

Ash Dam Augmentation Project

Environmental Assessment

Prepared for
Origin Energy Resources Limited
15 August 2018



Ash Dam Augmentation Project

Environmental Assessment

Client: Origin Energy Resources Limited

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Executive Summary

Origin Energy (Origin) owns and operates Eraring Power Station (EPS) and associated Eraring Ash Dam located on Rocky Point Road at Eraring, in the Lake Macquarie Local Government Area (LGA). EPS has been operating since 1982 and is Australia's largest power station with a generation capacity of 2,880 megawatts. Currently Coal Combustion Products (CCP) generated during the production of electricity is either reclaimed for beneficial reuse or deposited hydraulically via pipelines into the Eraring Ash Dam in accordance with Project Approval 07_0084 (dated 29 April 2008).

Origin is proposing to augment the ash dam using an alternate placement strategy and landform design (the project) to maintain operational flexibility and extend the storage life of the Eraring Ash Dam in the short to mid-term whilst continuing to support long term ash placement strategies towards 2032.

The Eraring Ash Dam has a finite ash storage capacity and the efficient and effective utilisation of this critical asset is vital to the continued operation of EPS.

It is expected that there will continue to be an increasing reliance on EPS following the recent and planned closures of large generation assets in NSW (e.g. Munmorah Power Station which closed in 2012 and Liddell Power Station which is due to be closed in 2022) and in Victoria and South Australia. The continued operation of the Eraring Ash Dam is a business critical priority for Origin and is required to ensure future power system security within the broader National Electricity Market.

It is essential that the currently anticipated storage life of the ash dam be increased in order to ensure the continued operation of EPS and to cater for the needs of the National Electricity Market.

The proposed ash dam augmentation would involve the placement of ash in a series of upstream raises or terraces, or through placement from a pipe (or pipes) from the edges of the dam to form a 'beach' extending across the length of the ash dam operational area to achieve ash deposition to Relative Level (RL) 140 m. The design shares similarities with the existing project approval in terms of the overall landform profile and ash placement techniques. However the augmented landform requires a western saddle embankment, improved stormwater diversion system and remediation of mine voids underlying the Eraring Ash Dam.

The preferred option would retain operational flexibility whilst providing an estimated additional 5 million cubic metres of storage capacity, extending the operational life of the Eraring Ash Dam to approximately 2024. A key feature of the augmented ash dam deposition strategy is that deposition is limited to the existing operational footprint of the Eraring Ash Dam, limiting environmental impacts when compared to other mid-term alternatives.

Biodiversity

The Project would result in direct impacts on biodiversity values through the loss of vegetation and fauna habitats as a result of clearing works and subsequent facility operations. A Biodiversity Development Assessment Report has been prepared in accordance with the *Biodiversity Conservation Act 2016* (BC Act).

Approximately 8.95 hectares of native vegetation would be directly impacted by the Project. Three ecosystem-credit species were recorded during field surveys or were considered likely to occur within the Project area, including:

- Black-eyed Susan (*Tetradlea juncea*)
- Squirrel glider (*Petaurus norfolcensis*)
- Stephen's banded snake (*Hoplocephalus stephensii*).

Following the application of avoidance and mitigation measures, assessment in accordance with the Biodiversity Assessment Method identified that the following biodiversity credits would be required to offset the impacts of the Project:

- 22 ecosystem credits for PCT1627 Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast

- 261 ecosystem credits for PCT1636 Scribbly Gum – Red Bloodwood – *Angophora inopinata* heathy woodland on lowlands of the Central Coast
- 327 species credits each for Black-Eyed Susan – (*Tetradlea juncea*), Squirrel Glider (*Petaurus norfolcensis*) and Stephen's Banded Snake – (*Hoplocephalus stephensi*).

Offset requirements under the *BC Act* would be fulfilled using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits.
- Securing required credits through the open credit market and/or;
- Payments to the Biodiversity Conservation Fund.

In-perpetuity conservation would form the preferred method of offsetting under the *BC Act* where practicable. Origin has undertaken preliminary investigations of land-based offset opportunities and identified approximately 60ha of potentially suitable land. An additional 500ha of potential offset sites have been identified within 10km of the Project Area.

Hydrology

During operation of the proposed stormwater diversion system for the project, additional run-off from an estimated catchment area of approximately 86,400m² would be diverted to a proposed receiving pond. This accounts for an increase in just over 70% of the existing catchment area. Sustained heavy rain events would utilise overtopping storages which extend beyond the constructed limits of the receiving pond based on local topography and be diverted to a new discharge point via pipeline, some 360m to the west.

Diverted water would only be discharged during times of sustained rainfall events when it is anticipated that the estimated 10,000m³ storage capacity of the receiving pond may be exceeded. Flows discharged from the receiving pond would be limited to a rate of 240m³/hour (by pipeline diameter) and therefore water received during peak storm inflows would be discharged over a prolonged period.

Potential impacts to coastal wetlands and the coastal environment were considered based on the existing flow path of stormwater from the site. The diverted catchment (approximately 20.7ha) is much smaller than the area of wetland it is flowing into (estimated to be an area of around 90ha to 100ha). The flow pathway is approximately 3.5 km from the receiving pond also collects a larger catchment associated with the existing EPS and surrounds. Consequently, the volume of water diverted as a result of the project is likely to comprise a small proportion of total flows entering the wetland. Further, diverted flows would be limited to a maximum rate of 240m³ per hour and would be temporary in nature (less than 40 minutes during a 1% AEP storm event and 5.4 hours during a Probable Maximum Flood). Therefore the volume, duration and frequency of diverted flows are likely to be inconsequential in comparison to the current flows reaching the wetland under existing conditions.

Geotechnical

Disused mine workings (the former Awaba Mine, operated by Centennial Coal) have previously been identified beneath the north western portion of the Eraring Ash Dam. An assessment of potential mine subsidence impacts was prepared to review and assess potential geotechnical risks of the project relating to the proximity of the underground mine workings.

The assessment identified two potential risks associated with the project:

- Potential for subsidence in the form of either pillar collapse or roof failures leading to sinkhole formation and impacting on the ash dam and the western saddle embankment.
- Mining induced fractures resulting in connectivity and the potential for surface water to flow from the ash dam into the mine workings.

Both subsidence and surface water connectivity hazards can be effectively controlled through the application of mine void filling technologies. The area that would be required to be remediated would depend on a range of factors including the hydraulic conductivity of the fill material and the effectiveness of the filling strategy used. The design would be further developed relying on further testing and the available engineering approaches.

Aboriginal Heritage

An Aboriginal heritage due diligence assessment was undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* and included a visual inspection of the project area by a heritage specialist.

The Aboriginal Heritage Due Diligence Assessment did not identify any areas of Aboriginal archaeological or cultural sensitivity and found that Aboriginal sites or objects are unlikely to be discovered or impacted as a result of the project. In the unlikely event that Aboriginal objects are identified at any point during the construction of the project, works would cease and relevant agencies would be contacted.

Air Quality

The project area is surrounded predominantly by undeveloped bushland, which serves as a buffer zone between the EPS and surrounding residential areas. Residential receivers closest to the Eraring Ash Dam are located in Eraring, approximately 1km to the south. The Myuna Bay Sport and Recreation Centre is located approximately 500m to the south.

The project would continue to utilise dense phase ash placement as per existing operations and is not expected to generate a significant increase in air emissions. Potential emissions from construction works would be minor and temporary and would be managed in accordance with standard construction management measures. Progressive rehabilitation of completed surfaces of the Eraring Ash Dam would be undertaken in a staged manner where possible, minimising the potential for dust emissions. Targeted treatment of localised dusting events would continue to be undertaken using water suppression.

Traffic

The transport of up to some 48,000m³ of fill material and cement to site would require up to 600 trucks. When compared to existing traffic levels utilising the intersections of Wangi Road / Rocky Point Road (Eraring) and Dora Street / Short Street (Morisset), these additional temporary truck movements would not significantly impact the capacity of the existing traffic network. The transport of fill and cement materials would be undertaken in a staged manner over a short term construction period.

Other Environmental Issues

The operation of the project would not introduce additional waste streams to those associated with the existing operation of the Eraring Ash Dam. During construction of the project, waste materials generated are likely to consist of minor quantities of vegetation waste and construction wastes such as concrete, metals and pipes. Where possible, materials would be reused or recycled to minimise the quantities of waste disposed in landfill. All waste would be classified in accordance to the *Waste Classification Guidelines* (NSW Environmental Protection Authority, 2014) prior to disposal and transported to a licensed waste disposal facility.

There would be temporary noise impacts associated with the construction of the project from the movement of construction vehicles and plant associated with required earthworks. These impacts would be minor given the distance to the nearest residential receivers (approximately 1km to the south).

Conclusion

The potential environmental impacts of the project have been assessed and it is considered that whilst the project may have some residual impacts, the mitigation measures identified would effectively ensure that the environmental consequences associated with the proposed modifications are minimised and are likely to remain substantially the same as those currently approved.

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1.0 Introduction

1.1 Background

Origin Energy (Origin) owns and operates Eraring Power Station (EPS) and associated Eraring Ash Dam on Rocky Point Road, in the Lake Macquarie Local Government Area (LGA). EPS has been operating since 1982 and comprises four 720 MW coal fired units. EPS is Australia's largest power station with a generation capacity of 2,880 MW, and accounts for approximately 25 per cent of New South Wales' power requirements. Eraring Power Station is expected to reach the end of its operational life by 2032.

Currently Coal Combustion Product (CCP) generated during the production of electricity is either reclaimed for beneficial reuse or deposited hydraulically via pipelines into the Eraring Ash Dam. Project Approval 07_0084 (dated 29 April 2008) details an ash placement strategy consisting of beached deposition of dense phase ash slurry from three dispersal pipelines (nodal points) to a relative height of 140m.

This deposition strategy has been further optimised to ensure the optimum storage of ash in response to increasing market demands, using various cells constructed out of reclaimed ash, located within the footprint of the 2008 Project Approval.

Origin is proposing to augment the ash dam using an alternate placement strategy and landform design to maintain operational flexibility and extend the storage life of the Eraring Ash Dam in the short to mid-term whilst continuing to support long term ash placement strategies towards 2032.

1.2 The Proponent

Origin is the proponent and current owner of EPS and the Eraring Ash Dam. These facilities previously operated under the ownership of the NSW State Government via the state owned entity Eraring Energy (under the *State Owned Corporations Act 1989*, the *Energy Services Corporations Act 1995* and the *Energy Services Corporation (Eraring Energy) Regulations 2000*).

In July 2013, Origin took over ownership and operation of EPS and the adjoining Eraring Ash Dam. Origin has a large portfolio of power stations around Australia, with Eraring being the company's only coal-fired power station. Origin also operates gas, cogeneration and pumped storage hydro plants.

1.3 Existing Approvals

The *Eraring Power Station Act 1981* (EPS Act) commenced on 15th December 1981 by proclamation in the NSW government gazette and authorised the development of EPS.

Various upgrades at the EPS site have subsequently been approved, including construction of an emergency turbine generator, upgrade of the Eraring Ash Dam facilities and capacity upgrades. EPS currently operates under the following Project Approvals:

- **Project Approval 05_0138** (14 December 2006) – Construction and operation of a 42MW emergency turbine generator.
- **Concept Approval 05_0138** (14 December 2006) – Upgrade of the ash disposal facility at the Eraring Power Station.
- **Project Approval 07_0084** (29 April 2008) – Staged expansion of the coal combustion product (CCP) management facility (Eraring Ash Dam) in conjunction with changes in the CCP disposal method from lean phase to dense phase.

- **Project Approval 06_238** (26 June 2008) – Capacity increase and performance improvements at the existing Eraring power station comprising:
 - *Replacement / upgrade of plant components such that the nominal capacity of each turbine is increased from 660 megawatts to 750 megawatts*
 - *Construction and operation of up to a 920 megalitre cooling water attemperation reservoir with associated infrastructure to manage cooling water temperatures and permit extended operation of the power station*
 - *Ancillary works and activities associated with these improvements.*

1.4 Purpose of this Report

This Environmental Assessment (EA) has been prepared for Origin to accompany an application under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to modify the existing Project Approval (07_0084). The modification is seeking approval for the augmentation of the Eraring Ash Dam on the EPS site.

Origin briefed the Department of Planning and Environment (DP&E) regarding the proposed Project on 22 February 2018 and submitted documentation detailing the proposal on 28 February 2018. Advice received from DP&E (dated 28 February 2018) confirmed that a modification to Project Approval (07_0084) under Section 75W of the EP&A Act would be the appropriate approval pathway for the Project.

2.0 The Site

2.1 Site Description

The EPS site is located on Rocky Point Road, Eraring, about 40 km southwest of Newcastle in the Lake Macquarie LGA. The entire EPS site comprises approximately 1200 hectares of land owned by Origin, with the power station itself located on approximately 150 hectares and the Eraring Ash Dam occupying approximately 250 hectares. The remainder of the land is largely undeveloped consisting of open grassland, canals and bushland (refer Figure 1).

Operations at EPS are separated from surrounding land uses by extensive land holdings. Existing development in the vicinity of the site includes the West Wallsend and Newstan Colliery, as well as the Vales Point Power Station. The Sydney to Newcastle Railway Line is located west of the EPS and further west the Pacific Motorway (M1) also runs parallel to the Site. There is a mix of vegetated buffer lands and cleared agricultural land for grazing purposes west of the EPS, and Lake Macquarie lies to the east. The closest residential area is situated in Border Street in the suburb of Eraring approximately 1km south of the power station itself.

Eraring Ash Dam is located adjacent to Main Road 217 (Wangi Road) at Myuna Bay, about 6 km north-east of Dora Creek. The Eraring Ash Dam is accessed via the ash pipeline bench or coal conveyor access road from the EPS.

Eraring Ash Dam was constructed on Crooked Creek, approximately 2km northeast of EPS. The dam consists of a zoned earthfill embankment some 25 m high with upstream and downstream slopes of approximately 40%. A bund, around 30m wide, is incorporated in the dam wall design of the downstream face of the dam for stability and seepage control.

2.2 Site History

Construction of the EPS began in 1976, with four generating units being operational by April 1984 (NSW Office of Environment and Heritage (OEH), 2008; Lake Mac Libraries, n.d). The original proponent of the EPS was the then Electricity Commission of New South Wales which was the statutory authority responsible for generating and supplying electricity in New South Wales under the now repealed *Electricity Commission Act 1950*.

The Electricity Commission of New South Wales began trading as Pacific Power on 1 January 1992 (NSW Government: State Records, 2016). Eraring Energy, a NSW State Government Owned Corporation later took over the management of the EPS and Ash Dam in August 2000 from Pacific Power (HLA-Envirosciences, 2007). In July 2013, Origin acquired the EPS and Ash Dam from Eraring Energy and continued operation of the site.

The Eraring Ash Dam was founded on ash deposits from the former Wangi Power Station in 1977 and was completed in 1982. In 2008, the Ash Dam placement strategy was revised to support continued operation of the station and raise the total capacity from the original 29.2 million cubic metres to approximately 40 million cubic metres (based on the technical expectations of the time). This was achieved through an alternate design and ash placement strategy developed in combination with the implementation of a new 'dense phase' ash storage and pumping system. The dense phase pumping system was envisaged to use a slurry mix of up to 70% ash and 30% water to allow for up to 40% more ash to be placed per cubic metre of Ash Dam volume than seen in the previous 'lean phase' system (HLA, 2007).



Origin EPS Landholdings

Site Overview
 Ash Dam Augmentation Project
 Source: Origin 2018, DFSI 2018

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Fig. **1**

0 0.25 0.5 1
 Kilometres

2.3 Current Operations

The site currently generates power for the National Electricity Market from the four 720 megawatt generators to meet consumer demands. Coal Combustion Product (CCP) produced by electricity generation is captured and categorised to determine suitability for beneficial reuse. Resource recovery orders and exemptions exist for coal ash or blended coal ash under the *Protection of the Environment Operations Act 1997* (POEO Act) and *Protection of the Environment Operations (Waste) Regulation 2014* (Waste Regulation).

The categories of CCP at the EPS site are separated as follows:

- Fly ash
- Mixed Fly ash
- Bottom ash.

To support the processing and supply of these different CCP products to industries, a number of separate CCP facilities currently operate onsite at EPS. These facilities are operated by third party contractors, including Flyash Australia and Boral.

The Flyash Australia Eraring Plant manages the reuse of fly ash and operates continuously to supply fine grade fly ash and tailor made ashes that can be utilised in a variety of concrete applications (Flyash Australia, 2010). These reuse initiatives are complemented by the Boral Recycling facility which reclaims bottom ash from the Ash Dam for use as an aggregate in applications such as bitumen in road construction projects. Together these and other initiatives have sustained an ash reuse rate averaging approximately 40% between 2005 and 2016.

CCP that is not suitable for reuse by these contractors or surplus to market demand is currently collected in large silos and deposited as a dense phase slurry into the Eraring Ash Dam. The Eraring Ash Dam provides limited ash storage capacity and Origin aims to increase the proportion of CCP that is beneficially reused towards a goal of 80% reuse by 31 December 2021.

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3.0 Project Justification and Alternatives Considered

3.1 Need for the Project

The Ash Dam provides finite ash storage capacity and the efficient and effective utilisation of this critical asset is vital to the continued operation of Eraring Power Station (EPS). Ash Dam operations at EPS are undertaken in accordance with an Ash Dam Operations Management Strategy and a Long Term Management Strategy (Coal Combustion Products).

It is expected that there will continue to be an increasing reliance on EPS following the recent and planned closures of large generation assets in NSW (e.g. Munmorah Power Station which closed in 2012 and Liddell Power Station which is due to be closed in 2022) and in Victoria and South Australia. The continued operation of the Ash Dam is a business critical priority for Origin and is required to ensure future power system security within the broader National Electricity Market.

Project Approval 07_0084 (dated 29 April 2008) details an ash placement strategy consisting of beached deposition of dense phase ash slurry from three dispersal pipelines (nodal points) to a relative height of 140m. The design relied on beaching of fly ash towards the main embankment at a grade of 2.5%. It was estimated that the design would provide an additional 10.3Mm³ storage capacity (Aurecon, 2009).

To meet market demand and ensure system security (as a result of recent power station closures) EPS has operated at higher than planned output rates. This has resulted in an increase in ash disposal rates which has reduced the defined capacity of the Eraring ash dam within a shorter timeframe than planned. Consequently alternative ash placement strategies are required to extend the storage capacity of the ash dam in the short to mid-term.

An assessment of ash dam storage capacity has been undertaken and has determined that the Eraring Ash Dam would likely reach its capacity sometime between October 2023 and March 2026 based on alternate ash placement strategies (see Table 1) (Origin, 2018). It is noted that the alternate ash placement strategies would require approval and provide additional capacity compared to current ash placement activities undertaken in accordance with Project Approval 07_0084.

Table 1 Storage Capacity Assessment

Scenario	Description	Ash generations (approximate tonnes per month)	Potential Ash Reuse (%)	Storage life
1	Base case	106,118	37%	November 2025
2	Increased generation	133,691	30%	October 2023
3	Increased re-use	106,118	40%	March 2026
4	Increased generation and decreased re-use	133,691	27%	July 2023

Ultimate ash dam capacity is influenced by a number of factors including electricity generation requirements, deposition density and rates of ash reuse which are subject to market conditions. Reaching ash dam capacity would require that electricity generation operations cease at EPS due to the inability to deposit ash without significant risks to safety and the environment. Therefore, it is essential that the currently anticipated storage life of the ash dam be increased in order to ensure the continued operation of EPS and to cater for the needs of the National Electricity Market.

3.2 Objectives of the Project

In consideration of the need for the project outlined in Section 3.1, the objectives of the project are to extend the storage life of the Ash Dam in a manner that:

- Maintains operational flexibility in terms of future ash deposition strategies and engineering design
- Supports the continued operation of EPS to 2032 and deposition of ash towards a final landform that is both safe and stable in the long term
- Is technically feasible
- Remains consistent with Dams Safety Committee of NSW (DSC) guidance and Australian National Committee on Large Dams (ANCOLD) guidelines
- Minimises potential impacts to the environment.

3.3 Consideration of Alternatives

3.3.1 'Do nothing'

The 'do nothing' option would require that electricity generation operations cease at EPS considerably ahead of plan due to the inability to deposit ash without significant risks to safety and the environment.

This is not considered acceptable given the increase in national electricity demands and the reliance on Eraring Power Station following the recent closures of large generation assets in Victoria and South Australia.

3.3.2 Ash reuse

The option of increasing offsite ash reuse or recycling was considered to extend the storage life of the Ash Dam by reducing the amount of ash needing to be placed in the dam. Ash management at EPS is undertaken in accordance with a Long-Term Management Strategy (LTMS) which is updated annually and represents a commitment by Origin to improve the efficiency of ash reuse and reduce environmental impacts associated with operation of EPS and the Ash Dam.

A substantial proportion of CCP produced at EPS is already reused, with some 1.05 million tonnes of CCP or 38.7% having been reused between July 2014 and June 2016. Demand for CCP derived products is primarily governed by building and construction industries in the Sydney and Hunter Regions. These industries are heavily influenced by key State-resourced transport infrastructure projects and the broader construction needs of the region.

Whilst Origin aims to increase the proportion of CCP that is beneficially reused towards a goal of 80% reuse by 31 December 2021, reuse rates remain heavily influenced by market demand. Projections for population growth and infrastructure projects within the region suggest that an ash utilisation rate of 30-50% is realistic for the near future. Therefore, ash reuse in isolation would not address the deficiencies in the required storage capacity in the short to medium term. Origin will continue to work with the industry to identify new market opportunities and drive the development of new reuse streams through innovation and product development.

Ash Recycling Facility

Origin is also in the early planning stages of a new onsite ash-recycling facility. This initiative alone would not provide a sufficient increase in storage life of the Ash Dam, considering available capacity and fluctuations in market demand. As there is currently no planning approval for this facility to proceed it cannot be considered further in the context of ensuring ash dam capacity within the timeframes required by operations at EPS.

3.3.3 Ash disposal options assessment

An Ash Disposal Options Assessment undertaken in 2014 considered alternative on-site ash disposal options at EPS. A variety of deposition strategies were investigated using 3D modelling of deposition from various RL heights to gain an appreciation of the existing and potential future capacity of the ash dam. Based on initial investigations, three options were selected for further analysis:

Option 1 – RL 150 Maximised Footprint - This option was designed to maximise the footprint within the available ash dam expansion areas based on planned deposition to RL150. This option would have provided a gain in storage capacity of approximately 16.8 Mm³. A key constraint associated with this option included likely impacts to areas currently reserved for habitat offsets and previously revegetated areas.

Option 2 – RL 150 Reduced Footprint – This option was configured to specifically exclude encroachment into existing offsets, previously rehabilitated areas and an existing constructed wetland located north east of the ash dam. However Option 2 – RL 150 covered the smallest footprint and therefore provided the least additional storage capacity at approximately 13.5 Mm³.

Option 3 – RL 138 Embankment Raise was designed specifically to maximise potential storage capacity. Option 3 consisted of an 8m downstream raise to the existing main embankment to provide additional storage capacity of approximately 20.5 Mm³. The preliminary design of this option was configured to exclude encroachment into habitat offset areas and a constructed wetland. Constraints associated with this option included placement of ash over approximately 59.6 hectares of land undergoing progressive rehabilitation and significant capital expenditure to raise the main embankment.

Investigation of a number of options, including the above, are being undertaken to identify a long-term ash disposal solution to enable operations until 2032.

3.3.4 Augmentation of the Ash Dam deposition strategy – The Preferred Option

This option would employ beaching, a series of upstream raises or terraces extending across the length of the ash dam operational area to achieve ash deposition to RL140m. The design shares similarity with the existing project approval in terms of the overall landform profile and ash placement to a maximum height of RL 140. However, the design extends the overall placement strategy towards the west of the ash dam, requiring a western perimeter embankment in place of an originally proposed earth embankment which would otherwise have been located within the ash dam itself.

The preferred option would retain operational flexibility whilst providing an estimated additional 5 Mm³ of storage capacity, extending the operational life of the Eraring Ash Dam to approximately 2024. A key feature of the augmented ash dam deposition strategy is that deposition is limited to the existing operational footprint of the Eraring ash dam, limiting environmental impacts when compared to other mid-term alternatives.

The augmentation of the ash dam deposition strategy is considered to be the preferred option given the ability of the option to support the continued operation of the Eraring Ash Dam consistent with project objectives identified in Section 3.2.

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4.0 The Project

The augmentation of the ash dam (the project) would broadly involve the following components that would be implemented through a staged approach:

- Amendment of the ash deposition strategy, including:
 - Combination of beaching and ash terrace deposition methods
 - Construction of new decant infrastructure associated with ash terraces
- Establishment of the Western Emplacement Area to enable ash deposition to RL140 within existing operational areas, requiring:
 - Construction of a western saddle embankment
 - Reconfiguration of RL140 Access Road
 - Filling of Mine Voids underlying the Eraring Ash Dam
- Upgrades to ancillary infrastructure including:
 - Stormwater diversion systems
 - Ash delivery line re-configuration
- Decommissioning and relocation of bottom ash recycling infrastructure.

The existing Eraring Ash Dam is generally bounded on the west and north by an access road nominally established at RL140 m. Upgrades to ancillary infrastructure and establishment of the Western Emplacement Area will require works beyond the existing Eraring Ash Dam footprint (as described within Section 4.1). The concept design showing the proposed landform for the project and the extent of additional disturbance required to facilitate construction and operation is shown in Figure 2. The project would be constructed in accordance with DSC guidance, ANCOLD guidelines and current codes of practice.

The Environmental Assessment that informed Project Approval 07_0084 for the staged expansion of the Eraring Ash Dam in 2008 envisaged that ash placement would be limited to relative level (RL) 140metres. The project as modified would not involve ash storage above RL 140 metres and retains broadly similar landform characteristics to the original design. However, establishment of an improved stormwater diversion system and western saddle embankment are new design elements which require earthworks and clearing of additional vegetation.



Project Design Elements (Proposed)

- Western Extent of Ash Placement - Existing
- Ash Placement to RL140
- Limit of additional surface disturbance to facilitate filling of mine voids

Ash Placement Contours

Roadway

Bored Tunnel

Western Saddle Embankment

Stormwater Discharge Point

Stormwater Diversion Alignment

Stormwater Detention Basin

Design Landform - Ash placement to RL140
Ash Dam Augmentation Project
Source: Origin 2018

0 50 100 200 Meters

16/08/2018
60521040
Fig. **2**

4.1 Project Elements

4.1.1 Amended ash deposition strategy

The project would involve the amendment of the current ash deposition strategy to achieve the landform shown in Figure 2. Ash deposition is a dynamic process which is influenced by a number of characteristics such as fly ash slurry content, beach slope and in situ (or settled) ash density. These parameters are variable and whilst well understood at EPS, necessitate flexibility in terms of ash deposition techniques. Ash deposition is typically undertaken in a staged manner in general accordance with the Ash Dam Management Strategy and other strategy documents to achieve desired placement outcomes.

Consequently, ash would continue to be deposited within the Eraring Ash Dam using a combination of techniques as appropriate based on observed fly ash characteristics and ongoing ash dam surveillance. Deposition techniques would be adjusted as required to achieve the design landform. The proposed placement techniques to be employed at Eraring are discussed in greater detail below.

Hydraulic ash placement

Hydraulic ash placement involves the hydraulic pumping of ash via pipeline and subaerial deposition onto the surface of the ash dam. Typically, ash is deposited from the perimeter of the ash dam, beaching towards the main embankment at a grade of 1 to 2.5%. When employed over a large area, dense phase ash will typically flow conically from the point of deposition subject to the existing landform.

Cell deposition

Cell deposition involves the establishment of self-contained cells on the ash dam surface with interior containment bunds typically constructed from reclaimed fly ash material. This process allows for greater operational control over deposition, potentially providing improved outcomes for deposition density and management of process water within the ash dam itself. Cell deposition is a strategy employed to reach target design heights and would be used in combination with other deposition strategies.

Where cell deposition is the preferred placement method, ash deposition into the cells would be subaerial (where placement of the ash forms an exposed beach over most of the cell area). Evaporative drying of the ash surface improves the density of the ash and increases storage capacity.

Deposition into each cell would occur from multiple discharge points around the cells. Discharge spigots would be located at each corner of the cell and if required, intermittently between the corners. Ash would be progressively deposited so that each cell would slope downwards to the north and upwards towards the new ash terrace to the south.

The ash would be deposited such that decant water is allowed to escape the cell and reach the decant pond via low spots within the cells. These low spots would be raised progressively as the level of the ash rises within each cell. Cycling deposition between multiple cells and the existing beach will further aid in allowing the ash to air dry and consolidate, improving the in-situ density of the hydraulically placed ash and minimising dust generation.

Progressive ash terrace deposition strategy

An ash terrace would be progressively established within the Ash Dam as shown in Figure 2. The ash terrace would 'step' up from the south before reaching its high point and sloping down towards the RL140 roadway. It is anticipated that each terrace would achieve between a 0.5 and 1 metre increase in height of ash placement. The ash terrace would be progressed with an approximate 2 to 3% overall batter slope, subject to detailed design. Regular quality control testing and monitoring would be undertaken during development of the ash terrace to confirm the adopted stability input parameters are suitable.

Earthen embankments may be employed to effectively manage ash deposition and form temporary spillways to manage process water within the ash dam. In these areas the terracing arrangement may be complemented by sediment controls (e.g. rip rap material and aggregate). Corrugated polypropylene drain pipe or equivalent (nominally DN375 but sized based on application) may be employed to enable transfer of process water from the terrace to the decant water pond. Temporary placement of timber sleepers, sediment fencing and suitable materials would be employed as necessary to manage ash deposition.

4.1.2 Establishment of Western Emplacement Area for ash deposition

The project would include ash deposition to RL 140m within the western operational footprint of the ash dam as shown in Figure 2.

Western saddle embankment

A western saddle embankment is required along the perimeter of the Western Emplacement Area to enable safe placement of ash to RL 140m.

The concept design of the new western saddle embankment incorporates:

- An earthfill embankment;
- Faces battered at nominal 1.5:1 upstream and 3:1 downstream subject to ground conditions and detailed design;
- An embankment approximately 600 m in length constructed to a maximum height of 10 m depending on topography (also acting as an access road);
- Incorporation into existing embankments;
- An access ramp extending approximately 80 m connecting the embankment to an existing access road.

The western saddle embankment is estimated to require approximately 32,000m³ to 40,000m³ of fill material with final volumes subject to detailed engineering design. Where possible, material won during excavation activities may be reused to construct the divider berms and other dam structures. Where required additional fill material including Virgin Excavated Fill Material (VENM) and clays may be imported to site.

The Eraring Ash Dam is identified as a prescribed dam under Schedule 1 of the Dams Safety Act 1978. Therefore, design of the western saddle embankment of the Eraring Ash Dam has been undertaken in consultation with the NSW Dam Safety Committee (DSC), relevant DSC guidelines and the requirements of the *Dams Safety Act 2015*.

Reconfiguration of RL140 Access Road

The Eraring Ash Dam is bounded on the west and north by an access road nominally established at RL140 m. Establishment of the western saddle embankment would require re-alignment of the existing access road to connect with the crest of the embankment (which will form an extension of the existing access road). Whilst the crest of the western saddle embankment follows the general alignment of the existing RL140 access road, a new roadway approximately 80 m in length will be required to connect the northern embankment to the RL140 access road.

Whilst the RL140 access road is established at a nominal height of RL 140m, actual road level is variable along the alignment. To support stormwater diversion works it would be necessary to adjust gradients by raising the road at the Rail Loop Pond location by up to 1.9m and grading the road at 0.5% in both directions back to original levels. It is anticipated that up to 500m of existing roadway may require regrading. Select fill would be used to achieve design grades. Granular materials would be imported to site. Piling, buttressing or retaining works may be required to ensure geotechnical stability and would remain within the proposed disturbance footprint.

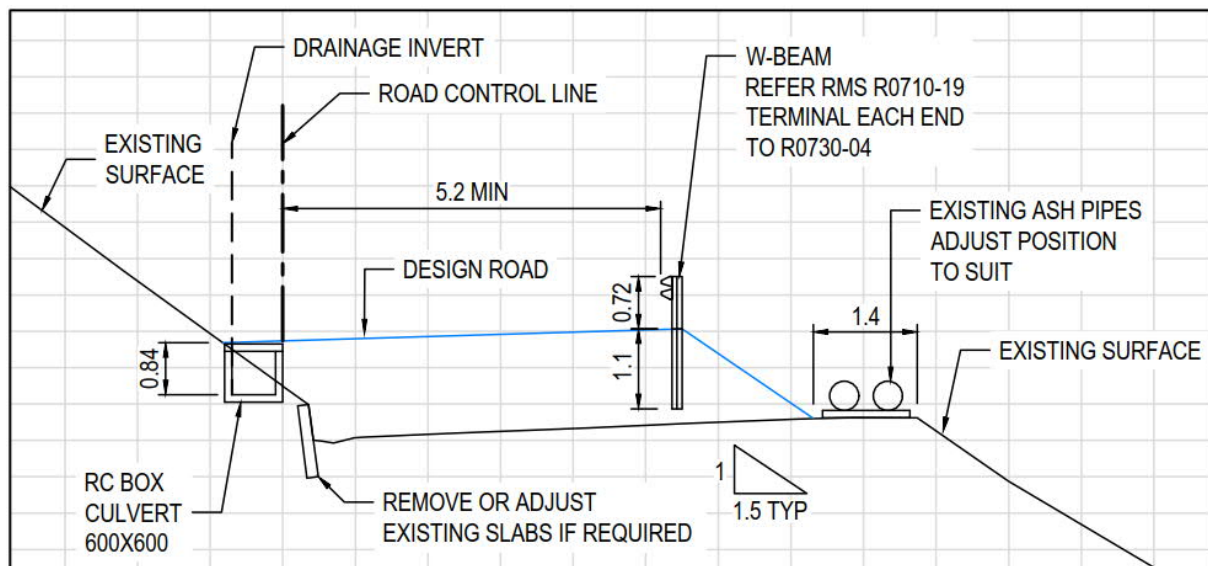


Figure 3 Road Design - Indicative Cross Section

Filling of mine voids

As the western emplacement area is located above inactive mine workings, remedial action is required to address the potential for:

- subsidence causing fractures and ground movements potentially impacting works associated with the project;
- the potential for direct water connectivity between the Eraring Ash Dam and mine workings.

A range of remedial approaches would be employed to effectively mitigate subsidence hazards identified for the site and include the following techniques:

- Filling of mine voids with stabilised fill material
- Excavating and collapsing of shallow mine workings; and/or
- Installing an impervious barrier using clays or suitable stabilised fill materials.

The preferred strategy may employ all or a combination of the above techniques. The effectiveness of these remedial actions would be confirmed prior to ash placement above RL130 within the emplacement area.

Mechanically stable fill material would be used to fill voids and fractures that exist within the overburden strata. Boreholes would be drilled from the surface to mine voids below to enable deposition of a cement stabilised fly ash fill material.

The cement ratio required to stabilise the fill would be confirmed based on detailed design and site parameters but is expected to be in the range of 2 to 4% cement content for fly ash fill. The fill material would be designed to be viscous enough to displace in situ water present within the voids being filled and to avoid dilution of the grout material. Grout material would be processed on site through operation of a temporary batching plant mixing reclaimed ash material from the Eraring Ash Dam with cement and stabilising product. The temporary batching plant would be located within existing operational areas of the Eraring Ash Dam.

To achieve effective treatment an estimated 100-130 boreholes would be drilled from the surface to depths ranging from 15 to 40m. Boreholes would be spaced according to the Awaba mine plan and located in areas of overlap with the Eraring Ash Dam and key project elements to achieve effective treatment of subsidence risks. Additional boreholes would be drilled from the existing RL140m access road, the conveyor access road and rail access road as required to minimise the potential for direct water connectivity between the Eraring Ash Dam and mine workings. The volume of mine voids to be filled is estimated to be approximately 200,000m³.

Where appropriate and safe to do so excavations may be undertaken to collapse shallow workings and improve stability. Materials would be stockpiled temporarily before being replaced or reused in construction activities to achieve design levels.

All remedial works would be limited to existing access tracks and operational areas where practical to minimise removal of vegetation. Remedial works would extend no further than around 100m from the proposed limit of ash placement. The limit of additional disturbance associated with these works is identified in Figure 2.

4.1.3 Water management systems

Improved controls and structures would be required to effectively manage both stormwater and process flows in and around the ash dam. This would include new stormwater works intercepting potential surface flows to the Western Emplacement Area, diverting these clean water flows to water storages within the broader Eraring catchment.

Stormwater diversion works

New stormwater diversion works are required along the RL140m access road for a length of approximately 1 kilometre to the north-west of the Eraring Ash Dam. The works would divert stormwater flows from local catchments into an existing receiving pond located to the west of the Eraring Ash Dam which would otherwise enter the ash dam through a series of culverts beneath the RL140m access road. The design allows for installation of a culvert and would require clearing of vegetation and earthworks along the length of the alignment.

Key components of the culvert design include:

- An outlet culvert from Rail Loop Pond consisting of 600 x 600mm rectangular precast concrete, at 0.5% grade
- A trapezoidal earth embankment drainage channel from the Rail Loop Pond to the Receiving Pond, nominally 2400mm wide, 600mm deep with 1:1.5 slope batters
- Piped sections of drainage channel which would consist of headwalls and nominally, DN900 polypropylene type pipes at two locations to avoid over-deep excavations or to cross the road
- A trash rack incorporating mesh to catch debris transported during storm events, a concrete apron and concrete/gravel access track to facilitate maintenance.

Raising of the RL140 Access Road is required to achieve design gradients and flows as described in Section 4.1.2.

Receiving pond

Diverted stormwater flows would enter an existing receiving pond which would be reshaped (within the same general footprint as currently exists) to accommodate design storage volumes (see Table 2). The receiving pond will provide an estimated 10,000m³ of storage volume, and additional buffer storage and overtopping storage based on the surrounding terrain.

Table 2 Receiving pond storage capacities

Storage element	Details	Estimated Capacity (m ³)
Receiving pond	Below RL 129 (estimated)	10,000
Buffer storage	Between RL 129 and RL 131	21,346
Overtopping storage	Between 131 and RL 132	17,996

Works associated with the receiving pond would require:

- Refurbishment (requiring earthworks and reshaping) of the existing receiving pond
- Constructing a new inlet structure at the existing receiving pond incorporating concrete vehicle access ramps, walkways, handrails, pipe and weir structures
- A new HDD pipeline (nominally DN 300 mm internal diameter) which would receive water from the inlet structure and extend some 360m underground to the west towards a new discharge point. The discharge point would consist of a precast headwall and rock lined channel extending for approximately 5 metres.

Establishment of the new discharge point would require localised removal of vegetation within an area of up to 20x20 metres and vegetation removal would be minimised where practical.

Clearing of an access corridor up to 10 metres wide and 20 metres in length would be required to facilitate access for construction machinery. Access would be limited to existing access tracks and operational areas where practical to minimise removal of vegetation.

4.1.4 Upgrades to ancillary infrastructure

Upgrades and modification of existing ancillary infrastructure is required to support the alternate deposition strategy and to ensure the continued safe operation of the Eraring Ash Dam.

Ash deposition pipelines

New ash deposition pipelines would be required to transport and deposit dense phase ash slurry within the ash dam. Pipelines would be constructed with multiple discharge points and connect to existing ash pipeline network. Discharge spigots may be located strategically within the ash dam to enable staggered deposition. Deposition pipelines may be relocated as required throughout the course of the project to enable the most efficient deposition of ash material.

4.1.5 Decommissioning of ancillary infrastructure

Establishment of the Western Emplacement Area would require relocation of fly ash recycling infrastructure currently operated by Boral. Infrastructure in this area primarily consists of mobile plant which is readily relocatable. Existing culverts acting to drain process water from the clean water detention pond to the ash dam would be decommissioned either by removal or filling with a suitable grout material.

4.2 Construction Work

4.2.1 Construction timing

Construction of the project would be staged to ensure the ongoing operation of the Ash Dam throughout the construction period. Construction works are anticipated to occur according to the following indicative schedule:

- Site establishment and other lead-in works including decommissioning of fly ash recycling infrastructure: October 2018 to November 2018.
- Establishment of the Western Emplacement Area including filling of mine voids: November 2018 to December 2018.
- Construction of western saddle embankment: December 2018 to January 2019.
- Upgrades to ancillary infrastructure: October 2018 to January 2019.

Construction works potentially audible at residential premises would only be undertaken during hours specified in Condition 2.3 to Project Approval 07_0084:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- At no time on Sundays and Public Holidays.

Not all the project components described in Section 4.1 would require discrete construction works, as some components relate to ongoing operational ash management practices (e.g. the establishment of the ash terrace deposition strategy). These operational activities would be undertaken for the duration of operations at Eraring Power Station. Station operations are undertaken 24 hours a day, seven days a week.

4.2.2 Construction activities

Construction activities for the project would include:

- Vegetation clearing
- Earthworks for the establishment of the western emplacement area, the south-western embankment wall and elsewhere as required (e.g. site drainage)
- Installation and modification of ancillary infrastructure
- Testing and commissioning.

Material excavated during clearing and establishment works would be reclaimed and used as material for the construction of embankments and other structures as required, such as internal divider berms. However, the potential use of material would be subject to further engineering investigation and evaluation. Therefore, suitable construction material may need to be transported to site to support the augmentation.

4.2.3 Construction equipment

An indicative list of plant and equipment that would be used at various stages of the construction of the project is provided below:

- Backhoe/mini excavator
- Generators
- Mobile crane up to 20t
- HDD drilling rig
- Dozers up to D9/D10
- Compactors
- Excavator 12-20t, 32 tonne, long arm excavator
- Hand held power tools such as metal and timber cut off saw, electric hand saw, hammer drill etc
- Heavy vehicles to transport excavated material and material for establishment of embankments
- Light vehicles and utility vehicles
- Loader
- Water cart.

4.3 Project Staging

It is noted that deposition of ash within the Eraring Ash Dam is by nature a dynamic process requiring operational flexibility and an adaptive approach to achieve efficient deposition towards the intended landform. Construction of key project elements outlined in Section 4.1 would be undertaken on a progressive basis subject to operational requirements.

Progressive review may require alternate configuration of water management systems or cell design to ensure efficient ash placement and to maintain operational safety. Staging of internal cell walls and terraces, their construction and configuration may also require review and adjustment based on ash material characteristics (which may change over time) and design specifications.

However it is anticipated that all ash dam operations would be undertaken in general accordance with the description provided in Section 4.1, remain within the operational footprint of the ash dam and progress towards achieving the landform shown in Figure 2.

4.4 Closure and Rehabilitation

Following decommissioning of EPS it is anticipated that the site will be rehabilitated to a point that will allow further uses, for example industrial and/or community uses. Origin will rehabilitate the final footprint of the CCP management facility in a manner generally consistent with the surrounding landform.

4.5 Modification of Conditions

Project Approval 07_0084 currently states:

The Proponent shall carry out the project generally in accordance with:

- a. Major Project Application 07_0084
- b. *Environmental Assessment – Upgrade and Expansion of the Coal Combustion Product Management System, Eraring Power Station*, dated 13 November 2007, and prepared by HLA – ENSR
- c. *Upgrade and Expansion of the CCP Management System, Eraring Power Station – Submissions Report*, dated 15 February 2008, and prepared by HLA – ENSR
- d. The conditions of approval granted by the Minister for Planning for the upgrade of the Ash Disposal Facility at the Eraring Power Station (Application Number 05_0138)
- e. The conditions of this approval.

This condition would be required to be modified to include the title of this environmental assessment (*Environmental Assessment – Ash dam augmentation, Eraring Power Station*, dated DY MNTH 2018, and prepared by AECOM).

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5.0 Statutory Planning

5.1 Commonwealth Legislative Requirements

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the approval of the Commonwealth Department of Environment and Energy (DoEE) for actions that would have, or are likely to have, a significant impact on matters of National Environmental Significance (NES). The EPBC Act lists nine matters of NES which must be addressed.

A Protected Matters Search of NES Matters was undertaken on 10 April 2018 to determine what NES features may be present within 10km of the Project site. The results of this database search are summarised in Table 3 and provided in full at Appendix B.

Table 3 Consideration of matters of NES under the EPBC Act

NES Matters	Results of Protected Matters Search
World Heritage properties	None
National Heritage places	None
Ramsar wetlands of international importance	None
Listed threatened ecological communities	None
Listed threatened species	The search identified the potential for 32 listed threatened species to exist at the Site. A biodiversity assessment was undertaken for the project which considered listed threatened species and is summarised in Section 8.1.
Listed migratory species	The search identified the potential for 17 listed migratory species to exist at the Site. A biodiversity assessment was undertaken for the project which considered listed migratory species and is summarised in Section 8.1.
Commonwealth marine areas	None
Great Barrier Reef Marine Park	None
Nuclear actions (including uranium mining)	None
Water resources impacted on by a coal seam gas or large coal mining development	None

The Project is not expected to have a significant impact on relevant matters of NES. Accordingly, the Project would not need to be referred to the DoEE.

5.2 NSW Legislative Requirements

5.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for environmental planning in NSW.

The EPS currently operates under a number of Project Approvals (refer Section 1.3) including Project Approval 07_0084 for the management of CCP at the EPS site. Project Approval (07_0084) was issued under Part 3A (repealed) of the EP&A Act. Part 3A of the EP&A Act was repealed in 2011, however transitional arrangements were set out in Schedule 6A of the EP&A Act which provided that Part 3A continued to apply to approved Part 3A project, including modifications to Project Approvals under section 75W of the EP&A Act.

On 1 March 2018, amendments to the EP&A Act were enacted to remove these Part 3A transitional arrangements. The transitional arrangements that were previously contained within Schedule 6A of the EP&A Act were transferred to Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, with additional provisions inserted regarding the removal of these transitional Part 3A arrangements including:

3BA Winding-up of transitional Part 3A modification provisions on cut-off date of 1 March 2018 and other provisions relating to modifications

1. *For the purposes of this clause, the cut-off date is 1 March 2018.*
2. *An approved project or a concept plan cannot be modified under section 75W on or after the cut-off date, except as provided by this clause.*
3. *Subclause (2) does not apply if the request to modify the approved project or concept plan under section 75W was lodged before the cut-off date. Accordingly, the provisions of this Schedule relating to a modification made pursuant to such a request continue to apply.*
4. *A request to modify an approved project or concept plan under section 75W that may be dealt with because of subclause (3) cannot be dealt with under section 75W if:*
 - a. *the request has not been determined by 1 September 2018, and*
 - b. *the Secretary is of the opinion that insufficient information has been provided to deal with the request and notifies the person who made the request that it will not be dealt with under section 75W.*

Origin briefed the DP&E regarding the proposed Project on 22 February 2018 and submitted documentation detailing the proposal on 28 February 2018. Advice received from DP&E (dated 28 February 2018) confirmed that a modification to Project Approval (07_0084) under Section 75W of the EP&A Act would be the appropriate approval pathway for the Project.

