



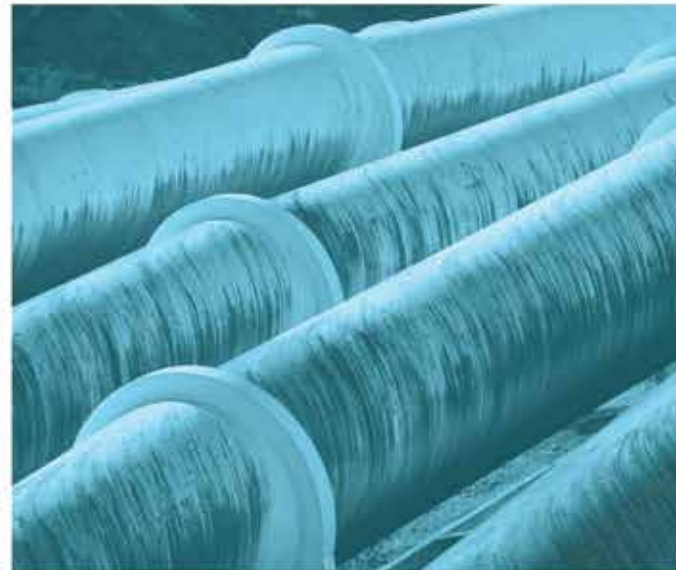
APPENDIX G - REVISED BDAR



Luddenham Advanced Resource Recovery Centre

Biodiversity Development Assessment Report

Prepared for Coombes Property Group and KLF Holding Pty Ltd
April 2021





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Luddenham Advanced Resource Recovery Centre

Biodiversity Development Assessment Report

Report Number

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Client

Coombes Property Group and KLF Holding Pty Ltd

Date

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Version

v3 Final

Prepared by



Steven Ward
Associate Ecologist
28 April 2021

Approved by



Paul Rossington
Associate Ecologist
28 April 2021

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Executive Summary

ES1 Background

In late 2019, CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), acquired the property at 275 Adams Road, Luddenham New South Wales (NSW) (Lot 3 in DP 623799, 'the subject property') within the Liverpool City Council municipality. The subject property is host to an existing shale/clay quarry (the quarry site).

CPG in partnership with KLF (the applicants) are seeking to construct and operate a new construction and demolition advanced resource recovery centre (the ARRC) on the subject property. The project is classed as a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).

A Biodiversity Development Assessment Report (BDAR) was prepared by EMM Consulting Pty Limited (EMM) on behalf of the applicants, to support the Environmental Impact Statement (EIS) for the project (EIS BDAR). The EIS BDAR addressed the requirements of the Secretary's Environmental Assessment Requirements (SEARs) and documented the terrestrial biodiversity assessment methods and results. The EIS BDAR also documented the initiatives built into the project design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements proposed to address any unavoidable residual impacts.

Since submission of the EIS, refinements have been made to the project in response to further detailed design and in response to submissions received on the EIS. During further design of the proposed road upgrades to Adams Road and the Elizabeth/Adams Road intersection the need to clear road-side native vegetation has been identified. There have also been changes to the size and footprint of the ARRC onsite detention basin.

This revised BDAR has been prepared by EMM to consider and outline the revised impacts associated with the refined project. The assessment also addresses the Department of Planning, Infrastructure and Environment; Environment, Energy and Science group (EES) submissions and provides further information regarding the biodiversity values at the subject property and the level of direct and indirect impacts on these values. Accordingly, this revised BDAR supersedes the EIS BDAR.

In parallel to the SSD application, the applicants are progressing an application to reactivate quarrying operations on the subject property to the south of the ARRC site. The proposal is to modify the existing development consent (DA No. 315-7-2003) for Luddenham Quarry. A BDAR has been submitted to address the environmental and planning obligations of the Modification (MOD 5 BDAR). Impacts associated with the proposal for the ARRC are assessed in this report, whilst impacts associated with MOD 5 are assessed in a separate BDAR. The study area for this report is broader than that assessed for the MOD 5 BDAR, consisting of the ARRC property, as well as land within and adjacent to Adams Road and Elizabeth Drive, and covers 23.9 ha in total.

ES2 Overview of the proposed ARRC

A detailed description of the project was provided in Chapter 2 of the Environmental Impact Statement (EIS) (EMM 2020a). An overview of the ARRC project is shown in Figure 1.2. The key components of the project are:

- construction and operation of an advanced construction and demolition resource recovery centre;
- all acceptance, processing, storage and dispatch of waste and recycled product will be carried out within an enclosed warehouse;
- accepting and processing up to 600,000 tonnes per annum (tpa) of waste for recycling;

- dispatch of up to approximately 540,000 tpa of recycled product;
- dispatch of approximately 60,000 tpa of non-recyclable residues either to an offsite licensed waste facility or to the adjacent quarry void (following approval of quarry rehabilitation activities);
- upgrade of the access road from the subject property to Adams Road;
- use of the access road from the subject property to Adams Road; and
- ARRC operations up to 24 hours a day, 7 days per week.

ES3 Landscape

The development is situated within the Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) region, and Cumberland subregion. The subject property is located within the upper reaches of the Hawkesbury River catchment, with Oaky Creek running along the eastern boundary.

The locality is considered highly cleared and fragmented, with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land. The subject property itself has previously been utilised for quarrying and agricultural land uses. The Western Sydney International (Nancy-Bird Walton) Airport (WSA) site is located immediately to the east and south of the subject property, and its construction has, or will, remove native vegetation across the footprint of the WSA during the course of that project.

There are no areas of outstanding biodiversity value, as defined in Part 3 of the *Biodiversity Conservation Act 2016* (BC Act) within a 1,500 m buffer of the subject property.

ES4 Native vegetation

Survey identified that most of the subject property is dominated by open grasslands of varying condition and quality. Most of these areas have been heavily impacted by pastoral activities, particularly grazing and previous quarry activities, and are dominated by exotic plant species. Consequently, the majority of the study area is mapped as cleared or exotic (22.61 ha). The following native plant community types (PCTs) were recorded within the subject property:

- PCT 849 – Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, which is consistent with the BC Act listed *Cumberland Plain Woodland in the Sydney Basin Bioregion Critically Endangered Ecological Community* (Cumberland Plain Woodland CEEC); a subset of this area along Adams Road, is also consistent with the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC*.
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley, which is consistent with the BC Act listed *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community* (Swamp Oak Floodplain Forest EEC); a subset of this area along Oaky Creek is also consistent with the EPBC Act listed *Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland EEC*.

PCT 849 areas in medium (0.92 ha) and poor (0.37 ha) condition are located within the property and adjacent to Adams Road and Elizabeth Drive. This vegetation community will be impacted due to road widening works. All areas of PCT 849 are consistent with the relevant BC Act CEEC, whereas only a subset of the PCT within the study area consisting of less fragmented areas, is consistent with the EPBC Act CEEC (0.84 ha).

PCT 1800 occurs in medium (1.44) and poor (1.23 ha) condition on the site. All areas of PCT 1800 are consistent with the relevant BC Act EEC, whereas only a subset of the PCT within the study area consisting of less fragmented areas, is consistent with the EPBC Act EEC (2.12 ha).

ES5 Threatened species

No threatened flora species were recorded across the study area.

Targeted survey was undertaken for the Green and Golden Bell Frog, targeting the ponds, exotic grasslands, and current quarry pit, but the species was not detected. However, due to a lack of access to potential habitat along Cosgroves Creek to the west of Adams Road, the presence of the species in this area was assumed.

One candidate species credit species, Southern Myotis (*Myotis macropus*) was recorded within the subject property, foraging over ponds along Oaky Creek. In addition, Southern Myotis was recorded roosting within a culvert over Oaky Creek, underneath an old eastern access road. This culvert sits within Commonwealth land that is part of the WSA. None of the proposed activities on the subject property propose changes to the culvert, and the old access road has been fenced off and will no longer be utilised due to the WSA development. Outcomes for the culvert itself will be subject to the WSA development activities.

Passes for a number of other threatened bat species were detected through bat detector survey, but for these species only ecosystem credit components were identified as present within the site and surrounding landscape.

ES6 Impact avoidance, minimisation and mitigation

The proposed ARRC including road upgrades has been designed to avoid and minimise impact on sensitive biodiversity areas. The revised ARRC footprint has been designed to, where possible, avoid impacts to:

- BC-listed Cumberland Plain Woodland CEEC (PCT 849) present along Adams Road and Elizabeth Drive, and in the western-most portion of the Subject Property;
- EPBC-Act listed *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* CEEC (PCT 849), present along Adams Road and Elizabeth Drive;
- BC-Act listed Swamp Oak Floodplain Forest EEC (PCT 1800), present along Elizabeth Drive and along the eastern boundary of the subject property; and
- EPBC-Act listed *Coastal Swamp Oak* (*Casuarina glauca*) *Forest of the New South Wales and South East Queensland* EEC (PCT 1800), present along Elizabeth Drive and along the eastern boundary of the Subject Property.

Key avoidance measures to be implemented by the proponent comprise:

- avoidance of direct impacts to Oaky Creek;
- avoidance of works on the Elizabeth Drive bridge over Cosgrove Creek, which would have resulted in impacts to the adjoining vegetation;
- minimisation of impacts to PCT 849, by avoiding areas outside the road corridor;
- minimisation of impacts to PCT 1800, by only impacting on small areas of the fragmented habitat and vegetation present within the road corridor;
- minimisation of impacts to PCT 1800, by avoiding impacts to the vegetation on the south-western boundary;

- utilisation of the existing cleared areas wherever feasible; and
- designing a water management system to minimise potential impacts to Oaky Creek.

ES7 Biodiversity impacts and offsets

Following the implementation of avoidance and minimisation measures, the project will remove 0.42 hectares of native vegetation, of which 0.11 ha is BC Act listed Cumberland Plain Woodland CEEC (PCT 849) and 0.31 ha is BC Act listed Swamp Oak Floodplain Forest EEC (PCT 1800).

Species polygons were determined for Green and Golden Bell Frog and Southern Myotis.

In addition, two ephemeral ponds, designated as pond 1 and pond 4, within the ARRC project, will need to be removed. It is noted that pond 4 will be replaced by a stormwater detention basin in approximately the same location as the current pond. Due to the development of Western Sydney International (Nancy-Bird Walton) Airport immediately to the east of the project, the new stormwater basin will be required to be netted, to reduce the risk of bird or bat strike on planes utilising the airport once operational.

The project proposes to compensate for loss of two ponds, designated as pond 1 and pond 4, which are 0.04 ha and 0.08 ha in area respectively, within the ARRC project, due to potential for these ephemeral waterbodies to provide foraging habitat for Southern Myotis. It is unknown to what degree these ponds are utilised for foraging by Southern Myotis, and due to their small area and shallow depth they may be of limited value. Furthermore, the BAM does not contain any formal requirement for offsets to be delivered for impacts on areas that are not mapped as a PCT. Nonetheless, a total of 6 additional Southern Myotis credits are proposed to be retired, treating both ponds as if they were ideal habitat for Southern Myotis.

The project requires the following biodiversity credits:

- PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion – 4 credits.
- PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – 7 credits.
- Green and Golden Bell Frog – 5 credits.
- Southern Myotis – 16 credits (10 credits as determined by the BAM calculator and 6 credits to account for prescribed impacts).

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Abbreviations

ARRC	Advanced Resource Recovery Centre
BAM	Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity Conservation Division
BDAR	Biodiversity Development Assessment Report
BioNet	NSW BioNet
Biosecurity Act	NSW <i>Biosecurity Act 2015</i>
BOS	Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CHM	Canopy Height Model
CPG	Coombes Property Group
DAWE	Commonwealth Department of Agriculture, Water and Environment
DFSI	NSW Department of Finance, Services and Innovation
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESCP	Erosion and sediment control plan
FM Act	NSW <i>Fisheries Management Act 1994</i>
GDE	Groundwater-dependent ecosystem
GPS	Geographic Positioning System
IBRA	Interim Biogeographic Regionalisation of Australia
KFH	Key Fish Habitats
KLF	KLF Holding Pty Ltd
KTP	Key Threatening Process
LGA	Local Government Area
LiDAR	Light Detection and Ranging
MNES	Matters of National Environmental Significance
MOD 5	Modification 5 of DA NO. 315-7-2003
NSW	New South Wales
OEH	Office of Environment and Heritage (now BCD)
PCT	NSW Plant Community Type

PMST	Protected Matters Search Tool
RVA	Rapid Vegetation Assessment
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SRD	State and Regional Development
SSD	State Significant Development
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities
TPZ	Tree Protection Zone
VIS	Vegetation Information System
WSA	Western Sydney International (Nancy-Bird Walton) Airport

STAGE 1: BIODIVERSITY ASSESSMENT

1 Introduction

1.1 Overview

In late 2019, CFT No 13 Pty Ltd, a member of Coombes Property Group (CPG), acquired the property at 275 Adams Road, Luddenham NSW (Lot 3 in DP 623799, 'the site') within the Liverpool City Council municipality. The subject property is host to an existing shale/clay quarry. The subject property shares its southern and eastern boundaries with the Western Sydney International (Nancy-Bird Walton) Airport (WSA) development site (Figure 1.1).

CPG owns, develops, and manages a national portfolio of office, retail, entertainment, land, and other assets. The company's business model is to retain long-term ownership and control of all its assets. CPG has the following staged vision for the long-term development of the site:

- **Stage 1 Quarry Reactivation: Solving a problem.** CPG intends to responsibly avoid the sterilisation of the remaining natural resource by completing the extraction of shale which is important to the local construction industry as raw material used by brick manufacturers in Western Sydney. Following the completion of approved extraction activities, the void will be prepared for rehabilitation.
- **Stage 2 Advanced Resource Recovery Centre and Quarry Rehabilitation: A smart way to fill the void:** CPG in partnership with KLF Holdings Pty Ltd (KLF) and in collaboration between the circular economy industry and the material science research sector, intends to establish a technology-led approach to resource recovery, management, and reuse of Western Sydney's construction waste, and repurposing those materials that cannot be recovered for use to rehabilitate the void. This will provide a sustainable and economically viable method of rehabilitating the void for development.
- **Stage 3 High Value Employment Generating Development: Transform the land to deliver high value agribusiness jobs.** CPG intends to develop the rehabilitated site into a sustainable and high-tech agribusiness hub supporting food production, processing, freight transport, warehousing, and distribution, whilst continuing to invest in the resource recovery research and development (R&D) initiatives. This will deliver the vision of a technology-led agribusiness precinct as part of the Aerotropolis that balances its valuable assets including proximity to the future WSA and Outer Sydney Orbital.

This report relates to a new development application relating to the delivery of Stage 2 above.

KLF is an Australian-owned and operated waste management company that operates two strategically located resource recovery and recycling facilities in Sydney; one at Camellia and another at Asquith. KLF has 20 years' experience in the waste recycling and resource recovery industry. KLF facilities are licensed by the NSW Environment Protection Authority (EPA) and have full International Organisation for Standardisation (ISO) accreditation.

The project is integral in achieving the intended future commercial/industrial land use for the subject property as the project provides a commercially viable means to infill the quarry void (subject to separate development consent). This will support the Western Sydney Airport and ongoing development of the Western Sydney Aerotropolis.

1.2 Background

CPG in partnership with KLF (the applicants) are seeking to construct and operate a new construction and demolition advanced resource recovery centre (the ARRC) on the subject property to the north of the existing quarry void. The ARRC site is shown in Figure 1.2. The project is classed as a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).

A new State significant development (SSD) consent under Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is required to establish the ARRC. On 24 April 2020, the Department of Planning, Industry and Environment (DPIE) issued Secretary's Environmental Assessment Requirements (SEARs) for the environmental impact statement (EIS) for the project. The SSD consent application number is SSD-10446.

A Biodiversity Development Assessment Report (BDAR) was prepared by EMM Consulting Pty Limited (EMM) on behalf of the applicants, to support the EIS for the project (EIS BDAR). The EIS BDAR addressed the requirements of the Secretary's Environmental Assessment Requirements (SEARs) and documented the terrestrial biodiversity assessment methods and results. The EIS BDAR also documented the initiatives built into the project design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements proposed to address any unavoidable residual impacts.

Since submission of the EIS, refinements have been made to the project in response to further detailed design and in response to submissions received on the EIS. Further design of the proposed road upgrades to Adams Road and the Elizabeth/Adams Road intersection has identified the need to clear road-side native vegetation. There have also been changes to the size and footprint of the ARRC onsite detention basin.

This revised BDAR has been prepared by EMM to consider and outline the revised impacts associated with the refined project. The assessment also addresses the Department of Planning, Infrastructure and Environment; Environment, Energy and Science group (EES) submissions and provide further information regarding the biodiversity values at the subject property and the level of direct and indirect impacts on these values. Accordingly, this revised BDAR supersedes the EIS BDAR.

The subject property contains an existing clay and shale quarry approved under Development Consent DA315/7/2003, as modified. The quarry is currently inactive. It is noted that Development Consent DA315/7/2003 remains in force, including modifications 1–3, with quarrying activities currently allowed to occur until 31 December 2024. Modification 4 was withdrawn.

CPG and KLF (the 'applicants') have commenced the application process to modify the quarry's consent to allow quarry operations to recommence, with the primary intention of changing the approved access to the subject property to allow quarry operations (Modification 5, also referred to as MOD 5). A BDAR has been submitted to address the environmental and planning obligations of the Modification (MOD 5 BDAR). Impacts associated with the proposal for the ARRC are assessed in this report, whilst impacts associated with MOD 5 are assessed in a separate BDAR.

In addition, further design of the proposed road upgrades on Adams Road and the Elizabeth/Adams Road intersection has identified the need to clear road-side native vegetation. Accordingly, this BDAR incorporates assessment of impacts due to these road upgrades.

The approved quarry water management system includes a quarry sump to dewater the quarry void to two sedimentation dams. Water collected in the surface water management system is used for dust suppression or irrigation or is discharged to Oak Creek.

A Vegetation Management Plan (VMP), as required under the quarry consent, was prepared and approved (UBM Ecological 2009). Vegetation west of the site was identified as "Western Eucalypt Woodland" consistent with Cumberland Plain Woodland. Vegetation along the eastern roughly 40 m edge of the property was identified as "Riparian Zone" (Figure 1.3).

For clarity, no application has yet been submitted for the infill of the quarry or Stage 3 for Employment Generating Development. These applications will be subject to relevant additional assessment at the time of application, and therefore are not discussed within this report.

1.3 Project overview

A detailed description of the project was provided in Chapter 2 of the Environmental Impact Statement (EIS) (EMM 2020a). An overview of the ARRC project is shown in Figure 1.2. The key components of the ARRC project are as follows:

- Construction and operation of an advanced construction and demolition resource recovery centre.
- Accepting and processing up to 600,000 tonnes per annum (tpa) of waste for recycling.
- Despatch of approximately 540,000 tpa of recycled product.
- Despatch of approximately 60,000 tpa of unrecyclable material either to an offsite licensed waste facility or to the adjacent quarry void (the later will be subject to separate approval).
- Upgrade of the access road from the subject property to Adams Road.
- Use of the access road from the subject property to Adams Road.
- The AARRC will not accept putrescibles, liquid or hazardous waste.
- The AARRC will operate up to 24 hours a day, 7 days per week.

The AARRC will accept general solid waste comprising building and demolition waste as well as selected commercial and industrial waste. No special, liquid, hazardous, restricted solid water, putrescible solid waste, or odorous waste will be accepted at the AARRC.

The vast majority of materials accepted will be recovered, the remaining minor amount (10%) of unrecyclable materials will be disposed of at an offsite licensed landfill or to the quarry void on the site as part of rehabilitating the void (subject to a future application). The proposed project layout is shown in Figure 1.2.

Refinements to the project as described in Chapter 2 of the EIS have been made in response to submissions received and further detailed design of the project. These include minor refinements to the ARRC footprint and layout as described below:

- Refinements to the size and footprint of the onsite detention basin. These refinements have slightly increased the biodiversity impacts of the project. This minor increase in impact has been assessed in this revised BDAR.
- The overflow structure from the onsite detention basin has been designed since submission of the EIS and will include a control pit, an overflow pit and a discharge pipe. Stormwater will discharge via the discharge pipe and outfall structure to a small depression immediately adjacent to Oak Creek. The outfall structure includes scour protection and suitable energy dissipation measures.

The revised ARRC site layout is shown in Figure 1.2.

In addition, the following road upgrades will be required along Adams Road and the Elizabeth/Adams Road intersection:

- Upgrade of the Elizabeth Drive/Adams Road intersection including:
 - provision of a 90 m deceleration left-hand turn lane into Adams Road to Austroads standards;

- restriction of right-hand heavy vehicle turn into Adams Road with inbound heavy vehicles accessing the site from Elizabeth Drive west using The Northern Road/Adams Road intersection;
 - provision of a short right-hand turn lane into Adams Road for light vehicles only;
 - widening of existing intersection to accommodate B-double swept paths; and
 - provision of a short left hand turn lane on Adams Road into Elizabeth Drive to minimise queuing on Adams Road.
- Road widening will also be required at the site access/Adams Road intersection to allow B-doubles to turn into the ARRC site without encroachment.
 - Pavement upgrades on Adams Road between Elizabeth Drive and Anton Road to enable the existing road load limit to be lifted. It is noted that pavement upgrades will likely be carried out between the site access and Elizabeth Drive as part of the quarry reactivation (MOD 5). Pavement upgrades on Adams Road between The Northern Road and Anton Road will be carried out as part of road upgrades required for the WSA. Pavement upgrades will not include widening outside of the existing road surface (including unsealed verge).

The road upgrade footprint is shown in Figure 1.1 and Figure 4.1.

1.4 Purpose of this report

This revised BDAR has been prepared by EMM to consider and outline the revised impacts associated with the refined project. The assessment also addresses the Department of Planning, Infrastructure and Environment; Environment, Energy and Science group (EES) submissions and provides further information regarding the biodiversity values at the subject property and the level of direct and indirect impacts on these values.

Accordingly, this revised BDAR supersedes the EIS BDAR.

The revised BDAR documents the terrestrial biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise impacts to terrestrial biodiversity, and the mitigation and management measures, including offset requirements proposed to address any unavoidable residual impacts.

The specific objectives of this assessment are to:

- describe the existing biodiversity values and existing environment;
- identify and assess the potential for presence of biodiversity values, including threatened species and communities under relevant legislation including the NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- identify ecological constraints within, and impacts arising from, the project;
- provide mitigation measures to reduce the impacts from the project on biodiversity wherever possible; and
- where impacts are unavoidable, identify compensatory measures that are appropriate.

1.5 EES Submission on the EIS BDAR

Matters raised in EES's submission on the EIS have been considered and addressed in this revised assessment. Detailed responses to all the submissions received are provided in the Submissions Report prepared for the project (EMM 2021b). A summary of the key matters relevant to this assessment are provided in Table 1.1, together with how each matter has been addressed within this report.

Table 1.1 Key matters raised in EES' submission

Matter raised	Where addressed
Regarding the onsite detention (OSD) storage, the surface water assessment (EMM 17 July 2020) state (page ES.2) "Discharges are predicted to occur from the onsite detention storage into Oaky Creek. Scour protection and energy dissipation will be constructed at the discharge location and at the confluence with Oaky Creek to reduce erosion potential associated with the increase flow rates from the immediate site." It is not stated in the BDAR or in the surface water assessment how the water will be delivered to Oaky Creek to reduce erosion potential associated with the increased flow rates from the immediate site." It is not stated in the BDAR or in the surface water assessment how the water will be delivered to Oaky Creek but the final drawing of the surface water assessment shows a structure for this (see the drawing titled 'Stormwater Catchment Plan', drawing no. 030, AMDT D). Figure 1.2 of the BDAR shows no such structure and its impacts have not been considered.	The overflow structure from the onsite detention basin will include a control pit and overflow pit and discharge pipe. Stormwater will discharge via the discharge pipe and outfall structure to a small depression immediately adjacent to Oaky Creek. The outfall structure includes scour protection and suitable energy dissipation measures.
The full impacts of the OSD storage needs to be assessed in the BDAR.	The changes in the ARRC site as a result of the overflow structure and changes to the onsite detention basin size are assessed in this revised BDAR (refer Chapter 6).
Although the BDAR does not mention dewatering dams, it is conceivable that this will be needed for some of the ponds shown in Figure 5.2. This needs to be confirmed and the impacts assessed; accordingly, mitigation measures also need to be addressed.	Ponds 1 and 4 shown in Figure 4.1 will be removed as part of the construction of the ARRC.
No construction footprint is given in the BDAR and the potential impacts associated with construction, like the stockpiling of materials and the storage of plant and equipment, has not been considered; this could have negative implications for any retained vegetation and habitat on the subject property.	Their removal is assessed in the Chapter 6, including proposed management and mitigation of dam dewatering.
As such, the BDAR needs to include a construction footprint and needs to assess any associated impacts and include appropriate mitigation measures.	Construction of the ARRC will be contained within the direct impact footprint as shown in Figure 4.1.

Table 1.1 Key matters raised in EES' submission

Matter raised	Where addressed
<p>The biodiversity development assessment report (BDAR) contains inconsistent information relating to the targeted surveys for Green and Golden Bell Frog (GGBF). Importantly, Table 5.12 states “egg mass were detected during the nocturnal searches listed above” while Table 5.16 states “Not recorded during targeted surveys”.</p> <p>Figure 5.2 shows the survey effort was confined to the vegetation near the dams on the ARRC site and subject property, and along those parts of Oaky Creek in the vicinity of the subject property. This survey effort is inadequate because potential habitat was not surveyed.</p> <p>Also, the Threatened species survey and assessment guidelines: filed survey methods for fauna Amphibians (DECC, April 2009) states, for survey methods and effort (page 15). “Combination of tadpole surveys, call surveys (this species has a distinctive call) and active searching both during the day and night.” However, diurnal searches for this species were not carried out (see Table 5.12).</p> <p>Furthermore, Table 5.12 states “Green and Golden Bell Frog confirmed calling at a reference population” but no information is given about the reference population (including location) and how and when it was observed.</p> <p>As such: targeted surveys need to be completed to cover all available habitat on the subject property for this species; diurnal surveys need to be carried out; and information needs to be given on the location of the reference population and when and how it was observed, and what was observed.</p>	<p>Green and Golden Bell Frogs (GGBFs) or egg masses were not detected by EMM during nocturnal surveys. Neither were GGBFs detected during diurnal surveys targeting threatened snail species and threatened flora, which consisted of walking over the site, including grassland areas.</p> <p>The GGBF survey effort is shown in Figure 5.2. The surveys involved walking transects across the study area, listening for calls, and turning over logs/litter/rubbish where encountered. The survey included transects covering the entire study area, where accessible. Inaccessible areas included fenced areas, flooded areas, the quarry pit, and Cosgroves Creek. Although these areas were not walked, it is considered that calling frogs present in those areas would be heard during the diurnal or nocturnal surveys, with the exception of Cosgroves Creek due to lack of access. Refuge habitat (eg logs and tin panels) were also checked during night surveys (refer Table 5.2).</p> <p>Information regarding the GGBF reference population, including location and when the reference population was surveyed, has been included in Table 5.8 of the revised BDAR.</p> <p>It has also been assumed that GGBF could be present along Cosgroves Creek because it was not possible to access this waterway.</p>
<p>The BDAR contains inconsistent information relating to the targeted survey for Cumberland Plain Land Snail (CPLS). Table 5.13 shows the search was confined to the Cumberland Plain Woodland on the subject property (PCT 849) but Figure 5.2 shows transects were done across a much larger area. These transects, however, appear to be the same as those shown in Figure 5.1 (that is, there are one and the same as the targeted flora searches) and Table 5.4 states, in relation to CPLS, “Species associated with PCT 849 which is located outside of the impact area.”</p> <p>Considering these things, the survey effort for CPLS is considered inadequate because the Cumberland Swamp Oak Riparian Forest (PCT 1800) was not surveyed. Bionet contains at least eight records for this species from the past years, within approximately 4 km of the site. As such, a targeted survey that incorporates PCT 1800 and any areas of rubbish or coarse woody debris or grass clumps, needs to occur.</p>	<p>Targeted surveys were carried out for GGBF, Cumberland Plain Land Snail and threatened flora concurrently.</p> <p>Both PCT 849 and PCT1800 were surveyed. As shown in Figure 5.2, all accessible parts of the study area were surveyed.</p>

Table 1.1 Key matters raised in EES' submission

Matter raised	Where addressed
Prescribed impacts on habitat for species credit species The Biodiversity Assessment Method Operational Manual Stage 2 (DPIE 2019) discusses direct and prescribed impacts on species credit species. It is recommended that the approach described in Box 3 (page 20) of this manual is considered for GGBF and Southern Myotis.	<p>This report provides a detailed assessment of the prescribed impacts on Southern Myotis in accordance with the BAM Operational Manual Stage 2 (DPIE 2019) (refer Section 6.2.2v).</p> <p>With regards to GGBF the species was not detected within the ARRC site, and therefore it is considered that there will not be prescribed impacts as a result of removal of ponds. However, due to the lack of access to Cosgroves Creek it has been assumed that GGBF could potentially occur in adjoining habitat. Figure 5.3 delineates the area subject to the buffer around Cosgroves Creek as potential habitat, and the native vegetation which will be directly and indirectly impacted. Prescribed impacts on non-native vegetation are assessed in Table 6.3. Additional offsets for prescribed are not proposed as these are potential impacts should the species be present along Cosgroves Creek.</p>
This case was checked in BOAMs on 11 August 2020 and was founded to be 'in progress'. The BAM-C needs to be finalised and the case submitted so it can be reviewed by EES.	The BAM-C has been revised and will be submitted to EES concurrently with the submission of the Submissions Report and revised BDAR.
<p>The BDAR does not address asset protection zones (APZs) but the environmental impact statement (EMM 22 July 2020) states (page 18) "All areas of the ARRC site external to the ARRC warehouse will be hardstand with the exception of small landscaped areas near the ARRC site office and along the site access road (see Appendix T). Hardstand areas will accommodate internal access roads, parking and required bushfire asset protection zones (APZs)." and (page 26) "There will be 7–12 m-wide APZs maintained between the riparian corridor of Oaky Creek and the eastern wall of the ARRC warehouse (refer to Section 6.4.1). Fire and Rescue NSW will be consulted further during the detailed design of the fire protection strategy and complete the design accordingly."</p> <p>The locations and impacts of APZs need to be confirmed in the BDAR.</p>	The required asset protection zones (APZs) will be accommodated within the hardstand development footprint area of the ARRC site (EMM 2021a, Section 3.2.1).

