

Station Street, Menangle: Flora and fauna assessment

Final Report

Prepared for Calibre Consulting (NSW) Pty Ltd

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Biosis offices

NEW SOUTH WALES

Albury

Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle

Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne

Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta

Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

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Report to: Calibre Consulting (NSW) Pty Limited

Prepared by: Paul Price
Kayla Asplet

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Summary

Biosis Pty Ltd was commissioned by Calibre Consulting (NSW) Pty Limited to undertake a flora and fauna assessment for a proposed residential subdivision development at Station Street, Stage 1, Menangle NSW (study area). The study area is located in a residential suburb approximately 37 kilometres north-west of Wollongong Central Business District (CBD). The study area is defined by the extent of proposed works.

This assessment will include consideration of potential direct and indirect impacts to both the subject site and the study area.

The study area encompasses approximately 26 hectares of land in total where the area consists of cleared paddocks and constructed agricultural assets supported by combination of exotic plant communities and built structures associated with a single residential dwellings and farming infrastructure.

Ecological values

Key ecological values include:

- Ephemeral drainage lines and dam basins totalling approximately 0.3 hectares. This area is highly degraded due to invasive weeds and soil compaction by livestock. However, the area was identified as providing marginal foraging habitat for birds within the area.
- One large hollow-bearing Narrow-leaved Ironbark *Eucalyptus crebra*, situated within the centre of the study area, contained three medium hollows and one large hollow, providing suitable habitat for a variety of large bird species and arboreal mammals.
- One riparian corridor (First Order stream) dissects the study area, which is a sources for the constructed dams. Further north of the proposed development footprint, two additional riparian corridors have been mapped, one of which constitutes the Nepean River. The Riparian Corridors within the site have been assessed in relation to the Water Management Act 2000 (WM Act) and Guidelines for Riparian Corridors on Waterfront Land (Office of Water, 2012). The NSW Department of Primary Industries (DPI) - Water recommends riparian widths based on watercourse order under the Strahler method.

An Assessment of Significance in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Biodiversity Conservation Act 2016*, for threatened microbats considered likely to occur within the study area found no significant impacts to these species as a result of the proposed work.

Recommendations

The primary recommendation to minimise impacts to ecological values at the site is to undertake pre-clearance inspection of hollows by an Ecologist for fauna and/or signs of fauna activity prior to any tree removal.

Government legislation and policy

An assessment of the project against key biodiversity legislation and policy is provided and summarised below.

Table 1 Key biodiversity legislation relative to the project

Legislation / Policy	Relevant ecological feature	Permit / approval required
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	The project will not affect matters of National Environmental Significance.	None required.
<i>Biodiversity Conservation Act 2016</i>	The study area contains potential habitat for four threatened fauna species.	Refer to Section 6.2 for recommendations.
<i>Environmental Planning & Assessment Act 1979</i>	Potential threatened species habitat is present.	Assessments of Significance for threatened microbats is recommended.
<i>Water Management Act 2000</i>	One first order watercourse occurs within the study area	Removal of riparian vegetation is proposed within 10 metres the mapped watercourse and as such a controlled activity permit is required.
<i>State Environmental Planning Policy No 44</i>	Potential Koala habitat was not identified within the study area.	None required.
<i>Biosecurity Act 2015</i>	The following priority weeds are present: <ul style="list-style-type: none"> • Alligator Weed. • African boxthorn. • African Olive. • Fireweed. • Athel pine. 	Control requirements for these priority listed weeds is outlined in section 6.4.

Note: Guidance provided in this report does not constitute legal advice.

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Calibre Consulting (NSW) Pty Ltd to undertake a flora and fauna assessment (FFA) for a proposed residential subdivision (Stage 1), Menangle, NSW (study area). Calibre Consulting (NSW) Pty Ltd proposes to develop residential dwellings within the study area (the project, Figure 1). The works proposed to support development of the study area include:

- Bulk excavation works within Stage 1 of the works.
- Construction of 100 low density residential dwellings.
- Construction of community infrastructure in the form of drainage and one main detention basin.
- Establishment of a recreational open space and park, with associated service utilities.

1.2 Scope of assessment

The objectives of this investigation are to:

- Describe the ecological values present within the study area.
- Map native vegetation and other habitat features.
- Review the implications of relevant biodiversity legislation and policy.
- Identify potential implications of the proposed development and provide recommendations to assist with development design.
- Recommend any further assessments of the site that may be required (such as targeted searches for threatened biota).

1.3 Location of the study area

The study area is located approximately 71 kilometres south west of the Sydney Central Business District (CBD) and is accessible primarily via Station Street and Moreton Park Road, Menangle. (Figure 1). It encompasses 24 hectares of private land adjacent to Menangle train station to the east. It is currently zoned R2 - Low Density Residential and RU1 - Primary Production under the Wollondilly Local Environmental Plan 2011 (LEP 2011).

The study area is within the:

- Sydney Basin Bioregion.
- Hawkesbury-Nepean Catchment.
- Greater Sydney Local Land Services (LLS) Management Area.
- Wollondilly Local Government Area (LGA).

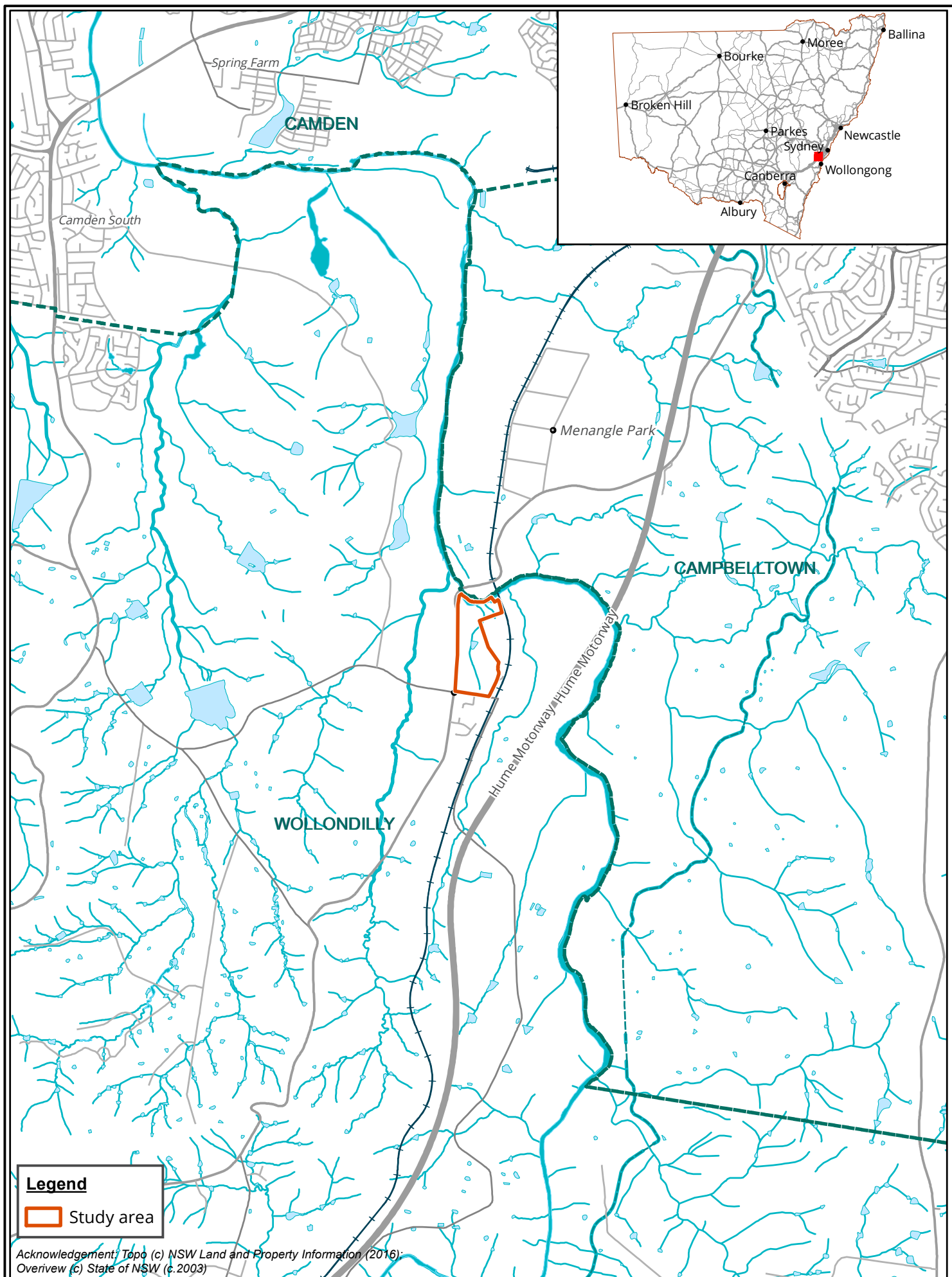


Figure 1: Location of the study area

2 Legislative context

This section provides an overview of key biodiversity legislation and government policy considered in this assessment. Where available, links to further information are provided. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

2.1 Commonwealth

2.1.1 *Environmental Protection and Biodiversity Conservation Act 1999*

The 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 (NES) protected under the Act.

Nine Matters of NES 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).
- 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 Matters of NES must be referred to the Commonwealth Minister for the Environment for assessment.

Matters of NES relevant to the current project include nationally threatened species and ecological communities and migratory species.

2.2 State

2.2.1 *Environmental Planning & Assessment Act 1979*

The 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 and Environment (DP&E).

The EP&A Act provides the overarching structure for planning in NSW and is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

A Development Application (DA) has been submitted to Wollondilly Council for assessment under Part 4 of the EP&A Act.

State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are environmental planning instruments under the EP&A Act that outline policy objectives relevant to State or regional environmental planning issues. There are over 65 SEPPs; however, only those relevant to the proposed development have been considered and are detailed below.

SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas, to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP.

The project is within Wollondilly LGA, a Schedule 1 listed Council. Therefore SEPP No. 44 is relevant to the current assessment and is discussed further in Section 6.2.

Local Environment Plans

Local Environment Plans (LEPs) are created by Councils in consultation with their community and guide planning decisions for LGAs. They apply either to the whole or part of a LGA and make provision for the protection or utilisation of the environment through zoning of land and development controls.

The study area is subject to the Wollondilly LEP 2011 and is zoned R2 and RU1. Elements of the LEP objectives are relevant to this assessment and are discussed further in Section 6.2.

Development Control Plans

Development Control Plans (DCPs) are developed by Council and provide detailed planning and design guidelines to support the planning controls in the LEP. DCPs identify additional development controls and standards for addressing development issues at a local level and can be applied more flexibly than a LEP.

Elements of the DCP relevant to this assessment are discussed further in Section 6.2.

2.2.2 Biodiversity Conservation Act 2016

As a part of the *Biodiversity Conservation Act 2016* (BC Act), the NSW Government has established transitional arrangements associated with biodiversity assessment for a variety of development consent and/or approvals. This is in the form of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. As a result, local developments with the local government areas of Camden, City of Campbelltown, City of Fairfield, City of Hawkesbury, City of Liverpool, City of Penrith and Wollondilly will have 12 months from 25 August 2017 to submit an application under the previous legislation, being the TSC Act.

2.2.3 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) came into effect as of 1 July 2017 and repeals the *Noxious Weeds Act 1993*. The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to:
 - Out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

- Harm or reduce biodiversity.

The Biosecurity Act introduces the concept of Priority Weeds. A priority weed is any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. Where a local strategic plan means a local strategic plan approved by the Minister under Division 2 of Part 4 of the *Local Land Services Act 2013*.

The Biosecurity Act also introduces the General Biosecurity Duty, which states:

All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Priority Weeds are discussed further in Section 6.4.

2.2.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the state's water for the benefit of both present and future generations based on the concept of ecologically sustainable development.

Under the WM Act an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt (WM Act, section 91E). Waterfront land is the bed of any river, lake or estuary and any land within 40 metres of the highest bank of the river, the lake shore or the mean high water mark of the estuary. In the WM Act, controlled activity means:

- The erection of a building or the carrying out of works (within the meaning of the EP&A Act 1979).
- The removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise.
- The deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise.
- The carrying out of any other activity that affects the quantity or flow of water in a water source.

In relation to controlled activities, the WM Act states amongst other things that the carrying out of controlled activities must avoid or minimise land degradation, including soil erosion, compaction, decline of native vegetation and where possible land must be rehabilitated.

The WM Act is supported by a series of interpretation guidelines including Controlled activities on waterfront land - guidelines for riparian corridors on waterfront land (NSW Office of Water, 2012a). This guideline defines a riparian management envelope referred to as the vegetated riparian zone (VRZ). The width of the VRZ within a riparian corridor has been pre-determined and standardised for first, second, third and fourth order and greater watercourses according to the Strahler System of ordering watercourses. The width of the VRZ is measured from the top of the highest bank on both sides of the watercourse. This guideline also presents the riparian corridor matrix that assists applicants for controlled activity approvals to identify certain works and activities that can occur on waterfront land and in riparian corridors. The guideline also includes overarching management measures for works on waterfront land.

An assessment of whether a Controlled Activity Approval from the NSW Department of Primary Industries is required under the WM Act is provided in Section 6.5.

3 Methods

3.1 Literature and database review

In order to provide a context for the study area, information about flora and fauna from within five kilometres (the 'locality') was obtained from relevant public databases. Records from the following databases were collated and reviewed:

- Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the EPBC Act 1999.
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife, for threatened flora, fauna and ecological communities protected by the BC Act.
- The NSW Department of Primary Industries (DPI) Spatial Data Portal for *Fisheries Management Act 1994* (FM Act) listed threatened species, populations and communities.
- NSW DPI WeedWise database for *Biosecurity Act, 2015* listed Priority listed weeds for the Greater Sydney Local Land Services (LLS) area within the Wollondilly region.
- NSW OEH Vegetation Information System (VIS) mapping through the Spatial Information eXchange (SIX) Vegetation Map Viewer, Defining the legislative framework for assessment.

Database searches were undertaken in January 2018.

Other sources of biodiversity information:

- Relevant vegetation mapping, including:
 - *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (SCIVI) (Tozer et al. 2010).
 - *Cumberland Plain Vegetation Mapping* (NPWS 2002).

3.2 Site investigation

3.2.1 Flora assessment

A flora assessment of the study area was undertaken on 11 May 2018 by Kayla Asplet (Zoologist) and Paul Price (Botanist) using random meanders to determine the vegetation types present. The methodology aligns with the field survey requirements outlined in Chapter 5 of *Threatened Species Survey and Assessment: Guidelines for Development and Activities* (OEH 2014).

General classification of native vegetation in NSW used in this report is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. The grouping referred to in this report is Plant Community Type (PCT) as defined by the BioBanking Assessment Methodology (BBAM) (OEH 2014).

The vegetation types were first stratified into PCTs broadly based on previous vegetation mapping, and vegetation boundaries were marked in the field with a hand-held GPS. PCTs were then defined on the basis of species composition and structure, known geographical distribution, landscape position, underlying geology, soil type, and any other diagnostic features.

The general condition of native vegetation and the current effects of seasonal conditions were recorded in the field. Notes were made on priority weed infestations, evidence of management works, current grazing impacts and the regeneration capacity of the vegetation.

3.2.2 Fauna assessment

The study area was investigated on 11 May 2018 to determine its values for fauna. Values were determined primarily on the type and quality of habitat present.

All species of fauna observed during the assessment were noted and active searching for fauna traces, tracks and scats was undertaken. This included searching under rocks and logs, inspection of hollow-bearing trees, culverts and examination of tracks and scats. Particular attention was given to searching for suitable habitat for threatened biota.

Fauna species were recorded with a view to characterising the values of the site and the investigation was not intended to provide a comprehensive survey of all fauna with potential to utilise the site over time. Fauna records will be submitted to OEH for incorporation into the NSW BioNet Wildlife Atlas.

Habitat surveys were undertaken to determine the likelihood of threatened fauna species to occur within the study area, based on the habitat features present.

3.2.3 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2019). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2019).

3.3 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, and ephemeral status of waterbodies and migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall ecological values of a site.

The current flora and fauna assessment was conducted in autumn, which is not an optimal time for survey. The field investigation was conducted on cool day during clement weather, at a time when many fauna species would more likely be active. Due to the size of the study area it is not possible to comprehensively observe all potential threatened fauna on site and the determination of the occurrence of threatened species is based on the identification, or lack of, suitable habitat. However, in consideration of the sparse vegetation and lack of structural habitat components, the assessment is considered sufficient for determining the likelihood of threatened species occurring on site.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

3.4 Mapping

Site plans were supplied by Calibre Consulting and aerial imagery supplied by NearMap (2018).

Mapping was conducted using hand-held (uncorrected) GPS/Tablet Personal Computer units (GDA94) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Mapping has been produced using a Geographic Information System (GIS). Electronic GIS files containing the relevant flora and fauna spatial data are available to incorporate into design concept plans. Note that this mapping may not be sufficiently precise for detailed design purposes.

4 Results

The ecological values of the study area are described below and mapped in Figure 2.

4.1 Landscape context

4.1.1 Study Area history and disturbances

The project area is predominantly cleared of native vegetation where current land uses include areas used for cattle grazing and cropping. Outside of the study area, land use is agricultural and extensive past clearing of native vegetation and intensive grazing by cattle is evident.

4.1.2 Habitat connectivity

The study area provides limited connectivity to bushland remnants and the Nepean River as a result of historical land clearing and current land uses. Two dams, both without water during the field investigations, provided marginal foraging habitat for native fauna, predominantly wading birds.

4.1.3 Topography and soils

Regional soil landscape mapping indicates that the study area occurs primarily on the residual Blacktown landscape (Hazelton and Tille 1990) part of the Wianamatta Group. The Blacktown group soil landscape is characterised by gentle undulating topography with broad rounded ridges and crests to 200-600 metres above sea level. The Stage 1 section of the study area is underlain by fluvial Theresa Park landscape which is characterised by tertiary and quaternary floodplains of the Nepean River south of Cobbitty creek with gently undulating slopes. This soil landscapes is associated with clear, low open woodland with a moderate erodibility. The composition of the soil is highly influential on the vegetation communities observed.

4.2 Flora and fauna

Threatened biota includes all flora and fauna species, populations and ecological communities listed under the EPBC Act and BC Act. Background research found 27 threatened flora and 50 threatened fauna species recorded (OEH 2018) or predicted to occur (DEE 2018) within 10 kilometres of the study area.

Species recorded during the flora assessment are listed in Table A.1 of Appendix 1 (flora). Unless of particular note, these species are not discussed further. No threatened flora species were recorded within the study area. A list of threatened biota recorded or predicted to occur in the local area is also provided in the appendix, along with an assessment of the likelihood of the species occurring within the study area.

Species recorded during the fauna assessment are listed in Appendix 2, Table A.3 (fauna). No threatened species were recorded during the field investigation. However, Cattle Egret *Ardea ibis* was identified during the investigation and is classified as migratory under the Commonwealth EPBC Act.

Unless of particular note, these species are not discussed further. A list of threatened biota recorded or predicted to occur in the local area is also provided in the appendix, along with an assessment of the likelihood of the species occurring within the study area.

4.2.1 Vegetation communities and fauna habitat

The majority of the vegetation and fauna habitat of the study area has been modified by past disturbances, including agricultural practices and most recently, urban residential land use.

The study area supports a limited number of ecological values including areas of exotic vegetation, scattered trees and waterways (Figure 3).

