MUSEUMS DISCOVERY CENTRE EXPANSION
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX N
BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

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SEPTEMBER 2020

POWERHOUSE MUSEUM DISCOVERY CENTRE EXPANSION PROJECT

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

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Powerhouse Museum Discovery Centre Expansion Project
Biodiversity Development Assessment Report

Create NSW

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RevC	21/9/2020	Final

	NAME	DATE	SIGNATURE
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Reviewed by:	Toby Lambert	22/9/2020	
Approved by:	Toby Lambert	22/9/2020	

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GLOSSARY

Definitions

Biodiversity Assessment Method	The Biodiversity Assessment Method (BAM) is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites and stewardship sites. It is a scientific document that provides: • a consistent method for the assessment of biodiversity on a proposed development or major project, or clearing site, • guidance on how a proponent can avoid and minimise potential biodiversity impacts, and • the number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.
Biodiversity credits	Ecosystem credits or species credits
Biodiversity credit report	The report produced by the Biodiversity Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development.
Biodiversity Credit Calculator (BCC)	The computer program that provides decision support to assessors and proponents by applying the Biodiversity Assessment Method, which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development site	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance and loss of habitat for a development. It is predictable, usually occurs at or near to the development site and can be readily identified during the planning, design, construction, and operational phases of a development.
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique location. Ecological communities can be listed as threatened under the EPBC Act and/or BC Act.

Definitions

Ecosystem credit	A measurement of the value of endangered ecological communities (EECs), critically endangered ecological communities (CEECs) and threatened species habitat for species that can be reliably predicted to occur with a plant community type (PCT). Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	Threatened species that can be reliably predicted to occur with a PCT, for which species-specific biodiversity credits are not required.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact. Compared to direct impacts, indirect impacts often: • occur over a wider area than just the site of the development • have a lower intensity of impact in the extent to which they occur compared to direct impacts • occur off site • have a lower predictability of when the impact occurs • have unclear boundaries of responsibility.
Local population	The population that occurs in the development site. In cases where multiple populations occur in the development site and/or a population occupies part of the development site, impacts on the entirety of each population must be assessed separately.
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1: 250,000.
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.

Definitions

Plant community type	A NSW plant community type identified using the plant community type (PCT) classification system. The PCT classification was created in 2011 by consolidating two existing community-level classifications: the NSW Vegetation Classification and Assessment database; and the BioMetric Vegetation Types database used in NSW regulatory programs. The PCT classification is now maintained in the BioNet Vegetation Classification application. It is a way to classify vegetation types.
Population	A group of organisms, all of the same species, occupying a particular area.
Project area / Project site	The area of land that is directly impacted on by a proposed Major Project that is under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act), including access roads, and areas used to store construction materials.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed according to section 6.4 of the BAM which may generate species-specific biodiversity credit requirements.
Study area	The development site and any other areas surveyed and assessed for biodiversity values which may be subject to indirect impacts.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
Threatened Biodiversity Data Collection	Part of the BioNet database, accessible from the BioNet website at www.bionet.nsw.gov.au.
Threatened species	A species listed under the NSW Biodiversity Conservation Act 2016 (BC Act), Fisheries Management Act 1994 (FM Act) or EPBC Act.
Threatened ecological community	A community of different species associated with one another and sharing the same habitat, that is listed under the NSW Biodiversity Conservation Act 2016 (BC Act), Fisheries Management Act 1994 (FM Act) and Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Threatened ecological communities are listed as endangered or critically endangered under the NSW Biodiversity Conservation Act 2016 (BC Act), or may be listed as vulnerable, endangered or critically endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

ABBREVIATIONS

Abbreviations

BAM	Biodiversity Assessment Method
BCC	Biodiversity Credit Calculator
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Federal)
IBRA	Interim Biogeographical Regionalisation of Australia
MNES	Matters of National Environmental Significance
PCT	plant community type
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
VIS	Vegetation information system (BioNet Vegetation Classification)

1 INTRODUCTION

This report supports a State Significant Development (SSD) Application for the proposed construction and use of a new building to facilitate the expansion of the Museums Discovery Centre (MDC) site at 2 Green Road, Castle Hill.

The primary objective of the SSD Application is to provide expanded facilities to accommodate the Powerhouse collection including spaces for storage, conservation, research and display and spaces to facilitate increased public access to the collection through education, public programs, workshops, talks, exhibitions and events. The expansion of the existing MDC facility within the site at 2 Green Road Castle Hill will integrate with the existing MDC site located at 172 Showground Road, Castle Hill and its operations on a permanent basis.

The proposal is a type of "Information and Education Facility" with a Capital Investment Value (CIV) in excess of $30 million and is classified as SSD under Schedule 1 Clause 13 of the State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP).

Create Infrastructure is the proponent of the SSD Application.

1.1 BACKGROUND

The MDC is owned and operated by the Museum of Applied Arts and Sciences (MAAS) and features exhibitions and displays in collaboration with Australian Museum and Sydney Living Museums, who also maintain collection storage and conservation facilities on the site. The MDC is located at 172 Showground Road, Castle Hill. There are six buildings primarily providing collection storage as well as areas for displays and education and public programs, accessible to visitors (Building E). During 2017-2018 a total of 17,481 persons visited the MDC site.

The MDC Expansion is part of the renewal of the Museum of Applied Arts and Sciences, known as the Powerhouse Program, that includes:

— Powerhouse Parramatta: A new benchmark in cultural placemaking for Greater Sydney that will be a symbol of a new approach to creative activity and engagement.

— Powerhouse Ultimo: The NSW Government recently announced that the Museum's Ultimo site will be retained, and the Museum will operate over four sites across the Greater Sydney area.

— Powerhouse Collection Relocation and Digitisation Project: The relocation of the Powerhouse collection and digitisation of around 338,000 objects, enhancing the collection's accessibility for local, national and international audiences.

The MDC expansion is an integral component of the Powerhouse Program and will provide the opportunity to increase visitation to the site, forming an important and significant cultural institution within The Hills Shire. In addition to the storage component of the proposal, the expansion will increase access to the Powerhouse collection through a range of spaces for visible storage, research and viewing of the collection, as well as flexible spaces for education and public programs, workshops, talks, exhibitions and events.

1.2 SITE DESCRIPTION

The proposed Building J site is located within the property known as 2 Green Road, Castle Hill which comprises a single lot legally described as Lot 102 DP 1130271 (see Figure 1.1). The site is generally square in shape with a splay corner to the intersection of Green Road and Showground Road and a total area of approximately 3.8ha. The site has a primary frontage of approximately 183m to Green Road and a secondary frontage of approximately 186m to Showground Road. Refer to Figure 1.2. The location of the proposed new MDC building (to be known as "Building J") is located on the

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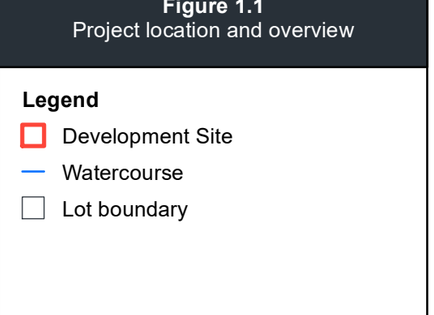
Powerhouse Castle Hill Project

Figure 1.1
Project location and overview

Legend

- Development Site
- Watercourse
- Lot boundary



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western end of the site and is marked on Figure 1.2 in a dashed yellow line (referred as the Building J Site). The overall site contains large institutional buildings set within a landscaped setting featuring a high tree canopy.

The overall site is a TAFE campus that caters for approximately 400 enrolled students, and provides courses on business and financial services, hospitality, general education, community services, health, nursing, carpentry, building and retail. The site currently includes TAFE buildings, car parking and vegetated open space areas. A dam is situated in the north eastern part of the site.

The MDC site is located immediately west of the existing TAFE site at 172 Showground Road, Castle Hill. A subdivision application (included within this SSD Application) will consolidate the site of the proposed Building J with the existing MDC site. The main public vehicle access to the MDC site is via Windsor Road. There is also a vehicular access point to the MDC on Showground Road. The MDC and TAFE have a longstanding arrangement, that permits vehicle access to the MDC site from Green Road, allowing vehicles to traverse across the TAFE site to access the MDC site.

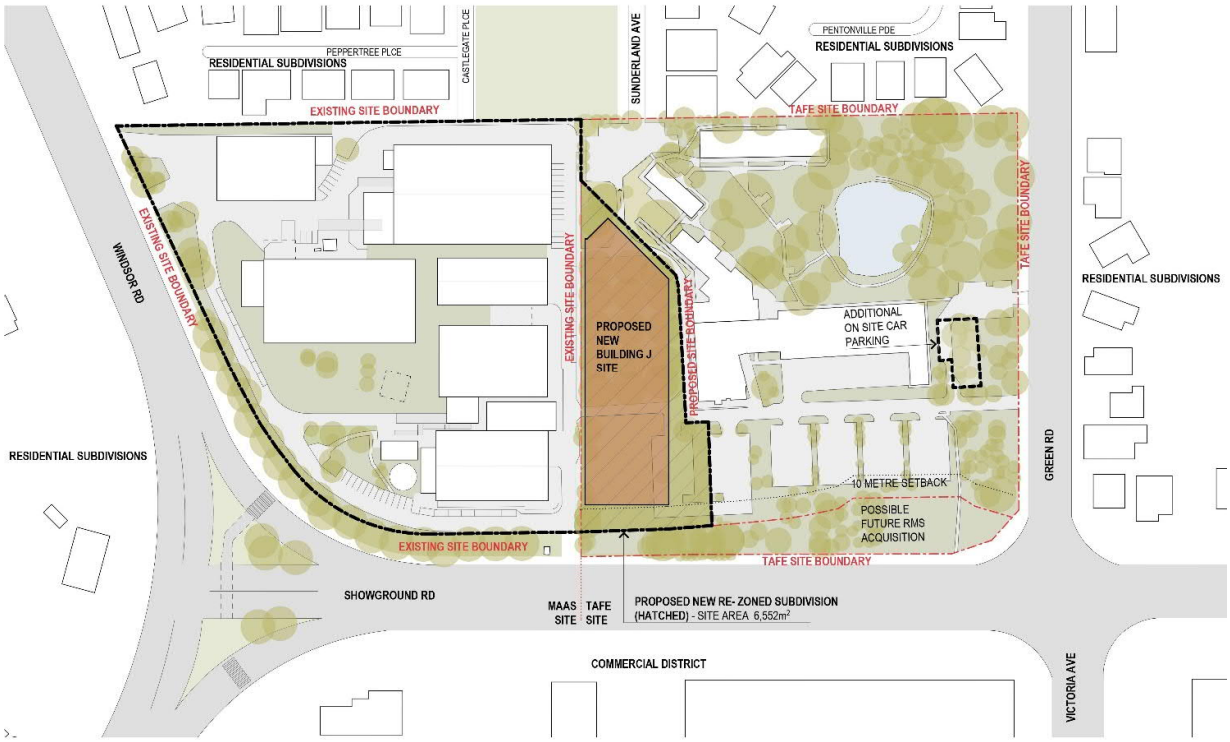

Figure 1.2 Existing site layout plan and proposed development site (Source: Lahznimmo Architects)

Development surrounding the site to the east, and north consists of established residential neighbourhoods generally comprising two storey detached dwellings. Opposite the site to the south east and south west are a mix of warehouses, industrial units, and large format bulky goods retail premises. Views into the TAFE and MDC site from the surrounding roads is obscured by dense trees and vegetation along the perimeter of the sites.

A public park and children's playground is adjacent to the north of the site that is bound by Sunderland Avenue to the east and Castlegate Place to the west. The dwellings along Sunderland Avenue and the southern side of Pentonville Parade are the nearest residential properties to the proposed Building J site.

1.3 OVERVIEW OF PROPOSED DEVELOPMENT

The successful delivery of this SSD project supports a priority cultural infrastructure project and is a NSW Government 2019 election commitment (Powerhouse Precinct at Parramatta). This application will deliver a significant cultural institution for Castle Hill and The Hills Shire.

The proposed Building J will offer many opportunities for public engagement as part of a desire to increase public access to the Powerhouse collection. The renewal of the site offers a range of opportunities to increase public access including visible storage facilities, booked tours, Open Days, public and education programs, workshops, talks and other events. The facilities in Building J will serve the needs of a variety of user groups including staff, volunteers, education groups, researchers, artists, scientists, industry partners and the general public.

The SSD Application seeks consent for the delivery of the MDC expansion as a single stage, comprising:

- Site preparation works, including the termination/relocation and installation of site services and infrastructure, tree removal (337 trees in total), earthworks, and the erection of site protection hoardings and fencing.
- Demolition of existing car park and vehicle accessway along the eastern and north eastern parts of the site. A new at-grade car park is proposed to be constructed on the eastern side of the TAFE site and will accommodate 24 car parking spaces removed from the Building J site.
- Construction of the proposed new Building J. The proposed new Building J will cater for the following uses:
  - Storage for the Powerhouse collection and archives (both collected archives and institutional archives).
  - Flexibles spaces for education and public programs, workshops, talks, exhibitions and events.
  - Suites of conservation laboratories and collection work spaces.
  - Photography, digitisation and collection documentation facilities.
  - Work space for staff, researchers, industry partners and other collaborators. This will include amenities, meeting and storage rooms, collection research and study areas as well as other ancillary facilities.
  - Components of the image and research library.
  - Object and exhibition preparation, packing, quarantine and holding areas.
- Construction of new vehicle accessways to maintain connectivity to the MDC and TAFE sites.
- Subdivision of the proposed Building J site from the TAFE site including creation of right-of-carriageway easement to facilitate access over the new realigned accessway by TAFE vehicles and consolidation to form a single lot with the existing MDC site.

1.4 PURPOSE AND SCOPE OF THIS REPORT

This Biodiversity Development Assessment Report (BDAR) is one of a number of technical documents that form part of the Environmental Impact Statement for the project. The purpose of the BDAR is to identify and assess the biodiversity impacts of the project. In doing so it responds to the Secretary's Environmental Assessment Requirements outlined below in Section 1.3.

1.5 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Secretary's Environmental Assessment Requirements (SEARs) were issued for the project on 4 July 2020. The requirements specific to biodiversity, and where these requirements are addressed in this BDAR, are outlined in Table 1.1.

Table 1.1 Biodiversity specific Secretary's Environmental Assessment Requirements for the project

SEAR	WHERE ADDRESSED
16. Biodiversity The EIS shall:	
Include a Biodiversity Development Assessment Report (BDAR), except where a waiver for preparation of a BDAR has been granted.	This report is the BDAR as required under Section 7.9 of the BC Act.
The BDAR must: — provide an assessment of biodiversity impacts related to the proposed development in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016*, the Biodiversity Assessment Method — include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method, including an assessment of the impacts of the proposal (including an assessment of impacts prescribed by the regulations).	This report is the BDAR as required under Section 7.9 of the BC Act. This report is the BDAR as detailed in the BC Act (s6.12) and contains the content as required by the Biodiversity Conservation Regulation 2017 (s6.8). The BDAR was prepared by an accredited person (Lukas Clews Accredited BAM Assessor No. BAAS17060) in accordance with the Biodiversity Assessment Method (Office of Environment and Heritage, 2017) and guidance provided in the Biodiversity Assessment Method Operation Manual Stage 1 (State of NSW and Office of Environment and Heritage, 2018) and Biodiversity Assessment Method Operation Manual Stage 2 (State of NSW and Department of Planning Industry and Environment, 2019) (see Section 2), including an assessment of the impacts of the proposal (including an assessment of impacts prescribed by the regulations). The BAM-C case associated with this BDAR is 00020561/BAAS17060/20/00020562.