1.6 Site context

The ARRC site is within 275 Adams Road, Luddenham NSW (the subject property described as Lot 3 in DP 623799) in the Liverpool City Council local government area in the Greater Western Sydney region of New South Wales (NSW). The subject property is approximately 19 kilometres (km) north-west of the city of Liverpool, 25 km south-west of the city of Parramatta and approximately 43 km south-west of the city of Sydney.

The subject property covers approximately 19 hectares (ha) and is bordered to the east and south by the Commonwealth-owned WSA site. The WSA has been approved and construction, including bulk earthworks and road infrastructure upgrades, is currently underway. In addition to WSA, surrounding land uses include a mix of agricultural, rural industrial and commercial, and residential development. Oaky Creek forms the eastern boundary of the site.

Oaky Creek runs along the eastern border of the subject property. A strip of land along the eastern side of Oaky Creek is zoned as Environment and Recreation under the Western Sydney Aerotropolis State Environmental Planning Policy.

The road upgrade footprint encompasses two distinct areas the Adams Road/site access intersection and the Elizabeth Drive/Adams Road intersection.

The subject property and road upgrade footprint are included within the Draft Cumberland Plain Conservation Plan (DPIE 2020), which if approved would result in most of the vegetation in the western part of the subject property and all the vegetation in the road upgrade footprint being granted biodiversity certification as it is identified as being 'Certified – Urban Capable'.

1.7 Project area, survey area, disturbance and avoidance footprint definitions

Table 1.2 defines the areas discussed in the BDAR. The ARRC site and road upgrade footprint is illustrated in Figure 1.2 and covers the development application area for the project.

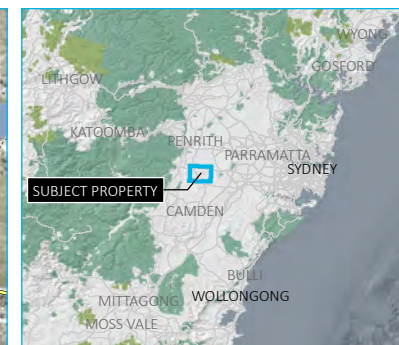
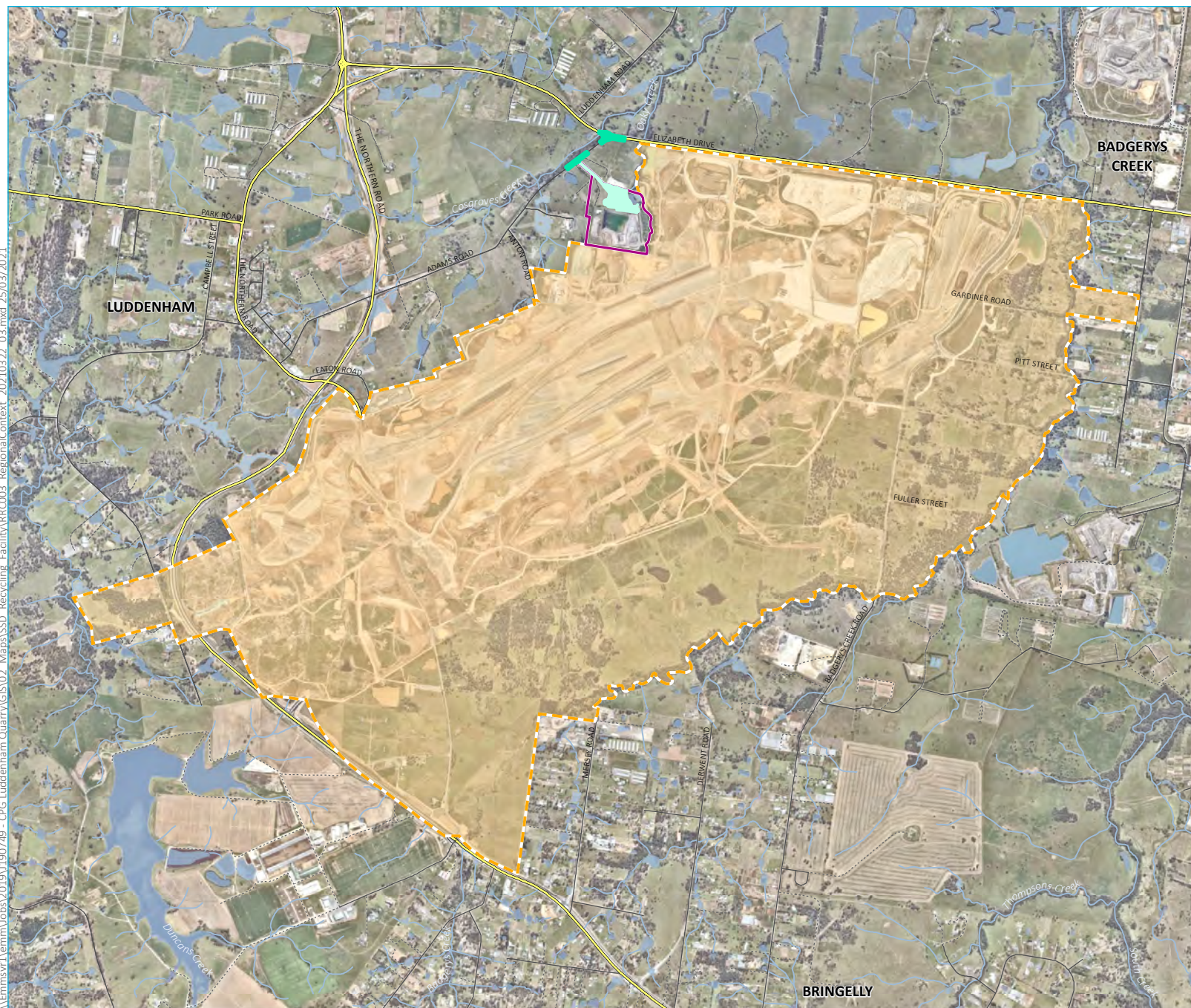
Table 1.2 Naming of areas referred to in this BDAR

Project elements	Definition
Native vegetation assessment area	Subject property plus 1,500 m buffer.
Study area	Area which was surveyed for ecological values. For the ARRC this was the subject property boundary and the section of Adams Road leading from the site entrance to Elizabeth Drive (Figure 4.1).
Subject property	The property within which the ARRC development will occur. It excludes the road upgrade footprint.
ARRC site	Area subject to proposed direct impacts within the subject property. It excludes the road upgrade footprint.
Road upgrade footprint	After submission of the draft EIS, the need was identified for road upgrade works along Adams Road and Elizabeth Drive. At the stage of preparation of this BDAR detailed design for the road upgrades had not been undertaken. Due to this a conservative approach was utilised whereby a conservative footprint was identified for the anticipated road upgrade works, including all vegetation and biodiversity values within the full width of the road corridor identified. This has been identified as the 'road upgrade footprint' at this stage, noting that not all vegetation may require removal.
Direct impact footprint/project footprint	The direct impact footprint is the combined ARRC site and road upgrade footprint.
Indirect impact area	Area subject to anticipated indirect impacts, which was delineated as a 20 m buffer from the direct impact footprint (the combined ARRC site area and road upgrade footprint areas).
Subject land	Combined direct impact and indirect impact areas

1.8 Assessment guidelines and requirements

This BDAR has been prepared in accordance with the *Biodiversity Assessment Method* (BAM; OEH 2017) and the legislative framework outlined in Chapter 2. It is noted that whilst an updated BAM has been adopted and released (DPIE 2020), Section 6.31 of the Biodiversity Conservation Regulation allows the use of the previous method for a 12-month period for SSD, SSI and Biodiversity Certification projects, and 6 months for any other type of assessment. This BDAR has been prepared in accordance with, and utilises, BAM 2017 (OEH 2017).

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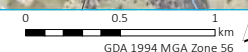
- KEY**
- Subject property
 - Direct impact footprint
 - ARRC Site
 - Road upgrade footprint
 - Western Sydney International (Nancy-Bird Walton) Airport
 - Major road
 - Minor road
 - Vehicular track
 - Watercourse/drainage line

Regional context

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 1.1



Source: EMM (2021); DFSI (2017); Nearmap (2021)



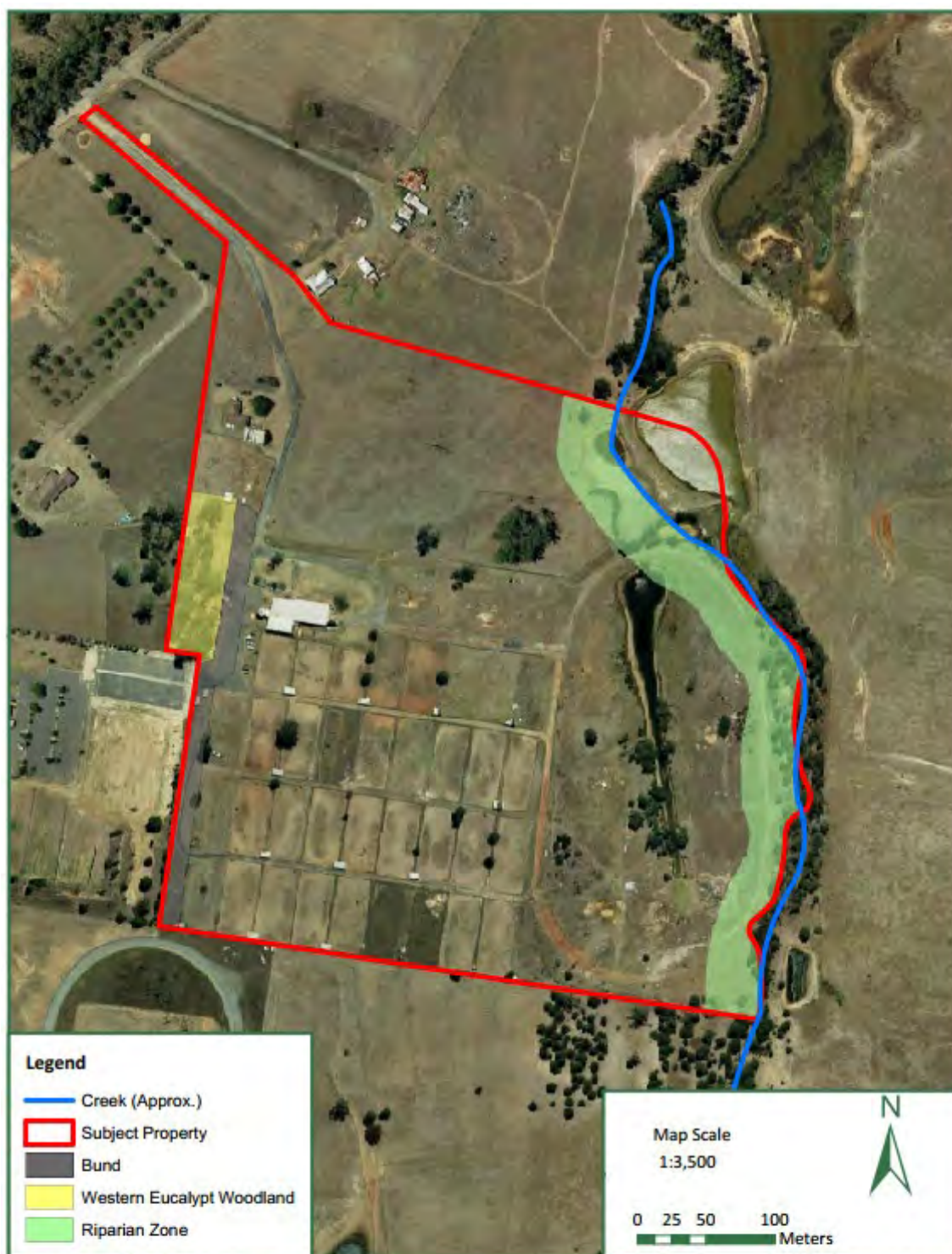


Figure1.3 Areas to which this VMP Applies

UBM ECOLOGICAL CONSULTANTS PTY LTD
\\UBMC\CONSULTANCY\Blue Sky Mining Luddenham\Mapping\1.3 Management.mxd



Source: UBM Ecological (2009)

Figure 1.3 Vegetation Management Plan areas

1.9 Information sources

1.9.1 Publications and databases

In order to provide a context for the project, information about flora and fauna within 10 km of the study area was obtained from relevant public databases. The centre point of the study area was taken as Latitude -33.87, Longitude 150.72. Records from the following databases were collated and reviewed:

- BioNet Atlas of NSW Wildlife for previous threatened species records.
- Commonwealth Department of the Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) likely to occur within the study area.
- The NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Information System database.

The following studies and reports were also reviewed:

- Development Consent, DA No. 315-7-2003, for Badger Mining Company Pty Limited.
- Phillips C 2004, Assessment report: Proposed clay/shale extraction operation, Lot 3 – 275 Adams Road, Luddenham, prepared for Badger Mining Company Pty Limited.
- Douglas Nicolaisen & Associates Pty Ltd 2003, Environmental Impact Statement – Proposed Clay/Shale Extraction Operation – Lot 3 - 272 Adams Road Luddenham NSW, prepared for Badger Mining Company Pty Limited 275 Adams Road Luddenham NSW.
- Department of Infrastructure and Regional Development (DIRB) 2016, Western Sydney Airport EIS Biodiversity Assessment, prepared for Western Sydney Unit – Western Sydney Airport EIS, 21/24265.
- UBM Ecological 2009 Vegetation Management Plan for a clay shale quarry, Adams Road, Luddenham, prepared for Blue Sky Mining P/L.

1.9.2 Spatial data

Mapping has been produced using a Geographic Information System (GIS). The following spatial datasets were utilised during the development of this report:

- Site plans supplied by CPG Stage 01 Masterplan Rev. E.
- Remnant Vegetation of the western Cumberland subregion, 2013 Update. VIS_ID 4207 (OEH 2015).
- Mitchell Landscapes Version V3.1 (OEH 2016a).
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2017a).
- Directory of important wetlands (DoEE 2018).
- NSW Wetlands (OEH 2010).

- Base map data for the study area was obtained from Department of Finance, Services and Innovation (DFSI) NSW databases, with cadastral data obtained from DFSI digital cadastral database.
- Mapping for stream orders was obtained from the Water Management (General) Regulation 2018 hydroline spatial data 1.0.

1.9.3 Limitations

Vegetation mapping was conducted using a mobile phone running Collector for ArcGIS™ and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 m) and dependent on the limitations of aerial photo rectification and registration.

Surveys were completed during Summer 2020, when field conditions were conducive to detecting many of the flora and fauna species known to occur in the area. Surveys were undertaken in accordance with relevant NSW and Commonwealth survey guidelines for threatened species and the requirements of the Framework for Biodiversity Assessment (OEH 2018). Some flora species may be missed in surveys for a variety of reasons, for example: biannual flowering, poor flowering conditions, herbivory, heavy grazing pressures and drought conditions.

During the flora and fauna surveys the following limitations occurred:

- The south-eastern corner of the subject property was surrounded by a security fence, so threatened flora and habitat assessments were undertaken from the other side of the fence.
- Portions of vegetation communities were flooded at the time of survey (preventing identification of the groundlayer), limiting the locations where plots could be performed, as the water prevented identification of the groundlayer species and cover.
- No targeted flora or targeted snail surveys were completed within the quarry pit, in fenced areas or in flooded areas.
- Most of the mapped vegetation and BAM plots occur outside the ARRC site direct impact area due to the limited and small patches of vegetation within the impact area.
- It was not possible to access vegetation outside of the Adams Road and Elizabeth Drive road easements for assessment of vegetation and to undertake threatened species survey, as these are private landholdings.

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (MNES) protected under the Act.

Nine MNES are identified under the EPBC Act:

- world heritage properties;
- national heritage places;
- wetlands of international importance (also known as 'Ramsar' wetlands);
- nationally threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on MNES must be referred to the Commonwealth Minister for the Environment for assessment. Assessment of MNES is provided in Chapter 7.

2.1.2 Supplementary environmental assessment requirements

The SEARs and the section which they are addressed are provided in Table 2.1.

Table 2.1 SEARs

Requirement	Section addressed
An assessment of biodiversity impacts in accordance with the BAM and documented in a BDAR.	Provided in 6.1.
Measures to avoid, mitigate or offset all direct, indirect and prescribed impacts in accordance with the BAM	Provided in 6.2.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The EP&A Act is administered by the NSW Department of Planning, Industry and Environment (DPIE).

As described in Chapter 1, the project is State significant development (SSD) pursuant to Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP). Accordingly, approval is required under Part 4, Division 4.1 of the EP&A Act for the project.

i State Environmental Planning Policy (Koala Habitat Protection) 2021

State Environmental Planning Policy (Koala Habitat Protection) 2021 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

The Koala SEPP 2021 applies all land use zones within the Liverpool City Council local government area. However, the project is not a development application and does not require approval from Council, and thus consideration of the Koala SEPP 2021 is not triggered under Part 2 of the SEPP. Nonetheless, consideration has been given to the potential occurrence and impacts upon the koala within this report.

2.2.2 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) details mechanisms for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the NSW Biodiversity Conservation Regulation 2017 (BC Regulation), established the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the Biodiversity Assessment Method (BAM, OEH 2017) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities (TECs) and their habitats and determine offset requirements.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values in order to:

- identify the biodiversity values on land subject to proposed development area;
- determine the residual impacts of a proposed development following all measures to avoid, minimise and mitigate impacts; and
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been prepared in accordance with the BAM and addresses the requirements of the BC Act.

2.2.3 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, key fish habitat, biodiversity, threatened species, populations and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve key fish habitats (KFH). These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in sections 3.2.1 and 3.2.2 of the Policy and Guidelines for Fish Conservation and Management (DPI 2013).

The study area is not mapped as a KFH in the Key Fish Habitat map. The project will not impact on any threatened aquatic species, populations, communities, habitats and KFH.

2.2.4 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) replaced the *Noxious Weeds Act 1993* on 1 July 2017. The Biosecurity Act aims broadly to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, carriers and other activities. The Act is administered by the Department of Primary Industries.

Weeds of National Significance identified and recorded during the flora surveys include:

- Alligator Weed (*Alternanthera philoxeroides*);
- African Boxthorn (*Lycium ferocissimum*);
- Blackberry (*Rubus fruticosus*);
- Bridal Creeper (*Asparagus asparagoides*); and
- Chilean Needle Grass (*Nassella neesiana*).

3 Landscape features

The identification of landscape features in the study area was determined using Section 4 of the BAM (OEH 2017), as summarised within this chapter.

3.1 Landscape features

3.1.1 Bioregions and landscapes

The study area is confined to the Cumberland Interim Biogeographic Regionalisation of Australia (IBRA) subregion, within the Sydney Basin bioregion (Figure 3.1). The Bionet landscape is entirely Cumberland Plain.

The majority of the site is within the Mitchell Landscape “Hawkesbury - Nepean Channels and Floodplains”, but part of the southern portion of the site is within “Cumberland Plain” landscape. As the site is predominately “Hawkesbury - Nepean Channels and Floodplains” this was utilised in the BAM calculator.

3.1.2 Watercourses and wetlands

One mapped watercourse, Oaky Creek, and two dams intersect the study area (Figure 3.2). Oaky Creek flows into Cosgroves Creek north of Elizabeth Drive.

3.1.3 Connectivity

The locality is considered highly fragmented with native vegetation often occurring in isolated patches surrounded by a matrix of agricultural land. This is also consistent with the remaining vegetation within and adjoining the study area.

3.1.4 Areas of geological significance and soil hazard features

The study area does not contain karsts, caves, crevices, cliffs or other areas of geological significance. Similarly, there are no soil hazard features that occur within the study area.

3.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value within the study area, or the 1,500 m buffer.

3.2 Assessment of site context

The site context has been assessed in accordance with Section 4.3 of BAM (OEH 2017) for site-based developments.

3.2.1 Native vegetation cover

Native vegetation cover within the buffer area (including the subject property) was determined as the sum of the areas of native vegetation map, divided by the entire buffer area (Table 3.1). It is noted that a significant proportion of the vegetation within the 1,500 m buffer is approved for clearing associated with the Stage 1 development of the Western Sydney International (Nancy-Bird Walton) Airport.

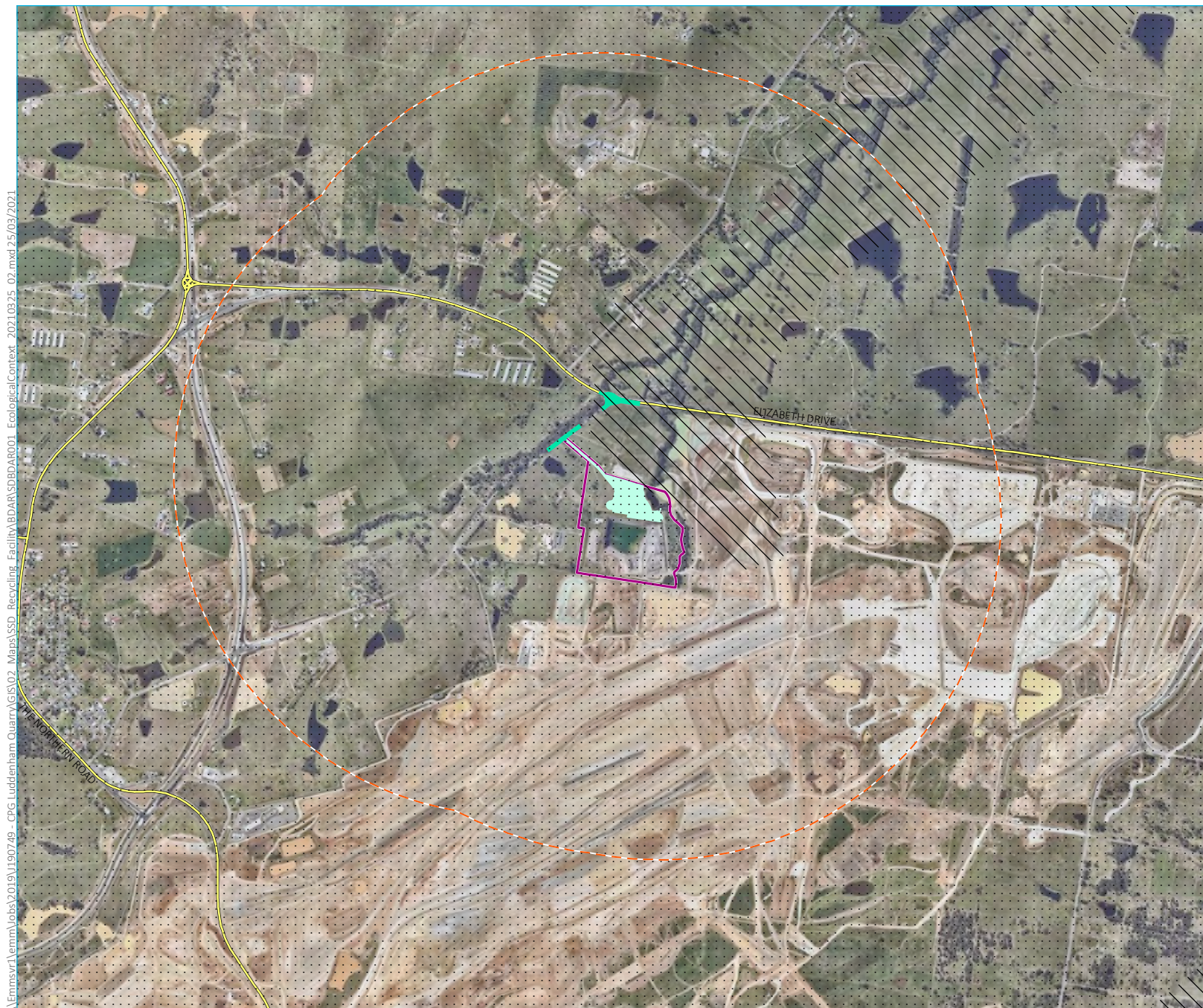
Table 3.1 **Percentage of native vegetation cover**

Native vegetation in buffer area (ha)	Buffer area (ha)	Percentage of native vegetation in buffer area
48.7	828.5	5.9%

3.2.2 **Assessment of patch size**

For each vegetation zone within the impact area, patch size was assessed in ArcGIS, using existing vegetation mapping and aerial imagery. All intact native vegetation separated by a distance of less than 100 m (woody vegetation ecosystems) or 30 m (non-woody vegetation ecosystems) was included in the patch size assessment of each zone.

This process showed that all vegetation zones within the study area are part of a patch of connecting vegetation of a size of >100 ha. A patch size of 101 ha was used in the calculator.



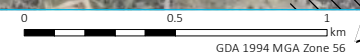
- KEY**
- Subject property
 - ARRC impact area BDAR buffer
 - Direct impact footprint
 - ARRC Site
 - Road upgrade footprint
 - Major road
 - NSW Mitchell landscape
 - Cumberland plain
 - Hawkesbury - nepean channels and floodplains
 - IBRA region: Sydney Basin
 - IBRA subregion: Cumberland

Regional ecological context

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 3.1



Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2020); DOE (2019)



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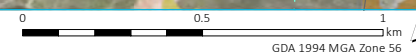
- KEY**
- Subject property
 - ARRC impact area BDAR buffer
 - Direct impact footprint
 - ARRC Site
 - Road upgrade footprint
 - Strahler stream order
 - 1st order
 - 2nd order
 - 3rd order
 - 4th order
 - 1,500 m native vegetation cover
 - PCT 850 - Shale Hills Woodland
 - PCT 849 - Shale Plains Woodland
 - PCT 835 - Alluvial Woodland
 - Unidentified vegetation (added by EMM consulting)
 - Existing environment
 - Waterbody
 - Major road
 - Minor road
 - Vehicular track

Site context

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Figure 3.2



Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2020); OEH (2018)



4 Native vegetation

The extent of native vegetation within the study area was determined using Section 5 of the BAM (OEH 2017), as summarised within this chapter.

4.1 Background review

A review of regional vegetation mapping was undertaken to inform the survey. OEH (2015) identified the following PCTs within the study area (Figure 4.1):

- Alluvial Woodland which is equivalent to: PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.
- Shale Plains Woodland which is equivalent to: PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

DIRD (2016) identified and mapped HN526 Forest Red Gum – Rough-barked Apple grassy woodland on floodplains, Sydney Basin, as being present on the eastern side of Oaky Creek. This community corresponds to River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (EEC) under the BC Act and Critical EEC (CEEC) under the EPBC Act.

4.2 Methods

The following sections outline the methods employed to map vegetation, and to assess the vegetation integrity of native vegetation within the impact area.

4.2.1 Detailed vegetation mapping and habitat assessment

Native vegetation was assessed in the field by EMM on the following dates:

- 30 January 2020.
- 24 February 2020.
- 9 December 2020.

Field surveys on 30 January and 9 December stratified the study area by air photo interpretation and on-ground validation into PCTs. Mapping of vegetation communities was conducted using hand-held tablet computers using the ArcGIS Collector application and aerial photo interpretation.

PCTs were stratified into vegetation zones based on broad condition state. Depending on the condition of these PCTs, they were allocated to a condition class of Medium or Poor. PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 4.1.

Table 4.1 Definitions used in delineation of vegetation zones

Condition class	Description
Medium	Some elements or strata missing or immature, but minimal disturbance.
Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance.

4.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the impact area, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 5 of the BAM (OEH 2017). Five plots were undertaken (Figure 4.1). At each plot location the following was undertaken:

- One 20 x 20 m plot, for assessment of composition and structure.
- One 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1–5%) or estimated to the nearest 5% (5–100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017). Datasheets are provided in Appendix A, while compiled plot data is provided in Appendix B.

Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined. Identification of PCTs within the study area was confirmed with reference to the community profile descriptions (and diagnostic species tests) held within the NSW VIS: Classification Version 2.1 (OEH 2014).

Plots were undertaken on 24 February and 9 December 2020. In order to keep plots as close as possible to the impact area, plots were sometimes placed in sub-optimal areas, such as adjacent to access routes. Three plots were located partially outside of their respective mapped PCTs. Constraints to choosing plot locations were:

- parts of the PCTs occur near the edge of the quarry pit where it is unsafe to survey;
- ephemeral flooding of parts of the ARRC site vegetation for the medium condition PCT 1800 during the survey, preventing adequate survey of the ground layer (hence plots were located in dry locations outside of the ARRC site); and
- most of the vegetation mapped occurs outside the ARRC site.

Surveys for flora and vegetation communities were completed under the authority of Scientific License (SL100409). A list of flora species was compiled for each plot and PCT. Records of all flora species will be submitted to Biodiversity Conservation Division (BCD) for incorporation into the Atlas of NSW Wildlife.