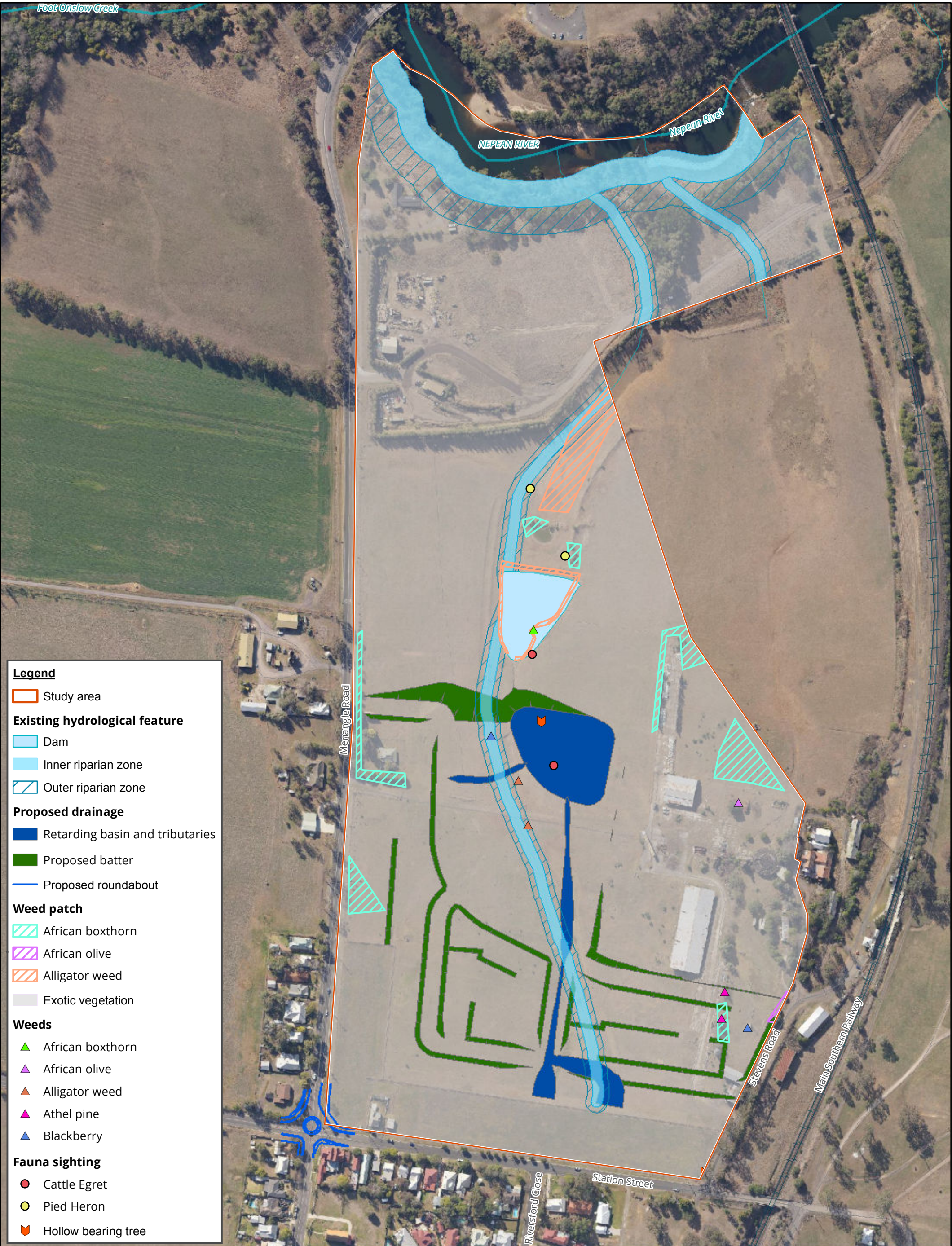
One vegetation type was recorded within the study area; being cleared/exotic vegetation. A description of the community is provided below in Table 2.

Table 2 Vegetation communities of the study area

Cleared/exotic vegetation	
PCT	None
Extent within study area	Approximately 24 hectares of cleared and/or exotic vegetation was recorded within the study area.
Description	Areas of cleared vegetation were dominated by exotic herb and grass species such as <i>Paspalum dilatatum</i> , Kikuyu <i>Cenchrus clandestinus</i> Veldt Grass <i>Ehrharta erecta</i> , Fleabane <i>Conyza bonariensis</i> and Cobbler's Pegs <i>Bidens pilosa</i> .
Condition	The community is considered to be in a poor condition due to the dominance of exotic species.
Associated soils, rainfall and landscape position	Not applicable
Threatened ecological community	Not applicable
Threatened species habitat	<p>This community is considered to provide marginal habitat, in the form of a single hollow bearing tree, for the following threatened fauna:</p> <p>Microbat species - Eastern Bentwing-Bat <i>Miniopterus oceanensis schreibersii</i>, Little Bentwing-Bat <i>Miniopterus australis</i>, Southern Myotis <i>Myotis macropus</i> and Greater Broad-nose Bat <i>Scoteanax rueppellii</i>.</p>

4.2.2 Aquatic habitats

Aquatic habitats within the study area are considered to be in a highly disturbed state, however they do present foraging habitat for wading bird species. There is one unnamed ephemeral drainage line and one artificial dam within the study area.



Legend

Study area

Existing hydrological feature

Dam

Inner riparian zone

Outer riparian zone

Proposed drainage

Retarding basin and tributaries

Proposed batter

Proposed roundabout

Weed patch

African boxthorn

African olive

Alligator weed

Exotic vegetation

Weeds

African boxthorn

African olive

Alligator weed

Athel pine

Blackberry

Fauna sighting

Cattle Egret

Pied Heron

Hollow bearing tree

Figure 2. Ecological features of the study area

4.3 Threatened biota

Threatened biota includes all flora and fauna species, populations and ecological communities listed under the EPBC Act and BC Act. Eighteen flora species and eight fauna species have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area is provided in Appendix 1 (flora) and Appendix 2 (fauna). Previous records of threatened biota within the locality are shown in Appendix 1 (flora) and Appendix 2 (fauna). An assessment of the likelihood of these species occurring in the study area, and an indication of the likelihood of the project resulting in a significant impact is also included.

No areas of critical habitat for flora or fauna have been declared within the study area. One flora species and six fauna species have been identified as having a medium or greater likelihood of occurrence. Table 3 discusses areas of value and potential impacts to these species, and determines the need for an Assessment of Significance under the EP&A Act or Significant Impact Criteria assessment under the EPBC Act. These assessment are included in Appendix 3.

Table 3 Threatened biota likely to occur in the study area

Species name	EPBC status	BC status	Relevance to study area and potential for impact
Fauna			
Little Bentwing Bat		V	This species has been recorded within 10 kilometres of the study area. The species occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains.
Southern Myotis		V	This species has been recorded within 10 kilometres of the study area. The species roosts within close vicinity to waterbodies (within 500 metres, particularly maternal roosts). It is known to roost within artificial structures (i.e. culverts).
Eastern Bentwing Bat		V	There has been sightings of the species within 10 km of the study area. The species is known to generally roost in caves, however it has been found roosting in man-made structures (i.e. bridges, culverts), it prefers forested areas for foraging; may be found roosting in the culvert on the northern portion of the site.
Greater Broad-nose Bat		V	This species has been recorded within 10 kilometres of the study area. The species can utilise a variety of habitats from open woodland to moist eucalypt forests. The species has records of roosting within tree hollows and man-made structures. Greater Broad-nose Bat is known as an open forager and prefers open areas to intercept prey (i.e. insects and other microbat species), the site has patches of open space and potentially suitable roosting habitat (stags with hollows). An assessment of impacts to the species habitat is required.

Known habitats for migratory species protected under the EPBC Act have been considered and are addressed in Appendix 2. Migratory species previously recorded within 10 kilometres of the study area include Red Knot *Calidris canutus* and Little Tern *Sternula albifrons*.

5 Ecological impacts and recommendations

This section identifies the potential impacts of proposed development on the ecological values of the study area and includes recommendations to assist Calibre Consulting to design a development to avoid and minimise impacts on ecological values.

The principal means to reduce impacts on ecological values will be to minimise removal of native vegetation and areas of higher quality habitat. Under the current proposal, one hollow-bearing Narrow-leaved Ironbark *Eucalyptus crebra* within the central drainage line is at risk of being removed for drainage infrastructure. This habitat feature showed evidence of bird occupancy (i.e. whitewash) and contained large hollows which may provide habitat for larger threatened bird species. It is recommended that a pre-clearance inspection of hollows by an Ecologist for fauna and/or signs of fauna activity is completed prior to any tree removal.

Drainage lines within the current study area are already highly modified. The drainage lines throughout the study area are classed as a moderate ecological constraint and provide intermittent foraging habitat for bird species. The current proposal has planned to incorporate drainage and water detention basins down slope of the proposed residential development to capture runoff. The drainage system will follow the current drainage lines, and the detention basin will provide foraging opportunity for transient avifauna.

The proposed open space/ parkland on the southern portion of the site has the opportunity to enhance the landscape in terms of habitat opportunity. The current landscape is highly degraded from agricultural practices and is highly fragmented and dominated by invasive weeds. The parkland may provide opportunity to increase vegetation connectivity and habitat availability throughout the landscape.

The results of this flora and fauna assessment should therefore be used to provide input into the final design of the development.

A summary of potential implications of development of the study area and recommendations to minimise impacts during of the project are provided in Table 4 below.

