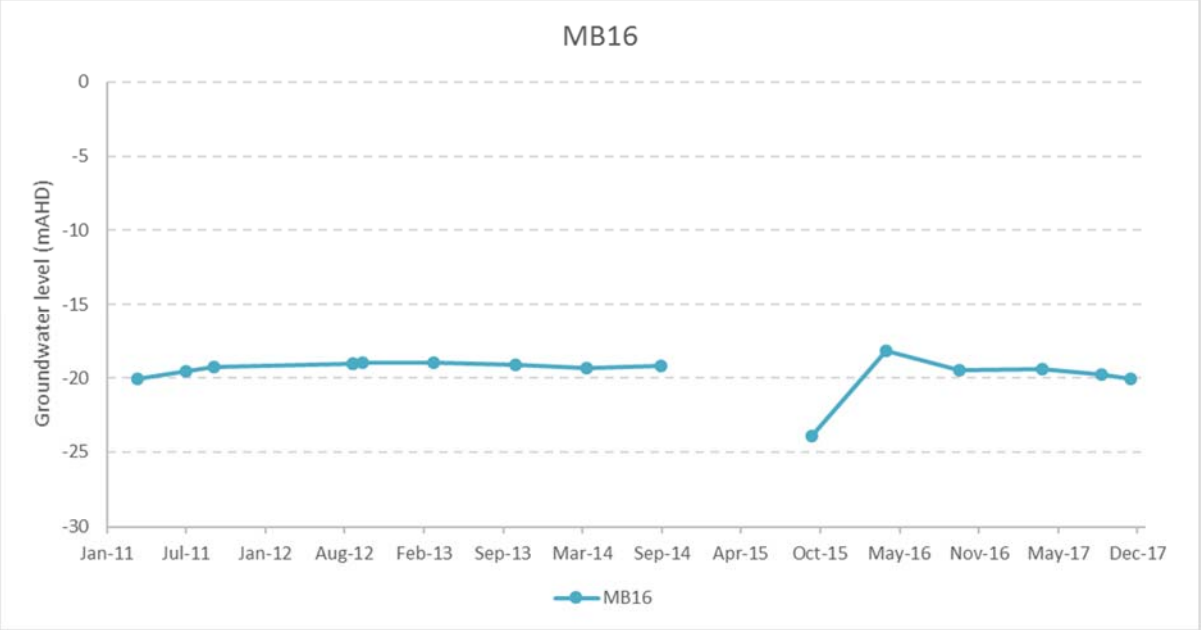
Nov-16
May-17
Dec-17
MB15


MB16
Groundwater level (mAHD)
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-10
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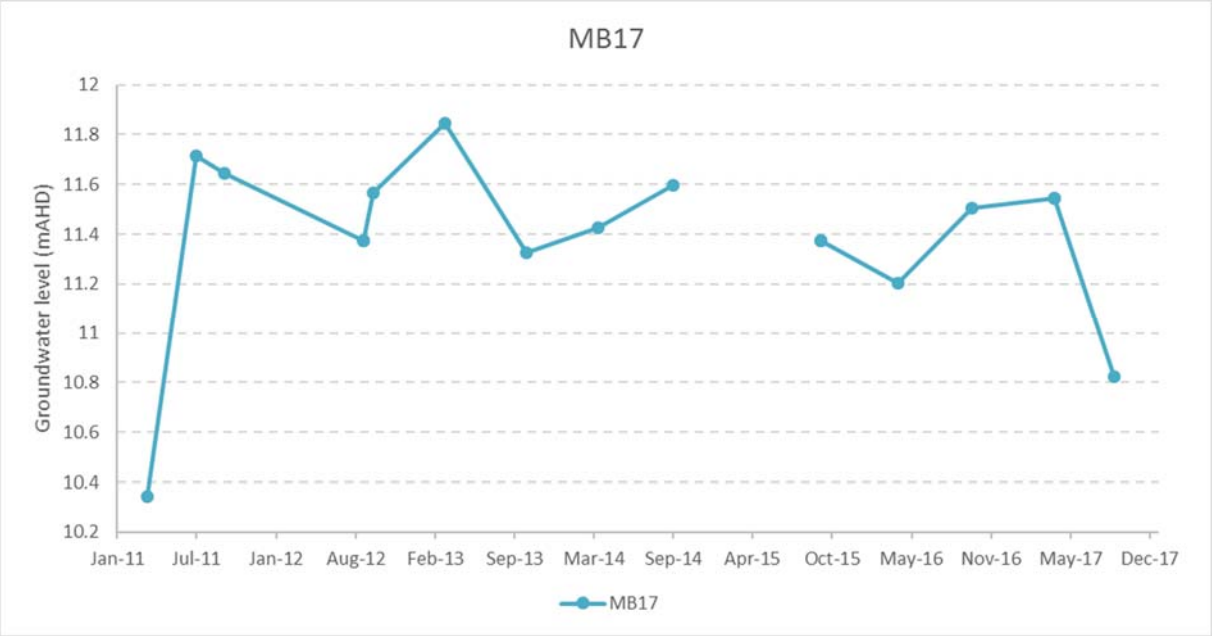
Dec-17
MB16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Groundwater level (mAHD)
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11.8
11.6
11.4
11.2
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Jul-11
Jan-12
Aug-12
Feb-13
Sep-13
Mar-14
Sep-14
Apr-15
Oct-15
May-16
Nov-16
May-17
Dec-17
MB17

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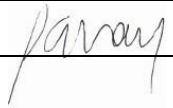
2219545-42553/https://projects.ghd.com/oc/newcastle1/newstanmod8wria/Delivery/Documents/2219545-REP-Newstan_MOD_8-Water_resources_impact_assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
2	JC, SG, TT	S. Gray		S. Gray		12/09/2018

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Appendix H – Air quality impact assessment

NEWSTAN COLLIERY

Modification 8
Air Quality Impact Assessment

Prepared for:

Centennial Coal

SLR Ref: 610.18169-R02
Version No: v1.1
September 2018

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18169-R02-v1.2	13 September 2018	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence
610.18169-R02-v1.1	9 August 2018	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence
610.18169-R02-v1.0	8 August 2018	Varun Marwaha	Kirsten Lawrence	Kirsten Lawrence

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1 Introduction

Centennial Coal (Centennial) has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery. Presently, the development consent for Newstan Colliery (DA 73-11-98) approves the extraction up to 4 million tonnes per annum (Mtpa) of run of mine (ROM) coal, and has an expiry date of 6 July 2020. A modification is being sought to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021, with up to 2 Mtpa coal to be extracted during this period by first workings only.

This Air Quality Impact Assessment (AQIA) assessment has been prepared to assess air quality impacts due to Newstan Colliery's operations proposed as part of the eighth modification to the original consent for Newstan Colliery (DA 73-11-98) (hereafter 'MOD 8').

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Newstan Pty Ltd (Centennial Newstan) to undertake an AQIA to assess the potential impacts on local air quality due to the proposed modification, in particular the extraction of 2 Mtpa of coal from Newstan Colliery.

1.1 Background

The air quality impacts from Newstan Colliery's operations were assessed as part of the Northern Coal Logistics (NCL) Project by SLR in December 2014 (SLR 2014). The development consent for NCL Project (SSD-5145) was granted in December 2017.

The NCL Project assessment area comprised the Newstan Colliery Surface Site, Cooranbong Entry Site, private haul roads and Hawkmount quarry. The Newstan Colliery Surface Site includes coal handling and preparation infrastructure, rail loading infrastructure, coal reject emplacement facilities and ventilation infrastructure for Newstan Colliery's underground workings.

Extraction of the coal from Newstan Colliery's underground workings forms part of the development consent for Newstan Colliery (DA 73-11-98) until it reaches the surface, at which point it becomes part of the development consent for the NCL Project (SSD-5145). Whilst the mine ventilation system for the underground workings of Newstan Colliery was also modelled as part of the NCL Project to provide a comprehensive cumulative assessment of air quality impacts at the Newstan Colliery Surface Site, they remain approved under DA 73-11-98. Air quality impacts as a result of MOD 8 are therefore only associated with Newstan Colliery's ventilation facility which forms the basis of this report.

For consistency, the AQIA presented in this report references some information and data compiled as part of the NCL Project AQIA (SLR 2014).

1.2 Assessment Approach

The pollutant emission rates for MOD 8 operations have been estimated and compared to the operations assessed as part of the NCL Project.

The impacts predicted due to Newstan ventilation fan operations in the NCL Project AQIA have been referenced to assess the scale of impacts from the proposed MOD 8 operations.

2 Project Overview

2.1 Overview

Centennial has initiated feasibility investigations into the recommencement of mining at Newstan Colliery located at Fassifern, NSW.

Investigations are currently focused in the southern portion of the Colliery Holding Boundary under and surrounding Awaba Colliery and are remote from residential areas. Centennial is evaluating mine design options in addition to methods of extraction in conjunction with relevant technical experts to understand the potential impacts on sensitive surface features. In addition, Centennial is examining the requirement for potential surface infrastructure to support the operation.