1.6 KEY TERMS USED IN THIS REPORT

The following areas are discussed throughout the technical paper which aligns with terminology of the Biodiversity Assessment Method (BAM) are defined as:

— Development site: this area includes all areas to be directly impacted by the project (see Figure 1.1). The development site is also known as the 'subject land' in the BAM. For the purposes of this BDAR, the term development site is used.

— Locality: This is defined as the area within a 10-kilometre radius surrounding the development site.

— Bioregion: The study area is located in the Sydney Basin bioregion, specifically the Cumberland subregion (Thackway and Cresswell, 1995).

— 1,500 metre landscape buffer: The assessment area surrounding the development site (or subject land) includes the area of land in the 1,500 metre landscape buffer around the development site. The landscape buffer is an assessment

area used to identify landscape features surrounding the development site to provide site context and to inform the likely habitat suitability of the development site.

2 METHODOLOGY

This section documents the methodology applied in the preparation of the BDAR. The BDAR was prepared in accordance with the Biodiversity Assessment Method (Office of Environment and Heritage, 2017) and guidance provided in the Biodiversity Assessment Method Operation Manual Stage 1 (State of NSW and Office of Environment and Heritage, 2018) and Biodiversity Assessment Method Operation Manual Stage 2 (State of NSW and Department of Planning Industry and Environment, 2019).

2.1 AUTHORS

The work to prepare this BDAR was undertaken by appropriately qualified and experienced ecologists as outlined in Table 2.1.

Table 2.1 Personnel, role and qualifications

NAME	ROLE	QUALIFICATIONS
Lukas Clews	Principal Ecologist – Technical lead, Vegetation Integrity Surveys and targeted plant searches, reporting, data management	Master of Scientific Studies Graduate Certificate in Applied Science Bachelor of Science Diploma in Conservation and Land Management Certified Environmental Practitioner (CEnvP) by the Environment Institute of Australia and New Zealand (EIANZ) Accredited BAM Assessor (No. BAAS17060)
Toby Lambert	Principal Ecologist – Technical review and input	Bachelor of Environmental Science Accredited BAM Assessor (No. BAAS17046)

2.2 BACKGROUND RESEARCH AND DATA SOURCES

To build a preliminary overview of the ecological values of the development site, a background review of existing information was carried out to identify the existing environment within a nominal search area of 10 kilometres surrounding the development site. The review focussed on database searches, relevant ecological reports pertaining to the development site (where publicly available) and relevant GIS layers. The review was used to prepare a list of plant community types (PCTs), threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also carried out to identify if any Areas of Outstanding Biodiversity Value were present.

The following databases were searched or viewed:

— BioNet – the website for the Atlas of NSW Wildlife and Threatened Species Data Collection (searched May 2019)

— The federal Department of the Environment and Energy's Protected Matters Search Tool (PMST) (searched May 2019)

— BioNet NSW Vegetation Classification database (viewed May 2019)

Regional vegetation mapping, geology and soil mapping projects were reviewed including:

— Bushland Survey - Baulkham Hills Shire (State Government of NSW and Department of Planning, Industry and Environment, 2010)

- Southeast NSW Native Vegetation Classification and Mapping – SCIVI (State Government of NSW and Department of Planning, Industry and Environment, 2010)
- Remnant Vegetation of the western Cumberland subregion, 2013 Update (State Government of NSW and Department of Planning, Industry and Environment, 2015)
- Penrith 1:100 000 Geological Sheet 9030 (Clarke and Jones, 1991)
- Soil landscapes of the Penrith 1:100,000 Sheet 9030 (Hazelton et al., 1989)
- Australian Soil Classification (ASC) Soil Type map of NSW (State Government of NSW and Department of Planning, Industry and Environment, 2012).
- Soil and Land Resources of Central and Eastern NSW (Office of Environment and Heritage, 2018).
- Acid Sulphate Soil Risk Maps (Naylor *et al*, 1998).
- Western Sydney Hydrogeological Landscapes: May 2011 (First Edition) (State Government of NSW and Department of Planning, Industry and Environment, 2011).

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed from the NSW Threatened Species Scientific Committee web resources. At the time of writing, there are no preliminary or provisional listings of relevance to the project. The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act was reviewed.

The Arboricultural Impact Assessment and Tree Survey prepared by Mackay Tree Management (2020) was also reviewed to obtain tree inventory and health information that was used to supplement the work carried out for this report.

2.3 MAPPING EXTENT OF NATIVE VEGETATION COVER

The extent of native vegetation in the development site was ground-truthed and mapped using up to date aerial imagery. Polygons were digitised in a GIS (QGIS) at a scale of between 1:1,000 and 1:5,000. To assess per cent of current extent of native vegetation, a landscape buffer of 1,500 metres was placed around the boundary of the development site in accordance with the BAM.

2.3.1 DEFINITION OF NATIVE VEGETATION

Under the BAM, native vegetation has the same meaning as in section 1.6 of the BC Act which states that native vegetation and clearing native vegetation have the same meanings as in Part 5A of the *Local Land Services Act 2013*. Part 5A 60B of the *Local Land Services Act 2013* defines the meaning of native vegetation as any of the following types of plants native to New South Wales:

- trees (including any sapling or shrub or any scrub)
- understorey plants
- groundcover (being any type of herbaceous vegetation)
- plants occurring in a wetland.

A plant is native to New South Wales if it was established in New South Wales before European settlement.

2.4 PLANT COMMUNITY TYPE IDENTIFICATION

The type and distribution of PCTs within the development site were identified and mapped during the field survey. The vegetation within the development site was assigned to a PCT as described in the BioNet Vegetation Classification

database. Each PCT was assigned to the relevant corresponding Threatened Ecological Community (TEC) (where applicable). The development site lacks remnant vegetation and the trees are a result of planting. However, as the trees are native to NSW they have been surveyed and assessed in accordance with the BAM and must be assigned to a PCT.

There are no naturally occurring PCTs present in the development site, so the planted trees have been assigned to the nearest locally occurring PCT based on a combination of floristic composition, geological substrate and soils, landscape position, location, and relevant regional vegetation classification.

A plot-based floristic vegetation survey as described in section 5.2 of the BAM was carried out in areas where the vegetation was of sufficient size and shape to allow for plots to be completed. In other areas, rapid plotless vegetation assessments were carried out where natural vegetation did not occur to identify street trees and habitats. The field surveys were carried out over one day in June 2020.

2.4.1 PLOT BASED FLORISTIC VEGETATION SURVEY AND VEGETATION INTEGRITY ASSESSMENT

A plot-based full floristic survey and Vegetation Integrity Assessment was carried out according to the BAM using a 20 x 20 metre plot nested inside a 20 x 50 metre plot. The location of the survey plot completed during the survey is illustrated in Figure 2.1. The plot was located in the only area of vegetation that was large enough to contain the 50 metre transect and 20 x 20 metre floristic plot. The remaining patches of vegetation were too small and therefore a BAM Vegetation Integrity Assessment could not be undertaken in those small patches.

A summary of the survey effort completed in each vegetation zone is provided in Table 2.2. One combined plot-based full floristic survey and Vegetation Integrity Assessment plot was completed. There is approximately 0.50 hectares of native vegetation within the development site.

Table 2.2 Summary of vegetation survey effort

VEGETATION ZONE	NEAREST PLANT COMMUNITY TYPE ID NO.	NEAREST PLANT COMMUNITY TYPE NAME	BROAD CONDITION CLASS	VEGETATION ZONE AREA IN DEVELOPMENT SITE (HA)	MINIMUM NUMBER OF PLOTS REQUIRED	NUMBER OF PLOTS COMPLETED
1	849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor – Plantings	0.50 (5,019 m^2)	1	1

2.5 PATCH SIZE

A patch is defined in the BAM as an area of intact native vegetation that occurs on the development site. The patch may extend onto adjoining land beyond the footprint of the development site, and for woody ecosystems, includes native vegetation separated by less than or equal to 100 metres from the next area of intact native vegetation. Patch size for each vegetation zone located on the development site was mapped in accordance with subsection 5.3.2 of the BAM and conservatively allocated to the >100 hectares patch size class as the patch size of all vegetation zones within the development site is 128 hectares. The patch is made up of many small fragments situated within 100 metres of each other connected to the larger area of bushland along Cattai Creek and Fred Caterson Reserve.

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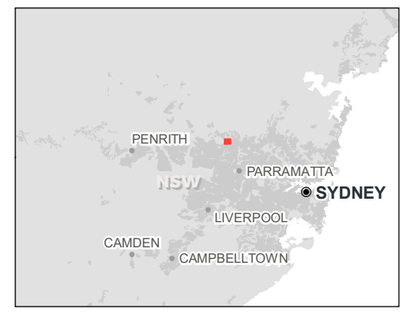
Powerhouse Castle Hill Project

Figure 2.1
Location of plot based floristic vegetation survey and vegetation integrity assessment

Legend

- Development Site
- Floristic / Vegetation Integrity Plot
- Lot boundary



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Data sources: - DFSI, Geoscience Australia

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2.6 THREATENED SPECIES HABITAT ASSESSMENT

The list of candidate threatened species for assessment (species credit species) was developed using the BAM-C based on the criteria outlined in section 6.4.1.3 of the BAM using the data gathered on landscape context, PCTs, and vegetation integrity scores. To supplement the results of the BAM-C, the BioNet search and the PMST search were also used to inform development of the candidate species list.

Some species were removed from the assessment due to the absence of suitable habitat in the development site in accordance with BAM Section 6.4. The development site has been cleared in the past and the current habitat is the result of planting. The development site is highly urbanised and lacks high quality natural habitats and habitat features. A candidate species predicted by the BAM-C may be excluded from needing further assessment if:

- Ecological information about a species provided in Threatened Biodiversity Data Collection (EES Group, 2020) or published, peer reviewed literature, suggests that the species is unlikely to occur, or habitat is unlikely to be suitable (BAM Section 6.1.1.2).
- Habitat constraints (defined in Threatened Biodiversity Data Collection (EES Group, 2020)) are not present within the Study area (BAM Section 6.4, step 2).
- Habitat is not suitable because it is substantially degraded (BAM Section 6.4, step 3).
- If the species is a vagrant in the IBRA subregion, the species is considered unlikely to occur and no further assessment is required (BAM Section 6.4.1.14).

Each threatened species identified was subject to a habitat suitability assessment which is provided in Appendix A. These assessments considered microhabitats, soils, geologies, landscape position, vegetation types and condition and historic disturbance within the development site. Species considered to have a low likelihood of occurrence and that did not require survey were excluded from the assessment at this habitat suitability assessment stage (see Appendix A).

The candidate list of threatened species for assessment returned by the BAM-C is provided in Section 5.

2.7 THREATENED SPECIES SURVEYS

After the on-site habitat assessment and vegetation integrity surveys had been completed, a candidate species list had been developed (see Section 2.6), targeted threatened species surveys were undertaken where the habitat was suitable. The surveys carried out for candidate threatened species of plants and animals are outlined in Section 2.7.1 and 2.7.2. The habitat assessment identified that there is limited habitat in the development site for most threatened species. Surveys were undertaken in June 2020.

2.7.1 THREATENED PLANT SURVEYS

After the PCTs and finer scale habitats within the development site had been identified, and the threatened species habitat assessment had been undertaken, threatened plant surveys were undertaken for species that had potential habitat (see Table 2.3).

Random meander surveys (a variation of the transect type survey) were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the study area recording key plant species (i.e. threatened species). The aim of the random meander surveys was to locate any threatened plants or potentially suitable habitat. If a threatened plant or potentially suitable habitat was located then parallel transects would be conducted to determine the size and extent of the population in accordance with the methodology and effort as outlined in the *Surveying Threatened Plants and Their Habitats: NSW Survey Guide for the Biodiversity Assessment Method* (State of New South Wales and Department of Planning, Industry and Environment, 2020). Due to the small size of the development site, the entirety of the area could be covered by this approach.

Table 2.3 Summary of survey effort for threatened plant species (V = Vulnerable species, E = Endangered species)

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	REQUIRED SURVEY PERIOD	SURVEY COMPLETED
Acacia pubescens	Downy Wattle	V	V	All year	Survey completed in June 2020.
Cynanchum elegans	White-flowered Wax Plant	E	E	All year	Survey completed in June 2020.
Dillwynia tenuifolia	Dillwynia tenuifolia	-	V	Limited to August, September and October	Survey completed in June 2020, outside of accepted survey period by an experienced botanist familiar with the morphology of the species. Unlikely to be confused with any other species even when out of flower.
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	-	V	All year	Survey completed in June 2020.

2.7.2 THREATENED ANIMALS

Targeted threatened species surveys were not undertaken for animals. The habitat assessment identified that there is limited habitat in the development site for most threatened species (see Appendix A). However, where suitable habitat for a threatened species was found to be present, the species was assumed to be present.

Fauna habitat assessments were undertaken in the development site, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, nest trees, vegetation patch size, connectivity, density of understorey vegetation, level of disturbance, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted. The habitat assessments included searches for resources of potential value to threatened fauna, including:

- Wetlands, ponds, drains, dams that could provide habitat for frogs and threatened migratory birds
- Trees with bird nests or other potential fauna roosts (with a focus on searching for raptor nests)
- Hollow-bearing trees (with a focus on searching hollows great than 20-centimetre diameter suitable for owls and large cockatoos)
- Specific food trees (e.g. Winter flowering trees that may be important for the Grey-headed Flying-fox and Swift Parrot)
- Rocky outcrops and ground debris
- Evidence of fauna species included searches for:
  - Distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites
  - Tracks or animal remains
  - Evidence of activity such as feeding scars, scratches and diggings
  - Evidence of foraging.

3 LANDSCAPE FEATURES

3.1 IBRA BIOREGIONS AND SUB-REGIONS

The development site is located in the Sydney Basin bioregion within the Cumberland subregion (Thackway and Cresswell, 1995).

3.2 BIONET NSW LANDSCAPES

The development site is located on the Cumberland Plain Mitchell Landscape as mapped by the NSW National Parks and Wildlife Service (NPWS) (2002).

3.3 RIVERS, STREAMS AND ESTUARIES

There are no rivers, streams or wetlands within or adjacent to the development site. The nearest waterway is Cattai Creek which is located more than 600 metres to the east of the development site.

3.4 WETLANDS

There are no wetlands in or adjacent to the development site.