Table 4 Ecological values, impacts and recommendations

Ecological value (Figure 2)	Impacts	Recommendations	
		Avoid	Minimise and mitigate
Hollow-bearing trees	One hollow-bearing tree is situated within the southern portion of the proposed drainage and detention basin footprint.	Removal of the tree cannot be avoided as it is situated on the site of a proposed detention basin.	Pre-clearance inspection of hollows by an Ecologist for fauna and/or signs of fauna activity is recommended prior to any tree removal.
Waterways – one ephemeral drainage line and dam area	<p>Central watercourse flowing north-south:</p> <ul style="list-style-type: none"> The current drainage lines and remnant dam within the study area will be reticulated and repurposed for drainage infrastructure that will be utilised for capturing and treating urban runoff. 	<ul style="list-style-type: none"> Restrict construction of ancillary facilities to outside of the 20 metre Vegetated Riparian Zone buffer for all second order watercourses (i.e. the Nepean River) on the northern portion of the site. 	<ul style="list-style-type: none"> All site access should be located away from watercourses. Appropriate sediment controls are to be implemented during construction works to avoid erosion, sediment accumulation and the spread of weeds. Potential controls include: <ul style="list-style-type: none"> Installation of sedimentation fencing upstream of receiving watercourses. Implement the ecological restoration activities to be outlined in a Vegetation Management Plan (VMP) for the site.

6 Assessment against key biodiversity legislation

6.1 Environmental Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of NES, against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the project are summarised in Table 5.

Table 5 Assessment of the project against the EPBC Act

Matter of NES	Project specifics	Assessment against Commonwealth of Australia (2013)
EPBC Act listed threatened species (flora and fauna)	<p>Thirteen flora species and eight fauna species listed under the EPBC Act have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area is provided in Table A.1 of Appendix 1 (flora) and Table A.2 of Appendix 2 (fauna).</p> <p>No species listed under the EPBC Act were recorded within the study area or were assessed as having a moderate or greater likelihood of occurring.</p>	The study area does not support limiting habitat for EPBC Act listed flora and fauna, therefore no assessments against the Significant Impact Criteria (CoA 2013) were considered necessary to be undertaken for the project.
Threatened ecological communities	No EPBC Act listed TECs were mapped within the study area.	Not applicable.
Migratory species	Two migratory species have been recorded or are predicted to occur in the locality (Table A.5 of Appendix 2).	Some of these species would be expected to use the study area on occasions. However, the study area does not provide important habitat for an ecologically significant proportion of any of these species.
Wetlands of international importance (Ramsar sites)	There are 12 Ramsar sites in NSW, the closest one being the Towra Point Nature Reserve on the Kurnell Peninsula in Sydney.	The study area does not flow directly into a Ramsar site and the development is not likely to result in the ecological character of any Ramsar Site.

Given the low likelihood for species listed under the EPBC Act to occur in the study area, and the absence of EPBC listed ecological communities, no Significant Impact Criteria (SIC) assessments were completed for the project. Referral to the Minister is not required.

6.2 Environmental Planning & Assessment Act 1979

An assessment of the project against the relevant sections of the EP&A Act is provided below.

Assessment of Significance

Assessments of Significance has been completed for four threatened fauna species considered to have a medium or greater likelihood of occurrence within the study area (see Appendix 3).

The AoSS determined that the proposed development is not likely to significantly impact Eastern Bentwing-Bat, Southern Myotis, Little Bentwing-Bat or Greater Broad-nosed bat within the study area or wider locality, as:

- The proposal will alter a small area of potential foraging habitat, to construct permanent drainage retention infrastructure.
- The habitat to be removed is not considered important to the survival of the species.
- Suitable extensive habitat is available less than 500 metres to the north of the study area.
- Preclearance protocols will be implemented to avoid mortality of individuals.
- The proposal does not significantly contribute to a KTP for these species.

State Environmental Planning Policies

SEPP No. 44 – Koala Habitat Protection

The study area is located within the Wollondilly LGA, a Schedule 1 listed Council. Therefore, SEPP No. 44 is relevant. The study area does not support Koala feed tree species as defined in Schedule 1 of the SEPP. Therefore the vegetation within the study area would not be considered potential Koala habitat as defined under SEPP No. 44.

Results from the field investigation identified no evidence of Koala presence (scats or scratch marks). Within the locality of the study area, Koalas have recently been recorded east of the study area.

The study area is not considered to support Core Koala Habitat and a Plan of Management is not required.

Local Environment Plans

The study area is subject to the Wollondilly Local Environment Plan (LEP) (Wollondilly Council 2011) and will be zoned RE1– Public Recreation, B1 – Neighbourhood Centre and R2 – Low Density Residential. The relevant objectives of zoning are to:

RE1:

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.

B1:

- To provide a range of small-scale retail, business and community uses that serve the needs of people who live in or work in the surrounding neighbourhood.
- To encourage development that does not impact on the viability of land within Zone B2 Local Centre.

- To support small-scale residential development in conjunction with retail, business and commercial uses in a manner that increases the vitality of the surrounding neighbourhood.

R2:

- To provide for the housing needs of the community within a low density residential environment.
- To enable other land uses that provide facilities or services to meet the day to day needs of residents.

The project is considered consistent with the above objectives.

Development Control Plans

The Wollondilly Development Control Plan 2016 (DCP) has been prepared in accordance with Division 6 of the EP&A Act and with Part 3 of the Environmental Planning and Assessment Regulation 2000. The DCP provides more detailed provisions than the LEP for development within the Wollondilly Local Government Area.

The project is considered consistent with the DCP.

6.3 Biodiversity Conservation Act 2016

An assessment of the likelihood of threatened biota occurring within the study area is provided in Appendix 1 (flora) and Appendix 2 (fauna) along with an assessment of whether the project has potential to result in a significant effect. These assessments determined that four fauna species have a medium or greater likelihood of occurring within the study area.

6.4 Biosecurity Act 2015

Six weeds listed as a priority weed in the Wollondilly LGA under the Biosecurity Act were recorded within the site and landowners and occupiers are under legal obligations to manage such species in line with the General Biosecurity Duty which states;

All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Table 6 Priority weeds within the study area

Scientific name	Common name	General Biosecurity Duty	WoNS
<i>Alternanthera philoxeroides</i>	Alligator Weed	<i>Biosecurity Zone</i> <i>The Alligator Weed Biosecurity Zone is established for all land within the state except land in the following regions: Greater Sydney; Hunter (but only in the local government areas of City of Lake Macquarie, City of Maitland, City of Newcastle or Port Stephens). Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed.</i>	Yes
<i>Lycium ferocissimum</i>	African boxthorn	<i>Prohibition on dealings</i> <i>Must not be imported into the State or sold</i>	Yes

Scientific name	Common name	General Biosecurity Duty	WoNS
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	<i>Regional Recommended Measure</i> Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Core infestation area: Land managers prevent spread from their land where feasible.	No
<i>Rubus fruticosus</i> species aggregate	Blackberry	<i>Prohibition on dealings</i> <i>Must not be imported into the State or sold</i>	Yes
<i>Senecio</i> <i>madagascariensis</i>	Fireweed	<i>Prohibition on dealings</i> <i>Must not be imported into the State or sold</i>	Yes
<i>Tamarix aphylla</i>	Athel pine	<i>Prohibition on dealings</i> <i>Must not be imported into the State or sold</i>	Yes

To prevent the spread of the above listed Priority Weeds from the study area, it is recommended that practical steps be taken to control the weeds prior to vegetation removal.

6.5 Water Management Act 2000

Any works will need to be consistent with the riparian corridor matrix of the NSW Office of Water (2012a) including establishment a 40 metre vegetated riparian zone (VRZ) along the Nepean River. Works will require the preparation of a Vegetation Management Plan (NSW Office of Water 2012b).

Works are proposed on a mapped first order waterway and therefore consultation with Department of Planning - Water is recommended, to resolve the identification of waterfront land, as the bank of the waterway is indistinguishable within the surrounding landscape.

In accordance with the riparian corridor matrix stream realignment and road crossings can occur on waterfront land, however these works will be subject to a controlled activity permit, following the streamlined assessment, or a determination from DPI Water that the proposed works will not be on waterfront land.

7 Conclusion

This report is an assessment of the potential impact of the proposed development at Lot 201 DP590247, Station Street, Menangle on ecological values in accordance with the EP&A Act and BC Act.

The proposed activities that will result in impacts to ecological values include:

- Bulk excavations within Stage 1 of the works.
- Construction of 100 low density residential dwellings.
- Construction of community infrastructure in the form of drainage and one main detention basin.
- Establishment of a recreational open space and park, with associated service utilities.
- Potential removal of a hollow-bearing tree within the study area.
- Direct and indirect impacts to watercourses.
- Fragmentation of existing habitat.

No Endangered or Threatened flora species or threatened ecological communities listed under the EPBC Act or BC Act were recorded during the field surveys.

Following field investigations, eight fauna species listed under the BC Act were considered to have a moderate likelihood of occurrence in the study area:

- Microbats – Eastern Bentwing-Bat *Miniopterus oceanensis schreibersii*, Little Bentwing-Bat *Miniopterus australis*, Southern Myotis *Myotis macropus* and Greater Broad-nose Bat *Scoteanax rueppellii*.

Assessments of significance have been undertaken for these species and are not considered likely to be subject to significant direct or indirect impacts associated with the project.

Safeguards specific to the removal of threatened and general fauna species habitat have been included in Section 5 of this report, including inspection of hollow-bearing trees prior to removal as well as advice on riparian corridor management (refer to Table 4 for full details regarding proposal safeguards).