Newstan Colliery began mining operations in 1887. After the introduction of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), mining operations continued on the basis of existing use pursuant to the provisions of Part 4, Division 10 of the EP&A Act (existing use rights). Newstan Colliery is currently approved under DA 73-11-98 which was originally granted in May 1999. The original approval enabled mining to continue within the existing mining areas as well as the expansion into areas that had not previously been mined. The approved Newstan Colliery Life Extension Area under Development Consent DA 73-11-98 essentially filled in the gap between the Newstan Colliery and Awaba Colliery lease areas. Since the initial approval of DA 73-11-98, the progressive history of mining approvals for Newstan Colliery has resulted in a patchwork of approved areas from the originally approved mining area (under existing use rights) to the current approved mining areas (comprising the Consolidated Consent Boundary under Development Consent DA 73-11- 98 as modified). DA 73-11-98 has since been modified seven times; most recently in December 2015.

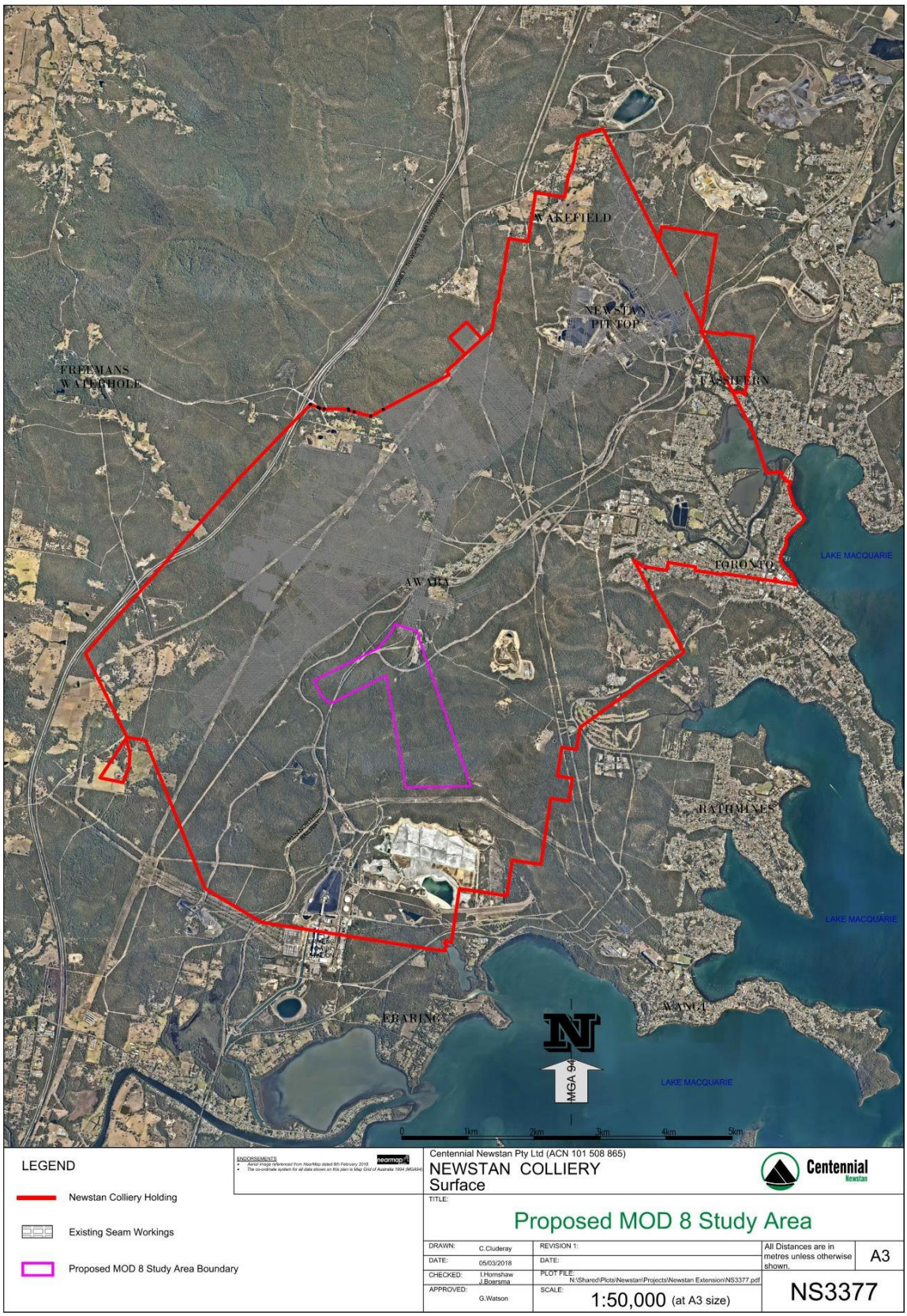
Various seams have been mined at Newstan Colliery, being the upper seams (Great Northern and Fassifern seams) and the lower seams (West Borehole, Borehole, Young Wallsend and Yard seams). Prior to being placed on care and maintenance, mining was undertaken in the West Borehole Seam under the provisions of Development Consent DA 73-11-98. Newstan has current approval to extract up to 4 Mtpa of ROM coal. The mine, along with beneficiation by the Newstan Coal Preparation Plant (CPP), can produce thermal coal products suitable for domestic and export markets, and a low sulphur semi-soft coking coal product.

A modification is required to enable first workings to proceed and determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021. It is proposed to modify the Newstan Colliery Development Consent DA 73-11-98 pursuant to Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A Section 75W application was made on 26 February 2018 and was accepted by the NSW Department of Planning and Environment noting that formal Environmental Assessment Requirements will not be issued for the modification.

Figure 1 shows the Colliery Holding Boundary with respect to existing workings. **Figure 1** additionally illustrates the study area regarding the proposed MOD 8 first workings area.

Table 1 provides an overview of the modification by summarising current approved activities alongside the proposed modifications.

Figure 1 Proposed MOD 8 Study Area



Source: Centennial 2018

Table 1 Key Features of the Proposed Project Compared with Existing Operations

Key Feature	Description of Existing Operations	Proposed Change
Project Life	DA 73-11-98 approves mining activities for a period of 21 years from the date of granting of a mining lease pursuant to this consent. ML1452 was granted on 6 July 1999 hence the expiry date is 6 July 2020.	Extend the life of DA 73-11-98 for an additional 12 month period to 6 July 2021.
Development Consent Boundary	As per Appendix 1 of DA 73-11-98.	Expand the development consent boundary to include an additional approximately 193 ha within the existing Newstan Colliery Holding Boundary. The proposed first workings would be undertaken within a 229 ha area, of which 193 ha is not within the current consolidated development consent boundary for DA 73-11-98.
Hours of Operation	Newstan is approved to undertake mining operations 24 hours seven days a week.	No change
Employment	Newstan is currently approved to have up to 320 full-time employees.	No change
Mining Method	Areas on longwall and bord and pillar extraction.	First workings only being sought which would not have any measurable surface related subsidence and would be designed to be long term stable.
Mining Area	Defined existing mining area.	First workings into the proposed extension area. The first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings.
Coal Production	Approved to extract up to 4 Mtpa	No change to upper coal extraction limit of 4 Mtpa. Seeking to extract up to 2 Mt from proposed first workings area.
Coal Handling and Preparation	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal Stockpiles	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal Transport	All ROM coal delivered to Northern Coal Logistics Project	No change
Waste/Reject Management	All ROM coal delivered to Northern Coal Logistics Project	No change
Site Access	Newstan pit top accessed via Miller Road	No change
Mine Support Facilities	Newstan pit top surface facilities	No change
Underground Water Management	Managed in accordance with Newstan Colliery water management system	No change
Surface Water Management	Managed in accordance with Newstan Colliery water management system	No change
Mine Ventilation	Managed in accordance with Newstan Colliery Ventilation Management System	No change
Construction	Existing approved ventilation facility	No change
Rehabilitation	Progressive rehabilitation in accordance with Mine Site Closure and Rehabilitation Plan	No change

2.2 Project Elements with Potential for Air Quality Impacts

The project elements with potential for air quality impacts have been identified as the mine ventilation shafts and ventilation fans located within the Newstan Colliery Surface Site. There are two ventilation fans which are owned and operated by Centennial Newstan to ventilate the underground workings of the Newstan Colliery, which work one at a time with the other being a backup.

The emissions from the ventilation fans include particulates (TSP, PM_{10}, $PM_{2.5}$) and odour.

There are likely to also be some minor emissions of combustion gases from the ventilation shaft due to combustion of diesel in underground equipment used to mine the coal. However, any emissions from the combustion of fuel in equipment on site would not be emitted in high enough concentrations to have potential to result in any adverse off-site air quality impacts. The emissions of products of combustion from equipment use are not considered further in this assessment.

The location of the two ventilation fans is shown in **Figure 2**.

The other elements of the Newstan Colliery Surface Site form part of the NCL Project, which is proposed to continue operations as per the original consent SSD-5145.