As this modification request was submitted prior to the cut-off date of 1 March 2018, the provisions of the former Part 3A continue to apply to this modification request. The current Project would therefore be undertaken as a modification to the existing Project Approval (07_0084) under section 75W of the EP&A Act. The approval authority is the Minister for Planning.

5.2.2 Eraring Power Station Act 1981

The *Eraring Power Station Act 1981* (EPS Act) authorises development of the Eraring Power Station site. The EPS Act commenced on 15th December 1981 by proclamation in the NSW government gazette.

Specifically, section 21(2) of the EPS Act authorises and approves, and deems to have always been authorised and approved for the purposes of any other act, 'development' of the Eraring power station site for 'approved purposes'. Definitions of 'development' and 'approved purposes' in the EPS Act are as follows:

approved purposes means:

- (a) *the purposes of electricity generating works, public utility undertakings, the transmission or supply of electricity, the storage of water and coal, coal conveyors, coal loading facilities, the storage and use of hazardous substances, the construction of dams, the storage and disposal of spoiled water, ash and waste, bulk stores, offices, recreation facilities and parking or any of those purposes,*
- (b) *purposes connected with facilities associated with the generation, transmission or supply of electricity, or*
- (c) *purposes ancillary to or associated with any of the foregoing purposes.*

development means:

- (a) *buildings, structures and improvements erected or constructed or to be erected or constructed on, in or over land comprising the whole or any part of the site,*
 - (b) *works carried out or to be carried out on, in or over any such land, and*
 - (c) *subdivision effected or to be effected of any such land,*
- whether erected, constructed, carried out or effected before, on or after the day appointed and notified under section 2 (2).*

The date referred to in the definition of ‘development’, being the date notified under section 2(2) of the EPS Act, is the date notified by proclamation in the Government Gazette. This date was 15 December 1981. Current operation of the Eraring Ash Dam is undertaken in accordance with existing use rights afforded by the EPS Act.

5.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) aims to conserve biodiversity at bioregional and State levels to maintain the diversity and quality of ecosystems. The BC Act provides for the protection of threatened species, populations and ecological communities, their habitats and critical habitat. Species, populations and ecological communities that are listed as critically endangered, endangered or vulnerable are identified in Schedule 1 of the BC Act.

A Biodiversity Development Assessment Report was undertaken to address potential impacts to threatened species, populations or ecological communities within the Project area (refer to Section 8.1).

5.2.4 National Parks and Wildlife Act 1974 (NPW Act)

The NPW Act provides for the conservation of nature, including habitat, ecosystems and ecosystem processes, and Aboriginal places and objects throughout NSW. Under the NPW Act, it is an offence to harm an Aboriginal object or place without consent. Where an activity is likely to harm an Aboriginal object or place, approval under Section 90 of the NPW Act is required through issue of an Aboriginal Heritage Impact Permit (AHIP).

A search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken for the proposed works (refer to Section 8.4). Review of the location of previously recorded Aboriginal sites indicated that no sites lie within areas potentially disturbed by the project.

A visual inspection of the project area was undertaken on 7 May 2018 and potential impacts to aboriginal places or objects considered in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010:10). Taking into account the nature and extent of past ground disturbances across the project area, as well as the results of previous Aboriginal archaeological assessments in the Lake Macquarie area, the Aboriginal archaeological sensitivity of land within the project area was assessed as ‘low’.

5.2.5 Protection of the Environment Operations Act 1997

EPS is managed in accordance with Environmental Protection Licence (EPL) No. 1429 issued by the NSW Office of Environment and Heritage under the *Protection of the Environment Operations Act 1997*.

There are two licenced discharge locations associated with the operation of the Ash Dam. EPS currently has a license to discharge from the Ash Dam to either the outfall canal or Crooked Creek (both locations ultimately discharge to Myuna Bay). Generally, discharge occurs in accordance with licence conditions via the outfall canal, however, under emergency conditions (e.g. as a result of sustained heavy rainfall) it may be necessary to discharge to Crooked Creek to lower the water level in the dam.

A comprehensive air quality, surface water and groundwater monitoring program is maintained in accordance with EPL 1429. Results are reported on an ongoing basis in accordance with the requirements of the licence and the POEO Act.

5.2.6 Dams Safety Act 2015

The Dams Safety Act 2015 provides the framework for the regulation of dam safety in NSW. The Dams Safety Act 1978 has recently been updated by the Dams Safety Act 2015, but until that Act is fully implemented, dams will continue to be regulated under the 1978 Act.

The Act constitutes the NSW Dams Safety Committee (DSC) and sets out its functions and powers. Schedule 1 of the Dams Safety Act 1978 lists those dams that are proclaimed to be “prescribed dams”. Eraring Ash Dam is listed in this schedule.

The DSC has established guidelines for dam owners relating to the design, safety management and surveillance of dams. In particular, the guidelines require compliance in the areas of flood capacity, seismic stability, emergency planning, inspection and monitoring activities, safety management, surveillance reporting and hydrological analysis.

Design of the western saddle embankment of the Eraring Ash Dam has been undertaken in consultation with the NSW Dam Safety Committee (DSC), relevant DSC guidelines and the requirements of the Dams Safety Act 2015.

5.2.7 Coal Mine Subsidence Compensation Act 2017

Part 3 of the *Coal Mine Subsidence Compensation Act 2017* requires approval from the Chief Executive for development within a mine subsidence district. The Eraring Power Station and Eraring Ash Dam are located within the West Lake Mine Subsidence District.

Subsidence Advisory NSW was consulted (project briefing held on 20/04/2018) with regard to the current proposed project, given the proximity of the Eraring Ash Dam to historical underground workings. An assessment of potential mine subsidence impacts was subsequently prepared by SCT Operations Pty Ltd to review and assess potential geotechnical risks of the project relating to the proximity of the underground mine workings.

The mine subsidence impact assessment identified two potential risks associated with the project (SCT, 2018):

- Potential for subsidence in the form of either pillar collapse or roof failures leading to sink hole formation and impacting on the ash dam and the western saddle embankment.
- Connectivity and the potential for surface water to flow from the ash dam into the mine workings.

A range of remedial approaches would be employed to effectively mitigate subsidence hazards identified for the site and include the following techniques:

- Filling of mine voids with stabilised fill material;
- Excavating and collapsing of shallow mine workings; and/or
- Installing an impervious barrier using clays or suitable stabilised fill materials.

The preferred strategy may employ all or a combination of the above techniques. The effectiveness of these remedial actions would be confirmed prior to ash placement above RL130 within the emplacement area. Approvals under Part 3 of the *Coal Mine Subsidence Compensation Act 2017* would be sought and obtained as appropriate.

5.2.8 State Environmental Planning Policies

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP)

The Coastal Management SEPP promotes an integrated and co-ordinated approach to land use planning in the coastal zone. The EPS site is located in proximity to the coastal environment associated with Lake Eraring and Myuna Bay. The mapped coastal environment area and mapped areas of coastal wetlands under the Coastal Management SEPP are located within the EPS site. No construction activities would be undertaken within these areas however potential indirect impacts to the coastal wetlands and coastal environment area as a result of stormwater diversion works have been assessed in Section 8.2 .

The coastal wetlands, Lake Eraring and Lake Macquarie are also listed as a coastal environment area under the *Coastal Wetlands and Littoral Rainforests Area Map*. Division 3, Section 13.1 of the SEPP Coastal Management provides that:

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

- (a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,*
- (b) coastal environmental values and natural coastal processes,*

- (c) *the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,*
- (d) *marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,*
- (e) *existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,*
- (f) *Aboriginal cultural heritage, practices and places,*
- (g) *the use of the surf zone.*

Potential impacts to coastal areas are considered throughout section 8.0.

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44)

SEPP 44 aims to encourage the conservation and management of areas of natural vegetation that provide a habitat for koalas. SEPP 44 requires a plan of management for areas of more than one hectare that contain koala habitat for which a development application has been made to council. Although development consent from Council is not required for this proposed modification, the intent of this SEPP has been considered.

Potential impacts to koala habitat from vegetation clearing are considered in Section 8.1.

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55)

SEPP 55 provides a state-wide planning control for the remediation of contaminated land to reduce the risk of harm to human health or other environmental systems. Clause 7 of SEPP 55 requires consideration of whether the land is contaminated and whether it is suitable (or can be made suitable) for proposed development.

A search of the EPA contaminated land record of notices was undertaken on 12th of June 2016 did not identify any relevant notices identifying existing or potential contamination within the project area. The site is currently used as a power station and the proposed modification is for augmentation works to existing operations on the site. Given the nature of the existing and proposed uses, the site is considered to be suitable for the proposed development from a contamination perspective. An assessment of potential contamination impacts is provided in Section 8.2.

5.3 Local Matters

5.3.1 Lake Macquarie Local Environmental Plan 2014

The provisions of the Lake Macquarie Local Environmental Plan 2014 (LEP 2014) do not apply as the project is being assessed under transitional arrangements for projects previously determined under Part 3A of the EP&A Act. However, LEP 2014 has been considered consistent with best practice environmental planning.

EPS is located within the SP2 – Infrastructure zone under LEP 2014. The objectives of the zone are to:

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.
- To provide land required for the development or expansion of major health, education and community facilities.

The project is considered to be consistent with the objectives LEP for the SP2 – Infrastructure zone.

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6.0 Stakeholder Consultation

Relevant stakeholders were identified based upon legislative requirements, assessment methodologies and a prioritisation of environmental issues (see Section 7.0). A summary of stakeholder consultation undertaken in relation to the project is provided in Table 4.

Project briefings were held with individual stakeholder organisations to provide an overview of the project, key design elements, potential environmental impacts and where relevant identify potential areas of focus or concern. This consultation process has informed the environmental impact assessment (see Section 8.0).

Table 4 Stakeholder Consultation

Stakeholder	Consultation
Lake Macquarie Council	Project Briefing held on 20/04/2018.
Mine Subsidence Board	Project Briefing held on 20/04/2018.
Centennial Coal	Project Briefing held on 19/06/2018. Summary of Mine Subsidence Impact Assessment findings provided on 18/07/2018.
Dams Safety Committee	Project Briefing held on 14/06/2018.
Office of Environment & Heritage	Project Briefing held on 13/06/2018
NSW Environment Protection Authority	Project Briefing held on 05/06/2018. Summary of Mine Subsidence Impact Assessment findings provided on 20/07/2018.

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7.0 Prioritisation of Issues

An assessment of potential environmental impacts associated with the project based on existing data and knowledge of the site was carried out. A risk analysis was undertaken to rank these issues according to the level of environmental risk.

7.1 Risk Matrix

Potential impacts are ranked according to the risk matrix (see Table 5) as being a High, Medium, Low or Very Low risk to the environment. The allocation of risk is based upon the following considerations:

Potential Consequences:

1. *Broad scale environmental impact.*
2. *Regional environmental impact.*
3. *Local environmental impact.*
4. *Minor environmental impact.*
5. *Insignificant environmental impact.*

Likelihood of adverse impact:

- a. *Almost certain.*
- b. *Likely.*
- c. *Possible.*
- d. *Unlikely.*
- e. *Rare*

Table 5 Risk Matrix

Potential Consequence	Likelihood of adverse impact					
		A	B	C	D	E
	1	High	High	Medium	Low	Very Low
	2	High	High	Medium	Low	Very Low
	3	Medium	Medium	Medium	Low	Very Low
	4	Low	Low	Low	Low	Very Low
	5	Very Low	Very Low	Very Low	Very Low	Very Low

7.2 Risk Analysis

The prioritisation of potential environment issues related to the project is provided in Table 6. The ranking aims to allow the prioritisation of issues for assessment and does not consider the application of mitigation measures to manage the environment effects. In each case, appropriate and proven mitigation measures would be used to minimise and manage potential impacts identified in this risk analyses. These measures are described throughout Section 8.0 of this EA and are summarised in Section 9.0.

Table 6 Prioritisation Analysis

Environmental Aspect	Potential Environmental Issue(s)	Consequence	Likelihood	Ranking
Biodiversity	Vegetation clearing	3	B	High
Hydrology	Contamination of surface water and groundwater from contaminants associated with the existing ash dam Changes to the hydrology of the area	3	C	Medium
Geotechnical	Subsidence impacts associated with previous underground mine workings within the Project Area	3	C	Medium

Environmental Aspect	Potential Environmental Issue(s)	Consequence	Likelihood	Ranking
Aboriginal heritage	Impacts to Aboriginal heritage items	3	D	Low
Air Quality	Generation of fugitive emissions and dust	4	C	Low
Traffic and Transport	Traffic impacts during construction and operation	4	D	Low
Waste	Generation of waste requiring disposal	3	E	Very Low
Noise	Noise impacts to residential receivers	4	E	Very Low
Visual	Visual impacts to residential receivers	4	E	Very Low
Greenhouse Gas (GHG) Emissions	Generation of GHG, including carbon dioxide, methane and oxides of nitrogen	4	E	Very Low
Non-Aboriginal Heritage	Impacts to Non-Aboriginal heritage items	5	E	Very Low
Social and Economic	Potential impacts and benefits to the local and wider community.	5	E	Very Low
Cumulative Impact	Potential impacts taking into account other existing and approved development in the area	5	E	Very Low

7.3 Key issues

Based on the risk analysis presented above, the key issues requiring detailed assessment within this EA were identified and include:

- Biodiversity
- Hydrology
- Geotechnical
- Aboriginal Heritage
- Air Quality
- Traffic.

These key issues are assessed in Section 8.1 to Section 8.6 of this EA. Other issues having very low or no anticipated impact are addressed in Section 8.7.

8.0 Environmental Impact Assessment

8.1 Biodiversity

8.1.1 Existing Environment

Local Ecological Context

The Project area comprises remnant vegetation within the EPS site adjacent to existing disturbances including the Eraring Ash Dam, access tracks and roads and power line easements. Intact vegetation is generally in moderate to good condition. Vegetation in disturbed areas is dominated by exotic plant species.

The project area is located in the west of the Lake Macquarie region. The locality is occupied by rural landscapes and residential areas associated with Dora Creek, Eraring, Myuna Bay and Rathmines with substantial areas of intact vegetation within the buffer land associated with EPS. Key land uses around the Project area include rural and residential areas, infrastructure, transport routes and open space. The M1 Pacific Motorway and Main Northern Railway are located to the west of the project area and contribute to fragmentation and barriers to fauna movement.

Lake Macquarie's freshwater or brackish wetlands include areas of coastal lagoons, creek lines and alluvial flats. They can take the form of paperbark and casuarina forests, heath communities and sedge and reed associations. These habitats can provide important spawning and nursery areas for many species of freshwater fish, provide habitat for a high number of bird and amphibian species and absorb and recycle nutrients through the ecosystem.

Field Survey Results

Surveys of the project area identified two Plant Community Types (PCTs) (refer Table 7) assessed as being in good condition. Descriptions of these PCTs are provided in Section 3.1.1 of Appendix C. These PCTs are not consistent with any Threatened Ecological Community (TEC) listed under the BC Act or EPBC Act. No TECs were recorded within the project area.

Table 7 Plant Community Types within the project area

Plant Community Type	Vegetation Class	Area (ha)
PCT 1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Sydney Coastal Dry Sclerophyll Forests	0.95
PCT 1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast	Sydney Coastal Dry Sclerophyll Forests	8.0

An assessment of the suitability of habitat in the project area was undertaken to determine the likely occurrence of ecosystem-credit species in the vegetation zones identified. Targeted surveys were undertaken for species-credit species predicted to occur by the BAM calculator or identified in the literature review.

Three ecosystem-credit species were recorded during surveys or were considered likely to occur within the project area, including:

- Black-eyed Susan (*Tetradlea juncea*)
- Squirrel glider (*Petaurus norfolcensis*)
- Stephen's banded snake (*Hoplocephalus stephensii*).

The project area contains a range of exotic vegetation, including dense monocultures of woody weeds and exotic grasses. The most abundant exotic species present include castor oil plant (*Ricinus communis*), Rhodes grass (*Chloris gayana*), pampas grass (*Cortaderia selloana*), whisky grass (*Andropogon virginicus*) and lantana (*Lantana camara*), which dominate the native vegetation in some areas. Other exotic species present include crofton weed (*Ageratina adenophora*), fireweed (*Senecio madagascariensis*), camphor laurel (*Cinnamomum camphor*), cobbler's pegs (*Bidens pilosa*), wild tobacco bush (*Solanum mauritianum*) and Bitou Bush (*Chrysanthemoides monilifera*). A number of weeds present in the project area are classed as High Threat Weed species under the BAM.

8.1.2 Potential Impacts

Direct Impacts

The Project would result in direct impacts on biodiversity values through the loss of vegetation and fauna habitats as a result of clearing works and subsequent facility operations. Approximately 8.95 hectares of native vegetation would be directly impacted by the Project. Three threatened species have been identified to occur within the project area and the site contains a range of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat).

Origin has sought to avoid and minimise the potential impacts on the ecological values of the project, primarily through minimisation and careful selection of the location of potential disturbance. The project has been designed to occur in areas surrounding existing disturbed areas that are likely to be subject to edge effects and indirect impacts from the current Power Station operations. The alternative options considered by Origin are described in Section 3.3 of this EA. Mitigation measures set out in Section 8.1.3 would be implemented for the Project to minimise the impacts of vegetation clearing on native vegetation and threatened species.

Indirect Impacts

The Project is not expected to result in additional indirect impacts on the biodiversity values of surrounding lands. No substantial indirect impacts are expected to occur in relation to connectivity, corridors, habitat fragmentation or light emissions beyond minimal encroachment from the project area. However, some minor indirect impacts associated with noise, dust, weeds and feral animals may occur during the construction and operation of the Project.

Increased noise has the potential to adversely impact native species, by disturbing the roosting and foraging behaviour of fauna species or reducing the occupancy of areas of suitable habitat. The Project is not expected to result in substantial change to noise impacts compared to existing operations and noise emissions are not likely to significantly impact threatened species, populations and communities.

Dust emissions can adversely impact native species during ground disturbing works, including dust covering vegetation thereby potentially reducing vegetation health and growth. Dust control measures would be implemented for the Project to minimise the potential for dust generation, as set out in Section 8.5.3 of this EA. The Project is not expected to substantially change dust impacts given that the project area is directly adjacent to existing operations. Impacts resulting from dust are not expected to be significant in relation to threatened species, populations and communities.

There is potential for weed species to be inadvertently brought onto the site during transport of machinery or materials. Ground disturbance and native vegetation removal may provide increased opportunities for weed spread and propagation. Populations of feral fauna species such as foxes, rabbits and cats can increase and quickly populate new areas as a result of disturbance. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species.

However the Project is not expected to substantially change the potential for weeds or feral animals to invade or spread within the Project Area. Mitigation measures outlined in Section 8.1.3 of this EA would be implemented to minimise the potential for weed encroachment and spread of feral animals into areas surrounding the project area.

Prescribed Impacts

The *Biodiversity Conservation Regulation 2017* (BC Regulation) includes a number of impacts considered to be ‘prescribed impacts’. An assessment of the prescribed impacts relevant to the project is provided in Table 8.

Uncertain prescribed impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes and increased vehicle strikes. The Project is unlikely to result in uncertain prescribed impacts.

Table 8 Prescribed Impacts

Prescribed Impact	Assessment with regard to the Project
Impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation.	No impacts are expected to occur on threatened species or community habitat associated with karst, caves, crevices, cliffs and other geological features of significance, rocks or human-made structures as these do not occur within the project area.
Impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	Important connectivity and movement habitat is unlikely to be substantially impacted by the Project.
Impacts on movement of threatened species that maintains their life cycle.	The Project proposes to impact areas surrounding existing cleared areas and will not result in severing any major fauna movement habitat which would result in the loss of connectivity in the wider landscape or movement important for threatened species to maintain their life cycle.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.	No impacts on water quality or hydrological processes that sustain threatened species and threatened ecological communities are likely to occur.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	No change is proposed to vehicle site access. Access to the project area will continue via existing access tracks. Due to the disturbed condition of the site, it is unlikely that any threatened species or animals that are part of a TEC would be adversely impacted by the increase in vehicle movement in the project area.

Serious and Irreversible Impacts (SAIL)

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

None of the PCTs or species-credit species that generate biodiversity credits for the Project are nominated as candidate SAIL entities in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (OEH 2017b). As no species or ecological communities listed as SAIL entities are likely to occur within the project area, further assessment of SAIL is not required.

Biodiversity Credit Impact Summary

The BDAR included an assessment of biodiversity credits required as a result of impacts on biodiversity values within the project area. Two PCTs and three species-credit species would require offsetting in accordance with the BAM. The BDAR concluded that credits as described in Table 9 would be required to offset the impacts of the Project on biodiversity values.

Table 9 Impacts Requiring Offset

PCT/Species-credit	Area (ha)	Credits Required
1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Good Condition</i>	0.95	22
1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast <i>Good Condition</i>	8.00	261
black-eyed Susan - <i>Tetratheca juncea</i>	8.96	327
squirrel glider - <i>Petaurus norfolcensis</i>	8.96	327
Stephen's banded snake - <i>Hoplocephalus stephensii</i>	8.96	327

8.1.3 Mitigation Measures

Construction

A Construction Environmental Management Plan (CEMP) would be prepared and implemented during construction of the Project. The CEMP would identify mitigation measures and procedures including:

- Vegetation clearing activities would be undertaken in accordance with existing procedures outlined in the Land and Biodiversity Management Plan (AECOM, 2017). The procedures would incorporate:
 - A documented risk assessment prior to clearing commencing
 - Establishment of exclusion zones (e.g. in areas in proximity to existing habitat offset sites)
 - Identification of habitat trees and inspections pre and post felling
 - Staged clearing activities
- Ground disturbance and soil handling activities would be undertaken in accordance with existing procedures outlined in the Biodiversity and Land Management Plan (AECOM, 2017). The procedures would incorporate:
 - Weed management activities
 - Soil handling protocols including stockpiling procedures
- Areas disturbed as a result of construction activities which are not required for future operational use would be progressively stabilised and rehabilitated as soon as practical following disturbance. Rehabilitation activities would be undertaken in accordance with the Biodiversity and Land Management Plan (AECOM, 2017).

Operation

The following control measures will be implemented on an ongoing basis in accordance with the existing Biodiversity and Land Management Plan (AECOM, 2017):

- weed management
- vertebrate pest control
- fencing and access control
- bushfire management
- progressive rehabilitation.

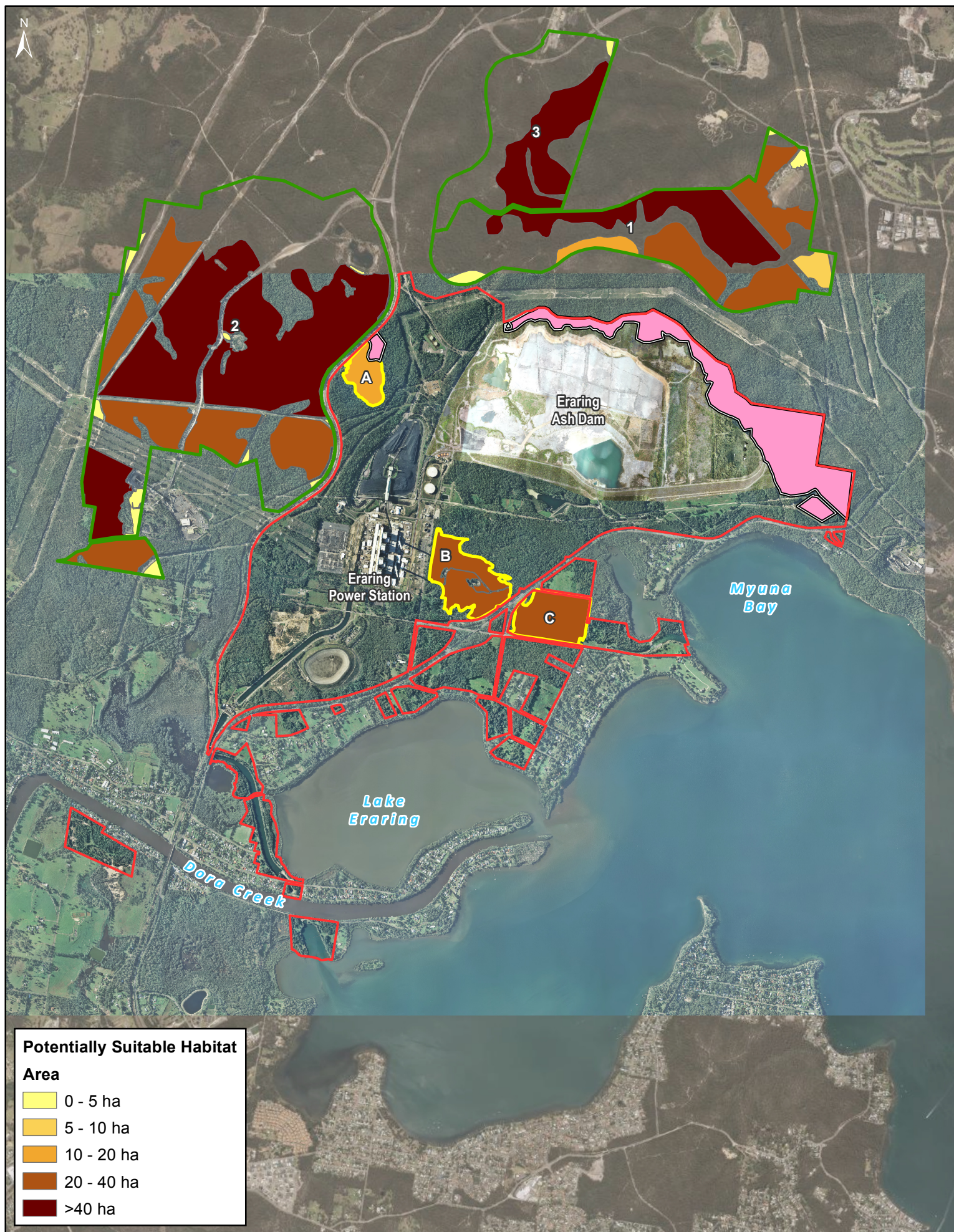
Offset Strategy

Origin is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project. Offset requirements under the BC Act would be fulfilled using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits
- Securing required credits through the open credit market and/or;
- Payments to the Biodiversity Conservation Fund.

In-perpetuity conservation would form the preferred method of offsetting under the BC Act where practicable. Origin has undertaken preliminary investigations of land-based offset opportunities in the vicinity of the project area both within and outside of Origin's existing landholdings. Approximately 60ha of land likely containing target PCTs and suitable habitat for target threatened species have been identified within the broader Project Area (see Figure 4). An additional 500ha of potential offset sites have been identified within 10km of the Project Area.

Identification and selection of a suitable stewardship site or sites would be informed by further detailed field based assessment. Offsets would be established through appropriate legal mechanisms or agreements to ensure the conservation of a stewardship site (or sites) in perpetuity prior to the commencement of vegetation clearing activities within the project area.



Potential Offset Locations
Ash Dam Augmentation Project

Source: Origin 2018, DFSI 2018

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Fig. **4**

8.2 Hydrology

8.2.1 Existing environment

Surface water

The previous EA prepared for the upgrade and expansion of the Ash Dam (HLA, 2007) included a review of the water quality and groundwater within the study area. A site water balance model to address both clean and process water systems and storages at EPS has since been prepared to assist in the effective management of water on site (AECOM, 2015).

The Ash Dam operations involve the use of water for the dense phase ash placement whereby a slurry of up to 70% ash and 30% water is discharged to the Ash Dam.

The Ash Dam receives flow from a range of sources including:

- Incidental rainfall and adjacent contributing catchment
- Power station fly ash (solid tailings and water) via a pipe
- Power station bottom ash (solid tailings and water) via an open channel
- Outflows from the transfer pond via an open channel
- Captured seepage pumped from the Toe Drain Pond
- Treated drainage water from designated station hard stand areas
- Pumped outflow from the Demin Plant
- Pumped flow from the Return Water Tank and Outfall Canal as required for maintaining water level in the Ash Dam
- Pumped excess water from Awaba Mine.

Part of the rehabilitated surface area of the ash dam and the natural catchments towards the north are diverted into the adjacent constructed wetland, and serve to reduce clean catchment inflows into the Ash Dam.

In addition to evaporative processes, captured water is discharged by:

- Outflow via a siphon pipe controlled by a valve to the Return Water Dam
- Overflow discharge via a spillway to the Return Water Dam
- Seepage, some of which is collected in the Toe Drain Pond and re-circulated to the Ash Dam
- Some minor losses due to moisture content of the ash which is harvested and transported offsite.

Groundwater

Groundwater beneath the site is expected to be present within the shallow soils and former ash placement areas of the former Wangi Power Station. The nearest groundwater receptors surrounding the Ash Dam are Crooked Creek and Lake Macquarie which are both located approximately 400m from the main embankment.

Data from groundwater bores on or near the EPS site indicate that the depth to groundwater ranges from approximately 21 to 16 m below ground level (HLA, 2006). It is expected that in general terms groundwater migrates from north of the ash dam, down gradient, towards Myuna Bay. Historical groundwater monitoring results obtained on site indicate that there are a number of trace metals in groundwater beneath the Ash Dam which have, on occasion, been recorded in concentrations in excess of the ANZECC 2000 criteria. It is unclear whether the concentrations can be attributed to background or naturally elevated conditions (HLA, 2007).

Existing water monitoring

Surface water and groundwater monitoring activities are currently undertaken in accordance with the requirements of EPL 1429. EPL 1429 sets out the concentration and volume limits for discharges from the licensed discharge points as well as relevant monitoring requirements. Surface water and groundwater monitoring locations are shown in Figure 5.



Figure 5 Surface and Groundwater Monitoring Locations

Key parameters of the surface water monitoring program include metals, selenium, temperature, pH, nutrients and total suspended solids (TSS). In the event that monitoring results indicate an exceedance of specified EPL criteria for these parameters, the results are reported to the relevant government agencies and further site specific investigations are undertaken.

Groundwater monitoring at the EPS site includes a specific Ash Dam groundwater monitoring program which monitors anions (sulphate, chloride, fluoride), cations (calcium, magnesium, sodium, potassium, iron), boron, manganese, alkalinity, pH and total dissolved solids.

Groundwater monitoring is complemented by monthly lake water quality monitoring from within Myuna Bay (considered to be the ultimate receiving water body). Results for temperature, salinity, dissolved oxygen, water clarity and zooplankton are recorded for potential trend analysis.

EPL 1429 does not contain specific impact assessment criteria for groundwater monitoring. The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* published by Australian and New Zealand Environment Conservation Council (ANZECC, 2000) provides a framework for the assessment of water quality in fresh environments. Monitoring results are compared against the impact assessment criteria (trigger values) provided in the ANZECC guidelines. Where monitoring results fall outside the impact assessment criteria, further action is taken to investigate or address the cause.

Additional due diligence surface and groundwater monitoring is undertaken in accordance with the Water Management Plan (Umwelt, 2013). The Water Management Plan includes a Trigger Action Response Plan which provides appropriate response protocols for events that may result in adverse impacts to the surrounding surface water and/or groundwater environment. Response protocols include a notification process including reporting of non-compliances with the Project Approval or EPL conditions to the DP&E and EPA. The incident reporting process is described in Origin's Pollution Incident Response Management Plan (PIRMP) prepared in accordance with the POEO Act.

8.2.2 Potential impacts

Potential impacts to surface water and groundwater as a result of the upgrade and expansion of the Ash Dam were previously assessed in the 2007 EA and include:

- Potential water quality impacts to receiving waters
- Alterations to the local hydrological regime
- Changes to runoff patterns resulting in erosion and sedimentation
- Temporary impacts to water quality during the construction period as a result of earthworks and construction traffic.

Surface water

Construction

Potential water quality impacts during construction of the Project may include increased erosion and sedimentation resulting from removal of vegetation and ground disturbance associated with establishment of the western emplacement area. These activities may result in the liberation of sediments during rain events which may discharge into the Eraring Ash Dam or receiving water pond (see Figure 2). Whilst it is expected that in most instances impacts would be localised with sediment settling out during a typical rain event, there is potential for an increase in total suspended solids to occur in discharges to Lake Macquarie via the cooling water outlet canal.

These potential impacts would be adequately managed through standard construction management measures and erosion and sediment controls. Improved stormwater controls and structures would be required to effectively manage both stormwater and process flows in and around the ash dam. This would include stormwater works intercepting potential surface flows to the western emplacement area and diverting these clean water flows to water storages within the broader Eraring catchment.

New stormwater diversion works are described in Section 4.1.3 and include:

- Clearing and earthworks to the north west of the western emplacement area along a 1km alignment, to divert stormwater flows into the existing receiving pond located to the west of the Ash Dam
- A new inlet structure at the existing receiving pond
- A new HDD pipeline which would extend underground to the west from the new inlet structure, for around 360 metres, towards a new discharge point consisting of a rock lined channel.

These stormwater diversion works may result in increased erosion and sedimentation. Pipeline installation would be via directional drilling and as such there would be no surface disturbance along the pipeline route. Construction of the outlet structure would require surface disturbance including vegetation clearing, earthworks for construction of the headwall and channel and for the temporary location of drilling equipment. The location of the outlet structure has been selected to minimise vegetation clearing requirements. Potential impacts associated with these construction activities would be adequately managed through standard mitigation measures.

The clearing of vegetation and earthworks required during construction of the stormwater diversion system creates the potential for sediments to be mobilised. Sediments have the potential to inhibit light travelling through the water column and disrupt the photosynthesis of submerged vegetation and can introduce contaminants and promote algal blooms. Standard erosion and sediment controls would be implemented during the construction of the stormwater diversion system and as such, the risk of sedimentation would be minor.

Drilling of an estimated 100-130 boreholes (to facilitate the filling of mine voids) from the surface to depths ranging from 15m to 40m has the potential to generate unconsolidated materials. Excavation activities associated with mine void remediation activities may require handling and stockpiling of large quantities of soil. If not managed appropriately unconsolidated materials may be liberated during rain events, smothering vegetation or accumulating in water storages or natural depressions and reducing their capacity. Drilling fluids and minor quantities of groundwater intercepted during these activities has the potential to negatively impact on surface water quality if discharged to the environment. However, potential impacts associated with drilling activities would be adequately managed through standard mitigation measures such as sump collection and covering of temporary stockpiles (see Section 8.2.3).

Operation - Stormwater diversion systems

Survey and site investigations were carried out as part of the Clean Water Design, Stormwater Drainage Design Report (Aurecon, 2018). Three catchments were identified that contribute to the proposed new stormwater system, being Catchments 1, 2 and 3 (refer to Figure 6). Catchments 4 and 5 divert to an existing water storage located in the north west of the Earing Ash Dam.

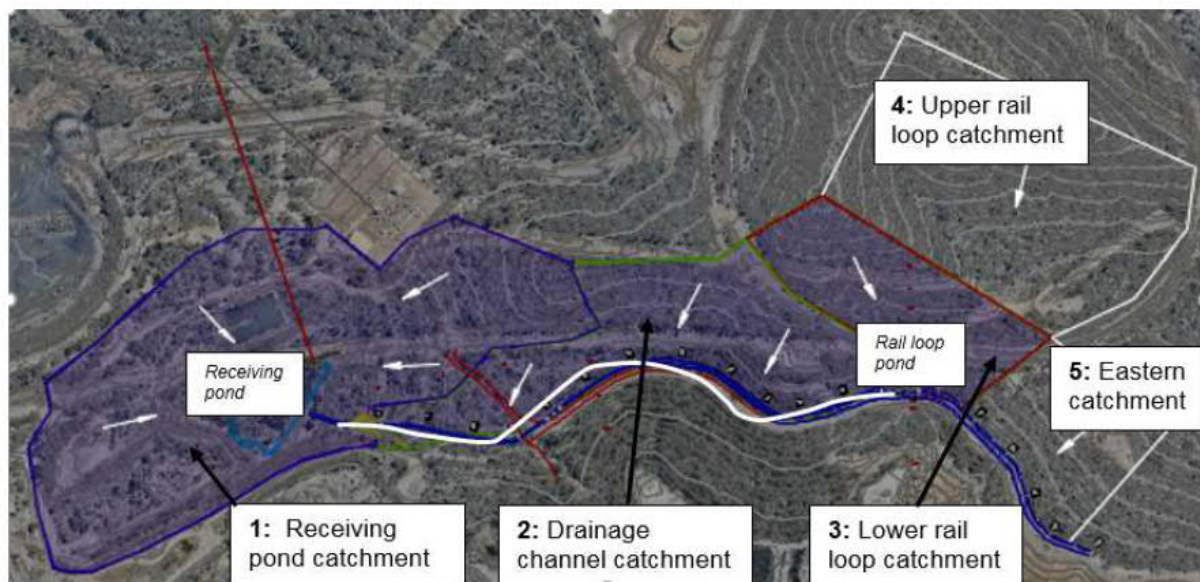


Figure 6 Local Catchments (Indicative)

The total area of Catchments 1, 2 and 3 is estimated to be 207,332m². The surface run-off from Catchment 1 currently drains to the receiving pond whilst run off from Catchments 2 and 3 drains to the ash dam as shown in Figure 6. The catchment descriptions and catchment areas are summarised in Table 10 below.

Table 10 Catchments that contribute to the proposed stormwater system

Catchment number	Catchment name	Notes	Catchment area (m ²)
1	Receiving pond catchment	Flows from all directions into receiving pond without flowing via main drainage channel.	120,968
2	Drainage channel catchment	Currently flows under road via various culverts into Ash Dam. Under proposed new drainage system, flows into new drainage channel to receiving pond.	55,783
3	Lower rail loop catchment	Flows into Rail Loop Pond, which currently flows under the road into the Ash Dam. Under proposed new drainage system, flows west via main drainage channel to Receiving Pond.	30,581
Total			207,332

During operation of the stormwater diversion system, surface water run-off from Catchments 1, 2 and 3 would be diverted to the receiving pond. These flows would be separated from ash dam process water flows at all times (i.e. the diversion is designed for stormwater only). Whilst surface run-off from Catchment 1 currently drains to the receiving pond through existing surface flow paths, Catchments 2 and 3 would be diverted to the receiving pond. This accounts for an estimated catchment area of 86,364m² or an increase in just over 70% of the existing catchment area draining to the receiving pond.

The proposed receiving pond would be constructed with additional buffer storage and overtopping storage based on the surrounding terrain. Sustained heavy rain events would utilise overtopping storages which extend beyond the constructed limits of the receiving pond based on local topography and would temporary inundate Ulan Road (a private access road) and the coal conveyor (see Figure 7 and Figure 8).

Receiving pond storage capacities are identified in Table 11. The proposed design allows for an approximate 100% increase in storage capacity during typical wet weather events compared to a 70% increase in total catchment area received. During sustained extreme wet weather the overtopping storage would provide an additional 17,996m³ of storage capacity.

Table 11 Receiving pond storage capacities

Storage element	Details	Capacity (m ³)
Receiving pond	Below RL 129 (estimated)	10,000
Buffer storage	Between RL 129 and RL 131	21,346
Overtopping storage	Between 131 and RL 132	17,996

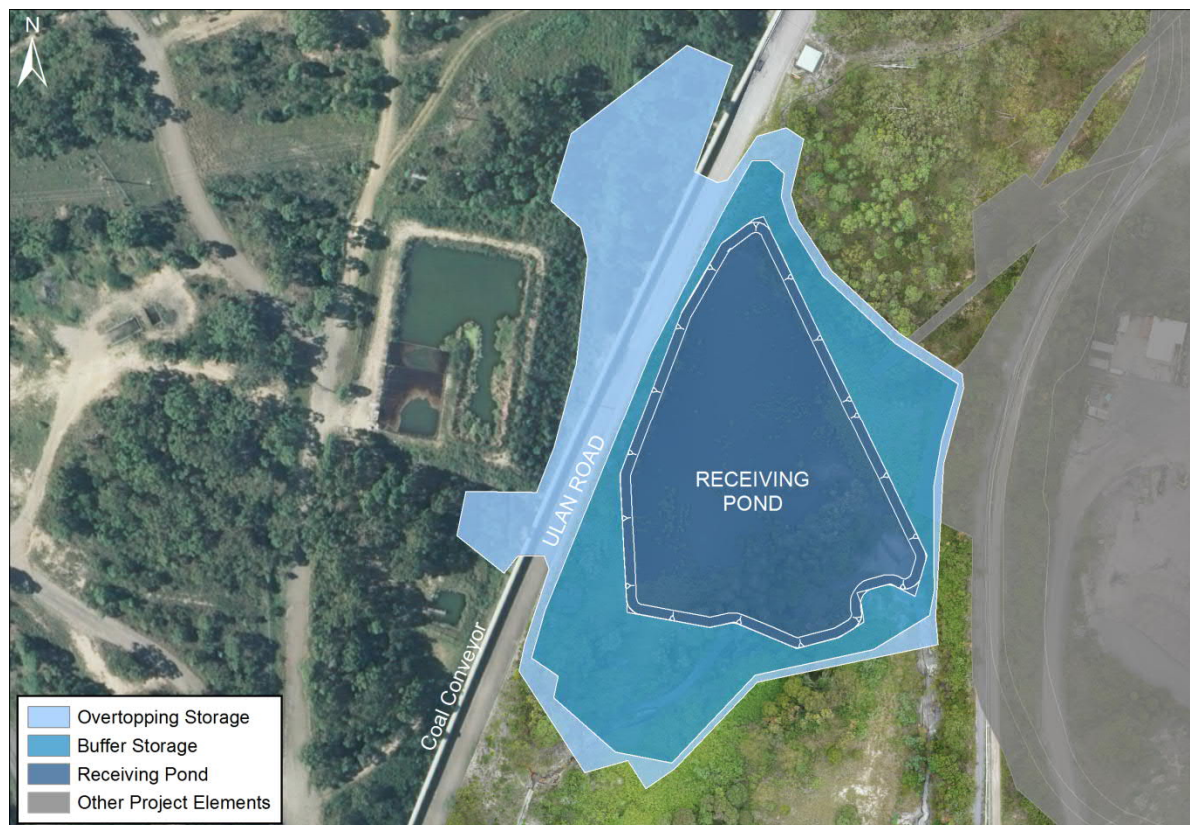


Figure 7 Receiving Pond Water Storages

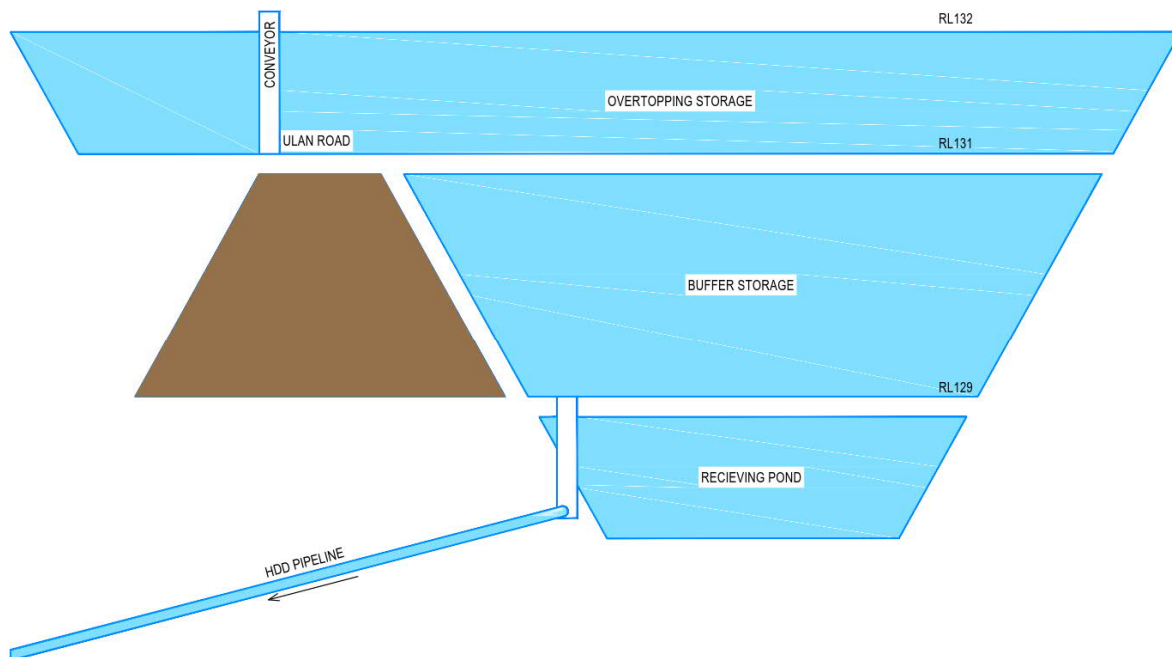


Figure 8 Receiving Pond Conceptual Arrangement in Cross Section

When the current holding capacity of the receiving water pond is exceeded, water would be discharged via an underground HDD pipeline to a new discharge point (refer Figure 9). The proposed discharge point is located approximately 360m to the west of the receiving water pond, directly north of the existing coal stockpile. The discharge point would consist of a precast headwall and rock lined channel extending for approximately 5 metres to reduce the potential for local scour or erosion to occur.

Diverted water would only be discharged during times of sustained rainfall events when the receiving pond's estimated 10,000m³ storage capacity may be exceeded (Aurecon, 2018). Flows discharged from the receiving pond would be limited to a rate of 240m³/hour by the DN300 HDD pipeline diameter and therefore water received during peak storm inflows would be discharged over a prolonged period. Storage performance during both Probable Maximum Precipitation (PMP) and 1% AEP rainfall events are summarised in Table 12.