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Appendices

Appendix 1 Flora

Appendix 1.1 Flora species recorded from the study area

Notes to tables:

Status – EPBC Act: CE – Critically Endangered EN – Endangered VU – Vulnerable	Status – BC Act: E1 – endangered species (Part 1, Schedule 1) E2 – endangered population (Part 2, Schedule 1) E4 – presumed extinct (Part 4, Schedule 1) E4A – critically endangered V – vulnerable (Part 1, Schedule 2)
Status – Exotic # – Native species outside natural range * – priority weed species declared under the Biosecurity Act 2015	

Table A.1 Flora species recorded from the study area

Scientific name	Common name	Commonwealth status	NSW status
Native species			
<i>Eucalyptus crebra</i>	Narrow-leaved ironbark		
<i>Juncus ussata</i>	Common Rush		
Exotic species			
* <i>Alternanthera philoxeroides</i>	Alligator Weed		
<i>Araujia sericifera</i>	Moth Vine		
<i>Bidens pilosa</i>	Cobbler's Pegs		
<i>Cenchrus clandestinus</i>	Kikuyu Grass		
<i>Conyza bonariensis</i>	Fleabane		
<i>Cupressus macrocarpa</i>			
<i>Ehrharta erecta</i>	Panic Veldtgrass		
<i>Hypochaeris radicata</i>	Catsear		
<i>Ligustrum lucidum</i>	Large-leaved Privet		
* <i>Lycium ferocissimum</i>	African boxthorn		
* <i>Olea europaea subsp. cuspidata</i>	African Olive		
<i>Paspalum dilatatum</i>	Paspalum		
* <i>Rubus fruticosus</i>	Blackberry		
<i>Setaria parviflora</i>			
<i>Sida rhombifolia</i>	Paddy's Lucerne		

Scientific name	Common name	Commonwealth status	NSW status
* <i>Senecio madagascariensis</i>	Fireweed		
<i>Sporobolus africanus</i>	Parramatta Grass		
<i>Tamarix aphylla</i>	Athel pine		
<i>Verbena bonariensis</i>	Purpletop		
<i>Xanthium spinosum</i>	Bathurst Burr		

Appendix 1.2 Threatened flora species and ecological communities

The following table includes a list of the threatened flora species and ecological communities that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas and the Protected Matters Search Tool (DEE; accessed on 15/03/2018).

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria for likely occurrence in the site
Recorded	<ul style="list-style-type: none"> Recorded in the site during current assessment. Records in the site, as indicated by background research.
High	<ul style="list-style-type: none"> Species/ecological communities recorded in the site during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the site during current or previous assessment/s. Sufficient good quality habitat is present in the site or in connected waterbodies in close proximity to the site (aquatic species). The site is within species natural distributional range (if known). Species has been recorded within five kilometres or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial biota within five kilometres of the site or of aquatic species in the relevant basin/neighbouring basin. Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	<ul style="list-style-type: none"> No records within five kilometres of the site or for aquatic species, the relevant basin/neighbouring basin. Marginal habitat present (low quality & extent). Substantial loss of habitat since any previous record(s).
Unlikely	<ul style="list-style-type: none"> Habitat not present in the site. Habitat for aquatic species not present in connected waterbodies in close proximity to the site. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table A.2 Threatened flora species recorded / predicted to occur within 10 kilometres of the study area

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Acacia bynoeana</i>	Bynoe's Wattle	VU	E1	2013	Unlikely	19 records have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area the likelihood of occurrence is considered unlikely.	Semi prostrate shrub growing in central eastern NSW spanning from the Hunter District, west to the Blue Mountains and south to the Southern Highlands. Grows in a variety of communities including; Southern Tableland Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands and Sydney Coastal Heaths. Prefers open, slightly disturbed sites on sandy soils.
<i>Allocasuarina glareicola</i>		EN	V1	2018		One record have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area the likelihood of occurrence is considered unlikely.	Small shrub restricted to the Richmond districts and outlier populations located at Voyager Point. Grows within Castlereagh woodlands, Cumberland Dry Sclerophyll Forests, Coastal Heaths, and New England Dry Sclerophyll Forests on sandy soils.
<i>Callistemon linearifolius</i>			V	1912	Unlikely	Two records has been documented within a ten	Small shrub restricted to a few populations in the Richmond district with an outlier population at

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the age of the records and lack of previous records in relation to the study area, the likelihood of occurrence is considered unlikely.	Voyager Point in Liverpool. Grows in Castlereagh Woodlands, Cumberland Dry Sclerophyll Forest, Sydney Hinterland Dry Sclerophyll Forest and Sydney Sand Flats Dry Sclerophyll Forests. Grows in lateritic soil.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	VU	V	1999	Unlikely	There has been no documented records within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area the likelihood of occurrence is considered unlikely.	Orchid with a distribution from Gibraltar Range National Park to coastal areas near Orbost, Victoria. Grow with a variety of communities including Sydney Coastal Dry Sclerophyll Forests, Coastal Swamp Heaths, Coastal Heaths, and New England Dry Sclerophyll Forests on sandy soils.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	EN	E1	1999	Unlikely	Six records has been documented within a ten kilometre radius of the study area. Residing vegetation does not	Climbing vine restricted to eastern NSW from Brunswick Heads to Gerroa in the Illawarra region. Grows in rainforest gully scrub and scree slope on the edge of dry rainforests in a variety of communities including Coastal Floodplain

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						support a suitable habitat for this species. Given the lack of previous records in relation to the study area the likelihood of occurrence is considered unlikely.	Wetlands, Maritime Grasslands, Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests.
<i>Eucalyptus benthamii</i>	Camden White Gum	VU	V	2015	Unlikely	162 records have been documented within a ten kilometre radius of the locality yet the study area does not support the preferred habitat of the Camden White Gum. As a result, it is considered that the likelihood of occurrence within the study area is considered unlikely.	The Camden White Gum occurs within deep alluvial sand flats on the Nepean river primarily within the local government areas of Camden and Cobbitty, with small populations recorded on Werriberri Creek and within the Nattai Creek catchment (Nattai National Park).
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	EN	E1	1967	Unlikely	One record has been documented within a ten kilometre radius of the locality. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the site the	Bauer's Midge Orchid's preferred habitat is within dry sclerophyll forest and moss gardens from a sandstone derived substrate.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						likelihood of occurrence is considered unlikely.	
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small Flowered Grevillea	VU	V	2017	Unlikely	170 records has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area the likelihood of occurrence is considered unlikely.	Low spreading to erect shrub sporadically distributed throughout the Sydney Basin, most notably in the Picton, Appin and Bargo regions. Isolated populations from the Cessnock - Kurri Kurri area, Putty to Wyong to Lake Macquarie. Grows in Shale Sandstone Transition Forest, Kurri Sand Swamp Woodland, <i>Corymbia maculata</i> - <i>Angophora costata</i> Open Forest in the Dooralong Area, Sydney Sandstone Ridgetop Woodland at Wedderburn and Cooks River/Castlereagh Ironbark Forest at Kemps Creek. Grows in sandy or light clay soils including tertiary alluviums over thin shales and lateritic ironstone gravels.
<i>Gyrostemon thesioides</i>			E1	1910	Unlikely	One record has been documented within a ten kilometre radius of the site. Residing vegetation does not support a suitable habitat for this species. Given the previous record and lack of preferred habitat in the site the likelihood of occurrence is considered unlikely.	Only recorded in three sites in western Sydney primarily associated with the hill side and banks of rivers growing on fine sandy soils.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Square Raspwort	VU	V	#	Unlikely	There are no records within a ten kilometre radius of the site. Given the lack of previous records in relation to the study area, the likelihood of occurrence is considered unlikely.	Square Raspwort occurs on protected and shaded damp situations in riparian habitats. It has been recorded 4 widely scattered localities in eastern NSW.
<i>Hibbertia puberula</i>		VU	V	2016	Unlikely	One record has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the previous record and lack of preferred habitat in the site the likelihood of occurrence is considered unlikely.	Grows in a variety of communities including Southern Tablelands Dry Sclerophyll forests, Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests,, Coastal Heath Swamps on sandy and occasionally clay, soils.
<i>Leucopogon exolasius</i>		VU	V	2013	Unlikely	Eight records have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area,	Erect shrub confined to the upper Georges River area and Heathcote National Park. Grows in a variety of communities including Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Sydney Montane Dry Sclerophyll Forests, Eastern Riverine Forests, and

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						the likelihood of occurrence is considered unlikely.	Sydney Coastal Heaths. Grows on sandstone substrates.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Native Pear		E2	2016	Unlikely	19 records have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area, the likelihood of occurrence is considered unlikely.	Native Pear occurs within an open shale woodland community, primarily within vine thickets associated with Cumberland Dry Sclerophyll Forests and Dry Rainforests within western Sydney and north of the Razorback Range.
<i>Maundia triglochinos</i>			V	2008	Unlikely	One record has been documented within a ten kilometre radius of the locality. The site supports a very limited representation of the preferred habitat. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Perennial sedge restricted to coastal NSW from Wyong extending northwards to southern Queensland. Grows in shallow freshwater channels, lagoons, creeks, dams or swamps in a variety of communities including Coastal Floodplain Wetlands, Coastal Swamp Forests, Coastal Freshwater Lagoons, Coastal Heath Swamps and Coastal Valley Grassy Woodlands. Grows in heavy clay, low nutrient soils.
<i>Melaleuca deanei</i>	Deane's Paperbark	VU	V	2013	Unlikely	Seven records have been documented within a ten	Medium sized shrub found growing in two distinct populations in the Ku-ring-gai/Berowra and