4.3 Results

4.3.1 Vegetation description

Most of the study area is dominated by open grasslands of varying condition and quality. Most of these areas have been heavily impacted by pastoral activities, particularly grazing, and are dominated by exotic plant species. In some areas of grassland, native cover of species such as Kangaroo Grass (*Themeda triandra*), Red-anthered Wallaby Grass (*Rytidosperma pallidum*) and Weeping Grass (*Microlaena stipoides*) occurs, but is <10% of the cover, resulting in the areas still being mapped as exotic.

The remaining wooded habitat within the study area is comprised of a highly degraded woodland in the western section, a narrow riparian corridor dominated by Swamp Oak (*Casuarina glauca*), and scattered Swamp Oak in some areas of the subject property.

Site investigations, including determination of vegetation communities used the methods described in Section 5.2 of the BAM (OEH 2017). The PCTs found, their condition listing status and extent are described within Table 4.2 and shown in Figure 4.1. The PCTs are described in further detail within the following section.

Cleared or exotic vegetation covers 22.61 ha of the study area. The exotic vegetation lacks a canopy and only very rarely contains a midstorey, which is dominated by African Boxthorn (*Lycium ferocissimum*), Blackberry (*Rubus fruticosus* aggregate) and European Olive.

The groundlayer contains a very low and patchy cover of native species, comprising mainly Kangaroo Grass and Speargrass (*Austrostipa* spp.). The dominant species are Kikuyu followed by Rhodes Grass. Other less common species include Fennel (*Foeniculum vulgare*), African Lovegrass (*Eragrostis curvula*), Salsify (*Tragopogon porrifolius*), Bull Thistle (*Cirsium vulgare*), Sow Thistle (*Sonchus oleraceus*), Prairie Grass (*Bromus catharticus*), Common Sida, Onion Grass, Fleabane (*Conyza* spp), Slender Celery (*Cyclosporum leptophyllum*), Hedge Mustard (*Sysimbrium officinale*) and Flat weed (*Hypochaeris radicata*).

Table 4.2 Plant Community Types, condition, status and extent

PCT ID	PCT name	Condition	Association with BC Act TEC	Association with EPBC Act TEC ¹	Direct impact area (ha) ¹	Indirect impact area (ha) ¹	Study Area (ha) ¹
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Medium	Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC	0.11 (0.09)	0.51 (0.48)	0.92 (0.84)
		Poor		Not associated	0	0.01	0.37
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Medium	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions ECC	Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland EEC	0.24 (0.05)	0.35 (0.35)	1.44 (1.24)
		Poor			0.07 (0.03)	0.12 (0.07)	1.23 (0.88)
-	Cleared or exotic plantings	n/a	nil	nil	4.13	8.40	22.61
Total	-	-	-	-	4.24	8.93	23.90

¹ Area in brackets is area of vegetation which meets EPBC Act condition thresholds, see Figure 4.1 for location of vegetation considered to be consistent with EPBC Act vegetation community definitions.

\\lemmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02 Maps\SSD Recycling Facility\BOAR\SDBOAR005 PCTs 20210331 10.mxd 31/03/2021



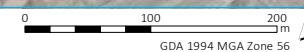
- KEY**
- Direct impact area
 - Indirect impact area
 - Study area
 - Waterbody
 - Cadastral boundary
 - P Vegetation plot
- Plant community type**
- PCT 849 - Grey Box Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
 - Medium
 - Poor
 - PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley
 - Medium
 - Poor
- Threatened ecological community (TEC)**
- Cumberland Plain Woodland in the Sydney Basin Bioregion (BC Act)
 - Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin, South East Corner Bioregions (BC Act)
 - Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act)
 - Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (EPBC Act)

Plant community types and plot locations

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Figure 4.1



Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2021); DOE (2019)



4.3.2 Plant community type descriptions

Descriptions of the PCTs are provided in Table 4.3. PCTs and vegetation zones are mapped in Figure 4.1.

Table 4.3 PCT 1800 – Cumberland Swamp Oak riparian forest description

PCT 1800 – Cumberland Swamp Oak riparian forest	
PCT ID	1800
Common name	Cumberland Swamp Oak riparian forest
Condition classes	Two vegetation zones were mapped within the subject property: <ul style="list-style-type: none"> • Medium • Poor
Extent within the study area	Total area 2.67 ha 1.44 ha (medium) 1.23 ha (poor)
Extent within subject land	Total area 0.78 ha 0.59 ha (medium) 0.19 ha (poor)
Description	<p>The below description relates to vegetation surveyed within the study area. The poor vegetation zone inside the subject property – but outside the ARRC site – includes a greater variety of canopy and midstorey species, such as Cabbage Gum (<i>Eucalyptus amplifolia</i>), Woollybutt (<i>E. longifolia</i>) and an unknown Ironbark (<i>Eucalyptus</i> sp.). The greater diversity appears to have resulted from previous planting of native species within the ‘riparian zone’ as part of the Vegetation Management Plan prepared under the quarry consent (UBM Ecological 2009).</p> <p>The PCT comprises a canopy dominated by Swamp Oak.</p> <p>The midstorey is sparse, comprising African Boxthorn (<i>Lycium ferocissimum</i>) and Moth Vine (<i>Araujia sericifera</i>) in the ARRC site, and Native Blackthorn (<i>Bursaria spinosa</i>) and Paperbark (<i>Melaleuca</i> sp.) in the roadside area.</p> <p>The groundlayer is dominated by exotic species. Exotic grasses are: Kikuyu (<i>Cenchrus clandestinus</i>), Paspalum (<i>Paspalum dilatatum</i>) and Marsh Bristlegrass (<i>Setaria parviflora</i>).</p> <p>Exotic forb species are: Alligator Weed, Black-berry Nightshade (<i>Solanum nigrum</i>), Bridal Creeper (<i>Asparagus asparagoides</i>) and Paddy’s Lucerne (<i>Sida rhombifolia</i>).</p> <p>Native grasses and forbs comprise Common Couch (<i>Cynodon dactylon</i>), an Oxalis (<i>Oxalis exilis</i>), Climbing Saltbush (<i>Einadia</i> spp.), Indian Pennywort (<i>Centella asiatica</i>), Kidney Weed (<i>Dichondra repens</i>), Red Grass (<i>Bothriochloa macra</i>), Slender Rat’s Tail Grass (<i>Sporobolus elongatus</i>), Variable Glycine (<i>Glycine tabacina</i>), Weeping Grass (<i>Microlaena stipoides</i>), Cockspur Flower (<i>Plectranthus parviflorus</i>) and Wiry Spurge (<i>Phyllanthus virgatus</i>).</p>
Survey effort	<p>Three plots/transects within the subject property:</p> <ul style="list-style-type: none"> • Medium: 2 plots (plots 3 and 4) • Poor: 1 plot (plot 2) <p>One plot occurs within the impact area:</p> <ul style="list-style-type: none"> • Medium: 1 plot
Condition description	The community is in medium to poor condition with a high cover of introduced plant species due to past and current grazing activities. Vegetation zones were delineated largely based off whether the canopy was dense or sparse.

Table 4.3 PCT 1800 – Cumberland Swamp Oak riparian forest description

PCT 1800 – Cumberland Swamp Oak riparian forest

Characteristic species used for identification of PCT	<p>This PCT could align with PCT 1800 or PCT 835.</p> <p>According to the NSW VIS Classification (OEH 2014), PCT 1800 Cumberland Swamp Oak Riparian Forest (<i>Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley</i>) is found on the riverflats of the Cumberland Plain in western Sydney and in the Hunter Valley. The distinguishing feature is the prominent stands of Swamp Oak found along or near streams. This community features an open grassy and herbaceous understorey, as is typical of riverflat forests. It may be that this is a pioneering community that is re-establishing following clearing. It is known that many creeklines in western Sydney are slightly saline, particularly during drought (Benson and Howell 1990).</p> <p>The NSW VIS Classification for PCT 835 Cumberland River-flat Forest (<i>Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion</i>) is found on broad alluvial flats of the Hawkesbury and Nepean river system. It also forms narrower ribbons alongside streams and creeks that drain the Cumberland Plain. Typically, the canopy includes one of either rough-barked apple (<i>Angophora floribunda</i>) or broad-leaved apple (<i>Angophora subvelutina</i>) and one or both of forest red gum (<i>Eucalyptus tereticornis</i>) and cabbage gum (<i>Eucalyptus amplifolia</i>). The understorey within this riverflat forest is characterised by an occasional sparse to open small tree stratum of paperbark (<i>Melaleuca</i> spp.) and wattles (<i>Acacia</i> spp.).</p>
Justification of evidence used to identify the PCT	<p>PCT 1800 is chosen because:</p> <ul style="list-style-type: none"> the study area is on the Cumberland Plain; a canopy of Swamp Oak is characteristic of this PCT. The description of Cumberland Riverflat Forest in the Sydney Metro veg classification, lists Swamp Oak as an ‘uninformative’ (non-diagnostic) species sometimes found (22% frequency) in the community; the area mapped is regularly inundated, providing swamp conditions; and analysis of plot data against key characteristic species provides: <ul style="list-style-type: none"> 20% (Canopy), 7% (Understorey) and 11% (Groundlayer), noting that VIS treats Swamp Oak as both a canopy and understorey species; otherwise, the score for understorey would be 0%. <p>The description of PCT 1800 acknowledges that “It may be that this is a pioneering community that is re-establishing following clearing”.</p> <p>In conclusion, PCT 1800 has been chosen as the current best fit, based on landform subject to periodic inundation and species currently present, in particular that the vegetation is dominated by Swamp Oak. However, it is noted that the vegetation has likely colonised responding to past clearing; and is probably vegetation in a transitional state between PCT 1800 and PCT 835.</p>
Status	<p>PCT 1800 Cumberland Swamp Oak riparian forest Bioregion is associated with the BC Act <i>Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community</i> listing and EPBC Act listing as <i>Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland Endangered Ecological Community</i>.</p> <p>The PCT aligns with the BC Act listing because:</p> <ul style="list-style-type: none"> it occurs on the Cumberland plains; it comprises a dense tree canopy; it is regularly waterlogged; and the canopy comprises Swamp Oak. <p>The PCT aligns with the EPBC Act (as shown in Figure 4.1) listing because:</p> <ul style="list-style-type: none"> the patch is greater than 2 ha; Non-native species comprise less than 80% of total understorey vegetation cover; and Transformer species (eg. Kikuyu) comprise less than 50% of total understory vegetation cover.

Table 4.3 **PCT 1800 – Cumberland Swamp Oak riparian forest description**

PCT 1800 – Cumberland Swamp Oak riparian forest

Estimate of percent
cleared value of PCT
within NSW



Photograph 4.1 **Cumberland Swamp Oak riparian forest within the ARRC site (Medium condition - plot ID P03).**

Table 4.4 **PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description**

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

PCT ID	849
Common name	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
Condition classes	Two vegetation zones were mapped within the study area: <ul style="list-style-type: none"> • Medium • Poor
Extent within the study area	Total area: 1.29 ha 0.92 ha (medium) 0.37 ha (poor)
Extent within subject land	Total area: 0.63 ha 0.62 ha (medium) 0.01 ha (poor)
Description	<p>The canopy in the poor condition vegetation comprises dying Grey Box (<i>Eucalyptus moluccana</i>). It is assumed that they are dying from either the drought conditions or from dieback. Due to the absence of fruiting material, adult leaves or a healthy tree form, identification was based on juvenile leaves, bark, and the local species in the area. Trees inspected in the road corridor just outside the property are predominantly Grey Box.</p> <p>The canopy in the medium condition vegetation is much healthier and is dominated by Grey Box. It also comprises Kurrajong (<i>Brachychiton populneus</i>), River Oak (<i>Casuarina cunninghamiana</i>), Forest Red Gum (<i>Eucalyptus tereticornis</i>) and an unknown Stringybark (<i>Eucalyptus</i> sp.).</p> <p>The midstorey is absent in the poor condition vegetation, and dense in the medium condition vegetation. Midstorey vegetation comprises mainly native Blackthorn, and exotic European Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>) and African Boxthorn.</p> <p>The groundlayer is co-dominated by exotic grass and forb species. Exotic grass and grass-like species include: Kikuyu, Rhodes Grass (<i>Chloris gayana</i>), Paspalum and Marsh Bristlegrass, African Lovegrass (<i>Eragrostis curvula</i>), and Phalaris (<i>Phalaris aquatica</i>), which are all commonly associated with exotic grasslands and are often cultivated.</p> <p>Exotic forb and vine species are Moth Vine, Turnip Weed (<i>Rapistrum rugosum</i>), Paddy's Lucerne (<i>Sida rhombifolia</i>), Small-flowered Mallow (<i>Malva parviflora</i>), Lamb's Tongues (<i>Plantago lanceolata</i>), Apple of Sodom (<i>Solanum linnaeanum</i>), Black-berry Nightshade, Onion Grass (<i>Romulea rosea</i>) and Shore Vervain (<i>Verbena caracasana</i>).</p> <p>The native grasses, grass-like species and forbs include: Common Couch, Weeping Grass, Kangaroo Grass, Tick-trefoil (<i>Desmodium</i> sp.), Old Man's Beard (<i>Clematis aristata</i>), Saltbush (<i>Einadia</i> spp.), Early Spring Grass (<i>Eriochloa pseudoacrotricha</i>), Kidney Weed (<i>Dichondra repens</i>), <i>Paspalidium distans</i>, <i>Senecio</i> spp., Dock (<i>Rumex</i> spp.), Toad Rush (<i>Juncus bufonius</i>), and Cockspur flower (<i>Plectranthus parviflorus</i>).</p>
Survey effort	Medium: 1 plot (plot 5) Poor: 1 plot (plot 1)
Condition description	<p>The community is in poor and medium condition with a high cover of introduced or cultivated plant species.</p> <p>In poor condition areas, the overstorey consists of dead and dying trees, where the healthier specimens are covered in large juvenile leaves, but no adult leaves are visible.</p>

Table 4.4 PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	
	<p>Medium condition areas of the community have a mixed native groundlayer and understorey. The native canopy is present on the western side of Adams Road and northern side of Elizabeth Drive, but absent on the eastern side of Adams Road.</p> <p>Surrounding land use (mostly grazing) and associated edge impacts contribute to the degraded condition of this PCT.</p>
Characteristic species used for identification of PCT	<p>The canopy is dominated by Grey Box, which is a dominant species of both PCT 849 and 850.</p> <p>The midstorey is sparse. The groundlayer includes Kidney Weed (which is characteristic of PCT 849 and 850) and <i>Paspalidium distans</i> (characteristic of PCT 849 only).</p>
Justification of evidence used to identify the PCT	<p>According to the NSW VIS Classification (Version 2.1.9), grassy woodlands in the Cumberland Plains are likely to fit one of two PCTs, which together are known as Cumberland Plain Woodland in the Sydney Basin Bioregion EEC: PCT 849 and 850. These PCTs are very similar. Both comprise a canopy of two to three dominant species, of which Grey Box is one. The elevation is 69 m, which could fit either PCT description.</p> <p>PCT 849 was chosen because:</p> <ul style="list-style-type: none"> • of the lack of Hickory Wattle (<i>Acacia implexa</i>) within the study area (which the VIS specifically states is a characteristic distinction between the two PCTs); • of lack of evidence of shale; • the analysis of plot data against key characteristic species fits PCT 849 best: <ul style="list-style-type: none"> – PCT 849: 100% (canopy), 100% (midstorey), 26% (groundlayer); and – PCT 850: 66% (canopy), 50% (midstorey), 33% (groundlayer).
Status	<p>PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion is associated with the BC Act listing <i>Cumberland Plain Woodland in the Sydney Basin Bioregion Critically Endangered Ecological Community</i> and the EPBC Act listing as <i>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest Critically Endangered Ecological Community</i>. The PCT aligns with the BC Act listing because:</p> <ul style="list-style-type: none"> • it occurs on the Cumberland plains; • it has an open tree canopy; • it contains a continuous groundcover dominated by grasses and herbs; and • the canopy is dominated by Grey Box. <p>The Medium-condition areas of the PCT comprise multiple patches throughout the study area. The vegetation patch to the west of Adams Road aligns with the EPBC Act listing because:</p> <ul style="list-style-type: none"> • the canopy is dominated by native trees (Grey Box and sparse Forest Red Gum); • native trees in the patch provide at least 10% cover; • the patch is greater than 5 ha in size; and • at least 30% of the cover of perennial understorey vegetation is native. <p>The other patches of Medium-condition PCT do not align with the EPBC Act because:</p> <ul style="list-style-type: none"> • One patch lacks 10% overstorey foliage cover (ie. the very thin patch on the east side of Adams Road); and • All other patches are each less than 0.5 ha (ie. All other patches of PCT 849 not discussed above). <p>The Poor-condition areas of the PCT do not align with the EPBC Act listing because they are less than 0.5 ha in area, are isolated from other patches of vegetation, and native midstorey is absent.</p>

Table 4.4

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion description

PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

Estimate of percent cleared value of PCT within NSW

93%



Photograph 4.2

Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion within the subject property (Poor condition – plot ID P01).

4.3.3 Vegetation integrity score

The vegetation integrity score for each vegetation zone of PCT 1800 and PCT 849 within the study area is presented in Table 4.5.

Table 4.5 Vegetation zones mapped within the impact area

Plant community type	Condition	Vegetation integrity score
PCT 849 – Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain	Medium	39.1
	Poor	21
PCT 1800 – Cumberland Swamp Oak riparian forest	Medium	43.7
	Poor	44.2

4.4 Groundwater dependent ecosystems

An assessment was completed to identify terrestrial ecosystems which potentially use and/or are reliant on groundwater in the study area. It included reviewing the Groundwater Dependent Ecosystem (GDE) Atlas (BOM 2020a) and groundwater monitoring data.

4.4.1 Identification of potential GDEs

Ecosystems that could rely on either surface or subsurface expression of groundwater within or surrounding the study area are those associated with:

- creeks where deep groundwater is discharging and provides baseflow;
- shallow (perched) groundwater systems;
- springs; and
- terrestrial vegetation overlaying shallow groundwater (within the vegetation roost zone).

These ecosystems have been classified into three categories according to their dependence on groundwater:

- non-dependent;
- facultative; and
- entirely dependent/obligate:
 - opportunistic;
 - proportional; and
 - highly dependent.

Considerations in evaluating PCTs and their potential dependency on groundwater include:

- the physiology of plant species that occur in that community and their likely dependence on water availability;

- the PCTs location in the landscape; and
- if the rooting depth of vegetation would be able to take up groundwater based on likely depth of the aquifer and soil characteristics.

Access to the groundwater is dependent on a number of factors with the core factor being the depth to the water table. As terrestrial vegetation communities are composed of a range of vegetation types with a range of rooting depths and strategies there is a relationship between groundwater depth and the types and composition of the vegetation that is able to access it (Serov P 2012).

4.4.2 Potential GDEs

The GDE Atlas (BOM 2020a) does not show any terrestrial GDEs as occurring in the study area. It is not considered that the ARRC site will have an impact on the water table as no groundwater extraction has been proposed as part of the works.

5 Threatened species

5.1 Fauna habitat assessment

Fauna habitat primarily comprises the riparian corridor running along the eastern boundary of the subject property (Oak Creek), and the vegetation adjacent to Cosgroves Creek, to the west of Adams Road. The fauna habitat associated with the subject property and Adams Road/Elizabeth Drive are discussed in relevant sections below.

5.1.1 Subject property

The extensive history of use of the subject property for agricultural purposes and quarrying has resulted in large areas of exotic grassland, a highly degraded woodland, and a narrow riparian corridor. Scattered native trees and some ephemeral dams also provide some habitat. As a result, the subject property provides limited refuge or habitat for fauna. Scattered trees within the subject property comprise Swamp Oak, from regenerating trees to mature trees. No hollows were identified.

The exotic grassland comprises dense patches of pasture grasses, particularly Kikuyu. Habitat features, such as bare ground, inter-tussock-space, logs, and perching structures are virtually absent.

PCT 849 within the subject property is comprised of trees in very poor condition. The area contains minimal areas of fallen timber, with some areas of scattered rubbish providing some habitat in the groundlayer. The canopy of the trees is limited to dense epicormic growth. No adult leaves were seen during the surveys in January and February 2020.

The Oak Creek riparian corridor largely comprises Swamp Oak with occasional juvenile planted native trees. Due to the young age of these trees, presence of habitat features (such as logs, hollow-bearing trees, etc) is very limited. During periods of low flow, Oak Creek consists of a series of disconnected pools with a muddy base and little aquatic vegetation.

The bottom of the quarry pit has filled with water but lacks aquatic plants or vegetation (Photograph 5.1).

The ephemeral dams and swamps are dominated by exotic species. The groundlayer is either absent or dominated by wetland plants, depending on the frequency and duration of flooding events (Pond 1 Photograph 5.2, Pond Photograph 5.3, Pond 3 Photograph 5.4, and Pond 4 Photograph 5.5).

A shed associated with the quarry occurs to the south west of the ARRC site. This building is an open large tin shed, with no roof voids with no features considered likely to support fauna species.

A bridge crosses Oak Creek in the southeast of the subject property and is considered to provide potential microbat habitat.

No threatened flora or fauna were recorded along the eastern side of Oak Creek within the Western Sydney Airport (DIRD 2016).



Photograph 5.1 **Quarry pit (views from the northeast and southeast respectively)**



Photograph 5.2 **Pond 1**



Photograph 5.3 **Pond 2**



Photograph 5.4 **Pond 3**



Photograph 5.5 **Pond 4**

5.1.2 Adams Road and Elizabeth Drive

Adams Road and Elizabeth Drive are both sealed public roads, with one lane in either direction. Vegetation and fauna habitat within the road corridors is limited to sparse young trees and exotic grass on Elizabeth Drive, and to narrow, disconnected patches of native shrubland along the eastern side of Adams Road, interspersed with exotic grassland.

The primary fauna habitat is woodland present along Cosgroves Creek, to the west of Adams Road. Cosgroves Creek and the riparian vegetation surrounding it were viewed from within the road corridor, as they occur on private land. The creek is not visible from the road corridor. The riparian vegetation provides connected habitat that passes beneath Elizabeth Drive to join up Oaky Creek. Canopy, understorey and groundlayer species were present. No hollow bearing trees were observed within the road corridor study area.

5.2 Ecosystem credit species assessment

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM (DPIE 2020), ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the study area, based on the PCTs present and generated by the calculator associated within the BAM (DPIE 2020) is provided in Table 5.1. The potential for these species to occur within the subject land was assessed in accordance with Section 5.2.2 of the BAM (DPIE 2020).

Table 5.1 Assessment of ecosystem credit species within the disturbance footprint

Scientific name	Common name	Justification for exclusion
<i>Anthochaera phrygia</i>	Regent Honeyeater (Foraging)	Excluded from condition class Poor.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Excluded from condition class Poor.
<i>Chthonicola sagittata</i>	Speckled Warbler	Excluded from cleared vegetation zones and condition class Poor.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	Excluded from cleared vegetation zones and condition class Poor.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Spotted-tailed Quoll use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites in areas containing rainforest, open forest woodland, coastal heath and inland riparian forest. The impact area lacks suitable den features. The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat. This species is excluded.
<i>Glossopsitta pusilla</i>	Little Lorikeet	Excluded from cleared vegetation zones and condition class Poor.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Foraging)	Excluded from cleared vegetation zones and condition class Poor.

Table 5.1 **Assessment of ecosystem credit species within the disturbance footprint**

Scientific name	Common name	Justification for exclusion
<i>Lathamus discolor</i>	Swift Parrot (Foraging)	Swift Parrot occur in areas where eucalypts are flowering profusely or where lerp (from sap-sucking bugs) infestations are abundant. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Forest Red Gum (<i>E. tereticornis</i>), Mugga Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>). This species is excluded from cleared vegetation zones, PCT 1800 class and Poor condition vegetation.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	Not excluded.
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Not excluded. This species was recorded within the study area.
<i>Miniopterus australis</i>	Little Bent-winged Bat (Foraging)	Not excluded. This species was recorded as having a probable pass during the acoustic detection survey.
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat (Foraging)	Not excluded. This species was recorded during the acoustic detection survey.
<i>Pandion cristatus</i>	Eastern Osprey (Foraging)	Excluded from condition class Poor.
<i>Petroica boodang</i>	Scarlet Robin	Excluded from condition class Poor.
<i>Petroica phoenicea</i>	Flame Robin	Excluded from condition class Poor.
<i>Phascolarctos cinereus</i>	Koala (Foraging)	The surrounding habitat has been cleared for farming and is highly isolated from larger patches of more suitable habitat. This species is excluded.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Foraging)	Excluded from condition class Poor. This species was recorded within the impact area during nocturnal surveys.
<i>Stagonopleura guttata</i>	Diamond Firetail	Not excluded.

5.3 Species credit species

Candidate species assessment

In accordance with Step 3 (Section 5.2.3 of BAM (DPIE 2020)), a field assessment of habitat constraints and microhabitats was undertaken in the field to determine the suitability of habitat within the study area for:

- predicted species (ecosystem credit species associated with recorded PCTs, predicted by the Biodiversity Assessment Method Calculator (BAMC));
- candidate species (species credit species associated with specific geographic and landscape feature constraints); and
- species predicted to occur by the EPBC Act Protected Matters Search Tool.

Candidate species predicted by the BAMC are shown in Table 5.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2.1 to 5.2.3) of the BAM.

Table 5.2 **Candidate threatened species assessment**

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species		Step 3 – Identify candidate species for further assessment	
Scientific name	Common name	Habitat/geographic constraints	Constraint present in disturbance footprint?	Vagrant species?	Candidate species (yes/no) and rationale
Flora					
<i>Acacia bynoeana</i>	Bynoe's Wattle	-	-	No	Yes
<i>Acacia pubescens</i>	Downy Wattle	-	-	No	Yes
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	-	-	No	Yes
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Sandy, alluvial or colluvial soil within 50 m of a water course.	Yes	No	Yes
<i>Deyeuxia appressa</i>	-	-	-	No	Yes
<i>Dillwynia tenuifolia</i>	-	Within 50 m of ephemerally and semi-permanently wet areas.	Yes	No	Yes
<i>Dillwynia tenuifolia</i> , Kemps Creek	Dillwynia tenuifolia, endangered population	Within the relevant geographic area (Kemps Creek).	No	No	No.
<i>Eucalyptus benthamii</i>	Camden White Gum	-	-	No	Yes
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper Leaved Grevillea	-	-	No	Yes
<i>Gyrostemon thesioides</i>	-	Sandy, alluvial or colluvial soil within 50 m of a water course.	Yes	No	Yes. The study area is within 50 m of a water course.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	-	-	-	No	Yes

Table 5.2 **Candidate threatened species assessment**

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species		Step 3 – Identify candidate species for further assessment	
Scientific name	Common name	Habitat/geographic constraints	Constraint present in disturbance footprint?	Vagrant species?	Candidate species (yes/no) and rationale
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas.	The LGAs named in the population's listing.	Yes	No	Yes. The study area is within Liverpool LGA.
<i>Maundia triglochinoides</i>	-	Ephemerally and semi-permanently wet areas. Wet areas up to 1 m deep. Wet areas can be man-made or natural.	Yes	No	Yes. The study area contains semi-permanent and ephemeral wet areas suitable to support this species.
<i>Persicaria elatior</i>	Tall Knotweed	Semi-permanent or ephemeral wet areas. Or within 50 m of swamps or waterbodies, including wetlands.	Yes	No	Yes. The study area contains semi-permanent and ephemeral wet areas suitable to support this species.
<i>Persoonia bargoensis</i>	Bargo Geebung	-	-	No	Yes
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	-	No	Yes
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	-	-	No	Yes
<i>Pimelea spicata</i>	Spiked Rice Flower	-	-	No	Yes
<i>Pomaderris brunnea</i>	Brown Pomaderris	-	-	No	Yes

Table 5.2 **Candidate threatened species assessment**

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species		Step 3 – Identify candidate species for further assessment	
Scientific name	Common name	Habitat/geographic constraints	Constraint present in disturbance footprint?	Vagrant species?	Candidate species (yes/no) and rationale
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	-	-	No	No. There is a lack of microhabitat features required by this species, namely sandstone benches. Further, the vegetation present is in disturbed condition (ie habitat is degraded and/or absent).
<i>Pultenaea pedunculata</i>	Matted Bush Pea	-	-	No	Yes
<i>Thesium australe</i>	Austral Toadflax	-	-	No	Yes
Fauna					
<i>Anthochaera phrygia</i>	Regent Honeyeater (Breeding)	Important mapped areas.	No	N/A	No. The study area is not within a mapped important area.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (Breeding)	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	Yes	No	No. No stick nests observed.
<i>Lathamus discolor</i>	Swift Parrot (Breeding)	Important mapped areas.	No	No	No. The study area is not a mapped important area.
<i>Litoria aurea</i>	Green and Golden Bell Frog	Within 1 km of semi-permanent or ephemeral wet areas, or swamps, or waterbodies.	Yes	No	Yes. The study area contains semi-permanent and ephemeral wet areas suitable to support this species.
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	-	-	No	Yes.