Figure 2 Location of the Ventilation Fans at Newstan Colliery Surface Site

Source: Google Earth 2018

2.3 Sensitive Receptors

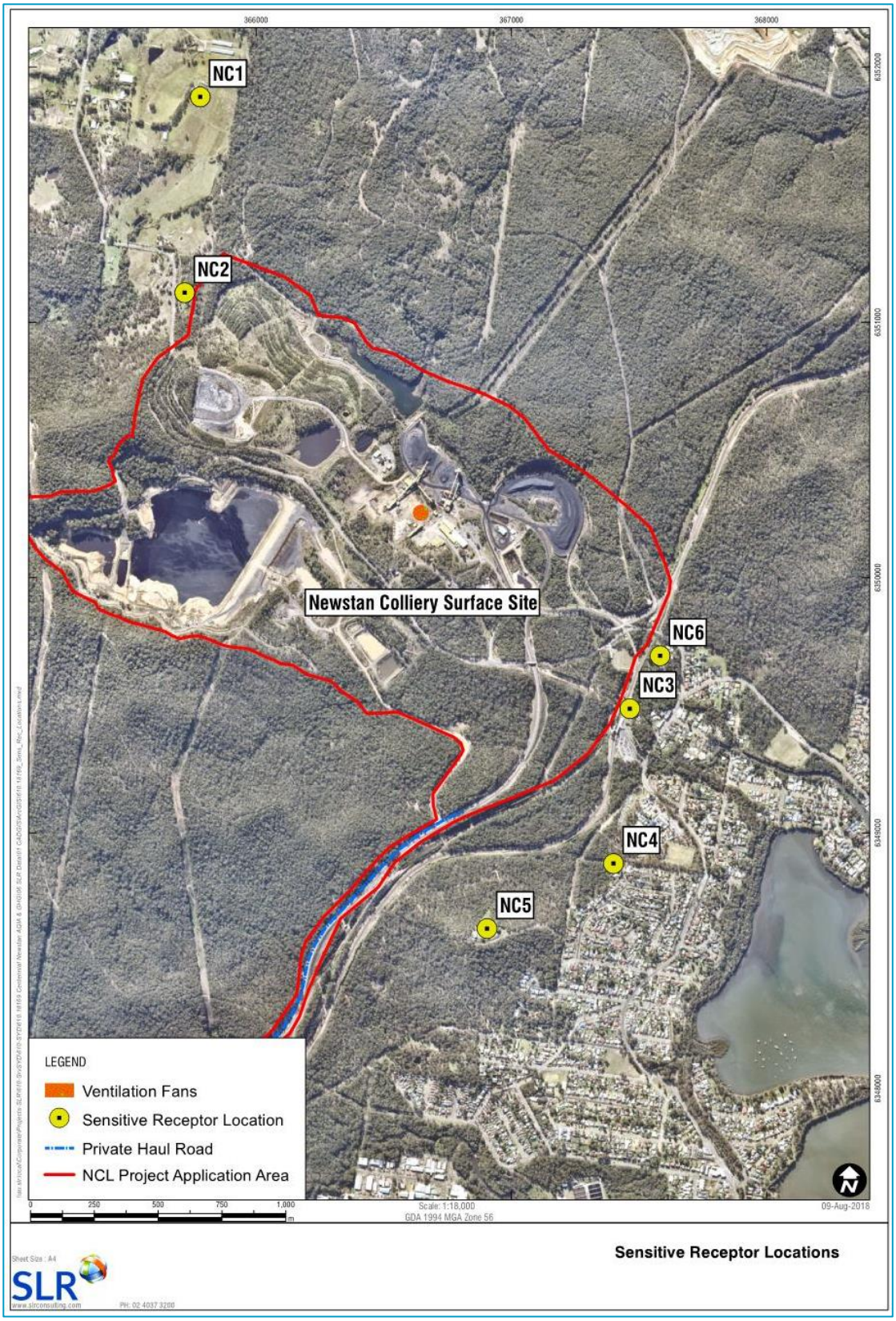
As part of the NCL Project AQIA, air quality impacts were assessed at a total of six (6) sensitive receptors around the Newstan Colliery Surface Site. These sensitive receptors are considered to be relevant to the MOD 8 Project.

The locations of the sensitive receptors identified in the vicinity of Newstan Colliery Surface Site are listed in **Table 2** and shown in **Figure 3**.

Table 2 Newstan Colliery Surface Site - Surrounding Sensitive Receptor Locations

Receiver ID	Location	Location (m, UTM)		Elevation (m, AHD)
		Easting	Northing	
NC1	Dwelling - Jefferson Road, Wakefield	365,779.7	6,351,882.4	40
NC2	Dwelling - Miller Road, Fassifern	365,720.1	6,351,115.5	58
NC3	Dwelling - Wallsend Road, Fassifern	367,462.9	6,349,487.1	12
NC4	Dwelling - Narara Street, Fassifern	367,399.3	6,348,880.4	27
NC5	Dwelling - Reynolds Street, Fassifern	366,904.1	6,348,625.7	72
NC6	Fassifern Primary School	367,580.8	6,349,693.9	11

Figure 3 Newstan Colliery Surface Site - Surrounding Sensitive Receptor Locations



Source: SLR 2014

3 Ambient Air Quality Criteria

3.1 Particulates

The current air quality criteria for Newstan Colliery, as listed under Section 6.1 C of Development Consent DA 73-11-98, are reproduced as follows:

> *The Applicant shall 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 Table 1 at any residence on privately owned land.*

Table 1: Air Quality

Pollutant	*Averaging period*	*Criterion*	
Particulate matter < 10 µm (PM10)	24 hour	[a] 50 µg/m^3	
Particulate matter < 10 µm (PM10)	Annual	[a,d] 30 µg/m^3	
Total suspended particulates (TSP)	Annual	[a,d] 90 µg/m^3	
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a,d] 4 g/m^2/month

a Cumulative impact (ie increase in concentrations due to the development plus background concentrations due to all other sources).

b Incremental impact (ie increase in concentrations due to the development alone, with zero allowable exceedances of the criteria over the life of the development.

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 by the Secretary.

Since the Development Consent DA 73-11-98 was granted on 15 December 2015, the National Clean Air Agreement (NCAA) was endorsed by Commonwealth, State and Territory Environment Ministers. Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles. All jurisdictions have agreed to implement strengthened standards for particles, as well as move to even tighter standards for annual average and 24-hour $PM_{2.5}$ in 2025.

As such, in February 2016, a variation to the Ambient Air Quality National Environment Protection Measure (NEPM) was made to extend its coverage to $PM_{2.5}$, setting reporting standards for $PM_{2.5}$ with no allowable exceedances (NEPC 2016). In addition, the Ambient Air Quality NEPM revised the standard for annual average PM_{10} to be in line with the NCAA.

These standards have now been adopted by NSW Environment Protection Authority (EPA). The updated standards are outlined in the NSW EPA document '*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*' (EPA 2017) (hereafter 'the Approved Methods').

The updated standards for particles are reflected in the NCL (modified) consent SSD-5145 granted in December 2017, which accessed the Newstan Colliery ventilation fans, as shown below. In particular, the criterion for annual average PM_{10} is noted to be updated from 30 µg/m^3 to 25 µg/m^3.

Table 4: Air quality criteria

Pollutant	Averaging Period	Criterion	
Particulate matter < 10 µm (PM_{10})	Annual	[a,d] 25 µg/m^3	
Particulate matter < 10 µm (PM_{10})	24 hour	[b] 50 µg/m^3	
Total suspended particulates (TSP)	Annual	[a,d] 90 µg/m^3	
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a,d] 4 g/m^2/month

a Cumulative impact (ie increase in concentrations due to the development plus background concentrations due to all other sources).

b Incremental impact (ie increase in concentrations due to the development alone, with zero allowable exceedances of the criteria over the life of the development.

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 by the Secretary.

The air quality goals adopted for particulate matter in this study, which conform to current EPA and Federal air quality criteria, are summarised in **Table 3**.

Table 3 Adopted Project Air Quality Goals

Pollutant	Averaging Period	Criteria (µg/m^3)	Source
PM_{10}	24 hours	50	EPA 2017
	Annual	25	EPA 2017
$PM_{2.5}$	24 hours	25	EPA 2017
	Annual	8	EPA 2017
TSP	Annual	90	EPA 2017
		Criteria (g/m^2/month)	
Deposited dust	Annual	2 (maximum increase in deposited dust level) 4 (maximum total deposited dust level)	EPA 2017

3.2 Odour

The current condition for odour compliance for Newstan Colliery, as listed under Section 6.1 A of Development Consent DA 73-11-98, is reproduced as follows:

> *"The Applicant shall ensure that no offensive odours, as defined under the POEO Act, are emitted from the site."*

The NSW EPA impact assessment criteria for complex mixtures of odours have been designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. Where a number of the factors simultaneously contribute to making an odour "offensive", an odour goal of 2 ou at the nearest residence (existing or any likely future residences) is appropriate.

An odour criterion of 2 ou has been adopted for this assessment, which is consistent to that adopted in the NCL Project AQIA for receptors around the Newstan Colliery Surface Site.

4 Emissions Estimation Methodology

Measurements of particulate and odour emissions from ventilation fans at Newstan Colliery Surface Site are not available. Instead, results from particulate and odour monitoring conducted on the ventilation fans at the Mandalong Mine Access Site have been adopted (consistent with the NCL Project AQIA). The results from the particulate and odour monitoring are reproduced in **Table 4**.