Figure 9 Proposed discharge point and Flow Path

Table 12 Buffer storage performance with DN300 HDD pipeline

Storm event	Duration (hours)	Intensity (mm)	Flow IN (m ³ /hr)	Flow OUT (m ³ /hr)	Stored (m ³)	% buffer storage used	% overtopping storage used	Time to drain storage (hours)
Probable Maximum Precipitation (PMP)	0.25	180	21,348	240	5,277	25	0	0.9
	1	400	11,860	240	11,620	54	0	2.0
	2	620	9,192	240	17,903	84	0	3.1
	3	760	7,511	240	21,814	102	3	3.8
	6	1,010	4,991	240	28,506	134	40	4.9
	24	1,140	1,408	240	28,039	131	37	4.9
	72	1,640	675	240	31,339	147	56	5.4
1% AEP storm	0.25	51	6,038	240	1,449	7	0	0.3
	1	89	2,651	240	2,411	11	0	0.42
	2	112	1,660	240	2,841	13	0	0.49
	3	129	1,275	240	3,105	15	0	0.54
	6	167	825	240	3,511	16	0	0.61
	24	301	372	240	3,162	15	0	0.5
	72	440	181	240	0	0	0	0

The summary calculations demonstrate that the receiving water pond exhibits the following key performance characteristics:

- Critical 1% AEP storm duration is 6 hours, which fills the buffer storage to 16% full, which drains back to dry weather level after 0.61 hours
- Critical PMP storm duration is 72 hours, which completely fills the buffer storage, and fills the overtopping storage to a maximum of 56% full, and drains back to dry weather level after 5.4 hours.

The PMP rainfall event, although rare, would inundate Ulan Road (a private access road) and the coal conveyor.

Flows from the proposed discharge point would be directed south towards two existing corrugated pipes which cross underneath the coal stockpile to the west of the power station before discharging to a swale adjacent to the switchyard. Flows would then be directed south-west through existing drainage pathways to enter existing wetlands prior to flowing into Lake Eraring and ending in Lake Macquarie.

The wetland areas that the diverted water would ultimately flow through are listed coastal wetlands as identified in the *Coastal Wetlands and Littoral Rainforests Area Map in State Environmental Planning Policy (Coastal Management) 2018 (SEPP Coastal Management)*. The coastal wetlands, Lake Eraring and Lake Macquarie are also listed as a coastal environment area under the *Coastal Wetlands and Littoral Rainforests Area Map*.

Section 5.2.8 outlines conditions specified under the SEPP Coastal Management for development within the coastal environment area. The proposal does not involve physical development within the coastal environment, however the potential that the stormwater diversion works may indirectly impact upon areas in the coastal environment has been considered.

Altering natural flow regimes through the introduction of additional volumes of water to a wetland ecosystem has the potential to inundate or waterlog areas that are not generally under water causing more permanent flooding. These factors have the potential to contribute to a loss of biological diversity and ecological function in aquatic ecosystems. However, the diverted area of Catchments 1, 2, and 3 (approximately 20.7ha) is much smaller than the area of wetland it is flowing into (estimated at 90 to 100ha). Further, the flow pathway of approximately 3.5 km from the receiving pond encounters many diversion drains and ditches which collect a larger catchment associated with the existing Eraring Power Station and surrounds.

As such the volume of water diverted as a result of the project is likely to comprise a small proportion of total flows entering the wetland from the muddy lake settling basin. Further, diverted flows would be limited to a maximum rate of 240m³ per hour and temporary in nature (less than forty minutes during a 1% AEP storm event and 5.4 hours during a PMF). Therefore the volume, duration and frequency of diverted flows are likely to be inconsequential in comparison to the existing flows reaching the wetland under existing conditions.

Impacts to water quality and potential sedimentation are other potential risks that may arise from the stormwater diversion system. The water being diverted from Catchments 1, 2 and 3 into the receiving pond and potentially the wetlands would be comprised entirely of surface water flows. These surface water flows would not come into contact with the ash dam or be mixed with process water. The water would be considered 'clean' and of comparable quality to other surface run-off that drains into the wetland from the surrounding environment.

Given that additional surface flows would only be generated during periods of sustained high rainfall, the additional inflows from the stormwater diversion works are not anticipated to significantly impact upon the integrity or resilience of the coastal wetlands environment.

A potential minor risk associated with the proposal would be the movement of weeds through the new stormwater diversion path towards the coal stockpile. Additional water flows during sustained rain events could create wetter conditions conducive to the growth and propagation of weeds. This has the potential to alter the floristic composition of the surrounding environment, potentially outcompeting native plants and altering habitat and food resources for fauna.

However, additional water would only be diverted towards the wetland during sustained heavy rainfall, when the capacity of the stormwater basin has been exceeded. Therefore, the surrounding area would generally be saturated from the rain event and the water diversion would not further contribute to creating suitable conditions for weed propagation.

Operation of the Ash Dam

Potential impacts to surface water quality and receiving waters resulting from the operation of the Ash Dam predominantly include increased pollutant concentrations and sediments in surface runoff from the Ash Dam, resulting in the potential for increased pollutant concentrations to be discharged to Lake Macquarie.

The primary pollutant of concern associated with surface runoff from the Ash Dam is selenium, which is a trace element commonly found in coal. EPL 1429 specifies that selenium should not exceed 2 µg/L in water discharged to Lake Macquarie via the cooling water outlet canal.

As part of the 2007 EA, investigations were undertaken to model the effect of dense phase placement on the concentrations of selenium in discharges to Lake Macquarie. The selenium modelling considered natural mechanisms of selenium removal from the ash dam, including:

- Losses from biological activity
- Physical/chemical adsorption of selenium on the fly ash/sediments which form in the ash dam
- Equilibrium release back to the ash dam from the fly ash/sediments, and biological processes.

The modelling estimated that under dense phase operation, a greater area of fly ash per unit volume of storage would be in contact with the overlying body of pond water. This would provide increased opportunity for re-adsorption of selenium onto the deposited fly ash surface, reducing the concentration of selenium in the stilling pond.

The 2007 EA noted that management of the catchment area surrounding the Ash Dam was expected to reduce water inflows and hence water discharges to Lake Macquarie. This would result in a corresponding reduction of selenium concentration in the cooling water outlet canal. Selenium modelling also indicated that internal losses of selenium from the Ash Dam were high, primarily due to re-adsorption of leached selenium back onto fly ash deposits.

Augmentation of the Eraring Ash Dam and establishment of the western emplacement area will result in ash deposition to RL 140m within the western operational footprint of the ash dam. However process water will continue to be directed to the main decant pond. The decant pond would retain a 250m setback for ash deposition under the proposed arrangement, maintaining existing water management practices. Selenium concentrations are routinely monitored against EPL limits as part of routine monitoring activities. The Project also incorporates 1km of stormwater diversion works, further reducing potential surface water in-flows to the Eraring Ash Dam. The Project would provide additional opportunities for water management, ensuring existing controls at licenced water discharges to Lake Macquarie are maintained.

Groundwater

Potential impacts to groundwater quality associated with the utilisation of the Ash Dam are primarily related to the seepage and migration of potentially contaminated groundwater. The seepage and migration of potentially contaminated groundwater has the potential to impact local groundwater quality, as well as the water quality of receiving waters of Lake Macquarie, such as Myuna Bay.

There is potential for seepage and downward vertical migration of water from the Ash Dam, which may result in impact to local groundwater quality. Potential groundwater contaminants that may originate from the Ash Dam primarily include heavy metals and trace elements such as selenium. Historical groundwater monitoring results indicate that there are a number of trace metals in groundwater beneath the Ash Dam which have, on occasion, been recorded in concentrations in excess of the ANZECC 2000 criteria. It is unclear whether the concentrations can be attributed to background or naturally elevated conditions (HLA, 2007).

The Project is not expected to significantly impact the groundwater quality beneath or downgradient of the Ash Dam. The cementitious nature of the dense phase placement is considered likely to reduce the potential for groundwater seepage when compared to previous lean phase placement methods (i.e. using slurry containing a higher proportion of water) (HLA, 2007). In the event that seepage which has the potential to migrate off-site is identified, Earing would conduct further monitoring to determine the requirement for mitigating actions.

The western emplacement area would be located over the mine workings of the former Awaba Mine (further discussion of this issue including remedial work is provided in Section 8.3). The proposed final ash placement level at this location is approximately RL 140 whereas the existing extent of the ash dam sits at approximately RL 130. Water within the deposited ash slurry would drain towards the water collection point at the lowest part of the ash dam. Therefore, due to the gradient and existing groundwater flow regime there is expected to be minimal available water to infiltrate into groundwater surrounding the western emplacement area. Filling of mine voids (as described in Section 4.1.2 and 8.3) would further reduce the potential for seepage or groundwater migration from the site.

Bore MW01 (EPL Point 21) is located directly adjacent to the proposed western emplacement area and is an existing background monitoring bore which would be maintained and monitored in accordance with EPL 1429.

A depression approximately 3ha in extent located within the current western extent of the ash dam currently collects some stormwater drainage from the immediate catchment area. This water storage would be made redundant by the proposed stormwater diversion works. Ash placed within this area during the Project would displace water, reducing the volume of standing water available to infiltrate as groundwater in this area.

8.2.3 Mitigation measures

Construction

- A Construction Environmental Management Plan (CEMP) would be prepared and implemented during construction of the Project. The CEMP would include an Erosion and Sediment Control Plan which would describe the safeguards to be implemented during construction to minimise potential impacts to surface water and groundwater resources. The Erosion and Sediment Control Plan would incorporate principles and relevant procedures identified within the site Water Management Plan (Umwelt, 2013).
- Erosion and sediment control activities would be undertaken in accordance with guidelines from Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Volumes 2A, 2C, 2D and 2E (DECC 2008a-d) (the Blue Book).
- All drilling fluid would be captured and disposed of appropriately and in accordance with the *Waste Avoidance & Resource Recovery Act 2001*.
- All drilling fluid irrigated to land would have the bulk sediment removed. Land irrigation would not be undertaken within 50 metres of a drainage line or watercourse, existing habitat offset areas or within areas of Ecologically Endangered Communities (EEC) or Aboriginal heritage sites. All land irrigation would be undertaken in a manner to prevent runoff and erosion.
- All excess excavated material that cannot be returned to excavations or reused in construction activities would be stockpiled or temporarily placed in skip bins held on site prior to being assessed in accordance with NSW Waste Classification Guidelines (EPA, 2014). Excess material would be reused in rehabilitation activities where appropriate or appropriately disposed of in accordance with the *Waste Avoidance & Resource Recovery Act 2001*.
- Disturbance would be minimised where possible and stabilised by progressive rehabilitation as soon as practicable.
- Ground disturbance and soil handling activities would be undertaken in accordance with existing procedures outlined in the Land and Biodiversity Management Plan (AECOM, 2017). The procedures would incorporate:
 - Weed management activities
 - Soil handling protocols including stockpiling procedures.

Operation

- The Water Management Plan (Umwelt, 2013) would be reviewed and updated if necessary to incorporate the Project.
- The existing surface water and groundwater monitoring program would continue to be implemented for the Project in accordance with Project Approval and EPL conditions.

8.3 Geotechnical

Disused mine workings (the former Awaba Mine, operated by Centennial Coal) have previously been identified beneath the north western portion of the Eraring Ash Dam. An assessment of potential mine subsidence impacts was prepared by SCT Operations Pty Ltd to review and assess potential geotechnical risks of the Project relating to the proximity of the underground mine workings. The assessment was informed by a field investigation undertaken on 19 June 2018. A project briefing was held on the same day to discuss details of the mine plan and historical mining history at Awaba Colliery with representatives from Centennial Coal Pty Ltd. A summary of the mine subsidence assessment is provided below, while the full report is provided in Appendix D.

8.3.1 Existing environment

Underground workings associated with Awaba Colliery extend under the existing Eraring Ash Dam footprint. These workings include areas of full extraction and areas of standing pillars. Awaba Colliery mined within the Great Northern Seam, however details of the stratigraphy within the project area are not known. The Great Northern Seam typically comprises a conglomerate roof and a claystone floor.

While the condition of the conglomerate roof strata is not known some weathering is likely to occur over time. The claystone floor has the potential to deteriorate over time, particularly when the mine becomes flooded.

Overburden depth

Estimates of the overburden depth indicates the area near the edge of the proposed ash dam ranges from 20 metres near the edge of the Awaba workings to over 50 metres at a distance of 300 metres from the edge of the ash dam. Overburden depth appears likely to be up to 6 metres greater based on the difference between LIDAR measurements of the surface level and surveys of the mine floor level shown on Awaba Colliery mine plans.

Mining systems and geometries

It is understood that the mining height at Awaba Colliery varies between 2.5 metres and 3.2 metres and that, in the area of interest, the mined height is likely to be approximately 3 metres (SCT, 2018). Individual roadways are shown as close-spaced parallel lines. The assessment determined roadways were potentially mined between 5.5 metres and 6.5 metres wide.

The mine plan (see Figure 10) presents three types of mining within the proposed ash dam:

- On the development, the system of mining involved driving roadways to form generally square pillars at nominally 36 metre centres. Where the overburden depth is very low, no further mining was conducted.
- In 101, 102 and 103 Panels, the larger square pillars formed on development were subsequently fully extracted. Extracted pillars are shown as cross-hatched (Figure 10). Pillar extraction typically allows up to approximately 85% of the coal to be safely recovered.
- In 5 South, the large square pillars were split and quartered to form smaller square pillars, nominally 11.5 – 12.5 metres wide (measured from rib-to-rib) but in practice would be 10 – 11 metres wide. The roof of these pillar splits would not be typically supported or reinforced with roof bolts.

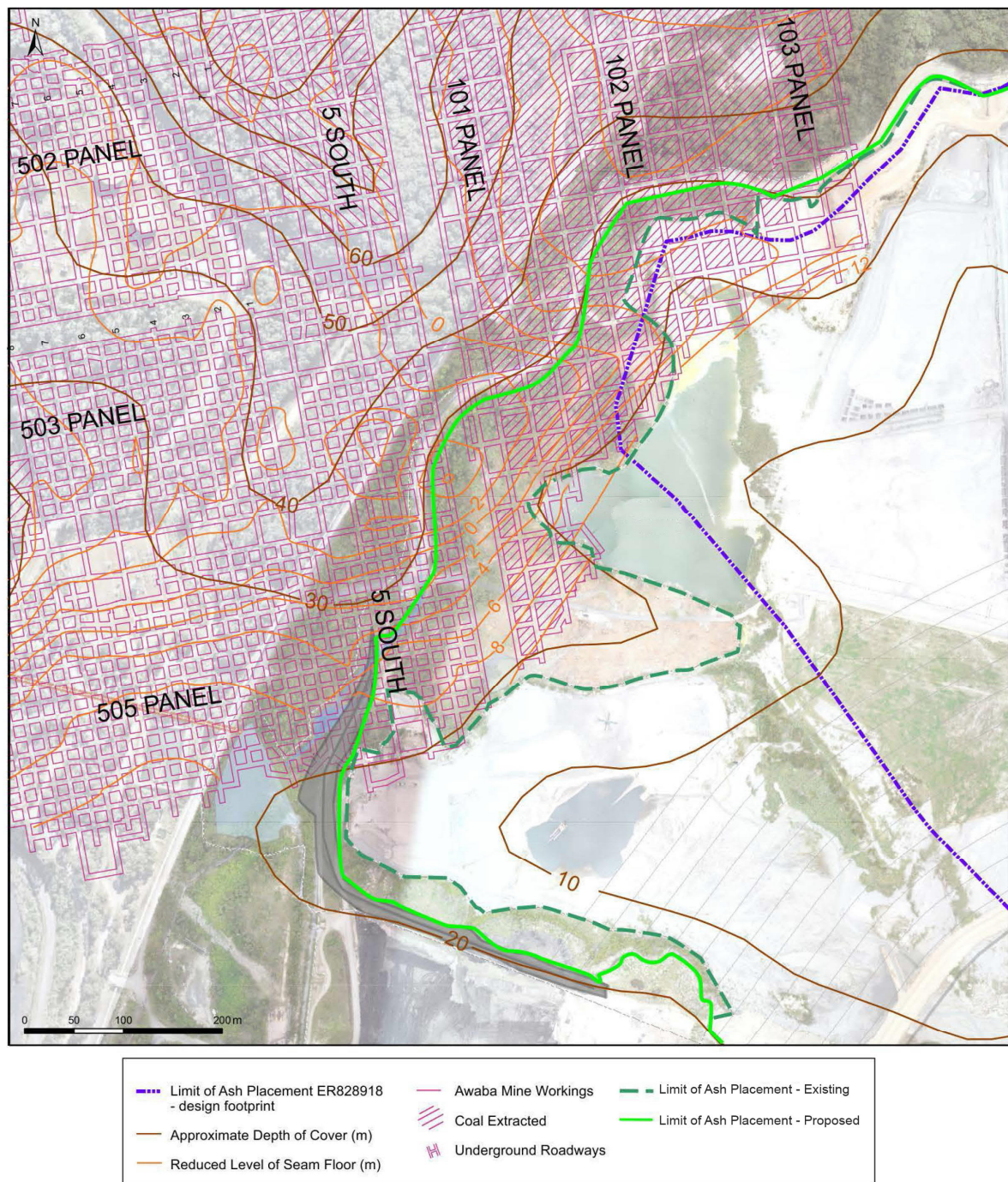


Figure 10 Overview of Awaba Colliery Workings

The condition of the overburden strata within the project area is not known and therefore the potential for sinkhole subsidence cannot be accurately estimated. However a sinkhole close to the edge of the existing limit of ash placement was identified during the site visit. Sinkholes are commonly observed in the Newcastle area at shallow overburden depths ranging up to 30m and occasionally observed to overburden depths up to 50m (SCT, 2018). Further sinkholes similar to the one observed on site are considered almost certain to be present along the edges of areas of pillar extraction at shallow depths (SCT, 2018).

Mine water level and flow paths

Awaba Colliery is flooded and fully connected across the footprint of the mine. Only small areas of the mine in the north and east are dry; the seam floor rises above the water level in the mine in these areas. SCT notes (based on discussions with Centennial Coal Pty Ltd) that:

- Water level within the mine is artificially maintained in the range of 16.5 metres AHD to 17 metres AHD, from pumping at two locations and by natural overflow at low points within the surface topography in the south western parts of the mine.
- One of the reasons for this pumping is to control the potential for artesian outflows at Eraring Power Station during periods of extended rainfall.
- The water level increases with increasing rainfall consistent with the inflow of water through fractured and naturally jointed overburden strata.

8.3.2 Potential impacts

The mine subsidence impact assessment identified two potential risks associated with the Project (SCT, 2018):

- Potential for subsidence in the form of either pillar collapse or roof failures leading to sink hole formation and impacting on the ash dam and the western saddle embankment.
- Connectivity and the potential for surface water to flow from the ash dam into the mine workings.

Subsidence hazard

There is potential for mine subsidence in the form of either pillar collapse or roof failures leading to sinkhole formation, impacting the ash dam or western saddle embankment. The subsidence hazard associated with pillar collapse has the potential to cause differential movements at the surface of up to several metres. These movements are likely to be expressed as a step change around the edges of the area where pillar collapse has occurred. This hazard is more likely to exist over 5 South Panel (see Figure 10), where small pillars are still standing, and claystone floor strata which are expected to occur at the site may create the opportunity for gradual deterioration over time.

The potential for sinkhole subsidence depends on the stratigraphic profile above the coal seam and the degree of weathering in this profile. The potential for sinkhole subsidence is likely to be greatest along the edges of areas where pillars have been extracted and large differential movements have already occurred. Sinkhole subsidence is also possible over 5 South Panel where most of the roadway intersections are likely to still be standing and above the standing intersections in Panels 101, 102 and 103.

The consequences of differential ground movement occurring through either subsidence mechanism are likely to depend on where this movement occurs. If differential movements occur below the proposed western saddle embankment, there is potential for loss of integrity of the embankment followed by piping failure and loss of material from the emplacement. If the differential movement occurs below the ash dam itself, there is potential for flow pathways to develop between the surface and the underground mine workings.

Surface water interconnectivity hazard

Mining induced fractures caused by extractive mining at shallow depth are expected to provide a flow pathway between the ash dam and the underground workings of Awaba Colliery. This flow pathway would be expected to extend from these underground workings to locations where the surface level above the Awaba Colliery workings is less than the water level within the flooded workings. The sinkhole observed on site is consistent with the presence of a flow pathway in close proximity to the existing ash dam. There are likely to be similar features along the edge of areas where coal has been extracted, including directly below the existing ash dam along the edge of 102 Panel (SCT, 2018).

Under these conditions a flow pathway may establish between surface water in the ash dam and the nearby tributaries of Dora Creek (SCT, 2018). The water level in Awaba Colliery is currently managed by pumping at a level in the range RL16 to 17 metres AHD. At this water level, artesian flow could be expected to reach tributaries of Dora Creek. Figure 11 shows where artesian flows are likely to emerge and flow into the tributaries of Dora Creek when the water level in the mine is greater than about RL16 metres AHD.



Figure 11 Potential outflow points for water from the Awaba Colliery underground workings (SCT, 2018)

Without intervention, the cessation of pumping at the closure of Awaba and Eraring Power Station would potentially lead to the creation of an ongoing flow pathway whereby processed water from the Eraring Ash Dam flows into Awaba workings and would potentially flow into the nearby tributaries of Dora Creek. Water falling as rainfall onto the surface of the ash dam would potentially be at an elevation above RL 40 metres AHD (RL140 metres using the Eraring Datum). The water level in the mine workings would potentially be at an elevation in the range of RL17 metres to RL 20 metres depending on rainfall levels. Water would potentially continue to flow as artesian flow into waterways around the edge of Awaba at multiple low points within the topography as it does currently.

8.3.3 Mitigation measures

A range of remedial approaches would be employed to effectively mitigate subsidence hazards identified for the site (refer 4.1.2) and include the following techniques:

- Filling of mine voids with stabilised fill material;
- Excavating and collapsing mine workings; and/or
- Installing an impervious barrier using clays or suitable stabilised fill materials

The preferred strategy may employ all or a combination of the above techniques.

Both subsidence and surface water connectivity hazards can be effectively controlled through the application of mine void filling technologies (SCT, 2018). Filling of the mine voids would eliminate the potential for subsidence associated with pillar collapse and sinkhole formation to impact the project area.

It is envisaged that the area required to be filled to control the water flow risk could extend from the edge of the mine workings to a distance up to 100m from the limit of proposed ash placement. However, the area that would be required to be filled would depend on a range of factors including the hydraulic conductivity of the fill material and the effectiveness of the filling strategy used. The design would be further developed relying on further testing and the available engineering approaches.

Assuming a 100m wide barrier of stabilised fill is required beyond the limit of proposed ash placement the volume of mine voids required to be filled to control the potential for both subsidence impacts and water connectivity, is estimated to be up to 200,000m³. It is anticipated that the area of standing pillars (5 South) could be filled from 30 to 50 boreholes drilled from the surface to depths ranging from 15 metres to 30 metres and the area of extracted coal (101, 102 and 103 Panel) could be filled from 70 to 80 boreholes drilled from the surface to depths of 15 metres to 40 metres.

In summary the following mitigation measures would be applied to the Project:

- A range of remedial approaches would be employed to effectively mitigate subsidence hazards identified for the site and include the following techniques:
 - Filling of mine voids with stabilised fill material
 - Excavating and collapsing of shallow mine workings; and/or
 - Installing an impervious barrier using clays or suitable stabilised fill materials.The preferred strategy may employ all or a combination of the above techniques and may be informed by additional geotechnical or environmental investigations.
- A Mine Void Remediation Plan would be prepared prior to mine void remediation activities commencing. The Mine Void Remediation Plan would identify the proposed void treatment methods, excavations, a material placement strategy and design criteria. The plan would also identify bulk material handling practices, water management procedures and appropriate environmental safeguards to minimise risks to the environment.
- The requirement to remediate areas where ash is retained and the required extent of mine void remediation activities would consider the hydraulic conductivity of the fill material, the height to which the voids are filled, and the expected effectiveness of the filling strategy used.
- Pressure grouting would be employed where appropriate to fill voids from seam level through to the surface but would be limited and controlled so as not to induce hydraulic fractures of the overburden strata.
- Mine void remediation activities (and associated disturbance) would extend no further than 100m from the proposed limit of ash placement.
- A verification report would be prepared to determine the effectiveness of the applied remedial action and treatment works. The report would describe geotechnical and/or groundwater investigations undertaken to identify and if required, further manage residual risk associated with subsidence and surface water connectivity hazards prior to ash disposition above RL 130 within the western emplacement area.

8.4 Aboriginal Heritage

An Aboriginal heritage due diligence assessment was undertaken for the Project. Information regarding the known and potential Aboriginal heritage resource of the project area was obtained from:

- A review of the landscape context of the project area and surrounds.
- A review of existing Aboriginal Heritage Information Management System (AHIMS) data for land within and surrounding the project area, obtained from the Office of Environment and Heritage (OEH) on 20 March 2018 (AHIMS search #334621).
- A search of the National Native Title Register (NNTR) and Register of Native Title Claims (RNTC) administered by the National Native Title Tribunal (NNTT) for land within and surrounding the project area.
- A review of the findings of past Aboriginal archaeological investigations near and within the project area.
- A visual inspection of the project area by AECOM Senior Heritage Specialist Luke Atkinson on 7 May 2018.

8.4.1 Existing environment

Landscape context

The Aboriginal heritage due diligence assessment considered the landscape context of the project area. The nature and distribution of Aboriginal archaeological materials are closely connected to the environments in which they occur. Environmental variables such as topography, geology, hydrology and the composition of local floral and faunal communities would have affected the availability of suitable campsites, drinking water, economic plant and animal resources, and raw materials for the production of stone and organic implements. At the same time, an assessment of historical and contemporary land use activities, as well as geomorphic processes such as soil erosion and aggradation, is critical to understanding the formation and integrity of archaeological deposits.

Key observations from a review of the landscape context of the project area are summarised below:

- The surface and subsurface geology of the project area is characterised by the Newcastle Coal Measures, a Permian-aged deposit which outcrops north of the project area, particularly around nearby Toronto. The coal measures are overlain by the Triassic Narrabeen sandstone group, which outcrops along the west coast of Lake Macquarie, south of Toronto. The former is a conglomerate comprising sandstone, tuff, shale and coal, while the latter is composed of sandstone and siltstone. Areas of Lake Macquarie foreshore and surrounding environment comprise Quaternary alluvial and aeolian deposits.
- Reference to the Soil landscapes of the Gosford-Lake Macquarie 1:100 000 sheet (Murphy, 1993) indicates the dominant soils of the project area are classified into the Doyalson (*do*) and Awaba soil landscapes. Disturbed soils are also extensive across the project area, generally occurring in terrain that has been previously impacted by human activity. Extant vegetation in these areas has generally been cleared but may contain regrowth forest. Typically, soils of the Doyalson soil landscape are found on gentle undulating slopes and comprise Yellow earths (50-150 cm), Yellow podsollic soils (50-150 cm) and Soloths (50-150 cm) with some Red podsollic soils formed on siltstone. Awaba soil landscape units generally comprise shallow Lithosols (Tenosols) found on steep slopes, shallow to moderately deep Soloths (Sodosols) and Yellow Podzolic Soils (Kurosols, Chromosols) on gentler slopes, with Soloths (Sodosols) occupying drainage lines.
- Vegetation within the project areas generally comprises open forest dominated by scribbly gum (*Eucalyptus haemastoma*), red bloodwood (*E. gummifera*), brown stringybark (*E. capitella*), smooth barked apple (*Angophora costata*) and grey gum (*E. punctata*), with an understorey of banksia (*Banksia oblongifolia*) and mountain devil (*Lambertia Formosa*). Poorly drained Doyalson soils and Wyong soils have a vegetation community dominated by flax leaved paperbark (*Melaleuca linariifolia*), and prickly leaved paperbark (*M. styphelioides*). Swamp oak (*Casuarina glauca*) is also prevalent in tidal channels. Invasive weeds such as Lantana (*Lantana camara*) were identified during the visual inspection of the project area.

AHIMS database

The OEH AHIMS database contains records of all Aboriginal objects reported to OEH in accordance with Section 89A of the *National Parks and Wildlife Act 1974*. It also contains information about Aboriginal places, which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are known as 'Aboriginal sites'.

A search of the AHIMS database was undertaken on 20 March 2018 with an approximate 8 km radius centred on the project area (the 'AHIMS search area'). The AHIMS search results (attached at Appendix E) identified 47 Aboriginal sites recorded in or near the AHIMS search area. A single listing was identified as 'not a site', resulting in 46 valid entries within the AHIMS search area. As indicated in Table 13, middens comprising shell material and artefacts are the most common site type represented within the AHIMS search area, accounting for 39% of known sites. Open artefact sites represented 30% of all sites. A single 'restricted' site was also identified within the AHIMS search area.

Review of the location of previously recorded Aboriginal sites indicates that no sites lie within areas potentially disturbed as a result of the project.

Table 13 AHIMS data for Aboriginal sites within the AHIMS search area

Site Type	Count (n)	Percentage of Total
Restricted	1	2%
Water Hole	1	2%
PAD	4	9%
Culturally Modified Tree	8	17%
Open Artefact Site	14	30%
Midden	18	39%
Grand Total	46	100%

Native title

A search of the National Native Title Register (NNTR) and Register of Native Title Claims (RNTC) administered by the National Native Title Tribunal was undertaken on the 8 August 2017 for the Lake Macquarie City Council Local Government Area (LGA), inclusive of land within and surrounding the project area. Three (3) determinations are listed for the Lake Macquarie City Council LGA. The listings identify that Native title does not exist in all three determinations.

Previous Aboriginal heritage investigations

Existing AHIMS data and previous Aboriginal archaeological investigations indicate that the Lake Macquarie region is relatively understudied in terms of Aboriginal archaeology, with few regional models developed. Of those that have been undertaken, collectively the results of previous surface and subsurface investigations have established an impression of past-Aboriginal land-use, attesting to an emphasis on heavy utilisation of the Lake Macquarie coastline for selective shellfish exploitation (e.g. Haglund, 1986; Dyall, 1977) generally consisting of shallow deposits with low technological diversity. On the basis of limited technological diversity, Dallas & Navin (1993) suggested these sites were likely used seasonally or only occasionally. Most of the sites distributed around Lake Macquarie are located on the eastern side allowing the exploitation of the lake and ocean. Consequently, Aboriginal sites in the western areas of Lake Macquarie are relatively scarce. Of the sites that have been identified, most are found in the near-coastal areas or creek lines and attest to shellfish exploitation.

In 2006, HLA-Envirosciences Pty Ltd (HLA, now AECOM) undertook archaeological survey for proposed alterations and additions to the existing Eraring Power Station, specifically the expansion of its ash dam and the installation of a black start/peaking generator. The survey did not identify evidence of surface Aboriginal sites and assessed the potential for subsurface archaeological sites to be low on the basis of a lack of a developed or *in situ* soil profile within the project area. Prior and subsequent assessments completed by HLA in the area (e.g. 2004; 2006a) facilitated the development of a preliminary archaeological model which suggested that Aboriginal occupation typically focused within two areas - along the Lake Macquarie foreshore (comprising artefact scatters and shell middens) and in the foot slopes and mountains of the Dividing Range to the west of Lake Macquarie. Likely migratory routes between the two foci were attributed to major watercourses in the area, including Wyee, Dora, Cockle, Kilabeen and Wallarah Creeks where minor archaeological deposits (open artefact sites and middens) and scarred trees may also be present.

Excavations undertaken at Reid's Mistake Headland by Dyall & Bentley (1972), approximately 12 km east of the project area, identified an occupation site with the skeletal remains of 21 individuals. The site contained evidence of multiple occupation units and was interpreted as a frequently occupied site. Radiocarbon data for these deposits identified basal dates to approximately 7,850 years B.P. (Before Present). The skeletal remains appeared to be part of a later period of occupation, estimated to 2,700 years B.P. This evidence indicates that the use of the coastal areas by Aboriginal people was continuous throughout the Holocene.

Key observations to be drawn from a review of the existing environment and archaeological context of the project area are as follows:

- Aboriginal site types with low potential to occur within the project area will comprise middens (shell deposits with or without artefacts) and open artefact sites (i.e., artefact scatters and isolated artefacts) scatters only.
- Scarred trees, burials, hearths, bora (ceremonial) rings, stone arrangements and scarred axe grinding grooves are unlikely to occur within the project area.
- Rocks suitable for the production of flaked objects (e.g. chert, quartz, silcrete) or ground-edge tools (e.g. quartzite, basalt) are unlikely to occur within the project area.
- For most areas, the presence or absence of surface artefacts will not be a reliable indicator of Aboriginal archaeological sensitivity and/or subsurface deposits.
- Archaeological site visibility will be highest on erosional surfaces (e.g. creek banks) and lowest on depositional ones (e.g. floodplain contexts, levees, vegetated terraces).
- On the basis of the above and in context of historical disturbances and land use, a preliminary prediction of archaeological potential within the project area is low.

Visual inspection

A visual inspection of the project area was undertaken by AECOM senior heritage specialist Luke Atkinson on 7 May 2018. The primary aim of the inspection was to identify and record any existing surface evidence of past Aboriginal occupation within the project area. The inspection was tracked in real-time using handheld GPS units, with associated transect data (e.g. Ground Surface Visibility (GSV) and Ground Integrity (GI) ratings) and photographs recorded. The following key observations were made during the visual inspection:

- No Aboriginal objects or sites were identified during visual inspection.
- Aboriginal archaeological sensitivity within the project area was generally assessed as low due to the areas of gross impact (e.g. earthworks, road construction, buildings and infrastructure) within it and overall low sensitivity landforms present within the project area.
- Ground surface visibility was variable, owing to the variable ground conditions within the project area. Generally, GSV along unpaved vehicle tracks was classified as good. The southern half of the project area comprising gently undulating, cleared and lightly-vegetated land was assessed as being of poor GSV due to grass cover and the remainder classified as nil GSV in areas of paved hardstand and existing building footprints.
- Ground integrity was likewise variable, owing to the range of landuse activities within the project area. Generally, areas retaining natural ground surfaces (e.g. open spaces) were assessed as retaining a moderate GI due to limited impacts from vegetation removal and minor landscaping activities. The remainder of the project area was assessed as having low GI, where buildings or paved hardstands were present.
- Stone suitable for flaked and/or ground stone artefact manufacture is, at present, absent from the immediate vicinity of the project area. Likewise, middens containing shell materials were not identified, nor were any landforms or landscape features (i.e. creeks and the Lake Macquarie foreshore) contained within the project area.
- Native vegetation within the project area has been extensively modified with the majority cleared historically. Current vegetation appears to comprise regrowth with infrequent mature woody vegetation. There is low potential for the project area to contain trees with cultural scarring and none were identified during the visual inspection.

8.4.2 Potential impacts

Potential impacts of the Project on Aboriginal heritage include damage to Aboriginal sites as a result of construction works, in particular the vegetation clearing and earthworks required for establishment of the western emplacement area, western saddle embankment and stormwater diversion system.

The key findings and predictions of this Aboriginal due diligence assessment are as follows:

- No existing Aboriginal archaeological sites (as indicated on the AHIMS database) are located within the project area, nor were Aboriginal archaeological sites located during the visual inspection component of this assessment. Spatial data within the AHIMS database indicates that a single Aboriginal site (45-7-0070; Eraring; Crooked Creek) lies within the existing ash dam, approximately 700m east of the project area. Although the site card for 45-7-0070 lacks a map indicating the location, the description identifies the approximate position along the foreshore of Lake Macquarie, placing it outside the project area.
- Land within the project area has been subject to varying levels of disturbance, with the most severe impacts occurring in areas of earthworks and paved hardstand.
- Taking into account the nature and extent of past ground disturbances across the project area, as well as the results of previous Aboriginal archaeological assessments in the Lake Macquarie area, the Aboriginal archaeological sensitivity of land within the project area is assessed as 'low'.

Table 14 provides a summary of the key questions asked as part of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010:10). Should the answer to Question 4 be 'yes', further investigation and impact assessment may be required.

Table 14 Due Diligence Process Questions

Will the activity disturb the ground surface or any culturally modified trees?		
1	Yes. The Project will require the disturbance of ground surfaces for construction activities. No culturally modified trees are present within the project area.	Proceed to Question 2
2a Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?		
2a	Yes. The background review component of this assessment included a review of previously-recorded Aboriginal sites within 8 km of the project area. To date, no Aboriginal sites have been identified within areas potentially disturbed by the Project. The visual inspection component of this assessment did not identify any Aboriginal sites or areas of Aboriginal archaeological or cultural sensitivity within the project area.	Proceed to Question 2b
2b Are there any other sources of information of which a person is already aware?		
2b	Yes. AECOM reviewed available archaeological assessment reports for lands within and surrounding the project area.	Proceed to Question 2c
2c Are there any landscape features that are likely to indicate presence of Aboriginal objects?		
2c	No. The visual inspection and environmental review components of this assessment did not identify any areas of Aboriginal archaeological or areas of previously-recorded or known Aboriginal cultural sensitivity within areas potentially disturbed by the Project.	Proceed to Question 3
3 Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?		
3	N/A. The visual inspection and background review components of this assessment did not identify any areas of Aboriginal archaeological sensitivity within areas potentially disturbed by the Project.	Proceed to Question 4

4	<p><i>Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or that they are likely?</i></p> <p>This Aboriginal Heritage Due Diligence Assessment did not identify any areas of Aboriginal archaeological or cultural sensitivity within areas potentially disturbed by the Project. It is concluded that Aboriginal sites or objects within the project area are unlikely.</p>	<p>Proposed activity can proceed subject to recommendations provided below.</p>
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8.4.3 Mitigation measures

The following mitigation measures would be implemented during construction of the Project:

- In the unlikely event that Aboriginal objects, including possible human skeletal remains, are identified at any point during construction of the Project, the following procedure would be followed:

Aboriginal Sites

1. All works must cease immediately in the area to prevent any further impacts to the site;
2. Engage a suitably qualified heritage consultant to determine the nature, extent and significance of the find and provide appropriate management advice. Management action(s) will vary according to the type of evidence identified, its significance (both scientific and cultural) and the nature of potential impacts; and
3. Prepare and submit an AHIMS site card for the site.

Human Skeletal Remains

In the event that potential human skeletal remains are identified at any point during the life of the Project, the following standard procedure (New South Wales Police Force, 2015; NSW Health, 2013) should be followed.

1. All work in the vicinity of the remains should cease immediately.
2. The location should be cordoned off and the NSW Police notified.
3. If the Police suspect the remains are Aboriginal, they will contact the Office of Environment and Heritage and arrange for a forensic anthropologist or archaeological expert to examine the site.

Subsequent management actions will be dependent on the findings of the inspection undertaken (at Point 3).

- If the remains are identified as modern and human, the area will become a crime scene under the jurisdiction of the NSW Police
- If the remains are identified as pre-contact or historic Aboriginal, OEH and all RAPs are to be formally notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided an appropriate management mitigation strategy will be developed in consultation with OEH and RAPs
- If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Division contacted
- If the remains are identified as non-human, work can recommence immediately.

8.5 Air Quality

8.5.1 Existing environment

The project area is surrounded predominantly by undeveloped bushland, which serves as a buffer zone between the EPS and surrounding residential areas. There are a number of coal mines located in the vicinity of the project area, including the Myuna Colliery to the east, Mandalong Mine to the west, and the Newstan Colliery to the north.

The nearest residential receivers to the project area include the suburb of Eraring (approximately 1 km south), Dora Creek (approximately 4 km southwest), Wangi Wangi, Arcadia Vale and Buttaba (approximately 3 km east), Awaba (approximately 3 km north), and Toronto (approximately 4.5 km northeast).

EPS operates in accordance with the site's EPL 1429. Continuous ambient air quality monitoring is currently undertaken at two locations, including south of the EPS site at Dora Creek and east of the EPS site in Marks Point. Continuous monitoring is undertaken for sulfur dioxide (SO₂), nitrogen oxides (NO, NO_x and NO₂) as well as various meteorological parameters. Depositional dust is also monitored at four locations in the vicinity of EPS. Stack emission monitoring is conducted at discharge points on the four boiler units at EPS and on the Emergency Turbine Generator. The results of the air quality monitoring are reported to the EPA as part of the Annual Return submitted in accordance with the conditions of the EPL 1429.

A Dust Emission Dispersion Study (AECOM, 2016) was previously undertaken to better understand the distribution and potential impact of dust emissions from the Eraring Ash Dam. The dispersion study involved detailed sampling of the Ash Dam, determination of the airborne emission rates and detailed meteorological and air dispersion modelling. Based on the quantified findings of the study, potential management and mitigation measures were provided.

In general, dust production was found to be a transient occurrence with a few hours of each day resulting in steady dust production. Many of the extreme dust production episodes occur during the early morning hours during winter whilst during summer dust generation events tend to occur during the day.

The peak dispersion impacts were predicted to the east of the EPS site over the suburbs of Rathmines, Balmoral, Buttaba, Arcadia Vale and Wangi Wangi. However the potential influence of the Ash Dam emissions dispersion on local receptors was well below the EPA criteria. No exceedances were found to occur at any of the residential areas as a result of the Ash Dam emissions, with a maximum criterion contribution of 27% (24 hour PM₁₀ concentration of 13.6 µg/m³ compared to the EPA PM₁₀ 24 hour criterion of 50 µg/m³). A screening analysis for heavy metal impacts using ash composition and total suspended particulates (TSP) dispersion modelling predicted all heavy metals met relevant EPA assessment criteria by a large margin.

The results and recommendations of the Dust Emissions Dispersion Study were used to inform the Ash Dam Management Strategy (Origin, 2017) which defines the overarching management philosophy and guides the operation of the Eraring Ash Dam and related infrastructure. The Ash Dam Management Strategy sets out the dust management practices that are currently implemented, including strategic placement of ash, water management practices which increase the extent of wetted down ash and targeted treatment of localised dusting events with water suppression. These are detailed further in Section 7.4.3.

8.5.2 Potential impacts

Construction

Potential impacts to air quality during construction of the Project would primarily relate to the generation of dust associated with vegetation clearing, earthworks for construction of the south west perimeter wall and stormwater diversions, and stockpiling of construction and waste materials. Emissions may also be generated as a result of diesel powered plant and equipment and the transport of construction / waste materials to and from the site.

The potential emissions from construction works would be minor and temporary and would be managed in accordance with standard construction management measures. Air quality impacts to residential receivers are not expected to be significant given the distance from the project area to the closest residential receiver (approximately 1km) and the screening provided by the dense vegetation of the buffer lands.

Operation

The operation of the augmented ash dam is not expected to generate a significant increase in air emissions compared to the existing operations. The Project would continue to utilise dense phase ash placement as per existing operations, with an amended ash deposition strategy. This would involve deposition from multiple discharge points around the Ash Dam, and is not expected to result in increased dust emissions.

Dust control measures are currently implemented at the Eraring Ash Dam in accordance with Origin's Ash Dam Management Strategy (Origin, 2017), such as wetting the surface during dry, high wind conditions to ensure that dust emissions are maintained at an acceptable level. The water level in the Eraring Ash Dam is maintained at the maximum operating level to mitigate dust generation within the fly ash delta. The water level is checked daily by operational staff to ensure normal operating levels are maintained. Slurry pumps and direct water application through spray irrigation are used to wet the surface and suppress dust generation.

Origin has commenced an extensive program of rehabilitation and revegetation of areas affected by the operations of the EPS. Progressive rehabilitation of completed surfaces of the Ash Dam would be undertaken where possible, which would minimise the potential for generation of dust emissions.

Targeted treatment of localised dusting events is currently undertaken using water suppression. Should a dusting event occur with the potential for offsite impacts, the procedure set out in the PIRMP would be followed including, where required, notification of relevant government agencies.

8.5.3 Mitigation measures

Construction

A CEMP would be prepared and implemented during construction of the Project. The CEMP would consider potential sources of dust and would include mitigation measures to be implemented during construction to minimise potential air quality impacts.

Operation

The Ash Dam Management Strategy (Origin, 2017) would be reviewed and updated if required to incorporate the Project. Existing management measures would continue to be implemented for the Project, including the following general measures for mitigating dust generation:

- Maximising inundation of ash below water level
- Progressive rehabilitation of completed surfaces
- Use of vegetative screens and bunds
- Direct water application through sprays or water cannon
- Application of fresh fly ash slurry or purpose specific crusting agents
- Temporary mobile or longer term fixed wind breaks.

Should a dusting event occur with the potential for offsite impacts, the procedure set out in the PIRMP would be followed including, where required, notification of relevant government agencies.

8.6 Traffic

8.6.1 Existing environment

The EPS site is currently accessed via an entry point on Construction Road and internal site roads provide access to the Eraring Ash Dam. There is an existing left turning lane to facilitate movements into the EPS site from the northbound side of Construction Road. Southbound traffic can also turn right into the EPS site via the entry point. Construction Road is an EPS internal road with a single lane in each direction and experiences light volumes of traffic. The speed limit is variable along Construction Road, with a posted 20km/hour speed limit near the entry point and approximately 150 metres southbound, the speed limit is increased to 50km/hour.

Heavy vehicles travel to the EPS site via Construction Road, Rocky Point Road, Wangi Road, Macquarie Street, Dora Street and then Mandalong Road to the Pacific Highway (M1).

The local centre of Morisset is approximately eight kilometres south of the EPS site. Heavy vehicles accessing the EPS site travel from Pacific Highway via Dora Street. At the centre of Morisset is Morisset train station, and a four-way signalised intersection with Dora Street, Short Street and the train station access road. Dora Street and Short Street generally provide a single traffic lane in each direction at this location, with a speed limit of 50km/h.

Vehicle traffic counts were undertaken on 5 April 2018 during the morning period (7.00am to 10.00am) and afternoon period (4.00pm to 7.00pm) at the intersection of Dora Street and Short Street, Morisset. During the morning period 4,450 vehicles utilised the Dora Street / Short Street intersection, of which there were 224 heavy vehicles (approximately 5%). During the afternoon period 4,609 vehicles utilised the Dora Street / Short Street intersection of which there were 103 heavy vehicles (approximately 2%). In each period the majority of vehicles (approximately 90%) travelled straight through the intersection along Dora Street.