3.5 CONNECTIVITY OF HABITAT

The habitat within the development site has a low degree of connectivity to other areas of habitat due to the impacts of urbanisation. The habitats that do remain immediately adjacent to the development site are generally small isolated fragments or individual street trees within the urban matrix of residential, commercial and industrial development. Continuous physical connectivity in an easterly direction to Fred Caterson Reserve and the Cattai Creek riparian corridor has been broken by urban development. There is some limited 'stepping stone' connectivity with Strangers Creek to the west through street trees and small remnants and planted vegetation on the Golf Course. The patchwork of planted trees and gardens surrounding the development site allows for some landscape permeability for mobile species such as bats and birds that can exploit the resources available in urban areas. However, overall habitat connectivity is low.

3.6 AREAS OF GEOLOGICAL SIGNIFICANCE AND SOIL HAZARD FEATURES

Areas of geological significance generally include karst, caves, crevices and cliffs. There are no areas of geological significance within or adjacent to the development site.

The development site is located on the Glenorie soil landscape (low hills on Wianamatta Group Shale (shale) in the Hornsby Plateau, Blue Mountains Plateau, Cumberland Plain and Somersby Plateau) (see Office of Environment and Heritage, 2018). Within this soil landscape, minor gully erosion is evident along unpaved roads, moderate sheet erosion occurs on cultivated lands or overgrazed paddocks (Office of Environment and Heritage, 2018). Acid sulphate soils are not identified on the development site in the Acid Sulphate Soils Risk Maps (see Naylor *et al*, 1998). The development site is located on the Glenhaven hydrogeological landscape (see State Government of NSW and Department of Planning, Industry and Environment, 2011). Land salinity within the Glenhaven hydrogeological landscape is low with occasional sites appearing in the more poorly drained areas of the lower slopes and drainage depressions. Salt export is low due to

limited salt expression, high run-off and sandstone dominated drainage lines (State Government of NSW and Department of Planning, Industry and Environment, 2011).

3.7 AREAS OF OUTSTANDING BIODIVERSITY VALUE

The proposed development site does not contain any areas of outstanding biodiversity value listed on the register of declared areas of outstanding biodiversity value.

3.8 NATIVE VEGETATION EXTENT

To assess per cent current extent of native vegetation, a buffer of 1,500 metres was placed around the boundary of the development site. Native over-storey vegetation was derived from aerial imagery. Vegetation within the 1,500 metre landscape buffer was digitised and obviously cleared areas were excluded from the mapping. Effort was made to only map areas of native vegetation however as this was a desktop exercise some areas of non-native vegetation and shadows from trees may be included. This will slightly over estimate the native vegetation cover extent.

The 1,500 metre landscape buffer is approximately 782 hectares in size. There is approximately 132 hectares of native vegetation (woody and non-woody vegetation) within the 1,500 metre landscape buffer. This results in a per cent native vegetation cover in the landscape of approximately 17 per cent. Native vegetation cover in the landscape buffer is low and in the >10 – 30 per cent cover class.

These calculations are an approximation only. The purpose of the percentage vegetation cover calculation is to create a figure of native vegetation cover that is used in the Biodiversity Assessment Method Calculator (BAM-C) to predict threatened species likely to occur or use habitat on a site. Minor adjustments to polygon boundaries would not affect the outcome.

Refer to Figures 3.1 and 3.2 for native vegetation extent in the landscape and development site.

wsp

Powerhouse Castle Hill Project

Figure 3.1
Location map

Legend

- Development Site
- 1500m Buffer
- Watercourse (SO)
- Native vegetation cover %
- Riparian Corridor
- Threatened species or communities (BV Map)
- IBRA Subregion Boundary
- Lot boundary

0 100 200 300 400 500 Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:12,500 Date: 7/2/2020

Data sources: - DFSI, Geoscience Australia

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wsp

Powerhouse Castle Hill Project

Figure 3.2
Site map

Legend

- Development Site
- Native vegetation cover %
- Lot boundary

0 10 20 30 40 50 Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:1,000 Date: 7/2/2020

Data sources: - DFSI, Geoscience Australia

4 NATIVE VEGETATION AND VEGETATION INTEGRITY

4.1 REGIONAL VEGETATION MAPPING

The development site is located on the Glenorie soil landscape (low hills on Wianamatta Group Shale) (see Office of Environment and Heritage, 2018), and the Glenhaven hydrogeological landscape (see State Government of NSW and Department of Planning, Industry and Environment, 2011). This landscape lies at the edge of the Cumberland Plain and the vegetation is typically characterised by variants of wet sclerophyll forest particularly the vegetation community Turpentine Ironbark Forest, with minor occurrences of Blue Gum High Forest and Sandstone Ridgetop Woodland on the sandstone boundary (State Government of NSW and Department of Planning, Industry and Environment, 2011). Variants of Cumberland Plain Woodland occur adjacent to these communities further into the Cumberland Plain.

The *Remnant Vegetation of the western Cumberland subregion, 2013 Update* (State Government of NSW and Department of Planning, Industry and Environment, 2015) maps the vegetation within the development site as Turpentine Ironbark Forest (PCT 1281 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion). The *Southeast NSW Native Vegetation Classification and Mapping – SCIVI* (State Government of NSW and Department of Planning, Industry and Environment, 2010) does not map the vegetation on the development site but there are patches of Sydney Turpentine Ironbark Forest mapped to the north of the development site. The *Bushland Survey - Baulkham Hills Shire* (see State Government of NSW and Department of Planning, Industry and Environment, 2010) maps the vegetation in the development site as the Cumberland Plain Woodland community.

Given the landscape within which the development site is situated, and the classification of nearby vegetation provided in regional vegetation mapping projects, it is not possible to predict with complete accuracy what the original vegetation within the development site would have been.

4.2 PLANT COMMUNITY TYPES

This BDAR describes PCTs in terms of their floristic composition, geological substrate and soils, landscape position, location, and relevant regional vegetation classification. The distribution of PCTs within the development site is outlined in Figure 4.1. Descriptions of the vegetation that occurs in the development site are provided below and the vegetation is matched to the most likely PCT as described in the BioNet Vegetation Classification database.

The naturally occurring vegetation has been cleared from the development site. The development site now contains trees that formed part of a plantation by the Museum as an exercise in researching essential oils. This research continued until 1979 when the exercise was taken over by the Department of Agriculture. The plantation is dominated by *Corymbia citriodora* which is not a species native to NSW. The plantation also contains some *Corymbia maculata* plants. However, the plantings are outside of their natural occurrence since *Corymbia maculata* is unlikely to have naturally occurred in this part of the Cumberland Plain.

In addition to the eucalypt plantations there are a number of other tree species that are either remnant or have been planted including *Eucalyptus tereticornis, Eucalyptus punctata, Eucalyptus resinifera, Eucalyptus sideroxylon, Eucalyptus bosistoana, Eucalyptus baueriana* (tentative identification as the plant was young and not reproductive, so positive identification could not be made), *Eucalyptus microcorys, Acacia decurrens, Grevillea robusta, Brachychiton acerifolius, Acmena smithii* and *Melia azedarach.*

Amongst the plantation trees there are a number of scattered native shrubs including *Melaleuca styphelioides, Melaleuca alternifolia* (a small stand that was planted for oil production), *Acacia falcata, Bursaria spinosa,* and *Syzygium australe* that have been planted, self-seeded, or have germinated from the soil stored seedbank.

wsp

Powerhouse Castle Hill Project

Figure 4.1
Map of plant community types and vegetation zones

Legend

- Development Site
- Vegetation Zones
- Lot boundary

0 10 20 30 40 50 Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:1,000 Date: 7/2/2020

Data sources: - DFSI, Geoscience Australia

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The groundcover is sparse and dominated by leaf litter due to the dense eucalypt canopy but there are some native species including *Lomandra longifolia, Lomandra multiflora, Paspalidium distans, Dianella longifolia, Dichondra repens* and *Glycine tabacina.*

While the vegetation within the development site is not naturally occurring and has been planted, there are a number of species native to NSW including natural regeneration and as such this vegetation must be assessed in accordance with the BAM.

Table 4.1 provides a summary of the PCTs found within and adjacent to the development site.

Table 4.1 Plant community types and vegetation zones identified in the development site

VEGETATION ZONE	NEAREST PLANT COMMUNITY TYPE ID NO.	NEAREST PLANT COMMUNITY TYPE NAME	BROAD CONDITION CLASS	VEGETATION ZONE AREA IN DEVELOPMENT SITE (HA)
1	849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor – Plantings	0.50 (5,019 m^2)

4.2.1 GREY BOX – FOREST RED GUM GRASSY WOODLAND ON FLATS OF THE CUMBERLAND PLAIN, SYDNEY BASIN BIOREGION – PCT 849

Vegetation formation: Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands **PCT ID: 849**

The Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion PCT (PCT 849) is described in the BioNet Vegetation Classification database as a grassy woodland located on the gentle topography associated with the shale plains of western Sydney. This PCT is generally dominated by *Eucalyptus moluccana, Eucalyptus tereticornis*, and *Eucalyptus crebra/Eucalyptus fibrosa*, with localised patches of *Corymbia maculata*. It is typified by a sparse to moderate cover of shrubs and a high cover of grasses and forbs.

The naturally occurring vegetation has been cleared from the development site and it now contains trees that formed part of a plantation by the Museum as an exercise in researching essential oils. The plantation is dominated by a dense stand of *Corymbia citriodora* which is not a species native to NSW. The plantation also contains some *Corymbia maculata* plants mixed in with the *Corymbia citriodora* along with regrowth of a number of other native species. Given the species that are present as regrowth and from examination of the landscape and adjacent bushland remnants, particularly the trees present the north east of the development site between Green Road and the TAFE pond (*Eucalyptus moluccana, Eucalyptus tereticornis, Eucalyptus crebra*), this vegetation within the development site has been matched to PCT 849. The vegetation within the development site is considered to be nearest to being representative of PCT 849 for the following reasons:

— The upper stratum contains species typical of PCT 849 including *Eucalyptus tereticornis* and *Corymbia maculata* with *Acacia decurrens*. Adjacent stands of vegetation outside of the development site contain *Eucalyptus moluccana* and *Eucalyptus crebra*.

— The very sparse mid stratum contains regrowth of species typical of PCT 849 including *Melaleuca styphelioides, Acacia falcata* and *Bursaria spinosa.*

— The very sparse ground cover contains species typical of PCT 849 including *Paspalidium distans, Lomandra multiflora, Dianella longifolia* and *Dichondra repens.*

— The vegetation occurs on shale on the Cumberland Plain and the native shrub and ground cover species that are present are likely regrowth from the remaining soil seedbank.

No other PCTs as described in the BioNet Vegetation Classification database provide a better fit for the description of this vegetation. A summary of the vegetation structure and floristics of PCT 849 within the development site is given below in Table 4.1. This list of species reflects the local variation gathered from the floristic plot undertaken within the development site.

This PCT is usually part of the Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a Critically Endangered Ecological Community under the BC Act.

Table 4.2 Floristic and structural summary of PCT 849 within the development site

VEGETATION LAYER	DOMINANT SPECIES FROM THE PLOT
Tree canopy (upper stratum)	Occasional *Corymbia maculata* (canopy dominated by exotic species)
Midstorey (mid-stratum)	Largely absent but with occasional *Acacia decurrens* and *Grevillea robusta*
Groundcovers (ground stratum)	Largely absent but with occasional *Paspalidium distans*, *Lomandra multiflora,* and *Glycine tabacina*
Exotic species	*Corymbia citriodora* (dominant canopy tree)
High Threat Weeds	*Ligustrum sinense*.

Photo 4.1 Native vegetation at the location of the survey plot within the development site (location of the proposed new building J) showing dominance of *Corymbia citriodora* and sparse midstorey and ground layer

Photo 4.2 Row of plantings at the eastern edge of the existing on-grade parking in the in the area of proposed new building J

Photo 4.3 Row of plantings between the existing on-grade parking in the development site and the MAAS access road in the area of proposed new building J

Photo 4.4 Plantings in the area of proposed new building J south of the access driveway and the MAAS access road

Photo 4.5 Plantings in the area of proposed new building J north of the existing access driveway

Photo 4.6 Plantings in the northern area of proposed new building J

Photo 4.7 Plantings in the area of the proposed new on-site car parking east of the TAFE building

4.3 VEGETATION ZONES AND VEGETATION INTEGRITY SCORE

A description of the vegetation zones identified within the development site and the corresponding vegetation integrity score developed from the BAM-C is presented in Table 4.6. The vegetation integrity survey plot data is provided in Appendix D.

There was one vegetation zone identified within the development site. The broad condition is plantings with some native species regrowth. The identified vegetation zone is in poor condition as reflected by the vegetation integrity score of 1.9 out of 100. This low score is due to the low composition score caused by low native species richness, a lack of vegetation structure due to the canopy of the vegetation being dominated by exotic species (*Corymbia citriodora*) and very sparse mid storey and ground layer, and absence of function attributes such as large trees (over the 50 cm large tree threshold), hollow-bearing trees and coarse woody debris.

The vegetation zone is technically representative of a critically endangered ecological community but has a vegetation integrity score of less than 15. As such, according to Section 10.3.1.2 of the BAM an offset for this vegetation is not required.

Table 4.3 Summary of vegetation zones and vegetation integrity score

VEGETATION ZONE	PLANT COMMUNITY TYPE ID NO.	PLANT COMMUNITY TYPE NAME	BROAD CONDITION CLASS	VEGETATION ZONE AREA IN DEVELOPMENT SITE (HA)	VEGETATION INTEGRITY SCORE
1	849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Poor – plantings	0.50	1.9

4.4 THREATENED ECOLOGICAL COMMUNITIES

There is one Threatened Ecological Community (TEC) listed under the BC Act that technically occurs in the development site: Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as critically endangered. This TEC corresponds to PCT 849 and the TEC is in poor condition (see the vegetation integrity score above in Section 4.3) and is represented by regrowth trees, shrubs and groundcovers amongst trees that were established for a eucalyptus oil plantation.

There are no condition thresholds placed on threatened ecological communities that are listed under the BC Act. As the regrowth is on the Cumberland Plain and the native species that are present are characteristic of this community and are likely regrowth from the soil seedbank, the Cumberland Plain Woodland in the Sydney Basin Bioregion community as listed under the BC Act is considered to be present, albeit in a modified form. Cumberland Plain Woodland in the Sydney Basin Bioregion is a Serious and Irreversible Impact (SAII) entity (discussed further in Section 8).

The vegetation does not however conform to the condition criteria specified for the EPBC Act listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC (see discussion in Section 6).

5 HABITAT SUITABILITY FOR THREATENED SPECIES

The BAM-C was used to derive the list of candidate species for this assessment, but the results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection, to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the broader locality and development site. This section provides the results of the habitat suitability assessment for threatened species as outlined in Section 6 of the BAM.