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the lack of previous records in relation to the study area, the likelihood of occurrence is considered unlikely.	Holsworthy/Wedderburn areas along with a few outliers at Springwood and in the Wollemi National Park, Yalwal and the Central Coast regions. Grows in ridgetop woodland in a variety of communities including Sydney Coastal Dry Sclerophyll Forests, South East Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands, and Sydney Coastal Heaths. Grows on sandstone substrates in alluvial soils.
<i>Pelargonium sp. striatellum</i> (G.W.Carr 10345)	Omeo Stork's Bill	EN		#	Unlikely	There are no records within a ten kilometre radius of the study area. Given the lack of previous records in relation to the study area, the likelihood of occurrence is considered unlikely.	Omeo Stork's Bill grows just above the water level of irregularly inundated or ephemeral lakes and lake beds in upland wetlands of the New England and Temperate Grassland of the Southern Tablelands of NSW and the ACT.
<i>Persicaria elatior</i>	Tall Knotweed	VU	V	2018	Low	One record has been documented within a ten kilometre radius of the study area. The study area supports a limited representation of the preferred habitat. Given the limited records in relation to the site, the likelihood of occurrence is	Tall Knotweed is known from the North Coast, Central Coast and South Coast Botanical Subdivisions in New South Wales (NSW) and Moreton Pastoral District in south-east Queensland. Knotweed normally grows in damp places, including coastal with swampy areas and along watercourses, streams and lakes.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Persoonia bargoensis</i>	Bargo Geebung	VU	E1	1989	Unlikely	considered low. Three records has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone.
<i>Persoonia hirsuta</i>	Hairy Geebung	EN	E1	2017	Unlikely	Nine records has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the site, the likelihood of occurrence is considered unlikely.	Spreading, hairy shrub with a scattered distribution throughout Sydney from Singleton to the north, the east coast of Bargo to the south and the Blue Mountains to the west. Grows at elevations between 350 - 600 metres in a variety of communities including Southern Tableland Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Western Slopes Dry Sclerophyll Forests, Coastal Valley Grassy Woodlands, Sydney Coastal Heaths and Southern Escarpment Wet Sclerophyll Forests. Grows in sandy soils on sandstone substrates.
<i>Pimelea spicata</i>	Spiked Rice-flower	EN	E1	2017	Unlikely	462 records have been documented within a ten kilometre radius of the	Small erect or spreading shrub with populations occurring in two disjunct areas, one occurring on the Cumberland Plain from Marayong and Prospect

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						study area. Residing vegetation does not support a suitable habitat for this species therefore the likelihood of occurrence is considered unlikely.	Reservoir south to Narellan and Douglas Park, and the other occurring in the Illawarra from Landsdowne to Shellharbour and north Kiama. Grows in Maritime Grasslands and Coastal Valley Grassy Woodlands including Cumberland Plain Woodlands and Moist Shale Woodlands within the Cumberland Basin and in Coast Banksia Open Woodland Coastal Grasslands in the Illawarra region. Grows on well-structured clay soils.
<i>Pomaderris adnata</i>	Sublime Point Pomaderris		E1	2008	Unlikely	One record has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Sublime Point Pomaderris is restricted to one site at Sublime point, north of Wollongong where it grows on sandstone substrate in sandy loam soils.
<i>Pomaderris brunnea</i>	Brown Pomaderris	V	E1	1996	Unlikely	43 records have been documented within a ten kilometre radius of the locality. The study area supports a very limited representation of the preferred habitat. Given	Brown Pomaderris occurs moist woodland or forest on clay and alluvial soils of flood plains and creek lines but is found in very limited areas around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						the lack of preferred habitat in relation to the study area the likelihood of occurrence is considered unlikely.	
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	EN	E1	1990	Unlikely	Two records have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Sydney Plains Greenhood occurs between Picnic Point to Picton NSW, primarily growing adjacent to riparian areas on shallow soil lenses over sandstone derived sheets.
<i>Pultenaea pedunculata</i>	Matted Bush-Pea		E1		Unlikely	Nine records have been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Small prostrate, mat forming shrub restricted to three disjunct populations, in Villawood, Prestons and north-west of Appin in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. Found growing in a variety of habitats including intact woodland, creek-lines, broad valleys, headlands, rock crevices, disturbed sites such as road batters and coastal cliffs in a variety of communities including Central Gorge Dry Sclerophyll Forests, South Coast Sands Dry Sclerophyll Forests, Cumberland Dry Sclerophyll Forests, Temperate

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							Montane Grasslands, Coastal Valley Grassy Woodlands and Southern Tableland Wet Sclerophyll Forests. Grows in a variety of soils including sandy clay soils, loam soils, transitional soils with ironstone nodule inclusions and soils derived from Wianamatta shale, laterite or alluvium.
<i>Thelymitra kangaloonica</i>	Kangaloon Sun Orchid	CE	E4A	#	Unlikely	There are no records within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Kangaloon Sun Orchid is confined to the Southern Tablelands primarily located on Sydney catchment Authority managed assets within swamps and Montane Bogs at elevations between 550 and 700 meters.
<i>Thesium australe</i>	Austral Toadflax	VU	V		Unlikely	This species has not been recorded within a ten kilometres radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is	Small, straggling herb with a distribution comprising of small populations scattered along the coast of eastern NSW including the Northern and Southern Tablelands, Tasmania, Queensland and eastern Asia. A root parasite found growing on damp sites in grassland, grassy woodlands and coastal headlands often in association with Kangaroo Grass <i>Themeda triandra</i> in a variety of communities including New England Dry Sclerophyll Forests, Western Slopes Grasslands, Northern Tableland

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						considered unlikely.	Wet Sclerophyll Forests, Brigalow Clay Plain Woodlands, Subalpine Woodlands and Maritime Grasslands.
<i>Wodyetia bifurcata</i>		VU		2013	Unlikely	One record has been documented within a ten kilometre radius of the study area. Residing vegetation does not support a suitable habitat for this species. Given the limited records in relation to the study area, the likelihood of occurrence is considered unlikely.	Tall palm tree, endemic to Queensland, occurring at one locaton Cape Melville National Park on Melville Range on the Cape York Peninsula. Found growing up to elevations of 400 metres in open woodland communities adjacent to creeklines and at the foot of boulder hills in association with rainforest species such as Small-leaved Fig <i>Ficus obliqua</i> . Grows on granite substrates.

* - habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Appendix 2 Fauna

Appendix 2.1 Fauna species recorded from the study area

Notes to tables:

Status – EPBC Act:	Status – BC Act:
CE – Critically Endangered	E1 – endangered species (Part 1, Schedule 1)
EN – Endangered	E2 – endangered population (Part 2, Schedule 1)
VU – Vulnerable	E4 – presumed extinct (Part 4, Schedule 1)
	E4A – critically endangered
	V – vulnerable (Part 1, Schedule 2)

Table A.3 Fauna species recorded from the study area

Scientific name	Common name	Commonwealth status	NSW status
Native species			
<i>Ardea ibis</i>	Cattle Egret	Migratory	-
<i>Rhipidura dryas</i>	Willie Wagtail	-	-
<i>Ardea picata</i>	Pied Heron	-	-
<i>Bos taurus</i>	Cattle (Cow)	-	-

Appendix 2.2 Threatened fauna species

The following table includes a list of the significant fauna species that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas, BirdLife Australia data search and the Protected Matters Search Tool (DEE; accessed on 15/03/2018).

Notes to table:

#	species predicted to occur by the DEE database (not recorded on other databases)
##	species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched
Year	recorded on databases listed above
2018	recorded during current survey

Likelihood of occurrence	Potential criteria
High	<ul style="list-style-type: none"> Species recorded in study area during current or previous assessment/s. Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). Study area is within species natural distributional range (if known). Species has been recorded within <5 or 10 km> or from the relevant catchment/basin.
Medium	<ul style="list-style-type: none"> Records of terrestrial species within <5 or 10 kilometres> of the study area or of aquatic species in the relevant basin/neighbouring basin. Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	<ul style="list-style-type: none"> No records within <5 or 10 km> of the study area or for aquatic species, the relevant basin/neighbouring basin. Marginal habitat present (low quality & extent). Substantial loss of habitat since any previous record(s).
Unlikely	<ul style="list-style-type: none"> Habitat not present in study area Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table A.4 Threatened fauna species recorded, or predicted to occur, within 10 kilometres of the study area

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
Mammals							
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle		V	2016	Low	There has been sightings of the species within 5 km of the study area. However, the site is heavily disturbed by clearing and does not provide suitable habitat.	Prefers wet sclerophyll and trees taller than 20 m. Roosts in hollow and under loose bark.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-Bat		V	2017	Moderate	There has been sightings of the species within 5 km of the study area. The species is known to generally roost in caves, however it has been found roosting in man-made structures (i.e. bridges, culverts), it prefers forested areas for foraging; may be found roosting in the culvert on the northern portion of the site.	Prefers forested areas for foraging, tends to roost in karst environments however it has been found roosting within man-made structures.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	2017	Unlikely	The species is known to roost in sandstone caves. Found in dry open sclerophyll forest.	Prefers sandstone caves for roosting.
<i>Kerivoula papuensis</i>	Golden-tipped Bat		V	2014	Low	The site does not provide suitable habitat for the species.	Occurs in a narrow region down the coast from Cap York to Eden, in moist, closed forest that receives high rainfall.
<i>Miniopterus australis</i>	Little Bentwing-Bat		V	2014	Moderate	The site provides marginal roosting habitat for the species.	The species occurs from Northern Queensland to the Hawkesbury River

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains.
<i>Mormopterus norfolkensis</i>	Eastern Freetail-Bat		V	2017	Low	The site provides marginal roosting habitat.	The species distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodlands. Individuals tend to forage in natural and artificial structures.
<i>Myotis macropus</i>	Southern Myotis		V	2017	Moderate	Generally found in open forests, woodlands, swamp woodlands, farmlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.	The species roosts within close vicinity to waterbodies (within 500 metres, particularly maternal roosts). It is known to roost within artificial structures (i.e. culverts).
<i>Scoteanax rueppelli</i>	Greater Broad-nose Bat		V	2017	Moderate	The species can utilise a variety of habitats from open woodland to moist eucalypt forests. The species has records of roosting within tree hollows and man-made structures. Greater Broad-nose Bat is known as an open forager and prefers open areas to intersect prey (i.e. insects and other microbat species), the site has patches of open space and potentially suitable roosting	The species utilizes a range of habitat.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	2017	Unlikely	habitat (stags with hollows). The species may forage within the study area when suitable feed trees are in flower; however, no camps occur within the study area and the species would be considered nomadic. There is low potential for the species to occur within the study area due to the low availability of feed trees.	Nomadic species.
<i>Petauroides volans</i>	Greater Glider	V		1996	Unlikely	This species is known to roost in medium to large sized hollows. They are known to be restricted to eucalypt forest and woodland; they forage on eucalypt leaves and the occasional flower. Foraging habitat for the species within the study area is relatively limited.	During daytime hours the species is known to shelter in large tree hollows. Greater Glider favours forests with diverse eucalypt species.
<i>Petaurus australis</i>	Squirrel Glider		V	1999	Unlikely	The species prefers tall mature eucalypt forests.	This species is known to occur in tall mature eucalypt forest generally in areas of high rainfall and nutrient rich soils.
<i>Perameles nasuta</i>	Long-nosed Bandicoot		E	2015	Unlikely	The species is widespread throughout NSW, particularly in coastal areas. There have been species sightings in urban backyards. Mostly found in in	This species is found in eastern Australia, from Queensland down to Victoria. Solitary animals for most of the