Vehicle traffic counts were also undertaken on 5 April 2018 during the morning and afternoon periods at the intersection of Rocky Point Road and Construction Road. During the morning period 213 vehicles utilised the Rocky Point Road / Construction Road intersection, of which there were 32 heavy vehicles (approximately 15%). During the evening period 582 vehicles utilised the Rocky Point Road / Construction Road intersection, of which there were 26 heavy vehicles (approximately 5%). The majority of vehicles (approximately 61-70% travelled straight through the intersection along Rocky Point Road. During each period approximately 22 vehicles (including nine heavy vehicles) exited the intersection onto Construction Road (northbound). During the morning period 25 vehicles (including 14 heavy vehicles) entered the intersection from Construction Road (southbound), while during the afternoon period 177 vehicles (including 12 heavy vehicles) entered the intersection from Construction Road (southbound).

8.6.2 Potential impacts

Access arrangements to the EPS site and internal access to the Eraring Ash Dam would remain unchanged compared to existing conditions,

The transport of fill material and cement to the EPS site would generate additional construction traffic. Construction of the Project would require up to 40,000m³ of fill material for construction of the south-west perimeter embankment and approximately 8,000 m³ of cement which would be mixed with reclaimed fly ash on site and used for the filling of underground mine workings. This estimate is based on a ratio of 4% cement to fly ash required to fill the estimated mine void of 200,000 m³.

Where possible, excavated material from on site would be reused as fill material for the construction of the south-west perimeter wall. However, this is subject to further engineering investigation and evaluation of the suitability of reclaimed material. Clean fill material may need to be imported to site if suitable material is not available on site in sufficient quantities. To provide a conservative estimate of transport requirements, this assessment has assumed that the total volume of clean fill material required would be transported from off-site sources.

The transport of up to 40,000 m³ of fill material and 8,000m³ of cement to the EPS site would require up to 600 trucks, based on a typical B-double capacity of 80m³. The construction works would be undertaken over a period of approximately 3 months. Therefore, construction of the Project may generate additional traffic movements of 50 trucks per week, or approximately 10 truck movements per day. When compared to existing traffic levels utilising the intersections of Wangi Road / Rocky

Point Road (Eraring) and Dora Street / Short Street (Morisset), these additional temporary truck movements would not significantly impact the capacity of the existing traffic network. The transport of fill and cement materials would be undertaken in a staged manner over a short term construction period.

Other construction vehicle movements would include the transport of minor quantities of construction materials / wastes to and from the EPS site and construction employees travelling to the EPS site. These vehicle movements are expected to be minimal.

Operation of the Project may generate additional traffic movements associated with the transport of fill material to the EPS site for the construction of ancillary dam structures such as internal cell divider berms. These works would be undertaken progressively throughout the life of the Eraring Ash Dam as required in accordance with the amended ash deposition strategy. It is noted that these construction activities in the Eraring Ash Dam are currently undertaken using excavated material obtained from within the EPS site.

The Project may continue to utilise excavated material obtained on site, however this would depend on the suitability of available material. Clean fill material may need to be transported to the EPS site for these operational activities. While additional traffic movements cannot be quantified at this stage, it is highly unlikely that heavy vehicles movements during operation would be greater than those assessed for the construction period. These additional traffic movements would be undertaken in a staged manner and would have a minor, short term impact on the surrounding traffic network.

8.6.3 Mitigation measures

The following measures would be implemented during construction and operation as part of the CEMP to minimise potential traffic impacts:

- All truck drivers would be provided with route maps to ensure that they access the site from the proposed route (being via the Pacific Highway (M1), Mandalong Road and through Morisset onto Wangi Road, Rocky Point Road and Construction Road).
- Heavy vehicle truck movements would be staged in order to minimise impacts on the surrounding traffic network.
- All additional car and truck parking would be managed wholly within the EPS site.

8.7 Other Environmental Issues

Other environmental issues that were identified in **Section 7.0** as having very low or no anticipated impact include:

- Waste
- Noise
- Visual
- Traffic and Transport
- GHG Emissions
- Non-Aboriginal Heritage
- Social and Economic
- Cumulative Impact.

Consideration of these matters is provided in **Table 15**.

Table 15 Other Environmental Issues

Environmental aspect	Consideration
Waste	<p>During construction of the Project, waste materials generated are likely to consist of minor quantities of vegetation waste and construction wastes such as concrete, metals and pipes. Where possible, materials would be reused or recycled to minimise the quantities of waste disposed in landfill. Vegetation waste (excluding weeds, which would be separated) would be mulched and used in landscaping around the EPS site where appropriate to do so.</p> <p>All waste would be classified in accordance to the Waste Classification Guidelines (EPA, 2014) prior to disposal and transported to a licensed waste disposal facility.</p> <p>The operation of the project would not introduce additional waste streams to those associated with the existing operation of the Eraring Ash Dam. The Project involves the storage of a by-product from the operation of EPS. Ash is currently captured and either beneficially reused by the existing onsite ash recycling facility or pumped into the Eraring Ash Dam.</p> <p>Ash management at EPS is undertaken in accordance with Origin's LTMS. The key goal of the LTMS is to develop and implement strategies that maximise the reuse potential of fly ash and bottom ash produced at EPS. Origin will continue to investigate new methods and markets for the reuse of ash generated at EPS.</p> <p>Refer to Section 9.0 for standard measures that would be implemented to manage potential waste impacts.</p>
Noise	<p>There are sufficient areas of buffer land located between the Eraring Ash Dam and nearby sensitive receivers to minimise potential noise impacts. The closest sensitive receivers include:</p> <p>Residential receivers on Biddulph Street, Wharf Street and Payten Street, Eraring, located over one kilometre to the south; and Myuna Bay Sport and Recreation Centre, located approximately 500 metres to the south.</p> <p>Residential receivers are separated from the EPS site by Wangi Road and Rocky Point Road. These roads carry high traffic volumes including heavy vehicle traffic and therefore generate a substantial level of road traffic noise (HLA, 2006).</p> <p>The existing noise environment at the southern periphery of the EPS site is dominated by road traffic noise from Wangi Road (HLA, 2006). The majority of the works for the project would be undertaken in the western and northern sections of the Eraring Ash Dam, which would provide a further buffer (around an additional 500 metres) for potential noise impacts.</p> <p>Construction works potentially audible at residential premises would only be undertaken during hours specified in Condition 2.3 to Project Approval 07_0084:</p> <ul style="list-style-type: none"> • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • At no time on Sundays and Public Holidays. <p>There would be temporary noise impacts associated with the construction of the project from the movement of construction vehicles and plant associated with required earthworks. These impacts would be minor given</p>

Environmental aspect	Consideration
	<p>the distance to the nearest sensitive receivers outlined above.</p> <p>Noise impacts associated with the operation of the Project would primarily be associated with the movement of vehicles and plant involved in the establishment of the western emplacement area and ongoing ash placement activities. The Project involves the pumping of ash slurry from the main plant area to the ash dam, with new ash deposition pipelines connected to the existing ash pipeline network.</p> <p>Operations would be undertaken 24 hours a day, seven days a week. Operation of the Project is not expected to significantly alter noise emissions compared to those already occurring as a result of existing operations. Potential noise impacts are expected to remain substantially the same during operation of the Project (as modified).</p>
Visual	<p>There are sufficient areas of land located between the Eraring Ash Dam and nearby sensitive receivers to minimise potential visual impacts. The Eraring Ash Dam is not visible from Wangi Road or from nearby residential receivers on Biddulph Street.</p> <p>The 2006 EA concluded that the expanded ash dam would not be visible from most surrounding residential areas and public places due to local terrain. The Project involves deposition of ash to the same height (RL 140m) within a similar footprint to the existing design. Therefore it can be concluded that the Project would not result in visual impacts to nearby receivers during construction or operation.</p>
GHG Emissions	<p>Vehicles, plant and machinery used during construction of the Project would generate GHG emissions, however these emissions would be minimal, given the scope of works and short duration of construction.</p> <p>The operation project would not require additional vehicle movements and electricity usage during operation would be similar to existing operations. Therefore there would be no additional GHG emissions associated with the operation project.</p>
Non-Aboriginal Heritage	<p>The EPS site including the Eraring Ash Dam is listed as a heritage item under the LEP 2014. As described in the statement of significance for the heritage item, the EPS <i>“represents the “State of the Art” in its technology, and is one of the biggest power stations in NSW. It is undoubtedly highly significant, although considering its youth, it is arguable whether EPS yet qualifies as a heritage item”</i> (OEH, 2008). The significance of EPS is considered to relate primarily to electricity generation infrastructure and technology associated with the power station building.</p> <p>The project would not directly or indirectly impact key electricity generation infrastructure or technology at EPS. The project would be primarily located within the existing operational footprint of the Eraring Ash Dam. It is therefore considered that impacts to the heritage item would be negligible.</p>
Social and Economic	<p>The construction of the project would produce a marginal, temporary increase in demand for construction and installation workers/contractors in Lake Macquarie.</p> <p>The project would require the decommissioning of fly ash recycling infrastructure currently operated by Boral. Infrastructure in this area primarily consists of mobile plant which is readily relocatable and so impacts to Boral would be minor and temporary. The relocation of this infrastructure in a different location at the site would be subject to separate environmental assessment.</p>

Environmental aspect	Consideration
	The operation of the project would ensure the ongoing operation of EPS to cater for the increasing needs of the national electricity market. The continued effective utilisation of the Ash Dam is a business critical priority for Origin and is required to ensure future power system security within the broader national electricity market. Furthermore, there will continue to be an increasing reliance on Eraring following the recent and planned closures of large generation assets in NSW (eg Munmorah Power Station (closed in 2012) and Liddell Power Station (due to be closed in 2022) as well as in Victoria and South Australia.
Cumulative impacts	EPS is not located in proximity to proposed developments that would result in cumulative environmental impacts to nearby receivers. Construction activities for the project relate primarily to excavations and earthworks and so it is considered unlikely that the project would contribute to a shortage of construction materials in Lake Macquarie or nearby regions.

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9.0 Summary of Management Measures

A summary of the management measures that Origin would implement during construction and operation of the Project is presented in Table 16.

Table 16 Summary of management measures

Issue	Mitigation Measures
General	<p>Construction works potentially audible at residential premises would only be undertaken during hours specified in Condition 2.3 to Project Approval 07_0084:</p> <ul style="list-style-type: none"> • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays • At no time on Sundays and Public Holidays. <p>Operations would be undertaken 24 hours a day, seven days a week.</p> <p>A Construction Environmental Management Plan (CEMP) would be prepared and implemented during construction of the Project.</p>
Biodiversity	<p>Construction</p> <p>The CEMP would identify mitigation measures and procedures including:</p> <ul style="list-style-type: none"> • Vegetation clearing activities would be undertaken in accordance with existing procedures outlined in the Land and Biodiversity Management Plan (AECOM, 2017). The procedures would incorporate: <ul style="list-style-type: none"> - A documented risk assessment prior to clearing commencing - Establishment of exclusion zones - Identification of habitat trees and inspections pre and post felling - Staged clearing activities • Ground disturbance and soil handling activities would be undertaken in accordance with existing procedures outlined in the Land and Biodiversity Management Plan (AECOM, 2017). The procedures would incorporate: <ul style="list-style-type: none"> - Weed management activities - Soil handling protocols including stockpiling procedures • Areas disturbed as a result of construction activities which are not required for future operational use would be progressively stabilised and rehabilitated as soon as practical following disturbance. Rehabilitation activities would be undertaken in accordance with the Land and Biodiversity Management Plan (AECOM, 2017). <p>Operation</p> <p>The following control measures will be implemented on an ongoing basis in accordance with the existing Land and Biodiversity Management Plan (AECOM, 2017):</p> <ul style="list-style-type: none"> • weed management • vertebrate pest control • fencing and access control

Issue	Mitigation Measures
	<ul style="list-style-type: none"> • bushfire management • progressive rehabilitation. <p>Offset Strategy</p> <p>Offset requirements under the BC Act would be fulfilled using one or a combination of the following offset strategies:</p> <ul style="list-style-type: none"> • In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits • Securing required credits through the open credit market and/or • Payments to the Biodiversity Conservation Fund. <p>In-perpetuity conservation would form the preferred method of offsetting under the BC Act where practicable.</p>
Hydrology	<p>Construction</p> <ul style="list-style-type: none"> • A Construction Environmental Management Plan (CEMP) would be prepared and implemented during construction of the Project. The CEMP would include an Erosion and Sediment Control Plan which would describe the safeguards to be implemented during construction to minimise potential impacts to surface water and groundwater resources. The Erosion and Sediment Control Plan would incorporate principles and relevant procedures identified within the site Water Management Plan (Umwelt, 2013). • Erosion and sediment control activities would be undertaken in accordance with guidelines from Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom 2004) and Volumes 2A, 2C, 2D and 2E (DECC 2008a-d) (the Blue Book). • All drilling fluid would be captured and disposed of appropriately and in accordance with the <i>Waste Avoidance & Resource Recovery Act 2001</i>. • All drilling fluid irrigated to land would have the bulk sediment removed. Land irrigation would not be undertaken within 50 metres of a drainage line or watercourse, existing habitat offset areas or within areas of Ecologically Endangered Communities (EEC) or Aboriginal heritage sites. All land irrigation would be undertaken in a manner to prevent runoff and erosion. • All excess excavated material that cannot be returned to excavations or reused in construction activities would be stockpiled or temporarily placed in skip bins held on site prior to being assessed in accordance with NSW Waste Classification Guidelines (EPA, 2014). Excess material would be reused in rehabilitation activities where appropriate or appropriately disposed of in accordance with the <i>Waste Avoidance & Resource Recovery Act 2001</i>. • Disturbance would be minimised where possible and stabilised by progressive rehabilitation as soon as practicable. • Ground disturbance and soil handling activities would be undertaken in accordance with existing procedures outlined in the Land and Biodiversity Management Plan (AECOM, 2017). The procedures would incorporate: <ul style="list-style-type: none"> - Weed management activities; and - Soil handling protocols including stockpiling procedures.

Issue	Mitigation Measures
	<p>Operation</p> <ul style="list-style-type: none"> The Water Management Plan (Umwelt, 2013) would be reviewed and updated if necessary to incorporate the Project. The existing surface water and groundwater monitoring program would continue to be implemented for the Project in accordance with Project Approval and EPL conditions.
Geotechnical	<p>The following mitigation measures would be applied to the project:</p> <ul style="list-style-type: none"> A range of remedial approaches would be employed to effectively mitigate subsidence hazards identified for the site and include the following techniques: <ul style="list-style-type: none"> Filling of mine voids with stabilised fill material Excavating and collapsing of shallow mine workings; and/or Installing an impervious barrier using clays or suitable stabilised fill materials. <p>The preferred strategy may employ all or a combination of the above techniques and may be informed by additional geotechnical or environmental investigations.</p> A Mine Void Remediation Plan would be prepared prior to mine void remediation activities commencing. The Mine Void Remediation Plan would identify the proposed void treatment methods, excavations, a material placement strategy and design criteria. The plan would also identify bulk material handling practices, water management procedures and appropriate environmental safeguards to minimise risks to the environment. The requirement to remediate areas where ash is retained and the required extent of mine void remediation activities would consider the hydraulic conductivity of the fill material, the height to which the voids are filled, and the expected effectiveness of the filling strategy used. Pressure grouting would be employed where appropriate to fill voids from seam level through to the surface but would be limited and controlled so as not to induce hydraulic fractures of the overburden strata. Mine void remediation activities (and associated disturbance) would extend no further than 100m from the proposed limit of ash placement. A verification report would be prepared to determine the effectiveness of the applied remedial action and treatment works. The report would describe geotechnical and/or groundwater investigations undertaken to identify and if required, further manage residual risk associated with subsidence and surface water connectivity hazards prior to ash disposition above RL 130 within the western emplacement area.
Aboriginal Heritage	<p>The following management measures would be implemented during construction of the Project:</p> <ul style="list-style-type: none"> In the unlikely event that Aboriginal objects, including possible human skeletal remains, are identified at any point during construction of the Project, the following procedure would be followed:

Issue	Mitigation Measures
	<p><u>Aboriginal Sites</u></p> <ol style="list-style-type: none"> 1. All works must cease immediately in the area to prevent any further impacts to the site 2. Engage a suitably qualified heritage consultant to determine the nature, extent and significance of the find and provide appropriate management advice. Management action(s) will vary according to the type of evidence identified, its significance (both scientific and cultural) and the nature of potential impacts 3. Prepare and submit an AHIMS site card for the site. <p><u>Human Skeletal Remains</u></p> <p>In the event that potential human skeletal remains are identified at any point during the life of the Project, the following standard procedure (New South Wales Police Force, 2015; NSW Health, 2013) should be followed.</p> <ol style="list-style-type: none"> 1. All work in the vicinity of the remains should cease immediately. 2. The location should be cordoned off and the NSW Police notified. 3. If the Police suspect the remains are Aboriginal, they will contact the Office of Environment and Heritage and arrange for a forensic anthropologist or archaeological expert to examine the site. <p>Subsequent management actions will be dependent on the findings of the inspection undertaken (at Point 3).</p> <ul style="list-style-type: none"> • If the remains are identified as modern and human, the area will become a crime scene under the jurisdiction of the NSW Police • If the remains are identified as pre-contact or historic Aboriginal, OEH and all RAPs are to be formally notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided an appropriate management mitigation strategy will be developed in consultation with OEH and RAPs • If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Division contacted • If the remains are identified as non-human, work can recommence immediately.
Air Quality	<p>Construction</p> <p>A CEMP would be prepared and implemented during construction of the Project. The CEMP would consider potential sources of dust and would include mitigation measures to be implemented during construction to minimise potential air quality impacts.</p> <p>Operation</p> <p>The Ash Dam Management Strategy (Origin, 2017) would be reviewed and updated if required to incorporate the Project. Existing management measures would continue to be implemented for the Project, including the following general measures for mitigating dust generation:</p> <ul style="list-style-type: none"> • Maximising inundation of ash below water level • Progressive rehabilitation of completed surfaces • Use of vegetative screens and bunds • Direct water application through sprays or water cannon

Issue	Mitigation Measures
	<ul style="list-style-type: none"> • Application of fresh fly ash slurry or purpose specific crusting agents • Temporary mobile or longer term fixed wind breaks. <p>Should a dusting event occur with the potential for offsite impacts, the procedure set out in the PIRMP would be followed including, where required, notification of relevant government agencies.</p>
Traffic	<p>The following measures would be implemented during construction and operation as part of the CEMP to minimise potential traffic impacts:</p> <ul style="list-style-type: none"> • Access arrangements would be communicated with all truck drivers (e.g. using route maps) to ensure that they access the site from the proposed route (being via the Pacific Highway (M1), Mandalong Road and through Morisset onto Wangi Road, Rocky Point Road and Construction Road). • Heavy vehicle truck movements would be staged in order to minimise impacts on the surrounding traffic network. • All additional car and truck parking would be managed wholly within the EPS site.
Waste	<p>All waste would be classified in accordance to the Waste Classification Guidelines (EPA, 2014) prior to disposal and transported to a licensed waste disposal facility.</p> <p>Where possible, materials would be reused or recycled to minimise the quantities of waste disposed in landfill.</p>
Noise	<p>A CEMP would be prepared and implemented during construction of the Project. The CEMP would consider potential sources of noise and would include mitigation measures to be implemented during construction to minimise potential noise impacts.</p>

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10.0 Conclusion

This Environmental Assessment provides details of the Project, describes the existing environment, assesses the potential impacts of the project on the environment and identifies management measures aimed at minimising or avoiding the identified impacts.

The Project seeks approval for the augmentation of the Eraring Ash Dam in order to increase its storage life and ensure the ongoing operation of the EPS. The continued operation of the Eraring Ash Dam is a business critical priority and is required to ensure future power system security within the broader national electricity market.

The project would extend the storage life of the Eraring Ash Dam in a manner that:

- Maintains operational flexibility in terms of future ash deposition strategies and engineering design
- Supports the continued operation of EPS to 2032 and deposition of ash towards a final landform that is both safe and stable in the long term
- Is technically feasible
- Remains consistent with Dams Safety Committee of NSW (DSC) guidance and Australian National Committee on Large Dams (ANCOLD) guidelines
- Minimises potential impacts to the environment.

The potential environmental impacts of the project have been assessed and it is considered that whilst the project may have some residual impacts, the mitigation measures identified would effectively ensure that the environmental consequences associated with the proposed modifications are minimised and likely to remain substantially the same as those currently approved.

Offset requirements under the BC Act would be fulfilled in accordance with a Biodiversity Offset Strategy which would ensure that the unavoidable loss of biodiversity values as a result of the Project is appropriately compensated. In-perpetuity conservation would form the preferred method of offsetting under the BC Act where practicable with a number of potential offset opportunities identified in the vicinity of the Project area both within and outside of Origin's existing landholdings.

Subsidence hazards would be effectively controlled through remedial action with works verified to determine their effectiveness.

The benefits of the Project would outweigh its potential impacts with the implementation of the proposed management and mitigation measures as identified in this EA. It is therefore considered that it is appropriate and in the public interest to approve the Project.

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Appendix A

Existing Project Approvals

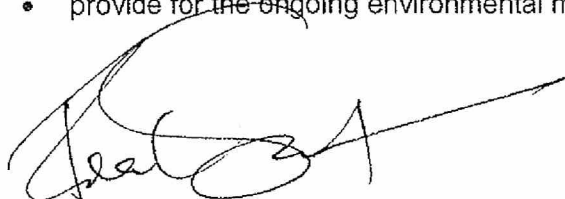
Appendix A Existing Project Approvals

Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

I, the Minister for Planning, approve the project referred to in Schedule 1, subject to the conditions in Schedule 2. These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.



Frank Sartor MP
Minister for Planning

Sydney

29 April 2008

File No: S07/01073-1

SCHEDULE 1

Application No:	07_0084
Proponent:	Eraring Energy
Approval Authority:	Minister for Planning
Land:	Lot 11 DP 1050120; Lots 301 & 302 DP 806475; Lot 3/8 Section L DP 6747; Lots 13/16 Section O & Part Lot 13/16 Section U DP 6747; Lot 7/16 DP 262501; Lot 19 DP 262501; Lot 1 DP 817425; Lots 100 and 101 DP 828283; Lot 211 DP 840670; Lots 50 and 51 DP 840671; Lots 1, 2 and 3 DP 621697; Lot 1 DP 816174; and Lots 20 and 21 DP 734860. Crown Land adjoining the northern boundary of Lot 11 DP 1050120 to the ridge line known as Lots 1 and 2 DP 1109558. Eraring Power Station, Rocky Point Rd, Dora Creek, Lake Macquarie local government area
Project:	Staged expansion of the coal combustion product (CCP) management facility in conjunction with changes in the CCP disposal method from lean phase to dense phase. The project also includes the installation of new infrastructure comprising of CCP collection, storage, conditioning and pumping facilities to allow for storage and transportation of CCP from the power station to the CCP management facility.
Major Project:	The proposal is declared a Major Project under section 75B(1) of the Environmental Planning and Assessment Act 1979 because it is a project of a kind described in clause 24 of

Schedule 1 to the *State Environmental Planning Policy (Major Projects) 2005*.

Concept Plan Approval:

On 14 December 2006, the Minister for Planning approved the concept plan for the project.

KEY TO CONDITIONS

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SCHEDULE 2

Act, the	<i>Environmental Planning and Assessment Act 1979</i>
CCP	Coal Combustion Product
Conditions of Approval	The Minister's conditions of approval for the project
Council	Lake Macquarie City Council
DECC	Department of Environment and Climate Change
Department, the	Department of Planning
Director-General, the	Director-General of the Department of Planning (or delegate)
EA	<i>Environmental Assessment – Upgrade and Expansion of the Coal Combustion Management System, Eraring Power Station, dated November 2007, and prepared by HLA - ENSR</i>
EPL	Environment Protection Licence issued under the <i>Protection of the Environment Operations Act 1997</i>
Minister, the	Minister for Planning.
Proponent	Eraring Energy
Site	The land to which this approval applies

1. ADMINISTRATIVE CONDITIONS

Terms of Project Approval

- 1.1 The Proponent shall carry out the project generally in accordance with:
 - a) Major Project Application 07_0084;
 - b) *Environmental Assessment – Upgrade and Expansion of the Coal Combustion Product Management System, Eraring Power Station*, dated 13 November 2007, and prepared by HLA – ENSR;
 - c) *Upgrade and Expansion of the CCP Management System, Eraring Power Station – Submissions Report*, dated 15 February 2008, and prepared by HLA – ENSR;
 - d) the conditions of approval granted by the Minister for Planning for the Upgrade of the Ash Disposal Facility at the Eraring Power Station (Application Number 05_0138); and
 - e) the conditions of this approval.
- 1.2 In the event of an inconsistency between:
 - a) the conditions of this approval and any document listed from condition 1.1a) to 1.1c) inclusive, the conditions of this approval shall prevail to the extent of the inconsistency; and
 - b) any document listed from condition 1.1a) to 1.1c) inclusive, and any other document listed from condition 1.1a) to 1.1c) inclusive, the most recent document shall prevail to the extent of the inconsistency.
- 1.3 The Proponent shall comply with any reasonable requirement(s) of the Director-General arising from the Department's assessment of:
 - a) any reports, plans or correspondence that are submitted in accordance with this approval; and
 - b) the implementation of any actions or measures contained in these reports, plans or correspondence.

Limits of Approval

- 1.4 This project approval shall lapse five years after the date on which it is granted, unless the works subject of this approval are physically commenced on or before that time.

2. SPECIFIC ENVIRONMENTAL CONDITIONS

Ecological Impacts

- 2.1 The Proponent shall provide a compensatory habitat package consisting of no fewer than two hectares of compensatory habitat for each hectare of terrestrial vegetation removed as part of the project. Specifications for the compensatory habitat, including location, composition, quality and management of the habitat, shall be determined in consultation with the DECC. The package must include:
 - a) a schedule of vegetation clearing, indicating stages and timing and compensatory habitat area(s) corresponding to each stage of clearing;
 - b) demonstration of consistency with the DECC's 'Offsetting Principles' contained in the draft *Lower Hunter Regional Conservation Plan (2006)*;
 - c) demonstration of potential coordination, connection and interaction with compensatory habitat provided in pursuance of the requirements of project approval for the Eraring Power Station Upgrade and Attenuation Reservoir;
 - d) demonstration of the potential for off-set areas to connect with and complement other areas of conservation value, particularly with respect to habitat corridors and connectivity;
 - e) details of proposed legal mechanisms to secure the protection of offsets in perpetuity; and
 - f) maintenance, monitoring and auditing program of the compensatory habitat areas.

The program of funding or works associated with the compensatory habitat package shall be submitted for the approval of the Director-General prior to the commencement of vegetation clearing, and/or each stage of clearing.

- 2.2 Within one year of operation of the project, or as otherwise agreed by the Director-General, the Proponent must develop and submit for the approval of the Director-General, a Rehabilitation Program for the decommissioned CCP storage areas outlining how their rehabilitation will be undertaken. The Program shall include, but not necessarily be limited to:
- a) a description of techniques to restore the area;
 - b) a timetable for the progressive staging of the rehabilitation program; and
 - c) monitoring and auditing of the Rehabilitation Program.

Noise Impacts

Construction Noise

- 2.3 The Proponent shall only undertake construction activities associated with the project that would generate an audible noise at any residential premises during the following hours:
- a) 7:00 am to 6:00 pm, Mondays to Fridays, inclusive;
 - b) 8:00 am to 1:00 pm on Saturdays; and
 - c) at no time on Sundays or public holidays.

This condition does not apply in the event of a direction from police or other relevant authority for safety reasons.

- 2.4 The hours of construction activities specified under condition 2.3 of this approval may be varied with the prior written approval of the Director-General. Any request to alter the hours of construction specified under condition 2.3 shall be:
- a) considered on a case-by-case basis;
 - b) accompanied by details of the nature and need for activities to be conducted during the varied construction hours; and
 - c) accompanied by written evidence of the DECC's agreement with the proposed variation in construction times, after providing any information necessary for the DECC to reasonably determine that activities undertaken during the varied construction hours will not adversely impact on the acoustic amenity of receptors in the vicinity of the site.

Soil and Water Quality Impacts

- 2.5 Except as may be expressly provided by an Environment Protection Licence (EPL) for the project, the Proponent shall comply with section 120 of the *Protection of the Environment Operations Act 1997* which prohibits the pollution of waters.
- 2.6 Soil and water management controls shall be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities, in accordance with Landcom's *Managing Urban Stormwater: Soils and Conservation*.

Groundwater

- 2.7 The Proponent shall design and construct the CCP storage facility expansion in a manner that does not intercept underlying groundwater.

Air Quality Impacts

Dust Generation

- 2.8 The Proponent shall construct the project in a manner that minimises dust emissions from the site, including wind-blown and traffic-generated dust. All activities on the site shall be undertaken with the objective of preventing visible emissions of dust from the site. Should such visible dust emissions occur at any time, the Proponent shall identify and implement all

practicable dust mitigation measures, including cessation of relevant works, as appropriate, such that emissions of visible dust cease.

Odour

- 2.9 The Proponent shall not permit any offensive odour, as defined under section 129 of the *Protection of the Environment Operations Act 1997*, to be emitted beyond the boundary of the site.

Waste Generation and Management

- 2.10 The Proponent shall beneficially reuse all non-contaminated spoil generated during the construction of the project on the site, or off-site should an appropriate off-site reuse location exist.
- 2.11 All wastes, and spoil unable to be reused in accordance with condition 2.10, shall be directed to a waste management facility lawfully permitted to accept those materials.
- 2.12 The Proponent shall ensure that all wastes generated as a consequence of the project are assessed and classified in accordance with *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (DECC, 2004).
- 2.13 Except as expressly permitted in an appropriate licence, waste shall not be received at the premises for storage, treatment, processing, reprocessing or disposal.

Aboriginal Archaeology

- 2.14 If during the course of construction the Proponent becomes aware of any previously unidentified Aboriginal object(s), all work likely to affect the object(s) must cease immediately and the Proponent must contact the DECC to determine an appropriate course of action prior to the re-commencement of work in the vicinity of the object(s).

3. ENVIRONMENTAL MONITORING AND AUDITING

Noise Performance Auditing

- 3.1 Within three months of commissioning of the fly ash conditioning plant, the Proponent must conduct a noise assessment of the plant while operating under full load conditions. The assessment shall meet the requirements of the DECC, and shall include, but not necessarily be limited to:
- a) noise assessment and monitoring, consistent with the guidelines provided in *NSW Industrial Noise Policy (EPA, 2000)*;
 - b) methodologies for noise monitoring;
 - c) location of noise monitoring;
 - d) frequency of noise monitoring;
 - e) identification of monitoring sites at which pre- and post-project noise levels can be ascertained; and
 - f) details of any complaints relating to noise impacts.

A report providing the results of the assessment shall be submitted to the Director-General and the DECC within 28 days of completion of the testing required under a).

Groundwater Monitoring

- 3.2 Prior to the commencement of the operation of the project, the Proponent shall undertake a review of the existing groundwater monitoring regime, which shall include but not necessarily be limited to:
- a) survey of existing monitoring bores;
 - b) parameters and pollutants to be monitored, including procedures and protocols for sampling and testing;

- c) review of the adequacy of existing groundwater monitoring network at the Eraring Power Station to determine whether current contaminant levels at receiving waters originate from existing activities associated with the power station, including the existing CCP storage facility;
- d) installation of any additional monitoring bore(s), both up and down gradient of the CCP storage facility;
- e) details of groundwater quality limits that would indicate impacts from the CCP storage facility, particularly as a result of seepage, and a contingency response plan in the events that impacts are identified;
- f) provisions for periodic auditing and reporting of results to the Director-General.

The Proponent shall revise its groundwater monitoring regime, as necessary, and update its existing Groundwater Management Plan in accordance with the groundwater monitoring review. A copy of the updated Plan shall be submitted to the Director-General for approval prior to its implementation.

4. ENVIRONMENTAL MANAGEMENT

Construction Environmental Management Plan

- 4.1 The Proponent shall prepare and implement a **Construction Environmental Management Plan** to outline environmental management practices and procedures to be followed during construction of the project. The Plan shall be consistent with *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004) and shall include, but not necessarily be limited to:
- a) a description of all activities to be undertaken on the site during construction including an indication of stages of construction, where relevant;
 - b) statutory and other obligations that the Proponent is required to fulfil during construction including all approvals, consultations and agreements required from authorities and other stakeholders, and key legislation and policies;
 - c) details of how the environmental performance of the construction works will be monitored, and what actions will be taken to address identified adverse environmental impacts. In particular, the following environmental performance issues shall be addressed in the Plan:
 - i) measures to monitor and manage dust emissions;
 - ii) measures to monitor and minimise soil erosion and the discharge of sediment and other pollutants to lands and/ or waters during construction activities;
 - iii) measures to monitor and control noise emissions during construction works;
 - d) a description of the roles and responsibilities for all relevant employees involved in the construction of the project;
 - e) the additional studies listed under condition 4.2 of this approval; and
 - f) complaints handling procedures during construction.

The Plan shall be submitted for the approval of the Director-General no later than one month prior to the commencement of any construction works associated with the project, or within such period otherwise agreed by the Director-General. Construction works shall not commence until written approval has been received from the Director-General.

- 4.2 As part of the Construction Environmental Management Plan for the project, required under condition 4.1 of this approval, the Proponent shall prepare and implement the following:
- a) a **Flora and Fauna Management Plan** to outline measures to protect and minimise loss of native vegetation and native fauna habitat. The Plan must include, but not necessarily be limited to:
 - i) plans showing terrestrial vegetation communities; important flora and fauna habitat areas; locations where threatened species, populations or ecological communities were recorded; and areas to be cleared. The plans must also identify vegetation adjoining the Site where this contains important habitat areas and/or threatened species, populations or ecological communities;

- ii) details of the timing of clearing to ensure that it does not adversely affect critical periods in the lifecycles of significant species;
 - iii) methods to manage impacts on flora and fauna species (terrestrial and aquatic) and their habitat which may be directly or indirectly affected by the project;
 - iv) flora and fauna monitoring programs to be implemented during both construction and operation; and
 - v) a Vegetation Clearance Protocol.
- b) a **Traffic Management Plan** to outline management of traffic conflicts that may be generated during construction of the project. The Plan shall address the requirements of Council and the Roads and Traffic Authority and shall include, but not necessarily be limited to:
 - i) details of traffic routes for heavy vehicles, including any necessary route or timing restriction for oversized loads;
 - ii) detailed consideration of measures to be employed to ensure traffic volume, acoustic and amenity impacts along the heavy vehicle routes are minimised;
 - iii) detailed consideration of alternative routes (where necessary);
 - iv) provisions for the management of disruptions to traffic, particularly on Wangi Road; and
 - v) demonstration that all statutory responsibilities with regard to road traffic impacts have been complied with.
- c) a **Construction Noise Management Plan** to detail how construction noise and vibration impacts would be minimised and managed, including, but not necessarily be limited to:
 - i) details of construction activities and a schedule for construction works;
 - ii) identification of construction activities that have the potential to generate noise and/ or vibration impacts on surrounding land uses, particularly residential areas;
 - iii) a detailed description of what actions and measures would be implemented to ensure that these works would comply with the relevant noise and vibration criteria/ guidelines;
 - iv) procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints; and
 - v) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken and how the results of this monitoring would be recorded.
- d) an **Erosion and Sedimentation Management Plan** to detail measures to minimise erosion and discharge of sediment and other pollutants to land and/or water during site preparation and construction works. The Plan must include, but not necessarily be limited to:
 - i) identification of the construction activities that could cause soil erosion or discharge sediment or water pollutants from the site;
 - ii) description of the management methods to minimise soil erosion or discharge of sediment or water pollutants from the site, including a strategy to minimise the area of bare surfaces during construction;
 - iii) demonstration that proposed erosion and sediment control measures will conform with, or exceed, the relevant requirements of *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004);
 - iv) details of an erosion monitoring program during construction of the project, including measures to address erosion, should it occur, and to rehabilitate/ stabilise disturbed areas of the Site.

Operation Environmental Management

- 4.3 The Proponent shall prepare and implement an **Operation Environmental Management Plan** to detail an environmental management framework, practices and procedures to be followed during operation of the project. The Plan shall be consistent with *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004) and shall include, but not necessarily be limited to:

- a) identification of all statutory and other obligations that the Proponent is required to fulfil in relation to operation of the project, including all approvals, licences, approvals and consultations;
- b) a description of the roles and responsibilities for all relevant employees involved in the operation of the project;
- c) overall environmental policies and principles to be applied to the operation of the project;
- d) standards and performance measures to be applied to the project, and a means by which environmental performance can be periodically reviewed and improved, where appropriate;
- e) management policies to ensure that environmental performance goals are met and to comply with the conditions of this approval;
- f) preparation of a **Coal Combustion Product Management Plan** to outline how the CCP storage facility and associated infrastructure will be managed to minimise potential impacts on the surrounding environment. The Plan shall include, but not necessarily be limited to:
 - i) likely quality and quantity of groundwater seepage and surface water runoff from the CCP storage facility and likely impact on receiving waters;
 - ii) management system or measures to prevent overflows from the CCP storage facility and weir during rainfall events; and
 - iii) water quality monitoring of selenium and other contaminants (both concentration levels and total load) discharged to receiving waters.

The Plan shall be submitted for the approval of the Director-General no later than one month prior to the commencement of operation of the project, or within such period otherwise agreed by the Director-General. Operation of the project shall not commence until written approval has been received from the Director-General.

- 4.4 The Proponent may satisfy condition 4.3 of this approval by demonstrating to the satisfaction of the Director-General that existing, equivalent documentation has been appropriately updated to reflect the CCP storage facility expansion.

5. ENVIRONMENTAL REPORTING

Incident Reporting

- 5.1 The Proponent shall notify the Director-General of any incident with actual or potential significant off-site impacts on people or the biophysical environment as soon as practicable and within 24 hours after the occurrence of the incident. The Proponent shall provide full written details of the incident to the Director-General within seven days of the date on which the incident occurred.
- 5.2 The Proponent shall meet the requirements of the Director-General to address the cause or impact of any incident, as it relates to this approval, reported in accordance with condition 5.1 of this approval, within such period as the Director-General may require.

Appendix B

Protected Matters Search

Appendix B Protected Matters Search



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

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[Summary](#)

[Details](#)

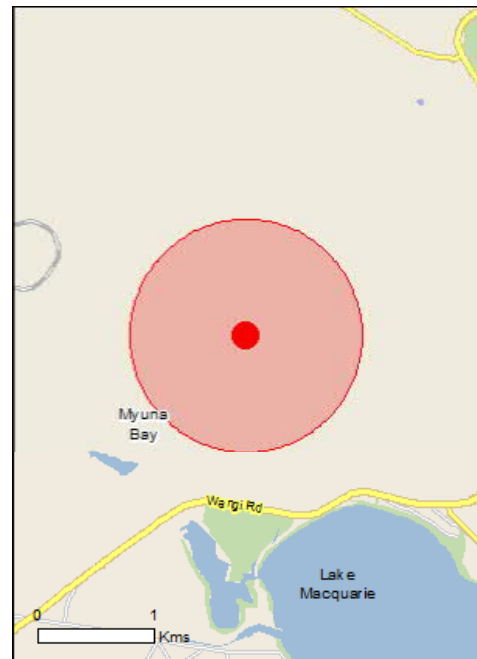
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

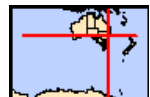
[Acknowledgements](#)



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[Coordinates](#)

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	32
Listed Migratory Species:	17

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	42
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat known to occur within area
Angophora inopina Charmhaven Apple [64832]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Tetralthea juncea Black-eyed Susan [21407]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
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Migratory Marine Birds

Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
---	--	--

Migratory Terrestrial Species

Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
--	--	--

Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
--	--	---

Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
--	--	---

Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
--	--	--

Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
---	--	--

Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
--	--	---

Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
---	--	--

Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
--	--	--

Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
--	--	--

Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
---	-----------------------	--

Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
--	--	--

Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
--	--	--

Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
---	--	---

Name	Threatened	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species

Name	Threatened	Type of Presence
Lathamus discolor Swift Parrot [744]	Critically Endangered	habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]	Critically Endangered	Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]		Species or species habitat known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]	Endangered*	Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Regional Forest Agreements

[[Resource Information](#)]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species

[[Resource Information](#)]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area

Name	Status	Type of Presence
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large- leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.04991 151.54508

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

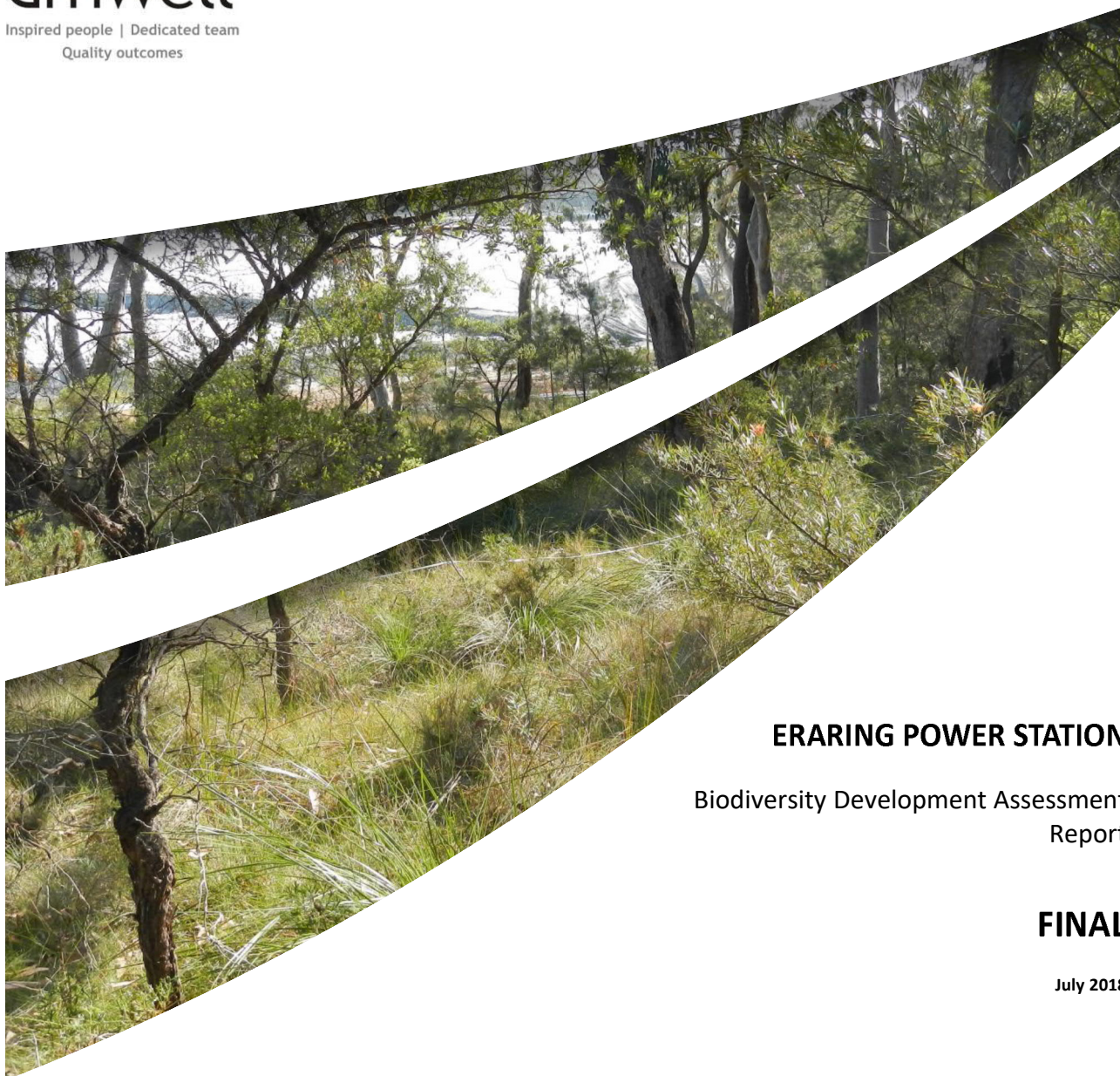
The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix C

Biodiversity Development Assessment Report

Appendix C Biodiversity Development Assessment Report



ERARING POWER STATION

Biodiversity Development Assessment Report

FINAL

July 2018

ERARING POWER STATION

Biodiversity Development Assessment Report

PRELIMINARY DRAFT

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
AECOM Australia Pty Ltd

Project Director:	Allison Riley
Project Manager:	Shaun Corry
Report No.	4145/R04/Final
Date:	July 2018



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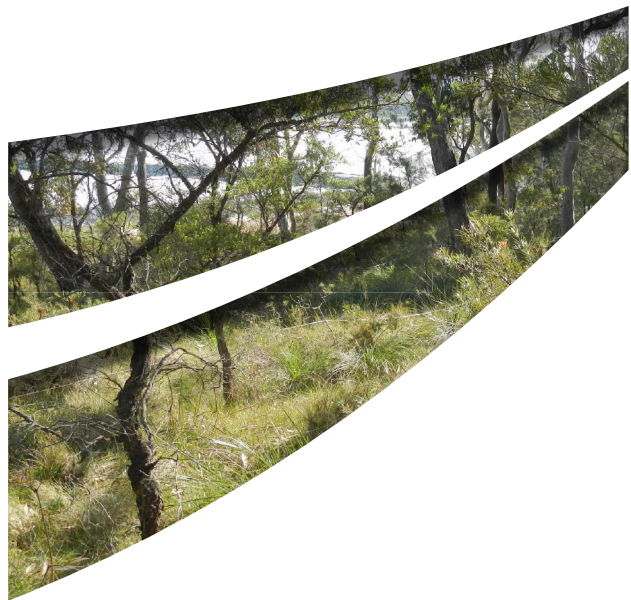
Ph. 02 4950 5322

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This report was prepared using
Umwelt's ISO 9001 certified
Quality Management System.

Executive Summary



Origin Energy Limited (Origin) is seeking a modification to the existing Part 3A approval (07_0084) for the Eraring Power Station Coal Combustion Product Management Facility. This includes augmentation of the Eraring Ash Dam and modifications to existing ancillary infrastructure.

The site is located along Wangi Road, Eraring and Myuna Bay, NSW in the Lake Macquarie Local Government Area (LGA). The site covers an area of approximately 15.1 hectares and is surrounded by generally intact buffer lands of the power station.

The NSW Department of Planning and Environment (DPE) has confirmed that the Proposed Modification will be assessed under the former Section 75W of the Environment Planning and Assessment Act 1979 (EP&A Act). As the Proposed Modification seeks to modify a major project approval it requires a Biodiversity Assessment Method (BAM) assessment under the Biodiversity Conservation Act 2016.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of AECOM to assess the potential biodiversity impacts of the Proposed Modification in accordance with the BAM.