Table 4 Particulate and Odour Monitoring Data from the Mandalong Mine Access Site Ventilation Fans

Parameter	Value	Unit [b]
Particulate Monitoring (SLR 2012a)		
Temperature	20.0	^{o}C
Velocity	10.3	m/s
Volumetric Flow	136.8	m^3/s
TSP Concentration	7.2	mg/m^3
PM_{10} Concentration	1.2	mg/m^3
$PM_{2.5}$ Concentration	1.2	mg/m^3
Odour Monitoring (SLR 2012b)		
Temperature	19.0	^{o}C
Velocity	9.75	m/s
Volumetric Flow	131.1	m^3/s
Odour Concentration[a]	231	ou

a The average of three samples has been adopted as the odour emission rate

b Flowrate and concentration results are presented at standard conditions (0°C and 1 atmosphere)

At the time of the particulate and odour monitoring campaigns at the Mandalong Mine Access Site, Mandalong Mine was approved to extract up to 6 Mtpa of coal. Newstan Colliery proposes to extract up to 2 Mtpa of coal as part of the MOD 8 operations. The particulate and odour concentrations shown in **Table 4** haven been assumed to be representative estimates of the emission levels that would be expected for the MOD 8 operations.

The ventilation fan flowrate for the MOD 8 scenario has been estimated by Centennial Newstan to be 180 m^3/s based on historical fan flowrate data from Newstan Colliery when mining was occurring at a rate equivalent to 2 Mtpa. Based on this, estimated mass emission rates of particulate matter and odour for MOD 8 operations have been calculated as shown in **Table 5**.

Table 5 Calculated Particulate and Odour Emission Rates for MOD 8

Parameter	Value	Unit
TSP Emission Rate	1.3	g/s
PM_{10} Emission Rate	0.2	g/s
$PM_{2.5}$ Emission Rate	0.2	g/s
Odour Emission Rate	41,580	$ou.m^3/s$

5 Impact Assessment

The assessment of air quality impacts associated with the proposed MOD 8 has been performed with reference to the off-site impacts predicted as a result of the ventilation fan emissions in the NCL Project AQIA (SLR 2014).

Potential off-site impacts are dependent on a range of input variables such as the meteorological conditions, regional topography, locations of the ventilation fans, operational conditions of the ventilation fans, relative location of the sensitive receptors and pollutant emission rates.

All the input variables are anticipated to be constant between the proposed MOD 8 operations and operations assessed as part of the NCL Project AQIA, with the exception of the operational conditions for the ventilation fans (i.e. exit velocity) and pollutant emission rates. A comparison of the particulate and odour emission rates estimated for MOD 8 operations and those assessed as part of the NCL Project AQIA is shown in **Table 6**. As shown in **Table 6**, the emission rates estimated for the proposed MOD 8 operations are approximately 30% higher than those used in the NCL Project modelling study which was based on the Mandalong Mine Ventilation Fans. The higher exit velocity of 9.9 m/s is based on historical operational data for Newstan Colliery.

Table 6 Estimated Fan Emission Data for MOD 8 Compared to the NCL Project AQIA

Parameter	MOD 8	NCL Project AQIA[1]
TSP Emission Rate (g/s)	1.30	0.99
PM_{10} Emission Rate (g/s)	0.22	0.16[2]
$PM_{2.5}$ Emission Rate (g/s)	0.22	0.17[2]
Odour Emission Rate ($ou.m^3/s$)	41,580	30,282
Exit Velocity (m/s)	9.9	7.5

[1] SLR 2014

[2] The PM_{10} emission rate was calculated to be fractionally lower than the $PM_{2.5}$ emission rate due to rounding of numbers.

A total of eight (8) operational scenarios were assessed as part of the NCL Project AQIA, based on a range of coal movement and coal handling options.

The dispersion modelling results in the NCL Project AQIA showed that at the identified sensitive receptors (see **Section 2.3**), the predicted annual average dust deposition rates, annual average TSP concentrations, annual average PM_{10} concentrations, annual average $PM_{2.5}$ concentrations and maximum 24-hour average $PM_{2.5}$ concentrations were below the respective criteria across all the scenarios.

In regards to the maximum 24-hour average PM_{10} concentrations, exceedances were predicted at receptor R6 for scenarios 2a, 3a and 3b, with 3a being the highest. Scenario 3a assessed the air quality impacts from the following operations:

- Receipt of 6 Mtpa of coal from the Cooranbong Entry Site;
- Export of 8 Mtpa of coal by rail;
- Trucks dumping coal at ROM stockpile;
- Trucks dumping coal at rail loop stockpile; and
- Manual train loading using FELs.

Condition 8 under the 'Limits of Consent' for Development Consent SSD-5145 is reproduced below:

> *"Prior to transporting more than 5.5 million tonnes of coal by rail in any calendar year, the Applicant must construct the automated coal recovery and train loading system as proposed in the EIS, to the satisfaction of the Secretary. Following its construction, the Applicant must use the automated coal recovery and train loading system for all transport of coal by rail."*

As per Centennial's *Northern Region – Air Quality and Greenhouse Gas Management Plan (May 2018)*, Centennial has committed to automating the train loading operations aspect once the amount of coal exported by rail reaches 5.5 Mtpa. Automation of the train loading facility is expected to reduce the air quality impacts compared to those predicted in the NCL Project AQIA, resulting in a lower risk of predicted exceedance.

A source contribution analysis was conducted for predicted maximum 24-hour PM_{10} concentrations at receptor R6 for scenario 3a. This analysis showed that:

- The contribution of emissions from the Newstan ventilation fans to the total predicted incremental impacts from the NCL Project was less than 0.4%.
- The combined impacts from dozers and front end loaders operating on the rail loop stockpile within the Newstan Colliery Surface Site contributed up to 47% of the total predicted incremental impacts from the NCL Project.
- Trucks transporting and dumping coal at the rail loop stockpile contributed up to 21% of the total predicted incremental impacts from the NCL Project.

Given the above, the 30% increase in the estimated emissions from the Newstan Colliery ventilation fans compared to that assumed in the modelling for the NCL Project, would not be expected to have any significant impact on the total offsite PM_{10} concentrations as the ventilation fans account for 0.4% of the site's total emissions.

Further, the higher exit velocity from the ventilation fans estimated for MOD 8 operations compared to that used in the NCL Project modelling study (see **Table 6**) can be expected to facilitate the dispersion of plumes and would potentially result in lower ground level concentrations being predicted at the sensitive receptors for this source.

As discussed in **Section 3**, there has been a change in the EPA criterion for annual average PM_{10} concentrations since Development Consent DA 73-11-98 was originally granted in May 1999, reducing it from 30 $\mu g/m^3$ to 25 $\mu g/m^3$. The maximum cumulative annual average PM_{10} concentration predicted in the NCL Project AQIA was 19.9 $\mu g/m^3$, at receptor R2. This represents approximately 80% of the new criterion of 25 $\mu g/m^3$.

In regards to the results predicted for odour in the NCL Project AQIA, the 99th percentile 1-hour average odour concentration were predicted to be less than 1 ou at all the identified sensitive receptors surrounding the Newstan Colliery Surface Site for all modelled scenarios.

Based on the above, even though there is an increase in the estimated pollutant emission for MOD 8 operations compared to ventilation fan operations assessed as part of the NCL Project AQIA, the impacts from the ventilation fans can be expected to still be negligible at the identified sensitive receptor locations compared to other sources at the Newstan Colliery Surface Site.

6 Conclusions

This AQIA has been prepared to assess potential air quality impacts due to operations proposed as part of the MOD 8 Project.

The air quality impacts from Newstan Colliery operations were assessed as part of the Northern Coal Logistics (NCL) Project by SLR in December 2014 (SLR 2014). The NCL Project application area comprises Newstan Colliery Surface Site, Cooranbong Entry Site, Private haul roads and Hawkmount quarry. The coal from Newstan Colliery forms part of development consent for Newstan Colliery (DA 73-11-98), until it reaches the surface when it becomes part of the development consent for NCL Project (SSD-5145).

The only potentially significant emissions to air that will occur as a result of MOD 8 will be emissions of particulate matter and odour from the ventilation fans discharging air from the underground workings. TSP, PM_{10}, $PM_{2.5}$ and odour emission rates have been calculated for MOD 8 operations and compared to the emission data assessed as part of the NCL Project. The incremental impacts predicted due to Newstan ventilation fan operations in the NCL Project AQIA have also been referenced to assess the scale of potential off-site impacts from MOD 8 operations.

The dispersion modelling results in the NCL Project AQIA showed that the annual average dust deposition rates, annual average TSP concentrations, annual average PM_{10} concentrations, annual average $PM_{2.5}$ concentrations and maximum 24-hour average $PM_{2.5}$ concentrations predicted at the identified sensitive receptors were all below the respective criteria.

An exceedance of the 24 hour average PM_{10} criterion was predicted at receptor R6, for Scenario 3a, which assessed potential air quality impacts from the export of 8 Mtpa of coal by rail. Centennial has committed to automating the train loading operations aspect once the amount of coal exported by rail reaches 5.5 Mtpa. Automation of the train loading facility is expected to reduce air quality impacts compared to those predicted in the NCL Project AQIA, resulting in a lower risk of predicted exceedance.

Notwithstanding above, the contribution of the Newstan ventilation fans to the predicted incremental PM_{10} concentrations for the whole NCL Project (i.e. including haul roads, coal handling and preparation infrastructure, rail loading infrastructure and coal reject emplacement facilities) was less than 0.4%. Further, the higher exit velocity estimated for the ventilation fans for MOD 8 operations is likely to facilitate the dispersion of the plume and result in lower ground level concentrations at the sensitive receptors than that predicted in the NCL Project AQIA for the ventilation fan emissions.