5.1 HABITAT SUITABILITY FOR SPECIES THAT CAN BE PREDICTED BY HABITAT SURROGATES (ECOSYSTEM CREDIT SPECIES)

Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection. Ecosystem credit threatened species have been assessed in conjunction with information about site context (section 4.3 and subsection 5.3.2 of the BAM), PCTs and vegetation integrity attributes (Chapter 5 of the BAM), and data from the Threatened Biodiversity Data Collection (section 6.1 of the BAM).

The BAM-C was used to generate a list of the predicted threatened species that met the criteria outlined in section 6.4.1.3 of the BAM. The initial list of predicted ecosystem credit species is provided in Table 5.1. Species were removed from the assessment if the geographic or habitat limitations for the species were not met. All other predicted ecosystem credit species were retained for the assessment as the habitat within the development site may provide some potential foraging habitat and the species may occur on rare occasion. The justification for including or excluding ecosystem credit species from the assessment is provided in Table 5.1.

Table 5.1 Summary of predicted ecosystem credit species that were assessed

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS
Birds					
Anthochaera phrygia	Regent Honeyeater (foraging)	CE	CE	Conservatively Included. This species infrequently visits the Sydney urban area but may on occasion forage in the subject land.	High
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	Conservatively Included. This species is commonly seen in the Sydney region and may forage in or over the subject land.	Moderate
Callocephalon fimbriatum	Gang-gang Cockatoo (foraging)	-	V	Conservatively Included. This species may on occasion forage in the subject land.	Moderate
Chthonicola sagittata	Speckled Warbler	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Daphoenositta chrysoptera	Varied Sittella	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Glossopsitta pusilla	Little Lorikeet	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Grantiella picta	Painted Honeyeater	V	V	Excluded as the habitat to be cleared is unlikely to be suitable for this species. The subject land does not contain mistletoes at a density of greater than five mistletoes per hectare (habitat constraint not met).	Moderate
Haliaeetus leucogaster	White-bellied Sea-Eagle (foraging)	M	V	Excluded as the habitat to be cleared is unlikely to be suitable for this species. The subject land does not contain any waterbodies and is not within 1 km of a river, lake, large dam or creek, wetland or coastline (habitat constraints not met). The small dam on the TAFE land is not suitable as foraging habitat for this species.	High
Hieraaetus morphnoides	Little Eagle (foraging)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Lathamus discolor	Swift Parrot (foraging)	CE	E	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Lophoictinia isura	Square-tailed Kite (foraging)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Neophema pulchella	Turquoise Parrot	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Ninox connivens	Barking Owl	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS
Ninox strenua	Powerful Owl	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Petroica boodang	Scarlet Robin	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Petroica phoenicea	Flame Robin	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Stagonopleura guttata	Diamond Firetail	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	Moderate
Tyto novaehollandiae	Masked Owl (foraging)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Mammals					
Dasyurus maculatus	Spotted-tail Quoll	E	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Miniopterus australis	Little Bent-winged Bat (foraging)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Miniopterus orianae oceanensis	Large Bent-winged Bat (foraging)	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Phascolarctos cinereus	Koala (foraging)	V	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Pteropus poliocephalus	Grey-headed Flying-fox (foraging)	V	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	Conservatively Included. Potential foraging habitat is present in the subject land.	High

Key: CE = critically endangered, E = endangered, V = vulnerable, M = migratory

5.2 HABITAT SUITABILITY FOR SPECIES THAT CANNOT BE PREDICTED BY HABITAT SURROGATES (SPECIES CREDIT SPECIES)

Species credit species are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits. Species credit species are those species for which the likelihood of occurrence, or elements of suitable habitat, cannot be confidently predicted by vegetation surrogates or landscape features. Species credit species have been assessed in conjunction with information collected about the site

context of the development site (section 4.3 of the BAM), on PCTs and vegetation integrity attributes in (section 5 of the BAM), and data obtained from the Threatened Biodiversity Data Collection (section 6.1 of the BAM).

Based on the results of the BAM-C, the species credit species as outlined in Table 5.2 are considered 'candidate species' for the assessment. The full threatened species habitat suitability assessment is provided in Appendix A. Species were removed from the assessment if the geographic or habitat limitations for the species were not met or of the habitat was substantially degraded to the point that a candidate species is unlikely to utilise the development site (Step 3 of the BAM). All other candidate species were retained for the assessment. The justification for including or excluding species credit species from the assessment is provided in Table 5.2.

There were a number of threatened species returned from the BAM-C that are species credit species if breeding habitat would be impacted. The development site does not contain breeding habitat for any of these identified species outlined in Table 5.2 so they were excluded from the assessment.

Table 5.2 Summary of candidate species credit species returned by the BAM-C

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Plants						
Acacia bynoeana	Bynoe's Wattle	V	E	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land also lacks the typical sandy soil or ironstone gravel habitat.	High	No
Acacia pubescens	Downy Wattle	V	V	Conservatively Included. This species has potential habitat within the subject land.	High	No
Caladenia tesselata	Thick Lip Spider Orchid	V	E	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	Moderate	Yes
Cynanchum elegans	White-flowered Wax Plant	E	E	Conservatively Included. This species has potential habitat within the subject land.	High	No
Dillwynia tenuifolia	Dillwynia tenuifolia	-	V	Conservatively Included. This species has potential habitat within the subject land.	High	No

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Dillwynia tenuifolia - endangered population	Dillwynia tenuifolia, Kemps Creek	-	EP	Excluded. The subject land is not bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool LGA (geographic limitation not met).	NA	No
Eucalyptus benthamii	Camden White Gum	V	V	Excluded. Species is vagrant. This species does not occur in the subject land and only occurs on the sandy alluvial soils in river valleys to the south-west of Sydney.	High	No
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	-	V	Conservatively Included. This species has potential habitat within the subject land.	High	No
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	-	EP	Excluded. The subject land is not in the Blacktown, Camden, Campbelltown, Canterbury-Bankstown, Cumberland, Fairfield, Liverpool or Penrith LGAs (geographic constraint not met).	High	No
Persoonia bargoensis	Bargo Geebung	V	E	Excluded. Species is vagrant. This species does not occur in the subject land and only occurs in the general Bargo area.	High	No
Pimelea curviflora var. *curviflora*	Pimelea curviflora var. curviflora	V	V	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	High	No

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Pimelea spicata	Spiked Rice-flower	V	E	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	High	No
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	High	No
Pultenaea pedunculata	Matted Bush-pea	-	V	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	NA	No
Thesium australe	Austral Toadflax	V	V	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. The subject land has been considerably disturbed and the ground layer almost completely removed.	Moderate	No
Birds						
Anthochaera phrygia	Regent Honeyeater (breeding)	CE	CE	Excluded as breeding habitat is not present in the subject land. No mapped important areas will be affected (habitat constraint not met).	High	Yes

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Burhinus grallarius	Bush Stone-curlew	-	E	Excluded. Fallen/standing dead timber including logs are absent from the subject land (habitat constraint not met). Habitat considered to be substantially degraded to the point that the species is unlikely to utilise the development site.	High	No
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)		V	Excluded. Hollow bearing trees absent and there were no Eucalypt tree species with hollows greater than 9 cm diameter (habitat constraint not met). Habitat considered to be substantially degraded to the point that the species is unlikely to utilise the development site.	High	No
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	M	V	Excluded. White-bellied Sea-Eagle breeding habitat is specified as live large old trees within one kilometre of rivers, lakes, large dams or creeks, wetlands and coastlines and the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period. There are no live large old trees within the development site that contain large stick nests. The habitats within the development site contain relatively small planted *Eucalyptus* spp. trees that are not suitable as nesting sites for the White-bellied Sea-Eagle (habitat constraint not met). Consequently, the White-bellied Sea-Eagle was removed from the candidate species list	High	No
Hieraaetus morphnoides	Little Eagle (breeding)	-	V	Excluded. Nest trees - live (occasionally dead) large old trees within vegetation) are not present within the subject land (habitat constraint not met).	Moderate	No

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Lathamus discolor	Swift Parrot (breeding)	CE	E	Excluded. The Swift Parrot breeds in Tasmania. As such, it was removed from the candidate species list	Moderate	Yes
Lophoictinia isura	Square-tailed Kite (breeding)	-	V	Excluded. Nest trees are not present within the subject land (habitat constraint not met).	Moderate	No
Ninox connivens	Barking Owl	-	V	Excluded. There are no hollow bearing trees, or living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground within the subject land (habitat constraint not met).	High	No
Ninox strenua	Powerful Owl	-	V	Excluded. There are no hollow bearing trees or living or dead trees with hollows greater than 20 cm diameter within the subject land (habitat constraint not met).	High	No
Tyto novaehollandiae	Masked Owl (foraging)	-	V	Excluded. There are no hollow bearing trees, or living or dead trees with hollows greater than 20 cm diameter within the subject land (habitat constraint not met).	High	No
Mammals						
Cercartetus nanus	Eastern Pygmy-possum	-	V	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. There are no suitable tree hollows or other nesting features present and the lack of dense shrub layer without nectar or pollen source suggests this species is unlikely to occur.	High	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Excluded. There are no cliffs in or near the subject land. The subject land is not within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels (habitat constraints not met).	Very High	Yes

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Miniopterus australis	Little Bent-winged Bat (breeding)	-	V	Excluded. Breeding habitat for the Little Bent-winged Bat is highly specific and is restricted to cave systems. There are no caves in or near the subject land. There are no tunnels, mines, culverts or other structures known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave', no records with observation type code 'E nest-roost', no observations with numbers of individuals >500, and no evidence from the scientific literature indicating a roost is present in or adjacent to the subject land (habitat constraints not met).	Very High	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	-	V	Excluded. Breeding habitat for the Large Bent-winged Bat is highly specific and is restricted to cave systems. There are no caves in or near the subject land. There are no tunnels, mines, culverts or other structures known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave', no records with observation type code 'E nest-roost', no observations with numbers of individuals >500 present in or adjacent to the subject land (habitat constraints not met).	Very High	Yes
Myotis macropus	Southern Myotis	-	V	Conservatively Included. The subject land does not contain hollow bearing trees and is not within 200 m of a riparian zone. The subject land does not contain any bridges, caves or artificial structures within 200 m of a riparian zone. However, there is a small dam within 200m of the site so the habitat constraints are met.	High	No

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	JUSTIFICATION FOR INCLUSION / EXCLUSION	SENSITIVITY TO GAIN CLASS	SAII ENTITY
Petaurus norfolcensis	Squirrel Glider	-	V	Excluded. Habitat considered to be substantially degraded to the point that the species is unlikely to be present on the development site. There are no suitable tree hollows present and the lack of dense shrub layer without dense Acacia stands and nectar or pollen source suggests this species is unlikely to occur.	High	No
Phascolarctos cinereus	Koala (breeding)	V	V	Excluded. There are no Koala breeding colonies in or near the development site. The subject land does not occur in an area identified as important habitat (habitat constraint not met).	High	No
Pteropus poliocephalus	Grey-headed Flying-fox (breeding)	V	V	Excluded. There are no Grey-headed Flying-fox breeding camps in the development site (habitat constraint not met).	High	No
Frogs						
Litorea aurea	Green and Golden Bell Frog	V	E	Excluded. The subject land is within 1 km of a small dam on the TAFE site but the habitat is considered to be substantially degraded to the point that the species is unlikely to be present on the development site.	High	No
Invertebrates						
Meridolum corneovirens	Cumberland Plain Land Snail	-	E	Conservatively Included. The subject land has dense leaf litter which may be suitable as habitat for this species. The habitat is degraded but potential habitat for this species is present.	High	No
Pommerhelix duralensis	Dural Land Snail	E	E	Conservatively Included. The subject land has leaf litter and shed bark (habitat constraints met). The habitat is degraded but potential habitat for this species is present.	High	No

Key: CE = critically endangered, E = endangered, V = vulnerable, M = migratory

5.3 THREATENED SPECIES SURVEY RESULTS

5.3.1 THREATENED PLANT SPECIES

No threatened plant species were found in the development site during the surveys. The surveys targeted the shrubs *Acacia pubescens, Dillwynia tenuifolia* and *Grevillea juniperina* subsp. *juniperina* and the climber *Cynanchum elegans*. These species are detectable year-round. While the BAM-C indicates that *Dillwynia tenuifolia* can only be surveyed for during August, September and October (main flowering period) the species has distinct foliage and is detectable by experienced observers outside of the flowering period, especially in sparse understory such as present on the development site. There were no species of *Dillwynia* detected within the subject land during the survey, so this species is considered unlikely to be present.

5.3.2 THREATENED ANIMAL SPECIES

Targeted surveys for threatened animals were not undertaken during the surveys undertaken for this BDAR. The assessment of these species was habitat based. Threatened animal species were assumed to be present if suitable habitat was present within the subject land in accordance with paragraph 6.4.1.21 of the BAM.

The Southern Myotis is considered likely to occur based on the presence of suitable habitat in the form of PCT 849 as there is a small dam on the TAFE site within 200m of the subject land, so the habitat constraints are met. The Southern Myotis may use the dam for foraging and therefore may use the vegetation in the subject land. The species polygon for the Southern Myotis is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1).

The Cumberland Plain Land Snail and Dural Land Snail are also assumed to be present in PCT 849. The dense leaf litter within this habitat may be suitable for either or both species. The subject land lies at the edge of the distribution of these two species and may be in an area of overlap. Taking a precautionary approach, both species are assumed to be present. The species polygons for the Cumberland Plain Land Snail and Dural Land Snail are estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1).

5.3.3 SERIOUS AND IRREVERSIBLE IMPACT ENTITIES

There are no threated species SAII entities that would be affected.

6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Matters of National Environmental Significance (MNES) applicable to this assessment include wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed), nationally threatened species and ecological communities, and listed migratory species included in one or more international agreements in which Australia is a party to including the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) or the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

For threatened biodiversity and migratory species listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013 (see Appendix E).

6.1 WETLANDS OF INTERNATIONAL AND NATIONAL IMPORTANCE

The development site does not contain any wetlands of international or national importance.

6.2 NATIONALLY LISTED THREATENED ECOLOGICAL COMMUNITIES

According to the Protected Matters Search Tool (PMST) nine EPBC Act listed TECs are known to occur, likely to occur, or may occur in the development site (see Appendix F). The PCT within the development site does not correspond to any EPBC Act listed TECs.

The patch of PCT 849 is too degraded to be part of the EPBC Act listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC according to the key diagnostic characteristics and condition criteria outlined by the Threatened Species Scientific Committee (2009) in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.* The canopy of the vegetation on the subject land is not dominated by the typical species *Eucalyptus moluccana, Eucalyptus tereticornis,* and *Eucalyptus fibrosa* and native tree species do not possess a foliage cover of 10% or more (*Corymbia maculata* scored 5% cover in the vegetation integrity plot).

The patch of PCT 849 would be large enough to meet condition criteria as there is approximately 0.5 ha of this PCT within the development site and there is more directly adjacent on the TAFE site which would form part of the same patch. However, the native ground cover is largely absent.

The PCT returned a vegetation integrity score of 1.9 (see Section 4.3) which indicates that the vegetation is significantly degraded.

This vegetation is considered unlikely to retain sufficient conservation values to be considered as a MNES and does not meet the technical requirements to be classified as Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.