Surveys of the Development Footprint identified two Plant Community Types (PCTs) and native fauna habitats being:

- 0.95 hectares of PCT1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast - Good Condition

- 8.00 hectares of PCT1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - Good Condition.

Following the application of avoidance and mitigation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Project:

- 22 ecosystem credits for PCT1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
- 261 ecosystem credits for PCT1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast
- 327 species credits each for black-eyed Susan – (*Tetratheca juncea*), squirrel glider (*Petaurus norfolcensis*) and Stephen's banded snake – (*Hoplocephalus stephensii*).

Origin is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project as required under the *Biodiversity Conservation Act 2016*. This will be undertaken using one or more of the following options:

- The establishment and retirement of credits within a Stewardship site.
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

Glossary

BDAR	Biodiversity Development Assessment Report
BAM	Biodiversity Assessment Methodology
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CEEC	Critically Endangered Ecological Community
Development Footprint	The total impact zone associated with the Project. The Proposed Disturbance Area is referred to throughout this report as the Development Footprint in accordance with the BAM.
DoEE	Commonwealth Department of the Environment and Energy
DNG	Derived Native Grasslands
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPS	Eraring Power Station
GDEs	Groundwater-dependent Ecosystems
GIS	Geographical Information System
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
LGA	Local Government Area
MGA	Map Grid of Australia
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection database.
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

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1 Introduction

Origin Energy Limited (Origin) is seeking a modification to the existing Part 3A approval (07_0084) for the Eraring Power Station Coal Combustion Product Management Facility. This includes the augmentation of the Eraring Ash Dam and modifications to existing ancillary infrastructure.

The Development Footprint is located along Wangi Road, Eraring and Myuna Bay, NSW (refer to **Figure 1.1** and **Figure 1.2**) in the Lake Macquarie Local Government Area (LGA). The Development Footprint covers an area of approximately 15.1 hectares and is surrounded by generally intact buffer lands of the power station.

The NSW Department of Planning and Environment (DPE) has confirmed that the Proposed Modification will be assessed under the former Section 75W of the *Environment Planning and Assessment Act 1979* (EP&A Act). As the Proposed Modification seeks to modify a major project approval it requires a Biodiversity Assessment Method (BAM) assessment under the *Biodiversity Conservation Act 2016*.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of AECOM to assess the potential biodiversity impacts of the Proposed Modification in accordance with the BAM.

1.1 The Proposed Modification

The Proposed Modification of the existing approval (07_0084) is shown on **Figure 1.2** and includes the following:

- Amendment of the ash deposition strategy, including
 - Combination of beaching and ash terrace deposition methods
 - Construction of new decant infrastructure associated with ash terraces
- Establishment of the Western Emplacement Area to enable ash deposition to RL140 within existing operational areas, requiring
 - Construction of a western saddle embankment
 - Reconfiguration of RL140 Access Road
 - Filling of Mine Voids underlying the Eraring Ash Dam
- Upgrades to ancillary infrastructure including
 - Stormwater diversion systems
 - Ash delivery line re-configuration and
- Decommissioning of bottom ash recycling infrastructure.

1.2 Purpose and Scope of this Report

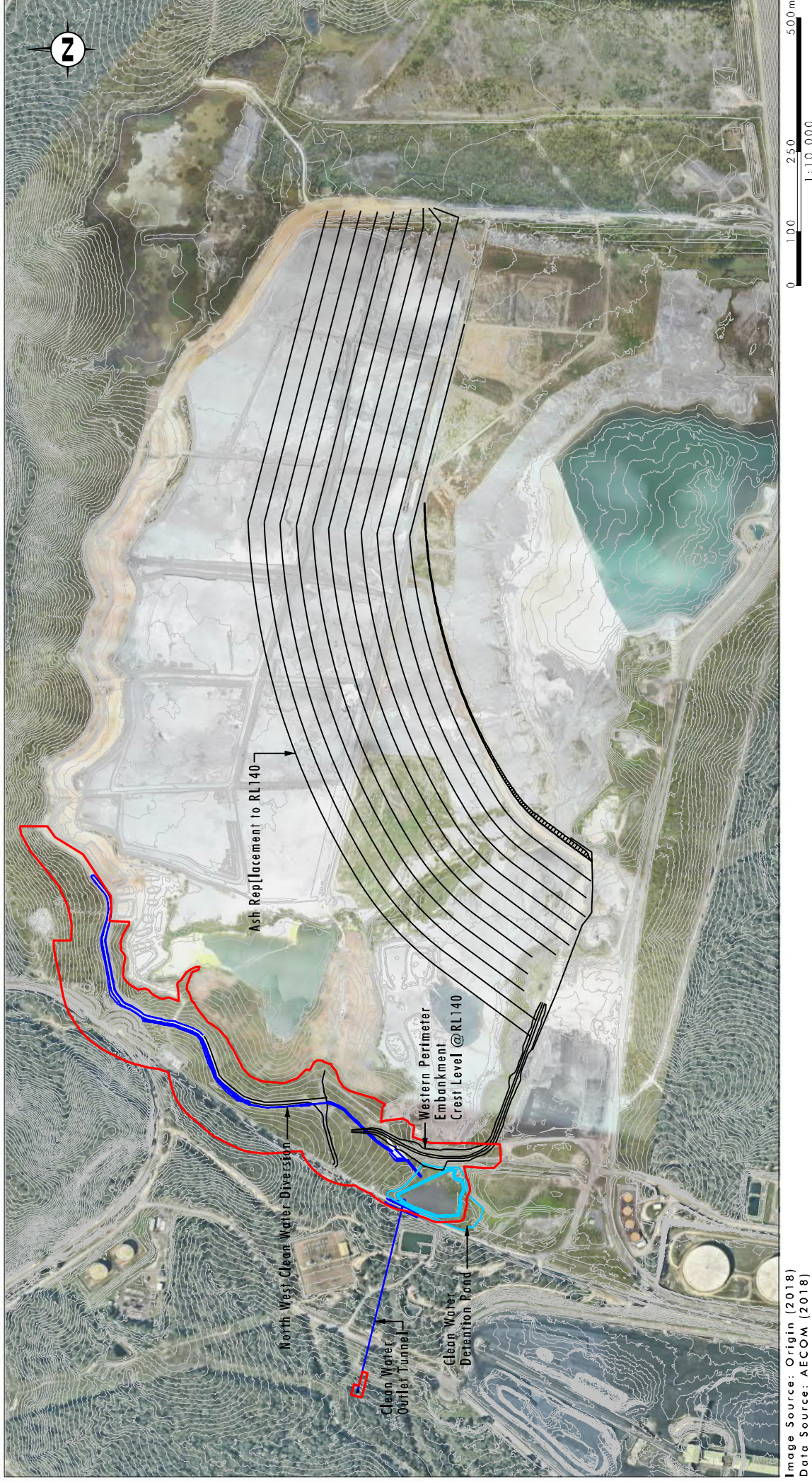
This report provides the findings of the Biodiversity Assessment of the Proposed Modification. It addresses the specific requirements of the BAM (OEH 2017a) which applies to all proposed modifications to major projects.



Legend

Development Footprint (Outside Existing Disturbed Areas)

FIGURE 1.1
Locality Plan



Legend

- ▬ Development Footprint (Outside Existing Disturbed Areas)

FIGURE 1.2

The Project - Overview

1.3 Development Footprint Information

The Development Footprint will be subjected to a range of disturbances as described in **Section 1.1** and **Section 5.0**.

The Development Footprint comprises remnant vegetation within the Eraring Power Station adjacent to existing disturbances including an ash dam, access tracks and roads and power line easements. Intact vegetation is generally in moderate to good condition with other disturbed areas dominated by exotic plant species.

Table 1.1 Development Footprint Location in the Landscape

Development Footprint Location in the Landscape	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Wyong
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
LGA	Lake Macquarie
Development Footprint Size	15.36 hectares
Assessment Type	Site-based
Lot and DP	Lot 11 DP1050120 Lot 1 DP 1109558 Lot 51 DP 840671

1.4 Local Ecological Context

The Development Footprint is located in the west of the Lake Macquarie region (refer to **Figure 1.3** and **Figure 1.4**). The locality is occupied by rural landscapes and residential areas associated with Dora Creek, Eraring, Myuna Bay and Rathmines with substantial areas of intact vegetation associated with buffer land associated with the Eraring Power Station. Key land uses around the Development Footprint include rural and residential areas, infrastructure, transport routes and open space. The M1 Pacific Motorway and Main Northern Railway are located to the west of the Development Footprint providing public transport routes northward and southward along the NSW coast but also contributing to fragmentation and barriers to fauna movement.

Where there is remnant native vegetation in the locality, a number of Threatened Ecological Communities (TECs) are known to occur including *Coastal Saltmarsh*, *Swamp Sclerophyll Forest on Coastal Floodplains*, *Freshwater Wetlands on Coastal Floodplains*, *Swamp Oak Floodplain Forest* and *River-flat Eucalypt Forest* all listed as endangered ecological communities (EECs) under the BC Act (refer to **Figure 1.5**). Where there is suitable habitat a range of threatened flora species are known to occur in the wider locality including Charmhaven apple (*Angophora inopina*), black-eyed Susan (*Tetradlea juncea*) small flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and biconvex paperbark (*Melaleuca biconvexa*) all listed as vulnerable under the BC and EPBC Acts (OEH 2018a). Records of threatened fauna species occur around the locality usually associated with the intact vegetated areas associated with Watagans National Park, Olney State Forest and Heaton State Forest and the Eraring Power Station buffer lands. This includes powerful owl (*Ninox strenua*), squirrel glider (*Petaurus norfolcensis*) and yellow-bellied glider (*Petaurus australis*) (OEH 2018a).



Image Source: Nearmap (Apr 2018), Origin (2018)
Data Source: AECOM (2018), Department of Finance, Services & Innovation (2018)

0 0.5 1.0 1.25 km
1:25 000

Legend

- ▬ Development Footprint (Outside Existing Disturbed Areas)
- ▬ 1500m Buffer Area
- ▬ Cadastre
- ▬ Drainage Line

FIGURE 1.3

Site Map

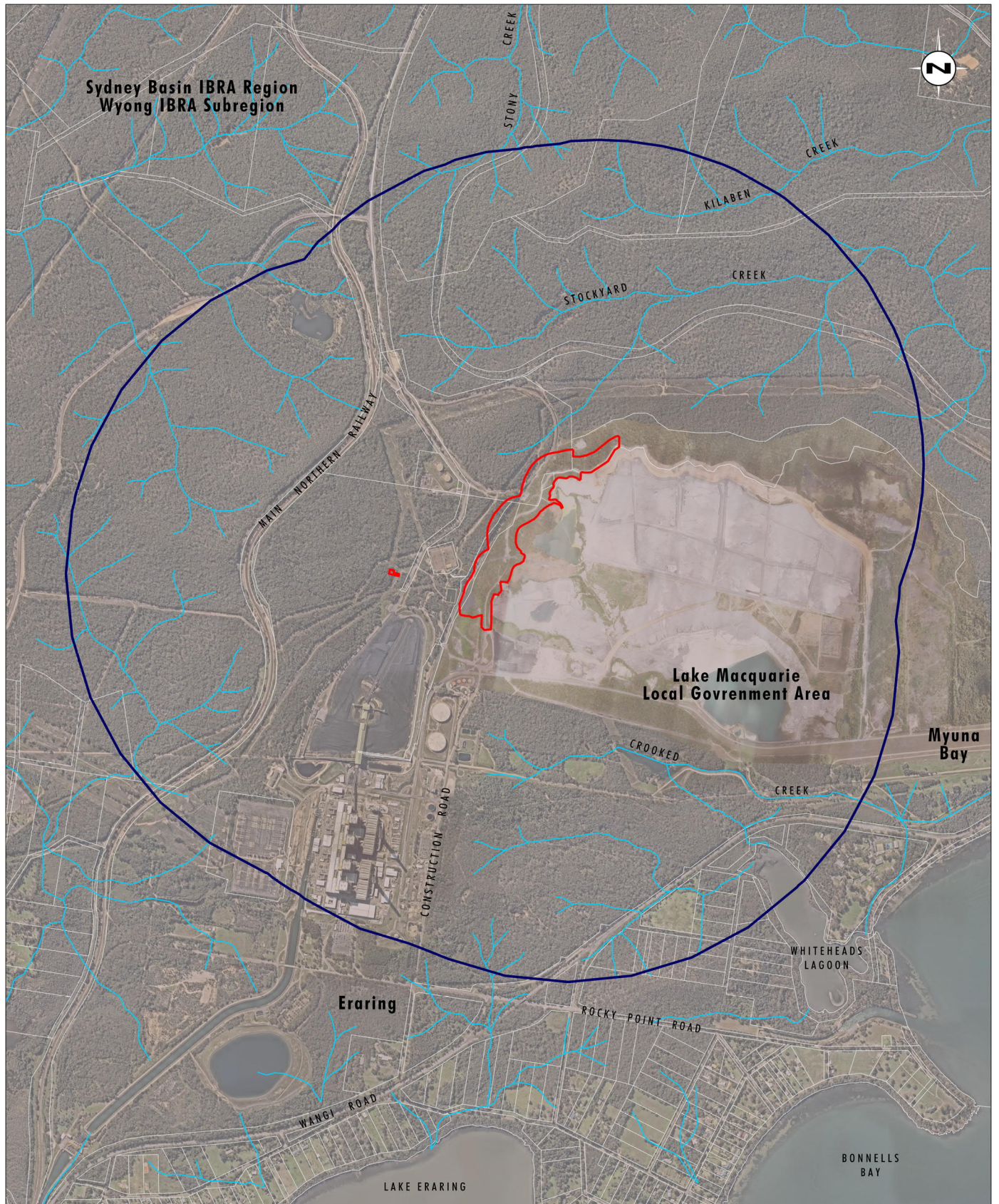


Image Source: Nearmap (Apr 2018), Origin (2018)
 Data Source: AECOM (2018), Department of Finance, Services & Innovation (2018),
 Australian Government Department of the Environment (2012), Commonwealth of
 Australia (2016)

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Legend

- Development Footprint (Outside Existing Disturbed Areas)
- 1500m Buffer Area
- Lake Macquarie City Council Local Government Area
- Cadastre
- Drainage Line

FIGURE 1.4

Location Map - IBRA Regions/Subregions
 and Local Government Area

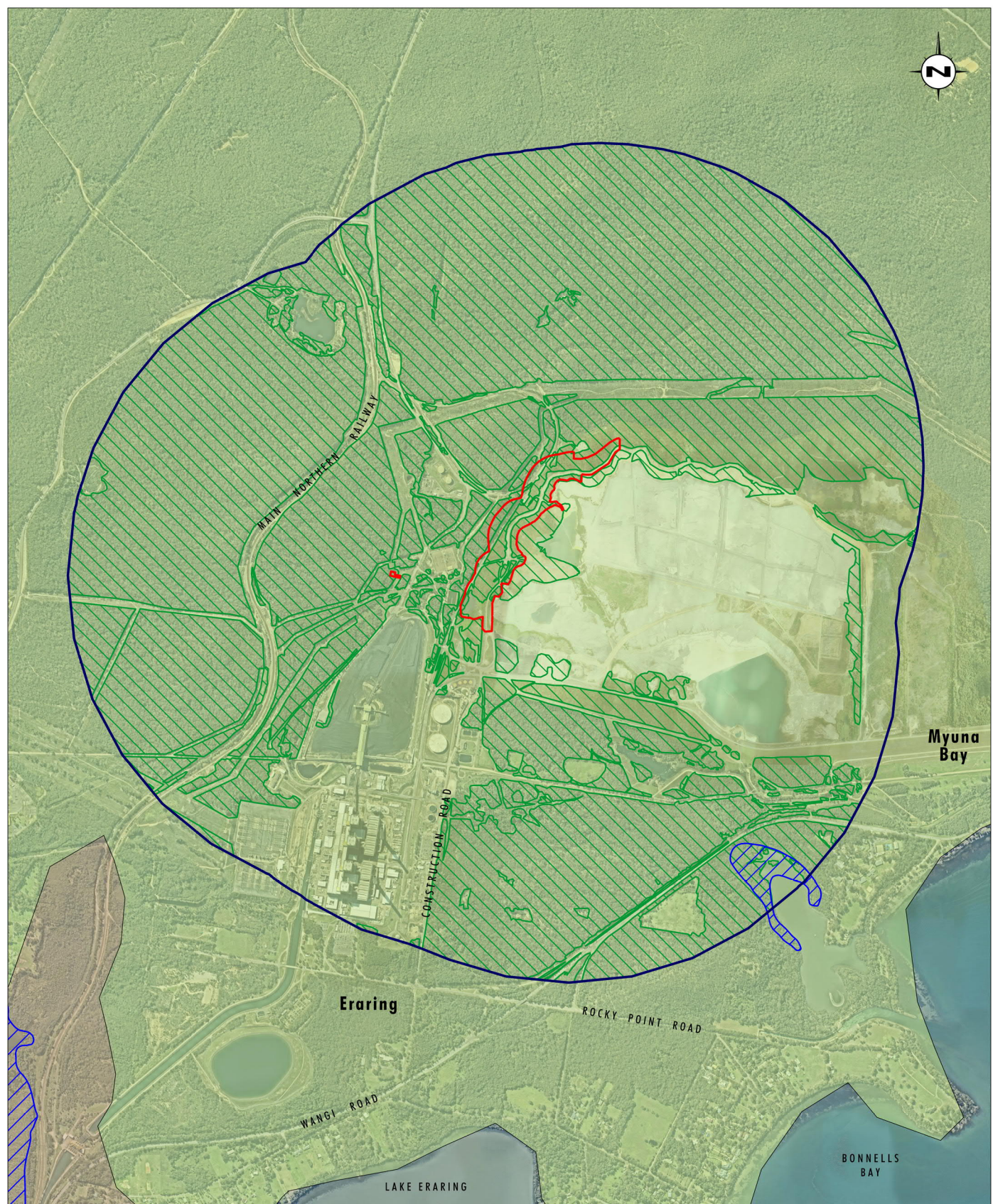


Image Source: Nearmap (Apr 2018), Origin (2018)
 Data Source: AECOM (2018), OEH (2017), Department of Planning and Environment (2017)

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 1:25 000

Legend

- Development Footprint (Outside Existing Disturbed Areas)
- 1500m Buffer Area
- Native Vegetation
- SEPP 14 Wetland
- Mitchell Landscapes:
- Gosford-Cooranbong Coastal Slopes
- Sydney-Newcastle Coastal Alluvial Plains

FIGURE 1.5

Location Map - Landscape Features

1.5 Key Resources, Policies and Documents

The following key resources, policies and documents were used during the preparation of this BDAR for the Proposed Modification:

- Biodiversity Assessment Method Order 2017
- Biodiversity Assessment Method Operational Manual (Stage 1)
- Biodiversity Assessment Calculator
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities –Working Draft (DEC 2004)
- BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2018a), accessed June 2018
- Threatened Biodiversity Data Collection (TBDC) (OEH 2018b), accessed June 2018
- Vegetation Information System (VIS) Classification Database (OEH 2018c), accessed June 2018
- NSW Guide to Surveying Threatened Plants (OEH 2016) and
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (DoEE 2018), accessed June 2018.

1.6 Report Preparation

This BDAR was prepared by Kate Connolly (Principal Ecologist), with review and technical direction from Shaun Corry (Principal Ecologist) and Allison Riley (NSW Ecology Manager). Field surveys were undertaken by a range of Umwelt ecologists including Shaun Corry and Allison Riley.

Table 1.2 below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the Project.

Table 1.2 Accredited BAM Assessors and their Role on this Project

Name	Assessor ID	Role
Allison Riley <i>NSW Ecology Manager</i>	BAAS17042	Review and technical direction Field surveys
Shaun Corry <i>Principal Ecologist</i>	BAAS17041	BAM calculator application Field surveys
Kate Connolly <i>Principal Ecologist</i>	BAAS17005	BDAR preparation

2 Methods

2.1 Landscape Features and Site Context

Landscape features such as IBRA bioregions, IBRA subregions and NSW Mitchell Landscape regions, native vegetation extent within a 1500m buffer area, cleared areas, rivers, streams, wetlands and connectivity features were identified within the Development Footprint where appropriate in accordance with Section 4.2 of the BAM (OEH 2017a).

Determining the 'Site Context' of the Development Footprint is calculated by assessing the native vegetation cover and patch size within the Development Footprint in accordance with Section 4.3 of the BAM (OEH 2017a).

2.2 Native Vegetation Assessment

2.2.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. The information obtained was used to inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species, endangered populations (EPs) and TECs.

Relevant documents included:

- Vegetation Mapping of Eraring Power Station (Bell 2007)
- Vegetation Mapping of Lake Macquarie LGA: Stages 1-3 (Bell and Driscoll 2012)
- Threatened Biodiversity Data Collection (OEH 2018b) reporting for known/predicted threatened communities in the Wyong IBRA subregion
- VIS Classification Database (OEH 2018c), accessed June 2018
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs, accessed June 2018.

2.2.2 Floristic and Vegetation Integrity Survey

Floristic and vegetation integrity surveys were undertaken over the following survey periods:

- 13 September 2017
- 27 and 28 September 2017
- 6, 21 and 25 June 2018
- 16 to 18 July 2018

A total of four BAM plots and one rapid vegetation assessments were conducted within the Development Footprint during the surveys undertaken for this assessment (refer to **Figure 2.1**). Floristic and vegetation integrity data was collected in accordance with minimum requirements under the BAM (OEH 2017a).

Table 2.1 outlines the floristic survey effort in the Development Footprint.

Table 2.1 Adequacy of Floristic and Vegetation Integrity Survey in the Development Footprint

Veg. Zone	Plant Community Type (PCT) <i>Condition Class</i>	Area in the Development Footprint (ha)	Number of Floristic and Vegetation Integrity Plots	
			Required	Completed
1	1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Good Condition</i>	0.95	1	1
2	1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast <i>Good Condition</i>	8.00	3	3
-	Exotic Vegetation	0.43	0	0
-	Other/cleared/waterbody	5.69	0	0
TOTAL		15.07	4	4

At each floristic and vegetation integrity plot, data was recorded according to Section 5 of the BAM (OEH 2017a). This involved setting out 20 x 50 m, 20 x 20 m and 1 x 1m plots. The location of each plot was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used.

At each plot/transect, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of any shrub, mid-storey, canopy and emergent layers were also thoroughly examined.

For each flora species recorded in the plot, the following data was collected in accordance with Table 2 of the BAM (OEH 2017a):

- stratum/layer in which the species occurs
- growth form
- scientific name and common name
- cover and
- abundance.

At each vegetation integrity plot the following attributes were recorded in accordance with the BAM (OEH 2017a) to determine the condition of the vegetation zone:

- **Composition** - native plant species richness by growth form (within the 20 x 20 m plot)
- **Structure** – estimate foliage cover of native and exotic species by growth form (within the 20 x 20 m plot)
- **Function** (within the 20 x 50 m plot) including, number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five 1 x 1 m plots), number of trees with hollows and high threat exotic cover.

2.2.3 Meandering Transects

Meandering transects were walked across much of the Development Footprint. Opportunistic sampling of vegetation was undertaken along these transects, particularly searches for threatened and otherwise significant species, endangered populations and TECs. Meandering transects enable floristic sampling across a much larger area than plot-based survey, especially where the number of plots is limited. Records along transects supplemented floristic sampling carried out in plots, however, the data collected are in the form of presence records, rather than semi-quantitative cover abundance scores.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Development Footprint.

2.2.4 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping of the Development Footprint.

Vegetation communities in the Development Footprint were mapped on-screen overlaying the May 2018 high resolution aerial photographs provided by Origin. Mapping was undertaken using the Manifold System 8.0 GIS and ESRI ArcMaps 10.6.

2.2.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within plots and on meandering transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2018).

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

2.2.6 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of PCTs (OEH 2018) and plant communities as described by Bell (2007 and 2015).
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data, and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

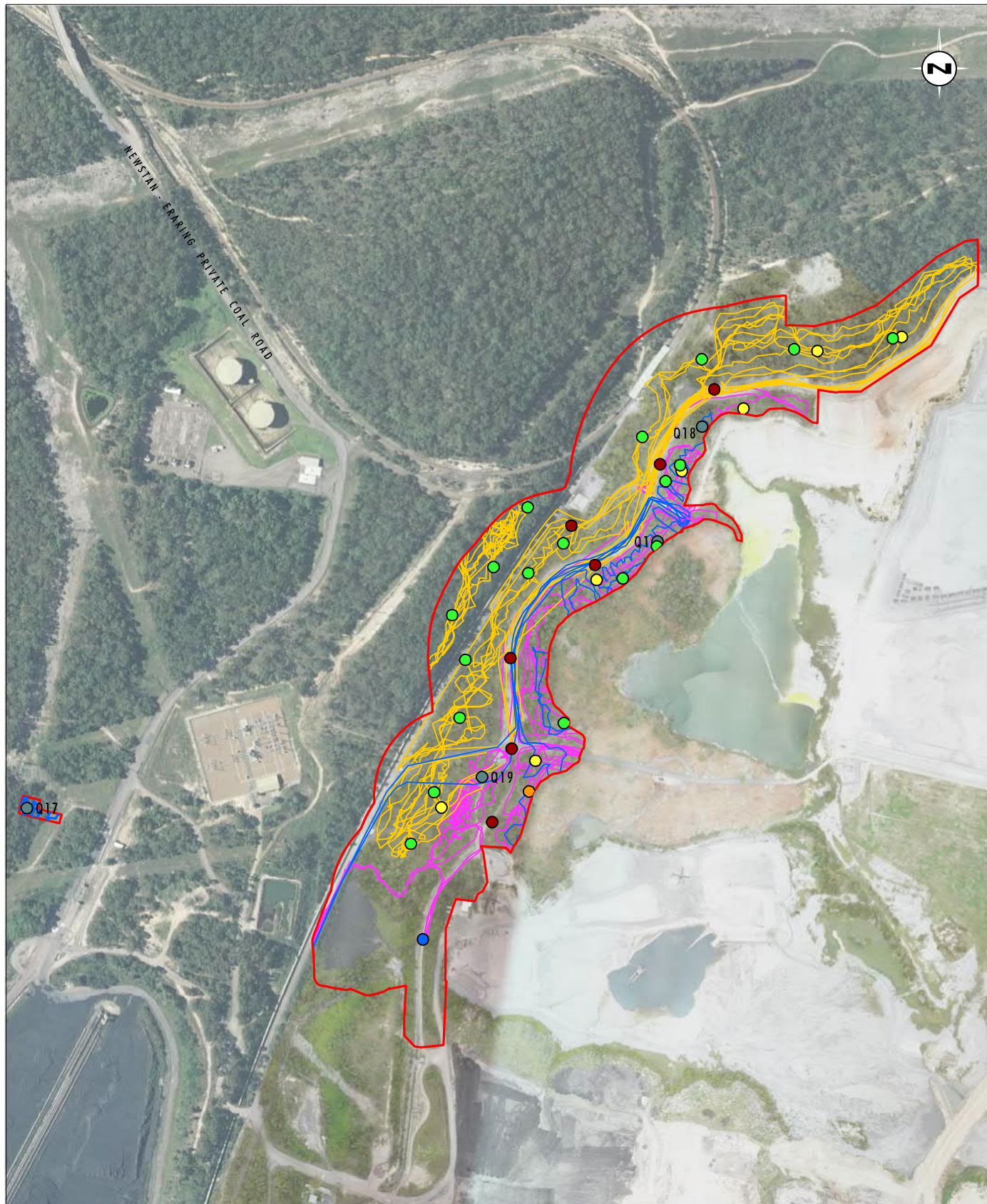


Image Source: Origin (2018)
Data Source: AECOM (2018)

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1:6000

Legend

- Development Footprint (Outside Existing Disturbed Areas)
- BAM Plot Location
- Rapid Assessment Location
- Anabat
- Koala SAT
- Owl Auditory Survey Point
- Remote Camera
- Targeted Survey Tracks - July
- Targeted Survey Tracks - October
- Targeted Survey Tracks - December

FIGURE 2.1
Survey Effort

2.2.7 Threatened Ecological Community Delineation Techniques

Where applicable, vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic plot assessments and meandering surveys to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of ‘important species’ as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth Department of Environment and Energy (DoEE) and the NSW OEH
- comparison with other assessments of TECs in the region.

2.2.8 Plant Community Type (PCT) Allocation

Each of the vegetation communities described within the Development Footprint were aligned with an equivalent PCT as detailed in the VIS Classification Database (OEH 2018c). For each vegetation community described in the Development Footprint, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCT were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Further detail regarding this allocation for individual PCT is outlined in **Section 3.2.1**.

2.3 Threatened Species

2.3.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included ecological reports, previous ecological surveys undertaken in the vicinity of the Development Footprint and also relevant ecological database searches. The information obtained was used to inform survey design where required, and was also used to assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents and resources included:

- OEH BioNet Atlas of NSW Wildlife database and mapping tool (OEH 2018a), accessed June 2018
- OEH Threatened Biodiversity Data Collection (OEH 2018b) for known/predicted threatened species in the Wyong IBRA subregion, accessed June 2018
- PlantNET (Botanic Gardens Trust) database search for threatened plants within a 10 kilometre radius search from Eraring, accessed June 2018
- DoEE Protected Matters Search Tool (DoEE 2018) for known/predicted EPBC Act-listed species, accessed June 2018.

A preliminary assessment using the TBDC was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TBDC review were used to design the appropriate survey requirements for species-credit species.

2.3.2 Ecosystem-credit Species

Ecosystem-credit species are those threatened species that can be predicted by vegetation surrogates and landscape features. Ecosystem-credit species are not required to be specifically targeted during field surveys, however an assessment of the suitability of habitat in the Development Footprint is undertaken to determine the species presence or otherwise in the vegetation zones identified.

Appendix A outlines the ecosystem credit species predicted by the BAM calculator or identified in the literature review.

2.3.3 Species-credit Species

Targeted and opportunistic surveys and walking transects for species-credit species were undertaken across the Development Footprint (refer to **Figure 2.1**). **Table 2.2** below outlines the dates, methods and species targeted during the surveys.

Table 2.2 Species credit species survey methodology and timing

Survey Date	Method	Species Targeted
13, 27 and 28 September 2017	BAM floristic surveys	NA
	Threatened species transects Opportunistic observations and habitat assessments	<i>Acacia bynoeana</i> <i>Angophora inopina</i> <i>Burhinus grallarius</i> <i>Caladenia tessellata</i> <i>Callistemon linearifolius</i> <i>Cynanchum elegans</i> <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (endangered population) <i>Genoplesium insigne</i> <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Haliaeetus leucogaster</i> <i>Hieraaetus morphnoides</i> <i>Lophoictinia isura</i> <i>Melaleuca biconvexa</i> <i>Pandion cristatus</i> <i>Rutidosia heterogama</i> <i>Tetratheca juncea</i>

Survey Date	Method	Species Targeted
12 October 2017	Targeted threatened species transects and habitat mapping	<i>Acacia bynoeana</i> <i>Angophora inopina</i> <i>Burhinus grallarius</i> <i>Caladenia tessellata</i> <i>Callistemon linearifolius</i> <i>Callocephalon fimbriatum</i> <i>Cynanchum elegans</i> <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (endangered population) <i>Genoplesium insigne</i> <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Hieraaetus morphnoides</i> <i>Lophoictinia isura</i> <i>Macropus parma</i> <i>Melaleuca biconvexa</i> <i>Pandion cristatus</i> <i>Pteropus poliocephalus</i> <i>Tetratheca juncea</i>
5 to 13 December 2017	Micro-bat echolocation recording Nocturnal searches Remote camera Hollow bearing tree analysis Threatened species transects	<i>Cryptostylis hunteriana</i> <i>Acacia bynoeana</i> <i>Angophora inopina</i> <i>Burhinus grallarius</i> <i>Callistemon linearifolius</i> <i>Callocephalon fimbriatum</i> <i>Cercartetus nanus</i> <i>Chalinolobus dwyeri</i> <i>Crinia tinnula</i> <i>Cryptostylis hunteriana</i> <i>Cynanchum elegans</i> <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (endangered population) <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Haliaeetus leucogaster</i> <i>Hoplocephalus bitorquatus</i>

Survey Date	Method	Species Targeted
		<i>Hoplocephalus stephensii</i> <i>Litoria aurea</i> <i>Lophoictinia isura</i> <i>Macropus parma</i> <i>Maundia triglochoides</i> <i>Melaleuca biconvexa</i> <i>Miniopterus australis</i> <i>Miniopterus schreibersii oceanensis</i> <i>Myotis macropus</i> <i>Ninox connivens</i> <i>Petaurus norfolkensis</i> <i>Phascogale tapoatafa</i> <i>Phascolarctos cinereus</i> <i>Pseudophryne australis</i> <i>Pteropus poliocephalus</i> <i>Rutidosia heterogama</i> <i>Tetratheca juncea</i> <i>Uperoleia mahonyi</i> <i>Vespadelus troughtoni</i> <i>Uperoleia mahonyi</i>
6, 21, 25 and 27 June 2018	BAM floristic surveys	NA
	Walking transects Opportunistic observations and habitat assessments Gang gang cockatoo and glossy black-cockatoo survey (breeding habitat) Nocturnal searches Stag watching and auditory surveys for large forest owls	<i>Angophora inopina</i> <i>Burhinus grallarius</i> <i>Crinia tinnula</i> <i>Cynanchum elegans</i> <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> - endangered population <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Lathamus discolour</i> <i>Macropus parma</i> <i>Melaleuca biconvexa</i> <i>Ninox connivens</i> <i>Ninox strenua</i> <i>Pandion cristatus</i>

Survey Date	Method	Species Targeted
		<i>Petaurus norfolkensis</i> <i>Phascogale tapoatafa</i> <i>Phascolarctos cinereus</i> <i>Pseudophryne australis</i> <i>Rutidosia heterogama</i> <i>Tyto novaehollandiae</i>
16 to 19 July 2018	BAM floristic surveys	NA
	Nocturnal searches Remote camera Hollow bearing tree analysis Threatened species transects Koala SAT surveys	<i>Angophora inopina</i> <i>Burhinus grallarius</i> <i>Calyptorhynchus lathamii</i> <i>Crinia tinnula</i> <i>Cynanchum elegans</i> <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> - endangered population <i>Grevillea parviflora</i> subsp. <i>parviflora</i> <i>Haliaeetus leucogaster</i> <i>Lathamus discolor</i> <i>Macropus parma</i> <i>Melaleuca biconvexa</i> <i>Ninox connivens</i> <i>Ninox strenua</i> <i>Pandion cristatus</i> <i>Petaurus norfolkensis</i> <i>Phascogale tapoatafa</i> <i>Phascolarctos cinereus</i> <i>Pseudophryne australis</i> <i>Rutidosia heterogama</i> <i>Tetratheca juncea</i> <i>Tyto novaehollandiae</i>

Species-credit surveys considered the following survey guidelines:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC 2004)
- *NSW Guide to Surveying Threatened Plants* (OEH 2016)
- *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC 2009)
- *Flora and Fauna Survey Guidelines - Version 4.2* (LMCC 2012)
- *Lake Macquarie City Council Flora and Fauna Survey Guidelines for T. juncea* (LMCC 2014)
- *Draft Survey Guidelines for Australia's Threatened Orchids* (DoE 2013).

Appendix B outlines the species-credit species predicted by the BAM calculator or identified in the literature review and the targeted survey effort undertaken in accordance with BAM survey requirements.

Appendix B also notes where species-credit species were not considered to require further survey in accordance with Section 6.4 (Step 3) of the BAM (2017).

2.3.4 Weather Conditions and Limitations

Table 2.3 below outlines the weather conditions for the surveys. Data is derived from the Lake Macquarie weather station in Cooranbong (061412) from the Bureau of Meteorology (2018).

Table 2.3 Weather Conditions for Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp.	Rainfall	Relative Humidity	Min-Max Temp (mean)	Rainfall (total)	Relative Humidity (mean)
13 September 2017	8.8-33.9	0mm	13%	6.0-25.0	12.4mm	30%
27 September 2017	10.2-23.9	0mm	61%			
28 September 2017	13.9-27.2	0mm	27%			
12 October 2017	19.3-31.5	0.6mm	39%	13.0-24.8	138.4mm	60%
4 December 2017	14.9-21.1	0mm	92%	17.3-29.4	52.0mm	56%
5 December 2017	16.9-25.0	8.6mm	61%			
6 December 2017	15.0-27.0	0mm	44%			
7 December 2017	12.1-33	2.8mm	49%			
13 December 2017	14.7-29.8	0mm	69%			
6 June 2018	9.0-17.1	2.6mm	97%	1.4-20.5	123.4mm	83%
21 June 2018	11.4-15.7	2.8mm	91%			
25 June 2018	1.6-18.5	0.2mm	98%			
27 June 2018	4.3-18.5	0.2mm	98%			
16 July 2018	-3.4-18.0	0	85	2.9-19.3	1.2mm	76%
17 July 2018	3.1-21.7	0.2	63			
18 July 2018	1.5-22.9	0	73			

The surveys were influenced by seasonal factors as the survey was primarily conducted during spring and summer. The use of the same surveyor for all surveys helped to minimise observer bias which may occur when surveys are conducted by more than one surveyor.

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens are forwarded to the National Herbarium of New South Wales if they were considered to be of potential significance or importance.

3 Results

3.1 Landscape Value

The buffer area contains a range of landscape features typical of the landscapes around western Lake Macquarie. These landscape features are shown in **Figure 1.4** to **1.5** and outlined in relation to the Development Footprint in **Table 3.1** below.

Table 3.1 Landscape Features in the Development Footprint

Landscape Features	
IBRA Bioregion	Sydney Basin
IBRA Subregion	Wyong
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
Rivers, Streams, Estuaries	No Strahler streams in the Development Footprint
Wetlands (within, adjacent to and downstream)	Lake Macquarie Coastal Wetlands - NSW189 (2km to the southeast) SEPP 14 Wetland 882a (1km to the southeast)
Native Vegetation Cover	756 hectares in the 1500m buffer area (63%)
Areas of Geological Significance or Soil Hazard Features	None identified
Areas of Outstanding Biodiversity Value	None identified
Cleared Areas	10.4 hectares within the Development Footprint
Connectivity Features	Not identified within a Priority Investment Area (OEH 2017). Not identified as an important flyway for migratory species. Lake Macquarie City Council corridor mapping indicates that vegetation on the Development Footprint contains native vegetation that contributes significantly to movement and viability of flora and fauna in the LGA (LMCC 2015).

3.2 Native Vegetation within the Development Footprint

3.2.1 Plant Community Types and Vegetation Zones

Surveys of the Development Footprint identified two Plant Community Types (PCTs) across one condition class being (refer to **Figure 3.1**):

- PCT1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast - Good Condition

- PCT1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast - Good Condition.

A description of the vegetation zones is outlined below and a flora species list is included in **Appendix C**.

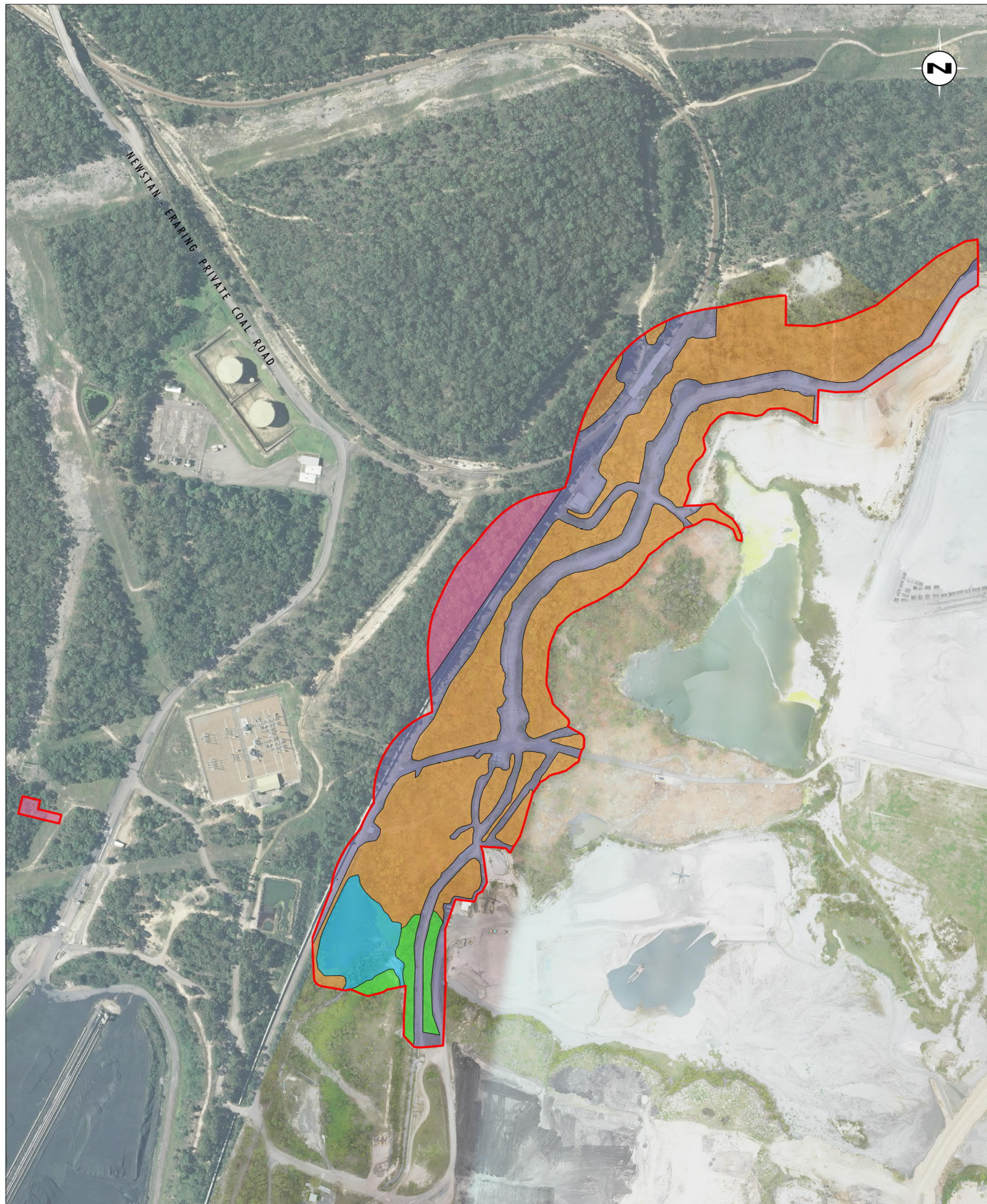


Image Source: Origin (2018)
Data Source: AECOM (2018)

0 100 200 300 m
1:6000


Legend

- Development Footprint (Outside Existing Disturbed Areas)
- 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast - Good Condition
- 1636 - Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast - Good Condition
- Cleared
- Constructed Waterbody
- Non-native vegetation

FIGURE 3.1


**Vegetation Zones in the
Disturbance Footprint**

Zone 1 – PCT 1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast

PCT Name	Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	
Condition	Good	
Formation	Dry Sclerophyll Forests (Shrubby sub-formation)	
Class	Sydney Coastal Dry Sclerophyll Forests	
Percent cleared	9.00	
Area in Development Footprint (ha)	0.95	
Patch Size Class (ha)	101	
General Description	Occurs on the lower slopes of the project area (refer to Figure 3.1). Has been subject to previous clearing (young tree cohort) and a recent fire.	
Canopy Description	Mid-dense canopy dominated by Sydney Red Gum (<i>Angophora costata</i>) and Sydney peppermint (<i>Eucalyptus piperita</i>). Scattered red bloodwood (<i>Corymbia gummifera</i>) occurred outside the plot)	
Mid-storey Description	<p>A mid-dense to dense midstorey dominated by flax-leaved paperbark (<i>Melaleuca linariifolia</i>) and forest oak (<i>Allocasuarina torulosa</i>), with occurrences of hairpin banksia (<i>Banksia spinulosa</i> var. <i>collina</i>) and <i>Acacia longifolia</i>.</p> <p>Dominant shrub species included tautoon (<i>Leptospermum polygalifolium</i>) and cheese tree (<i>Glochidion ferdinandi</i>).</p>	
Ground Cover Description	<p>This vegetation zone was characterised by a diverse and dense ground layer of ferns, sedges and sub-shrubs. Common species included rainbow fern (<i>Calochlaena dubia</i>), bracken (<i>Pteridium esculentum</i>), tall sedge (<i>Carex appressa</i>), tall saw-sedge (<i>Gahnia clarkei</i>), narrow-leaved palm lily (<i>Cordyline stricta</i>), blueberry lily (<i>Dianella longifolia</i>), blue flax-lily (<i>Dianella caerulea</i> var. <i>producta</i>), and common maidenhair (<i>Adiantum aethiopicum</i>).</p> <p>Native grasses included Australian basket grass (<i>Oplismenus aemulus</i>), wiry panic (<i>Entolasia stricta</i>) and weeping grass (<i>Microlaena stipoides</i>).</p>	

PCT Name	Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
Condition	Good
PCT Allocation	Vegetation Zone 1 was aligned with PCT1627 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (OEH 2017c). Its canopy is dominated by Sydney red gum (<i>Angophora costata</i>) and Sydney peppermint (<i>Eucalyptus piperita</i>), while tautoon (<i>Leptospermum polygalifolium</i>) dominates the shrub layer within the middle stratum. Both of these are key diagnostic species of PCT1627. The ground stratum further contains 50% of the species listed on the VIS Classification Database (OEH 2017c). PCT1627 was determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape. In addition, this PCT was mapped as MU 11 – Coastal Sheltered Apple-Peppermint Forest in the Lake Macquarie City Council Vegetation Community Map (Bell 2015) and was assigned to PCT 1627 as part of that mapping process.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

Zone 2 – PCT 1636 Scribbly Gum - Red Bloodwood - *Angophora inopina* heathy woodland on lowlands of the Central Coast

PCT Name	Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast	
Condition	Good	
Formation	Dry Sclerophyll Forests (Shrubby sub-formation)	
Class	Sydney Coastal Dry Sclerophyll Forests	
Percent cleared	58.00	
Area in Development Footprint (ha)	8.00	
Patch Size Class (ha)	101	
General Description	Occurred on the lower slopes across the project area (refer to Figure 3.1).	
Canopy Description	Sparse to mid-dense canopy dominated by broad-leaved scribbly gum (<i>Eucalyptus haemastoma</i>), red bloodwood (<i>Corymbia gummifera</i>) and brown stringybark (<i>Eucalyptus capitellata</i>), with occurrences of Sydney red gum (<i>Angophora costata</i>).	
Mid-storey Description	A sparse to mid-dense midstorey dominated by forest oak (<i>Allocasuarina torulosa</i>), hairpin banksia (<i>Banksia spinulosa</i>), old-man banksia (<i>Banksia serrata</i>) and Acacia longifolia. Dominant shrub species included mountain devil (<i>Lambertia formosa</i>), tantoon (<i>Leptospermum polygalifolium</i>), Xanthorrhoea latifolia, slender tea-tree (<i>Leptospermum trinervium</i>), crinkle bush (<i>Lomatia silaifolia</i>) and narrow-leaved geebung (<i>Persoonia linearis</i>).	
Ground Cover Description	This vegetation zone was characterised by a diverse and dense ground layer of ferns, sedges, herbs and sub-shrubs. Common species included <i>Lomandra obliqua</i> , variable sword-sedge (<i>Lepidosperma laterale</i>), blue flax-lily (<i>Dianella caerulea</i>), common maidenhair (<i>Adiantum aethiopicum</i>) and silky purple-flag (<i>Patersonia sericea</i>). Black-eyed susan (<i>Tetradlea juncea</i>) individuals were also present in this zone. Native grasses included kangaroo grass (<i>Themeda australis</i>), wiry panic (<i>Entolasia stricta</i>), threeawn speargrass (<i>Aristida vagans</i>), blady grass (<i>Imperata cylindrical</i>) and bushy hedgehog-grass (<i>Echinopogon caespitosus</i>).	