Table 5.2 **Candidate threatened species assessment**

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species		Step 3 – Identify candidate species for further assessment	
Scientific name	Common name	Habitat/geographic constraints	Constraint present in disturbance footprint?	Vagrant species?	Candidate species (yes/no) and rationale
<i>Miniopterus australis</i>	Little Bent-winged Bat (Breeding)	Caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'. Observation type code 'E nest-roost'. With numbers of individuals >500. Or from the scientific literature.	No	No	Yes.
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500. ¹	No	No	No.
<i>Myotis macropus</i>	Southern Myotis	Hollow-bearing trees; Within 200 m of riparian zone; Bridges, caves or artificial structures within 200 m of riparian zone; Waterbodies, including rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200 m of the site.	Yes	No	Yes. The study area is within 200 m of a riparian zone and contains a number of dams and waterbodies.
<i>Pandion cristatus</i>	Eastern Osprey (Breeding)	Presence of stick-nest in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.	No	No	The study area did not contain any evidence of stick-nest in trees or artificial structures within 100 m of the waterbodies.

Table 5.2 **Candidate threatened species assessment**

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species		Step 3 – Identify candidate species for further assessment	
Scientific name	Common name	Habitat/geographic constraints	Constraint present in disturbance footprint?	Vagrant species?	Candidate species (yes/no) and rationale
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	-	No	No. The study area does not support forests or woodlands dominated by Box species; nor is a shrubby or Acacia spp. dominated midstorey present. The subject property has been historically cleared and modified for farming and quarrying works and is located in a highly cleared landscape. As such the habitat is highly degraded for the Squirrel Glider.
<i>Phascolarctos cinereus</i>	Koala (Breeding)	Important' habitat (however this is not a mapped important habitat area), defined by the density of koalas and quality of habitat determined by on-site survey.	Yes	No	No. The subject property has been historically cleared and modified for farming and quarrying works and is located in a highly cleared landscape. As such the habitat is highly degraded for the Koala.
<i>Pommerhelix duralensis</i>	Dural Land Snail	Including logs and bark or within 50 m of logs or bark.	Yes	No	Yes. The study area (the western side of Adams Road) contains leaf litter and shed bark but lacks any rocky habitat. The species is associated with PCT 849.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (Breeding)	Breeding camps.	No	No	No. No breeding camps are located within or adjacent to the study area.

5.3.1 Candidate species credit species requiring further assessment

Candidate species for further assessment were identified in accordance with Step 1 to 2 (Section 5.2.1 to 5.2.2) of BAM (DPIE 2020). A list of species requiring further assessment is provided in Table 5.4.

Table 5.3 Candidate species credit species requiring further assessment

Scientific name	Common name	EPBC Act	BC Act	Flora or fauna
<i>Acacia bynoeana</i>	Bynoe's Wattle	V	E	Flora
<i>Acacia pubescens</i>	Downy Wattle	V	V	Flora
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Flora
<i>Deyeuxia appressa</i>	-			Flora
<i>Dillwynia tenuifolia</i>	-	V	V	Flora
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	Flora
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper Leaved Grevillea	-	V	Flora
<i>Gyrostemon thesioides</i>	-	-	E	Flora
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	Fauna
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	-	E	Flora
<i>Maundia triglochinos</i>	<i>Maundia triglochinos</i>	-	V	Flora
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	-	E	Fauna
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	-	V	Fauna
<i>Miniopterus australis</i>	Little Bent-winged Bat (Foraging)	-	V	Fauna
<i>Myotis macropus</i>	Southern Myotis	-	V	Fauna
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Flora
<i>Persoonia bargoensis</i>	Bargo Geebung	V	E	Flora
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	E	Flora
<i>Pimelea curviflora</i> var. <i>curviflora</i>	<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	Flora
<i>Pimelea spicata</i>	Spiked Rice Flower	E	E	Flora
<i>Pomaderris brunnea</i>	Brown Pomaderris	V	E	Flora
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E	Fauna
<i>Pultenaea pedunculata</i>	Matted Bush Pea	-	E	Flora
<i>Thesium australe</i>	Austral Toadflax	V	V	Flora

The presence or absence of these species in the impact area was determined in accordance with Section 6.4 of the BAM (OEH 2017). Survey methods and outcomes are discussed further below.

5.3.2 Targeted survey methods

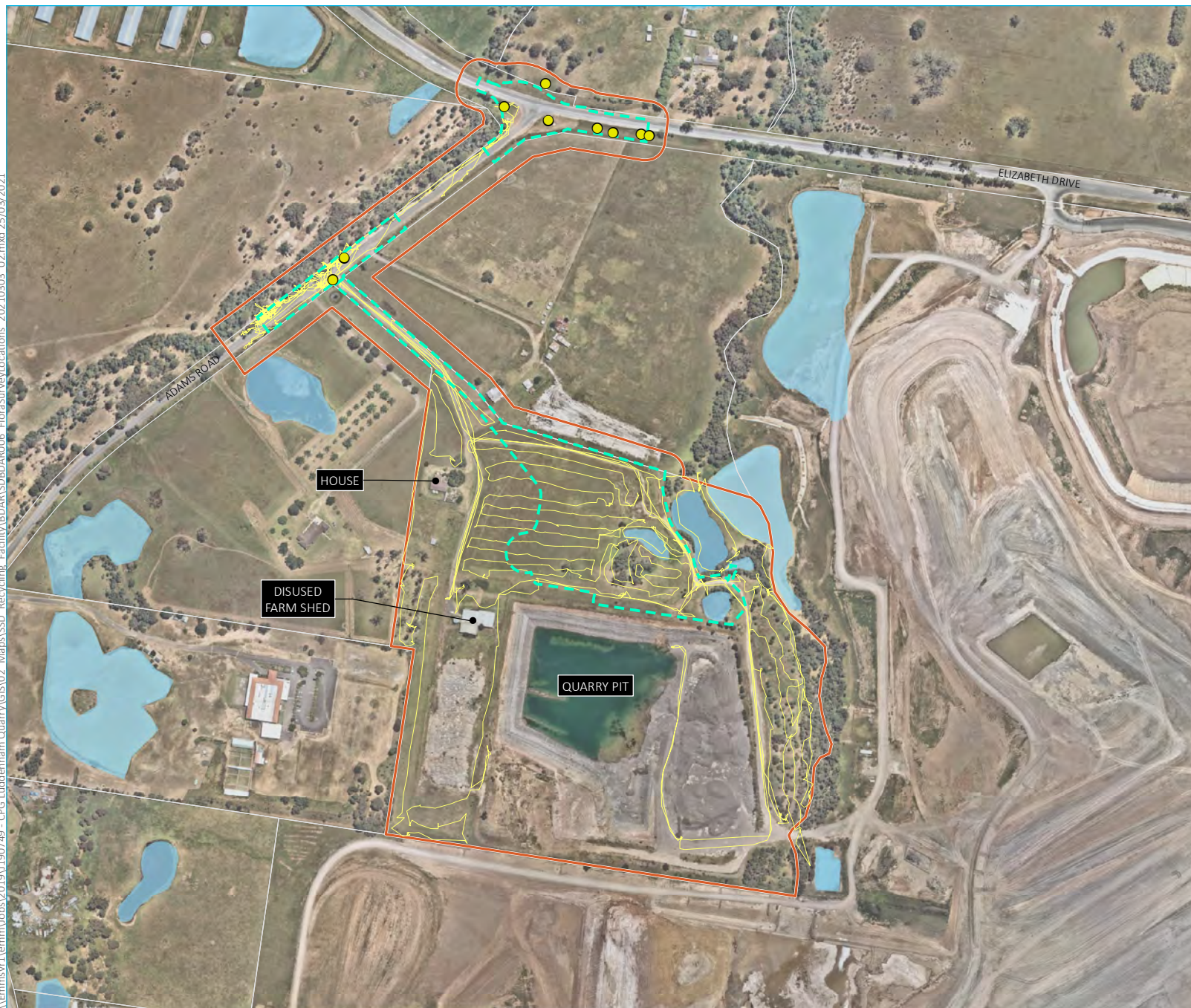
ii Targeted flora surveys

Targeted surveys were completed on 30 January and 9 December 2020. Surveys were undertaken by walking line transects in accordance with OEH *Guide to surveying threatened plants* (OEH 2016b) using transects spaced at 10 m intervals across accessible areas of the study area (ie. excluding the quarry, which is absent of vegetation). Table 5.4 shows the flora species that were able to be included as part of the flora searches, conducted 30 January and 9 December 2020.

Table 5.4 Targeted threatened flora searches within the subject property

Scientific name	Common name	Surveyed in survey guidance period
<i>Acacia bynoeana</i>	Bynoe's Wattle	Yes
<i>Acacia pubescens</i>	Downy Wattle	Yes
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Yes
<i>Dillwynia tenuifolia</i>	-	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property, and the few shrub species present along Adams Road were identifiable to species level.
<i>Eucalyptus benthamii</i>	Camden White Gum	Yes
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	Yes
<i>Maundia triglochinoides</i>		Yes
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population		Yes
<i>Persicaria elatior</i>	Tall Knotweed	Yes
<i>Persoonia bargoensis</i>	Bargo Geebung	Yes
<i>Pimelea curviflora</i> var. <i>curviflora</i>		Yes
<i>Pimelea spicata</i>	Spiked Rice-flower	Yes
<i>Pomaderris brunnea</i>	Brown Pomaderris	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property, and the few shrub species present along Adams Road were identifiable to species level.
<i>Thesium australe</i>	Austral Toadflax	Yes

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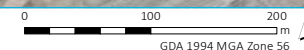
- KEY
- Study area
 - Direct impact area
 - Flora survey point
 - Flora survey effort
 - Waterbody
 - Cadastral boundary

Plant community types and
plot locations

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 5.1



Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2021); DOE (2019)



iii Targeted fauna surveys

Targeted fauna surveys were conducted for the species listed below. Stratification units – as well as survey methods and effort – are outlined for each fauna group below. Fauna survey locations are illustrated in Figure 5.2. Survey effort detailed in Appendix C and survey weather summary in Appendix D.

a Microbats

Microbat surveys were undertaken within the study area to target Southern Myotis. Stratification units and area of each survey unit in the subject property is shown in Table 5.5. Methods and survey effort have been developed in accordance with DEC (2004) and OEH (2018). Methods and survey effort are outlined in Table 5.6.

Microbat survey was not conducted along Adams Road or Elizabeth Drive as the habitat along Cosgroves Creek is located on private lands, but any species detected are also assumed to have the potential to occur in this area.

Table 5.5 Stratification units and survey area – microbats

Vegetation class	Area (ha)
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	2.67
PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	1.29
Total	2.82

Table 5.6 Methods and survey effort - microbats

Method	Survey description	Survey effort
Roost search (bridges and buildings)	<p>The disused road bridge was searched for the presence of roosting microbats and its suitability to support roosting microbats.</p> <p>The disused farm shed building (Figure 5.2) was not deemed suitable to support roosting microbats. The building is an open large tin shed (Photograph 5.6), with no roof voids (Photograph 5.7). No staining or microbat scats were observed at potential entry points considered suitable to be used by microbats.</p>	<p>The bridge was searched in its entirety. The disused farm shed building was inspected for signs of microbat presence such as guano.</p>
Acoustic detection	<p>OEH (2018) permits the use of acoustic devices to record presence of the Southern Myotis.</p> <ul style="list-style-type: none">• detectors were set out near bridge and waterbody features; and• detectors were placed out for a minimum of four nights. <p>Calls were analysed by a person experienced in bat call analysis.</p>	<p>OEH (2018) specifies a total effort of 16 nights for each 2.5 km of suitable habitat. An initial habitat assessment indicated that there was approximately 400 m of riparian habitat. As Southern Myotis was already confirmed within the subject property, observed roosting underneath the bridge and was observed foraging on the waterbodies during the frog surveys, only a total effort of 10 nights was undertaken.</p>



Photograph 5.6 Outside of disused farm shed (view from the south and west respectively)



Photograph 5.7 Inside of disused farm shed showing metal truss and roofing

b Amphibians

Amphibian surveys were undertaken within the study area to target Green and Golden Bell Frog. Stratification units and area of each survey unit in the subject property are shown in Table 5.7. Methods and survey effort have been developed in accordance with DoEWHA (2009), DECC (2009) and DSEWPaC (2010) and are outlined in Table 5.8.

Amphibian survey was not conducted along Adams Road or Elizabeth Drive as the habitat along Cosgroves Creek is located on private lands.

Table 5.7 Waterbody areas

Target species	Waterway	Area (ha)
Green and Golden Bell Frog	Pond 1 – western	0.04
	Pond 2 – middle	0.24
	Pond 3 – eastern	0.84
	Pond 4 – southern	0.08
	Cosgrove Creek (not surveyed due to lack of access)	-

Table 5.8 Methods and survey effort - amphibians

Method	Survey description	Survey effort
Habitat assessment	A habitat assessment was undertaken to identify suitable habitat along all the waterbodies within the study area.	All waterbodies were assessed for suitable habitat.
Diurnal searches	Surveys were undertaken on 30 January and 9 December 2020 as part of the threatened snail survey, with refuge habitat (eg logs and tin panels) checked.	The entire study area was walked in transect lines, where accessible. It is noted that this survey was undertaken concurrent with Cumberland Plain Land Snail and Dural Land Snail survey (Figure 5.2), as both involved searches of the ground layer and refuge sites.
Nocturnal searches	<p>Surveys were undertaken in accordance with the following:</p> <ul style="list-style-type: none"> • Surveyed over a minimum of four nights to increase the detection rate (27 February, and 2–4 March 2020 inclusive). • Between September and March, at the time of peak activity for the species. • During warm, windless and dry weather conditions following heavy rainfall earlier that month (433 mm in total, with a mean of 15 mm) (BOM 2020b) (See Appendix D for rainfall conditions during survey). 	<p>Each pond was surveyed as per the survey descriptions for four nights. Green and Golden Bell Frog were confirmed calling at a reference population at Kooragang Island on 2 March 2020 by Chad Beranek. Bionet also contains records of GGBF observed on 17 February (Wollongong), 25 February (Gosford), and 31 March (Nowra) (NSW Government 2020).</p> <p>Refuge habitats (eg logs and tin panels) were checked.</p> <p>The quarry pit was surveyed by listening for GGBF calls from two vantage points above the quarry, as the quarry itself was inaccessible at the time of the survey. The minimum survey effort was met.</p>
Egg mass and tadpole sampling surveys	<p>Egg mass and tadpole sampling was undertaken in accordance with the following:</p> <ul style="list-style-type: none"> • Egg mass (where detected during the nocturnal searches listed above). • Tadpole sampling was undertaken from visual inspections of banks and ponding water where suitable spawning habitat was present. 	DECC (2009) and Commonwealth of Australia do not specify minimum survey requirements for tadpoles. Tadpole searches occurred during each nocturnal search. No egg masses were detected.

c Terrestrial invertebrates

Snail surveys were undertaken for Cumberland Plain Land Snail and Dural Land Snail within the study area. Stratification units and area of each survey unit in the study area are shown in Table 5.9. However, in addition to survey of PCT 849 which is associated with habitat for this species, the majority of the site, including PCT 1800 vegetation along Oaky Creek was traversed (Figure 5.2).

Snail surveys were undertaken in vegetation located within the Adams Road corridor. Target snail surveys could not be conducted within the more extensive potential habitat along Cosgroves Creek as it is located on private lands.

Snail survey methods and survey effort have been developed in accordance with NSW NPWS (2010) guidance and Clark 2009 habitat requirements, see Table 5.10.

Table 5.9 **Stratification units and survey area – terrestrial invertebrates**

Stratification unit	Area (ha)
PCT 849 - Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	0.35
Total	0.35

Table 5.10 **Methods and survey effort – terrestrial invertebrates**

Method	Survey description	Survey effort
Area searches	<ul style="list-style-type: none">• Searches were performed under logs, debris, leaf and bark accumulation, bases of trees and grass clumps.• Quadrat searches: quadrats were placed beneath trees at random. Each quadrat was searched in detail by hand for three person minutes	Searches of all accessible areas of the study area (ie excluding the quarry and flooded areas), where vegetation is absent.

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- KEY**
- Study area
 - Direct impact area
 - Waterbody
 - Cadastral boundary
 - Green and Golden Bell Frog and Bush Stone-curlew survey effort
 - Cumberland Plain Land Snail and Dural Land Snail survey effort
 - Threatened fauna species survey**
 - Anabat location
 - Green and Golden Bell Frog vantage point
 - Hollow bearing tree

Fauna survey locations

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 5.2



5.3.3 Targeted survey results

iv Threatened flora species results

No threatened flora species were recorded during targeted surveys within the study area. All candidate threatened flora species are considered to be absent from the study area following targeted surveys.

v Threatened fauna survey results

a Green and Golden Bell Frog

GGBF inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. This species can occur in highly disturbed areas.

No GGBFs were recorded in the study area. Survey was conducted over the subject property. However, as survey was not conducted over the Cosgroves Creek to the west of Adams Road, due to lack of access, although the stream is unlikely to provide habitat it cannot be completely discounted. Therefore a 200 m buffer has been identified around Cosgrove Creek, and native vegetation that intersects with this buffer has been identified as a GGBF species polygon (Figure 5.3).

b Microbats

The targeted surveys recorded numerous Southern Myotis foraging around the main water bodies, and two Southern Myotis roosting underneath the bridge that crosses Oak Creek (Photograph 5.8). The bridge is located in the south-east corner of the study area, outside the impact area.

The anabat surveys identified five threatened bat species:

- Southern Myotis – definite record;
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – vulnerable – definite record (added to candidate species list);
- Little Bent-winged Bat (*Miniopterus australis*) – vulnerable – possible record;
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) – Vulnerable – probable record (added to predicted species list); and
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – Vulnerable – possible record (added to predicted species list).*

*The anabat report (Appendix I) notes that it can be difficult to identify calls between Eastern Broad-nosed Bat (*Scotorepens orion*), Greater Broad-nosed Bat and Eastern False Pipistrelle. The report considers Eastern False Pipistrelle less likely due to marginal habitat for the species.

Threatened Microbats were recorded using one PCT only:

- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

c Southern Myotis

Southern Myotis forage over streams and pools catching insects and small fish by raking their feet across the water surface. They roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.

The threatened biodiversity data collection specifies that the species polygon should be land within 200 m of a waterbody with pools/stretches 3 m or wider, including rivers and creeks. The species polygon should align with PCT 1800. A 200 m buffer was also applied around all waterbodies 3 m or wider for this species. This data was used to determine species polygons for the species (Figure 5.3).

Prescribed impact assessment also requires assessment of species credit species usage of water bodies and human made structures. The disused farm shed was inspected and no suitable roosting habitat for microbats was observed; nor were signs of microbat presence observed.

Two potential foraging areas, pond 1 and pond 4, will be removed as part of the project (Figure 5.2). These ephemeral ponds may potentially be utilised by Southern Myotis as foraging habitat. It is unknown to what degree these ponds are utilised for foraging by Southern Myotis, and due to their small size and shallow depth they may be of limited value. However, Southern Myotis was recorded from the Anabat recording site, which was located between all ponds.

Similarly, there is potential that water within the quarry pit may potentially also be utilised by Southern Myotis as foraging habitat.



Photograph 5.8 Roosting Southern Myotis underneath the bridge

d Large-eared Pied Bat

Ultrasonic bat call surveys detected Large-eared Pied Bats in the study area.

Large-eared Pied Bats roost in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.

Large-eared Pied Bat is a species credit species. The guideline for survey and establishment of threatened bat species polygons ('*Species credit threatened bats and their habitats*', OEH 2018), instructs that features to include in the species polygon for Large-eared Pied Bat are "*All habitat on the subject land where the subject land is within 2km of caves, scarps, cliffs, rock overhangs and disused mines*". An assessment for these features was conducted, by examining topographic contours within 2 km of the impact area. No caves, scarps, cliffs, rock overhangs or disused mines were detected within this 2 km buffer (Figure 5.5). Therefore, no species polygon has been established for this species.

Breeding habitat for the Large-eared Pied Bat is also a serious and irreversible impact (SAIL). However, the absence within 2 km of caves, scarps, cliffs, rock overhangs or disused mines which can provide opportunities for breeding sites for the Large-eared Pied Bat, means that no SAIL is triggered for this species.

Therefore, given the above, no species polygon has been established and no offsets are proposed for this species.

e Little Bent-winged Bat

Anabats recorded Little Bent-winged Bats on site.

Little Bent-winged occupy moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. They roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat (*Miniopterus schreibersii*) and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young. Only five nursing sites/maternity colonies are known in Australia.

Little Bent-winged Bat is a dual credit species. Potential breeding habitat is PCTs associated with the species within 100 m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings.

No breeding habitat is present in the study area, therefore no offsets are proposed for this species.

f Greater Broad-nosed Bat and Eastern False Pipistrelle

Greater Broad-nosed Bats and Eastern False Pipistrelles are ecosystem species, therefore no offsets are proposed for these species.

vi Candidate species presence, extent and habitat quality

A list of candidate species credit species predicted to occur within the study area, along with an assessment of whether the species will be impacted by the project is provided in Table 5.11.

Table 5.11 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Subject area	Recorded during field surveys	Impacted by development	Justification
Flora						
<i>Acacia bynoeana</i>	Bynoe's Wattle	2	Yes	No	No	Not recorded during targeted surveys.
<i>Acacia pubescens</i>	Downy Wattle	2	Yes	No	No	Not recorded during targeted surveys.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	2	Yes	No	No	Not recorded during targeted surveys.
<i>Deyeuxia appressa</i>	-	3	Yes	No	No	Not recorded during targeted surveys.
<i>Dillwynia tenuifolia</i>	-	2	Yes	No	No	Although surveys did not occur during survey season, the shrub form would have been readily detectable because no native shrub species were present in the subject property, and all native species in the road corridor were identifiable to species level.
<i>Eucalyptus benthamii</i>	Camden White Gum	2	Yes	No	No	Not recorded during targeted surveys.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	1.5	Yes	No	No	Not recorded during targeted surveys.
<i>Gyrostemon thesioides</i>	-	3	Yes	No	No	Not recorded during targeted surveys.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	-	2	Yes	No	No	Not recorded during targeted surveys.
<i>Maundia triglochinosoides</i>	-	2	Yes	No	No	Not recorded during targeted surveys.
<i>Persicaria elatior</i>	Tall Knotweed	2	Yes	No	No	Not recorded during targeted surveys.
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	3	Yes	No	No	Not recorded during targeted surveys.
<i>Persoonia bargoensis</i>	Bargo Geebung	2	Yes	No	No	Not recorded during targeted surveys.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		2	Yes	No	No	Not recorded during targeted surveys.

Table 5.11 Species credit species, habitat suitability and targeted survey results

Scientific name	Common name	Biodiversity risk weighting	Habitat present within the Subject area	Recorded during field surveys	Impacted by development	Justification
<i>Pimelea spicata</i>	Spiked Rice-flower	2	Yes	No	No	Not recorded during targeted surveys.
<i>Pomaderris brunnea</i>	Brown Pomaderris	2	Yes	No	No	Although surveys did not occur during survey season, the shrub form was readily detectable because no native shrub species were present in the subject property, and all native species in the road corridor were identifiable to species level.
<i>Pultenaea pedunculata</i>	Matted Bush-pea	2	Yes	No	No	Although surveys did not occur during survey season, the prostrate shrub form was readily detectable because no native shrub species were present in the subject property, and all native species in the road corridor were identifiable to species level.
<i>Thesium australe</i>	Austral Toadflax	1.5	Yes	No	No	Not recorded during targeted surveys.
Fauna						
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	2	Yes	Yes	No (foraging habitat only).	One definite pass recorded at each of the acoustic devices (Anabat detectors) during targeted surveys.
<i>Litoria aurea</i>	Green and Golden Bell Frog	2	Yes	No	Possible	Not recorded during targeted surveys. Assumed that potential habitat could be present along Cosgrove Creek, due to the lack of access to these lands, and species polygon created on this basis.
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	2	Yes	No	No	Not recorded during targeted surveys.
<i>Miniopterus australis</i>	Little Bent-winged Bat	3	Yes	Yes (probable)	Yes (foraging habitat only).	Recorded (probable record) during targeted surveys (feeding pass). However, no breeding sites were located, and no hollow-bearing trees were identified within the study area. Therefore, entered as 0 ha impacted.
<i>Myotis macropus</i>	Southern Myotis	2	Yes	Yes	Yes	Recorded roosting and foraging within the subject property.
<i>Pommerhelix duralensis</i>	Dural Land Snail	2	Yes	No	No	Not recorded during targeted surveys.

A summary of the survey results and areas impacted within species polygons are provided in Table 5.11.

Table 5.12 Species impact both direct and indirect (ha)

Species	PCT 849_Medium	PCT 849_Poor	PCT 1800_Medium	PCT 1800_Poor
Green and Golden Bell Frog	0.62	0.01	0.20	-
Southern Myotis	0.62	0.01	0.59	0.19

These species will require offsets in accordance with the BAM (OEH 2017). Species polygons are shown in Figure 5.3 and Figure 5.4.

\\lemmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02_Maps\SSD_Recycling_Facility\BOAR\SD8DAR008_ThreatenedFauna_20210401_06.mxd 1/04/2021



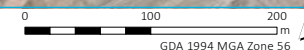
- Subject property
- Direct impact
- Indirect impact
- Waterbody
- Cadastral boundary
- Green and Golden Bell Frog direct impact species polygon
- Green and Golden Bell Frog indirect impact species polygon
- Green and Golden Bell Frog buffer around breeding habitat

Green and Golden Bell Frog potential habitat buffer and species polygon

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Recovery Centre
Biodiversity Development Assessment Report
Figure 5.3



Source: EMM (2021); DFSI (2017); GA (2011); Nearmap (2021); DOE (2019)



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- KEY**
- Indirect impact area
 - Direct impact area
 - Named watercourse
 - Southern Myotis indirect impact species polygon
 - Southern Myotis direct impact species polygon
 - Southern Myotis species habitat
 - Southern Myotis buffer around waterbodies
- Threatened fauna species survey
- Southern Myotis roost
- Threatened fauna species survey
- Southern Myotis record

Southern Myotis habitat buffer and species polygon

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Figure 5.4



Source: EMM (2020); DFSI (2017); GA (2011); ASGC (2006)



\\lemmsvr1\EMM\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02 Maps\SSD Recycling Facility\BOAR\SDBOAR011 Large-earedPiedBat_20210401_01.mxd 1/04/2021



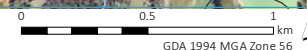
- KEY**
- Study area
 - 2 km study area buffer
 - Indirect impact area
 - Direct impact area
 - Major road
 - Named watercourse
 - Contour (10 m)

Large-eared Pied Bat habitat features assessment

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 5.5



Source: EMM (2021); DFSI (2017); GA (2011)



STAGE 2: IMPACT ASSESSMENT

6 Impact assessment (biodiversity values)

6.1 Potential direct, indirect and prescribed impacts

Despite implementation of measures to avoid, minimise and mitigate impacts, the project would result in direct impacts on biodiversity and may result in indirect impacts as summarised below.

6.1.1 Direct impacts

The main direct impacts of the project will be associated with impacts arising from the clearing works for construction of the project, they include:

- loss of native vegetation; and
- loss and degradation of native fauna habitats.

In addition to the direct impacts arising from this process, clearing of native vegetation has several indirect impacts.

6.1.2 Indirect impacts

Indirect impacts that could occur as a result of the project include:

- increase in weeds, resulting in degradation of retained native vegetation and habitat;
- stormwater entering the riparian vegetation and Oaky Creek;
- potential inadvertent disturbance of retained habitats; and
- increased movement of vehicles and people into the area has the potential to transport weeds into the subject property. Weeds have the potential to result in degradation of retained vegetation and fauna habitat.

Indirect impacts have been assessed in accordance with the BAM (OEH 2017) and credits have been calculated. The assessment of data collected as a part of the biodiversity monitoring program for Snowy 2.0 Exploratory Works (EMM 2019) showed a substantial difference in weed cover from 10 m to 50 m, but not from 10 m to 20 m or from 20 m to 50 m, and this was used to inform the approach to indirect impacts for the project. The BDAR (EMM 2020b) for Snowy 2.0 Main Works thus assumed that all vegetation within 20 m of the subject land will incur some indirect impacts. Reductions to native groundcover and litter cover scores were applied as a surrogate for increased weed density, as the BAM calculator does not allow scores (including exotic cover scores) to be increased for BDAR assessments. Changes in vegetation integrity score within the 20 m buffer comprise the following:

- The structure (cover) scores for 'grass', 'forbs', 'ferns' and 'other' growth forms were reduced by 10%, leaving scores for all other growth forms at the current score.
- Functional score for litter cover was reduced by 5%.

The same approach has been used to assess potential weed establishment for this project.

6.1.3 Prescribed impacts

Consideration has been given with regards to prescribed impacts on threatened species and communities recorded or assumed to be present within the subject property, as per Section 8.2.1.2 of the BAM (OEH 2017). The prescribed impacts relevant to the proposed modification are documented in Table 6.1, and prescribed impacts are assessed in Table 6.2 to Table 6.4.

Table 6.1 Prescribed biodiversity impacts relevant to the proposed project

Prescribed impact	Justification
Impacts of development on the habitat of threatened species or ecological communities associated with	
• karst caves, crevices, cliffs and other features of geological significance	None have been identified within the study area.
• rocks	None have been identified within the study area.
• Human made structures	Assessed in Table 6.2.
• Non-native vegetation	Assessed in Table 6.3.
The assessment of the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The project will not have a direct impact on the connectivity within the area. The ARRC site has previously been utilised as a quarry, and the ARRC project will be established to the north of the quarry pit. Oaky Creek provides limited connectivity to the north and will not be removed. Similarly, Cosgroves Creek provides limited connectivity and will not be removed. The WSA development is to the south and east, and as such ecological connectivity in these directions is effectively severed.
Impacts of the development on movement of threatened species that maintains their life cycle	No species have been identified where the proposal is considered to have impacts on their movement. Southern Myotis, and other threatened bats detected, are highly mobile species.
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	Assessed in Table 6.4.
Impacts of wind turbine strikes on protected animals	Not relevant to the proposed project.
Impact of vehicle strikes on threatened species of animals or on animals that are part of a TEC	The proposed works will involve installation of turning lanes and similar works to Adams Road and Elizabeth Drive. However, these roads are already present. No species have been identified within the subject land that are likely to have an impact from vehicle strikes. Mobile threatened bat have been identified foraging, but these are unlikely to be affected by vehicle strike. Green and Golden Bell Frog was not detected, though it could potentially occur within Cosgroves Creek, as the area could not be surveyed and assessed due to lack of access.