The 99th percentile 1-hour average odour concentration were predicted in the NCL Project AQIA to be less than 1 ou at all the identified sensitive receptors surrounding the Newstan Colliery Surface Site for all modelled scenarios

Based on the above, it is concluded that emissions from the ventilation fans during MOD 8 is would have a negligible impact on ambient air quality at the identified sensitive receptor locations.

7 References

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Appendix I – Greenhouse gas impact assessment

NEWSTAN COLLIERY

Modification 8
Greenhouse Gas Assessment

Prepared for:

Centennial Coal

SLR Ref: 610.18169-R01
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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Centennial Coal (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

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610.18169-R01-v2.0	21 August 2018	Kirsten Lawrence	Graeme Starke	Kirsten Lawrence
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1 Introduction

Centennial Coal (Centennial) has commenced feasibility investigations into the possible recommencement of mining at Newstan Colliery located at Fassifern, NSW. The development consent for Newstan Colliery (DA 73-11-98) approves the extraction of up to 4 million tonnes per annum (Mtpa) of run of mine (ROM) coal, and has an expiry date of 6 July 2020.

Centennial intends to develop and lodge a scoping report regarding the Newstan Extension Project with the NSW Department of Planning and Environment (DP&E) in 2018. The Newstan Extension Project will be assessed as a State Significant Development (SSD) application in accordance with the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project schedule regarding the assessment process indicates that determination is expected in late 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed ahead of the SSD application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021, with up to 2 Mt of ROM coal to be extracted during this period.

This greenhouse gas (GHG) assessment has been prepared to estimate the Scope 1, 2 and 3 GHG emissions associated with the additional coal resource to be extracted by the proposed modification. These emission estimates have been compared to those estimated for the current care and maintenance activities at the mine, as well as State and national GHG emission inventories.

This GHG assessment has been performed with reference to the Australian Department of Climate Change and Energy Efficiency (DCCEE) document "*National Greenhouse Accounts Factors*" (DEE, 2017), the National Greenhouse and Energy Reporting Act 2007 (NGER Act) and the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol Initiative (WRI, 2004).

2 Project Description

Centennial has initiated feasibility investigations into the recommencement of mining at Newstan Colliery located at Fassifern, NSW. Investigations are currently focused in the southern portion of the Colliery Holding Boundary under and surrounding Awaba Colliery and are remote from residential areas. Centennial is evaluating mine design options in addition to methods of extraction in conjunction with relevant technical experts to understand the potential impacts on sensitive surface features. In addition, Centennial is examining the requirement for potential surface infrastructure to support the operation.

Newstan Colliery began mining operations in 1887. After the introduction of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), mining operations continued on the basis of existing use pursuant to the provisions of Part 4, Division 10 of the EP&A Act (existing use rights). Newstan Colliery is currently approved under DA 73-11-98 which was originally granted in May 1999. The original approval enabled mining to continue within the existing mining areas as well as the expansion into areas that had not previously been mined. The approved Newstan Colliery Life Extension Area under Development Consent DA 73-11-98 essentially filled in the gap between the Newstan Colliery and Awaba Colliery lease areas. Since the initial approval of DA 73-11-98, the progressive history of mining approvals for Newstan Colliery has resulted in a patchwork of approved areas from the originally approved mining area (under existing use rights) to the current approved mining areas (comprising the Consolidated Consent Boundary under Development Consent DA 73-11- 98 as modified). DA 73-11-98 has since been modified seven times; most recently in December 2015.

Various seams have been mined at Newstan Colliery, being the upper seams (Great Northern and Fassifern seams) and the lower seams (West Borehole, Borehole, Young Wallsend and Yard seams). Prior to being placed on care and maintenance, mining was undertaken in the West Borehole Seam under the provisions of Development Consent DA 73-11-98. Newstan has current approval to extract up to 4 Mtpa of ROM coal. The mine, along with beneficiation by the Newstan Coal Preparation Plant (CPP), can produce thermal coal products suitable for domestic and export markets, and a low sulphur semi-soft coking coal product.

A modification (Modification 8) is required to enable first workings to proceed and determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, Modification 8 is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021. It is proposed to modify the Newstan Colliery Development Consent DA 73-11-98 pursuant to Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A Section 75W application was made on 26 February 2018 and was accepted by the NSW Department of Planning and Environment noting that formal Environmental Assessment Requirements will not be issued for the modification.

Figure 1 shows the Colliery Holding Boundary with respect to existing workings. **Figure 1** additionally illustrates the study area regarding the proposed Modification 8 first workings area.

Table 1 provides an overview of Modification 8 by summarising current approved activities alongside the proposed modifications.

Figure 1 Study Area

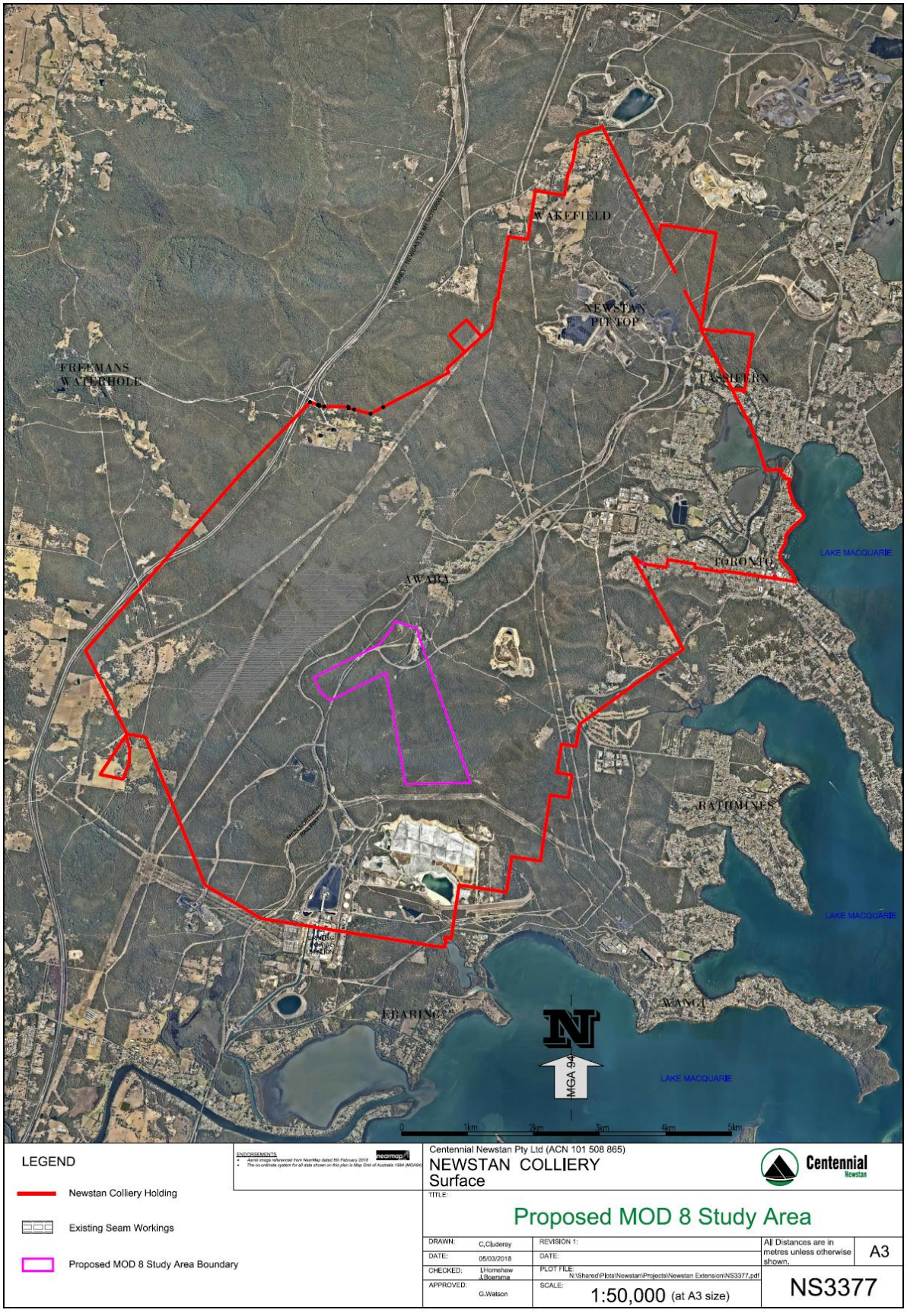


Table 1 Key Features of Modification 8 Compared with Existing Operations

Key Feature	Description of Existing Operations	Proposed Change
Project Life	DA 73-11-98 approves mining activities for a period of 21 years from the date of granting of a mining lease pursuant to this consent. ML1452 was granted on 6 July 1999 hence the expiry date is 6 July 2020.	Extend the life of DA 73-11-98 for an additional 12 month period to 6 July 2021.
Development Consent Boundary	As per Appendix 1 of DA 73-11-98.	Expand the development consent boundary to include an additional approximately 193 ha within the existing Newstan Colliery Holding Boundary. The proposed first workings would be undertaken within a 229 ha area, of which 193 ha is not within the current consolidated development consent boundary for DA 73-11-98.
Hours of Operation	Newstan is approved to undertake mining operations 24 hours seven days a week.	No change
Employment	Newstan is currently approved to have up to 320 full-time employees.	No change
Mining Method	Areas on longwall and bord and pillar extraction.	First workings only being sought which would not have any measurable surface related subsidence and would be designed to be long term stable.
Mining Area	Defined existing mining area.	First workings into the proposed extension area. The first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings.
Coal Production	Approved to extract up to 4 Mtpa	No change to upper coal extraction limit of 4 Mtpa. Seeking to extract up to 2 Mt from proposed first workings area.
Coal Handling and Preparation	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal Stockpiles	All ROM coal delivered to Northern Coal Logistics Project	No change
Coal Transport	All ROM coal delivered to Northern Coal Logistics Project	No change
Waste/Reject Management	All ROM coal delivered to Northern Coal Logistics Project	No change
Site Access	Newstan pit top accessed via Miller Road	No change
Mine Support Facilities	Newstan pit top surface facilities	No change
Underground Water Management	Managed in accordance with Newstan Colliery water management system	No change
Surface Water Management	Managed in accordance with Newstan Colliery water management system	No change
Mine Ventilation	Managed in accordance with Newstan Colliery Ventilation Management System	No change
Construction	Existing approved ventilation facility	No change
Rehabilitation	Progressive rehabilitation in accordance with Mine Site Closure and Rehabilitation Plan	No change