6.3 THREATENED PLANTS

Based on the results of the PMST search, 28 EPBC Act listed threatened plant species have the potential to occur within the search area (see Appendix F). Of these 28 threatened plant species, *Acacia pubescens* and *Cynanchum elegans* were considered to have potential habitat within the development site and were subject to surveys.

These species were not found within or adjacent to the development site during the surveys undertaken for this BDAR. As such, these species are considered unlikely to be impacted.

6.4 THREATENED ANIMALS

Based on the results of the PMST search, 28 EPBC Act listed threatened animal species have the potential to occur within the search area. This included 13 birds, four frogs, one insect, eight mammals, one snail and one reptile (see Appendix F). These results are largely based on modelled habitat and most of these species do not occur in the development site due to a lack of suitable habitat. Targeted surveys for threatened animals were not undertaken during the surveys for this BDAR due to the mostly non-natural created habitats present. The assessment of these species was habitat based.

The development site is dominated by a dense canopy of exotic *Corymbia citriodora* and this tree species is likely to provide potential winter foraging habitat for the EPBC Act listed species Grey-headed Flying-fox and Swift Parrot. The foraging habitat for the Grey-headed Flying-fox and Swift Parrot that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1). Breeding habitat for these two species is not present and no Grey-headed Flying-fox camp occurs.

The habitat within the development site may also provide foraging habitat for EPBC Act listed species including the Regent Honeyeater, Spotted-tail Quoll and Koala. However, the likelihood of these three species occurring is much lower as they are not commonly recorded in the urban areas of Sydney and the habitat within the development site is less than optimal. Still, the potential occurrence of these species on occasion cannot be discounted. The foraging habitat for these species that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1). Breeding habitat for these species is not present.

The Dural Land Snail was assumed to potentially be present in PCT 849. The dense leaf litter within this habitat may be suitable for this species, although the created habitat through tree planting of mostly exotic trees is not typical habitat for the species. The subject land lies at the edge of the distribution of the Dural Land Snail but taking a precautionary approach, the species is assumed to be present. The habitat for the Dural Land Snail that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1).

The predicted impacts to habitat for these EPBC Act listed species would be of low magnitude, so impacts to these species will be negligible and not significant (see Appendix E).

6.5 MIGRATORY SPECIES

The results of the PMST indicate that 19 listed migratory species may occur in the locality (see Appendix F). These 19 species include migratory marine birds (one species), migratory terrestrial species (seven species), and migratory wetlands species (nine species).

Of these listed migratory species, the following species are considered moderately likely to occur in, or fly over, the development site based on the presence of suitable habitats:

— Migratory marine birds – Fork-tailed Swift (Bonn, CAMBA, ROKAMBA)

— Migratory terrestrial species – White-throated Needletail (Bonn, CAMBA, ROKAMBA).

The Fork-tailed Swift and White-throated Needletail spend the non-breeding season in Australia and are primarily aerial. As such, they may fly over the development site as part of normal movement patterns. The habitat assessment for listed migratory species is provided in Appendix A. Migratory wetlands species are not considered relevant to this assessment as no wetland habitats will be impacted directly or indirectly.

While some migratory species of bird are likely to use the development site and locality, the development site would not be classed as an 'important habitat'. A nationally significant proportion of a population would not be supported by the habitats in the development site. The project would not substantially modify, destroy or isolate an area of important habitat for the migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds (see Appendix E).

7 IMPACT AVOIDANCE AND MINIMISATION

Combined with the safeguards that are to be implemented during construction, the siting and planning of the project is likely to be sufficient to ensure that the requirements to avoid and minimise impacts on biodiversity values as set out in section 8 of the BAM are met.

7.1 ANALYSIS OF ALTERNATIVES

7.1.1 STRATEGIC NEED FOR THE PROPOSAL

This proposal is consistent with the applicable strategic planning policies as detailed in the EIS and is a critical component of the NSW Government's plan to establish a new Powerhouse Museum at Parramatta. The successful delivery of this SSD project supports a priority cultural infrastructure project and is a NSW Government 2019 election commitment (Powerhouse Precinct at Parramatta). This application will deliver a significant cultural institution for Castle Hill and The Hills Shire. The Final Business Case Summary for "Powerhouse Museum in Western Sydney" provides the following matters of relevance:

"The Greater Sydney Region Plan Metropolis of three Cities identifies the relocated Museum as one of the key projects that will drive the transformation of Greater Parramatta. The Greater Sydney Commission's Central City District Plan states that "a new museum on the banks of Parramatta River will be the anchor for arts and culture for the District. It has potential to deliver world-class opportunities for education and research, alongside exhibition space, and space for social and digital interaction and exchange".

"Also included within the Project's scope is the expansion of the current Museum's Discovery Centre at Castle Hill to provide a purpose-built facility for the care and storage of MAAS's collections. This investment will reduce the need for collection treatment and storage in Parramatta, and thereby maximise gallery and visitor space."

The MDC expansion is an integral component of the Powerhouse Program and will provide an important and significant cultural institution within The Hills Shire and the Central "River City" District. In addition to the storage component of the proposal, the expansion will increase public access to the Powerhouse collection and opportunities for increased visitation to the site through a range of spaces for visible storage, research and viewing of the collection, as well as flexible spaces for education and public programs, workshops, talks, exhibitions and events.

7.1.2 ALTERNATIVE OPTIONS

Three options have been considered in response to the strategic need and objectives of the MDC Expansion Project. The options summarised have been developed to accommodate the operational requirements of MAAS and the applicable Final Business Case Summary prepared by Infrastructure NSW for the "Powerhouse Museum in Western Sydney". These options are described briefly below (refer to the Architectural Design Report within the EIS for an analysis of the design options B and C considered):

- Option A (within existing MDC site): This option involved the redevelopment of the existing G Store building to accommodate a new J Store building within the existing MDC site. A number of compromises were apparent with this option in relation to the architectural and urban design outcomes. Furthermore, this option would create a significantly larger building than the existing G Store building and yet would not result in the requisite floor area of the MDC Expansion Project.
- Option B (expansion beyond existing MDC site): Construction of the new Building J in the southern part of the site TAFE site along the Showground Road boundary in an east-west orientation. The building would have a footprint of approximately 110m by 35m. Removal of a majority of car parking spaces from the existing TAFE site car parking

would be required with limited scope to provide the car parking spaces at-grade elsewhere within the TAFE site. Vehicle access to the MDC site from Showground Road would be retained. Refer to Figure 7.1 below.

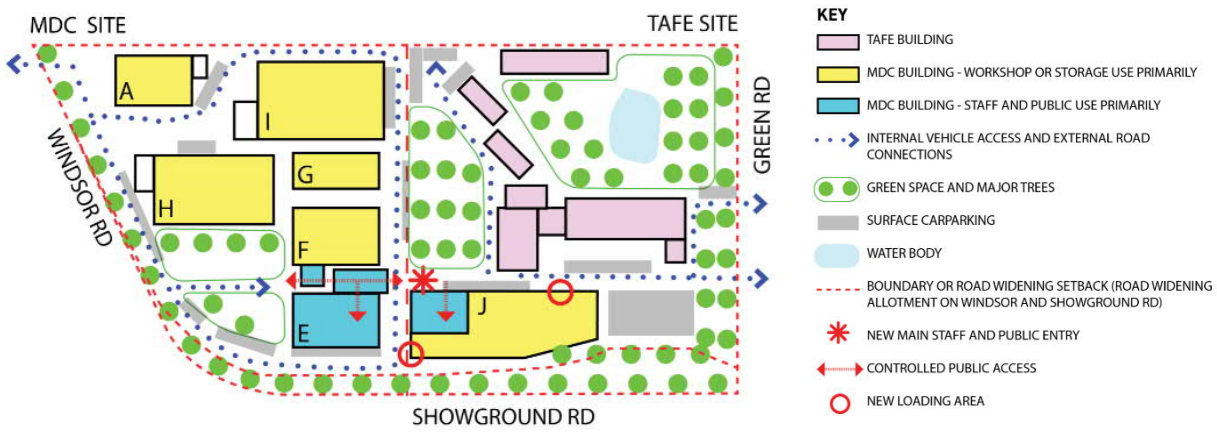

Figure 7.1 Option B site layout (preferred option) (Source: Lahznimmo Architects)

— Option C (preferred option): Construction of the new Building J in the western part of the TAFE site, running north to south along the eastern boundary of the MDC site. Option C includes removal of the existing plantation eucalyptus trees within the site and relocation of 24 car parking spaces to the eastern side of the TAFE site near the Green Road access point. The primary vehicle access to the MDC site from Showground Road will be retained. Refer to Figure 7.2 below.

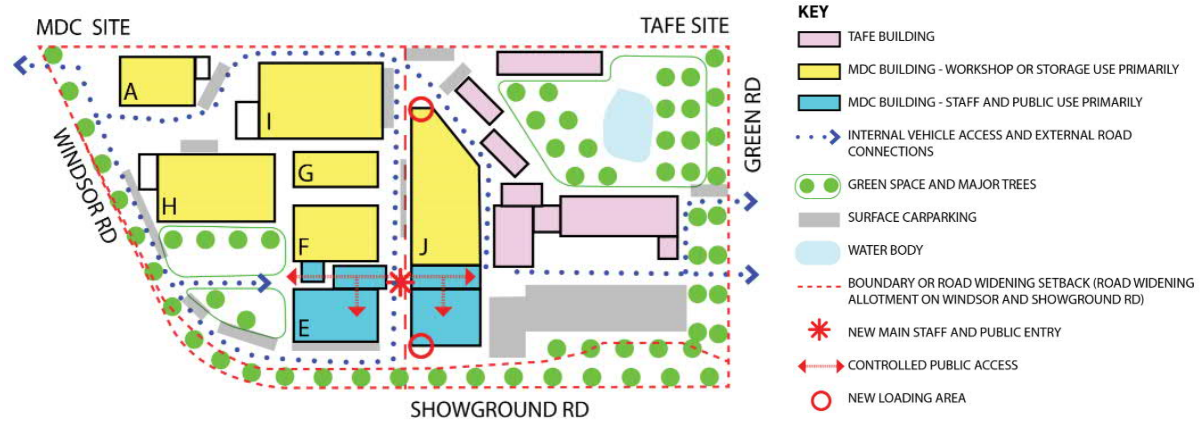

Figure 7.2 Option C site layout (preferred option) (Source: Lahznimmo Architects)

7.1.3 'DO NOTHING' SCENARIO

Under the 'Do Nothing' scenario, the proposed new Building J would not be built. The current MDC site facilities would not be able to accommodate the increased demand for storage requirements, conservation and research facilities and would jeopardise the NSW Government's plans to establish a new Powerhouse at Parramatta. The 'Do Nothing' scenario would negatively impact the ability of the existing facilities and buildings at the MDC site to facilitate public access to these collections through education, public programs, workshops, talks, exhibitions and events.

The 'Do Nothing' scenario would also fail to realise the strategic need for the proposal and would be inconsistent with the NSW Government strategic policies and the objectives of the final Business Case Summary for the "Powerhouse Museum in Western Sydney" to provide a "purpose-built facility for the care and storage of MAAS's collections. This investment will reduce the need for collection treatment and storage in Parramatta, and thereby maximise gallery and visitor space".

7.1.4 PREFERRED DESIGN OPTION (THE PROJECT)

Option C is the preferred development option to deliver the MDC Expansion Project. The proposal has been selected as it meets the operational requirements of MAAS, it aligns with the NSW Government strategic policy and achieves the following key design and planning outcomes:

- Logical functional arrangement and layout providing staff and public areas to the south and storage areas to the north of the building.
- Overall building height minimised and compliant with the proposed 15m building height.
- A compact MDC site that provides a distinct physical separation between the MDC and TAFE sites and allows for better master planning opportunities for the MDC and TAFE sites in the future.
- VLO storage provided on the lower ground level for ease of access.
- Reduced building facade facing Showground Road.
- No net loss of car parking from the TAFE site. Majority of existing TAFE site car parking is retained with 24 car parking spaces relocated to a new car parking area within the TAFE site.
- Compliance with the minimum 10m setback from the dedicated road widening reserve along Showground Road.

The proposal will also include the delivery of a Tree Replacement Strategy which will replace the 337 plantation eucalyptus trees removed from the site at a ratio of 2:1 within The Hills Shire Local Government Area resulting in a net positive impact to landscape canopy cover for the region.

The design for the new Building J has been the subject of a collaborative and iterative design process involving Lahznimmo Architects working closely with staff at MAAS and Create Infrastructure to develop the final scheme as described in Section 5 of this EIS. The design for the project was presented to the Government Architect NSW State Design Review Panel (SDRP) in July 2020. The SDRP endorsed the proposal and the feedback received from the SDRP has been incorporated into the final design.

7.2 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT

The development site is located within a highly urbanised environment that has been cleared in the past. The vegetation within the development site is the result of planting trees for essential oil research, with some naturally occurring regrowth. The vegetation integrity of the vegetation within the development site is poor (see Section 4.3). Habitat quality for threatened species is correspondingly low and the development site lacks important habitat features. Importantly, the development site does not contain a large area of intact native vegetation with high biodiversity value. Siting the project at this location has avoided impacting intact and higher quality vegetation remnants and threatened species habitats in the locality.

No declared areas of outstanding biodiversity value listed in accordance with section 3.1 of the BC Act would be affected by the project.

The final project footprint is shown in Figure 7.3.

wsp

Powerhouse Castle Hill Project

Figure 7.3
Final project footprint

Legend

- Development Site
- Lot boundary

0 10 20 30 40 50 Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:1,000 Date: 7/2/2020

Data sources: - DFSI, Geoscience Australia

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7.3 AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS

Clause 6.1 of the Biodiversity Conservation Regulation 2017 identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme. Importantly, the project would have negligible impact on most prescribed biodiversity values as:

- There would be no impacts to karst, caves, crevices, cliffs and other geological features of significance
- There would be no impacts to rocks that provide habitat for threatened species
- There would be no impacts to human made structures
- There would be no impacts on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- The project is not a wind farm development so the impacts of turbine strike on protected animals is not an issue
- While there would be some additional construction vehicle movements on existing roads, these are largely along busy roads and vehicle strike is unlikely to be a substantially increased.

The location of the project within a highly urbanised environment on land that has been cleared in the past with poor vegetation integrity and habitat quality for threatened species has avoided most prescribed biodiversity impacts. However, there would be unavoidable impacts to non-native vegetation, some impact to minor urbanised habitat connectivity and species movement. These prescribed impacts are discussed in Section 8.2.

8 ASSESSMENT OF IMPACTS

8.1 IMPACTS ON NATIVE VEGETATION AND HABITAT

The project would result in the direct removal of some native vegetation. The estimated clearing is approximately 0.5 hectares consisting of a heavily modified and poor condition Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion plant community type (PCT 849). As described in Section 4 the vegetation within the development site now contains trees that formed part of a plantation by the Museum as an exercise in researching essential oils. The plantation is dominated by *Corymbia citriodora* which is not a species native to NSW, but the plantings also contain some species native to NSW and regrowth of small trees, shrubs, grasses, other groundcovers and climbers is present.

The Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion plant community type (PCT 849) is part of the Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a critically endangered ecological community under the BC Act. This TEC is a significant and irreversible impact entity and the impacts to this TEC are described further in Section 8.2.

Table 8.1 provides a summary of the native vegetation clearing, that would occur within the development site including the corresponding TEC where applicable and the vegetation integrity loss. The vegetation integrity loss is 1.9 which is very low. Table 8.2 provides a summary of the expected threatened species habitat loss including the sensitivity to gain class for each species and whether or not the species is considered to be a significant and irreversible impact entity.

Indirect impacts to vegetation retained directly adjacent to the areas of direct impact are expected to be negligible. The vegetation adjacent to the development site are thin bands of roadside vegetation or other small remnants that are already subject to edge effects and the typical types of disturbance common to urban bushland remnants. There are no core habitats adjacent to the development site that are not currently heavily impacted by edge effects and disturbance. No further loss of vegetation integrity is expected in these areas because of the project so indirect and offsite impacts have not been calculated.

Table 8.1 Summary of native vegetation clearing within the development site

PCT ID NO.	PLANT COMMUNITY TYPE NAME	VEGETATION FORMATION	PCT PER CENT CLEARED (HISTORICALLY ACROSS RANGE)	CORRESPONDING THREATENED ECOLOGICAL COMMUNITY (TEC)	AREA (HA) IN DEVELOPMENT SITE	VEGETATION INTEGRITY LOSS
849	Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Valley Grassy Woodlands	93%	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.5	1.9

Table 8.2 Summary of direct impacts on threatened species credit species habitat associated with the loss of native vegetation in the development site

SPECIES NAME	COMMON NAME	EPBC ACT	BC ACT	SENSITIVITY TO GAIN CLASS	SAII	AREA (HA) IN DEVELOPMENT SITE
Mammals						
Myotis macropus	Southern Myotis	-	V	High	No	0.5
Meridolum corneovirens	Cumberland Plain Land Snail	-	E	High	No	0.5
Pommerhelix duralensis	Dural Land Snail	E	E	High	No	0.5

8.2 SAII ENTITIES - ADDITIONAL IMPACT ASSESSMENT PROVISIONS FOR ECOLOGICAL COMMUNITIES

The Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion plant community type (PCT 849) is part of the Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a critically endangered ecological community under the BC Act. This TEC is a significant and irreversible impact entity and as such the additional impact assessment provisions for ecological communities as outlined in Section 10.2.2 of the BAM are addressed here in Table 8.3.

Table 8.3 Additional impact assessment provision for ecological communities

FURTHER INFORMATION ABOUT POTENTIAL ECOLOGICAL COMMUNITIES (BAM SECTION 10.2.2.1)	
The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	The development site is located within a highly urbanised environment that has been cleared in the past. The vegetation within the development site is the result of planting with some naturally occurring regrowth. The vegetation integrity of the vegetation within the development site is poor (see Section 4.3). Habitat quality for threatened species is correspondingly low and the development site lacks important habitat features. Importantly, the development site does not contain a large area of intact native vegetation with high biodiversity value. Siting the project at this location has avoided impacting intact and higher quality vegetation remnants and threatened species habitats.
The area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone	Approximately 0.5 ha of the TEC would be impacted. The vegetation integrity score for the TEC is very low at 1.9 (see Section 4.3).

FURTHER INFORMATION ABOUT POTENTIAL ECOLOGICAL COMMUNITIES (BAM SECTION 10.2.2.1)	
A description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	A threshold for the SAII entity is under development. Given the small size of the impact at 0.5 ha and the poor condition of the TEC (vegetation integrity score of 1.9) the impact would be unlikely to exceed the threshold once it is developed.
The extent and overall condition of the potential TEC within an area of 1,000ha, and then 10,000ha, surrounding the proposed development site	Based on examination of regional vegetation mapping, the extent of the TEC is estimated as: — Approximately 16 ha within a 1,000 ha area surrounding the development site — Approximately 123 ha within 10,000 ha area surrounding the development site.
An estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration	Approximately 10,612 ha of this TEC in good condition (relatively intact native tree canopy) occurs within the Sydney Basin bioregion with a further 13,918 ha of poorer condition scattered canopy trees (see Department of Environment, Climate Change and Water (NSW), 2010). The impact from the project would reduce the extent of poorer condition patches of the TEC by 0.5 ha. Good condition patches will not be impacted.
An estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	Approximately 967 ha of this TEC occurs within the reserve system (see Department of Environment, Climate Change and Water (NSW), 2010).
The development, clearing or biodiversity certification proposal's impact on: (i) abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns (ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants (iii) the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC	Abiotic factors critical to the long-term survival of the potential TEC will not be significantly impacted. There will be no appreciable impact to surface water patterns within the surrounding retained vegetation and no groundwater impacts are predicted. The vegetation to be impacted is already missing most of the functionally important species. The vegetation integrity score is 1.9 (see Section 4.3). The quality and integrity of the TEC is already very poor (vegetation integrity score is 1.9 - see Section 4.3). The capacity of the project to further threats or indirect impacts is low given the context of the surrounding vegetation.

FURTHER INFORMATION ABOUT POTENTIAL ECOLOGICAL COMMUNITIES (BAM SECTION 10.2.2.1)	
Direct or indirect fragmentation and isolation of an important area of the potential TEC	Importantly, the action will not result in the breaking apart of large blocks of high-quality TEC. There would be no habitat fragmentation per se. The project would remove some small fragments thereby increasing isolation of other remaining poor condition patches to a small degree.
The measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.	The *Cumberland Plain Recovery Plan* (Department of Environment, Climate Change and Water (NSW), 2010). seeks to focus recovery efforts on those lands which represent the best opportunities to secure viable, long-term conservation outcomes in the region. These lands are referred to as the priority conservation lands. The development site is not within any identified priority conservation lands, so the project will not interfere with the recovery of this TEC.

8.3 PRESCRIBED BIODIVERSITY IMPACTS

This section identifies the potential prescribed biodiversity impacts on threatened species associated with the project in accordance with section 6.7 of the BAM and clause 6.1 of the Biodiversity Conservation Regulation 2017. These are impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat.

As identified in Section 7.3, the project would have negligible impact on most prescribed biodiversity values as:

- There would be no impacts to Karst, caves, crevices, cliffs and other geological features of significance
- There would be no impacts to Rocks that provide habitat for threatened species
- There would be no impacts to human made structures
- There would be no impacts on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- The project is not a wind farm development so the impacts of turbine strike on protected animals is not an issue
- While there would be some additional construction vehicle movements on existing roads, these are largely along busy roads and vehicle strike is unlikely to be a substantially increased.

However, there would be unavoidable impacts to prescribed biodiversity impacts including non-native vegetation, some impact to minor urban habitat connectivity and species movement. These prescribed impacts are discussed below.

8.3.1 IMPACTS ON THE HABITAT OF THREATENED SPECIES OR ECOLOGICAL COMMUNITIES ASSOCIATED WITH NON-NATIVE VEGETATION

Twenty-seven threatened species may utilise the non-native vegetation, including native and exotic planted trees, that are found within the development sites. These ecosystem credit species are outlined in Table 5.1. The habitat for these species is PCT 849 and thus PCT within the development site is characterised by a canopy of non-native species. As such, the impacts have already been identified and assessed in Section 8.1. The impacts are limited to potential foraging habitat and are estimated at approximately 0.5 ha and the project is unlikely to detrimentally affect the bioregional persistence of any threatened species given the small extent of habitat removal and poor quality of the habitat to be removed.

8.3.2 IMPACTS ON THE CONNECTIVITY OF DIFFERENT AREAS OF HABITAT OF THREATENED SPECIES THAT FACILITATES THE MOVEMENT OF THOSE SPECIES ACROSS THEIR RANGE

Habitat connectivity is identified as the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range. Threatened species movement is identified as the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle.

As identified in Section 3.5, the habitat within the development site has a low degree of connectivity to other areas of habitat due to the impacts of urbanisation. The habitats that do remain immediately adjacent to the development site are generally small isolated fragments or individual street trees within the urban matrix of residential, commercial and industrial development. Continuous physical connectivity in an easterly direction to Fred Caterson Reserve and the Cattai Creek riparian corridor has been broken by urban development. There is some limited functional 'stepping stone' connectivity with Strangers Creek to the west through street trees and small remnants and planted vegetation on the Golf Course. The patchwork of planted trees and gardens surrounding the development site allows for some landscape permeability for mobile species such as bats and birds that can exploit the resources available in urban areas. However, overall habitat connectivity is low.

The vegetation within the development site is likely to be used as a foraging or perching resource as part of daily movements by flying species. For example, a portion of the Grey-headed Flying-fox population is likely to fly over the development site as the animal's head from breeding camps to foraging grounds and this species may forage in the development site when the trees are in flower. Another example is the Swift Parrot that may pass through the development site during seasonal movements when other more favourable foraging grounds are not productive. Threatened microbats and other threatened bird species as identified in Section 5.3 are likely to visit the development site on occasion to forage. Threatened mammals, such as the Spotted-tail Quoll and Koala, are wide ranging and may visit the development site on rare occasion. The landscape of the locality in its current form is permeable to these species and the bioregional persistence of these species would not be detrimentally affected by the project.

Species including the Cumberland Plain Land Snail and the Dural Land Snail have much smaller home ranges than the threatened bird and mammal species. The natural habitats of these two species are severely fragmented due to past land clearance and if these species are present in the development site, the habitat is unlikely to contribute to the movement of those species across their range as the habitats in the development site is bordered by concrete and asphalt roads and pavement.

8.3.3 IMPACTS ON MOVEMENT OF THREATENED SPECIES THAT MAINTAINS THEIR LIFE CYCLE

Except for the Cumberland Plain Land Snail and the Dural Land Snail (if these species are present), the life cycle of threatened species known from the locality is unlikely to be dependent on the habitats to be impacted. No breeding habitats will be impacted as the development site lacks suitable breeding habitat features for most threatened species. The habitats to be affected are marginal foraging habitats.

No barriers to movement will be created by the project. The development site is not part of a recognised or important movement corridor that connects foraging grounds or breeding grounds. The development site does not provide a staging point for migration or other seasonal movement. The Cumberland Plain Land Snail and the Dural Land Snail (if these species are present), are not likely to move in or out of the development site due to existing barriers. The movement of threatened species between foraging and breeding grounds would not be affected, and the bioregional persistence of these species would not be detrimentally affected by the project.

8.4 CONTRIBUTION TO KEY THREATENING PROCESSES

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or an ecological community. There are 39 listed KTPs under the BC Act. There are 21 KTPs listed under the EPBC Act. Of these listed KTPs, the project may directly or indirectly contribute to the following as outlined in Table 8.4.

Table 8.4 Summary of Key Threatening Processes that the project may directly or indirectly contribute to

KEY THREATENING PROCESS	BC ACT OR EPBC ACT	LIKELIHOOD OF PROJECT DIRECTLY OR INDIRECTLY CONTRIBUTING TO THE KTP
Clearing of native vegetation	BC Act	High – clearing of native vegetation would occur. However, the magnitude of clearing is small (0.5 hectares).
Land clearance	EPBC Act	High – clearing of native vegetation would occur. However, the magnitude of clearing is small (0.5 hectares).
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of amphibian chytrid fungus.
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	EPBC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of amphibian chytrid fungus.
Infection of native plants by *Phytophthora cinnamomi*	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of *Phytophthora cinnamomi*.
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	EPBC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of *Phytophthora cinnamomi*.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	BC Act	Low – mitigation measures would be implemented to prevent the spread or introduction of rust fungi.
Invasion and establishment of exotic vines and scrambler	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don)	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by *Chrysanthemoides monilifera*	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion of native plant communities by exotic perennial grasses	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. Lat)	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.

9 MITIGATION

The biodiversity impacts expected to result from the project are minimal at approximately 0.5 ha of vegetation and habitat removal (see Section 8). Once steps have been made to avoid and minimise impacts mitigation measures would be implemented to reduce the potential ecological impacts of the proposal to the greatest extent practicable. There are a range of standard mitigation techniques to be applied, including managing the vegetation clearing process and protecting vegetation outside of the clearing area, re-establishment of native vegetation at the end of the project, weed and pathogen management, and installation of erosion and sediment controls. The mitigation measures to be implemented during the construction would be outlined in a Flora and Fauna Management Plan. Broadly, the mitigation measures for the project will include:

- Procedures for the clear marking out of areas of vegetation to be cleared and the identification of no-go zones to protect vegetation outside and adjacent to the construction footprint.
- Establishment of tree protection zones around trees to be retained in accordance with the guidance provided in Australian Standard AS4970-2009 Protection of Trees on Development Sites.
- Procedures for undertaking a pre-clearing search for threatened snail species Cumberland Plain Land Snail and the Dural Land Snail, and other threatened species. Procedures for relocating threatened snails if found during the pre-clearing inspection.
- Procedures for dealing with unexpected threatened species finds during construction
- Weed management measures in accordance with the *Biosecurity Act 2015*.
- Pathogen management measures to prevent introduction and spread of diseases including amphibian chytrid fungus, *Phytophthora cinnamomi* and Exotic Rust Fungi.
- Environmental inspection and monitoring requirements.
- Implementation of a proposed Tree Replacement Strategy in partnership with The Hills Shire Council.

10 THRESHOLDS FOR ASSESSMENT AND OFFSETS

10.1 IMPACTS ON A POTENTIAL ENTITY THAT ARE SERIOUS AND IRREVERSIBLE IMPACTS

The Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion plant community type (PCT 849) is technically part of the Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a critically endangered ecological community under the BC Act. This TEC is a significant and irreversible impact entity and as such the additional impact assessment provisions for ecological communities as outlined in Section 10.2.2 of the BAM were addressed in Section 8.2.

A threshold for the Cumberland Plain Woodland in the Sydney Basin Bioregion SAII entity is under development. Given the small size of the impact at 0.5 ha and the poor condition of the TEC (vegetation integrity score of 1.9) the impact would be unlikely to exceed the threshold once it is developed.

10.2 IMPACTS FOR WHICH THE ASSESSOR IS REQUIRED TO DETERMINE AN OFFSET REQUIREMENT

10.2.1 IMPACTS ON NATIVE VEGETATION (ECOSYSTEM CREDITS)

According to Section 10.3.1 of the BAM, the assessor is required to determine an offset for all impacts of development on PCTs that are associated with:

a a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or

b a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or

c a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

The vegetation integrity score for the vegetation zone present in the development site is 1.9. Consequently, the proposed clearing does not trigger any of the thresholds for offsets outlined in Section 10.3.1 of the BAM.

The areas not requiring an offset are shown in Figure 10.1.

10.2.2 IMPACTS ON THREATENED SPECIES (SPECIES CREDITS)

According to Section 10.3.2.1 of the BAM, the assessor is required to determine an offset for the impacts of development on the habitat of threatened species assessed for ecosystem credits and associated with a PCT in a vegetation zone with a vegetation integrity score ≥17. An offset is not required for impacts on threatened species habitat where the vegetation integrity score is below 17.