Table 6.2 Impacts of development on the habitat of threatened species or ecological communities associated with human made structures

<p>The assessment of the impacts of development on the habitat of threatened species or ecological communities associated with human made structures must:</p> <p>(a) identify the human made structures with potential to be habitat for threatened species or ecological communities</p>	<p>The human made structures with potential to be habitat for threatened species or ecological communities on site are:</p> <ul style="list-style-type: none"> the disused farm shed (Photograph 5.6); the house; and the underside of the bridge over Oaky Creek. <p>Note that none of these structures will be impacted by the proposed SSD.</p>
<p>(b) identify the species and ecological communities likely to use the habitat</p>	<p>Surveys confirmed that Southern Myotis and Large-eared Pied Bat are on ARRC site (Appendix I). Greater Broad-nosed Bat is probably on site. Eastern False Pipistrelle and Little Bent-winged Bat are possibly on site. No other threatened species were detected during targeted surveys.</p> <p>Eastern False Pipistrelle and Greater Broad-nosed Bat are unlikely to use human made structures.</p> <p>Other threatened species or ecological communities are unlikely to use the habitat.</p>
<p>c) describe the nature, extent and duration of short and long-term impacts</p>	<p>Not applicable, as no human made structures will be impacted.</p>
<p>(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities</p>	<p>The disused farm shed and house have been assessed for microbat habitat, or signs of microbat use, and were not considered to be habitat. The underside of the bridge over Oaky Creek has been assessed, and found to be utilised by a small number of Southern Myotis. Other culverts, bridges and disused structures are present within the bioregion and could be utilised by Southern Myotis, therefore the importance of the bridge structure is likely low. However, no disturbance to the bridge structure is proposed.</p>
<p>(e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.</p>	<p>No human made structures will be impacted. Therefore, the likely consequence of the project to the suite of threatened species and communities likely to use the site is negligible.</p>

Table 6.3 Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation

<p>(b) identify the species and ecological communities likely to use the habitat</p>	<p>No threatened species have been identified as using non-native vegetation. No threatened flora species were detected during target survey. Cumberland Plain land Snail, Dural Land Snail, and Green and Golden Bell Frog can potentially utilise disturbed areas, possibly included non-native vegetation, but none were detected during target survey. Green and Golden Bell Frog has been identified as potentially occurring within Cosgroves Creek, as the area could not be surveyed and assessed due to lack of access. If the species does occur, they could potentially utilise non-native vegetation areas.</p> <p>A number of threatened microchiropteran bats (Southern Myotis, Large-eared Pied Bat, Greater Broad-nosed Bat, Eastern False Pipistrelle, and Little Bent-winged Bat) have been recorded (or potentially recorded), and some of these species may potentially forage for insects, or fly over the non-native vegetation.</p>
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Table 6.3 Prescribed biodiversity impacts assessment: impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation

c) describe the nature, extent and duration of short and long-term impacts	The proposal would involve construction impacts and loss of non-native vegetation. The extent of duration is expected to be permanent.
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the habitat to these species or ecological communities	The non-native vegetation is not considered to be of importance to the threatened microchiropteran bats. These species are likely to prefer foraging within intact native vegetation. There are significant areas of non-native vegetation within the region. Should Green and Golden Bell Frog occur along Cosgroves Creek, the adjoining non-native vegetation is unlikely to be of significant importance given that better quality riparian vegetation is present in proximity to Cosgroves Creek.
(e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	The proposal would remove non-native vegetation for the length of operation of the ARRC. This is likely to be of negligible consequence to the threatened microchiropteran bats and Green and Golden Bell Frog (if present).

Table 6.4 Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	
(a) identify water bodies with potential to be habitat for threatened species or threatened ecological communities that are likely to be impacted by the proposal	The riparian habitat contains areas of dams and standing water associated with Southern Myotis and Swamp Oak Floodplain Forest EEC, Oaky Creek and Cosgrove Creek. This habitat is likely to be directly and indirectly impacted by the project.
(b) identify the threatened species and threatened ecological communities likely to use the habitat	Swamp Oak Floodplain Forest EEC, Green and Golden Bell Frog (potential habitat associated with Cosgrove Creek), Southern Myotis.
(c) identify hydrological processes that sustain threatened species or threatened ecological communities and the species and communities that are dependent on them	Oaky Creek receives surface and groundwater flows. This creek only flows during times of high rainfall. Swamp Oak Floodplain Forest EEC is dependent on the duration of waterlogging. Cosgrove Creek receives water runoff from Adams Road and a portion of Elizabeth Drive.
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the water body or hydrological process to these species or ecological communities	The Swamp Oak Floodplain Forest EEC is considered to not be dependent on the water bodies per se, but rather the hydrological processes such that this vegetation receives frequent water flows. It is also noted that vegetation within the ARRC site has likely colonised responding to past clearing; and is probably vegetation in a transitional state between PCT 1800 and PCT 835 (Table 4.3). That is, the vegetation present is responding to past disturbances, and may not be reflective of the vegetation community originally present. In this context the current hydrological processes, namely frequent water flows, is encouraging Swamp Oak which dominates the Swamp Oak Floodplain Forest EEC vegetation.

Table 6.4 Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

	For Southern Myotis the water bodies present are assumed to be utilised by Southern Myotis for foraging, with larger ponds along Oaky Creek considered more likely to be utilised. It is not considered that water bodies present within the site are of high importance within the bioregion. All ponds are used as part of the water management of the quarry. Further, there are numerous waterbodies in the region surrounding the site (Figure 3.2). Nonetheless, the ponds present within the site are likely to be utilised by Southern Myotis for foraging by the small number of individuals detected roosting in the bridge roost site to the southeast of the ARRC site (Figure 5.3).
(e) describe the nature, extent and duration of known short and long-term impacts on water bodies and hydrological processes	Indirect impacts on the hydrological process are likely to be long term from the project. However, due to the nature and small scale of these indirect impacts (ie occasional discharges of treated water and wet weather overflows, and runoff from Adams Road and Elizabeth Drive), the highly degraded and modified nature of the subject property, and that Adams Road and Elizabeth Drive are already in place, these impacts are unlikely to substantially change the nature of drainage into this habitat.
(f) describe the nature, extent and duration of short and long-term impacts on water quality	Water flows into Oaky Creek from the project will be controlled as part of the project's surface water management system. Flows into Cosgroves Creek from Adams Road and Elizabeth Drive upgrade works could occur and be impacted during the construction of the proposed upgrades to these roads.
(g) predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information	No significant impacts are predicted for the bioregional persistence of Southern Myotis, Green and Golden Bell Frog (should it occur), and Swamp Oak Floodplain Forest EEC. The habitat within the study area is disturbed.
(h) predict the nature, extent and duration of short and long-term impacts on the habitat and life cycle of species using the natural features of any water dependent plant community	No long-term impacts are predicted occur as a result of altered hydrology from the project. The small scale of the impact – and the highly degraded and modified nature of the vegetation – means that impacts are unlikely to change the nature of drainage into this habitat.
(i) justify predictions of impact on any water dependent plant communities, with appropriate modelling and with reference to relevant literature and other published sources of information	No surface or groundwater extraction has been proposed as part of the works. The proposed minor impacts to landform are unlikely to significantly change movement of surface or subsurface water in the area. Therefore, the project is unlikely to impact on any water-dependent plant communities.
(j) predict the cumulative impacts of the project together with existing mining operations mining underneath the same water dependent plant communities	The project does not propose any mining to occur. The quarry located in the subject property is open cut. The project is unlikely to impact the water table. Therefore, cumulative impacts to water dependent plant communities are likely negligible.
(k) based on predictions of impacts on water dependant plant communities and the species they support, calculate the maximum predicted offset liability in accordance with the Upland Swamp Policy	The maximum predicted offset liability to water dependent plant communities resulting from the project is negligible, as per the Addendum to NSW Biodiversity Offsets Policy for Major Projects (OEH 2016c).

Table 6.4 Prescribed biodiversity impacts assessment: water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

(I) justify any prediction of 'nil' or 'negligible' environmental consequences for any impact on water dependent plant communities and the species they support

The prediction of negligible consequences is based on:

- the negligible proposed impacts to Swamp Oak Floodplain Forest EEC, Green and Golden Bell Frog (should it occur), and Southern Myotis habitat.
- The negligible change to the shallow groundwater regime of the EEC. (The proposed works are considered to only have an indirect impact on the water quality from surface run off, which has been assessed as part of the overall credit calculations).
- The negligible change to the composition or distribution of the water dependent vegetation communities and threatened species.

6.2 Measures to avoid, minimise and mitigate impacts

6.2.1 Avoidance measures

The project has been designed, where possible, to avoid sensitive biodiversity areas.

The ARRC site has been sited to avoid potential impacts to the Swamp Oak Floodplain Forest Endangered Ecological Community (EEC) (PCT 1800) along the eastern boundary of the subject property and Cumberland Plain Woodland CEEC (PCT 849) that is present between the existing internal road and the western boundary. Similarly, the proposed upgrade to the Elizabeth Drive/Adams Road intersection has been designed to avoid impacts to Cosgrove Creek and the existing road bridge.

Iterative project planning, informed by the baseline studies outlined above, has allowed a range of impacts to be avoided and others to be minimised throughout the life of the project. To compensate for unavoidable disturbance, biodiversity offsets will be provided.

Key avoidance measures that are to be implemented by the proponent comprise:

- avoidance of direct impacts to Oaky Creek;
- avoidance of direct impacts to Cosgrove Creek;
- no impacts to PCT 849 in the subject property;
- minimisation of impacts to PCT 849 in the road corridor, by widening only where required to accommodate a B-double swept path;
- minimisation of impacts to PCT 1800, by only impacting on small areas of the fragmented habitat;
- avoiding impacts to PCT 1800, by avoiding impacts to the vegetation on the south-eastern boundary;
- utilisation of the existing cleared areas wherever feasible; and
- a water management system to minimise potential impacts to Oaky Creek (Section 6.1.2iii).

6.2.2 Mitigation measures

i Retention of vegetation, pre-clearing and clearing works

Site preparation works will require clearing of some native vegetation. These works have the potential to have an impact on fauna species including an indirect impact on the retained vegetation and fauna habitat. The following controls will prevent or minimise impacts to vegetation and fauna species:

- Implement exclusion zones around all areas of retained vegetation and fauna habitat. These areas will be fenced using appropriate fencing materials and designated and signed as 'No-go Zones' or 'Environmentally Sensitive Areas'.
- Where feasible or when required, set up tree protection zones (TPZs) around all retained trees and immediately adjacent to the disturbance footprint. If required, TPZs are to be established in accordance with the Australian Standard AS 4970-2009 Protection of trees on development sites (Standards Australia Committee 2009).

Native vegetation cleared should be mulched and stockpiled for re-use during any rehabilitation works. Any hollow-bearing trees and large tree limbs should be retained as hollows or logs for placement into rehabilitated areas or retained native vegetation.

These measures will be incorporated into a Construction Environmental Management Plan (CEMP).

ii Weed control

Indirect impacts could occur due to the introduction and/or spread of weeds into the subject property. To prevent this occurring the following controls will be implemented:

- Update of the Vegetation Management Plan to identify vegetation management to be applied to the riparian zone adjacent to Oak Creek in the eastern portion of the site, and implementation.
- Undertaking of weed control in key areas prior to construction works, to minimize the impacts of weeds during construction and to minimise the requirements for disposal and management of weeds on-site.
- Appropriate management and disposal of weed species during clearing works, in accordance with the biodiversity management plan.
- Active and intensive weed control will be undertaken within the subject property, in areas where significant weeds are known to occur to reduce the cover of weeds adjacent to the construction activities, preventing the spread of weeds into the riparian habitat associated with Oak Creek.

iii Water management

The key water management strategy adopted across the ARRC site is containment and management of water that has potentially been in contact with waste material, with reuse where feasible. The key features of the proposed water management system include:

- fully enclosing all waste handling and storage within the ARRC warehouse to prevent rainfall interacting with waste (or recycled products) and to prevent rainfall on hardstand that is used to store waste (or recycled products);
- collection of stormwater within an onsite detention storage;

- capture, treatment and reuse of water recycled from site activities in the warehouse; and
- discharge of excess stormwater from the onsite detention storage to Oaky Creek.

The Surface Water Assessment (EMM 2020a) carried out for the project concluded that the project's water quality controls are expected to function to prevent any material change or degradation of the water quality of Oaky Creek due to discharges.

The Surface Water SSD Report concludes:

"The onsite detention storage will receive stormwater runoff from the warehouse roof, site offices, roads, carparks and landscaped areas. Reuse of harvested stormwater will reduce the volume and frequency of discharges. The storage will function to attenuate stormwater flows from the site as well as providing water quality treatment through sedimentation. Discharges are predicted to occur from the onsite detention storage into Oaky Creek. Scour protection and energy dissipation will be constructed at the discharge location and at the confluence with Oaky Creek to reduce erosion potential associated with the increased flow rates from the immediate site.

"Water quality controls are expected to prevent any material change or degradation of the water quality of Oaky Creek due to discharges of excess stormwater. It is not proposed to discharge untreated dirty water or treated dirty water to the onsite detention storage or to Oaky Creek.

"The site is not expected to change existing flood conditions for all storm events up to and including the PMF event." (Surface Water SSD Report, ES5, pg ES.2).

iv Sediment control

Management of sedimentation will be a key measure to minimise and mitigate impacts. Management measures will be put in place to control sediment. The key period for mobilisation of large amounts of coarse sediment will be during construction. Key management measures to be implemented to manage this risk include:

- sediment controls are to be put in place within the ARRC site, and shall be consistent with relevant standards, including:
 - Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom 2004);
 - Managing Urban Stormwater: Soils and Construction – Volume 2C – Unsealed Roads (DECC 2008a); and
 - Managing Urban Stormwater: Soils and Construction – Volume 2D – Main Road Construction (DECC 2008b);
- an erosion and sediment control plan (ESCP) are to be prepared for each construction zone;
- where practical, clean water will be diverted around, rather than through, construction areas;
- consider local soil characteristics, topography and environmental constraints and proposed construction methods and identify risks associated with proposed activities;
- apply clean water management controls as per:
 - WM 1.1 for clean water management during surface construction disturbance;

- WM 2.1 for temporary waterway diversions around temporary surface infrastructure; and
- WM 3.1 for permanent waterway diversions;
- all temporary drainage and sediment control measures will be designed to have non-erosive hydraulic capacity and be structurally sound for the design events specified in Table 6-1 in Managing Urban Stormwater: Soils and construction – Volume 2D – Main Road Construction (DECC 2008b);
- consider all practical erosion control and rehabilitation methods and apply the most appropriate method;
- consider all practical methods to stabilise small temporary stockpiles and apply the most appropriate method. Apply management controls as per WM 2.5 for the management of large temporary stockpiles;
- apply enhanced erosion controls where significant risks are identified;
- include measures to manage the storage and handling of hydrocarbons and other chemicals that have potential to pollute receiving water;
- include measures to manage accidental leaks and spills; and
- be progressively amended as required during construction.

v Dewatering of dams

Ponds 1 and 4 will need to be dewatered (Figure 5.2). Any dewatering would be conducted in accordance with the CEMP. Any native animals captured would be moved to the adjacent pond 2 or Pond 3 outside the impact area.

It is noted that pond 4 will be replaced by a stormwater detention basin in approximately the same location. Due to the development of Western Sydney International (Nancy-Bird Walton) Airport immediately to the east of the project, the new stormwater basin will be required to be netted, to reduce the risk of bird or bat strike on planes utilising the airport once operational.

The project proposes to compensate for loss of two ponds, designated as pond 1 and pond 4, which are 0.04 ha and 0.08 ha in size respectively, within the ARRC site, due to potential for these ephemeral waterbodies to provide foraging for Southern Myotis. It is unknown to what degree these ponds are utilised for foraging by Southern Myotis, and due to their small size and shallow depth they may be of limited value. Furthermore, the BAM does not contain any formal requirement for offsets to be delivered for impacts on areas that are not mapped as a PCT. Nonetheless, a total of 6 additional Southern Myotis credits are proposed, treating both ponds as if they were ideal habitat for Southern Myotis habitat. This calculation is based on the application of equation 2 of the BAM, namely:

$$\begin{aligned}
 \text{Number of credits required} &= HC_i \times HL_i \times BRW \times 0.25 \\
 &= 100 \times 0.12 \times 2 \times 0.25 \\
 &= 6 \text{ credits}
 \end{aligned}$$

Where:

- HC_i (condition of habitat) = 100 assuming that habitat condition for Southern Myotis within pond 1 and pond 4 is at maximum value.
- HL_i (area of habitat) = the sum of 0.04 ha for pond 1 and 0.08 ha for pond 4 or 0.12 ha in total.
- BRW (biodiversity risk weighting) = 2 for Southern Myotis.

vi Noise, vibration and lighting

Impacts from noise and vibration will occur during the construction period, and also during operations from ARRC operations. Some impacts to fauna species such as the foraging habitat for the Southern Myotis may result. It is noted that the site will also have experienced previous noise impacts from operation of the quarry, and will also be immediately adjacent to Western Sydney International Airport which is currently being constructed. Thus, there will be some additional noise impacts.

Light spill from the warehouse doors during night operations has the potential to reduce the suitability of retained habitat for some fauna species. To minimise this directional lighting will be used, minimising light spill as much as possible.

vii Bushfire risk management measures

The bushfire assessment concludes that no additional vegetation needs to be cleared to achieve the 7-12 m wide APZ zone. Table 3.1 states “A defendable space is provided around the entire ARRC site (the APZ)” and furthermore “The APZ is wholly within the development footprint” (EMM 2021a, page 17).

Condition 1 of the NSW Rural Fire Service report states “the entire property must be managed as an inner protection zone (IPA) in accordance with the requirements of Appendix 4 of *Planning for Bush Fire Protection 2019*” (NSW RFS 2020, page 1). The ‘entire property’ refers to the ARRC site boundary (the direct impact area).

Condition 5 states “a Bush Fire Emergency Management and Evacuation Plan must be prepared” (page 2). The plan is likely to require the existing exotic grassland to the west of the ARRC site (but still within the subject property to be mown and that any areas identified on the site plan as ‘landscaping’ will require management to the standards of an IPA, in accordance with Appendix 4 of *Planning for Bush Fire Protection 2019*, including the trimming of planted trees and shrubs. However, the proposed landscaping occurs within the ARRC site and in areas that do not currently contain native vegetation. Therefore, no native vegetation will need to be removed for the maintenance of the APZs. As the APZs occur within the ARRC site (the impact area assessed within the BDAR) there will be no additional impact to native vegetation, threatened species and threatened ecological communities as a result of the management of the APZs.

6.2.3 Summary of measures to avoid, minimise and mitigate impacts

A summary of impacts arising from the proposed development, and measures outlined above to avoid, minimise and mitigate impacts, is provided in Table 6.5.

Table 6.5 **Summary of impacts, and measures to avoid, minimise and mitigate**

Impact	Impact avoidance	Impact minimisation	Impact mitigation
<p><i>Removal and disturbance of native vegetation and threatened species habitat.</i></p> <p>Type: direct and indirect impact.</p> <p>Frequency: once, during construction.</p> <p>Intensity: removal of 0.42 ha of native vegetation habitat that is listed as a TEC under the BC Act and habitat for threatened species.</p> <p>Duration: initial stages of construction.</p> <p>Consequence: permanent removal of native vegetation and threatened species habitat.</p>	<p>The ARRC site was designed to have minimal impact on the riparian habitat along Oaky Creek.</p> <p>The scope of the maximum footprint for road upgrade works along Adams Road and Elizabeth Drive was reduced from preliminary designs so as to reduce the clearing of native vegetation.</p>	<p>Siting of infrastructure in areas subject to existing disturbance.</p> <p>Use of the existing road network to minimise requirement for removal of native vegetation.</p> <p>Detailed design of the project, resulting in further minimisation of impacts to native vegetation.</p> <p>Minimisation of clearing during construction, wherever possible.</p>	<p>Establishment of exclusion zones around retained vegetation, including fencing and signage.</p> <p>Vegetation clearing undertaken in accordance with the two-stage process.</p> <p>Retention of any hollows logs and limbs for placement within retained vegetation and reuse during rehabilitation.</p>
<p><i>Increase in weeds and pathogens.</i></p> <p>Type: indirect impact.</p> <p>Frequency: ongoing during construction and operation.</p> <p>Intensity: likely low due to existing conditions.</p> <p>Duration: ongoing through construction phase.</p> <p>Consequence: potential to impact on threatened species habitat, resulting in decline in habitat quality.</p>	<p>Not required.</p>	<p>Update of the Vegetation Management Plan for the riparian zone and implementation</p> <p>Weed control prior to construction works being undertaken, where possible.</p> <p>Appropriate disposal and management of weeds during clearing works.</p> <p>Active weed control within the subject property.</p>	<p>Not required.</p>
<p><i>Light and noise pollution during night works.</i></p> <p>Type: indirect impact.</p> <p>Frequency: ongoing during construction and operation.</p> <p>Intensity: likely low due to existing conditions.</p> <p>Duration: ongoing during construction and operation.</p> <p>Consequence: potential to result in noise impacts to retained vegetation and light spill into adjacent habitat areas, impacting on occupancy for Southern Myotis.</p>	<p>Design of project to minimise lighting and noise impacts on surrounding landuses and habitat.</p>	<p>Use of directional lighting to retain lighting within works areas as much as possible.</p>	<p>Not required.</p>

Table 6.5 **Summary of impacts, and measures to avoid, minimise and mitigate**

Impact	Impact avoidance	Impact minimisation	Impact mitigation
<p><i>Changes to runoff regimes and sediment impacts.</i></p> <p>Type: prescribed impact.</p> <p>Frequency: ongoing during construction and operation.</p> <p>Intensity: potential to mobilise large amounts of sediment and impact on EEC habitat.</p> <p>Duration: initial stages of construction and potential ongoing operational discharges.</p> <p>Consequence: impact water quality, erosion and sedimentation in the area and breeding success.</p>	<p>Siting of key infrastructure away from sensitive receiving environments.</p> <p>Design of surface water management system.</p> <p>Fully enclosing all waste handling and storage within the ARRC warehouse to prevent rainfall interactions with waste or recycled products. Reuse of recycled water to minimise discharges from the site.</p>	<p>Appropriately designed stormwater sediment basin in accordance with the blue book, which does not directly impact on native vegetation, and which is designed to avoid any scouring impacts from overflow discharge.</p> <p>Stabilisation and rehabilitation of works areas as soon as practicable.</p>	<p>Not required.</p>
<p><i>Impacts to aquatic fauna within pond 1 and pond 4 from dam dewatering.</i></p> <p>Type: prescribed impact.</p> <p>Frequency: once, during dam dewatering.</p> <p>Intensity: potential loss of aquatic fauna when ponds are drained.</p> <p>Duration: initial stages of construction when pond 1 and 4 are drained.</p> <p>Consequence: potential loss of aquatic fauna.</p>	<p>Avoidance is not feasible.</p>	<p>Aquatic fauna will be captured and relocated to pond 2 or 3 when pond 1 and 4 are dewatered.</p>	<p>A new stormwater detention basin will be constructed in the approximate location of the current pond 4. This basin will be netted due to the proximity to Western Sydney International Airport, but may still become utilised by aquatic fauna once the basin is established.</p>

6.3 Serious and irreversible impacts (SAIL)

6.3.1 Threatened ecological communities

Section 10.2.2 of the BAM requires additional impact assessment for threatened ecological communities that are also listed as candidate entities for Serious and Irreversible Impacts (SAIL). Table 6.6 provides an assessment of Cumberland Plain Woodland CEEC against the assessment criteria provided in Section 10.2.2 of the BAM.

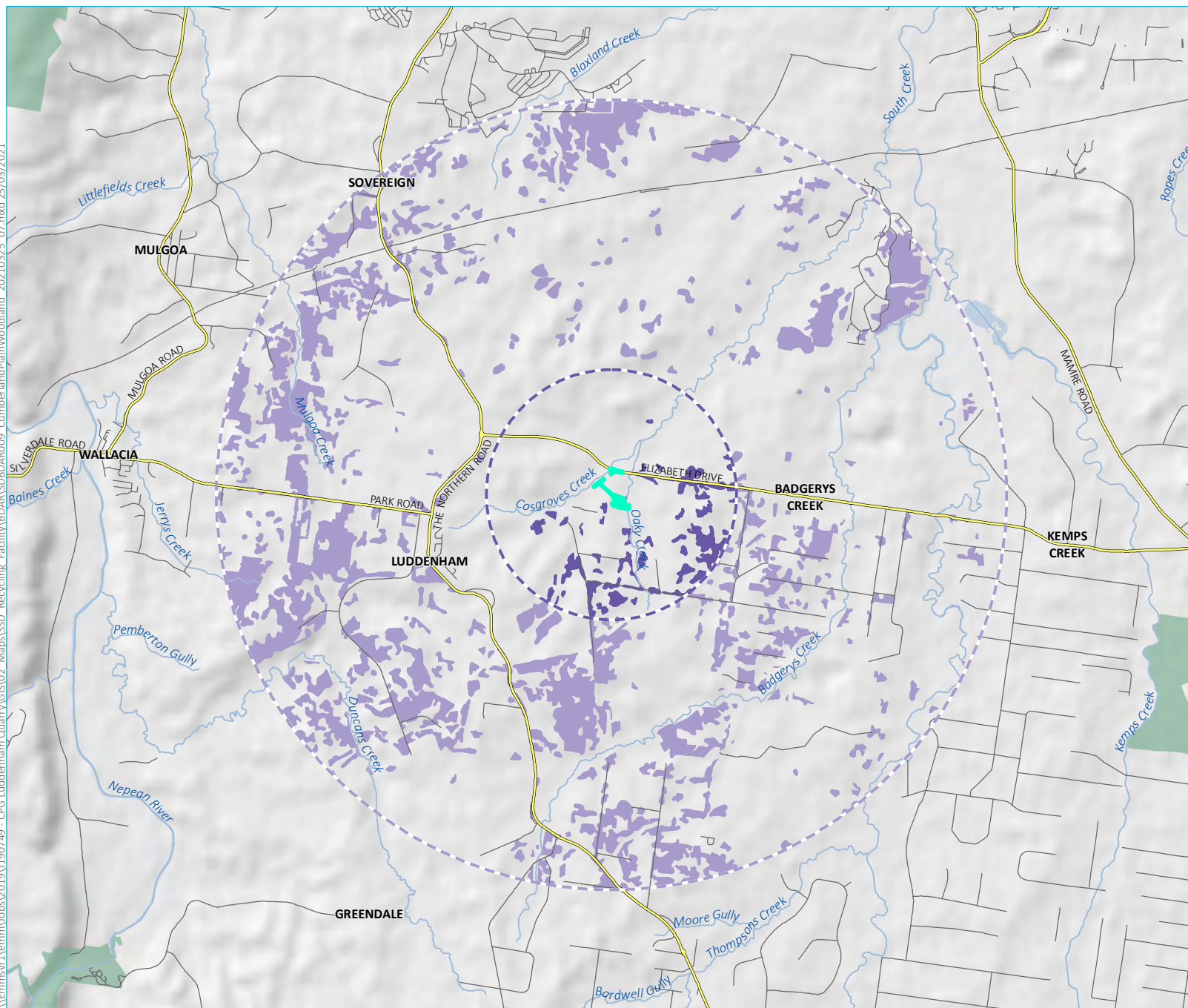
Table 6.6 SAIL assessment for Cumberland Plain Woodland

Assessment question	Response																
What is the action and what measures have been taken to avoid direct and indirect impacts on the SAIL candidate entity?	<p>The action will construct an Advanced Resource Recovery Centre and widen the Adams Road/site access intersection and Elizabeth Drive/Adams Road intersections (Figure 1.2).</p> <p>Impacts to Cumberland Plain Woodland within the study property have been avoided through changes to the design of the Project. Avoidance is discussed in Section 6.2 above. The impacts to Cumberland Plain Woodland are associated with the Adams Road and Elizabeth Drive proposed roadworks and cannot be avoided.</p>																
What is the area (ha) and condition (ie vegetation integrity score for each vegetation zone) of the TEC to be directly and indirectly impacted by the proposed development?	<p>The condition of the two vegetation zones is described in detail in Section 4.3 with the vegetation integrity score and the areas directly impacted displayed in Table 4.2, and summarised below. Some indirect impacts to the TEC may occur and have also been assessed. Mitigation measures are outlined in Section 6.2.</p> <table><tr><th>Vegetation zone</th><th>Direct impacts (ha)</th><th>Indirect impacts (ha)</th><th>VI score</th></tr><tr><td>849_Medium</td><td>0.11</td><td>0.51</td><td>39.1</td></tr><tr><td>849_Poor</td><td>-</td><td>0.01</td><td>20.7</td></tr><tr><td>Total</td><td>0.11</td><td>0.52</td><td>-</td></tr></table>	Vegetation zone	Direct impacts (ha)	Indirect impacts (ha)	VI score	849_Medium	0.11	0.51	39.1	849_Poor	-	0.01	20.7	Total	0.11	0.52	-
Vegetation zone	Direct impacts (ha)	Indirect impacts (ha)	VI score														
849_Medium	0.11	0.51	39.1														
849_Poor	-	0.01	20.7														
Total	0.11	0.52	-														
To what extent does the impact exceed the threshold for the candidate entity in <i>Guidance to assist a decision-maker to determine a serious and irreversible impact?</i>	No condition thresholds have been provided to date.																
What is the extent and overall condition of the TEC within a 1,000 ha and 10,000 ha buffer of the development footprint?	<p>The Remnant Vegetation of the western Cumberland subregion dataset (OEH 2015) was used to calculate the area of PCTs that align with the TEC. The estimated extent of the TEC within a 1,000 ha and 10,000 ha circle centred on the proposal is 75.6 ha and 1,385.9 ha respectively (Figure 6.1). Based on this mapping, the clearance of 0.11 ha will represent a loss of 0.15% of the TEC in within a 1,000 ha area and 0.008% within a 10,000 ha area.</p> <p>The amount of vegetation within the IBRA subregion (Cumberland) is 19,921.9 ha.</p> <p>The overall condition of the TEC in the buffer area is generally in a poor to medium condition. Cumberland Plain Woodland in the study area is highly fragmented, primarily consisting of large trees with little to no native understorey or groundstorey. Within the 1,000 ha area and 10,000 ha area the percentage of Cumberland Plain Woodland identified as being in higher condition (A, B or Cmi) is respectively 29.0% and 47.9%.</p>																
What is the extant area and overall condition of the TEC remaining in the IBRA subregion before and after the proposed development?	The amount of vegetation within the IBRA subregion (Cumberland) is 19,921.9 ha, in all condition classes, with 50.2% in higher condition (A, B or Cmi). The proposed development will remove up to 0.11 ha of vegetation, which equates to 0.0006% of the total extent in the IBRA subregion.																