3 GHG Emissions and Climate Change

3.1 The Greenhouse Effect

The greenhouse effect is a naturally occurring process that aids in heating the Earth's surface and atmosphere. It results from the fact that certain atmospheric gases, such as carbon dioxide, water vapour, and methane, are able to change the energy balance of the planet by absorbing longwave radiation emitted from the Earth's surface.

The amount of heat energy added to the atmosphere by the greenhouse effect is controlled by the concentration of GHGs in the Earth's atmosphere. Emissions of GHGs can result from natural or man-made (anthropogenic) sources. The separation of natural versus anthropogenic sources is complicated by the fact that natural processes may be manipulated by humans, resulting in increased emissions of GHGs.

Examples of natural sources include the decomposition or burning of plant material and emissions of methane from animal digestion processes. Emissions that occur as a result of human activities include the burning of fossil fuels, the use and leakage of refrigerants, and the use of fertilisers. The clearing of forest and other vegetation by humans also contributes to the greenhouse effect. Vegetation and soils typically act as a carbon sink, storing carbon dioxide that is absorbed through photosynthesis. When the land is disturbed, part of the stored carbon dioxide is emitted, through mechanisms such as burning or decomposition of vegetation etc., and re-enters the atmosphere.

3.2 Greenhouse Gases

A number of gases are involved in the human-caused enhancement of the greenhouse effect. These include:

- **Carbon dioxide** (CO_2): A minor but very important component of the atmosphere, CO_2 is released through natural processes such as respiration and volcanic eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels.
- **Methane** (CH_4): A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, CH_4 is a far more active GHG than CO_2, but also one which is much less abundant in the atmosphere.
- **Nitrous oxide** (N_2O): A powerful GHG produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.
- **Chlorofluorocarbons** (CFCs): Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also GHGs.

For comparative purposes, non-CO_2 GHGs are awarded a "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-e of a gas is calculated using an index called the Global Warming Potential (GWP) which represents the combined effect of the differing times GHGs remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

The GWPs of relevance to this assessment, as taken from the IPCC's Fourth (AR4) and Fifth (AR5) Assessment Reports are presented in **Table 2**. The AR5 values (IPCC, 2013) are the most recent, but the AR4 values (IPCC, 2007) are also listed because they are currently used in Australia for inventory and reporting purposes.

Table 2 Global Warming Potentials

Gas	Chemical Formula	IPCC GWP (100 year horizon)	
		Fourth Assessment Report [1]	Fifth Assessment Report [2]
Carbon dioxide	CO_2	1	1
Methane	CH_4	25	28
Nitrous oxide	N_2O	298	265
Hydrofluorocarbons[3]	CH_2FCF_3	1,430	1,300
Sulphur hexafluoride	SF_6	22,800	23,500

1: (IPCC, 2007)

2: (IPCC, 2013)

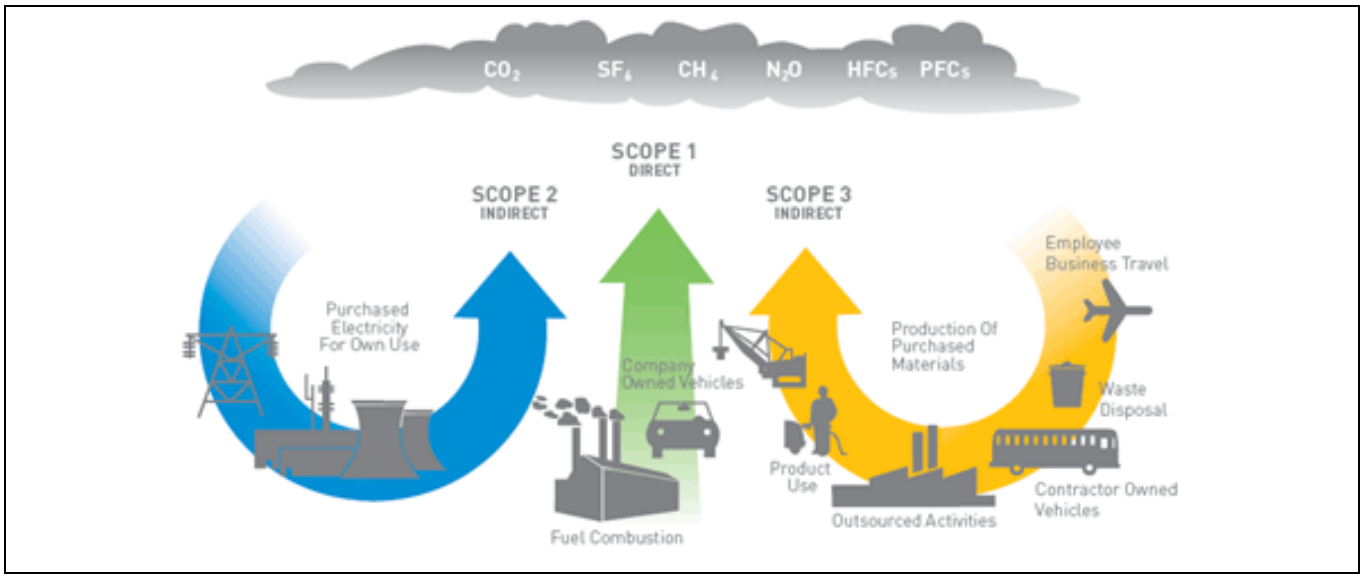
3: HFCs assumed to be HFC-134a

3.3 Scope Definition

Emissions of GHG can be termed as being *Scope 1, Scope 2* or *Scope 3*, and '*direct*' or '*indirect*' emissions (**Figure 2**). A discussion of what each Scope refers to, and how it relates to the Project is presented below.

The definitions below have been taken from the WRI and WBCSD GHG Protocol (WRI, 2004). These documents provide detailed information on the activities which should be included in each of the Scope 1, 2 and 3 boundaries. The definition of these boundaries allows the determination of those sources of GHG emissions which can be directly controlled by Centennial (Scope 1 and Scope 2), or those which Centennial would have some, but limited control over (Scope 3).

Figure 2 Scope 1, 2 and 3 GHG Emissions as Defined in the GHG Protocol Initiative



Source: WRI (2004)

3.3.1 Direct Emissions (Scope 1)

Direct emissions of GHG are termed Scope 1 emissions and are produced from sources within the boundary of an organisation and as a result of the organisation's activities. These direct emissions mainly arise from the following sources:

- Transportation of materials, products, waste or people e.g. the combustion of diesel in mobile equipment, including on-road and off-road vehicles and stationary equipment;
- Generation of electricity, heat and/or steam, e.g. the combustion of diesel in generators;
- Fugitive emissions, both intentional and unintentional, e.g. through the use of switchgear, methane from exposed coal, land clearing etc; and
- On-site waste management, e.g. solid and liquid waste management through landfill, sewage treatment, incineration etc.

3.3.2 Indirect Emissions (Scope 2 and Scope 3)

Indirect emissions are generated in the wider economy as a consequence of an organisation's activities but are physically produced by the activities of another organisation.

Scope 2 Emissions

The most important category of indirect emissions is from the consumption of purchased electricity (Scope 2 emissions). Scope 2 emissions relate to the GHG emissions from the generation of purchased electricity consumed in owned or controlled equipment or operations. In Australia this is primarily from coal fired power generation.

Scope 3 Emissions

Scope 3 indirect emissions are related to the upstream emissions generated in the extraction and production of fossil fuels and in the emissions from contracted/outsourced activities.

Scope 3 emissions are generally Scope 1 or 2 emissions for other companies. For example, in general, diesel use by contractors is a Scope 3 emission, yet is referred to as a Scope 1 emission in the GHG inventory of the contractor. Combustion of coal to produce electricity will result in a Scope 1 emission at the power station or a Scope 2 emission for industry or householders.

Scope 3 emissions may be, but are not required to be, reported as part of a project's GHG emissions assessment.

4 Relevant Legislation, Guidelines and Policies

4.1 The International Response to Climate Change

4.1.1 Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the international body tasked with assessing scientific knowledge on climate change. It was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988, and endorsed by the UN General Assembly, to provide policy makers with regular scientific assessments of climate change, its impacts and future risks, and the mitigation and adaptation options.