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						woodlands and heath; they are known to be insectivorous.	year and make nests from grasses and other plant material.
<i>Cercartetus nanus</i>	Eastern Pygmy-possum		V	2014	Unlikely	The study area does not support suitable habitat for the species. There is an absence of coastal heath scrub and feed tree species.	Preferentially found in abroad range of habitats from rainforest through to coastal heath shrub.
<i>Petaurus norfolcensis</i>	Squirrel Glider		V	1999	Unlikely	The study area does not support suitable habitat for the species. There is an absence of connect vegetation and abundant hollow-bearing trees.	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges and requires an abundance of hollow-bearing trees.
<i>Phascolarctos cinereus</i>	Koala	V	E	2017	Unlikely	The study area does not support suitable habitat for the species. There is an absence of feed trees.	Koalas feed exclusively on eucalyptus foliage, banksias and acacias.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	E	V	2009	Unlikely	The distribution of this species throughout New South Wales is patchy. They are generally found in heath or in open forest with a heath understorey on sandy soils. Their distinct habitat preference and patchy distribution indicates that the species is highly unlikely to occur on the site.	Occurs along the east coast of Australia and along the Great Dividing Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been in open country, grazing lands, rocky outcrops and other cleared areas.
Molluscs							
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail		E	2016	Unlikely	The study area does not provide suitable habitat for the species as	Occurs within Cumberland Plain Woodland Vegetation, in leaf litter and

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						there is an absence of Forest Red Gums.	bark below the base of Forest Red Gums.
Reptiles							
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	V	E	2015	Unlikely	The study area does not provide suitable habitat for the species.	Occurs in vegetation communities associated with Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath.
<i>Varanus rosenbergi</i>	Rosenberg's Goanna		V	2011	Unlikely	The study area does not provide suitable habitat for the species.	This species is a Hawkesbury/Nepean sandstone outcrop specialist. It occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests.
Amphibians							
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	1998	Unlikely	The species is defined to Sandstone geology, adjacent to perennial non-flooding creeks. The site does not provide suitable habitat.	This species known occurrence is in south eastern New South Wales and Victoria. The species spends 95 % of its time in non-breeding habitat; breeding occurs in Autumn in swamps, seepage lines and small pools of water.
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	2015	Unlikely	The species is known to inhabit marshes, streams and dam which contain Typha species and Eleocharis species. The riparian	Occurs on the New South Wales coast. Optimum habitat includes water-bodies that are unshaded, free of predatory

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
						area within the study area does not match these characteristics. There is also limited grassy areas.	fish (i.e. Gambusia holbrooki) and have a strong affinity with Kikuyu grass.
<i>Pseudophryne australis</i>	Red-crowned Toadlet		V	2014	Unlikely	The species is unlikely to occur on the site as it requires specific habitat features such as sandstone ridges and periodically wet drainage lines.	The species occurs in open forest, mostly on Hawkesbury Sandstone and inhabits periodically wet drainage lines.
Birds							
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E4A	2012	Unlikely	The site does not provide suitable foraging or roosting habitat.	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow		V	2017	Low	The site provides marginal habitat for the species.	Primarily inhabits dry, open eucalypt forests and woodlands.
<i>Burhinus grallarius</i>	Bush Stone-curlew		E	1990	Low	The study area lacks foraging and breeding habitat features for the species.	The species occurs in open forests and woodlands with sparse grassy ground layer and fallen timber.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		V	2016	Low	The species is somewhat likely to occur within the study area due to the presence of large hollows for roosting and breeding.	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo		V	2014	Low	The species is somewhat likely to occur within the study area due to the presence of large hollows for roosting and breeding.	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies.
<i>Chthonicola sagittata</i>	Speckled Warbler		V	2006	Low	The species is somewhat likely to occur within the study area.	The species is known to occur on the hills and tablelands of the Great Dividing Range. Found in eucalypt and cypress woodlands with a grassy understorey, often on ridges or gullies.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)		V	2006	Low	The study area is considered suitable for species.	Lives in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer.
<i>Circus assimilis</i>	Spotted Harrier		V	2000	Unlikely	The study area is considered suitable foraging habitat for the species.	The Spotted Harrier is found throughout Australia but rarely in densely forested and wooded habitat of the escarpment and coast. Preferred

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							habitat consists of open and wooded country with grassland nearby for hunting. Habitat types include open grasslands, acacia and mallee remnants, spinifex, open shrublands, saltbush, very open woodlands, crops and similar low vegetation. The Spotted Harrier is more common in drier inland areas, nomadic part migratory and dispersive, with movements linked to the abundance of prey species. Nesting occurs in open or remnant woodland and unlike other harriers, the Spotted Harrier nests in trees.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		V	2013	Unlikely	The study area does not provide suitable habitat for the species, however it may fly periodically over the site as the Nepean River is within close proximity.	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Hieraaetus morphnoides</i>	Little Eagle		V	2017	Transient	The study area is likely to provide suitable foraging habitat for the species and may occur infrequently.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
<i>Lathamus discolor</i>	Swift Parrot	CE	E1	2011	Low	The species is unlikely to occur on the site due to a low abundance of feed trees.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. 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> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . This species is migratory, breeding in Tasmania and also

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							nomadic, moving about in response to changing food availability.
<i>Lophoictinia isura</i>	Square-tailed Kite		V	2017	Moderate	The study area is likely to provide suitable foraging habitat for the species and may occur infrequently.	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.
<i>Neophema pulchella</i>	Turquoise Parrot		V	2012	Low	The species is unlikely to occur within the study area as habitat features are not favourable.	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs. Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies. Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Tyto novaehollandiae</i>	Masked Owl		V	2014	Low	The study area provides suitably sized tree hollows for roosting.	Generally found in open forests, woodlands, swamp woodlands, farmlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country.
<i>Ninox strenua</i>	Powerful Owl		V	2016	Low	The study area provides a suitably sized tree hollows for roosting, however the disturbed nature of surrounding vegetation and exposure preclude the occurrence of the species	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V	2015	Low	The study area consists of favourable habitat features.	The Varied Sittella inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
							understorey or grass ground cover or both.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork		E1	2005	Low	The study area does not provide suitable habitat for this species.	Occurs in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated land.
<i>Glossopsitta pusilla</i>	Little Lorikeet		V	2017	Low	The study area does not provide suitable habitat.	Occurs in forest and woodlands from the coast to the western slopes of the Great Dividing Range.
<i>Sternula albifrons</i>	Little Tern		E1	1999	Low	The study area provides unsuitable habitat for the species.	The Little Tern favours sheltered coasts, harbours, bays, lakes, inlets, estuaries, coastal lagoons and ocean beaches especially with sand-spits and sand islets. It forages over shallow waters close inshore or over sandbars and reefs.
<i>Falco subniger</i>	Black Falcon		V	2003	Transient	The study area is likely to provide suitable foraging habitat for the species and may occur infrequently.	Mainly occurs in woodlands and open country where we can hunt.
<i>Ixobrychus flavicollis</i>	Black Bittern		V	2010	Low	The study area does not provide suitable habitat for the species.	Occurs on coastal plains and inhabits terrestrial and estuarine wetlands.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)		V	2006	Low	The study area provides marginally suitable habitat for the species.	The species occurs in a wide range of dry eucalypt forests and woodlands.

Scientific name	Common name	Conservation status		Most recent record	Likely occurrence in study area	Rationale for likelihood ranking	Habitat description*
		EPBC	BC				
<i>Petroica boodang</i>	Scarlet Robin		V	2009	Low	The study area provides marginally suitable habitat for the species.	The species occurs in a wide range of dry eucalypt forests and woodlands.
<i>Petroica phoenicea</i>	Flame Robin		V	2007	Low	The study area provides marginally suitable habitat for the species.	The species occurs in a wide range of dry eucalypt forests and woodlands.
<i>Stagonopleura guttata</i>	Diamond Firetail		V	2009	Low	The study area provides marginally suitable habitat for the species.	The species occurs in open eucalypt forests, mallee and acacia scrubs. Often occur vegetation along watercourses.
<i>Stictonetta naevosa</i>	Freckled Duck		V	2006	Low	The study area does not provide suitable habitat.	The Freckled Duck occurs in permanent freshwater swamps that are heavily vegetated.

* - habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed, references within the above table are provided within the report reference list.

Appendix 2.3 Migratory species (EPBC Act listed)

Includes records from the following sources:

- NSW BioNet Wildlife Atlas (refer to Section 3.1)
- DEE database (accessed on 22/01/2018)
- BirdLife Australia data search
- Current survey

Bold denotes species recorded in the study area during the current assessment.

Table A.5 Migratory fauna species recorded or predicted to occur within 10 kilometres of the study area

Scientific name	Common name	Most recent record
<i>Sternula albifrons</i>	Little Tern	2009
<i>Calidris canutus</i>	Red Knot	1999

* - habitat descriptions have been adapted by qualified ecologists from the DSEWPac Species Profile for listed migratory species, references within the above table are provided within the report reference list.