Table 6.6 **SAIL assessment for Cumberland Plain Woodland**

Assessment question	Response
How much (ha) of the TEC is reserved within the IBRA region and IBRA subregion?	The total area of the TEC mapped within National Park reserves within the Cumberland IBRA subregion is 1,200.7 ha (based on interrogation of OEH 2015 map dataset combined with National Parks Reserves).
What is the development's impact on: abiotic factors critical to the long-term survival of the TEC (eg how much the impact will lead to a reduction of groundwater levels or alter surface flow patterns)?	Mitigation measures such as the water management infrastructure will be designed to manage impacts on abiotic factors. It is also noted that Adams Road and Elizabeth Drive road infrastructure is already in place, with the works consisting of widening the road.
Characteristic and functionally important species through impacts including, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or plant harvesting?	The ecosystem functioning of the TEC is already substantially altered given the surrounding agricultural land use (cropping and grazing) and quarrying. The project is unlikely to introduce any novel impacts beyond those which already occur, with the impacts largely related to the direct removal of the community.
The quality and integrity of an occurrence of the TEC through threats and indirect impacts (eg assisting invasive flora and fauna species to become established, mobilising chemicals or fertilisers that may harm or inhibit growth of the TEC)?	The project is unlikely to introduce any novel indirect impacts. Mitigation measures outlined in Section 6.2 will reduce indirect impacts so that impacts to Cumberland Plain woodland outside the disturbance footprint will be negligible. The TEC is currently impacted by altered drainage patterns, pollution, and fragmentation, with a high level of weed invasion and clearance.
Will an important area of the TEC be directly or indirectly fragmented or isolated?	The removal of Cumberland Plain Woodland vegetation will have a very limited impact on the existing connectivity of the community. The Cumberland Plain Woodland that will be impacted is at the edge of Adams Road, and the proposal is not likely to fragment or isolate an important area of habitat for the TEC.
What measures are proposed to assist with the TEC's recovery in the IBRA subregion?	The proposal includes weed control measures to avoid the establishment of additional weed species (Section 6.2.2).
Will the proposed development lead to a SAIL?	Based on the above assessment, the proposed development will not lead to a serious and irreversible impact upon Cumberland Plain Woodland.

\\Emmsvr1\emmm\Jobs\2019\190749 - CPG Luddenham Quarry\GIS\02 Maps\SSD Recycling Facility\BODAR\SDBDAR009 CumberlandPlainWoodland 20210325 07.mxd 25/03/2021



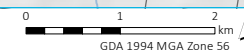
- KEY**
- Direct impact area
 - 1,000 Ha area from footprint
 - Cumberland Plain Woodland within 1,000 Ha
 - 10,000 Ha area from footprint
 - Cumberland Plain Woodland within 10,000 Ha
 - Major road
 - Local road
 - Watercourse
 - Waterbody
 - NPWS reserve

Extent of Cumberland Plain Woodland

Luddenham Advanced Resource
Recovery Centre
Biodiversity Development Assessment Report
Figure 6.1



Source: EMM (2021); DFSI (2017); GA (2011); ASGC (2006)



6.3.2 Threatened species

Section 10.2.3 of the BAM requires additional impact assessment for threatened species that are also listed as candidate entities for Serious and Irreversible Impacts (SAII). No species were identified as candidate species for serious and irreversible impacts (SAII), as per Section 6.5 of the BC Act.

6.4 Impacts requiring offsets

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017).

i Impacts on native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts on 0.11 ha of PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion;
- indirect impacts on 0.52 ha of PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion;
- direct impacts on 0.31 ha of PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley; and
- indirect impacts on 0.47 ha of PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

A summary of ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 6.7. A credit report is provided in Appendix E.

Table 6.7 **Summary of ecosystem credits required for impacts to all vegetation zones for the proposed development**

Vegetation zone number	PCT	Vegetation zone name	Impact Type	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Medium	Direct	0.11	39.1	0	-39.1	3
			Indirect	0.51		38.4	-0.7	
2	849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor	Indirect	0.01	21	20.7	-0.3	1
3	1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.	Medium	Direct	0.24	43.7	0	-43.7	5
			Indirect	0.35		42.3	-1.3	
4	1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.	Poor	Direct	0.07	44.2	0	-44.2	2
			Indirect	0.12		43.9	-0.3	

ii Impacts on threatened species

A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 6.8.

Table 6.8 Species habitat requiring offsets

Species	Vegetation zone name*	Area (ha)	Candidate SAI	Species credits
Green and Golden Bell Frog	849 - medium	0.62	No	2
	849 - poor	0.01		1
	1800 - medium	0.20		2
Southern Myotis	849 - medium	0.62	No	2
	849 - poor	0.01		1
	1800 - medium	0.59		5
	1800 - poor	0.19		2

* These areas include both direct and indirect impacts areas.

A total of 5 species credits are required for Green and Golden Bell Frog, and 10 credits for Southern Myotis to offset the residual impacts of the proposed development. A credit report is provided in Appendix E.

In addition, the prescribed impacts on Southern Myotis are proposed to offset with 6 additional credits (refer Section 6.2.2v). Thus, the total number of credits required for threatened species to account for all impacts is:

- Green and Golden Bell Frog 5 credits; and
- Southern Myotis 16 credits.

6.4.1 Impacts not requiring offsets

A number of vegetation zones were found to be in degraded condition. In line with the requirements of Section 10.3 of the BAM (OEH 2017) impacts to the vegetation zones and threatened species habitat do not require offsets.

Additional areas not requiring assessment in accordance with Section 10.4 of the BAM (OEH 2017) include:

- existing roads; and
- cleared and highly disturbed land.

EPBC Act Assessment

7 Impacts to MNES

7.1 Desktop assessment to identify candidate species and communities

A detailed desktop assessment was completed evaluating a range of information sources to gather information on the biodiversity values across the survey area and identify those MNES considered to have potential to occur. Information sources reviewed are summarised below:

- Department of Environment and Energy Protected Matter Search Tool (PMST).
- BioNet, held and maintained by the NSW Office of Environment and Heritage (OEH), to access the following:
 - Atlas of NSW Wildlife.
 - Threatened Biodiversity Data Collection.
 - Threatened species profiles.
 - Vegetation Classification System.

7.1.1 Candidate species assessment

A list of species and communities with potential to occur within the impact area was generated following the desktop assessment.

Two communities were identified as candidates for assessment:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland EEC; and
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC.

Species are listed in Table 7.1 were considered to have potential to occur within the impact area based on the desktop assessment.

Table 7.1 Threatened and migratory species with potential to occur in the subject property based on the desktop assessment

Scientific name	Common name	EPBC Act ¹	BC Act ²
Flora			
<i>Persicaria elatior</i>	Tall Knotweed	VN	V
<i>Pomaderris brunnea</i>	Brown Pomaderris	VN	V
Fauna			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V
Migratory species			
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi	-
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	-
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	-

Table 7.1 **Threatened and migratory species with potential to occur in the subject property based on the desktop assessment**

Scientific name	Common name	EPBC Act ¹	BC Act ²
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi	-
<i>Tringa nebularia</i>	Common Greenshank	Mi	-

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4B – critically endangered, E3 – endangered, V2 - vulnerable

An assessment of likelihood was completed for listed TECs, Threatened flora and fauna and migratory species predicted to occur in the region by the PMST search (Appendix G; Table G.1 to Table G.4). This assessment identified the following threatened species and migratory species were considered candidate species requiring further survey or assumed presence in Table 7.2.

Table 7.2 **Threatened and migratory species further assessment or presumed presence**

Scientific name	Common name	Survey undertaken	Recorded/assumed presence
Fauna			
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Yes	Recorded (one pass assumed to be a movement over the site)
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Incidental sighting	Recorded (foraging)
Migratory species			
<i>Cuculus optatus</i>	Oriental Cuckoo	No	Assumed presence
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	No	Assumed presence
<i>Gallinago hardwickii</i>	Latham's Snipe	No	Assumed presence
<i>Tringa nebularia</i>	Common Greenshank	No	Assumed presence

7.2 Significant impact assessments

To support a determination as to whether the project is likely to have a 'significant impact' on threatened species the Matters of National Environmental Significance – Significance Impact Guidelines 1.1 (DoE 2013) have been applied.

A 'significant impact' is defined as "an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends on the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts" (DoE 2013).

Consideration has been given to all communities, threatened and migratory species with potential to occur within the subject property, with reference to DoE (2013). Significant impact assessments have been completed for the species listed in Table 7.2 considered to have potential to be impacted by the project following the process outlined in this assessment report.

Significant impact assessment for the identified communities and species are provided in Appendix H.

The assessment concluded that no significant impacts are considered in the context of the findings of the project's biodiversity assessment and the area of high-quality habitat in the region.

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Appendix A

Vegetation integrity assessment – datasheets

BAM Site – Field Survey Form

Plot ID:	P01	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x50	
Datum:	GDA94	Easting:	288,740	Recorders:	RP			
Zone:	56	Northing:	6,249,454	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	164	
Plant Community Type:	849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion				Condition class:	Poor	PCT confidence:	medium
Vegetation Class:	Coastal Valley Grassy Woodlands				EEC:	no	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	3
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	3
	Shrubs:	0
	Grasses etc.:	62
	Forbs:	0.6
	Ferns:	0
	Other:	0
High Threat Weed cover:		93.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	3
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	6		
20 – 29 cm:	11	Tree hollow count	1
10 – 19 cm:	2		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	1	1	45	1	35
Average litter cover (%):	16.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance
Cultivated, no evidence of grazing or mowing (grass is very dense). All trees have severe dieback. Half are dead. All are dying.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P01	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Eucalyptus moluccana</i> (Grey Box)	3	10	no	N
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	85	10000	no	HTE
Forb (FG)	<i>Einadia</i> spp.	0.1	4	no	N
	<i>Malva parviflora</i> (Small-flowered Mallow)	0.1	100	no	E
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	50	10000	no	N
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	100	no	E
Forb (FG)	<i>Senecio</i> spp. (Groundsel, Fireweed)	0.2	100	no	N
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.3	20	no	E
	<i>Setaria parviflora</i>	2	500	no	E
Forb (FG)	<i>Rumex</i> spp. (Dock)	0.1	5	no	N
Grass & grasslike (GG)	<i>Eriochloa pseudoacrotricha</i> (Early Spring Grass)	10	2000	no	N
	<i>Solanum linnaeanum</i> (Apple of Sodom)	0.1	2	no	E
	<i>Paspalum dilatatum</i> (Paspalum)	2	15	no	HTE
	<i>Chloris gayana</i> (Rhodes Grass)	6	45	no	HTE
Forb (FG)	<i>Dichondra repens</i> (Kidney Weed)	0.2	40	no	N
	<i>Sida rhombifolia</i> (Paddy's Lucerne)	0.2	4	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	5	no	E
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	2	no	E
	<i>Araujia sericifera</i> (Moth Vine)	0.1	2	no	HTE
	<i>Juncus bufonius</i> (Toad Rush)	0.1	1	no	E
Grass & grasslike (GG)	<i>Paspalidium distans</i>	2	500	no	N

BAM Site – Field Survey Form

Plot ID:	P02	Date:	24-02-20	Project number:	J190749	Plot dimensions:	10x40	
Datum:	GDA94	Easting:	289,130	Recorders:	RP			
Zone:	56	Northing:	6,249,503	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	86	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Poor	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	no	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	3
	Forbs:	5
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	30
	Shrubs:	0
	Grasses etc.:	80.1
	Forbs:	0.7
	Ferns:	0
	Other:	0
High Threat Weed cover:		13.6

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	35	50	1	1	5
Average litter cover (%):	18.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features
Positioning plot very difficult. Dam in right, road in left, PCT curves in thin sliver. Steepish slope down to dam, very dense regrowth. Subplots are not representative of the PCT - they reflect the narrowness of the PCT, and the road/dam

Plot Disturbance
Exotic grass. Rubbish partially visible in tall dense vegetation. No evidence of grazing or mowing.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P02	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	30	25	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	6	100	no	HTE
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	50	10000	no	N
	<i>Rumex crispus</i> (Curled Dock)	0.1	2	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	2	no	E
	<i>Verbena bonariensis</i> (Purpletop)	0.1	4	no	E
	<i>Chloris gayana</i> (Rhodes Grass)	1	20	no	HTE
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	5	no	HTE
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.1	15	no	E
Forb (FG)	<i>Phyllanthus virgatus</i> (Wiry Spurge)	0.1	10	no	N
Forb (FG)	<i>Einadia</i> spp.	0.3	5	no	N
Grass & grasslike (GG)	<i>Typha orientalis</i> (Broad-leaved Cumbungi)	30	1000	no	N
	<i>Asparagus asparagoides</i> (Bridal Creeper)	0.1	10	no	HTE
	<i>Lycium ferocissimum</i> (African Boxthorn)	0.3	11	no	HTE
	<i>Setaria parviflora</i>	1.5	6	no	E
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	15	no	E
Forb (FG)	<i>Commelina cyanea</i> (Native Wandering Jew)	0.1	1	no	N
	<i>Dimorphotheca ecklonis</i> (Cape Daisy)	0.2	3	no	E
	<i>Madiola caroliniana</i> (Red-flowered Mallow)	0.1	2	no	E
	<i>Senecio madagascariensis</i> (Fireweed)	0.1	1	no	HTE
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.1	5	no	N
	<i>Dipogon lignosus</i> (Dolichos Pea)	0.1	2	no	E
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	6	50	no	HTE
	<i>Chenopodium album</i> (Fat Hen)	0.1	6	no	E
Forb (FG)	<i>Portulaca oleracea</i> (Pigweed)	0.1	1	no	N
	<i>Conyza sumatrensis</i> (Tall fleabane)	0.1	6	no	E
Grass & grasslike (GG)	<i>Carex</i> spp.	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	P03	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x20	
Datum:	GDA94	Easting:	289,086	Recorders:	RP			
Zone:	56	Northing:	6,249,612	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	87	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	yes	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	5
	Forbs:	6
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	0
	Grasses etc.:	15.7
	Forbs:	1.6
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		101.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	9
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	1		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	60	25	15	50	1
Average litter cover (%):	30.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features
Drainage line running through plot (currently wet). Contains a bees nest

Plot Disturbance
No evidence of grazing or mowing. Scattered rubbish.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P03	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	50	26	no	N
	<i>Setaria parviflora</i>	2	20	no	E
	<i>Asparagus asparagoides</i> (Bridal Creeper)	1	100	no	HTE
Other (OG)	<i>Glycine tabacina</i> (Variable Glycine)	0.1	20	no	N
Grass & grasslike (GG)	<i>Aristida warburgii</i>	0.5	10	no	N
Forb (FG)	<i>Centella asiatica</i> (Indian Pennywort)	0.1	5	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	30	5000	no	HTE
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	10	3000	no	N
	<i>Araujia sericifera</i> (Moth Vine)	2	200	no	HTE
Forb (FG)	<i>Galium</i> spp.	0.1	5	no	N
Forb (FG)	<i>Phyllanthus virgatus</i> (Wiry Spurge)	0.1	1	no	N
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	20	no	HTE
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	60	10000	no	HTE
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	3	no	E
Forb (FG)	<i>Einadia nutans</i> (Climbing Saltbush)	0.2	2	no	N
Grass & grasslike (GG)	<i>Sporobolus elongatus</i> (Slender Rat's Tail Grass)	0.1	1	no	N
Forb (FG)	<i>Oxalis exilis</i>	0.1	5	no	N
Grass & grasslike (GG)	<i>Bothriochloa macra</i> (Red Grass)	0.1	4	no	N
	<i>Lycium ferocissimum</i> (African Boxthorn)	8	20	no	HTE
Grass & grasslike (GG)	<i>Microlaena stipoides</i> (Weeping Grass)	5	1000	no	N
	<i>Sida rhombifolia</i> (Paddy's Lucerne)	3	150	no	E
Forb (FG)	<i>Dichondra repens</i> (Kidney Weed)	1	50	no	N

BAM Site – Field Survey Form

Plot ID:	P04	Date:	24-02-20	Project number:	J190749	Plot dimensions:	20x20	
Datum:	GDA94	Easting:	289,191	Recorders:	RP			
Zone:	56	Northing:	6,249,517	IBRA region:	Sydney Basin (Cumberland)	Midline bearing:	255	
Plant Community Type:	1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Coastal Floodplain Wetlands				EEC:	yes	EEC confidence:	medium

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	0
	Grasses etc.:	2
	Forbs:	6
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	50
	Shrubs:	0
	Grasses etc.:	25
	Forbs:	0.7
	Ferns:	0
	Other:	0
High Threat Weed cover:		66

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	4
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	2		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	45	90	10	75	50
Average litter cover (%):	54				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features
Multiple semi-connected swamps in PCT. edge of plot contains a swamp.

Plot Disturbance
Little weediness inside PCT. main weeds in plot are because PCT is too narrow, so includes the road verge weeds too. This is delineated on the floristics data sheet.

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	RP	Plot ID:	P04	Date:	24-02-20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	50	65	no	N
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	15	8000	no	N
	<i>Asparagus asparagoides</i> (Bridal Creeper)	2	30	no	HTE
	<i>Alternanthera philoxeroides</i> (Alligator Weed)	0.1	2	no	HTE
	<i>Juncus acutus</i>	60	500	no	HTE
	<i>Solanum nigrum</i> (Black-berry Nightshade)	0.1	3	no	E
	<i>Araujia sericifera</i> (Moth Vine)	0.1	5	no	HTE
	<i>Chloris gayana</i> (Rhodes Grass)	1	4	no	HTE
Forb (FG)	<i>Einadia nutans</i> subsp. <i>nutans</i> (Climbing Saltbush)	0.1	5	no	N
	<i>Plantago lanceolata</i> (Lamb's Tongues)	0.1	10	no	E
	<i>Rapistrum rugosum</i> (Turnip Weed)	0.1	25	no	E
Forb (FG)	<i>Commelina cyanea</i> (Native Wandering Jew)	0.1	2	no	N
	<i>Solanum pseudocapsicum</i> (Madeira Winter Cherry)	0.1	1	no	E
Forb (FG)	<i>Chamaesyce drummondii</i> (Caustic Weed)	0.1	1	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	0.8	5	no	HTE
	<i>Modiola caroliniana</i> (Red-flowered Mallow)	0.1	25	no	E
	<i>Setaria parviflora</i>	0.4	5	no	E
	<i>Solanum linnaeanum</i> (Apple of Sodom)	0.1	1	no	E
	<i>Verbena caracasana</i> (Shore Verbain)	0.1	2	no	E
	<i>Rumex crispus</i> (Curled Dock)	0.1	2	no	E
Forb (FG)	<i>Einadia</i> spp.	0.1	1	no	N
Forb (FG)	<i>Portulaca oleracea</i> (Pigweed)	0.2	15	no	N
	<i>Paspalum dilatatum</i> (Paspalum)	2	50	no	HTE
	<i>Chenopodium album</i> (Fat Hen)	0.1	10	no	E
Forb (FG)	<i>Oxalis exilis</i>	0.1	5	no	N
Grass & grasslike (GG)	<i>Microlaena stipoides</i> (Weeping Grass)	10	3000	no	N

BAM Site – Field Survey Form

Plot ID:	5	Date:	09/12/20	Project number:	J190749	Plot dimensions:	10 x 40	
Datum:	GDA94	Easting:	288,641	Recorders:	KD RP			
Zone:	56	Northing:	6,249,778	IBRA region:		Midline bearing:	36	
Plant Community Type:	849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion				Condition class:	Medium	PCT confidence:	medium
Vegetation Class:	Coastal Valley Grassy Woodlands				EEC:	yes	EEC confidence:	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	3
	Shrubs:	1
	Grasses etc.:	3
	Forbs:	5
	Ferns:	0
	Other:	2
Sum of Cover of native vascular plants by growth form group	Trees:	17
	Shrubs:	0.3
	Grasses etc.:	50.3
	Forbs:	0.9
	Other:	1.1
High Threat Weed cover:		42.2

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	2
80 + cm:	0		
50 – 79 cm:	1		
30 – 49 cm:	12		
20 – 29 cm:	1	Tree hollow count	0
10 – 19 cm:	1		
5 – 9 cm:	1		
< 5 cm:	1		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.

For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	30	30	1	15
Average litter cover (%):	16.2				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Roadside, flatish,

Plot Disturbance

Very weedy due to roadside

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code (if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
 Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
 Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	J190749				
Recorders:	KD RP	Plot ID:	5	Date:	09/12/20

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	<i>Eucalyptus moluccana</i> (Grey Box)	15	10	no	N
	<i>Olea europaea</i> subsp. <i>cuspidata</i> (African Olive)	5	6	no	E
	<i>Plantago lanceolata</i> (Lamb's Tongues)	3	40	no	E
	<i>Chloris gayana</i> (Rhodes Grass)	25	20	no	HTE
Forb (FG)	<i>Solanum</i> spp.	0.2	8	no	N
Tree (TG)	<i>Casuarina glauca</i> (Swamp Oak)	1	5	no	N
Shrub (SG)	<i>Bursaria spinosa</i> (Native Blackthorn)	0.3	2	no	N
	<i>Nassella neesiana</i> (Chilean Needle Grass)	1	10	no	HTE
Grass & grasslike (GG)	<i>Cynodon dactylon</i> (Common Couch)	10	200	no	N
	<i>Sida rhombifolia</i> (Paddy's Lucerne)	0.1	10	no	E
Grass & grasslike (GG)	<i>Microlaena stipoides</i> (Weeping Grass)	40	400	no	N
Grass & grasslike (GG)	<i>Themeda triandra</i>	0.3	5	no	N
Other (OG)	<i>Desmodium</i> spp. (Tick-trefoil)	0.1	3	no	N
Forb (FG)	<i>Plectranthus parviflorus</i>	0.2	10	yes	N
	<i>Cyclospermum leptophyllum</i> (Slender Celery)	0.2	20	no	E
	<i>Lycium ferocissimum</i> (African Baxthorn)	3	5	no	HTE
	<i>Taraxacum officinale</i> (Dandelion)	0.2	20	no	E
	<i>Paspalum dilatatum</i> (Paspalum)	10	100	no	HTE
	<i>Verbena bonariensis</i> (Purpletop)	5	30	no	E
	<i>Araujia sericifera</i> (Moth Vine)	2	10	no	HTE
	<i>Modiola caroliniana</i> (Red-flowered Mallow)	0.1	1	no	E
Other (OG)	<i>Clematis aristata</i> (Old Man's Beard)	1	5	no	N
	<i>Lepidium africanum</i> (Common Peppergrass)	0.1	3	no	E
	<i>Vulpia</i> spp. (Rat's-tail Fescue)	0.1	5	no	E
	<i>Senecio madagascariensis</i> (Fireweed)	0.2	10	no	HTE
Forb (FG)	<i>Schenkia australis</i> (Spike Centaury)	0.1	20	no	N
Tree (TG)	<i>Eucalyptus tereticornis</i> (Forest Red Gum)	1	1	no	N
	<i>Solanaceae</i> spp. (Nightshades)	0.1	10	no	N
	<i>Ehrharta erecta</i> (Panic Veldtgrass)	0.3	20	no	HTE
Forb (FG)	<i>Dianella</i> spp.	0.3	4	no	N
	<i>Tradescantia fluminensis</i> (Wandering Jew)	0.1	1	no	HTE
	<i>Briza subaristata</i>	0.1	2	no	HTE
	<i>Cenchrus clandestinus</i> (Kikuyu Grass)	0.5	2	no	HTE
Forb (FG)	<i>Brunoniella australis</i> (Blue Trumpet)	0.1	2	no	N

Appendix B

Vegetation integrity assessment – plot data

Table B.1 **Vegetation integrity data**

plot	pct	Condition class	zone	easting	northing	bearing	comp Tree	comp Shrub	comp Grass	comp Forbs	comp Ferns	comp Other	struc Tree	struc Shrub	struc Grass	struc Forbs	struc Ferns	struc Other	Fun Large Trees	Fun Hollow trees	Fun Litter Cover	Fun Len Fallen Logs	Fun Tree Stem 5 to 9	Fun Tree Stem 10 to 19	Fun Tree Stem 20 to 29	Fun Tree Stem 30 to 49	Fun Tree Stem 50 to 79	Fun Tree Regen	Fun High Threat Exotic
P01	849	Poor	56	288,740	6,249,454	164	1	0	3	4	0	0	3.0	0.0	62.0	0.6	0.0	0.0	0	1	16.6	3.0	0	1	1	1	0	0	93.1
P02	1800	Poor	56	289,130	6,249,503	86	1	0	3	5	0	0	30.0	0.0	80.1	0.7	0.0	0.0	0	0	18.4	0.0	1	1	0	1	0	1	13.6
P03	1800	Med-ium	56	289,086	6,249,612	87	1	0	5	6	0	1	50.0	0.0	15.7	1.6	0.0	0.1	1	0	30.2	9.0	1	1	1	1	1	1	101.1
P04	1800	Med-ium	56	289,191	6,249,517	255	1	0	2	6	0	0	50.0	0.0	25.0	0.7	0.0	0.0	0	0	54.0	4.0	1	1	1	1	0	1	66.0
P05	849	Med-ium	56	288641	6249778	36	3	1	3	5	0	2	17.0	0.3	50.3	0.9	0.0	1.1	0	0	16.2	2.0	1	1	1	1	1	1	42.2

Appendix C

Fauna survey effort summary

Table C.1 **Fauna survey effort**

Surveyor	Survey Type	Start Date	Survey Effort
JB JW	Nocturnal Birds / Green and Golden Frog	27/02/2020	1.5 hr
JB JW	Nocturnal Birds / Green and Golden Frog	02/03/2020	1.5 hr
JB RP	Nocturnal Birds / Green and Golden Frog	03/03/2020	1.5 hr
JB JW	Nocturnal Birds / Green and Golden Frog	04/03/2020	1.5 hr

Appendix D

Targeted survey weather conditions

Table D.1 **Weather conditions during fauna surveys**

Date	Min Temp (°C)	Max Temp (°C)	Rain (mm)	Max wind direction	Max wind speed (km/hr)
27/02/2020	18	27	0	NNE	35
02/03/2020	16	37	0	SE	52
03/03/2020	19	21	0	S	20
04/30/2020	18	23	11.2	NE	37

Appendix E

Credit report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00019773/BAAS17062/20/00019774	Luddenham Quarry	29/03/2021
Assessor Name	Report Created	BAM Data version *
	01/04/2021	38
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	BOS entry trigger
1	Part 4 Developments (General)	

* 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	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
Cumberland shale plains woodland											
1	849_Medium	Cumberland Plain Woodland in the Sydney Basin Bioregion	39.1	7.5	0.62	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	3

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2	849_Poor_Indirect	Cumberland Plain Woodland in the Sydney Basin Bioregion	21	0.3	0.01	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	1
									Subtotal		4
Cumberland Swamp Oak riparian forest											
3	1800_Medium	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	43.7	18.6	0.59	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00		5
4	1800_Poor	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	44.2	16.5	0.19	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00		2
									Subtotal		7
									Total		11

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Species credits
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<i>Litoria aurea / Green and Golden Bell Frog (Fauna)</i>								
1800_Medium	18.6	18.6	0.2	Endangered	Vulnerable	2	False	2
849_Medium	7.5	7.5	0.62	Endangered	Vulnerable	2	False	2
849_Poor_Indirect	0.3	0.3	0.01	Endangered	Vulnerable	2	False	1
							Subtotal	5
<i>Myotis macropus / Southern Myotis (Fauna)</i>								
1800_Poor	16.5	16.5	0.19	Vulnerable	Not Listed	2	False	2
1800_Medium	18.6	18.6	0.59	Vulnerable	Not Listed	2	False	5
849_Medium	7.5	7.5	0.62	Vulnerable	Not Listed	2	False	2
849_Poor_Indirect	0.3	0.3	0.01	Vulnerable	Not Listed	2	False	1
							Subtotal	10

Appendix F

EPBC PMST report



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.