The first meeting of the IPCC was held in Geneva in 1988. Since it was established, the IPCC has prepared five assessment reports, which have provided key inputs into the international negotiations to tackle climate change. The Fifth Assessment Report was released by IPCC in March 2014 which considers new evidence of climate change based on independent analyses from observations of the climate system and includes refined estimates of impact probability.

4.1.2 Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC). The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing GHG emissions. These targets amount to an average of five per cent reduction against 1990 levels over the five-year period 2008-2012.

Countries must meet their targets primarily through national measures to avoid, abate or offset GHG emissions. However, the Kyoto Protocol offers additional means of meeting targets through the following market-based mechanisms:

- Emissions trading: Gives corporations or individuals the opportunity to offset their GHG emission liability by purchasing Kyoto certified carbon credits generated by carbon emission reduction projects.
- Clean Development Mechanism (CDM): Where industrialised (or “Annex One” as defined in the Protocol) nations can implement Kyoto approved GHG reduction projects in developing nations (or “Non-Annex One” as defined in the Protocol) in order to generate Carbon Emission Reductions (CERs).
- Joint Implementation (JI): Allows developed (Annex One) nations to engage in emission reduction projects with other developed (Annex One) nations to generate CERs.

These mechanisms help stimulate investment in GHG-friendly actions and technologies and to meet emission targets in a cost effective manner. Comprehensive mechanisms have been set up under the UNFCCC that aim to ensure the validity and credibility of emissions avoidance, abatement and offset projects under the CDM and JI.

4.1.3 The Greenhouse Gas Protocol Initiative

Greenhouse gas accounting and reporting principles are intended to underpin all aspects of GHG accounting and reporting. The five principles outlined below are consistent with the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol Initiative (a globally adopted and leading GHG accounting strategy), and ISO 14064-1, 2, and 3 (GHG) guidelines (internationally accepted best practice). These principles are based on financial accounting and reporting standards and are taken from the GHG Protocol documentation (WRI, 2004).

The following outlines the basic requirements of any GHG assessment, as defined by WRI/WBCSD.

- **Relevance:** The relevance of a company's GHG report relates to the information which it contains. The information should allow stakeholders, both internal and external to the organisation, to make informed decisions about GHG management. An important aspect of relevance is the selection of appropriate boundary conditions which reflect the reality of the company's operations. The operation of the company, the purpose of the information and the needs of users will all inform the choice of the inventory boundary.
- **Completeness:** All relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled. WRI (2004) states that no materiality threshold (or minimum emissions accounting threshold) should be defined as this is not in line with the principle of completeness. However, if emissions are not able to be estimated or estimated at a sufficient level of quality, then these should be transparently documented and justified.
- **Consistency:** Consistency in an emissions inventory allows stakeholders to compare GHG emissions performance from year to year. This consistency also allows trends to be identified and performance against objectives and targets to be tracked. Any changes in the inventory (accounting approaches, boundaries, calculation methods) need to be transparently documented and justified.
- **Transparency:** All processes, procedures, assumptions and limitations of an inventory should be presented clearly and accurately. Information needs to be recorded, compiled and analysed in a way that enables internal reviewers and external auditors to verify the credibility of the inventory. Specific exclusions and inclusions are to be documented and justified, assumptions disclosed and appropriate references provided for the calculation methods applied and the data sources used. Transparency is essential in the production of a credible GHG inventory.
- **Accuracy:** Accuracy describes how close the estimates of GHG emissions are to the 'true' value. The accuracy of a GHG inventory should be sufficient for stakeholders to make decisions with reasonable assurance of the integrity of the reported information. Quality management measures should be implemented to maximise inventory accuracy.

Additional to the principles of GHG reporting, data materiality can be used to simplify the accounting process by omitting low level emission sources which do not make a significant contribution to overall Project emissions. Emissions which are within emission reporting errors or make up less than 5% or of the total Project emissions are deemed to be immaterial as their inclusion or omission does not have significant bearing on Project behaviours or processes (DoE, 2008).

4.2 Australian GHG Policy and Regulation

Australia ratified the Kyoto Protocol (the Protocol) in 2007 and as such made a commitment to reducing GHG emissions. In response to this ratification Australia adopted a number of Federal and State Government initiatives to achieve a reduction in GHG emissions to 5% below 1990 levels.

4.2.1 National Greenhouse and Energy Reporting (NGER)

The NGER Act 2007 provides a single national framework for the reporting and dissemination of information about the GHG emissions, GHG projects, and energy use and production of corporations. It makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds. Centennial reports emissions from the corporation on an annual basis, including those from the Newstan Colliery, in accordance with the NGER Act.

4.2.2 National Greenhouse Accounts (NGA) Factors

The National Greenhouse Accounts (NGA) Factors document is prepared by the Department of the Environment and Energy (DEE) and is designed for use by companies and individuals to estimate greenhouse gas emissions. The NGA default emission factors listed in this document have been estimated by the DEE using the Australian Greenhouse Emissions Information System (AGEIS) and are determined simultaneously with the production of Australia's National Greenhouse Accounts. This promotes consistency between inventories at company or facility level and the emission estimates presented in the National Greenhouse Accounts. The methods used at the national level, and reflected in the NGA Factors document, are consistent with international guidelines and are subject to international expert review each year.

4.3 Centennial Climate Change Policy

Centennial recognises that climate change response is an important aspect of its business that presents both challenges and opportunities. Centennial believes GHG's can be reduced, mitigated and offset, and also that coal will remain a significant energy source in a carbon constrained future and as such, low emission technologies are essential. Consequently, Centennial is implementing a Climate Change strategy that combines strategic, operational, commercial and technical aspects of climate change. The strategy includes a Climate Change Policy and development of a GHG Management System. Centennial is pursuing actions to:

- Reduce GHG emissions through energy efficiency and fugitive emission abatement; and
- Accurately monitor fugitive emissions from underground coal mining operations.

5 Estimated GHG Emissions and Assessment

A quantitative GHG assessment has been performed to determine the potential impact of Modification 8 on the GHG emissions from Newstan Colliery. In accordance with standard practice, this assessment has been guided with reference to the requirements of the GHG Protocol and IPCC and Australian Government emission calculation methodologies.

The calculation of GHG emissions from Modification 8 has been performed in a five stage process:

- Definition of the Project boundary (**Section 5.1**)
- Identification of emission sources within the Project boundary (**Section 5.2**)
- Identification of activity data for each emission source (**Section 5.3**)
- Identification of emission calculation methodologies for each source (**Section 5.4**)
- Calculation of GHG emissions (**Section 5.5**)

5.1 Definition of the Project Boundary

The geographical and operational boundary set for the GHG assessment includes the Newstan Colliery underground workings and delivery of the coal to the Newstan Colliery Surface Site. Fugitive emissions of CO_2 and CH_4 from the Newstan Colliery ventilation system are included, however additional fugitive CH_4 emissions that arise during post-mining activities, such as transportation and stockpiling of the coal, due to the release of residual gases not released during the mining process, are not included. These residual emissions form part of the GHG inventory for the Northern Coal Logistics Project.

Other sources of Scope 3 GHG emissions associated with the processing, rail transport, shipping and end use of the product coal are also outside the scope of this GHG assessment, as they are considered to form part of the GHG inventory for the Northern Coal Logistics Project.

Boundaries of a GHG assessment can be chosen to include/exclude sources as long as the process of definition is transparent and the inventory for the selected boundary is as complete as possible (refer **Section 4.1.3**).

5.2 Identification of Emission Sources

The proposed changes to the Newstan Colliery operations associated with Modification 8 that have the potential to increase GHG emissions from the site have been identified as follows:

- Scope 1:
  - Diesel use in equipment used to mine 2 Mt of ROM coal over approximately 18 months (assuming the modification will commence on 1 January 2020 and run until expiry on 6 July 2021)
  - Fugitive CH_4 and CO_2 emissions from the ventilation system
  - Consumption of oils during the 18 month period
- Scope 2:
  - Electricity consumption associated with the underground mine during the 18 month period
- Scope 3:
  - Emissions associated with the production and transport of diesel and oil consumed at the site during the 18 month period

The following activities/sources also have the potential to generate minor emissions of GHGs, however based on SLR's experience in preparing GHG emission inventories for similar projects, it can be assumed that they would contribute less than 5% or of the total Project emissions and can be deemed to be immaterial:

- Scope 1:
  - Treatment and disposal of sewage and solid waste generated on site during the 18 month period
- Scope 3:
  - Fuel consumption associated with workers and raw materials to site during the 18 month period

5.3 Activity Data

Projected activity data for the proposed Modification 8 operations have been estimated based on data provided by Centennial for historical operations at Newstan Colliery for the months of November 2008 and April 2009. The average ROM coal throughput for November 2008 and April 2009 was 167,536 tonnes. This is similar to one month's extraction (166,667 tonnes) at an annual throughput of 2 Mtpa. . The other activity data provided for these two months (diesel consumption, oil consumption and ventilation shaft emissions) were therefore averaged to provide activity data estimates for Modification 8. The data provided are summarised in **Table 3**. It is noted that the 2 Mt proposed to be extracted under Modification 8 would be extracted over an 18 month period, from 1 January 2020 to 6 July 2021, rather than one year, thus the annual activity data shown in **Table 3** for Modification 8 have been scaled accordingly.

The projected electricity consumption shown in **Table 3** was estimated by Centennial based on an expected power demand of 2.254 kW for the plant and equipment required for the proposed operations (including consideration of anticipated load factors for each piece of equipment).