PCT Name	Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast
Condition	Good
PCT Allocation	Vegetation Zone 2 was aligned with PCT1636 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (OEH 2017c). It is dominated by broad-leaved scribbly gum (<i>Eucalyptus haemastoma</i>) and red bloodwood (<i>Corymbia gummifera</i>) which are two of the three positive diagnostic species occurring in the canopy. Further, the middle stratum contains 60% of the species listed on the VIS Classification Database (OEH 2017c), with the ground stratum containing the diagnostic species kangaroo grass (<i>Themeda australis</i>). PCT1636 was determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape. In addition, this PCT was mapped as MU 31 – Coastal Plains Scribbly Gum Woodland in the Lake Macquarie City Council Vegetation Community Map (Bell 2015) and was assigned to PCT 1636 as part of that mapping process.
BC Act Status	This vegetation zone is not consistent with any TEC listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TEC listed under the EPBC Act.

3.2.2 Exotic Vegetation

The Development Footprint contains a range of exotic vegetation, including dense monocultures of woody weeds and exotic grasses (refer to **Plate 3.1**). The most abundant exotic species present include castor oil plant (*Ricinus communis*), Rhodes grass (*Chloris gayana*), pampas grass (*Cortaderia selloana*), whisky grass (*Andropogon virginicus*) and lantana (*Lantana camara*), which dominate the native vegetation in some areas. Other exotic species present include crofton weed (*Ageratina adenophora*), fireweed (*Senecio madagascariensis*), camphor laurel (*Cinnamomum camphor*), cobbler's pegs (*Bidens pilosa*), wild tobacco bush (*Solanum mauritianum*) and Bitou (*Chrysanthemoides monilifera*). A number of weeds present in the Development Footprint are classed as High Threat Weed species under the BAM, and are identified in the flora species list in **Appendix C**.



Plate 3.1 Exotic vegetation in the Development Footprint

© Umwelt, 2018

3.2.3 Threatened Ecological Communities

No threatened ecological communities were recorded within the Development Footprint.

3.2.4 Vegetation Integrity Score

Table 3.2 below details the vegetation integrity scores for each of the vegetation zones in the Development Footprint. The vegetation integrity data for each of the vegetation zones is provided in **Appendix D**.

Table 3.2 Vegetation Zone Vegetation Integrity Scores

Veg Zone	PCT Name	Composition	Structure	Function	Current Vegetation Integrity Score
1	1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Good Condition</i>	64.2	75.6	46.9	61.1
2	1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast <i>Good Condition</i>	65.1	64.9	97.7	74.4

3.3 Threatened Species within the Development Footprint

3.3.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they are considered likely to occur in the vegetation zones within the Development Footprint is provided in **Appendix A**. Threatened species records are shown on **Figure 3.2**.

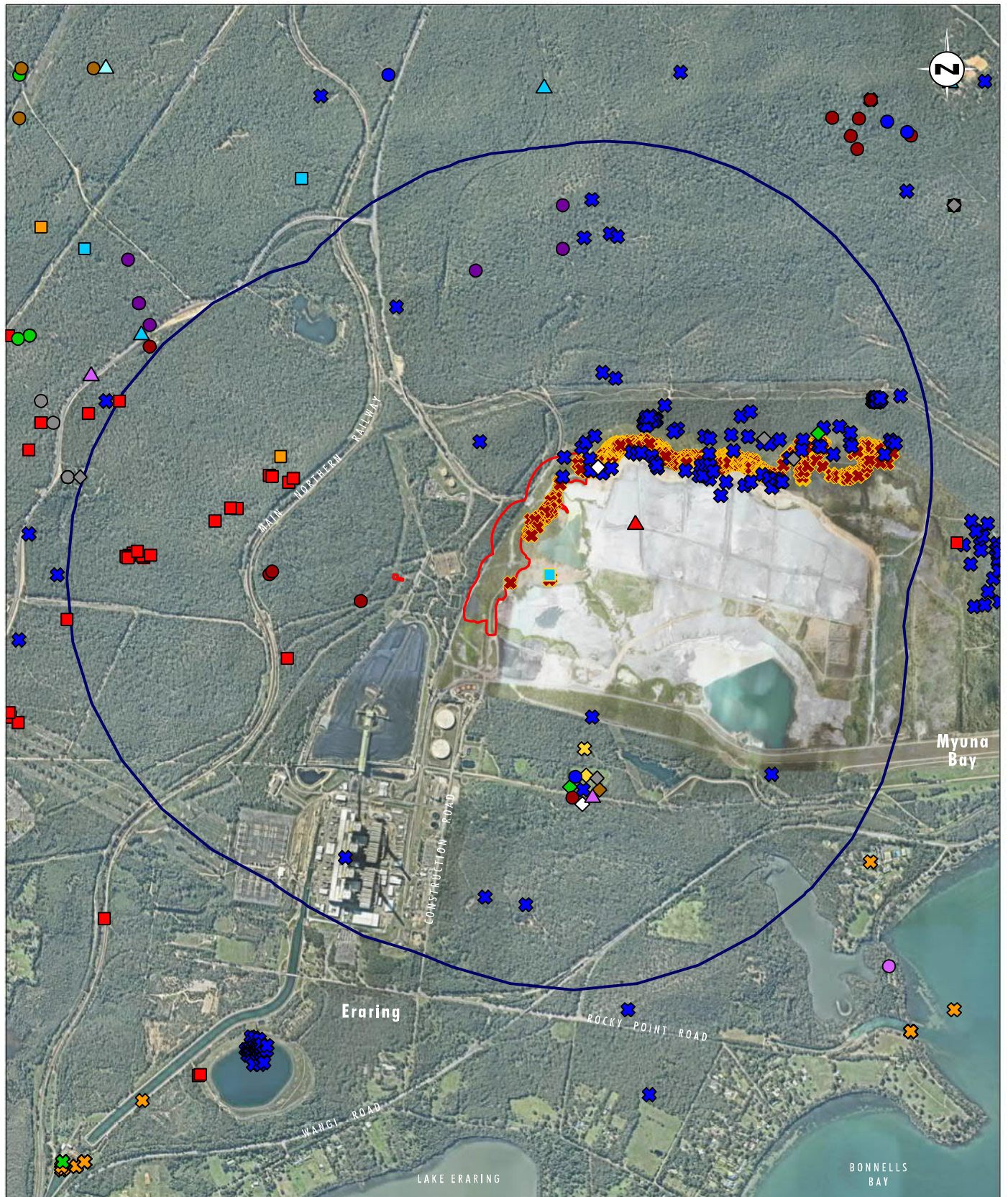


Image Source: Nearmap (Apr 2018), Origin (2018)
Data Source: AECOM (2018), ATLAS (2018)

0 0.5 1.0 1.25 km
1:25 000

Legend

- | | | | |
|--|---|--|--|
| Development Footprint (Outside Existing Disturbed Areas) | ■ <i>Acacia bynoeana</i> | ▲ Glossy Black-Cockatoo | ▲ Sooty Owl |
| 1500m Buffer Area | ● <i>Angaphora inopina</i> | × Green Turtle | ■ Spotted-tailed Quoll |
| Umwelt Flora Records: | ● <i>Grevillea parviflora</i> subsp. <i>parviflora</i> | ◆ Grey-headed Flying-fox | ■ Squirrel Glider |
| ✱ <i>Tetratheca juncea</i> | Atlas Fauna Records: | ◇ Koala | ▲ Stephens' Banded Snake |
| Umwelt Fauna Records: | ■ Dusky Woodswallow | ◇ Little Bentwing-bat | ● Swift Parrot |
| ■ Squirrel Glider | ◆ Eastern Bentwing-bat | ● Little Lorikeet | ● Varied Sittella |
| Atlas Flora Records: | ◆ Eastern False Pipistrelle | ✱ Loggerhead Turtle | ✱ Wallum Froglet |
| ✱ <i>Tetratheca juncea</i> | ◆ Eastern Freetail-bat | ● Masked Owl | ◆ White-bellied Sea-Eagle |
| | ▲ Eastern Osprey | ● Powerful Owl | |

FIGURE 3.2
Threatened Species

3.3.2 Species-credit Species

A list of the species-credit species predicted to occur by the BAM Calculator and/or the literature review and a discussion on their inclusion or exclusion from the calculator assessment is provided in **Appendix B**. Species-credit species recorded or assumed present are shown in Table 3.3 and further information on the surveys undertaken for these species is provided in **Appendix B**.

Table 3.3 Species-credit Species within the Development Footprint

Species	BC Act	EPBC Act	Species Presence	Justification
Stephen's banded snake <i>Hoplocephalus stephensii</i>	V	-	Yes (assumed)	This species has been previously recorded proximate to the Development Footprint (Umwelt 2014). It is considered that the good condition vegetation of the Development Footprint would provide likely habitat for this species. Refer to Figure 3.3 for the species polygon for this species.
squirrel glider <i>Petaurus norfolcensis</i>	V	-	Yes (surveyed)	The species was observed during spotlighting surveys in the Development Footprint in December 2017 and has been recorded previously proximate to the Development Footprint. All woodland and forest habitat in the Development Footprint is considered to be suitable habitat for the species. Refer to Figure 3.3 for the species polygon for this species.
black-eyed Susan <i>Tetratheca juncea</i>	V	V	Yes (surveyed)	The species was recorded in the Development Footprint during flora surveys undertaken for this assessment. All good condition woodland and forest habitat within the Development Footprint is considered to be suitable habitat for the species. Refer to Figure 3.3 for the species polygon for this species.

3.3.3 Species Habitat Polygons and Biodiversity Risk Weighting

Species habitat polygons have been prepared for the species outlined in **Table 3.4** below. Polygons are shown on **Figure 3.3**.

Table 3.4 Predicted Species-credit Species

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
black-eyed Susan <i>Tetradlea juncea</i>	2	8.96	All areas of Vegetation Zone 1 and 2 (1627_Good and 1636_Good) (refer Figure 3.1).
squirrel glider <i>Petaurus norfolcensis</i>	2	8.96	All areas of Vegetation Zone 1 and 2 (1627_Good and 1636_Good) (refer Figure 3.1).
Stephen's banded snake <i>Hoplocephalus stephensii</i>	2	8.96	All areas of Vegetation Zone 1 and 2 (1627_Good and 1636_Good) (refer Figure 3.1).

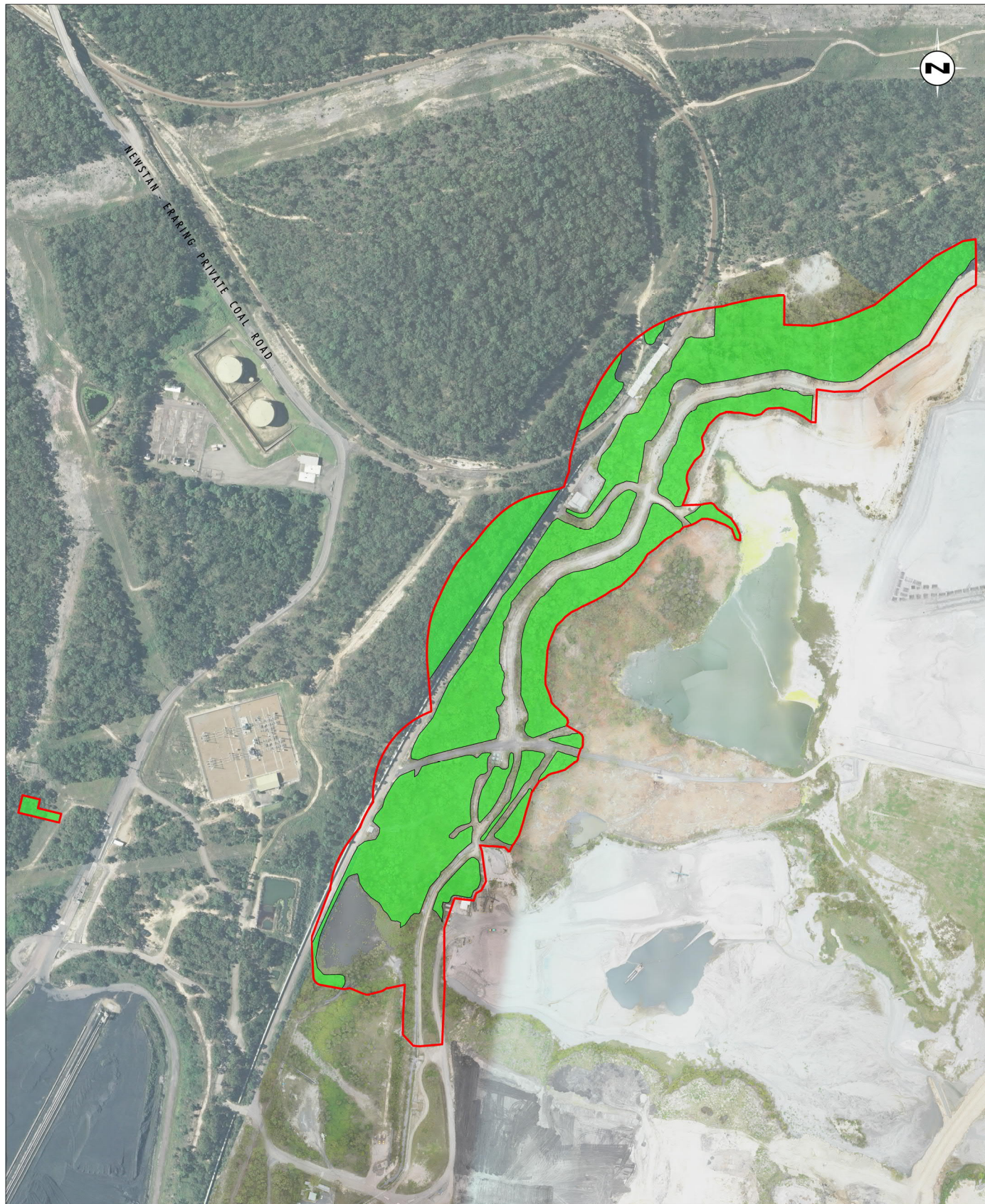


Image Source: Origin (2018)
Data Source: AECOM (2018)

0 100 200 300m
1:6000

Legend

- ▬ Development Footprint (Outside Existing Disturbed Areas)
- ▬ Threatened Species Area for:
 - Stephen's banded snake - *Hoplcephalus stephensii*
 - Squirrel glider - *Petaurus norfolcensis*
 - Black-eyed Susan - *Tetratheca juncea*

FIGURE 3.3

Threatened Species Polygon

4 Avoidance and Minimisation of Impacts

4.1 Avoidance of Native Vegetation and Habitat

An Ash Disposal Options Assessment undertaken in 2014 considered alternative on-site ash disposal options at EPS. A variety of deposition strategies were investigated using 3D modelling of deposition from various RL heights to gain an appreciation of the existing and potential future capacity of the ash dam. The three options considered include:

Option 1 – RL 150 Maximised Footprint

This option was designed to maximise the footprint within the available ash dam expansion areas based on planned deposition to RL150. This option would have provided a gain in storage capacity of approximately 16.8 Mm³. A key constraint associated with this option included likely impacts to areas currently reserved for habitat offsets and previously revegetated areas.

Option 2 – RL 150 Reduced Footprint

This option was configured to specifically exclude encroachment into existing offsets, previously rehabilitated areas and an existing constructed wetland located north east of the ash dam. However Option 2 – RL 150 covered the smallest footprint and therefore provided the least additional storage capacity at approximately 13.5 Mm³.

Option 3 – RL 138 Embankment Raise

This option was designed specifically to maximise potential storage capacity. Option 3 consisted of an 8m downstream raise to the existing embankment to provide additional storage capacity of approximately 20.5 Mm³. The preliminary design of this option was configured to exclude encroachment on habitat offset areas and the constructed wetland. Constraints associated with this option included placement of ash over approximately 59.6 hectares of land undergoing progressive rehabilitation and significant capital expenditure to raise the main embankment.

Investigation of a number of options, including the above, are being undertaken to identify a long-term ash disposal solution to enable operations until 2032. The augmentation of the ash dam deposition strategy is considered to be the preferred option given the ability of the option to support the continued operation of the Eraring Ash Dam consistent with the below objectives:

- Maintains operational flexibility in terms of future ash deposition strategies and engineering design
- Supports the continued operation of EPS to 2032 and deposition of ash towards a final landform that is both safe and stable in the long term
- Is technically feasible
- Remains consistent with Dams Safety Committee of NSW (DSC) guidance and Australian National Committee on Large Dams (ANCOLD) guidelines and
- Minimises potential impacts to the environment.

A key feature of the augmented ash dam deposition strategy is that deposition is limited to the existing operational footprint of the Eraring ash dam, limiting environmental impacts when compared to other alternatives.

4.2 Avoidance of Prescribed Impacts

The following impacts are considered ‘prescribed impacts’ under the BC Regulation:

- impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation.
- impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- impacts on movement of threatened species that maintains their life cycle
- impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- impacts of wind turbine strikes on protected animals
- impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

As outlined in **Section 4.1** above, Origin sought to avoid and minimise the potential impacts on the ecological values of the Project primarily through the careful selection of the location of the disturbance area. The Development Footprint has been located in areas surrounding existing disturbed areas that are likely to be subject to edge effects and indirect impacts from the current Power Station operations.

Further detail on the assessment of prescribed impacts is outlined in **Section 5.2**.

4.3 Minimisation Measures

Origin has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project. The following specific control measures are considered to be integral to the mitigation of impacts on the biodiversity features of the Development Footprint and surrounds. Control measures include:

- demarcation of approved clearance boundaries
- weed management
- pest animal control
- fencing and access control
- bushfire management

- providing appropriate environmental management measures as part of the operations to minimise the potential for indirect impacts including:
 - water management systems that seek to minimise the potential for damage to flora and fauna habitats from erosion and unnatural flooding events
 - erosion and sedimentation control
 - noise control systems
 - traffic control and speed limits
 - dust control measures
 - lighting controls

Each of these control measures will contribute to the maintenance of habitat quality adjacent to the Development Footprint outside existing approved disturbance.

4.4 Summary of Measures

Table 4.1 below outlines the avoidance and minimisation measures proposed for the Project including the timing, action, outcome and responsibility of these measures.

Table 4.1 Avoidance and Minimisation Measures

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Preliminary ecological site inspection	Pre-project design	N/A	N/A	<ul style="list-style-type: none"> Preliminary assessment of areas of avoidance to inform project design.
Location and design of facilities in existing disturbed areas.	Project design	N/A	N/A	<ul style="list-style-type: none"> Focus impacts on areas of low biodiversity value.
Relocation of earth bund and swale	Project design	N/A	N/A	<ul style="list-style-type: none"> Avoidance of freshwater wetland habitat.
Demarcation of approved clearance boundaries	Prior to clearance and during clearance activities	Site Manager	<ul style="list-style-type: none"> Establish construction fencing or marking tape around areas not proposed for clearance. 	<ul style="list-style-type: none"> Minimisation of unnecessary impacts to surrounding vegetation and habitats.
Weed management	Construction and operation	Site Manager	<ul style="list-style-type: none"> Chemical and physical removal of invasive weed species in accordance with the <i>Noxious and Environmental Weeds Handbook</i> (DPI 2014). Vehicle and machinery washing before entering and exiting the Development Footprint. 	<ul style="list-style-type: none"> Minimisation of environmental and noxious weeds in the Development Footprint. Minimisation of weed spread from and into the wider locality.
Pest animal control	Operation	Site Manager	<ul style="list-style-type: none"> Regular monitoring to be undertaken to assess the level of impact by feral animals. Feral animal control works to be undertaken as required to provide for the suppression of feral animals. 	<ul style="list-style-type: none"> Minimise potential for pest animals in the Development Footprint and the locality. Minimise potential impacts to native fauna species from out-competition and/or preying of pest or feral animal species.

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Fencing and access control	Construction and operation	Site Manager	<ul style="list-style-type: none"> Where possible, fencing will not include barbed wire on the top line of the fence. 	<ul style="list-style-type: none"> Provides for access control to avoid unwanted human interference and disturbance to non-operational areas. Minimisation of impacts to native fauna species from the use of barbed-wire fences.
Bushfire management	Construction and operation	Site Manager	<ul style="list-style-type: none"> Bushfire management will consider asset protections and the consideration of the sensitivities of threatened species and threatened ecological communities. 	<ul style="list-style-type: none"> Protect life and property, while supporting appropriate conditions for the existing ecological features.

5 Assessment of Impacts

5.1 Impacts on Native Vegetation and Habitat

5.1.1 Direct Impacts

The development of the Project will result in direct impacts on biodiversity values. Direct impacts include the loss of vegetation and fauna habitats as a result of clearance works and subsequent facility operations. The Development Footprint contains a range of habitat features (such as hollow-bearing trees, fallen logs and threatened flora species habitat) and species-credit species have been identified to occur within the Development Footprint.

Table 5.1 below outlines the direct impacts on native vegetation, which totals approximately 3.1 hectares. The final project footprint is shown in **Figure 5.1**. Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Section 4.0** above.

Table 5.1 Direct Impacts of the Proposed Modification on Biodiversity Features

Species	Area within the Development Footprint (ha)
Plant Community Type	
1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Good Condition</i>	0.95
1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast <i>Good Condition</i>	8.00
Species-credit Species Habitats	
black-eyed Susan - <i>Tetradlea juncea</i>	8.95
squirrel glider - <i>Petaurus norfolcensis</i>	8.95
Stephen's banded snake - <i>Hoplocephalus stephensii</i>	8.95



Image Source: Origin (2018)
Data Source: AECOM (2018)

0 100 200 300 m
1:6000

Legend

- ▬ Development Footprint (Outside Existing Disturbed Areas)
- ▨ Final Project Footprint

FIGURE 5.1

Final Project Footprint

5.1.2 Indirect Impacts

The Project is not expected to result in any additional indirect impacts on the biodiversity values of surrounding lands. No substantial indirect impacts are expected to occur in relation to connectivity, corridors, habitat fragmentation or light emissions beyond minimal encroachment from the Development Footprint. However, some minor indirect impacts associated with water runoff, noise, dust, weeds and feral animals may occur during the construction and operation of the Project. These are discussed below.

No indirect impact zones have been identified for this Project.

5.1.2.1 Downstream Impact from Clean Water Diversion

New stormwater diversion works include:

- Clearing and earthworks to the north west of western emplacement area along a 1km alignment to divert stormwater flows into the existing receiving pond located to the west of the Ash Dam
- A new inlet structure at the existing receiving pond and
- A new HDD pipeline which would extend underground to the west from the new inlet structure for around 360 metres towards a new discharge point consisting of a rock lined channel.

Flows from the proposed discharge point would be directed south towards two existing corrugated pipes which cross underneath the coal stockpile to the west of the power station before discharging to a swale adjacent to the switchyard. Flows would then be directed south-west through existing drainage pathways to enter existing wetlands prior to flowing into Lake Eraring and ending in Lake Macquarie. Diverted water would only be discharged during times of sustained rainfall events when the receiving pond's estimated 10,000m³ storage capacity may be exceeded (Aurecon, 2018). Diverted surface water flows would not come into contact with the ash dam or be mixed with process water. The water would be considered 'clean' and of comparable quality to other surface run-off that drains into the wetland from the surrounding environment.

The wetland areas the diverted water would ultimately flow through are listed coastal wetlands as identified in the Coastal Wetlands and Littoral Rainforests Area Map in State Environmental Planning Policy (Coastal Management) 2018 (SEPP Coastal Management). The coastal wetlands, Lake Eraring and Lake Macquarie are also listed as a coastal environment area under the Coastal Wetlands and Littoral Rainforests Area Map.

The diverted area (combined catchment accounting for approximately 20.6 ha) is much smaller than the area of wetland it is flowing into (estimated at 90 to 100ha). Further, the flow pathway of approximately 3.5 km from the receiving pond encounters many diversion drains and ditches which collect a larger catchment associated with the existing Eraring Power Station and surrounds. As such the volume of water diverted as a result of the project is likely to comprise a small proportion of total flows entering the wetland from the existing water storages. Therefore the volume of diverted flows are likely to be inconsequential in comparison to the existing flows reaching the wetland under existing conditions.

Given that additional surface flows would only be generated during periods of sustained high rainfall, the additional inflows from the stormwater diversion works are not anticipated to significantly impact upon the integrity or resilience of the coastal wetlands environment.

5.1.2.2 Noise Impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species
- noise reducing the occupancy of areas of suitable habitat.

Details of the noise controls that will be implemented as part of the Project are outlined in the Environmental Assessment.

In regard to potential impacts on biodiversity, there will be no substantial change to noise impacts given that the proposed extension is part of, and adjacent to, an existing operation with existing impacts. Noise from proposed operations is not expected to be of any level of significance in relation to threatened species, populations and communities.

5.1.2.3 Dust Impacts

Dust emissions have the potential to adversely impact native species during ground disturbing works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth. The design of the Project will include measures to minimise the potential for adverse dust impacts. These include:

- progressive rehabilitation and stabilisation of disturbed land
- dust suppression on haul roads and other operational areas to reduce vehicle generated dust emissions
- a range of other dust control measures as discussed in the main text of the EIS.

In regard to potential impacts on biodiversity, despite the Development Footprint being closer to vegetation, there will be no substantial change to dust impacts given that the proposed extension is directly adjacent to an already existing ash dam with existing impacts. Any additional impacts resulting from dust are not expected to be of any level of significance in relation to threatened species, populations and communities.

5.1.2.4 Weed and Feral Animal Encroachment

Weed species could be inadvertently brought into the Development Footprint with imported materials, or could invade naturally through removal of native vegetation. The presence of weed species within the Development Footprint has the potential to decrease the value of extant vegetation to native species. Mitigation measures outlined in **Section 4.0** will be implemented to minimise the potential for weed encroachment into areas surrounding the Development Footprint.

Populations of feral fauna species such as foxes, rabbits and cats can increase and quickly populate new areas as a result of disturbance. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species. Mitigation measures outlined in **Section 4.0** will minimise the potential for feral animal spread and impacts into surrounding areas around the Development Footprint.

There will be no substantial change to impacts from weeds or feral animals, given that the proposed extension is part of, and adjacent to, an existing operation with existing impacts. Any additional impacts resulting from weeds or feral animals are not expected to be of any level of significance in relation to threatened species, populations and communities.

5.2 Prescribed Impacts

No impacts are expected to occur to threatened species or community habitat associated with karst, caves, crevices, cliffs and other geological features of significance, rocks or human-made structures as these do not occur within the Development Footprint.

Important connectivity and movement habitat is unlikely to be substantially impacted by the Project. It is noted that Lake Macquarie City Council corridor mapping indicates that vegetation on the Development Footprint contains native vegetation that contributes significantly to movement and viability of flora and fauna in the LGA (LMCC 2015), although this appears to be the case for most remnant vegetation in the LGA. Corridor types identified in the Development Footprint include corridors narrowed to less than 200m in width and crossing points (i.e. cleared areas between larger remnant intact vegetation). The Project proposes to impact areas surrounding existing cleared areas and will not result in severing any major fauna movement habitat which would result in the loss of connectivity in the wider landscape or movement important for threatened species to maintain their life cycle.

No impacts on water quality or hydrological processes that sustain threatened species and threatened ecological communities are likely to occur.

No change is proposed to vehicle site access. Access to the Development Footprint will continue via existing access tracks. Due to the disturbed condition of the Development Footprint, it is unlikely that any threatened species or animals that are part of a TEC would be adversely impacted by the increase in vehicle movement in the Development Footprint.

The impacts of wind turbines are not applicable to this project.

5.2.1 Uncertain Prescribed Impacts

Uncertain impacts are those that are unable to be reliably predicted during the assessment process or are infrequent in nature. These usually refer to impacts associated with caves, cliffs, mine subsidence and wind turbine strikes and increased vehicle strikes. Indirect impacts associated with the interruption of ecosystem processes are also complex and difficult to quantify.

The Project is unlikely to result in any uncertain prescribed impacts.

5.3 Serious and Irreversible Impacts

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

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

None of the PCTs or species-credit species that generate biodiversity credits for the Project are nominated as candidate SAI entities in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (OEH 2017b). Furthermore, of the predicted species outlined in **Appendix B**, the candidate SAI entities are listed for breeding habitat components only (e.g. cave and cliff line habitat for cave-roosting microbat species), contain distributional restrictions (i.e. SAI for south of the Sydney Basin Bioregion only) or the species do not occur in the Development Footprint (i.e. flora species). In many cases, the thresholds for SAI have not been determined for these species.

No species or ecological communities listed as SAI entities are likely to occur within the Development Footprint and no further assessment of SAI is required.

6 Biodiversity Credit Impact Summary

6.1 Impacts Not Requiring Assessment

Under the BAM impacts to areas of land without native vegetation do not require further assessment. The Development Footprint contains approximately 6.12 hectares of cleared land, waterbodies and exotic vegetation that will be removed as a result of the Project as they do not contain native vegetation.

Figure 6.1 shows the areas within the Development Footprint not requiring assessment in accordance with Section 10.4 of the BAM.

6.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is associated with ecosystem-credit habitat or a VEC) or less than 15 (where it is representative of a EEC or CEEC).

As all native vegetation recorded within the Development Footprint has a higher vegetation integrity score than the required threshold, there are no areas of native vegetation impact not requiring offset.

6.3 Impacts Requiring Offset

Two PCTs and three species-credit species are considered to require offsetting in accordance with the BAM (OEH 2017a). **Table 6.1** summarises this outcome.

Table 6.1 Impacts Requiring Offset

Veg Zone	PCT/Species-credit	Vegetation Integrity Score			Area (ha)	Credits Required
		Current	Future	Change		
1	1627 Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast <i>Good Condition</i>	61.1	0	-61.1	0.95	22
2	1636 Scribbly Gum - Red Bloodwood - <i>Angophora inopina</i> heathy woodland on lowlands of the Central Coast <i>Good Condition</i>	74.4	0	--74.4	8.00	261
-	black-eyed Susan - <i>Tetratheca juncea</i>	-	-	-	8.96	327
-	squirrel glider - <i>Petaurus norfolcensis</i>	-	-	-	8.96	327
-	Stephen's banded snake - <i>Hoplocephalus stephensii</i>	-	-	-	8.96	327

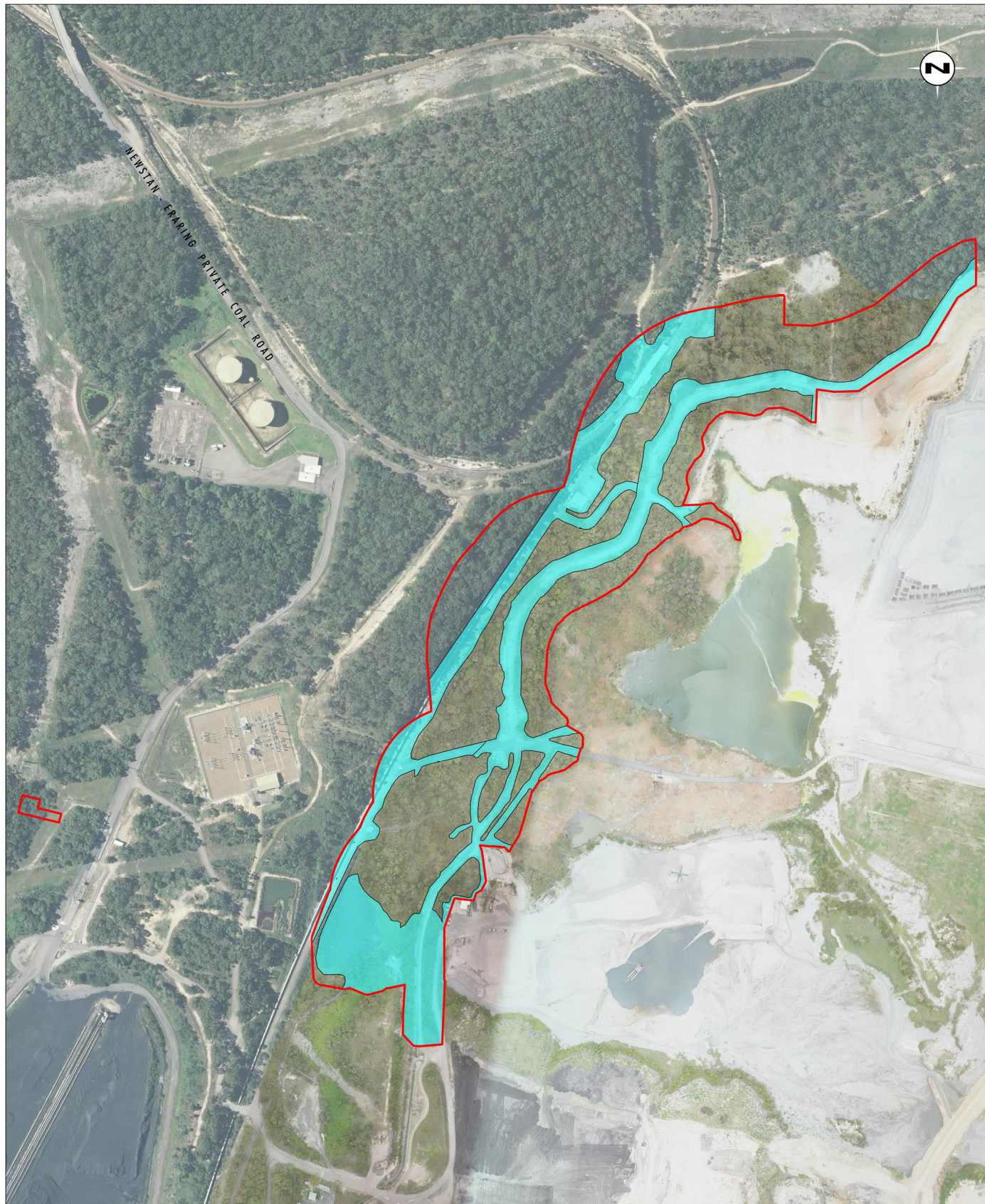


Image Source: Origin (2018)
Data Source: AECOM (2018)

0 100 200 300 m
1:6000

Legend

- ▬ Development Footprint (Outside Existing Disturbed Areas)
- ▬ Area not requiring further assessment, area not required to be offset

FIGURE 6.1

Offsetting Requirement

7 Biodiversity Credit Report

A full Biodiversity Credit Report is included in **Appendix E**.

8 Biodiversity Offset Strategy

Three potential offset sites have been identified within 10km from the ash dam as suitable sites based on existing mapping and proximity to existing offset areas (refer to **Figure 8.1**). These three offset areas comprise over 500 hectares in total and, based on a high level habitat suitability assessment, will likely generate the required credits to offset the impacts of the project if they were to be established as Biodiversity Stewardship sites.

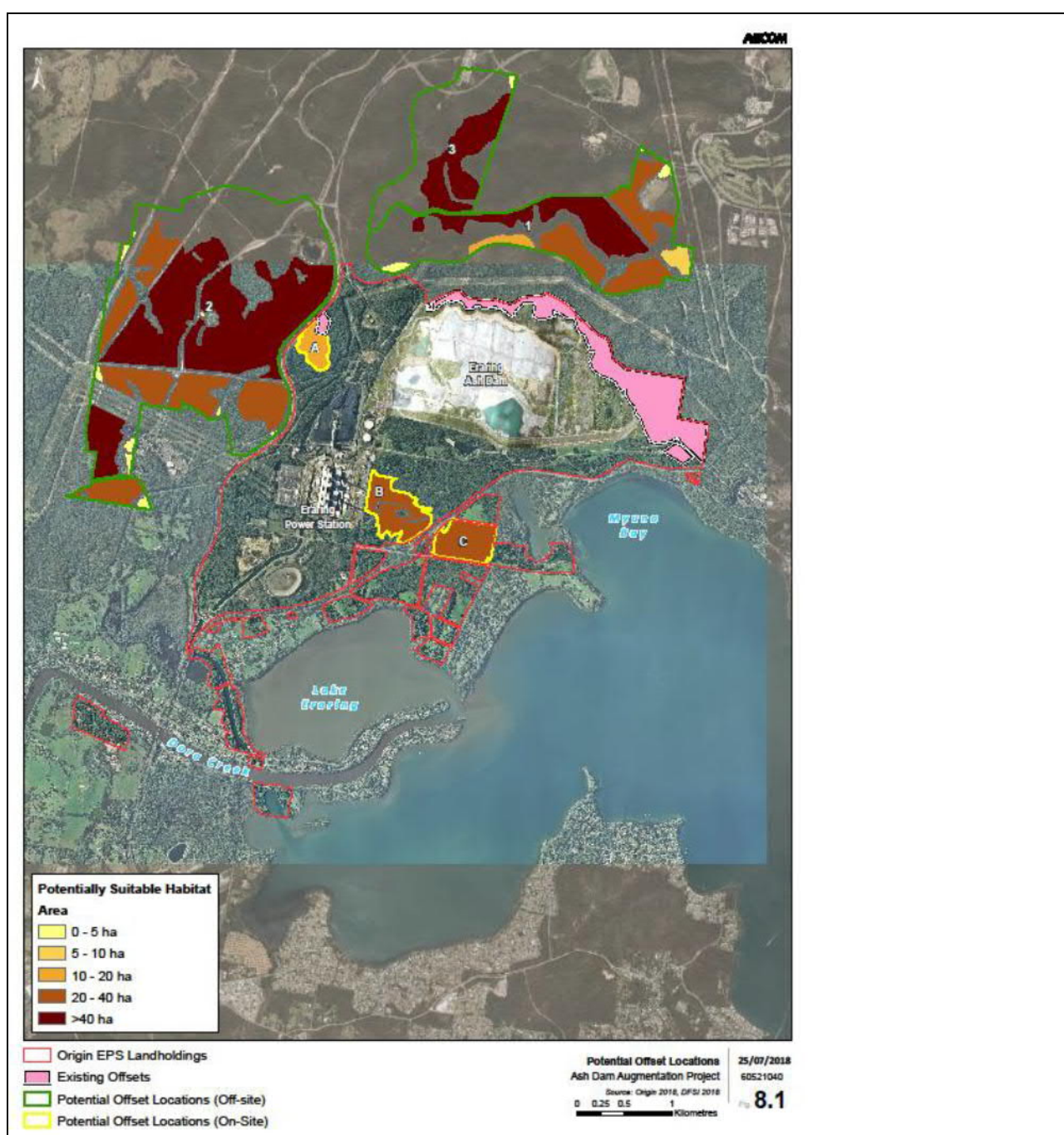


Figure 8.1 Preliminary Offset Investigation Sites

Origin is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the Project under the *BC Act 2016* and *Biodiversity Conservation Regulation 2017*. Firstly, Origin has, where possible, altered the Project to avoid and minimise biodiversity impacts in the project planning stage, and a range of impact mitigation strategies to mitigate the impact on ecological values (refer to **Section 4.0**) prior to the consideration of offsetting requirements.

Fulfilling offset requirements under the *BC Act 2016* can be undertaken using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site achieved and the retirement of credits.
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

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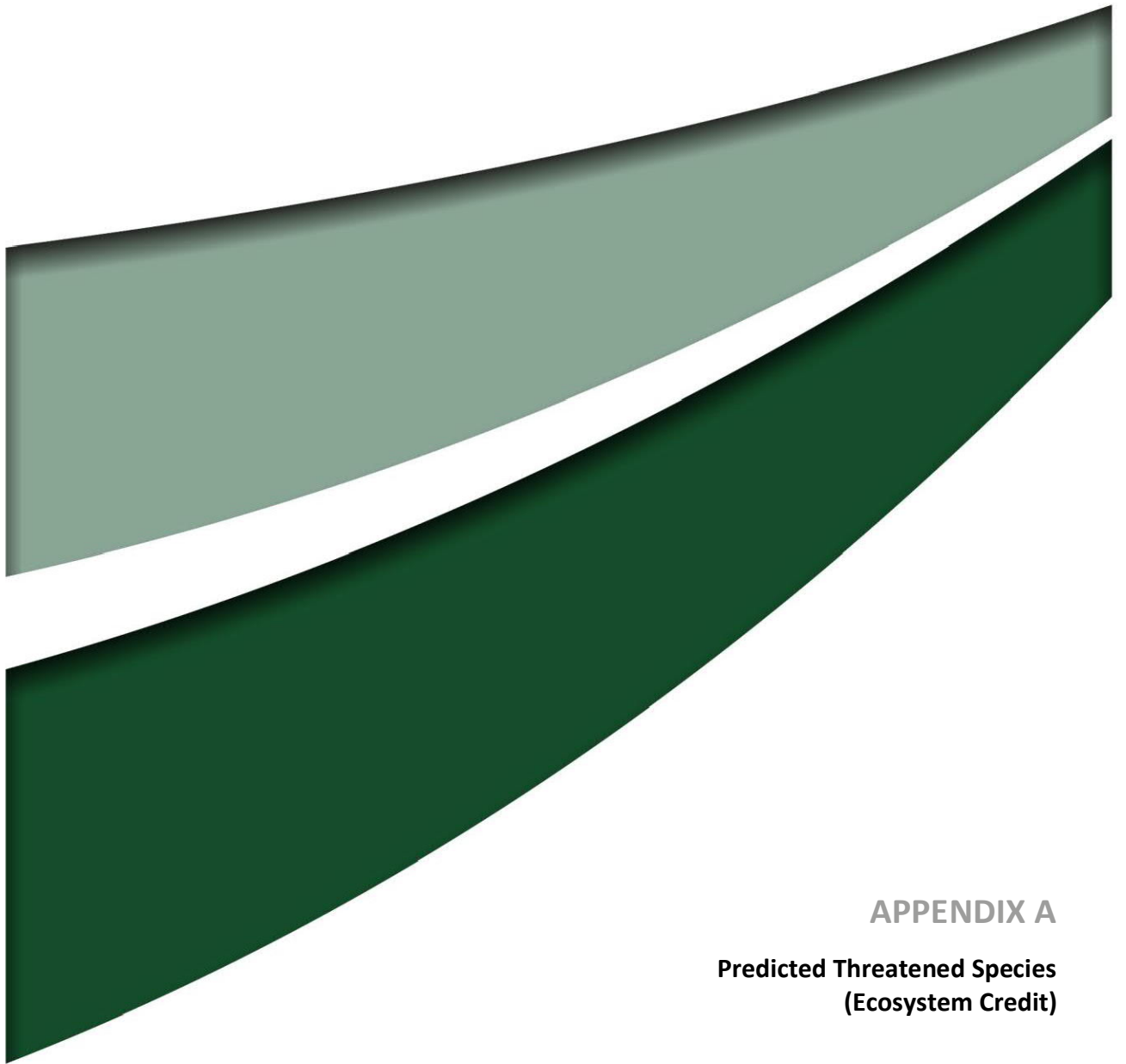
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APPENDIX A

**Predicted Threatened Species
(Ecosystem Credit)**

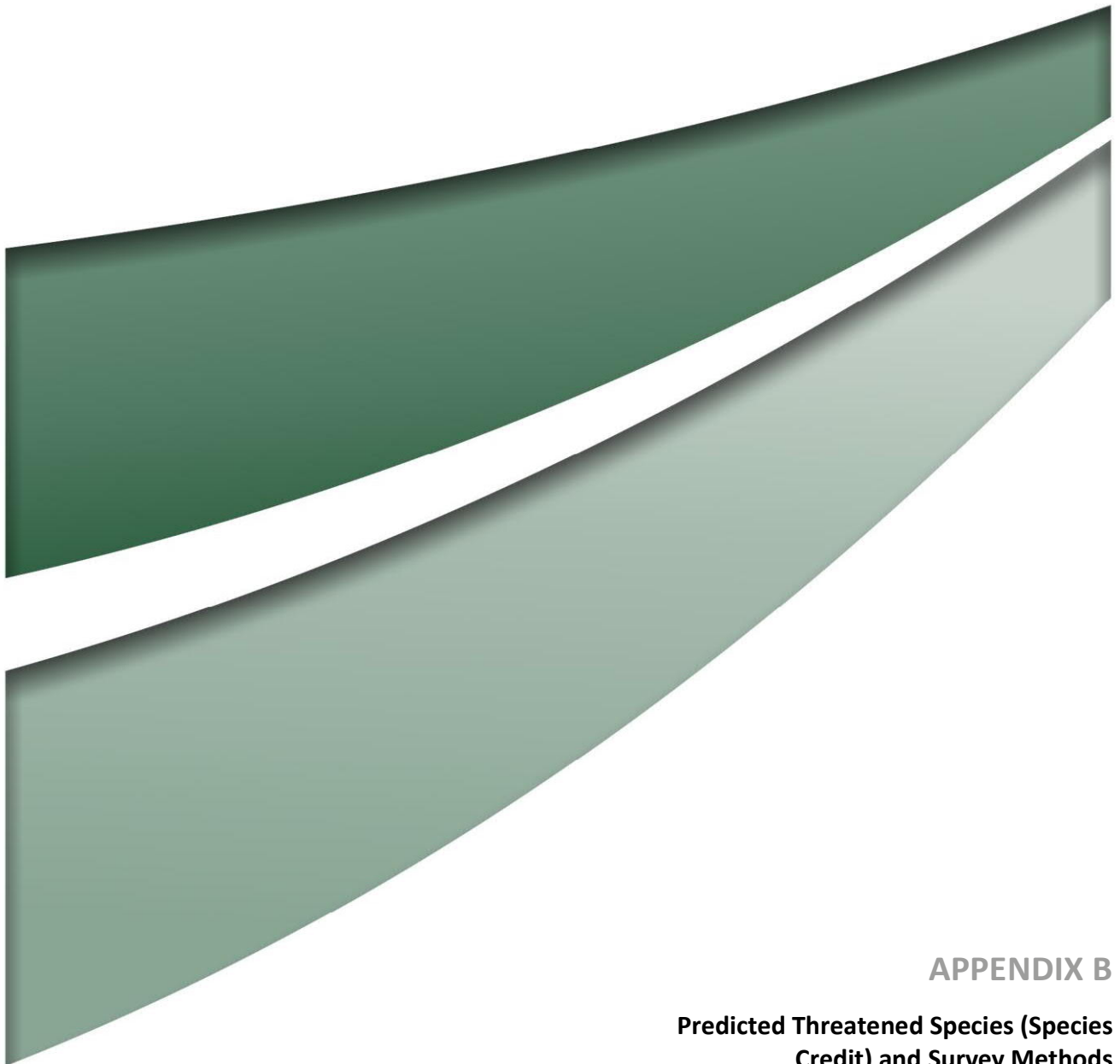
Predicted Threatened Species (Ecosystem Credit)

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	Moderate	-
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V	-	High	Presence of <i>Allocasuarina</i> and <i>casuarina</i> species.
speckled warbler <i>Chthonicola sagittata</i>	V	-	High	-
brown treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i>	V	-	High	-
varied sittella <i>Daphoenositta chrysoptera</i>	V	-	Moderate	-
spotted-tailed quoll <i>Dasyurus maculatus</i>	V	E	High	-
black-necked stork [^] <i>Ephippiorhynchus asiaticus</i>	E	-	Moderate	Shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300m of these swamps.
eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	High	-
little lorikeet <i>Glossopsitta pusilla</i>	V	-	High	-
painted honeyeater <i>Grantiella picta</i>	V	V	Moderate	Mistletoes present at a density of greater than five mistletoes per hectare.
white-bellied sea-eagle <i>Haliaeetus leucogaster</i>	V	-	High	Within 1km of a river, lake, large dam or creek, wetlands and coastlines.
little eagle <i>Hieraaetus morphnoides</i>	V	-	Moderate	-
broad-headed snake <i>Hoplocephalus bungaroides</i>	E	V	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
golden-tipped bat <i>Kerivoula papuensis</i>	V	-	High	-
swift parrot <i>Lathamus discolor</i>	E	CE	Moderate	-
square-tailed kite <i>Lophoictinia isura</i>	V	-	Moderate	-
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis gularis</i>	V	-	Moderate	-
little bentwing-bat <i>Miniopterus australis</i>	V	-	High	-
eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V	-	High	-
eastern freetail-bat <i>Mormopterus norfolkensis</i>	V	-	High	-
turquoise parrot <i>Neophema pulchella</i>	V	-	High	-
barking owl <i>Ninox connivens</i>	V	-	High	-
powerful owl <i>Ninox strenua</i>	V	-	High	-
blue-billed duck [^] <i>Oxyura australis</i>	V	-	Moderate	-
eastern osprey <i>Pandion cristatus</i>	V	-	Moderate	-
yellow-bellied glider <i>Petaurus australis</i>	V	-	High	Hollow-bearing trees with hollows greater than 25cm diameter.
scarlet robin <i>Petroica boodang</i>	V	-	Moderate	-
koala <i>Phascolarctos cinereus</i>	V	V	High	-

Species	BC Act	EPBC Act	Sensitivity to Gain	Habitat Constraint
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V	-	Moderate	-
long-nosed potoroo <i>Potorous tridactylus</i>	V	V	High	Dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).
eastern chestnut mouse <i>Pseudomys gracilicaudatus</i>	V	-	High	-
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V	V	High	-
yellow-bellied sheath-tail-bat <i>Saccolaimus flaviventris</i>	V	-	High	-
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V	-	High	-
diamond firetail <i>Stagonopleura guttata</i>	V	-	Moderate	-
freckled duck [^] <i>Stictometta naevosa</i>	V	-	Moderate	-
red-legged pademelon <i>Thylogale stigmatica</i>	V	-	High	-
masked owl <i>Tyto novaehollandiae</i>	V	-	High	-
Rosenberg's goanna <i>Varanus rosenbergi</i>	V	-	High	-

[^]Predicted by literature review.