Report created: 22/01/20 12:38:33

[Summary](#)

[Details](#)

[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

No Image
Available

This map may contain data which are
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[Coordinates](#)

Buffer: 1.0Km

No Image
Available

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:	4
Listed Threatened Species:	35
Listed Migratory Species:	15

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	None
Invasive Species:	46
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities

[Resource Information]

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.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
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Birds

Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area

Fish

Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
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Name	Status	Type of Presence
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat may occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat likely to 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 likely 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 likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may 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 may occur within area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat may occur within area
Allocasuarina glareicola [21932]	Endangered	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat may occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat may occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat may occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat likely to occur within area
Pomaderris brunnea Rufous Pomaderris [16845]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat may occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat known to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may 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
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]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may 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		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may 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

Commonwealth Land

[\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name	Threatened	Type of Presence
Commonwealth Land -		

Listed Marine Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	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]	Species or species habitat likely 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 may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered Species or species

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		habitat may occur within area Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to 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 likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

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 Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		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
Carduelis chloris European Greenfinch [404]		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
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		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		

Name	Status	Type of Presence
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
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
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		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
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		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
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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
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
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		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
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		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
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		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

-33.870702 150.715732,-33.870693 150.715721,-33.870577 150.715925,-33.871406 150.71717,-33.871753 150.717588,-33.872109 150.717921,-33.872608 150.719659,-33.872715 150.720657,-33.872537 150.720603,-33.873071 150.720968,-33.873766 150.721011,-33.874301 150.721633,-33.874871 150.721483,-33.875281 150.721655,-33.875548 150.721376,-33.87594 150.72129,-33.876136 150.721032,-33.876474 150.721182,-33.876741 150.72114,-33.876064 150.716397,-33.874319 150.716784,-33.874283 150.716526,-33.871967 150.717191,-33.870702 150.715732

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 G

EPBC Act protected matters likelihood of occurrence assessment

G.1 Likelihood of occurrence assessment – threatened ecological communities

Table G.1 Likelihood of occurrence assessment – threatened ecological communities

Threatened Ecological Community	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification for EPBC Act threatened ecological communities
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	E	V	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of the New South Wales and South East Queensland EEC	E	E1	Present	This habitat is associated with PCT 1800. Vegetation consistent with the listing has been identified as being present along Oaky Creek and on the western side of Adams Roads.
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	E1	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	E1	Present	This habitat is associated with PCT 849. Vegetation consistent with the listing has been identified as being present on the western side of Adams Roads.
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	E1	Negligible	This EEC was not recorded within the subject property. It is not associated with PCT 849 or PCT 1800.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V - vulnerable

G.2 Likelihood of occurrence assessment – threatened flora

Table G.2 Likelihood of occurrence assessment – threatened flora

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Acacia bynoeana</i>	Bynoe's Wattle	VN	E1	Low	Negligible	Bynoe's Wattle is a semi-prostrate shrub to a metre high. It is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1–5 plants). Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple. This species was not recorded during targeted surveys.
<i>Acacia pubescens</i>	Downy Wattle	VN	V	Low	Negligible	Downy Wattle occurs in open woodland and forest, in a variety of plant communities. Hybridises with other wattle species (<i>A. baileyana</i> , <i>A. decurrens</i> and <i>A. jonesii</i>). High Sensitivity to loss (ie providing protection above the listing status) based on recent population decline. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Allocasuarina glareicola</i>	-	EN	E1	Negligible	Negligible	Grows in Castlereagh woodland, which is absent from the subject property. Found in open woodland with Parramatta Gum, Red Ironbark, Narrow-leaved Apple (<i>Angophora bakeri</i>), Scribbly Gum (<i>Eucalyptus sclerophylla</i>) and White Feather Honey Myrtle (<i>Melaleuca decora</i>); none of these species are present within the subject property. Therefore, suitable habitat is considered to be absent.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	VN	V	Negligible	Negligible	Found in grassy sclerophyll woodland on clay loam or sandy soils. When not flowering, only a single leaf is visible above ground, and this leaf regrows each year. The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 1800, as such this species is not considered to occur within the subject property.

Table G.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Cynanchum elegans</i>	White-flowered Wax Plant	EN	E1	Low	Negligible	The rare species is known in rainforest gullies scrub and scree slopes. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	EN	E1	Negligible	Negligible	Grows in dry sclerophyll forest and moss gardens over sandstone, none of which is present within subject property. Therefore, suitable habitat is considered to be absent from the subject property.
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort,	VN	V	Negligible	Negligible	Predicted to occur in the Cumberland IBRA sub-region, but not recorded there. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property, except for the vegetation type “Miscellaneous ecosystems - highly disturbed areas with no or limited native vegetation”. Species habitat is considered absent from the subject property.
<i>Persicaria elatior</i>	Tall Knotweed	VN	V	Moderate	Negligible	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Persoonia hirsuta</i>	Hairy Geebung,	EN	E1	Negligible	Negligible	Known to occur in the Cumberland IBRA sub-region. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.
<i>Persoonia nutans</i>	Nodding Geebung	EN	E1	Negligible	Negligible	Known to occur in the Cumberland IBRA sub-region. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	Negligible	Negligible	In the Cumberland Plain this species is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) on well-structured clay soils. It is associated with Grey Box, Forest red gum (<i>E. tereticornis</i>) and narrow-leaved ironbark (<i>E. crebra</i>). Blackthorn (<i>Bursaria spinosa</i>) is often present at sites (and may be important in protection from grazing) and Kangaroo Grass (<i>Themeda australis</i>). The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. This species was not recorded during targeted surveys.

Table G.2 **Likelihood of occurrence assessment – threatened flora**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Likelihood of occurrence (following targeted survey)	Justification
<i>Pomaderris brunnea</i>	Brown Pomaderris	VN	V	Moderate	Negligible	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. It is associated with Cabbage Gum (<i>Eucalyptus amplifolia</i>) Rough-barked Apple (<i>Angophora floribunda</i>), Parramatta Wattle (<i>Acacia parramattensis</i>), Blackthorn, and White Kunzea (<i>Kunzea ambigua</i>). Marginal habitat was identified during initial surveys. This species was not recorded during targeted surveys.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	EN	E1	Negligible	Negligible	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. Habitat requires a native groundcover (ie over 50% native species). Subject property does not contain suitable habitat for this species.
<i>Pultenaea parviflora</i>		VN	E1	Low	Negligible	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. Not predicted to occur in any of the vegetation types or PCTs recorded within the subject property.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	VN	E1	Negligible	Negligible	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. The subject property is outside the known distribution for this species.
<i>Thesium australe</i>	Austral Toadflax	VN	V	Low	Negligible	It occurs in shrubland, grassland or woodland, often on damp sites , particularly areas with a ground layer of <i>Poa</i> spp., <i>Themeda australis</i> and <i>Cymbopogon refractus</i> . The subject property has been historically cleared and modified for farming and quarrying works. Habitat alterations have included the creation of dams. The habitat is highly degraded within PCT 849, as such this habitat is only considered marginal to support this species within the subject property.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable
 2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

G.3 Likelihood of occurrence assessment – fauna species

Table G.3 Likelihood of occurrence assessment – fauna species

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E4A	Negligible	<p>The Regent Honeyeater is a striking, predominantly black and yellow bird. Its head and neck are black, with warty pink or yellow skin around the eyes. Endemic to mainland south-eastern Australia, the species has a patchy distribution from south-east Queensland, through NSW and the ACT into central Victoria. Records are widely distributed across this range, but the species is only found regularly at a few localities in NSW and Victoria. Most records of regent honeyeaters come from box-ironbark eucalypt associations, where the species seems to prefer more fertile sites with higher soil water content. Other forest types regularly utilised by the Regent Honeyeater include wet lowland coastal forest dominated by Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum-Ironbark associations and riverine woodlands.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not support key habitat or feed tree species.</p>
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	E1	Low	<p>The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass growing over a muddy or peaty substrate.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E1	Low	<p>The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy beaches.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Grantiella picta</i>	Painted Honeyeater	VU	V	Low	<p>The Painted Honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The bill is a deep pink and the eye red. The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory, with inland slopes of the Great Dividing Range seeing greatest concentrations and almost all records of breeding. The species has a specialist diet mainly consisting of mistletoe fruits, but also includes nectar. The species inhabits mistletoes in a variety of vegetation types, including eucalypt forests/woodlands, riparian woodlands, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Hirundapus caudacutus</i>	White-throated Needletail	VU	-	Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to ‘cloud level’</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Lathamus discolor</i>	Swift Parrot	CE	E1	Negligible	<p>The Swift Parrot is a small fast-flying, nectivorous parrot which occurs in eucalypt forests in south eastern Australia. The species breeds in Tasmania and migrate to mainland Australia in autumn. During winter the parrots disperse across a broad landscape, foraging on nectar and lerps in eucalypt forests, particularly inland box-ironbark and grassy woodlands, and Coastal Swamp Mahogany (<i>E. robusta</i>) and Spotted Gum (<i>Corymbia maculata</i>) woodland when in flower.</p> <p>The subject property is outside of the known breeding habitat area for this species. The subject property does not contain suitable feed tree species for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE	-	Negligible	<p>The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not provide suitable intertidal habitat.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Rostratula australis</i>	Australian Painted Snipe	EN	E1	Low	<p>The Australian Painted Snipe is a stocky wading bird, endemic to Australia and has been recorded at wetlands in all states and territories. The species inhabits shallow ephemeral and permanent freshwater (occasionally brackish) wetlands.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	VU	V	Recorded	<p>Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.</p> <p>The subject property doesn't contain suitable maternity roost habitats in the form of sandstone overhangs.</p> <p>This species was recorded once passing over the subject property during the microbat surveys.</p>
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	Possible	<p>Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer.</p> <p>The subject property contains one hollow-bearing tree and some human made structures.</p> <p>This species was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be easily confused with Eastern Broad-nosed Bat (<i>Scotorepens orion</i>) and Greater Broad-nosed Bat, which are both more likely to occur on site than Eastern False Pipistrelle due to marginal habitat for the species.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	Probable	<p>The Greater Broad-nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.</p> <p>This species was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be easily confused with Eastern Broad-nosed Bat and Eastern False Pipistrelle (though Eastern False Pipistrelle is less likely to occur on site due to marginal habitat for the species).</p>
<i>Miniopterus australis</i>	Little Bent-winged Bat	-	V	Possible	<p>Prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.</p> <p>Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat (<i>Miniopterus schreibersii</i>) and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young. Only five nursing sites/maternity colonies are known in Australia.</p> <p>Little Bent-winged Bat was potentially recorded on site during microbat surveys, via anabats placed on site. The record is uncertain because calls may be from Chocolate Wattled Bat (<i>Chalinolobus morio</i>) which was confirmed as being present on site.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll	EN	V	Negligible	<p>The Spotted-tail Quoll is one of Australia’s largest extant marsupial carnivores and has a distinctive spotted appearance. The species is primarily forest-dependent, and occupies a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The species has home ranges of several hundred to several thousand hectares in size and will use multiple dens. moving between den sites every 1–4 days. The species occurs at low densities.</p> <p>The subject property is isolated from areas of suitable habitat for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Petauroides volans</i>	Greater Glider	VU	-	Negligible	<p>The Greater Glider is the largest gliding possum in Australia. The species is distributed across eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level. The species is restricted to eucalypt forests and woodlands, typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The species distribution may be patchy even in suitable habitat.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	VU	E1	Negligible	<p>The Brush-tailed Rock-wallaby Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Feeds on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Phascolarctos cinereus</i>	Koala	VU	V	Negligible	<p>The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus <i>Eucalyptus</i>. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL.</p> <p>The subject property does not contain suitable feed species to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	VU	-	Negligible	<p>The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	VU	V	Recorded	<p>The Grey-headed Flying-fox is a large, endemic megachiropteran bat occurring in south-eastern Australia. The species distribution extends from Bundaberg in Queensland to Melbourne in Victoria, and from the coast inland to the western slopes of NNSW. The Grey-headed Flying-fox feeds on nectar and pollen from flowers of canopy trees and fleshy fruits from rainforest trees and vines, with regional preferences shown.</p> <p>The species was recorded foraging within the subject property.</p>
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	VU	V	Negligible	<p>The Giant Burrowing Frog are found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Litoria aurea</i>	Green and Golden Bell Frog	VU	E2	Low	<p>This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. This species can occur in highly disturbed areas.</p> <p>This species was not recorded during targeted surveys within the subject property. However, as Cosgroves Creek could not be accessed to assess habitat potential and survey was not performed within vegetation adjacent to this creekline, a precautionary approach has been adopted within it has been assumed that the species could potentially occur in this area.</p>
<i>Macquaria australasica</i>	Macquarie Perch	EN	-	Negligible	<p>The Macquarie Perch is found in the Murray-Darling Basin, particularly the upstream reaches of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW. The draft National Recovery Plan for Macquarie Perch identifies four self-sustaining populations; none are within the subject property. Macquarie Perch prefer clear water and deep, rocky holes with extensive cover in the form of aquatic vegetation, large boulders, debris and overhanging banks. They spawn in spring or summer and lay their eggs over stones and gravel in shallow, fast-flowing upland streams or flowing parts of rivers. Macquarie Perch inhabiting impoundments would likely undertake upstream spawning migration in October to mid-January after which adults usually move from the streams to the lake. Migration may not be necessary in stream dwelling fish.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Prototroctes maraena</i>	Australian Grayling	VU	-	Negligible	<p>Australian grayling is a primarily freshwater fish found in coastal rivers in south-eastern mainland Australia and Tasmania.</p> <p>The subject property does not contain suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.3 **Likelihood of occurrence assessment – fauna species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Synemon plana</i>	Golden Sun Moth	CE	E1	Negligible	Golden Sun Moth occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by Spear Grasses (<i>Austrostipa</i> spp.) and/or Wallaby grasses (<i>Rytidosperma</i> spp.). They are known to spread into adjacent grasslands where Chilean Needle Grass (<i>Nassella neesiana</i>) and Serrated Tussock (<i>Nassella trichotoma</i>) are present. The subject property does not contain native grasslands. The woodland on site comprises an exotic groundlayer. Chilean Needle Grass and Serrated Tussock were not recorded on site either. Habitat is therefore considered to be absent for this species.

Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory
2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable

G.4 Likelihood of occurrence assessment – migratory species

Table G.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
Migratory Marine Birds					
<i>Apus pacificus</i>	Fork-tailed Swift	Mi		Low	Almost exclusively aerial (foraging). The Fork-tailed Swift breeds in Asia but migrates to Australia from September to April. Individuals or flocks can be observed hawking for insects at varying heights from only a few metres from the ground and up to 300 metres high. The species has not been recorded within 10 km of the subject property.

Table G.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
Migratory Terrestrial Species					
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi		Moderate	<p>In Australia, the Oriental Cuckoo is found in all regions, including some islands. It is widespread on the eastern side of the Great Dividing Range in Queensland and is found down through New South Wales and Victoria to Tasmania and South Australia. The Oriental Cuckoo is found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath. Sometimes found near clearings and in recently logged or burnt forests. Found in farmland with some trees, orchards, vineyards and urban parks and gardens.</p> <p>The subject property contains suitable habitat to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Hirundapus caudacutus</i>	White-throated Needletail	VU, Mi		Low	<p>An aerial species found in feeding concentrations over cities, hilltops and timbered ranges. Breeds in Asia. White-throated Needletails almost always forage aerially, at heights up to 'cloud level'</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi		Negligible	<p>A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not support suitable rainforest habitat.</p>
<i>Motacilla flava</i>	Yellow Wagtail	Mi		Low	<p>Regular spring-summer visitor in north of Australia, rare vagrant or occasional visitor farther south. Found in marshes, damp paddocks, airfields, cultivated fields, lawns and estuaries.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property is outside the known distribution of the species.</p>
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi		Low	<p>The Satin Flycatcher inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species can occur at elevations of up to 1,400 m ASL. The Satin Flycatcher breeds in heavily vegetated gullies.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi		Negligible	<p>Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. The species mainly inhabits wet sclerophyll forests often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>). During migration it can stray into gardens and more open areas.</p> <p>The subject property does not provide suitable habitat for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
Migratory Wetlands Species					
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi		Low	<p>Inhabits a wide range of coastal and inland wetlands, often with muddy or rocky margins. Also known to occur at estuaries, billabongs, dams, pools and lakes, often associated with mangroves.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi		Moderate	<p>The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also forage among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi	E1	Low	<p>The Curlew Sandpiper is a small, slim sandpiper. Inland, the species mainly occur around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi		Low	<p>Scarce, but regular visitor, usually recorded in summer from November to March. Widespread but scattered records in Australia. Usually found in fresh to saline wetlands, floodplains, swamps, estuaries and lagoons, sometimes with emergent or fringing vegetation such as grass.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi		Moderate	<p>Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi		Negligible	<p>The Eastern Curlew is the largest migratory shorebird in the world, migrating to Australia during the northern hemisphere winter. In Australia, the species has a primarily coastal distribution, inhabiting sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass.</p> <p>The species has not been recorded within 10 km of the subject property.</p> <p>The subject property does not provide suitable intertidal habitat.</p>
<i>Pandion haliaetus</i>	Osprey	Mi		Negligible	<p>The Osprey is cosmopolitan, being found in many coastal and lake areas of the world. In Australia, it is found on the north and east coast from Broome to the south coast of New South Wales. Ospreys are found on the coast and in terrestrial wetlands of tropical and temperate Australia and off-shore islands, occasionally ranging inland along rivers, though mainly in the north of the country.</p> <p>The subject property contains some marginal habitat that may be suitable to support foraging habitat, however, no active or old nesting sites were observed in the subject property for this species.</p> <p>The species has not been recorded within 10 km of the subject property.</p>

Table G.4 **Likelihood of occurrence assessment – migratory species**

Scientific name	Common name	EPBC Act ¹	BC Act ²	Likelihood of occurrence	Justification
<i>Tringa nebularia</i>	Common Greenshank	Mi		Moderate	<p>The Common Greenshank breeds in the Palaearctic regions and is widespread in Africa, Coastal Asia, the Indian subcontinent, the Philippines and southern New Guinea. They are common throughout Australia in the summer. Common Greenshanks are found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.</p> <p>The subject property contains some marginal habitat that may be suitable to support this species.</p> <p>The species was recorded within 10 km of the subject property.</p>
Notes: 1. EPBC Act status: CE- critically endangered, EN – endangered, VU – vulnerable, Mi – migratory 2. BC Act status: E4A – critically endangered, E1 – endangered, E2 – endangered population, V – vulnerable					

Appendix H

EPBC Act significant impact criteria assessments

H.1 Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Table H.1 Significant impact criteria assessment – Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Species profile	<p>Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community</p> <p>Status:</p> <p>Endangered (BC and EPBC)</p> <p>Distribution:</p> <p>The TEC comprises about 22,500 ha (or 26% of the pre-1750 extent) from near Bermagui (NSW) to just north of Gladstone (QLD).</p> <p>Physical environment:</p> <p>The TEC occurs in coastal catchments, mostly at elevations of less than 20m ASL which are typically found within 30km of the coast, and typically where groundwater is saline or brackish.</p> <p>Vegetative components:</p> <p>The canopy is dominated by Swamp Oak (<i>Casuarina glauca</i>). The understorey is sparse or absent. The groundlayer varies widely, as it is highly influenced by past management and groundwater salinity.</p> <p>Threats:</p> <p>Main threats are clearing and fragmentation, followed by weed incursion, feral animal incursion, agricultural activities, changes to hydrology, fire, recreational activity and climate change.</p>
Criteria	Discussions
Reduce the extent of an ecological community;	The project will result in direct impacts on vegetation that meets the Commonwealth Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland of 0.11 ha, and 0.42 ha of indirect impact. Whilst the extent will be reduced, this equates to a 0.0005% reduction in the overall extent of the community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;	<p>The project would remove isolated patches of the community and slightly reduce the connectivity of the linear patch that runs along Oaky Creek.</p> <p>The isolated patches were unlikely to contribute to the health of the larger patch running along Oaky Creek. The small area being cleared from the Oaky Creek patch is of poor quality and is almost isolated already (that is, a road runs between it and the rest of the Oaky Creek patch).</p>
Adversely affect habitat critical to the survival of an ecological community;	The project would alter the hydrology within the impact area (by clearing one pond and re-constructing another), however this would likely only affect those portions of the community that will be cleared.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;	The project is unlikely to modify or destroy abiotic factors necessary for the TEC's survival. The proposed recycling centre may mean that nutrient inputs to Oaky creek are very slightly lower than under the current consent, and therefore may be beneficial to the TEC.

Table H.1 Significant impact criteria assessment – Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;	The project is unlikely to cause a substantial change in the species composition of the TEC. The TEC will not be utilised by the project and is largely fenced off. The TEC will not be accessible to the public. All asset protections are inside the impact area; therefore, no burning is required.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: (a) assisting invasive species, that are harmful to the listed ecological community, to become established; or	The project is unlikely to assist invasive species to become established in the TEC as: no people or vehicles will have any reason to enter the TEC; large parts of the TEC are fenced off; there is no public access to the TEC; and, due to the nature of the proposed recycling centre, seeds or weeds are unlikely to be intentionally brought on site.
(b) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or	The project is unlikely to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the TEC as outlined above.
Interfere with the recovery of an ecological community.	The project will cause minor interference to the recovery of the ecological community by increasing the fragmentation of the Oaky Creek patch. It will not otherwise impact the recovery of the TEC.
Conclusion	The ARRC site is unlikely to result in a significant impact as: <ul style="list-style-type: none"> • The impact is limited to 0.11 ha of direct impact and 0.42 of indirect impact; and • The impact will not break the Oaky Creek or Cosgroves Creek vegetation into two or more patches.

H.2 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community

Table H.2 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community

Species profile	<p>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community.</p> <p>Status:</p> <p>Critically Endangered (EPBC)</p> <p>Distribution:</p> <p>The TEC comprises about 12,300 ha in and around western Sydney, New South Wales.</p> <p>Physical environment:</p> <p>The TEC occurs in coastal valley rain shadow occupying the driest part of the Cumberland Plain, at elevations of up to 350 m ASL. The community typically occurs on flat to undulating or hilly terrain, with annual rainfall of 700-900 mm.</p> <p>Vegetative components:</p> <p>The canopy is dominated by Grey Box (<i>Eucalyptus moluccana</i>). Other canopy species present include Kurrajong (<i>Brachychiton populneus</i>), River Oak (<i>Casuarina cunninghamiana</i>), and Forest Red Gum (<i>Eucalyptus tereticornis</i>). Midstorey vegetation comprises mainly native Blackthorn, and exotic European Olive (<i>Olea europaea subsp. cuspidata</i>) and African Boxthorn (<i>Lycium ferocissimum</i>). The groundlayer is co-dominated by exotic grass and forb species.</p> <p>Threats:</p> <p>Main threats are clearing and fragmentation, inappropriate grazing and fire regimes, weed invasion, the low level of protection in reserves, and climate change.</p>
Criteria	Discussions
Reduce the extent of an ecological community;	The project will result in impacts on vegetation that meets the Commonwealth Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community of 0.09 ha direct impact, and 0.48 ha of indirect impact. Whilst the extent will be reduced, this equates to a 0.0007% reduction in the overall extent of the community.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;	The project would remove a small area of the community within the existing road reserve to facilitate a road upgrade. Connectivity of the vegetation patch that runs along Cosgrove Creek will be maintained throughout the proposed work and therefore the ARRC is not anticipated to fragment or increase fragmentation of the community.
Adversely affect habitat critical to the survival of an ecological community;	The project would not adversely affect habitat critical to the survival of this community. Only a small area of a larger community patch will be cleared, and connectivity will be maintained.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;	The project is unlikely to modify or destroy abiotic factors necessary for the TEC's survival. The runoff received by Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest vegetation adjacent to Adams Road or Elizabeth Drive is unlikely to change substantially.

Table H.2 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest critically endangered ecological community

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;	The project is unlikely to cause a substantial change in the species composition of the TEC. A small amount of vegetation will be cleared within the existing road reserve. The TEC will not be otherwise impacted. All asset protection zones are inside the project area, therefore no burning is required.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: (a) assisting invasive species, that are harmful to the listed ecological community, to become established; or	The project is unlikely to assist invasive species to become established in the TEC as: no people or vehicles will have any reason to enter the TEC; there is no public access to the TEC; and, due to the nature of the proposed recycling centre, seeds or weeds are unlikely to be intentionally brought on site.
(b) causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or	The project is unlikely to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the TEC as outlined above.
Interfere with the recovery of an ecological community.	The project will have a negligible interference with the recovery of the ecological community by slightly reducing the extent on a fine local scale. It will not otherwise impact the recovery of the TEC.
Conclusion	The ARRC site is unlikely to result in a significant impact as: <ul style="list-style-type: none"> • The impact is limited to 0.09 ha direct impact, and 0.48 ha of indirect impact; and • The impact will not break the vegetation into two or more patches.

H.3 Green and Golden Bell Frog (*Litoria aurea*)

Table H.3 Significant impact criteria assessment – Green and Golden Bell Frog

Species profile	<p>Green and Golden Bell Frog</p> <p>Status: Vulnerable (EPBC Act), Endangered (BC Act)</p> <p>Distribution: This species has been recorded in approximately 50 locations within NSW, consisting mostly of small, coastal or near coastal populations. Large populations are located around the metropolitan areas of Sydney, Shoalhaven and the mid north coast.</p> <p>Biology: The Green and Golden Bell Frog is a relatively large frog ranging in size from 45 – 100 mm snout to vent length. They have a gold or creamy white stripe running along the side, extending from the upper eyelids almost to the groin, with a narrow dark brown stripe beneath it, from nostril to eye. Body colour varies however is usually a vivid pea-green splotched with an almost metallic brown or gold. The species is active during the day and usually breeds in summer when conditions are warm and wet.</p> <p>Habitat requirements: This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Preferred habitat includes waterbodies that are unshaded, free of predatory fish, and have a grassy area and diurnal sheltering sites available nearby. The species can occur in highly disturbed areas.</p> <p>Threats: The main identified threats to this species include:</p> <ul style="list-style-type: none"> • Habitat removal, degradation and fragmentation • Reduction in water quality and hydrological changes • Disease • Predation • Introduction or intensification of public access to habitats
Criteria	Discussions
Lead to a long-term decrease in the size of an important population of a species	<p>There are no known important populations present on the subject property, and the vegetation to be impacted is unlikely to be of key importance or to lead to a long-term decrease in a population. No individuals were recorded during targeted survey.</p> <p>Cosgroves Creek, situated north of the ARCC road upgrade works, may provide suitable habitat for the Green and Golden Bell Frog. The creek itself is situated outside of the impact area, however some potential habitat will be impacted. The amount of habitat impacted is 0.82 ha in total, which is mainly indirect impacts.</p>
Reduce the area of occupancy of an important population	<p>The riparian vegetation adjacent to Adams Road may be used by this species as a sheltering site only. However, given vegetation to be impacted is within the existing road reserve it is considered unlikely that impacts to this vegetation would reduce the area of occupancy for this species. Connectivity of this habitat type will be maintained throughout the proposed works.</p>
Fragment an existing important population into two or more populations	<p>There are no known existing important populations present. There is the potential that the species may occur in Cosgrove's Creek and surrounding vegetation as access was not available. Connectivity of potential habitat type will not be altered by the proposed works.</p>
Adversely affect habitat critical to the survival of a species	<p>The vegetation present is not considered critical to the survival of this species and therefore the proposed works will not adversely affect habitat critical to the survival of the species.</p>

Table H.3 Significant impact criteria assessment – Green and Golden Bell Frog

Disrupt the breeding cycle of an important population	There is no suitable breeding habitat (a water body known to be utilised by Green and Golden Bell Frog) within the impact area.
Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The road upgrade works will involve impacts to 0.82 ha of potential foraging habitat in total, which is mainly indirect impacts. The degree of impact is a small proportion of the native vegetation present, and thus the works are unlikely to cause this species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the vulnerable species' habitat	The project is unlikely result in the introduction of invasive species. Guidelines for the management of weed species can be found in the NSW Weed Control Handbook (DPI 2018).
Introduce disease that may cause the species to decline	The proposed works are considered unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	The proposed works are considered unlikely to interfere with the recovery of this species.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no breeding habitat will be removed, • connectivity of riparian habitat will be retained.