The vegetation integrity score for the vegetation zone present in the development site is 1.9. Consequently, the proposed clearing does not trigger the threshold for offsets outlined in Section 10.3.2 of the BAM. The areas not requiring an offset are shown in Figure 10.1.

wsp

Powerhouse Castle Hill Project

Figure 10.1
Areas not requiring an offset

Legend

- Development Site
- Area not requiring offsetting
- Lot boundary

0 10 20 30 40 50 Meters

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:1,000 Date: 2020-07-22

Data sources: - DFSI, Geoscience Australia

C:\Users\AUVL502876\WSP O365\AU-WKG - Geospatial - AIS - PS120245_Powerhouse_Castle\Mxd\02_BiodiversityDevelopmentAssessmentReport\PS120245_F007_NoOffsetReqd_r1v2.mxd

11 BIODIVERSITY CREDIT REQUIREMENTS

A summary of the biodiversity credit requirements for Stage 1 are provided below in Table 11.1 and Table 11.2. As described in Section 10 of this BDAR, the proposed clearing does not trigger any of the thresholds for offsets. The vegetation integrity score for the vegetation zone present in the development site is 1.9.

The proposed clearing does not trigger the threshold for offsets for threatened species as outlined in Section 10.3.2 of the BAM as follows:

- BAM Paragraph 10.3.2.1: The assessor is required to determine an offset for the impacts of development, clearing or impacts from the conferral of biodiversity certification on the habitat of threatened species assessed for ecosystem credits and associated with a PCT in a vegetation zone with a vegetation integrity score ≥17.
- BAM Paragraph 10.3.2.2 An offset is not required for impacts on threatened species habitat where the vegetation integrity score is below that set out in Paragraph10.3.2.1.

In line with Section 10.3.2 of the BAM, in June 2020 the Biodiversity Credit Calculator indicated that no credits were required for *Myotis macropus* (Southern Myotis), *Meridolum corneovirens* (Cumberland Plain Land Snail), and *Pommerhelix duralensis* (Dural Land Snail). Despite the vegetation integrity score being <17, the Biodiversity Credit Calculator as of 21 September 2020 indicates that one credit each is required for *Myotis macropus* (Southern Myotis), *Meridolum corneovirens* (Cumberland Plain Land Snail), and *Pommerhelix duralensis* (Dural Land Snail). The credit reports for June 2020 and September 2020 are provided in Appendix G.

The final credit requirement for the project will need to be clarified as according to Section 10.3.2 of the BAM, an offset is not required for impacts on threatened species habitat where the vegetation integrity score is below 17.

Table 11.1 Ecosystem credit summary

PLANT COMMUNITY TYPE	TEC	AREA OF IMPACT	NUMBER OF CREDITS TO BE RETIRED
Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.5 ha	0

Table 11.2 Species credit summary

SPECIES	AREA OF IMPACT	NUMBER OF CREDITS TO BE RETIRED (SEPTEMBER 2020 CALCULATION)
Page 51Myotis macropus (Southern Myotis)	0.5 ha	1
Meridolum corneovirens (Cumberland Plain Land Snail)	0.5 ha	1
Pommerhelix duralensis (Dural Land Snail)	0.5 ha	1

12 LIMITATIONS

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APPENDIX A

THREATENED SPECIES HABITAT SUITABILITY ASSESSMENT

Table A.1 Habitat suitability assessment for threatened plant species

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Acacia bynoeana (Bynoe's Wattles)	E	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Drooping Red Gum (*E. parramattensis*), Old Man Banksia (*Banksia serrata*) and Small-leaved Apple (*Angophora bakeri*).	Low in development site. There is no habitat considered suitable for this species in the development site.
Acacia gordonii (Gordon's Wattle)	E	E	It is chiefly found in the lower eastern slopes of the Blue Mountains but also occurs in the Glenorie-Maroota area on the northern outskirts of Sydney and there is one record from Hornsby. It occurs on rock platforms on ridgetops and spurs at 0-400 m asl in dry sclerophyll open forest, woodland and heath. The substrate is sandy soil derived from Hawkesbury Sandstone with some residual clay and laterite influence, low in nutrients and well drained.	Low in development site. There is no habitat considered suitable for this species in the development site.
Acacia pubescens (Downy Wattle)	V	V	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.	Low in development site. There is no habitat considered suitable for this species in the development site.
Allocasuarina glareicola	E	E	This species grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. These soils are low in fertility and are strongly to very strongly acidic. Rainfall in the area is lower than surrounding regions. The median annual rainfall is 803 mm (measured at the University of Western Sydney), with a summer peak. It is found in the Castlereagh open woodland community, with *Eucalyptus parramattensis, E. fibrosa, E. sclerophylla, Angophora bakeri* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa, Hakea dactyloides, H. sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, A. brownei, Themeda australis* and *Xanthorrhoea minor*.	Low in development site. There is no habitat considered suitable for this species in the development site.
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (*Syncarpia glomulifera* subsp. *glomulifera*), Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), Forest Oak (*Allocasuarina torulosa*) and Christmas Bush (*Ceratopetalum gummiferum*).	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Astrotricha crassifolia	V	V	Occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). Occurs on dry ridgetops to 300 m altitude and is associated with very rich heath, or dry sclerophyll woodland. Vegetation associations include typical sandstone genera such as *Hakea*, *Banksia* and *Xylomelum*.	Low in development site. There is no habitat considered suitable for this species in the development site.
Caladenia tessellata (Thick-lipped Spider-orchid)	E	V	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Low in development site. There is no habitat considered suitable for this species in the development site.
Callistemon linearifolius	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Was more widespread across its distribution in the past. Some populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park and Werakata National Park. Grows in open dry sclerophyll forest on a substrate of sandy to clayey soils on sandstone on the coast and ranges e.g. with *Corymbia eximia, Eucalyptus punctata, E. umbra, Allocasuarina littoralis,* and *Angophora costata.*	Low in development site. There is no habitat considered suitable for this species in the development site.
Cryptostylis hunteriana (Leafless Tongue-orchid)	V	V	The Leafless Tongue-orchid has been reported to occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, *Xanthorrhoea* spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation). Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils.	Low in development site. There is no habitat considered suitable for this species in the development site.
Cynanchum elegans (White-flowered Wax Plant)	E	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar. Typically occurs in rainforest gullies, scrub and scree slopes and at the ecotone between dry rainforest vegetation and dry subtropical forest/woodland communities. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (Leptospermum laevigatum) – Coastal Banksia (Banksia integrifolia subsp. integrifolia) coastal scrub; Forest Red Gum (Eucalyptus tereticornis) aligned open forest and woodland; Spotted Gum (Corymbia maculata) aligned open forest and woodland; and Bracelet Honeymyrtle (Melaleuca armillaris) scrub to open scrub.	Low in development site. There is no habitat considered suitable for this species in the development site.
Darwinia biflora	V	V	Occurs at 129 sites in the northern and north-western suburbs of Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai Local Government Areas (LGAs). Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include *Eucalyptus haemastoma, Corymbia gummifera* and/or *E. squamosa*. The vegetation structure is usually woodland, open forest or scrub-heath.	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Dillwynia tenuifolia	V	-	Core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. Other populations in Western Sydney are recorded at Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities include the Bulga Mountains at Yengo in the north, and Kurrajong Heights and Woodford in the Lower Blue Mountains. In western Sydney, it may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. At Yengo, is reported to occur in disturbed escarpment woodland on Narrabeen sandstone.	Low in development site. There is no habitat considered suitable for this species in the development site.
Dillwynia tenuifolia Sieber ex D.C. in the Baulkham Hills local government area	EP	-	The endangered population includes all locations for the species within the Baulkham Hills local government area. Only two confirmed locations are known, both near the junction of Wisemans Ferry and Sackville Roads.	Low in development site. There is no habitat considered suitable for this species in the development site.
Epacris purpurascens var. *purpurascens*	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, particularly sclerophyll forests, heathlands and swamps most of which have a strong shale soil influence.	Low in development site. There is no habitat considered suitable for this species in the development site.
Eucalyptus benthamii	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. A further 18 trees are scattered along the Nepean River, south to The Oaks. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. Associated species at the Bents Basin site include *Eucalyptus elata, E. baueriana, E. amplifolia, E. deanei and Angophora subvelutina*. Understorey species include *Bursaria spinosa, Pteridium esculentum* and a wide variety of agricultural weeds. The Kedumba Valley site lists *E. crebra, E. deanei, E. punctata, Leptospermum flavescens, Acacia filicifolia* and *Pteridium esculentum* among its associated species.	Low in development site. There is no habitat considered suitable for this species in the development site.
Eucalyptus camfieldii (Camfield's Stringybark)	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted specimens of *E. oblonga* (Narrow-leaved Stringybark), *E. capitellata* (Brown Stringybark) and *E. haemastoma* (Scribbly Gum).	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Eucalyptus sp. Cattai	CE	CE	Occurs in The Hills Local Government Area, with known populations occurring within the area bounded by Kellyville - Maraylya - Glenorie. Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small clustered groups. The sites at which it occurs are generally flat and on ridge tops. Associated soils are laterised clays overlying sandstone.	Low in development site. There is no habitat considered suitable for this species in the development site.
Genoplesium baueri (Bauer's Midge Orchid)	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	Low in development site. There is no habitat considered suitable for this species in the development site.
Grevillea juniperina subsp. *juniperina*	V	-	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest.	Low in development site. There is no habitat considered suitable for this species in the development site.
Hibbertia superans	E	-	Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites, and at one locality at Mount Boss, inland from Kempsey. No populations are known from a formal conservation reserve. Occurs in open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	Low in development site. There is no habitat considered suitable for this species in the development site.
Leptospermum deanei	V	V	Known from the Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Occurs in woodland on lower hill slopes or near creeks, sandy alluvial soil or sand over sandstone, riparian scrub woodland and open forest.	Low in development site. There is no habitat considered suitable for this species in the development site.
Leucopogon fletcheri subsp. *fletcheri*	E	-	Mainly found in north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains. Also recorded from the Georges River area near Kentlyn and from the Newnes Plateau near Lithgow. Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs.	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Marsdenia viridiflora R. Br. subsp. *viridiflora population* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP	-	Endangered population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas. Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Grows in vine thickets and open shale woodland.	Low in development site. There is no habitat considered suitable for this species in the development site.
Melaleuca biconvexa (Biconvex Paperbark)	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low in development site. There is no habitat considered suitable for this species in the development site.
Melaleuca deanei (Deane's Paperbark)	V	V	The distribution of the species extends from St. Albans (Hawkesbury LGA) in the north, Nowra (Shoalhaven LGA) in the south, and west to Faulconbridge (Blue Mountains LGA). It mostly occupies broad flat ridgetops, dry ridges and slopes between 20 and 410 metres above sea level. It is strongly associated with sandy loam soils that are low in nutrients, sometimes with ironstone present. In southern Sydney, the species most frequently occurs on deep and well developed lateritic soils, i.e. soils where an indurated iron-rich layer usually overlies a mottled clay and a pallid clay. It occurs in a wide range of vegetation communities but is most often found in Coastal Sandstone Ridgetop Woodland and to a lesser extent, Hinterland Sandstone Gully Forest, Sydney Hinterland Transition Woodland and Coastal Sandstone Gully Forest and other communities on sandstone and transitional geology.	Low in development site. There is no habitat considered suitable for this species in the development site.
Olearia cordata	V	V	It generally restricted to the south-western hunter Plateau, eastern Colo Plateau and the far north Hornsby Plateau of which most of the population occurs within conservation reserves. Populations are small and scattered growing in dry open forest and open shrubland, including on sandstone ridges.	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Persicaria elatior (Tall Knotweed)	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low in development site. There is no habitat considered suitable for this species in the development site.
Persoonia bargoensis (Bargo Geebung)	E	V	The Bargo Geebung is restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau and the northern edge of the Southern Highlands. The historical limits are Picton and Douglas Park (northern), Yanderra (southern), Cataract River (eastern) and Thirlmere (western). The 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. It favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (Hawkesbury Soil Landscape and Gymea Soil Landscape).	Low in development site. There is no habitat considered suitable for this species in the development site.
Persoonia hirsuta (Hairy Geebung)	E	E	*Persoonia hirsuta* is patchily distributed on the Central Coast and Tablelands of NSW, in an area bounded by Putty, Glen Davis and Gosford in the north, and Royal National Park (NP) and Hill Top in the south. It occurs in the Sydney coastal area (Gosford, Berowra, Manly and Royal NP), the Blue Mountains area (Springwood, Lithgow and Putty) and the Southern Highlands (Balmoral, Buxton, Yanderra and Hill Top). It is frequently found on ridge tops and the mid slopes of hills and rises in dry sclerophyll forest and woodland with a shrubby understorey, heath, shrubby thickets and sandstone scrubs from near sea level to 600 m altitude. Associated canopy species include *Eucalyptus sclerophylla*, *Corymbia gummifera*, *Leptospermum trinervium*, *Eucalyptus sieberi*, *Eucalyptus punctata*, *Eucalyptus sparsifolia*, *Corymbia eximia* and *Banksia ericifolia*. It grows on sandy to stony soils derived from sandstone or very rarely on shale and is often found in disturbed areas, like along track edges.	Low in development site. There is no habitat considered suitable for this species in the development site.
Persoonia mollis subsp. *maxima*	E	E	Highly restricted, known from the Hornsby Heights-Mt Colah area north of Sydney in the Sydney Basin Bioregion. Occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone. These habitats support relatively moist, tall forest vegetation communities, often with warm temperate rainforest influences. Flowers late December – March.	Low in development site. There is no habitat considered suitable for this species in the development site.
Persoonia nutans (Nodding Geebung)	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Core distribution occurs within the Penrith, and to a lesser extent, Hawkesbury LGAs, with isolated and relatively small populations also occurring in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Pimelea curviflora var. *curviflora* (Slender Curved Rice Flowers)	V	V	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Has an inconspicuous cryptic habit as it is fine and scraggly and often grows amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing, relying on energy reserves in its tuberous roots.	Low in development site. There is no habitat considered suitable for this species in the development site.
Pimelea spicata (Spiked-rice Flower)	E	E	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open woodland with a more well developed shrub and grass understorey.	Low in development site. There is no habitat considered suitable for this species in the development site.
Pterostylis gibbosa (Illawarra Greenhood)	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803).	Low in development site. There is no habitat considered suitable for this species in the development site.
Pterostylis saxicola (Sydney Plains Greenhood)	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population occurs within a conservation reserve at Georges River National Park. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Low in development site. There is no habitat considered suitable for this species in the development site.
Pultenaea parviflora (Sydney-bush Pea)	E	V	Endemic to the Cumberland Plain the core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. May be locally abundant, particularly within scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. Eucalyptus fibrosa is usually the dominant canopy species. Eucalyptus globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon may also be present or co-dominant, with Melaleuca decora frequently forming a secondary canopy layer. Associated species may include Allocasuarina littoralis, Angophora bakeri, Aristida spp., Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, Melaleuca nodosa, Ozothamnus diosmifolius and Themeda australis.	Low in development site. There is no habitat considered suitable for this species in the development site.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Pultenaea pedunculata	V	-	Widespread in Victoria, Tasmania, and south-eastern South Australia, however in NSW it is represented by just three disjunct populations on the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. NSW populations are generally among woodland vegetation, but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area.	Low in development site. There is no habitat considered suitable for this species in the development site.
Pultenaea villifera population in the Blue Mountains Local Government Area	EP	-	An endangered population in Blue Mountains LGA. Has a patchy distribution within NSW, occurring within the South and Central Coasts and Southern Tablelands. The population of P. villifera in the Blue Mountains Local Government Area is disjunct from other known populations and occurs only at a few small sites in the Springwood-Woodford Area. One of these populations occurs within Blue Mountains National Park. Grows in dry sclerophyll forest and woodlands on sandy soil and appears to favour sheltered locations.	Low in development site. There is no habitat considered suitable for this species in the development site.
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast it occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low in development site. There is no habitat considered suitable for this species in the development site.
Thesium australe (Austral Toadflax)	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	Low in development site. There is no habitat considered suitable for this species in the development site.
Zieria involucrata	E	V	It has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains local government areas. It occurs primarily on Hawkesbury sandstone and Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest, although some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Eucalyptus agglomerata* (Blue-leaved Stringybark) and *Allocasuarina torulosa* (Forest Oak).	Low in development site. There is no habitat considered suitable for this species in the development site.