APPENDIX B

**Predicted Threatened Species (Species
Credit) and Survey Methods**

Predicted Threatened Species (Species Credit) and Survey Methods

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
Flora Species						
Bynoe's wattle <i>Acacia bynoeana</i>	E	V	Sept-Mar	-	No	Threatened flora searches and walking transects targeting this species were undertaken in September, October and December 2017 in suitable habitat over 13 days. Opportunistic observations were completed throughout all Umwelt survey periods.
Charmhaven apple <i>Angophora inopinata</i>	V	V	All year	-	No	Threatened flora searches and walking transects targeting this species were undertaken in September, October and December 2017, and June and July 2018 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
thick-leaf star-hair <i>Astrotricha crassifolia</i>	V	V	All year	-	Yes	Not required. This species is not known from the Lake Macquarie area. The closest record occurs around 50km southwest of the Development Footprint near Woy Woy (OEH 2018a) and therefore does not require further assessment.
<i>Darwinia glaucophylla</i>	V	-	All year	-	No	Not required. This species is not known from the Lake Macquarie area. The closest record occurs around 40km southwest of the Development Footprint near Lisarow (OEH 2018a) and therefore does not require further assessment.
<i>Diuris bracteata</i>	E	-	Aug-Sept	-	Yes	This species is not known from the Lake Macquarie area. The closest record occurs around 40km southwest of the Development Footprint near Kulnura (OEH 2018a) and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
thick lip spider orchid <i>Caladenia tessellata</i>	E	V	Sept-Nov [^]	-	Yes	The development footprint is located approximately 20 km north of the most northern record of this species (OEH 2018). Threatened flora searches and walking transects targeting this species were undertaken in September and October 2017 in suitable habitat over four days.
netted bottle brush <i>Callistemon linearifolius</i>	V	-	Sept-Mar	-	No	Threatened flora searches and walking transects targeting this species were undertaken in September and October 2017 in suitable habitat over 16 days. This species is identifiable outside of its flowering period and opportunistic observations were completed throughout all Umwelt survey periods.
leafless tongue orchid <i>Cryptostylis hunteriana</i>	V	V	Nov-Feb	-	No	Threatened flora searches and walking transects were undertaken in December 2017 in suitable habitat over nine days. This species has not been recorded at Eraring Power Station despite numerous targeted searches (Bell 2007). Timing and flowering conditions were deemed suitable with surveys undertaken during the appropriate month (OEH 2018) and two other <i>Cryptostylis</i> species, <i>C. erecta</i> and <i>C. subulata</i> were recorded.
white-flowered wax plant <i>Cynanchum elegans</i>	E	E	All year	-	No	Threatened flora searches and walking transects were undertaken in September, October and December 2017, and June and July 2018 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
Camfield's stringybark <i>Eucalyptus camfieldii</i>	V	V	All year	-	No	Not required. This species is known to occur in tall coastal heath on exposed sandstone ridges. It has a scattered distribution, with the closest record being approximately 15km to the southeast of the Development Footprint (OEH 2018a). However, the Development Footprint does not contain suitable sandstone habitat for the species and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
variable midge orchid <i>Genoplesium insigne</i>	CE	CE	Sept-Oct	-	Yes	Threatened flora searches and walking transects targeting this species were undertaken in September and October 2017 in suitable habitat over four days.
small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V	V	All year	-	No	Threatened flora searches and walking transects were undertaken in September, October and December 2017, and June and July 2018 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
spreading guinea flower <i>Hibbertia procumbens</i>	E	-	Dec-Mar	-	No	Not required. This species is known to occur in heath on skeletal sandy soils, or 'hanging swamp' vegetation communities. It has been primarily recorded near Gosford, with the closest record being 30km southwest of the Development Footprint (OEH 2018a). The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.
Grove's paperbark <i>Melaleuca groveana</i>	V	-	All year	-	No	Not required. This species grows in heath and shrub land, often in exposed sites on rocky outcrops and cliffs. It has a scattered distribution, with the closest record being approximately 20km to the northwest of the Development Footprint (OEH 2018a). However, the Development Footprint does not contain suitable outcropping habitat for the species and therefore does not require further assessment.
tranquility mintbush <i>Prostanthera askania</i>	E	E	Sept-Dec	-	No	Not required. This species occurs over a very restricted geographic range (of less than 12 km) within the Wyong and Gosford local government areas. The closest record occurs around 30km south of the Development Footprint (OEH 2018a) and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
Somersby mintbush <i>Prostanthera junonis</i>	E	E	Sept-Nov	-	No	Not required. This species is not known from the Lake Macquarie area. The closest record occurs around 40km southwest of the Development Footprint around Somersby (OEH 2018a) and therefore does not require further assessment.
heath wrinklewort <i>Rutidosia heterogama</i>	V	V	All year	-	No	Threatened flora searches and walking transects were undertaken in September, October and December 2017, and June and July 2018 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
rainforest cassia <i>Senna acclinis</i>	E	-	All year	-	No	Not required. This species is found on the margins of subtropical, littoral and dry rainforests. It has been recorded in the nearby Watagan State Forest, with the closest record being approximately 25km to the southwest of the Development Footprint (OEH 2018a). The Development Footprint does not contain suitable rainforest habitat for the species and therefore does not require further assessment.
black-eyed Susan <i>Tetratheca juncea</i>	V	V	Jul-Dec	-	No	Threatened flora searches and walking transects were undertaken in September, October and December 201, and July 2018 in suitable habitat over 17 days. Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Tetratheca glandulosa</i>	V	-	Jul-Nov	-	No	Not required. This species is found in shale-sandstone transition habitat predominantly on ridgetops and upper-slopes. Its distribution lies primarily south of Olney State Forest. The closest record is approximately 10km to the southeast of the Development Footprint (OEH 2018a). The Development Footprint does not contain suitable shale-sandstone habitat for the species and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
<i>Maundia triglochinooides</i> [^]	V	-	Nov-Mar	Swamps or shallow fresh water on clay	No	Targeted habitat searches were undertaken as part of the surveys conducted in December 2017 in wetland/pond habitat over nine days.
<i>biconvex paperbark</i> [^] <i>Melaleuca biconvexa</i>	V	V	All year	Swamp margins or creek edges	No	Threatened flora searches and walking transects were undertaken in September, October and December 2017, and June and July 2017 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> [^]	EP	-	All year	-	No	Threatened flora searches and walking transects were undertaken in September, October and December 2017, and in June and July 2018 in suitable habitat over 21 days. Opportunistic observations were completed throughout all Umwelt survey periods.
Fauna Species						

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
bush stone-curlew <i>Burhinus grallarius</i>	E	-	All year	Fallen/standing dead timber including logs.	No	<p>Habitat assessments were undertaken in September, October and December 2017, and June and July 2018 over 21 days to identify potential habitat available for the species across the Development Footprint. Suitable fallen logs were inspected.</p> <p>Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights) and again at 13 locations from 16 – 18 July 2018 (3 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Nocturnal spotlighting searches were also undertaken in December 2017 and July 2018 over seven nights in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V	-	Oct-Jan	Eucalypt tree species with hollows greater than 9cm diameter.	No	<p>Habitat assessments were conducted in October and December 2017 over ten days to identify potential habitat available for the species across the Development Footprint. Suitable tree species containing hollows greater than 9 cm were recorded and inspected for occupants.</p> <p>Targeted surveys were conducted in June and July 2018 over eight days in proximity of the potential breeding habitat to identify potentially breeding pairs.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
glossy black-cockatoo <i>Calyptrorhynchus lathami</i>	V	-	Mar-Aug	Living or dead trees with hollows greater than 15cm diameter, and greater than 5m above ground.	No	Habitat assessments were conducted in December 2017 over nine days to identify potential habitat available for the species across the Development Footprint. Suitable tree species containing hollows greater than 15 cm were recorded. Targeted surveys were conducted in June and July 2018 over eight days in proximity of the potential breeding habitat to identify potentially breeding pairs. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern pygmy possum <i>Cercartetus nanus</i>	V	-	Oct-Mar	-	No	Habitat assessments were conducted in October and December 2017 over 10 days to identify potential habitat available for the species across the Development Footprint. Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
large-eared pied bat <i>Chalinolobus dwyeri</i>	V	V	Sept-Mar	Land within 2km of rocky areas containing cliffs, caves, overhangs, escarpments, outcrops, or crevices. Land within 2km of old mines or tunnels.	Yes	Echolocation surveys were conducted in December 2017 over 16 nights across the Development Footprint using four Titley Scientific Anabat Express detectors. At each site, the Anabat was positioned one metre above the and positioned towards potential micro-bat flyways along areas of suitable habitat. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017. Opportunistic observations were completed throughout all Umwelt survey periods.
Wallum froglet <i>Crinia tinnula</i>	V	-	All year	-	No	Habitat assessments were conducted in September, October and December 2017, and June and July 2018 over 20 days to identify potential habitat available for the species across the Development Footprint. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017, three nights in June 2018 and three nights in July 2018. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
white-bellied sea-eagle <i>Haliaeetus leucogaster</i>	V	-	Jul-Dec	Living or dead mature trees within suitable vegetation within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines.	No	Habitat assessments were conducted in September and December 2017, and July 2018 over sixteen days to identify potential habitat available for the species across the Development Footprint. Suitable nest trees and stags were recorded and inspected for large nests. Opportunistic observations were completed throughout all Umwelt survey periods.
giant burrowing frog <i>Heleioporus australiacus</i>	V	V	Sept-May	-	No	Not required. This species is found in hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features. The closest record of this species occurs around 20 km to the west of the Development Footprint in Watagan State Forest (OEH 2018a). The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.
little eagle <i>Hieraetus morphnoides</i>	V	-	Aug-Oct	Nest trees; live (occasionally dead) large old trees within vegetation.	No	Opportunistic observations were undertaken in September and October 2017 over four days to identify potential habitat available for the species across the Development Footprint. Suitable nest trees and stags were recorded and inspected for large nests. Opportunistic observations were completed throughout all Umwelt survey periods.
pale-headed snake <i>Hoplocephalus bitorquatus</i>	V	-	Nov-Mar	Within 500m of moderate to good vegetation.	No	Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
broad-headed snake <i>Hoplocephalus bungaroides</i>	E	V	Aug-Sept	Including escarpments, outcrops and pagodas within the Sydney Sandstone geologies	Yes	Not required. This species requires sandstone rocks on exposed cliff edges for breeding habitat. The closest record of this species occurs around 30 km to the west of the Development Footprint in Olney State Forest (OEH 2018a). The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.
Stephen's banded snake <i>Hoplocephalus stephensii</i>	V	-	Oct-Mar	Hollow-bearing trees, arboreal vine tangles, fallen/standing dead timber including logs, or within 500m of this habitat.	No	Habitat assessments were conducted in October and December 2017 over ten days to identify potential habitat available for the species across the Development Footprint. Suitable tree species containing hollows were recorded and inspected for occupants. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects.
swift parrot <i>Lathamus discolor</i>	E	CE	May-Aug	-	Yes	Opportunistic observations were undertaken in June and July 2018 over five days when the species is known to be occupying the wider Hunter Valley region. The presence or otherwise of flowering resources were noted.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
green and golden bell frog <i>Litoria aurea</i>	E	V	Nov-Mar	Semi-permanent/ephemeral wet areas, within 1km of swamps or waterbodies.	No	Targeted searches for this species were undertaken in December 2013, February 2014 and December 2017. Surveys included a mix of call playback and auditory surveys and well as active searches within suitable habitats. Habitat assessments were conducted in December 2017 to identify potential habitat available for the species across the Development Footprint. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017.
green-thighed frog <i>Litoria brevipalmata</i>	V	-	Oct-Mar	-	No	Habitat assessments were conducted in December 2017 to identify potential habitat available for the species across the Development Footprint. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017.
square-tailed kite <i>Lophoictinia isura</i>	V	-	Sept-Jan	Nest trees.	No	Habitat assessments were conducted in October and December 2017 over ten days to identify potential habitat available for the species across the Development Footprint. Suitable nest trees and stags were recorded and inspected for large nests. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
parma wallaby <i>Macropus parma</i>	V	-	All year	-	No	<p>Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights) and a further 13 cameras were installed from the 16-19 July 2018. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and three nights in June 2018 and three nights in July 2018 and included walking and driving transects.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
little bentwing-bat <i>Miniopterus australis</i>	V	-	Dec-Feb	Caves, tunnels, mine, culverts or other structures known or suspected to be used for breeding.	Yes	<p>Echolocation surveys were conducted in December 2017 over 16 nights across the Development Footprint using 4 Titley Scientific Anabat Express detectors.</p> <p>Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V	-	Nov-Feb	Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding.	Yes	Echolocation surveys were conducted in December 2017 over 16 nights across the Development Footprint using 4 Titley Scientific Anabat Express detectors. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects. Opportunistic observations were completed throughout all Umwelt survey periods.
stuttering frog <i>Mixophyes balbus</i>	E	V	Sept-Mar	-	Yes	Not required. This species is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. It has been recorded in the nearby Watagans National Park, with the closest record being approximately 10km to the west of the Development Footprint (OEH 2018a). However, the Development Footprint does not contain suitable rainforest habitat for the species and therefore does not require further assessment.
giant barred frog <i>Mixophyes iteratus</i>	E	E	Oct-Mar	Land within 50m of semi-permanent and permanent drainages	No	Not required. This species is found in moist riparian habitats such as rainforest or wet sclerophyll forest, along freshwater streams with permanent or semi-permanent water. It has been recorded in the nearby Watagans National Park, with the closest record being approximately 10km to the west of the Development Footprint (OEH 2018a). The Development Footprint does not contain suitable riparian habitat for the species and therefore does not require further assessment.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
southern myotis <i>Myotis macropus</i>	V	-	Nov-Mar	Hollow-bearing trees, bridges, caves or artificial structures, within 200m of riparian zone. Within 500m of foraging habitat.	No	Echolocation surveys were conducted in December 2017 over 16 nights across the Development Footprint using 4 Titley Scientific Anabat Express detectors. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects. Opportunistic observations were completed throughout all Umwelt survey periods.
barking owl <i>Ninox connivens</i>	V	-	May-Dec	Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground.	No	Habitat assessments were conducted in September, October and December 2017, and July 2018 over 17 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017, three non-consecutive nights in June 2018 and three consecutive nights in July 2018. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
powerful owl <i>Ninox strenua</i>	V	-	May-Aug	Living or dead trees with hollow greater than 20cm diameter.	No	<p>Habitat assessments were conducted in September, October and December 2017, and July 2018 over 17 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017, three non-consecutive nights in June 2018 and three consecutive nights in July 2018.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
eastern osprey <i>Pandion cristatus</i>	V	-	Apr-Nov	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.	No	<p>Opportunistic observations were undertaken in September and October 2017, and June and July 2018 over 12 days to identify potential habitat available for the species across the Development Footprint. Suitable nest trees and stags were recorded and inspected for large nests.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
squirrel glider <i>Petaurus norfolcensis</i>	V	-	All year	-	No	<p>Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights) and a further 13 cameras were installed from the 16-19 July 2018. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and three nights in June 2018 and three nights in July 2018, and included walking and driving transects.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E	V	All year	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	Yes	<p>Not required. This species is found on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges. It has been recorded in the nearby Watagan State Forest, with the closest record being approximately 15km to the west of the Development Footprint (OEH 2018a). The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.</p>
common planigale <i>Planigale maculata</i>	V	-	All year	-	No	<p>This species has not been recorded in the Wyong area and all records occur north of Dungog and east of the Barrington Tops over 80km from the Development Footprint (OEH 2018a). This species is unlikely to occur in the Development Footprint and does not require further assessment.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
brush-tailed phascogale <i>Phascogale tapoatafa</i>	V	-	All year	-	No	<p>Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights) and a further 13 cameras were installed from the 16-19 July 2018. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between the hours of sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and three nights in June 2018 and three nights in July 2018, and included walking and driving transects.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

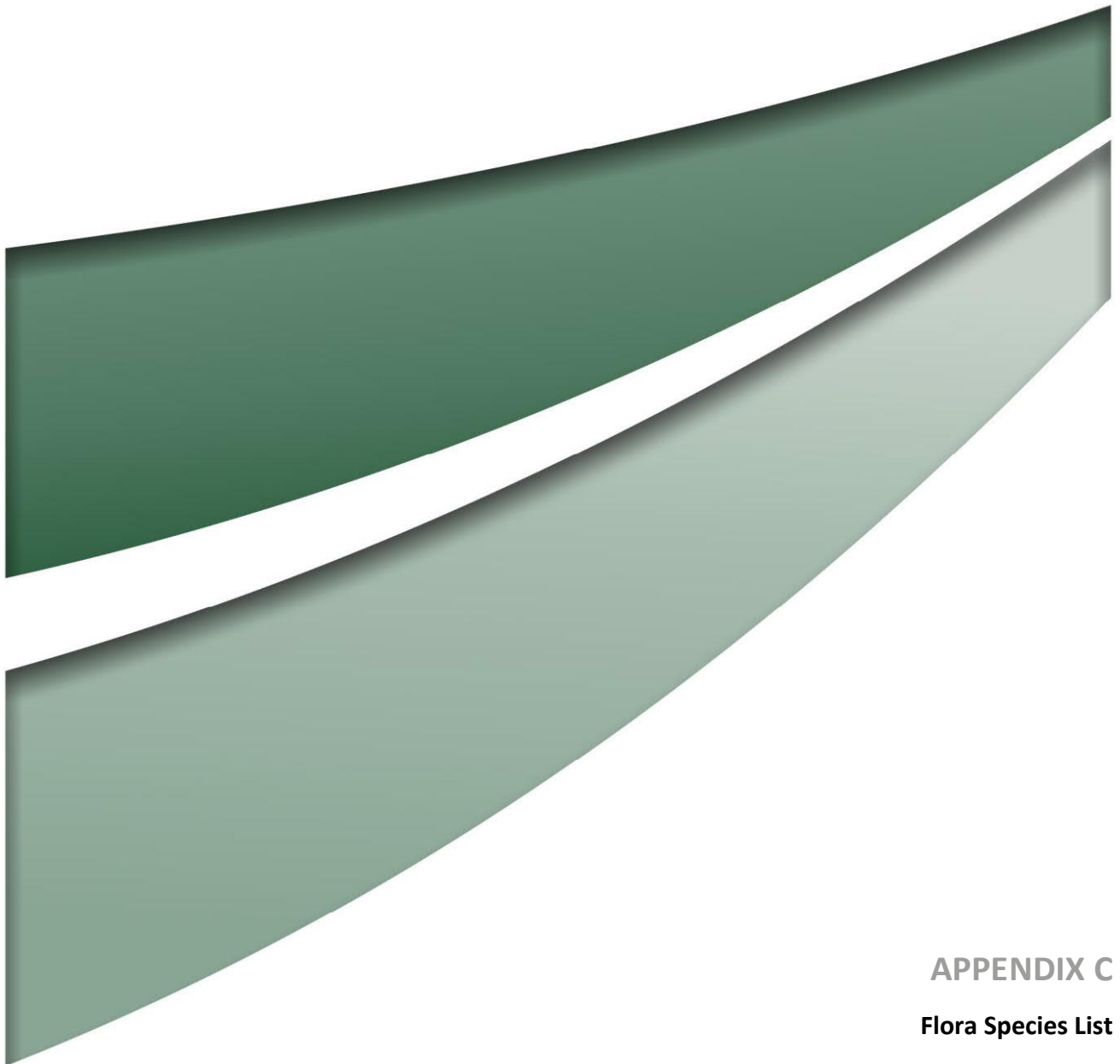
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
koala <i>Phascolarctos cinereus</i>	V	V	All year	-	No	<p>Targeted scat searches were undertaken across the development footprint in accordance with the Spot Assessment Technique (SAT). A total of 7 SAT searches were undertaken across the Development Footprint comprising 210 trees.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and three nights in June 2018 and three nights in July 2018 and included walking and driving transects.</p> <p>Bushnell Trophy Cam HD cameras were installed at 5 locations within and surrounding the Development Footprint from 4 December 2017 to 10 January 2018 (38 nights) and a further 13 cameras were installed from the 16-19 July 2018. At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
red-crowned toadlet <i>Pseudophryne australis</i>	V	-	All year	-	No	<p>Habitat assessments were conducted in September, October and December 2017, and July 2018 over 17 days to identify potential habitat available for the species across the Development Footprint. The Development Footprint does not contain suitable habitat for the species and therefore does not require further assessment.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V	V	Oct-Dec	Breeding camps.	No	<p>Habitat assessments were conducted in October and December 2017 over 10 days to identify potential flying-fox camps within the Development Footprint. Trees suitable for breeding camps were recorded and inspected for presence of the species.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>
masked owl <i>Tyto novaehollandiae</i>	V	-	May-Aug	Living or dead trees with hollows greater than 20cm diameter.	No	<p>Habitat assessments were conducted in December 2017, June 2018 and July 2018 over 14 days to identify potential habitat available for the species across the Development Footprint. Suitable living trees and stags were recorded and inspected.</p> <p>Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and over three non-consecutive nights in June 2018 and three nights in July 2018.</p> <p>Opportunistic observations were completed throughout all Umwelt survey periods.</p>

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	SAIL Entity	*Survey Method
Mahony's toadlet <i>Uperoleia mahonyi</i>	E	-	Oct-Mar	-	No	Habitat assessments were conducted in October and December 2017 over ten days to identify potential habitat available for the species across the Development Footprint. Nocturnal spotlighting searches were undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017. Opportunistic observations were completed throughout all Umwelt survey periods.
eastern cave bat <i>Vespardelus troughtoni</i>	V	-	Nov-Jan	Caves or within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	Yes	Echolocation surveys were conducted in December 2017 over 16 days across the Development Footprint using 4 Titley Scientific Anabat Express detectors. Nocturnal spotlighting searches were also undertaken in suitable habitat areas between sunset and midnight using 30 watt Lightforce hand-held spotlights and head torches. The surveys were undertaken over four nights in December 2017 and included walking and driving transects. Opportunistic observations were completed throughout all Umwelt survey periods.

^ Survey period derived from resources other than TBDC.

*survey method is in accordance with OEH's survey guidelines (OEH 2016).



APPENDIX C

Flora Species List

Flora Species List

The following list was developed from the floristic plot rapid transect surveys of the Development Footprint. It includes all species of vascular plants observed during these surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

AA denotes abundance rating according to BAM

PC cover measure according to BAM

asterisk (*) denotes species non-native species

double asterisk (**) denotes High Threat Weed species under the BAM

subsp. subspecies and

var. variety.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2018), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Family	Scientific Name	Common Name	Zone 1 PCT 1627			Zone 2 PCT 1636					
			Q17			Q01		Q018		Q19	
			PC	AA		PC	AA	PC	AA	PC	AA
Filicopsida - Ferns											
Adiantaceae	<i>Adiantum aethiopicum</i>	common maidenhair	0.2	20							
Adiantaceae	<i>Adiantum</i> spp.				0.1	1	0.1	10			
Dennstaedtiaceae	<i>Pteridium esculentum</i>	bracken	5	500							
Dicksoniaceae	<i>Calochlaena dubia</i>	rainbow fern	5	100							
Lindsaeaceae	<i>Lindsaea microphylla</i>	lacy wedge fern	0.1	20	0.1	2	0.2	20	0.2	20	
Magnoliopsida - Liliidae (Monocots)											
Asteliaceae	<i>Cordylina stricta</i>	narrow-leaved palm lily	0.2	10							
Cyperaceae	<i>Carex appressa</i>	tall sedge	2	200							
Cyperaceae	<i>Gahnia clarkei</i>	tall saw-sedge	2	100	0.1	1	0.1	5			
Cyperaceae	<i>Lepidosperma laterale</i>	variable sword-sedge			0.2	10	0.2	20	0.2	20	
Iridaceae	<i>Patersonia sericea</i>	silky purple-flag			0.2	20		10		100	
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	wattle mat-rush						0.2		50	
Lomandraceae	<i>Lomandra glauca</i>	pale mat-rush						0.1	10		
Lomandraceae	<i>Lomandra obliqua</i>		0.1	100	2	200	0.1	50			

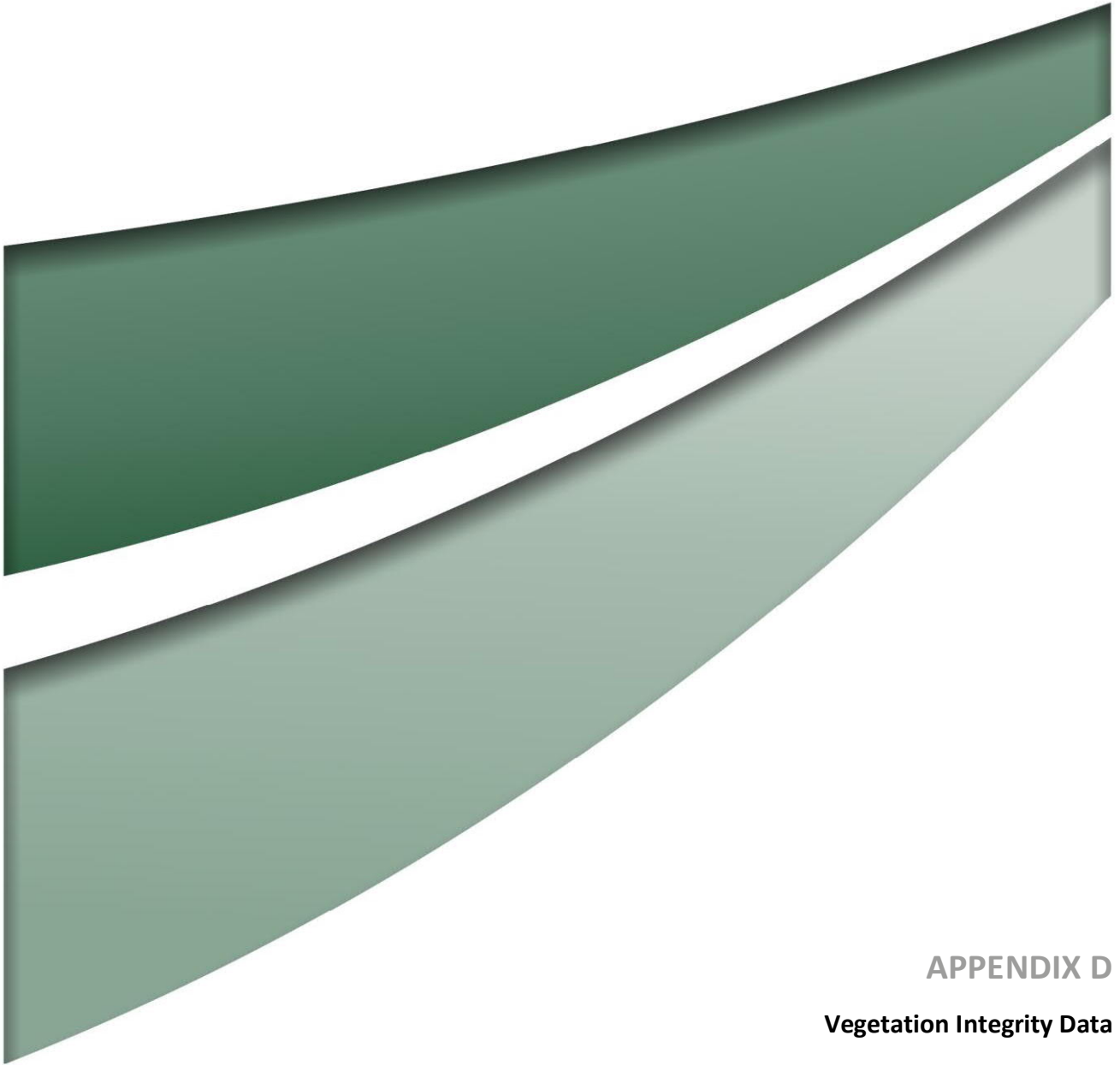
Family	Scientific Name	Common Name	Zone 1 PCT 1627		Zone 2 PCT 1636					
			Q17		Q01		Q018		Q19	
			PC	AA	PC	AA	PC	AA	PC	AA
Luzuriagaceae	<i>Eustrephus latifolius</i>	wombat berry			0.1	1				
Orchidaceae	<i>Caladenia catenata</i>	white caladenia			0.1	1				
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>		0.2	50	1	20	0.2	20	0.2	20
Phormiaceae	<i>Dianella longifolia</i>	blueberry lily	0.2	20						
Phormiaceae	<i>Dianella</i> spp.						0.1	1	0.1	1
Poaceae	<i>Entolasia stricta</i>	wiry panic	2	1000	30	1000	10	500	15	1000
Poaceae	<i>Microlaena stipoides</i>	weeping grass	0.1	20					0.2	50
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>						1	500		
Poaceae	<i>Oplismenus aemulus</i>		1	200						
Poaceae	<i>Themeda australis</i>	kangaroo grass					0.2	100	0.2	20
Xanthorrhoeaceae	<i>Xanthorrhoea latifolia</i>				40	100	1	20		
Xanthorrhoeaceae	<i>Xanthorrhoea latifolia</i> subsp. <i>latifolia</i>								30	100

Family	Scientific Name	Common Name	Zone 1 PCT 1627		Zone 2 PCT 1636							
			Q17		Q01		Q018		Q19			
			PC	AA	PC	AA	PC	AA	PC	AA		
Magnoliopsida - Magnoliidae (Dicots)												
Acanthaceae	<i>Pseuderanthemum variabile</i>	pastel flower			0.2	50	0.1	20	0.1		50	
Apiaceae	<i>Actinotus minor</i>	lesser flannel flower					0.2	10	0.1		5	
Apiaceae	<i>Centella asiatica</i>	Indian pennywort	0.1	100								
Apocynaceae	<i>Parsonsia straminea</i>	common silkpod			0.1	3	0.2	10	0.1		5	
Asteraceae	<i>**Ageratina adenophora</i>	Crofton weed	0.2	10								
Casuarinaceae	<i>Allocasuarina littoralis</i>	black she-oak					30	3				
Casuarinaceae	<i>Allocasuarina torulosa</i>	forest oak	10	3	30	30						
Dilleniaceae	<i>Hibbertia aspera</i>	rough guinea flower	0.1	10			0.1	10	2	50		
Dilleniaceae	<i>Hibbertia</i> spp.											
Elaeocarpaceae	<i>Tetratheca juncea</i>	black-eyed Susan			0.1	1						
Ericaceae	<i>Astroloma pinifolium</i>	pine heath							0.2	10		
Ericaceae	<i>Epacris microphylla</i>	coral heath					0.2	10	0.1	2		
Ericaceae (Epacridoideae)	<i>Lissanthe strigosa</i>	peach heath							0.2	10		

Family	Scientific Name	Common Name	Zone 1 PCT 1627		Zone 2 PCT 1636					
			Q17		Q01		Q018		Q19	
			PC	AA	PC	AA	PC	AA	PC	AA
Fabaceae (Faboideae)	<i>*Fabaceae indeterminate</i>	legumes			0.1	2				
Fabaceae (Faboideae)	<i>Daviesia squarrosa</i>		0.1	3						
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>				0.1	2			0.2	5
Fabaceae (Faboideae)	<i>Pultenaea paleacea</i>	chaffy bush-pea					0.2	50	0.2	20
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>		0.1	2						
Fabaceae (Mimosoideae)	<i>Acacia myrtifolia</i>	red-stemmed wattle							0.1	2
Goodeniaceae	<i>Dampiera stricta</i>		0.1	50	0.2	20	5	500	5	500
Haloragaceae	<i>Gonocarpus tetragynus</i>						0.1	10		
Lauraceae	<i>Cassytha glabella</i>						0.1	10	0.1	10
Lauraceae	<i>Cassytha</i> spp.				0.2	10				
Lobeliaceae	<i>Pratia purpurascens</i>	whiteroot	0.1	50						
Myrtaceae	<i>Angophora costata</i>	Sydney red gum	20	5			10	2	1	2
Myrtaceae	<i>Corymbia gummifera</i>	red bloodwood			10	3	2	5	10	6
Myrtaceae	<i>Eucalyptus capitellata</i>	brown stringybark			10	3	10	3	10	3

Family	Scientific Name	Common Name	Zone 1 PCT 1627		Zone 2 PCT 1636					
			Q17		Q01		Q018		Q19	
			PC	AA	PC	AA	PC	AA	PC	AA
Myrtaceae	<i>Eucalyptus haemastoma</i>	broad-leaved scribbly gum			10	2				
Myrtaceae	<i>Eucalyptus piperita</i>	Sydney peppermint	20	10						
Myrtaceae	<i>Eucalyptus signata</i>	scribbly gum					10	4	10	5
Myrtaceae	<i>Leptospermum polygalifolium</i>	tantoon	10	500	30	50				
Myrtaceae	<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>							10	15	100
Myrtaceae	<i>Leptospermum trinervium</i>	slender tea-tree			0.1	1				
Myrtaceae	<i>Melaleuca linariifolia</i>	flax-leaved paperbark	40	40						
Phyllanthaceae	<i>Glochidion ferdinandi</i>	cheese tree	0.2	5						
Pittosporaceae	<i>Billardiera scandens</i>	hairy apple berry	0.1	20					0.2	10
Proteaceae	<i>Banksia serrata</i>	old-man banksia			0.2	2	1	20	0.2	10
Proteaceae	<i>Banksia spinulosa</i>	hairpin banksia			10	10				
Proteaceae	<i>Banksia spinulosa</i> var. <i>collina</i>		0.2	4			1	50	0.5	50

Family	Scientific Name	Common Name	Zone 1 PCT 1627		Zone 2 PCT 1636			
			Q17		Q01		Q018	
			PC	AA	PC	AA	PC	AA
Proteaceae	<i>Hakea dactyloides</i>	finger hakea					0.1	1
Proteaceae	<i>Hakea sericea</i>	needlebush					0.1	10
Proteaceae	<i>Isopogon anemonifolius</i>	broad-leaf drumsticks			0.3	20	0.1	10
Proteaceae	<i>Lambertia formosa</i>	mountain devil			10	30	2	50
Proteaceae	<i>Lomatia silaifolia</i>	crinkle bush					0.2	20
Proteaceae	<i>Persoonia levis</i>	broad-leaved geebung			0.1	1		
Proteaceae	<i>Persoonia linearis</i>	narrow-leaved geebung						
Proteaceae	<i>Persoonia</i> spp.				0.1	1		
Ranunculaceae	<i>Clematis aristata</i>	old man's beard					0.1	1
Rosaceae	<i>Rubus moluccanus</i> var. <i>trilobus</i>	molucca bramble	0.1	2				
Sapindaceae	<i>Dodonaea triquetra</i>	large-leaf hop-bush						
Solanaceae	<i>*Solanum mauritianum</i>	wild tobacco bush	0.1	2				
Thymelaeaceae	<i>Pimelea linifolia</i> subsp. <i>linoides</i>	slender rice flower						
Verbenaceae	<i>**Lantana camara</i>	lantana	0.2	5				



APPENDIX D

Vegetation Integrity Data

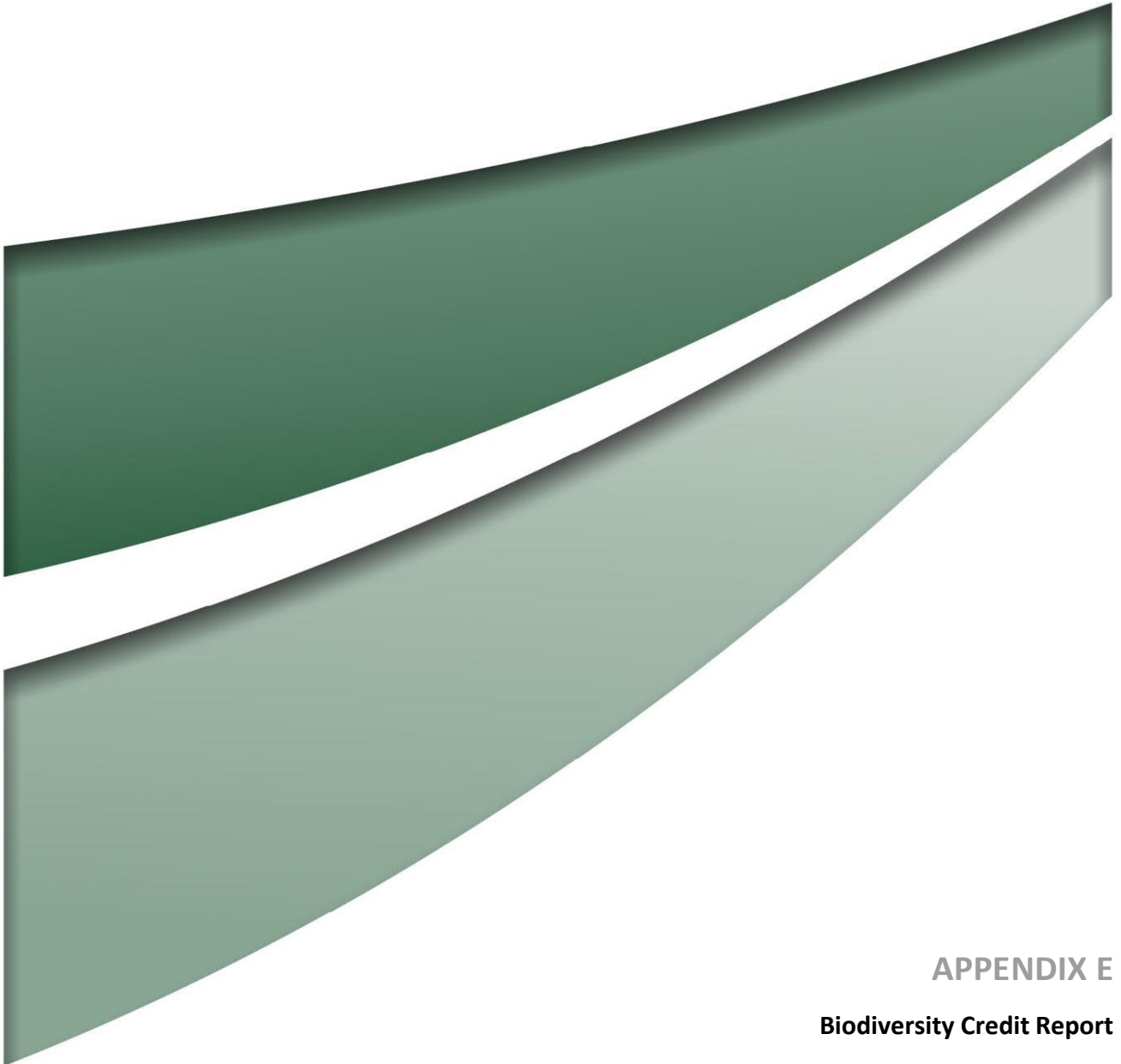
Vegetation Integrity Data

The following vegetation integrity data was collected from surveys of the Development Footprint. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each PCT in the Development Footprint.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form)

COMPOSITION										STRUCTURE					FUNCTION																	
										Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
																						>5	5-10	10-20	20-30	30-50	50-80					
VZ 1 – PCT1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint healthy woodland on sandstone ranges of the Central Coast - Good Condition																																
Q17	7	9	12	12	4	4	75.7	51.3	9.7	1.6	5.4	5.4	1	1	1	1	1	1	1	0	0	0	47	12	0.9							
VZ 2 – PCT1636 – Scribbly Gum - Red Bloodwood - Angophora inopina healthy woodland on lowlands of the Central Coast Scribbly Gum - Red Bloodwood - Angophora inopina healthy woodland on lowlands of the Central Coast - Good Condition																																
Q01	5	9	4	5	2	4	60.2	50.8	32.3	1.7	0.2	40.4	1	1	1	1	1	1	1	1	0	2	85	47	0							
Q18	6	10	7	6	2	4	63	4.2	11.7	5.7	0.3	1.4	20	1	1	1	1	1	1	1	5	3	52	62	0							
Q19	5	15	5	6	1	4	31.2	22.1	15.8	15.5	0.2	30.4	1	1	1	1	1	1	1	1	1	1	41	55	0							



APPENDIX E

Biodiversity Credit Report



BAM Credit Summary Report

Proposal Details

Assessment Id	00011115/BAAS17041/18/00011116	Proposal Name	BAM data last updated *
		Eraring Modification	24/02/2018
Assessor Name	Shaun Corry	Report Created	BAM Data version *
		19/07/2018	3

Assessor Number
BAAS17041

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAI	Ecosystem credits
Scribbly Gum - Red Bloodwood - Angophora inopina heathy woodland on lowlands of the Central Coast								
1	1636_Good	74.4	8.0	0.25	High Sensitivity to Potential Gain	1.75		261
							Subtotal	261

BAM Credit Summary Report

Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast						
2	1627_Good	61.1	1.0	0.25	High Sensitivity to Potential Gain	1.50
						22
					Subtotal	22
					Total	283

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAI	Species credits
<i>Hoplocephalus stephensii</i> / <i>Stephens' Banded Snake</i> (Fauna)						
1627_Good		61.1	0.95	0.25	2 False	29
1636_Good		74.4	8	0.25	2 False	298
					Subtotal	327
<i>Petaurus norfolcensis</i> / <i>Squirrel Glider</i> (Fauna)						
1627_Good		61.1	0.95	0.25	2 False	29
1636_Good		74.4	8	0.25	2 False	298
					Subtotal	327
<i>Tetratheca juncea</i> / <i>Black-eyed Susan</i> (Flora)						
1627_Good		61.1	0.95	0.25	2 False	29
1636_Good		74.4	8	0.25	2 False	298

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Appendix D

Mine Subsidence Impact Assessment

Appendix D Mine Subsidence Impact Assessment



AECOM

Assessment of Potential Mine Subsidence
Impacts for Proposed Eraring Ash Dam
Augmentation Project

AECOM4855


REPORT TO Gabriel Wardenburg
Principal Environmental Scientist
AECOM
PO Box 73
HUNTER REGION MC NSW 2310

TITLE Assessment of Potential Mine Subsidence
Impacts for Proposed Eraring Ash Dam
Augmentation Project

REPORT NO AECOM4855

PREPARED BY Ken Mills

DATE 14 July 2018



Ken Mills
Principal Geotechnical Engineer

Report No	Version	Date
AECOM4855	Draft	29 June 2018
AECOM4855	Draft 2	2 July 2018
AECOM4855	Draft 3	9 July 2018
AECOM4855	Final	14 July 2018

SUMMARY

Origin Energy (Origin) owns and operates Eraring Power Station located approximately 30km southwest of Newcastle in New South Wales. Origin is planning to extend the Eraring Ash Dam into areas where Awaba Colliery formed small pillars and extracted coal to about 20m below the surface. Origin commissioned AECOM to prepare an Environmental Assessment (EA) for this project and AECOM commissioned SCT Operations Pty Ltd (SCT) to review and assess aspects of the project relating to these underground mine workings. This report presents the results of our assessment.