H.4 Large-eared Pied Bat (*Chalinolobus dwyeri*)

Table H.4 Significant impact criteria assessment – Large-eared Pied Bat

Species profile	<p>Large-eared Pied Bat</p> <p>Status: Vulnerable (EPBC and BC Act)</p> <p>Distribution: The current distribution of this species is poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, New South Wales in the south.</p> <p>Biology: The large-eared pied bat is a small to medium-sized insectivorous bat measuring approximately 100 mm including the head and tail, and weighing between 7–12 g. It has shiny, black fur on the body and there is a white stripe on the ventral side of the torso where it adjoins the wings and tail. The ears are long and prominent and lobes of skin adorn the lower lip and between the corner of the mouth and the bottom of the ear.</p> <p>Habitat requirements: Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20–40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.</p> <p>Threats: The main identified threats to this species include:</p> <ul style="list-style-type: none"> • disturbance and damage at primary nursery roosts • long wall mining for coal; • loss of foraging habitat; and • predation by foxes (<i>Vulpes Vulpes</i>) and other predators.
Criteria	Discussions
Lead to a long-term decrease in the size of an important population	The subject property may be used by this species as a commuting route along Oaky Creek only. There is no known important population present on the subject property, and the vegetation is unlikely to be of key importance or to lead to a long-term decrease in an important population. No individuals were recorded at Western Sydney Airport (DIRD 2016).
Reduce the area of occupancy for an important population	The subject property may be used by this species as a commuting route along Oaky Creek only. No known important population present on the subject property.
Fragment an existing important population into two or more populations	The subject property is considered to be used by this species as a commuting route along Oaky Creek only. The commuting habitat will not be impacted on as part of the ARRC.
Adversely affect habitat critical to the survival of a species	The subject property is considered to be used by this species as a commuting route along Oaky Creek only.
Disrupt the breeding cycle of an important population	The subject property does not contain suitable maternity roost habitats in the form of sandstone overhangs. This species was recorded once passing over the subject property during the microbat surveys. The subject property is considered to be used by this species as a commuting route along Oaky Creek. There is no direct habitat loss as part of the ARRC site that is considered to disrupt the breeding cycle of a population.

Table H.4 Significant impact criteria assessment – Large-eared Pied Bat

Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The subject property does not contain suitable maternity roost habitats in the form of sandstone overhangs. This species was recorded once passing over the subject property during the microbat surveys. The subject property is considered to be used by this species as a commuting route along Oaky Creek. There is no direct habitat loss as part of the ARRC site that is considered to lead to a substantially modify, destroy or isolate an area of important habitat.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The subject property has the potential to be used by foxes as part of their hunting grounds. As no roosting or breeding habitat is present within the subject property no impacts are expected to occur on important habitat for this species.
Introduce disease that may cause the species to decline	The subject property is considered to be used by this species as a commuting route along Oaky Creek only.
Interfere substantially with the recovery of the species	The subject property is considered to be used by this species as a commuting route along Oaky Creek only.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no maternity roosts or potential habitat to support maternity roosts will be lost; and • the ARRC site will not disrupt the breeding cycle of this species population.

H.5 Grey-headed Flying-fox (*Pteropus poliocephalus*)

Table H.5 Significant impact criteria assessment – Grey-headed Flying-fox

Species profile	<p>Grey-headed Flying-fox</p> <p>Status: Vulnerable (EPBC and BC Act)</p> <p>Distribution: Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia.</p> <p>Biology: The Grey-headed Flying-fox is the largest Australian bat, with a head and body length of 23–29 cm. It has dark grey fur on the body, lighter grey fur on the head and a russet collar encircling the neck. The wing membranes are black and the wingspan can be up to 1 m.</p> <p>Habitat requirements: Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.</p> <p>Threats: Main threats to Grey-headed Flying-fox is disturbance or destruction of roosting camps.</p>
Criteria	Discussions
Lead to a long-term decrease in the size of an important population	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only. The vegetation is unlikely to be of key importance or to lead to a long-term decrease in an important population.
Reduce the area of occupancy for an important population	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Fragment an existing important population into two or more populations	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only. The ARRC site will not modify destroy or isolate an area of important habitat.
Adversely affect habitat critical to the survival of a species	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Disrupt the breeding cycle of an important population	The study area does not contain roosting camps. The ARRC site is not considered to disrupt the breeding cycle for the local population of this species.
Modify, destroy, remove, isolate or decrease the availability habitat to the extent that the species is likely to decline	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	As no roosting camps are presence within the subject property, no impacts from invasive species are expected to have an impact on important habitat for this species.

Table H.5 Significant impact criteria assessment – Grey-headed Flying-fox

Introduce disease that may cause the species to decline	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Interfere substantially with the recovery of the species	The study area does not contain roosting camps, this species is highly mobile and would use the site for foraging only.
Conclusion	<p>The proposal is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none">• no roosting camps will be impacted on; and• the ARRC site will not disrupt the breeding cycle of this species population.

H.6 Oriental Cuckoo (*Cuculus optatus*)

Table H.6 Significant impact criteria assessment – Oriental-Cuckoo

Species profile	<p>Oriental Cuckoo</p> <p>Status:</p> <p>Migratory (EPBC Act)</p> <p>Distribution:</p> <p>In Australia, the Oriental Cuckoo is found in all regions, including some islands. It is widespread on the eastern side of the Great Dividing Range in Queensland and is found down through New South Wales and Victoria to Tasmania and South Australia.</p> <p>Biology:</p> <p>Oriental Cuckoo is a regular non-breeding migrant from Asia.</p> <p>Habitat requirements:</p> <p>The Oriental Cuckoo is found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath. Sometimes found near clearings and in recently logged or burnt forests. Found in farmland with some trees, orchards, vineyards and urban parks and gardens.</p>
Criteria	Discussion
Substantially modify destroy or isolate an area of important habitat.	The ARRC will remove 0.42 ha of poor and medium condition native vegetation, this habitat is not considered important for this species. No impacts to Oakey Creek are to occur, which may be used as a habitat corridor for this species. The ARRC is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	This species uses as variety of habitats. Based on the proposed mitigation measures it is not expected that the ARRC site will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	The ARRC will remove 0.42 ha of poor and medium condition native vegetation, this habitat is not considered important for this species. The ARRC is unlikely to disrupt the breeding cycle of this species.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none">• only a small area of poor and medium condition habitat is to be removed; and• the ARRC site will not disrupt the breeding cycle of this species population.

H.7 Sharp-tailed Sandpiper (*Calidris acuminata*)

Table H.7 Significant impact criteria assessment – Sharp-tailed Sandpiper

Species profile	<p>Sharp-tailed Sandpiper</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution: The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage.</p> <p>Biology: The Sharp-tailed Sandpiper is a small-medium wader. The bird has a length of 17–22 cm, a wingspan of 36–43 cm and a weight of 65 g.</p> <p>Habitat requirements: The Sharp-tailed Sandpiper forages at the edge of water within wetlands or intertidal mudflats, either on bare wet mud, sand or shallow water. They will also forage among inundated vegetation of saltmarsh, grass or sedges. Roosting occurs at the edges of wetlands, on wet open mud or sand or in sparse vegetation.</p> <p>Threats: The main identified threats to this species include:</p> <ul style="list-style-type: none"> • habitat loss; • reduction in water quality and quantity; • disturbance; • global warming; and • hunting.
Criteria	Discussion
Substantially modify destroy or isolate an area of important habitat.	The ARRC is not considered to support areas of important habitat for the Latham's Snipe as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017b). The ARRC will remove any of the waterbodies within the subject property that may contain suitable foraging habitat with wet mud. Two ephemeral waterbodies will be lost, however in dry times it is largely dominated by grassland habitat. The ARRC is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	Based on the proposed mitigation measures it is not expected that the ARRC site will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	The Sharp-tailed Sandpiper breeds in northern Siberia, from the delta of the Lena River, east to Chaun Gulf and east of the Kolyma River delta. No impacts on the breeding cycle of this population is considered to occur.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact as:</p> <ul style="list-style-type: none"> • no suitable foraging habitat will be removed; and • the ARRC site will not disrupt the breeding cycle of this species population.

H.8 Latham's Snipe (*Gallinago hardwickii*)

Table H.8 Significant impact criteria assessment – Latham's Snipe

Species profile	<p>Latham's Snipe</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution:</p> <p>The Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. The species breeds in Japan and on the east Asian mainland.</p> <p>Biology:</p> <p>The Latham's Snipe is the largest snipe in Australia; mainly brown plumage, with a long straight bill and short pointed wings. The upper body is boldly patterned with black, brown and white. The sexes are similar in appearance and do not show seasonal variation unlike other migratory waders. Juveniles in fresh plumage differ only slightly from adults.</p> <p>Habitat requirements:</p> <p>The Latham's Snipe occurs in permanent and ephemeral wetlands up to 2,000 m ASL. The species inhabits open, freshwater wetlands with low, dense vegetation.</p> <p>Threats:</p> <p>The main threats associated with the Latham's Snipe include the loss of habitat caused by the drainage and modification of wetlands, diversion of water for storage or agriculture, development of land and land management practices such as mowing of habitat. The species was also previously legally hunted.</p>
Criteria	Discussion
Substantially modify destroy or isolate an area of important habitat.	The ARRC is not considered to support areas of important habitat for the Latham's Snipe as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017b). The ARRC is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	The <i>Threat Abatement Plan for predation by the European red fox</i> (DEWHA 2008) identifies the Latham's Snipe as one of the species likely to be affected by the European red fox. The ARRC will not result in an increase or introduction of the European red fox into an area of important habitat. As discussed above, the project area does not contain important habitat for the species and will not result in invasive species becoming established in an area of important habitat.
Disrupt the breeding cycle of a population.	The Latham's Snipe breeding range is confined to Japan and far eastern Russia, therefore the ARRC site will not impact the species breeding cycle.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact on Latham's Snipe as:</p> <ul style="list-style-type: none"> • no important habitat will be directly impacted on; and • the proposed action will not disrupt the breeding cycle of the species.

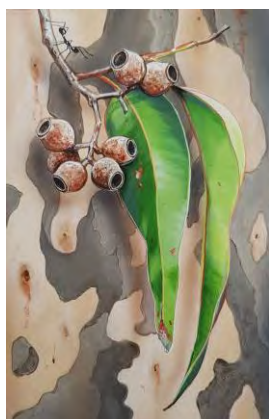
H.9 Common Greenshank (*Tringa nebularia*)

Table H.9 Significant impact criteria assessment – Common Greenshank

Species profile	<p>Common Greenshank</p> <p>Status: Migratory (EPBC Act)</p> <p>Distribution:</p> <p>The Common Greenshank is a non-breeding migrant to Australia. The species breeds in Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia.</p> <p>Biology:</p> <p>The Common Greenshank is a heavily built, elegant wader, 30–35 cm in length, with a wingspan of 55–65 cm and weight up to 190 g for both males and females.</p> <p>Habitat requirements:</p> <p>The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees.</p> <p>Threats:</p> <p>The main identified threats to this species include:</p> <ul style="list-style-type: none"> loss/modification of habitat; silt, pollution, weeds or pest invasion; disturbance; and introduced species.
Criteria	Discussion
Substantially modify, destroy or isolate an area of important habitat.	The ARRC is not considered to support areas of important habitat for the Common Greenshank as per the guidelines identified in <i>Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species</i> (DoEE 2017b). The ARRC is not considered to substantially modify, destroy or isolate areas of important habitat.
Result in an invasive species becoming established in an area of important habitat.	Based on the highly degraded nature and existing weed infestation on the subject property, it is not expected that the ARRC site will result in an increase of invasive species.
Disrupt the breeding cycle of a population.	The Latham's Snipe breeding range is confined to Eurasia, the northern British Isles, Scandinavia, east Estonia and north-east Belarus, through Russia, therefore the ARRC site will not impact the species breeding cycle.
Conclusion	<p>The ARRC site is unlikely to result in a significant impact on this species as:</p> <ul style="list-style-type: none"> no important habitat will be directly impacted on; and the proposed action will not disrupt the breeding cycle of the species.

Appendix I

Acoustic detection survey results



CORYMBIA ECOLOGY

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BAT CALL ANALYSIS RESULTS

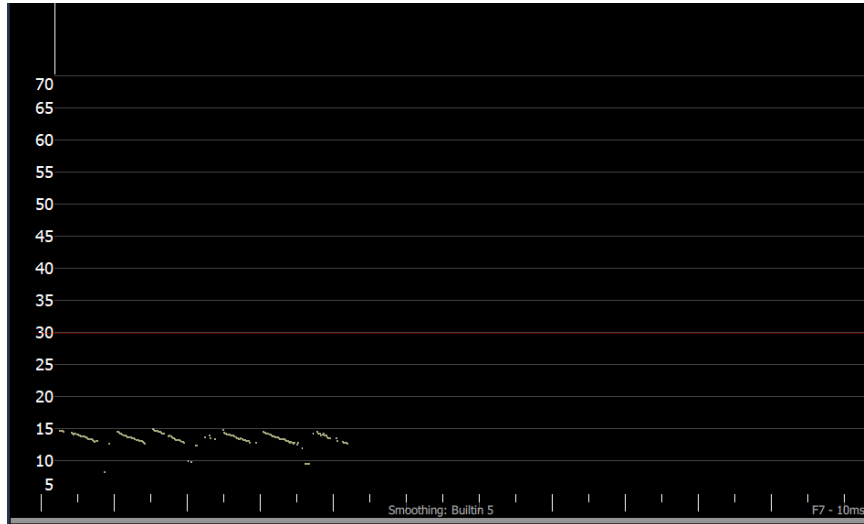
Jason Brown - EMM
J190749 – Adams Rd, Luddenham
27/02/2020 – 02/03/2020

Species	Anabat A	Anabat B	Notes
	SN507269 3892 files 2692 noise	SN507245 2005 files 855 noise	
<i>Austronomus australis</i>	D	D	
<i>Chalinolobus dwyeri</i>	D	D	Only one pass each detector
<i>Chalinolobus gouldii</i>	D	D	
<i>Chalinolobus morio</i>	D	D	
<i>Miniopterus schreibersii oceanensis</i>	D	Pr	
<i>Miniopterus australis</i>	Po	Po	Poor quality calls. Could just be clutter calls from <i>C. morio</i>
<i>Myotis macropus</i>		D	Lots of activity at Anabat B
<i>Mormopterus norfolkensis</i>	D	D	Can be difficult to ID calls between these species, unless clear highly characteristic passes
<i>Mormopterus norfolkensis</i> or <i>Mormopterus (ozimops) ridei</i>	E	E	
<i>Nyctophilus sp</i>	D	Pr	
<i>Scotorepens orion</i>	Pr	Pr	Calls may be easily confused between <i>Scotorepens orion</i> , <i>Scoteanax rueppellii</i> and <i>F. tasmaniensis</i> . Less likely to be <i>F. tasmaniensis</i> due to marginal habitat for the species.
<i>Scoteanax rueppellii</i>	Pr	Po	
<i>Falsistrellus tasmaniensis</i>	Po		
<i>Vespadelus vulturnus</i>	Pr		Only one pass. Not very clear

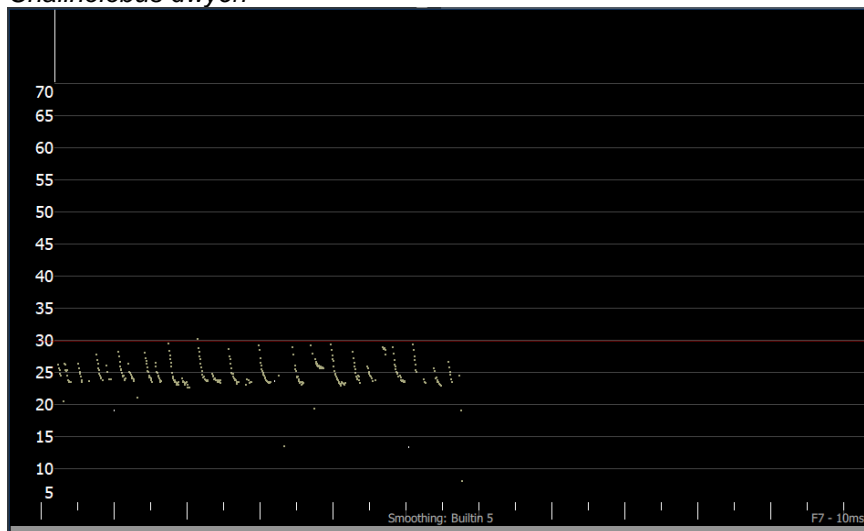
- D – definite; Pr – probable; Po – possible; E-either.
- Calls were analysed using Analook and Anabat Insight.
- Example calls presented below are displayed in this report at F7 or F8 (bottom right corner).
- Analysis was completed on the 15th March 2020
- The following resources were consulted during analysis:
 - Pennay M., Law B., and Reinhold L. (2004) Bat Calls of NSW. DEC of NSW.
 - Corben C. (2009) Anabat Techniques Workshop, Titley Scientific.
 - Anabat Insight Workshop (2019), Titley Scientific and Balance Environmental.
 - Personal experience analysing calls and collection of reference calls in NSW
- **Please note only species with a definite ID should be entered into Bionet.**

Examples of calls for definite identified species

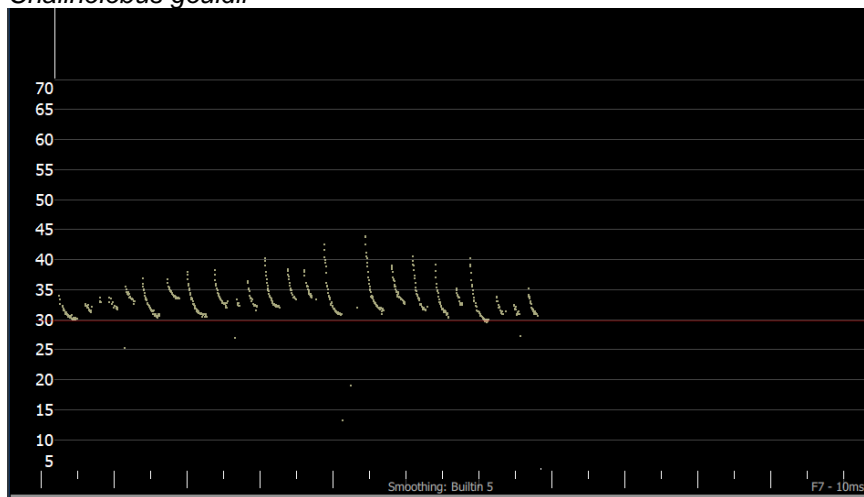
Austronomus australis



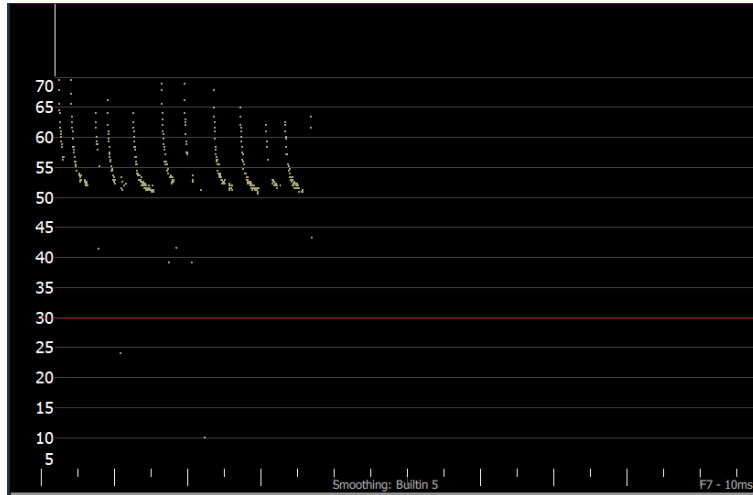
Chalinolobus dwyeri



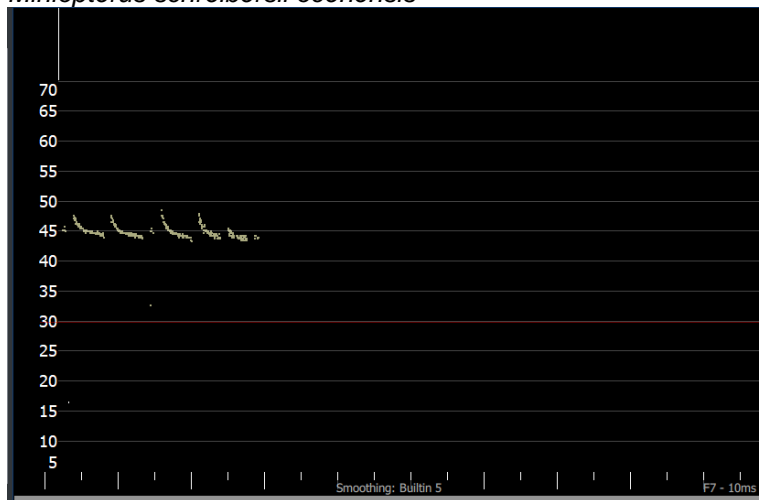
Chalinolobus gouldii



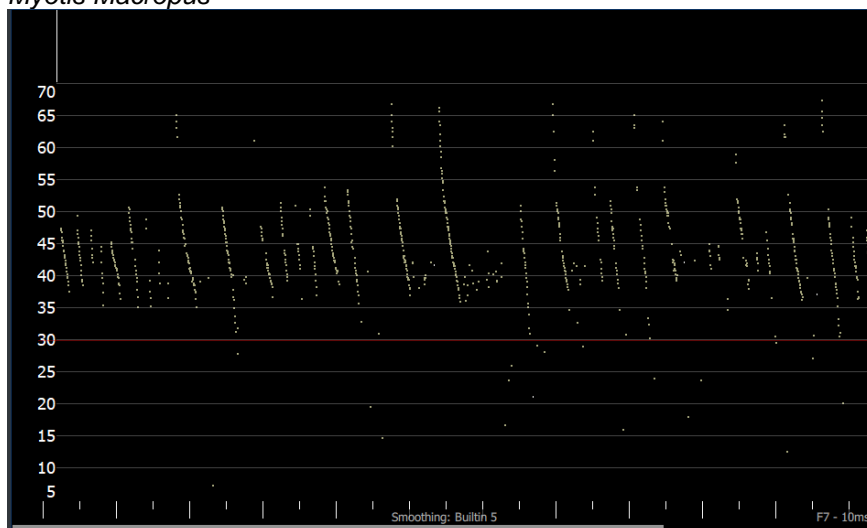
Chalinolobus morio



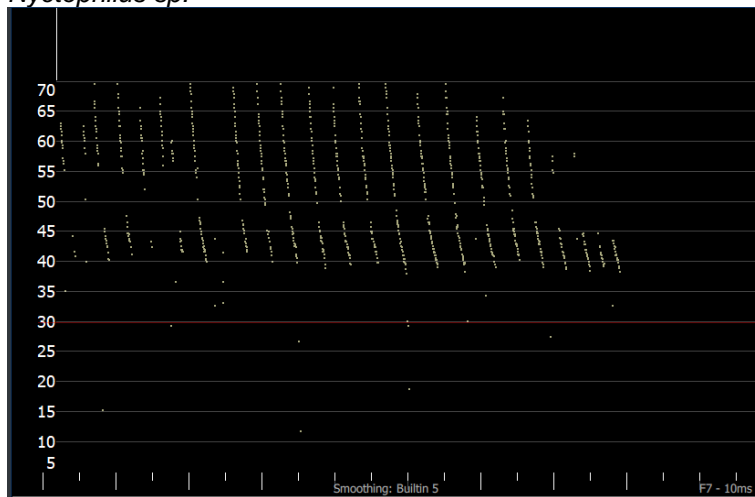
Miniopterus schreibersii oenensis



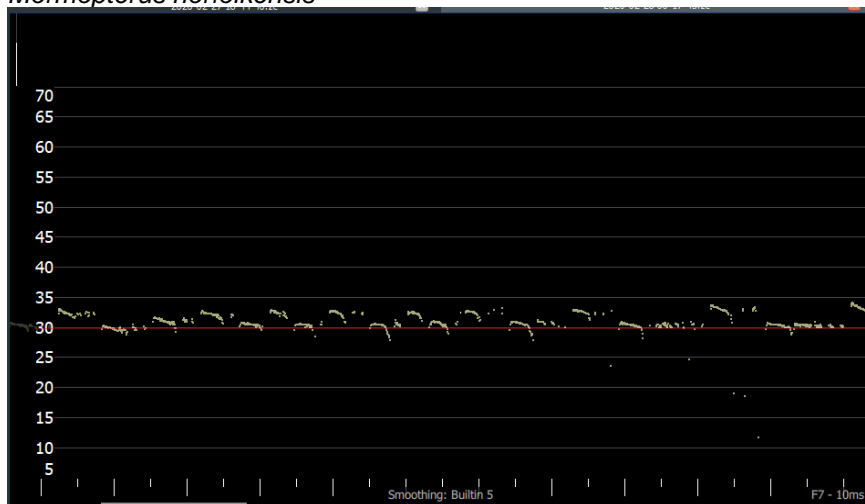
Myotis Macropus



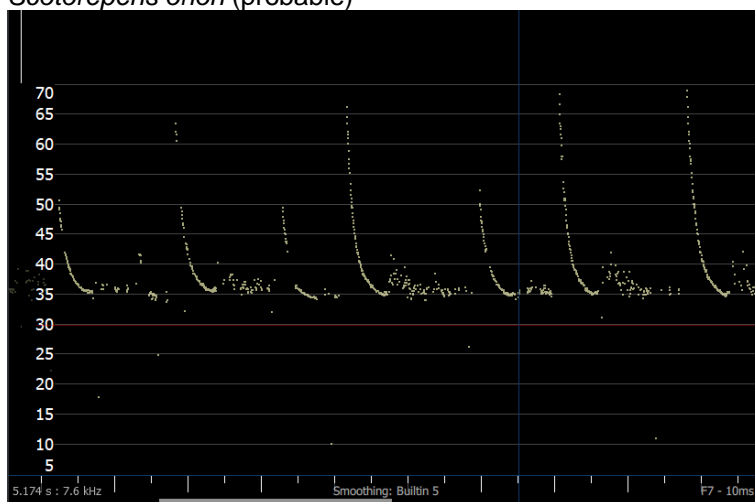
Nyctophilus sp.



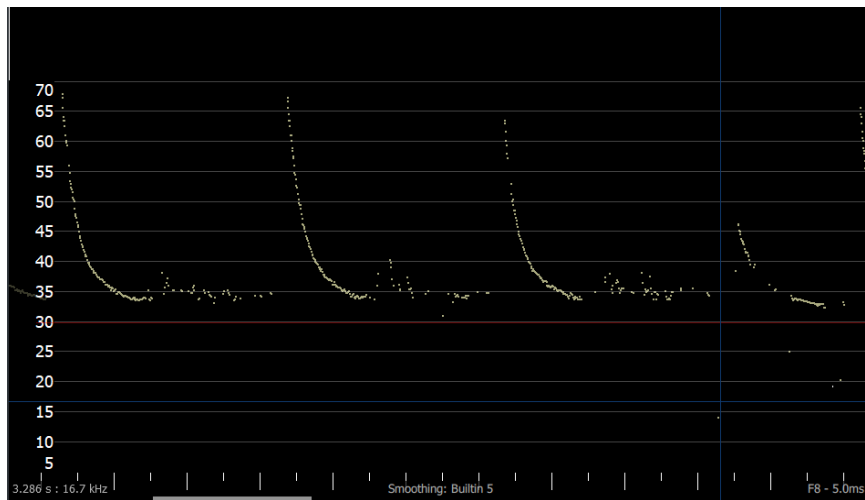
Mormopterus norfolkensis



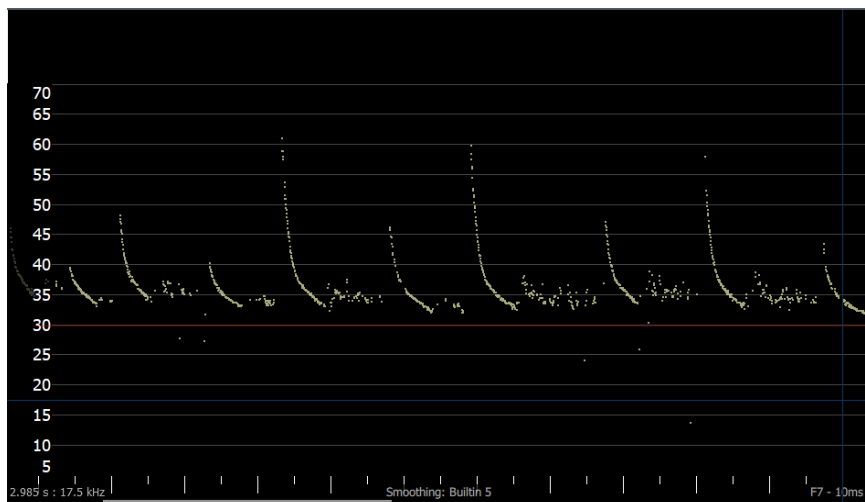
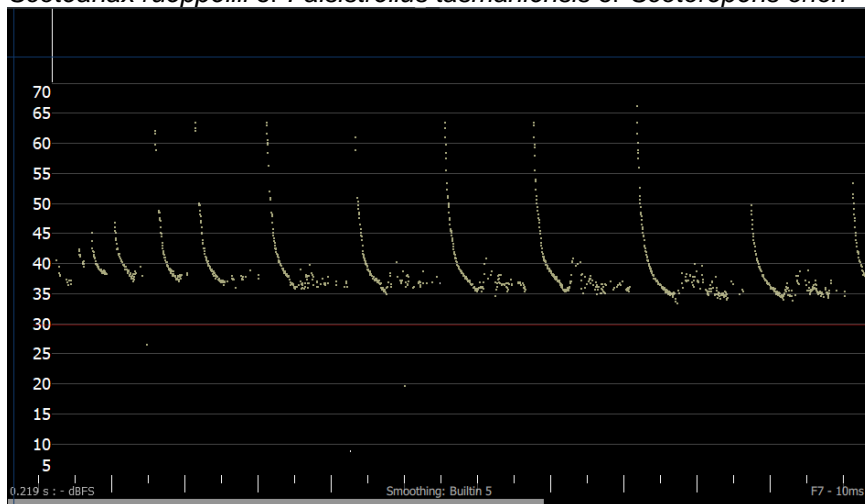
Scotorepens orion (probable)



Scoteanax rueppellii (Probable)



Scotianax rueppellii or *Falsistrellus tasmaniensis* or *Scotorepens orion*



Amy Rowles

A. Rowles