Appendix 3 Assessment of Significance

Due to the transitional arrangements in place to ensure a smooth transition to the BC Act, local developments within the Wollondilly LGA still apply for biodiversity assessments under the previous legislation, the *Threatened Species Conservation Act 1995* (TSC Act). As such, the following Assessment of Significance has been undertaken as per the seven-part under the NSW TSC Act.

Microchiropteran

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

Eastern Bentwing-bat is listed as a vulnerable species under the TSC Act. This species occupies a range of forested environments (including wet and dry sclerophyll forests), along the coastal portion of eastern Australia, and through the Northern Territory and Kimberley area (subject to subdivision of this species) (OEH 2017a).

This species has a fast, level flight exhibiting swift shallow dives. It forages from just above the tree canopy, to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component. This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation. Though individuals often use numerous roosts, it congregates in large numbers at a small number of nursery caves to breed and hibernate. Although roosting primarily occurs in caves, it has also been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows. This species occupies a number of roosts within specific territorial ranges usually within 300 kilometres of the maternity cave, and may travel large distances between roost sites (OEH 2017a).

Eastern Bentwing-bat is threatened by a number of processes including loss of foraging habitat, damage to or disturbance of roosting caves (particularly during winter or breeding), application of pesticides in or adjacent to foraging areas, and predation by feral cats and foxes (OEH 2017a).

There are known records of the species within 10 kilometres of the study area (OEH 2018a). There is potential for the vegetation in the northern portion of the study area (within close proximity to the Nepean River) to be used occasionally by this species for foraging, although it is unlikely that individuals rely upon resources in the study area. The northern portion of the study area will not be significantly altered as a result of the development. Alterations to a mapped first order waterway will occur to accommodate for permanent drainage and a retention basin for the proposed residential sub-division occurring on the southern portion of the study area.

Greater Broad-nosed Bat *Scoteanax rueppellii*

Greater broad-nosed Bat is listed as vulnerable under the TSC Act. It prefers habitat in woodland and rainforest, preferring open habitats or openings in wetter forests. It often hunts along creeks or river corridors. It preys on beetles and other large, flying insects, other bats and spiders and roosts in hollow tree trunks and branches (OEH 2017b). 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.

There are known records of the species within 10 kilometres of the study area (OEH 2018a). There is potential for the northern portion of the study area (adjacent to the Nepean River) to be used occasionally by this species for foraging, although it is unlikely that individuals rely upon resources in the study area.

Little Bentwing-Bat *Miniopterus australis*

Little Bentwing-Bat is listed as vulnerable under the TSC Act. It prefers habitat in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, storm water drains, culverts and bridges (OEH 2018b). They are known to roost with Eastern Bentwing-Bats and form a mixed cluster.

Little Bentwing-bat is threatened by a number of processes including loss of foraging habitat, damage to or disturbance of roosting caves (particularly during winter or breeding), application of pesticides in or adjacent to foraging areas, and predation by feral cats and foxes (OEH 2018b).

There are known records of the species within 10 kilometres of the study area (OEH 2018a). There is potential for the northern portion of the study area (adjacent to the Nepean River) to be used occasionally by this species for foraging, although it is unlikely that individuals rely upon resources in the study area. The northern portion of the study area will not be significantly altered as a result of the development.

Southern Myotis *Myotis macropus*

Southern Myotis is listed as vulnerable under the TSC Act. It is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found 100 kilometres inland, except along major rivers (OEH 2017c). The species generally roosts within close vicinity to water, and is known to roost in caves, under bridges, in culverts and mine shafts.

Southern Myotis forages over streams and pools of water gaffing insect and fish prey with their feet or interfemoral membrane. In NSW females tend to have one young each year, usually in November or December (OEH 2017c).

Southern Myotis is threatened by a number of processes including loss or disturbance of roosting site, clearing adjacent to foraging area (i.e. decreased numbers of insects), application of pesticides in or adjacent to foraging areas and reduction in stream quality affecting food resources (OEH 2017c).

There are known records of the species within 10 kilometres of the study area (OEH 2018a). There is a potential for the study area to be used occasionally by the species for foraging, although it is unlikely that individuals rely upon resources in the study area.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.

Greater Broad-nosed Bat

Impacts likely to have an adverse effect on the life cycle of Greater Broad-nosed Bat include direct mortality, disturbance to roosting and summer breeding sites, clearing of foraging habitats, loss of hollow-bearing trees, use of pesticides and herbicides that reduce prey items or result in the accumulation of toxic residues in individuals' fat stores, and changes to water regimes that impact food resources.

Greater Broad-nosed Bat could use ephemeral drainage lines throughout the study area for foraging. It could also utilise the riparian corridor of the Nepean River to the north. A hollow-bearing Narrow-leaved Ironbark *Eucalyptus crebra* found in the centre of the study area could provide roosting habitat for the species and will be removed as a result of the proposal. This singular hollow-bearing tree is relatively exposed and does not provide optimal shelter for microbats, particularly when other resources are available in the nearby riparian corridor and forested areas to the north.

The small area of foraging habitat proposed for removal, and the loss of one hollow-bearing tree from the local area could impact a small proportion of habitat for individual Greater Broad-nosed Bats. However, the

scale of clearance from an area containing more suitable habitat is unlikely to affect the life cycle of a viable local population of the species such that it could be placed at risk of extinction.

Eastern Bentwing-bat

Impacts likely to have an adverse effect on the life cycle of Eastern Bentwing-bat include direct mortality, loss of high productivity foraging habitat, introduction of exotic pathogens, particularly white-nose fungus, and hazard reduction and wildfire fires during the breeding season.

Eastern Bentwing-Bat could use ephemeral drainage lines throughout the study area for foraging. It could also utilise the riparian corridor of the Nepean River to the north. The current proposal is unlikely to impact potential breeding sites for the Eastern Bentwing-bat. The removal of a small area of marginal foraging habitat will not affect the life cycle of a local viable population of the species such that it could be placed at risk of extinction.

Little Bentwing-Bat

Impacts likely to have an adverse effect on the life cycle of Little Bentwing-Bat include general public accessing caves and adjacent areas particularly during winter or breeding, loss of high productivity foraging habitat, and hazard reduction and wildfire fires during the breeding season.

Little Bentwing-Bat could infrequently use ephemeral drainage lines throughout the study area for foraging. It could also utilise the riparian corridor of the Nepean River to the north. The proposal is unlikely to impact potential breeding sites for the Little Bentwing-bat. Direct mortality of individuals will be avoided by implementing preclearance surveys, if maintenance or alterations to drainage culverts are required in the future. The removal of a small area of marginal foraging habitat will not affect the life cycle of a local viable population of the species such that it could be placed at risk of extinction.

Southern Myotis

Roosting habitat for this species will not be affected by the proposal. Potential foraging habitat for the Southern Myotis occurs as ephemeral drainage lines within the study area and the Nepean River adjacent to the study area provides greater foraging opportunity. Potential impacts to this habitat from the proposal include disturbance of roost sites by the general public (particularly during breeding and gestation), loss, degradation or alterations to foraging habitat (i.e. waterbodies), public infrastructure upgrades leading to roost disturbance or roost exodus. The removal of a small area of marginal foraging habitat will not affect the life cycle of a local viable population of the species such that it could be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed action will result in the alteration of ephemeral drainage lines to form permanent drainage retention infrastructure. One hollow-bearing Narrow-leaved Ironbark representing potential roosting habitat for these bat species may be removed.

Weed management and vegetation management will be implemented as part of the proposed works, to ensure that vegetation retained and vegetation within adjacent areas is not modified as a result of the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed works will remove potential foraging habitat, and some structures that may be deemed as opportunistic habitat (i.e. dilapidated buildings). As a result, the proposed development will lead to further isolation of habitat within the study area.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,

The small area of potential habitat to be removed from the study area would represent a small proportion of available habitat for these species in the local area. There are larger, intact forested areas less than 500 metres to the north of the study area. The habitat of the study area is connected to these areas by the vegetated riparian corridor of the Nepean River. Therefore, the habitat to be removed would not be considered of high importance to the survival of the species in the locality. In addition, the modified nature of the study area, and the availability of larger forested areas less than 500 m to the north, indicates that the removal of habitat within the study area is considered of low importance to the survival of the species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No critical habitat has been declared for Eastern Bentwing-bat, Southern Myotis, Little Bentwing-Bat or Greater Broad-nosed Bat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for Eastern Bentwing-bat, Southern Myotis, Little Bentwing-Bat or Greater Broad-nosed Bat. However, these species have been assigned to the Landscape species management stream under the Saving our Species program and recovery actions are provided in the respective Action toolbox for each species.

The proposed development is consistent with the objectives of these recovery actions.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key threatening processes of relevance to the Eastern Bentwing-bat, Southern Myotis, Little Bentwing-Bat and Greater Broad-nosed bat include clearing of native vegetation and loss of hollow-bearing trees.

The current proposal will result in the removal of potential foraging habitat and opportunistic roosting habitat (dilapidated buildings). The proposed development will not significantly contribute to key threatening processes for the species.

Conclusion

In light of the consideration of the above seven factors (a-g), the proposed activity is not likely to significantly impact Eastern Bentwing-Bat, Southern Myotis, Little Bentwing-Bat or Greater Broad-nosed bat within the study area or wider locality, as:

- The proposal will alter a small area of potential foraging habitat, to construct permanent drainage retention infrastructure.
- The habitat to be removed is not considered important to the survival of the species.
- Suitable extensive habitat is available less than 500 metres to the north of the study area.
- Preclearance protocols will be implemented to avoid mortality of individuals.
- The proposal does not significantly contribute to a KTP for these species.