For comparison, activity data provided by Centennial for the current 'care and maintenance' operations at Newstan Colliery are shown in **Table 4**.

Table 3 Newstan Colliery Activity Data – Modification 8

Parameter	Newstan Colliery Historical Data			Estimate for Modification 8	
	November 2008	April 2009	Average Per Month	Total (18 Months)	Per Annum
ROM throughput (tonnes)	193,746	141,325	167,536	2,000,000	1,335,000
Diesel consumption (kL)	44.05	14.00	29.03	351.6	232.5
Oil consumption (kL)	0.0	0.0	0.0	0.0	0.0
CO_2 emissions from vent (1,000 m^3)	342.3	305.6	324.0	3,924.4	2,594.9
CH_4 emissions from vent (1,000 m^3)	1,654.3	1,473.5	1,563.9	18,944.7	12,526.8
Electricity consumption (MWh)	-	-	-	19,930.4	13,178.7

Table 4 Newstan Colliery Activity Data – Care and Maintenance Operations (2017 Data)

Parameter	Care and Maintenance Operations
ROM throughput (tonnes)	0
Diesel consumption (kL)	12.2
Oil/grease consumption (kL)	1.45
CO_2 emissions from vent (1,000 m^3)	406.3
CH_4 emissions from vent (1,000 m^3)	3,193.6
Electricity consumption (MWh)	5,587.1

5.4 Emission Factors

The emission factors used in the calculations for the estimates of Scope 1, 2 and 3 GHG emissions are presented below. These factors were sourced from the most recent NGA Factors workbook (DEE, 2017).

Table 5 GHG Emission Factors

Source/Activity	Energy Content Factor	Emission Factor			Units
	(GJ/kL)	CO_2	CH_4	N_2O	
Scope 1					
Diesel combustion - Stationary energy [1]	38.6	69.9	0.1	0.2	kg CO_2-e/GJ
Petroleum based oils	38.8	13.9	0.0	0.0	kg CO_2-e/GJ
Scope 2					
Electricity consumption	-	0.83			kg CO_2-e/kWh
Scope 3					
Diesel	38.6	3.6			kg CO_2-e/GJ
Petroleum based oils	38.8	3.6			kg CO_2-e/GJ

[1] Section 2.2 of the NGA Factors workbook states "*No transport factors are provided for vehicles not registered for road use. Stationary energy factors for individual fuel types should be used in these cases.*"

To convert the volumetric flows of CH_4 and CO_2 from the ventilation shaft (in m^3) shown in **Table 3** and **Table 4** to mass emissions (tonnes) of CO_2-e, the following conversion factors were used (DoE, 2008, p. 257):

- $CO_2 = 1.861 \times 10^{-3}$ tonnes CO_2-e/m^3
- $CH_4 = 16.960 \times 10^{-3}$ tonnes CO_2-e/m^3 (note, the GWP for CH_4 has been updated from 21 to 25 as per (DEE, 2017))

5.5 Estimated Emissions

The estimated GHG emissions for Modification 8 are shown in **Table 6** and compared to the annual emission rates estimated for current 'care and maintenance' operations (based on the activity data shown in **Table 4**).

Based on information presented in **Table 6**, the annual Scope 1 and Scope 2 GHG emissions from Modification 8 are estimated to be 0.17 tonnes of CO_2-e per ROM tonne of coal produced. If only the incremental increase in annual emissions compared to keeping the mine in 'care and maintenance' mode are considered, the GHG intensity estimate reduces to 0.13 tonnes of CO_2-e per ROM tonne of coal.

The main contributor to the estimated emissions is fugitive CH_4 and CO_2 emissions, which account for 94.9% of the total combined Scope 1 and Scope 2 emissions. Electricity and diesel fuel consumption are estimated to account for only 4.8% and 0.3% respectively.

Table 6 GHG Emission Inventory

Activity/Source	Estimated GHG Emissions (tonnes CO_2-e)		
	Care and Maintenance	Modification 8	
	Per Annum	Total (18 Months)	Per Annum
Scope 1			
Diesel consumption	33	953	630
Oil consumption	1	0	0
Fugitives – CH_4 and CO_2	54,920	328,605	217,284
Sub-Total – Scope 1	***54,954***	***329,558***	***217,914***
Scope 2			
Electricity consumption	4,637	16,542	10,938
Scope 3			
Diesel and oil production	2	49	32
Total	**59,593**	**346,149**	**228,885**

6 Comparison to National and State Emission Inventories

Australia's net greenhouse gas emissions totalled 533.0 Mt CO_2-e in 2016 (Australian Greenhouse Emission Information System (DEE, 2016)). The energy sector accounted for over 81% of the total national emissions with energy generation through the combustion of fossil fuels accounting for 79% of the national energy sector emissions. Fugitive emissions accounted for approximately 11% of energy sector emissions.

The reported 2016 total NSW emissions of 130.3 Mt CO_2-e accounted for approximately 24% of national GHG emissions. The energy sector contributed 110.1 Mt CO_2-e which is approximately 85% of the state emission total. Fugitive emissions account for approximately 14% of NSW total energy sector emission total.

The contributions of the predicted annual Scope 1 and 2 emissions resulting from Modification 8 are detailed in **Table 7**. As can be seen, the emissions are a relatively small proportion of both the Australian and NSW total emissions, accounting for approximately 0.04% of total Australian GHG production. As such, the relatively small amount of GHG emissions generated by Modification 8 will have an undetectable effect on global climate change.

Table 7 Project Emission Contribution to State and National Annual Emission Totals

	Modification 8 - Scope 1 and 2	Australia Total Emissions 2016	NSW Total Emissions 2016
Annual GHG Emissions (tonnes CO_2-e/annum)	228,852	532,971,150	130,273,520
Modification 8 as a percentage of national/State inventory	-	0.043%	0.18%

7 Abatement and Avoidance of Emissions

Table 6 highlights the significant contribution that fugitive CH_4 and CO_2 emissions (94.9% of Scope 1 and Scope 2 emissions) make to Newstan Colliery's GHG profile for the proposed Modification 8 activities. Electricity and diesel fuel consumption are estimated to account for only 4.8% and 0.3% of estimated fugitive emissions respectively.

There is currently no proven efficient, cost-effective and safe technology to abate VAM in coal mines. Research on reverse thermal oxidiser (RTO) technology is the most advanced; however there are safety concerns with integration of an RTO to a coal mine. The combination of unproven technology and no regulatory approval for direct coupling of any technology to a working coal mine in Australia means that VAM abatement is not considered feasible at this stage.

8 Conclusions

Centennial has initiated feasibility investigations into the recommencement of mining at Newstan Colliery (the Newstan Extension Project) located at Fassifern, NSW. The Newstan Extension Project will be assessed as a SSD application in accordance with the EP&A Act. The project schedule regarding the assessment process indicates that determination is expected in Quarter 3 2020. The approval timeline does not align with Centennial's business plan mining recommencement date being 1 January 2020. A modification is therefore being sought to address the shortfall to enable first workings to proceed ahead of the SSD application. Additionally, the first workings are required to determine the presence, throw and strike of the major fault projected from the historic Newstan workings. Due to the consent expiry date of 6 July 2020, the modification is additionally seeking to extend the life of DA 73-11-98 for a further 12 months to 6 July 2021, with up to 2 Mt of ROM coal to be extracted during this period.

This GHG assessment has been prepared to estimate the Scope 1, 2 and 3 GHG emissions associated with the additional coal resource to be extracted by the proposed modification. These emissions have been compared to those estimated for the current care and maintenance activities at the mine, as well as state and national GHG emission inventories.

The geographical and operational boundary set for the GHG assessment includes the Newstan Colliery underground workings and delivery of the coal to the Newstan Colliery Surface Site. Fugitive emissions of CO_2 and CH_4 from the Newstan Colliery ventilation system are included, however additional fugitive CH_4 emissions that arise during post-mining activities, such as transportation and stockpiling of the coal, due to the release of residual gases not released during the mining process, are not included. These residual emissions would form part of the GHG inventory for the Northern Coal Logistics Project. Other sources of Scope 3 GHG emissions associated with the processing, rail transport, shipping and end use of the product coal are also outside the scope of this GHG assessment, as they are considered to form part of the GHG inventory for the Northern Coal Logistics Project.

GHG emission estimates for Modification 8 were completed based on activity data provided by Centennial and published emissions factors. These calculations indicate that annual Scope 1 and Scope 2 GHG emissions from Modification 8 would be 0.17 tonnes of CO_2-e per ROM tonne of coal produced. The main contributor to these emissions is fugitive CH_4 and CO_2 emissions, which account for 94.9% of the total combined Scope 1 and Scope 2 emissions. Electricity and diesel fuel consumption are estimated to account for only 4.8% and 0.3% respectively.

The predicted Scope 1 and 2 emissions resulting from Modification 8 would represent a very small proportion of both the Australian and NSW total emissions, accounting for approximately 0.04% of total Australian GHG production in 2016 and 0.18% of total NSW production. As such, the relatively small amount of GHG emissions generated by Modification 8 will have an undetectable effect on global climate change.

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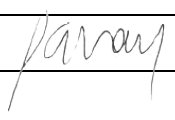
3	E Holland, J McDonough	M Dunlop		S Gray		24/09/2018

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