Two main risks associated with the abandoned workings of Awaba Colliery are recognised:

- the potential for subsidence in areas of standing pillars to impact the serviceability of the south western embankment
- connectivity between the surface and the underground workings at Awaba Colliery that has potential to provide a pathway for site process water retained in the ash dam to flow into nearby tributaries of Dora Creek.

A work program of filling the mine voids is recommended to manage these risks.

Subsidence movements associated with pillar collapse or sinkholes have potential to cause structural disturbance to, and possibly failure of, the proposed south western embankment and potentially loss of retained fly ash material. Filling the mine voids below the embankment and ideally to a distance of half depth to either side of the embankment is expected to be completely effective in controlling this risk.

Filling of the mine voids over the broader area of the ash dam would eliminate the potential for subsidence associated with pillar collapse and sinkhole formation to impact the proposed ash dam augmentation. Filling of all voids and mining induced fractures directly below the proposed south western embankment and below all areas where ash is retained would provide the most effective control, but other options based on the strategic filling of smaller areas to form a barrier may be possible with appropriate design. Cement stabilised fly ash is likely to be the most cost effective fill material for this purpose.

Sinkholes create additional direct pathways between the surface and underground, compromising effective containment of site process water within the ash dam. The connectivity created by these pathways is considered likely to be a function of area of ash dam located above the mine. Flow from the ash dam is expected to occur through the direct pathways created by sinkholes whilst ever the pressure head driving water from the ash dam into the mine remains positive, as it is currently. Filling up all the mine voids and mining induced fractures directly under and to an appropriate distance beyond the edge of the ash dam is expected to be effective as a control on the

potential for additional connectivity between the ash dam and underground workings at Awaba Colliery and as a control on the current flows.

A sinkhole at the edge of one area where coal has been extracted at Awaba Colliery was identified during a site visit to the area. More sinkholes and similar features are likely to exist elsewhere above these shallow workings. Water appears likely to be flowing from the existing ash dam into the mine workings based on the geometry and shallow depth of the extracted mine workings directly below the ash dam. Unless the mine voids are filled, this flow is expected to increase more than fivefold when the ash dam is extended, based on ratio of the area of ash dam currently located above the mine and the area of the ash dam that will be located above the mine at the completion of the ash dam and assuming the head of water in the ash dam remains similar.

As a general guide, the volume of mine voids to be filled is estimated to be up to approximately 200,000m³ (120,000m³ in the area of standing pillars and 80,000m³ in the areas where coal has been fully extracted). It is anticipated that the area of standing pillars (5 South) could be filled from 30-50 boreholes drilled from the surface to depths ranging from 15m to 30m. The area of extracted coal (101, 102 and 103 Panel) could be filled from 70-80 boreholes drilled from the surface to depths of 15m to 40m.

Other fill strategies based on forming a barrier around the edge of the ash dam may be effective, but the design of these strategies is beyond the scope of this assessment.

A program of validation testing is recommended as an integral part of any fill strategy. This testing should be aimed to confirm the effectiveness of the fill, particularly in relation to its function as a hydraulic barrier to flow into the mine workings beyond the project area.

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1. INTRODUCTION

Origin Energy (Origin) owns and operates Eraring Power Station located approximately 30km southwest of Newcastle in New South Wales. Origin is planning to extend the ash dam at Eraring into an area where Awaba Colliery previously extracted coal to about 20m below the surface. Origin commissioned AECOM to prepare an Environmental Assessment (EA) for this project and AECOM commissioned SCT Operations Pty Ltd (SCT) to:

- conduct a site visit to inspect the area of the proposed Eraring Ash Dam Augmentation located above workings at Awaba Colliery
- review the available information to determine the potential for the abandoned underground workings at Awaba Colliery to interact with the proposed extension
- outline a scope of works that would likely be required to mitigate the identified subsidence and water connectivity risks associated with these shallow mine workings.

This report presents the results of our assessment based on a site visit to the area of the proposed extension on 2018, a meeting with representatives from Centennial Coal Pty Ltd, the owners of Awaba Colliery, at the time of the site visit and information on the project provided by AECOM.

This report is structured to provide:

- an overview of the site
- discussion of the hazards to the project associated with the shallow mine workings
- a review of the adequacy of the previous EA in the context of these hazards
- a scope of works to manage the risks involved
- conclusions and recommendations.

2. SITE DESCRIPTION

Figure 1 shows an aerial photograph of the site, showing the limits of the Eraring Ash Dam extension at various stages of its development, a plan of the Awaba Colliery mine workings and isopachs of estimated overburden thickness between the surface and the mining horizon.

The ash dam currently extends over underground workings at Awaba Colliery including areas of full extraction and areas of standing pillars. The proposed changes would increase the area of the ash dam retention, so that the area of the ash dam directly over the workings of Awaba Colliery increases approximately fivefold.

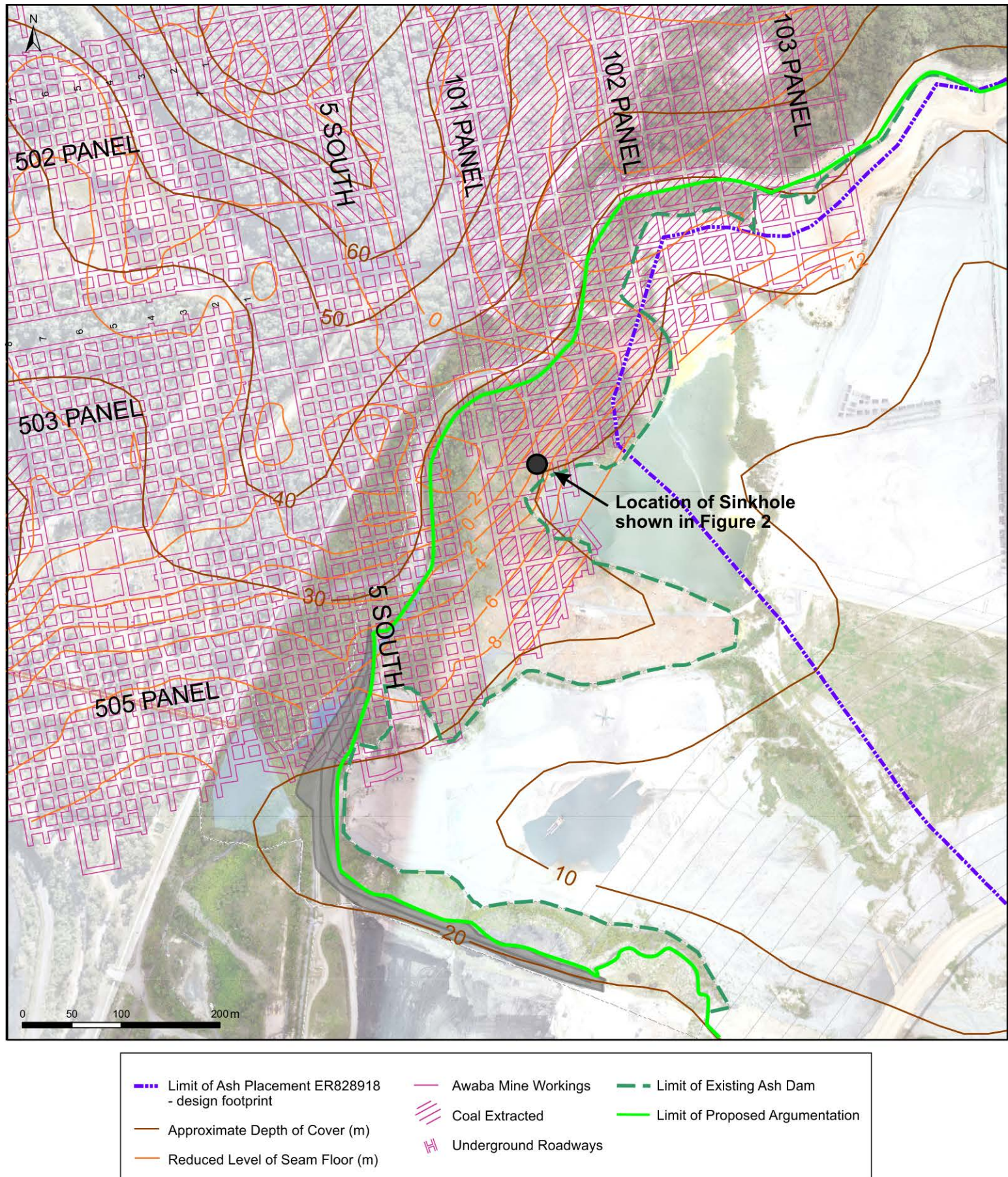


Figure 1: Site plan showing the extent and nature of the Awaba Colliery workings, the current extent of the ash dam, the proposed extension and contours of overburden depth and coal seam floor level (based on AECOM Fig1 60521040)

The proposed south western embankment would be located over standing pillars in Awaba Colliery.

Awaba Colliery mined the Great Northern Seam. The details of the stratigraphy in the area of interest are not known, but the Great Northern Seam typically has a conglomerate roof and a claystone floor. The condition of the conglomerate roof strata is not known but some weathering is likely. The claystone floor is recognised to have potential to deteriorate over time, particularly once the mine is flooded.

2.1 Overburden Depth

The overburden depth isopachs shown in Figure 1 of this report are reproduced from Figure 1 of the Origin EPS – Project Modification – Eraring Ash Dam. The overburden depth indicated in the area near the edge of the proposed ash dam ranges from 20m near the edge of the Awaba workings to over 50m at a distance of 300m from the edge of the ash dam.

The overburden depth contours shown appear to be an estimate. The overburden depth appears likely to be up to 6m greater based on the difference between LIDAR measurements of surface level and surveys of the mine floor level shown on Awaba Colliery mine plans. This difference is not considered significant for this assessment.

2.2 Mining Systems and Geometries

The site visit undertaken on 19 June 2018 included a visit to discuss details of the mining and mining history at Awaba Colliery with representatives from Centennial Coal Pty Ltd. SCT understands from the advice provided that the mining height at Awaba Colliery varies between 2.5m and 3.2m and that, in the area of interest, the mined height is likely to be approximately 3m. This value is considered to be a reasonable upper limit in the calculations of pillar stability. Any variation would not be significant in the context of the risk management strategies proposed in this report.

Individual roadways are shown in Figure 1 as the close-spaced parallel lines. Roadways are likely to have been mined at between 5.5m and 6.5m wide.

The mine plan shows three types of mining in the area of interest.

1. On development, the system of mining involved driving roadways to form generally square pillars at nominally 36m centres. Where the overburden depth is very low, no further mining was conducted.
2. In 101, 102, and 103 Panels, the larger square pillars formed on development were subsequently fully extracted. Extracted pillars are shown as cross-hatched in Figure 1. Pillar extraction typically allows up to about 85% of the coal to be safely recovered.
3. In 5 South, the larger square pillars were split and quartered to form smaller square pillars, nominally 11.5-12.5m wide (measured rib to rib)

but in practice most likely 10-11m wide. It is understood that the roof of these pillar splits is not typically supported or reinforced with roof bolts.

At overburden depths of 20-40m, the pillars formed on development and following split and quartering are likely to be only lightly loaded ($<2\text{MPa}$) relative to their nominal strength (7-8MPa). Nevertheless, the split and quartered pillars have a nominal width to height ratio in the range 3-4 and are, therefore, unlikely to be sufficiently large to prevent a pillar failure event propagating, should one commence. SCT understands that this potential was confirmed elsewhere in the mine when a panel of similar sized pillars collapsed in a few minutes after mining was complete.

Underground roadways, and particularly the intersections of roadways, which may be up to 10m diagonally across due to the turning requirements of underground mining machines, are likely to be susceptible to collapse over time depending on the nature of the overburden strata. At shallow depths where natural weathering of the immediate roof material is likely, failure of the roof strata has potential to break through to the surface as a sink hole. SCT is not aware of the condition of the overburden strata at this site and how significant the potential for sinkhole subsidence is. Sinkholes are commonly observed in the Newcastle area at shallow overburden depths ranging up to 30m. They are occasionally observed to overburden depths up to 50m.

A sinkhole close to the edge of the existing limit of ash placement was identified during the site visit. A photograph of this feature is shown in Figure 2. A step change in the surface topography nearby was also evident.

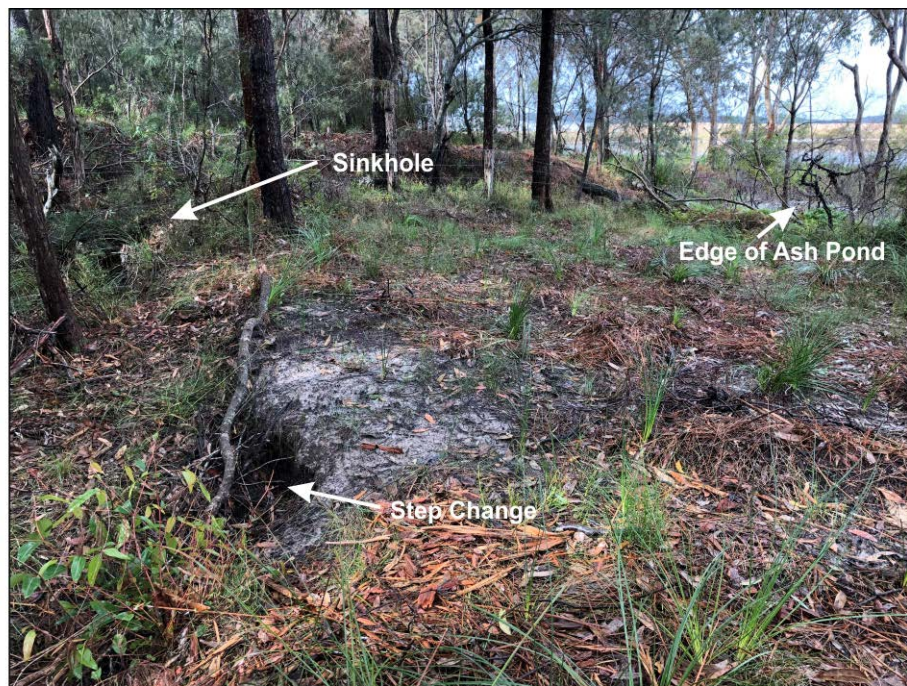


Figure 2: Photograph showing sinkhole near the edge of the Awaba Colliery workings and near the edge of the existing ash dam

Along the edge of areas of pillar extraction, failure of the overburden strata through to the surface is inevitable at shallow depths. Downward movement of up to 3m occurs in the immediate roof of the extracted void. With bulking of the falling overburden material, the ground displacements reduce gradually with height above the mining horizon. At shallow depths of less than 30m, there are likely to be a high number of open fractures that create direct pathways for water flow between the surface and underground. This type of failure may be expressed on the surface as a sinkhole or as a step change on the surface, depending on the composition of the near-surface soil profile.

Further sinkholes similar to one shown in Figure 2 are considered almost certain to be present along the edges of areas of pillar extraction at shallow depth.

2.3 Mine Water Level and Flow Paths

Awaba Colliery is flooded and fully connected across the footprint of the mine. Only small areas of the mine in the north and east are dry; the seam floor rises above the water level in the mine in these areas. SCT understands that:

- the water level in the mine is artificially maintained in the range RL16.5m AHD to RL17mAHD, by pumping at two locations and by natural overflow at low points in the surface topography in the southwestern parts of the mine
- one of the reasons for this pumping is to control the potential for artesian outflows at Eraring Power Station during periods of extended rainfall
- the water level increases with increasing rainfall consistent with the inflow of water through fractured and naturally jointed overburden strata.

3. HAZARD IDENTIFICATION

Major hazards associated with previous mine workings at Awaba Colliery with potential to impact the proposed ash dam augmentation project include:

1. Potential for subsidence in the form of either pillar collapse or roof failures leading to sink hole formation and impacts to the ash dam and the south western embankment.
2. Connectivity and the potential for surface water to flow from the ash dam into the mine workings and eventually into nearby tributaries of Dora Creek.

3.1 Subsidence Hazard

The subsidence hazard associated with pillar collapse has potential to cause differential movements at the surface of up to several metres. These movements are likely to be expressed as a step change around the edges of

the area where pillar collapse has occurred. This hazard is more likely to exist over 5 South Panel, where small pillars are still standing, and claystone floor strata expected at the site creates the opportunity for gradual deterioration over time.

The potential for sinkhole subsidence depends on the stratigraphic profile above the coal seam and the degree of weathering in this profile. The potential for sinkhole subsidence is likely to be greatest along the edges of areas where pillars have been extracted and large differential movements have already occurred. Sinkhole subsidence is also possible over 5 South Panel where most of the roadway intersections are likely to still be standing and above the standing intersections in Panels 101, 102 and 103.

The consequences of differential ground movement occurring through either subsidence mechanism are likely to depend on where this movement occurs. If differential movements occur below the proposed south western embankment, there is potential for loss of integrity of the embankment followed by piping failure and loss of material from the emplacement. If the differential movement occurs below the ash dam itself, there is potential for additional pathways for flow developing between the surface and underground mine workings.

There is a possibility that further mining in other seams in the future may trigger the onset of pillar instability. The likelihood or otherwise of any instability would depend on the nature of the mining proposed and the proximity of the coal seam to be mined to the Awaba Colliery mining horizon.

The most effective strategy to manage these hazards is to fill the mine voids and any fractures and voids that exist within the overburden strata with a stabilised fill material such as cement stabilised fly ash. Once the voids are filled, the potential for any further sudden ground movement at the surface associated with the underground workings at Awaba Colliery is completely eliminated.

3.2 Surface Water Interconnectivity Hazard

Mining induced fractures caused by extractive mining at shallow depth are expected to have potential to provide a direct flow pathway between the ash dam and the underground workings of Awaba Colliery. This flow pathway is likely to extend via these underground workings to wherever the surface level over the Awaba Colliery workings is less than the water level in the flooded workings. Figure 3 illustrates the flow pathway that is likely to exist between surface water in the ash dam and the nearby tributaries of Dora Creek. Figure 4 shows where artesian flows are likely to emerge into tributaries of Dora Creek when water level in the mine is greater than about RL16m AHD.

The sinkhole shown in Figure 2 is consistent with the presence of a potential flow pathway in close proximity to the existing ash dam. There are likely to be numerous similar features along the edge of areas where coal has been extracted, including directly below the existing ash dam along the edge of 102 Panel.

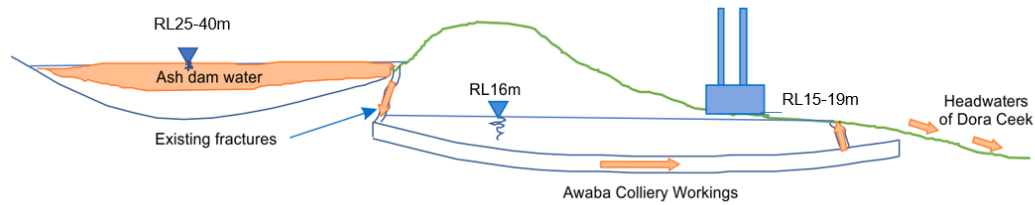


Figure 3: Potential flow path for water from ash dam to Dora Creek via Awaba Colliery underground workings



Figure 4: Potential outflow points for water from the Awaba Colliery underground workings

SCT understands that the water level in Awaba Colliery is currently managed by pumping at a level in the range RL16-17m AHD. At this water level, artesian flow of mine water would be expected into several tributaries of Dora Creek at the locations shown in Figure 4. Artesian flow at Eraring Power Station may also be possible.

Without intervention, the cessation of pumping at the closure of Awaba and Eraring Power Station could lead to the creation of an ongoing flow pathway whereby process water from the Eraring Ash Dam flowing into Awaba workings would ultimately flow into the nearby tributaries of Dora Creek. Water falling as rainfall onto the surface of the ash dam would always be at a higher elevation than the outflow points from the mine into Dora Creek. Water would

therefore continue to flow as artesian flow into waterways around the edge of Awaba at multiple low points in the topography as it currently does. The permanent positive head between the ash dam and tributaries of Dora Creek would ensure a constant gradient from the ash dam, through the mine voids and into these waterways.

This outflow could be eliminated by pumping down the water level in Awaba to a level where there is no artesian flow from the mine and treating the water so that it can be released safely into surrounding waterways, but this approach would need to be ongoing if it were to be effective and is unlikely to be sustainable in the long term.

An alternative strategy would involve restricting the flow pathway from the ash dam into the mine workings. A range of strategies to achieve this outcome are possible. The detailed design necessary to develop the optimum strategy is beyond the scope of this assessment.

The most effective strategy would involve filling the mining induced voids and fractures within the overburden strata with cement stabilised material of low hydraulic conductivity for a distance sufficient to reduce the potential for inflow from the surface to acceptably low levels. Creating an effective hydraulic barrier is likely to require a barrier that is larger than the barrier required for subsidence control. The distance from the edge of the ash dam that the mine voids and overburden fractures need to be filled would depend on the hydraulic conductivity of the fill material, the flow rates considered acceptable, water quality considerations and the strategy adopted.

A fill strategy that targets all the mine voids and overburden fractures below the ash dam would benefit from reduced pressure heads across the barrier compared to a fill strategy that aims to form a containment barrier around the edge of the ash dam, but it is possible that both strategies could be effective.

4. REVIEW OF EXISTING ENVIRONMENTAL ASSESSMENT

An existing EA was prepared for the “Upgrade and Expansion of the CCP Management System, Eraring Power Station” in November 2007. SCT has reviewed Section 7.7 Geotechnical of the EA, which addresses the potential geotechnical impacts having regard for the proximity of disused underground mine workings and the potential for impacts on the future extraction of coal reserves.

4.1 Conclusions of Existing EA

The EA indicates that the MSB gave conditional approval for the proposal in June 2006, provided the risk of subsidence was considered in the design of improvements to be built in the subject area.

The EA identifies the risk of localised subsidence and slumping of the land overlying Awaba Mine above the standing pillars in 101, 102 and 103 Panels. The risks associated with the standing pillars above 5 South are not

recognised, nor the risks associated with outflow of process water into the mine workings. The then Department of Primary Industries (DPI) indicated that for ash placement above RL133m (Eraring Datum), confirmation should be obtained from Centennial Coal that this area of the mine has been sealed.

The EA then goes on to state that:

"Centennial Coal, which operate [sic] Awaba Mine, confirmed the proposed expansion of the CCP storage facility overlays 101, 102 and 103 Panels and indicated that these panels have been fully extracted and are contained within a substantial barrier pillar. As such, Centennial Coal is satisfied that elevated vertical stress is not likely to impact upon underground pillar stability, and therefore it would not be necessary for the mine to be sealed."

EE [Eraring Energy] engaged technical engineering consultants Connell Wagner to review the advice provided by Centennial Coal, who confirmed that the mine would not require sealing, and that the cementitious nature of the dense phase emplacement would blanket seal the overlying surface of the mine workings."

The EA concludes that the proposed expansion of the CCP would not impact disused mine working in the vicinity of the CCP storage facility. The nature of the disused mine workings is not anticipated to be affected by elevated stress that may be placed on the area by the CCP storage facility. There is not likely to be future extraction of coal reserves in the area which would be impacted by the project.

4.2 Assessment

It is not clear to SCT what the term "sealed" means in the context of the EA statements. In any case, the EA concludes that sealing is not necessary.

The conclusions reached in the EA, that the ash fill is unlikely to overload the standing pillars at Awaba, are considered reasonable given that the standing pillars are lightly loaded by comparison with their estimated strength.

However, the potential for long term floor deterioration to degrade pillar stability has not been considered, nor has the potential for pillar instability deeper in the mine to cause a pillar creep. There has been previous experience of a pillar run (creep) at the mine in similar sized pillars. The additional abutment loading from areas of full pillar extraction has not been considered as an initiation point for instability. Small pillars are unlikely to be able to halt a pillar run once it starts.

A pillar run would be expected to lead to 1-2m of subsidence. There is some potential for further subsidence from pillar collapse at this site if pillar failure occurs due to deterioration of the floor strata anywhere within the panel. The consequences of such subsidence do not appear to have been considered.

The EA does not appear to recognise or address the major hazards identified in Section 3 of this report. These include:

- The presence of standing pillars below 5 South Panel which are much smaller, cover a larger area than the few standing pillars referred to in 101, 102 and 103 Panels, and are located directly below the proposed south western embankment.
- The potential for sink hole subsidence to occur below the emplacement and the proposed south western embankment irrespective of any pillar instability.
- The potential for further planned mining to destabilise the small pillars and/or overburden leading to increased potential for subsidence.
- The inflow of water from the ash dam into the mine workings and the potential for this inflow to increase due to increased water head and the larger area of mine workings covered by the ash dam; currently about 2ha and proposed to be increased to about 10ha.
- The potential for flow of water out into nearby tributaries of Dora Creek, particularly once dust suppression pumping ceases.

The 2007 EA does not appear to address the full range of risks which the project (as modified) may pose to the ash dam and the environment more generally.

5. MANAGING RISKS TO THE PROJECT

The shallow workings at Awaba Colliery present several significant risks to the proposed Eraring Ash Dam Augmentation Project. Approaches to manage these risks are discussed in this section.

5.1 Filling of Mine Voids

The two main risks considered are:

1. further subsidence causing additional fractures and ground movements
2. water connectivity between the ash dam and the mine workings because of the potential for outflow from the mine workings into tributaries of Dora Creek.

Both risks can be controlled through the application of mine void filling technologies, but the extent of void filling to control the water connectivity risk is expected to be larger than the extent of void filling for subsidence control so the subsidence risk is controlled by default if the water connectivity risks are managed.

5.1.1 Subsidence Control

The risks of any further subsidence can be completely eliminated by filling the mine voids and any fractures that exist within the overburden strata with mechanically stable fill material. Cement stabilised fly ash is a material that has been widely used in Australia at numerous sites, but there may be other suitable materials available. The technology for the placement of cement stabilised fill material is well established and there are several companies operating in Australia that specialise in this area.

The fill needs to be stabilised, typically with cement, so that it cannot migrate once it has been placed. Migration of fill material can occur through the action of erosion by water flow or as a result of further subsidence movements. The cement ratio required to stabilise the fill needs to be confirmed by mix design specific to the products used but, based on previous experience, is expected to be in the range 2-4% for fly ash fill.

The mine workings are flooded, so consideration needs to be given to designing the fill material to be viscous enough to displace in situ water from the voids being filled and to avoid dilution of the grout material. Suitable cemented stabilised fly ash grouts have been successfully placed below water level at numerous sites. The technology to design and place grout below water level is well established.

In areas where coal has been fully extracted, the voids created by mining have migrated upward and are distributed throughout the overburden strata making them more difficult to access. The total volume of these voids is less than the volume of coal mined because most of the void volume has migrated through to the surface as subsidence.

The areas that would need to be treated to control the potential for subsidence impacts include all the areas where there is overlap between the ash dam and the Awaba mine workings, including the area directly below the south western embankment as far as the downstream toe. It would be prudent to treat the mine workings and any fractures within the overburden strata to a distance of 10-20m beyond the edge of the ash dam and the toe of the south western embankment to completely eliminate any potential for subsidence impacts.

5.1.2 Water Flow Control

The potential for water connectivity between the surface and the underground workings would be controlled if the voids were filled with stabilised material of low hydraulic conductivity for a sufficient distance to limit flow rates to low levels. It is envisaged that cement stabilised fly ash has a sufficiently low hydraulic conductivity to provide an effective barrier. Suitable design and testing of the fill material would be required to confirm the hydraulic conductivity of the fill material and to determine how far the barrier would need to extend laterally to control flows to low enough levels to be acceptable.

To be effective for control of water flow, those sections of the mine where the pillars are still standing, would need to be completely filled at seam level and ideally pressure grouted to a nominal 100kPa. Those sections of the mine where coal has been extracted and the overburden has subsided would need to be filled from seam level through to the surface. Pressure grouting would be helpful to ensure voids are filled but would need to be limited controlled so as not to induce hydraulic fractures of the overburden strata. The technology to provide this control is available.

It is envisaged that the area required to be filled to control the water flow risk could extend from the edge of the mine workings to a distance of up to 100m from the limit of the proposed ash dam. However, the area that would be required to be filled would depend on a range of factors including the hydraulic conductivity of the fill material and the effectiveness of the filling strategy used. The detail of this design would rely on further testing and the engineering approach used and is therefore beyond the scope of this report.

5.1.3 Fill Estimates

Experience of filling mine voids at other sites, including the Hunter Expressway, Ipswich Motorway Upgrade, indicates that these controls can be effectively implemented using readily available technologies. Access to the site is good, drill depths are short and there is an ample supply of fly ash at hand.

The detail of the design is beyond the scope of this report, but an estimate of the volumes and areas involved is included to illustrate the scale of the treatments likely to be required.

Assuming a 100m wide barrier of stabilised fill is required beyond the limit of the proposed ash dam, the volume of mine voids to be filled is estimated to be approximately 200,000m³ (120,000m³ in the area of standing pillars and 80,000m³ in the areas where coal has been fully extracted). It is anticipated that the area of standing pillars (5 South) could be filled from 30-50 boreholes, drilled from the surface to depths ranging from 15m to 30m and the area of extracted coal (101, 102 and 103 Panel) could be filled from 70-80 boreholes drilled from the surface to depths of 15m to 40m.

These estimates need to be refined during detailed design and in discussion with mine fill contractors because there are a number of approaches that can be used to manage the filling process. Some of these required fewer drill holes and some may be more cost effective than others.

The footprint of void filling activities is likely to extend up to 100m from the edge of the proposed ash dam.

5.2 Other Considerations

SCT understands that the flow of water into the Awaba Colliery underground workings is currently being managed by pumping from a borehole in 10 South Panel. Once pumping ceases at the closure of Awaba Colliery and Eraring

Power Station, mine water is expected to continue to flow out of the mine workings as artesian flow into nearby tributaries of Dora Creek.

The hazard associated with this future flow of water already exists irrespective of the Eraring Ash Dam Augmentation Project. It is anticipated that strategies to manage increased water inflows from the proposed project would assist in mitigating this future hazard.

The surface is likely to be most accessible for mine void infilling and any other intervention strategies that might be proposed prior to filling of the ash dam. Once the ash fill has been placed, the challenges for surface access of machinery and drilling through the ash is significantly increased. Any works that are planned to be undertaken on the surface above Awaba Colliery should therefore be undertaken prior to ash placement onto those areas.

6. CONCLUSIONS AND RECOMMENDATIONS

The 2007 EA was reviewed to determine whether the findings remained relevant to the revised design. The current design is substantially different to that assessed in the 2007 EA and the findings of the previous EA are no longer considered relevant.

Risks to the proposed ash dam augmentation include:

1. further subsidence causing additional fractures and ground movements
2. water connectivity between the ash dam and the mine workings because of the potential for outflow from the mine workings into tributaries of Dora Creek.

Both risks can be controlled through the application of suitably engineered mine void filling technologies that are readily available in Australia. The extent of void filling required to control the water connectivity risk is expected to be larger than the extent of void filling for subsidence control, so that if the water connectivity risk is controlled, the subsidence risk would likely be controlled by default.

The detailed design of a fill strategy is beyond the scope of this assessment. A range of strategies are possible. The most effective approach is likely to involve filling all the mining related voids at the seam horizon and within the overburden strata with cement stabilised fly ash. Areas that would need to be treated using this strategy would include areas located below the proposed extension to the ash dam, directly below the south western embankment and beyond the limits of the ash dam to a sufficient distance out from the edge of the emplacement to provide an effective hydraulic barrier to lateral flow of surface water from the ash dam into the mine workings

To control water flow, those sections of the mine where the pillars are still standing, would need to be completely filled at seam level and ideally pressure grouted to a nominal 100kPa. Those sections of the mine where coal has been extracted and the overburden has subsided would need to be filled from seam

level through to the surface. Pressure grouting would be helpful to ensure voids are filled but would need to be limited controlled so as not to induce hydraulic fractures of the overburden strata. The technology to provide this control is available.

It is envisaged that the area required to be filled to control the water flow risk could extend from the edge of the mine workings to a distance of up to 100m from the limit of the proposed ash dam. However, the area that would be required to be filled would depend on a range of factors including the hydraulic conductivity of the fill material, the height to which the voids are filled, and the effectiveness of the filling strategy used. The detail of this design would rely on further testing and the engineering approach used and is therefore beyond the scope of this report.

Experience of filling mine voids at other sites indicates that these controls can be effectively implemented using readily available technologies. Access to the site is generally unconstrained, drill depths are short and there is an ample supply of fly ash at hand. As a general guide, the volume of mine voids to be filled is estimated to be up to approximately 200,000m³ (120,000m³ in the area of standing pillars and 80,000m³ in the areas where coal has been fully extracted). It is anticipated that the area of standing pillars (in 5 South) could be filled from 30-50 boreholes drilled from the surface to depths ranging from 15m to 30m. The area of extracted coal (in 101, 102 and 103 Panel) could also be filled from 70-80 boreholes drilled from the surface to depths of 15m to 40m.

Appendix E

AHIMS Search Results

Appendix E AHIMS Search Results

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60521040_8.15.1

Client Service ID : 334621

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-7-0147	Eraring;	AGD	56	362300	6339460	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	2630,102219
	<u>Contact</u>	<u>Recorders</u>	Doctor.Susan McIntyre-Tamwoy					<u>Permits</u>		
45-7-0151	M4;Balcolyn Street;	AGD	56	364620	6337170	Open site	Valid	Shell : -, Artefact : -	Midden	2685
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0161	M1;Hungary Point public reserve;	AGD	56	361610	6336400	Open site	Valid	Shell : -, Artefact : -	Midden	2685,102219
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0162	M2;Hungary Point Public Reserve;	AGD	56	361700	6336350	Open site	Valid	Shell : -, Artefact : -	Midden	2685,102219
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0163	M3;Crusader Camp, Yarrawonga Point;	GDA	56	364084	6337063	Open site	Valid	Shell : -, Artefact : -	Midden	2685,102219
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin,Extent Heritage Pty Ltd ,Mrs.La					<u>Permits</u>	4038,4224	
45-7-0171	M13;Balcolyn;	AGD	56	364620	6337170	Open site	Valid	Shell : -, Artefact : -	Midden	2685
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0172	M5;Beach Road, Boat Harbour;	AGD	56	365500	6336580	Open site	Valid	Shell : -, Artefact : -	Midden	2685
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0173	BB1;Fullers Creek, Bonnells Bay;	AGD	56	360800	6336100	Open site	Valid	Shell : -, Artefact : -	Midden	2693,102219
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0174	BB2;Freshwater Creek, Bonnells Bay;	AGD	56	361100	6335990	Open site	Valid	Artefact : -	Isolated Find	2693,102219
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists,Kerry Navin					<u>Permits</u>		
45-7-0205	Rocky point;	AGD	56	364500	6339500	Open site	Valid	Shell : -, Artefact : -	Midden	
	<u>Contact</u>	<u>Recorders</u>	Bonhomme Craib & Associates					<u>Permits</u>		
45-7-0208	Pipers Point;	AGD	56	363200	6338550	Open site	Valid	Shell : -, Artefact : -	Midden	102219
	<u>Contact</u>	<u>Recorders</u>	L.M Nelson					<u>Permits</u>		
45-6-2516	Pipers Point Rocky Point;	AGD	56	363450	6339000	Open site	Valid	Shell : -, Artefact : -	Midden	102219
	<u>Contact</u>	<u>Recorders</u>	Bonhomme Craib & Associates					<u>Permits</u>		
45-7-0069	Lake View Pantaloon Bay	AGD	56	365580	6340520	Open site	Valid	Shell : -, Artefact : -	Midden	
	<u>Contact</u>	<u>Recorders</u>	Len Dyll					<u>Permits</u>		
45-7-0070	Eraring;Crooked Creek;	AGD	56	363454	6341759	Open site	Valid	Shell : -, Artefact : -	Midden	
	<u>Contact</u>	<u>Recorders</u>	Len Dyll					<u>Permits</u>		
45-7-0090	Dora Creek;	AGD	56	362950	6338410	Open site	Valid	Shell : -, Artefact : -	Midden	102219
	<u>Contact</u>	<u>Recorders</u>	ASRSYS					<u>Permits</u>		
45-7-0002	Goat Island;Dora Creek;	AGD	56	361438	6337149	Open site	Valid	Shell : -, Artefact : -	Midden	102219
	<u>Contact</u>	<u>Recorders</u>	Richard Wright					<u>Permits</u>		
45-7-0004	Eraring Power Stn;Lake View;	AGD	56	364220	6339945	Open site	Valid	Shell : -, Artefact : -	Midden	

Report generated by AHIMS Web Service on 20/03/2018 for Luke Atkinson for the following area at Search using shape-file AHIMS_search_area_20180320.SHP with a buffer of 0 meters.

Additional Info : reporting. Number of Aboriginal sites and Aboriginal objects found is 47

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60521040_8.15.1

Client Service ID : 334621

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-3-0905	Sandy Creek;Sunday Creek;	AGD	56	358413	6342395	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-3-0907	Old Maitland Road Sandy Creek Sunday Creek	AGD	56	358116	6343578	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-3-1140	Morisset;	AGD	56	359290	6335970	Open site	Valid	Modified Tree (Carved or Scarred) : -	Scarred Tree	116,102219
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-7-0242	Bonnells Bay PAD	AGD	56	362150	6335830	Open site	Not a Site	Potential Archaeological Deposit (PAD) : -		102219
	<u>Contact</u> S Scanlon	<u>Recorders</u>						<u>Permits</u>	2234,2389	
45-7-0236	Fig Tree Point 1	AGD	56	365421	6337201	Open site	Valid	Shell : -		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-7-0240	Dora Creek (Stingaree Road)	AGD	56	360613	6337218	Open site	Valid	Artefact : 3, Shell : -		102219
	<u>Contact</u> Searle	<u>Recorders</u>						<u>Permits</u>	2215	
45-7-0243	WWSS3-2	AGD	56	360438	6337770	Open site	Valid	Potential Archaeological Deposit (PAD) : -		100134,102219
	<u>Contact</u> S Scanlon	<u>Recorders</u>						<u>Permits</u>	2273	
45-3-3232	Dora Ck Pad	AGD	56	358640	6339200	Open site	Valid	Potential Archaeological Deposit (PAD) : -		100145,102219
	<u>Contact</u> Searle	<u>Recorders</u>						<u>Permits</u>	2346	
45-3-3307	AA7	AGD	56	358156	6342811	Open site	Valid	Artefact : 4		
	<u>Contact</u> Searle	<u>Recorders</u>						<u>Permits</u>		
45-3-3373	AA2	AGD	56	359722	6342564	Open site	Valid	Artefact : 2		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-7-0261	Stockyard Creek AS with PAD (Swansea)	GDA	56	365653	6343871	Open site	Valid	Potential Archaeological Deposit (PAD) : 0, Artefact : 41		102458
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>	3095,3199	
45-7-0286	RPS MB 1	GDA	56	365025	6341071	Open site	Valid	Shell : -		
	<u>Contact</u> Awabakal LALC	<u>Recorders</u>						<u>Permits</u>		

Report generated by AHIMS Web Service on 20/03/2018 for Luke Atkinson for the following area at Search using shape-file AHIMS_search_area_20180320.SHP with a buffer of 0 meters.

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60521040_8.15.1

Client Service ID : 334621

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-7-0287	RPS MP 1 duplicate copy of 45-7-0317	GDA	56	364930	6336689	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact Awabakal LALC	Recorders	RPS Australia East Pty Ltd -Hamilton					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		
45-7-0304	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		
45-7-0311	RPS NEWST 18	GDA	56	360611	6341266	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Roger Mehr,RPS Australia East Pty Ltd -Hamilton					Permits		
45-7-0317	RPS MP1 duplicate copy of 45-7-0287	AGD	56	364930	6336689	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					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		
45-7-0292	RPS MP2	GDA	56	365342	6336208	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	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		
45-7-0302	RPS NEWST 9	GDA	56	362839	6343963	Open site	Valid	Artefact : -		
	Contact	Recorders	RPS Australia East Pty Ltd -Hamilton,Ms.Laraine Nelson					Permits		
45-7-0335	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		

Report generated by AHIMS Web Service on 20/03/2018 for Luke Atkinson for the following area at Search using shape-file AHIMS_search_area_20180320.SHP with a buffer of 0 meters.

Additional Info : reporting. Number of Aboriginal sites and Aboriginal objects found is 47

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 60521040_8.15.1

Client Service ID : 334621

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-7-0324	RPS COALLOG1	GDA	56	361815	6343309	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	Recorders	RPS - Echuca					Permits		
45-7-0328	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		
	Contact	Recorders	RPS - Echuca					Permits		
45-7-0358	Myuna Bay Sport and Recreation Centre Artefact Scatter 1 (MBSRC AS1)	GDA	56	364067	6340534	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Artefact - Cultural Heritage Management ,Mr.Alex Timms					Permits	4111	
45-7-0361	LMRC SM2	GDA	56	364140	6337122	Open site	Valid	Shell : -		
	Contact	Recorders	Extent Heritage Pty Ltd ,Mrs.Laressa Barry					Permits	4038,4224	

Report generated by AHIMS Web Service on 20/03/2018 for Luke Atkinson for the following area at Search using shape-file AHIMS_search_area_20180320.SHP with a buffer of 0 meters.

Additional Info : reporting. Number of Aboriginal sites and Aboriginal objects found is 47

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AECOM Australia Pty Ltd (previously HLA-Envirosciences)

Date: 20 March 2018

Level 21 420 George Street
SYDNEY New South Wales 2000

Attention: Luke Atkinson

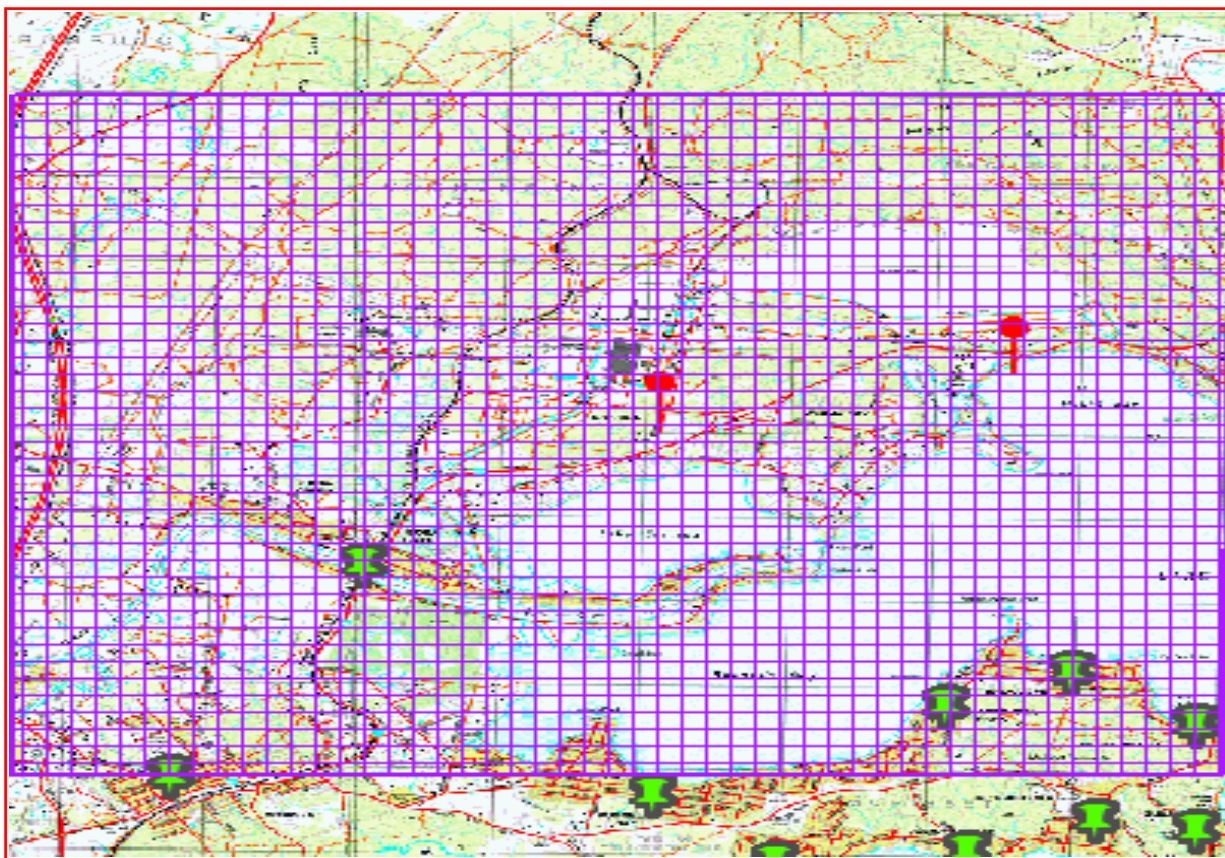
Email: luke.atkinson@aecom.com

Dear Sir or Madam:

AHIMS Web Service search for the following area at Search using shape-file

AHIMS search area 20180320.SHP with a buffer of 0 meters. Additional Info : reporting, conducted by Luke Atkinson on 20 March 2018.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

47	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