Distribution and habitat requirement information adapted from Australian Government Department of the Agriculture, Water and the Environment SPRAT http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl and NSW Department of Planning, Industry and Environment Threatened Species Data Collection https://www.environment.nsw.gov.au/threatenedspeciesapp/

Key: EP = endangered population, CE = critically endangered, E = endangered, V = vulnerable

Table A.2 Habitat suitability assessment for threatened animal species

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Birds				
Anthochaera Phrygia (Regent Honeyeater)	CE	CE	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (Casuarina spp) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species. There are four known key breeding areas: three in NSW and one in Victoria. Breeding varies between regions and corresponds with flowering of key eucalypt and mistletoe species. It usually nests in horizontal branches or forks in tall mature eucalypts and Sheoaks.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Apus pacificus (Fork-tailed Swift)	-	M	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	Moderate. Likely to use airspace above the development site during migratory movements.
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	V	-	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands and may be seen along roadsides and on golf courses.	Moderate. May forage over the development site and perch on trees.
Burhinus grallarius (Bush Stone-curlew)	E	-	Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	Low in development site. There is no habitat in the development site considered suitable for this species.
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests with an acacia understorey. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas, occasionally feeding on exotic plant species on urban fringe areas. Favours old growth forest and woodland attributes for nesting and roosting. Nesting occurs in Spring and Summer with nests located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Calyptorhynchus lathami (Glossy-black Cockatoo)	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, Allocasuarina diminuta, and A. gymnanthera. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata).	Low in development site. There is no habitat in the development site considered suitable for this species.
Chthonicola sagittata (Speckled Warbler)	V	-	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Circus assimilis (Spotted Harrier)	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Climacteris picumnus victoriae (Brown Treecreeper (eastern subspecies))	V	-	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Daphoenositta chrysoptera (Varied Sittella)	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Nests in an upright tree fork high in the living tree canopy.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Dasyornis brachypterus (Eastern Bristlebird)	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	Low in development site. There is no habitat in the development site considered suitable for this species.
Glossopsitta pusilla (Little Lorikeet)	V	-	In NSW it is found from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. The species forages primarily in the canopy of dry open eucalypt forest and woodland but also utilises paperbark (Melaleuca sp.) dominated forests. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited; riparian trees are often chosen, including non-eucalypt species such as she-oaks.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Grantiella picta (Painted Honeyeater)	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of birds, and almost all breeding, occur on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	Low in development site. There is no habitat in the development site considered suitable for this species.
Haliaeetus leucogaster (White-bellied Sea-Eagle)	V	M	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially Eucalyptus species), bushes, mangroves, cliffs, rocky outcrops, crevices, on the ground or even on artificial structures.	Low in development site. There is no habitat in the development site considered suitable for this species. There is no breeding habitat present.
Hieraaetus morphnoides (Little Eagle)	V	-	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Hirundapus caudacutus (White-throated Needletail)	-	V, M	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Moderate. Likely to use airspace above the development site. Unlikely to utilise the affected vegetation or be impacted.
Lathamus discolor (Swift Parrot)	E	CE	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (*E. robusta*) and spotted gum (*Corymbia maculata*) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon,* and *E. albens.* Commonly used lerp infested trees include *E. microcarpa, E. moluccana* and *E. pilularis.*	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Lophoictinia isura (Square-tailed Kite)	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii*. Individuals appear to occupy large hunting ranges of more than 100 km2. 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.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Melanodryas cucullata cucullata (Hooded Robin (south-eastern form))	V	-	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Melithreptus gularis gularis (Black-chinned Honeyeater (eastern subsp.))	V	-	Extends south from central Queensland, through NSW, Victoria into south-eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (Eucalyptus sideroxylon), White Box (E. albens), Inland Grey Box (E. microcarpa), Yellow Box (E. melliodora), Blakely's Red Gum (E. blakelyi) and Forest Red Gum (E. tereticornis). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.

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Motacilla flava (Yellow Wagtail)	-	M	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	Low in development site. There is no habitat considered suitable for this species. Vagrant birds may appear on occasion.
Neophema pulchella (Turquoise Parrot)	V	-	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Ninox connivens (Barking Owl)	V	-	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Ninox strenua (Powerful Owl)	V	-	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Petroica boodang (Scarlet Robin)	V	-	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Petroica phoenicea (Flame Robin)	V	-	The Flame Robin ranges from near the Queensland border to south-east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Petroica rodinogaster (Pink Robin)	V	-	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	Low in development site. There is no habitat in the development site considered suitable for this species. Any birds that may use the site would be vagrants.
Polytelis swainsonii (Superb Parrot)	V	V	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree.	Low in development site. There is no habitat considered suitable for this species. Records from the Sydney area are likely to be erroneous or aviary escapees.
Ptilinopus regina (Rose-crowned Fruit Dove)	V	-	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Low in development site. There is no habitat in the development site considered suitable for this species. This species is vagrant to the Sydney area.
Rhipidura rufifrons (Rufous Fantail)	-	M	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies usually with a dense shrubby understorey often including ferns.	Low in development site. There is no habitat in the development site considered suitable for this species.
Stagonopleura guttata (Diamond Firetail)	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Tyto novaehollandiae (Masked Owl)	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Inhabits dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Amphibians				

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Heleioporus australiacus (Giant Burrowing Frog)	V	V	The Giant Burrowing Frog is distributed in south-eastern NSW and Victoria and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	Low in development site. There is no habitat in the development site considered suitable for this species.
Litoria aurea (Green and Golden Bell Frog)	E	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range; however, they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.	Low in development site. There is no habitat in the development site considered suitable for this species.
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath-based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Low in development site. There is no habitat in the development site considered suitable for this species.
Mixophyes balbus (Stuttering Frog)	E	V	Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only *Mixophyes* species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Low in development site. There is no habitat in the development site considered suitable for this species.
Pseudophryne australis (Red-crowned Toadlet)	V	-	It has restricted distribution from Pokolbin to Nowra and west to Mt Victoria. Occurs in open forests and wet drainage lines below sandstone ridges that often have shale lenses or cappings in the Hawkesbury and Narrabeen Sandstones.	Low in development site. There is no habitat in the development site considered suitable for this species.
Invertebrates				
Meridolum corneovirens (Cumberland Plain Land Snail)	E	-	Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Moderate. Marginal habitat is present in the development site.

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Pommerhelix duralensis (Dural Land Snail)	E	E	The Dural land snail is endemic to New South Wales. The species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringe of the Cumberland Plain on shale-sandstone transitional landscapes. The species has been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath logs, rocks and light woody debris.	Moderate. Marginal habitat is present in the development site.
Synemon plana (Golden Sun Moth)	E	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses *Austrodanthonia* spp. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses *Austrostipa* spp. or Kangaroo Grass *Themeda australis*.	Low in development site. There is no habitat in the development site considered suitable for this species.
Mammals				
Cercartetus nanus (Eastern Pygmy-possum)	V	-	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Important habitat requirements include trees with hollows >2cm, loose bark of eucalypts or accumulations of shredded bark in tree forks for nesting; and associated vegetation types and with an understorey containing heath, banksias or myrtaceous shrubs and soft-fruited plants in rainforests.	Low in development site. There is no habitat in the development site considered suitable for this species.
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	Low in development site. There is no habitat in the development site considered suitable for this species.
Dasyurus maculatus (Spotted-tailed Quoll)	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows but has also been found under loose bark on trees or in buildings.	Low in development site. There is no habitat in the development site considered suitable for this species.

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Isoodon obesulus obesulus (Southern Brown Bandicoot)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	Low in development site. There is no habitat in the development site considered suitable for this species.
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	V	-	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Miniopterus australis (Little Bent-winged Bat)	V	-	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Miniopterus orianae oceanensis (Large Bent-winged Bat)	V	-	Occurs on east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Myotis macropus (Southern Myotis)	V	-	Roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Petauroides volans (Greater Glider)	-	V	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north-east Queensland to the Central Highlands of Victoria from sea level to 1200 m altitude. It feeds exclusively on eucalypt buds, flowers and mistletoe and favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. It roosts in tree hollows, with a particular selection for large hollows in large, old trees. Individuals use multiple hollows and a relatively high abundance of tree hollows (at least 4-8 suitable hollows per hectare) seems to be needed for the species to persist. Individuals occupy relatively small home ranges with an average size of 1 to 3 ha, but the species has relatively low persistence in small forest fragments and disperses poorly across vegetation that is not native forest. Forest patches of at least 160 km2 may be required to maintain viable populations.	Low in development site. There is no habitat in the development site considered suitable for this species.
Petaurus norfolcensis (Squirrel Glider)	V	-	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	Low in development site. There is no habitat in the development site considered suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges and isolated rock stacks. It also utilises tree limbs. While it appears that most Brush-tailed Rock-wallaby colonies are on north-facing slopes and cliff lines, colonies have been found on south-facing cliffs in Kangaroo Valley, in the Macleay River Gorge, in the Warrumbungles and at Mt Kaputar, although usually in lower densities. Rocky outcrops appear crucial to current habitat selection by rock-wallabies; however, vegetation structure and composition is also considered to be an important factor. In many parts of their range, including at the Warrumbungles, rock-wallabies are closely associated with dense arboreal cover, especially fig trees. The vegetation on and below the cliff appear to be important to this species as a source of food and shelter and in some cases may provide some protection from predation. A range of vegetation types are associated with Brush-tailed Rock-wallaby habitat, including dense rainforest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest.	Low in development site. There is no habitat in the development site considered suitable for this species.
Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Pseudomys novaehollandiae (New Holland mouse)	V	-	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	Low in development site. There is no habitat in the development site considered suitable for this species.
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Moderate. Marginal foraging habitat present in the development site. There is no breeding habitat present.
Reptiles				
Hoplocephalus bungaroides (Broad-headed Snake)	V	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	Low in development site. There is no habitat in the development site considered suitable for this species.

SCIENTIFIC NAME (COMMON NAME)	BC ACT	EPBC ACT	HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE
Notes: some species returned from the database searches such as turtles, whales, dolphins, fish, sharks, shorebirds, marine birds, wetland birds and waders have been excluded from this assessment, as the study area does not provide any habitat for these species. Distribution and habitat requirement information adapted from Australian Government Department of Agriculture, Water and the Environment SPRAT http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl and NSW Department of Planning, Industry and Environment Threatened Species Data Collection https://www.environment.nsw.gov.au/threatenedspeciesapp/ Key: EP = endangered population, CE = critically endangered, E = endangered, V = vulnerable, M = migratory				

APPENDIX B

BAM PREDICTED SPECIES REPORT

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020561/BAAS17060/20/00020562	POWERHOUSE MUSEUM DISCOVERY CENTRE EXPANSION PROJECT	18/06/2020
Assessor Name	**Report Created**	**BAM Data version ***
Lukas Clews	23/06/2020	29
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS17060	Major Projects	Open
	Assessment Revision	**Date Finalised**
	0	To be finalised

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

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	849-Cumberland shale plains woodland
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	849-Cumberland shale plains woodland
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	849-Cumberland shale plains woodland
Diamond Firetail	Stagonopleura guttata	849-Cumberland shale plains woodland
Dusky Woodswallow	Artamus cyanopterus cyanopterus	849-Cumberland shale plains woodland
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	849-Cumberland shale plains woodland
Flame Robin	Petroica phoenicea	849-Cumberland shale plains woodland
Gang-gang Cockatoo	Callocephalon fimbriatum	849-Cumberland shale plains woodland
Grey-headed Flying-fox	Pteropus poliocephalus	849-Cumberland shale plains woodland

Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	849-Cumberland shale plains woodland
Koala	Phascolarctos cinereus	849-Cumberland shale plains woodland
Large Bent-winged Bat	Miniopterus orianae oceanensis	849-Cumberland shale plains woodland
Little Bent-winged Bat	Miniopterus australis	849-Cumberland shale plains woodland
Little Eagle	Hieraaetus morphnoides	849-Cumberland shale plains woodland
Little Lorikeet	Glossopsitta pusilla	849-Cumberland shale plains woodland
Masked Owl	Tyto novaehollandiae	849-Cumberland shale plains woodland
Powerful Owl	Ninox strenua	849-Cumberland shale plains woodland
Regent Honeyeater	Anthochaera phrygia	849-Cumberland shale plains woodland
Scarlet Robin	Petroica boodang	849-Cumberland shale plains woodland
Speckled Warbler	Chthonicola sagittata	849-Cumberland shale plains woodland
Spotted Harrier	Circus assimilis	849-Cumberland shale plains woodland
Spotted-tailed Quoll	Dasyurus maculatus	849-Cumberland shale plains woodland
Square-tailed Kite	Lophoictinia isura	849-Cumberland shale plains woodland
Swift Parrot	Lathamus discolor	849-Cumberland shale plains woodland
Turquoise Parrot	Neophema pulchella	849-Cumberland shale plains woodland
Varied Sittella	Daphoenositta chrysoptera	849-Cumberland shale plains woodland
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	849-Cumberland shale plains woodland

Threatened species not within the area of these PCT's

Common Name	Scientific Name	Vegetation Types(s)
Painted Honeyeater	Grantiella picta	849-Cumberland shale plains woodland
White-bellied Sea-Eagle	Haliaeetus leucogaster	849-Cumberland shale plains woodland

APPENDIX C

BAM CANDIDATE SPECIES REPORT

BAM Candidate Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020561/BAAS17060/20/00020562	POWERHOUSE MUSEUM DISCOVERY CENTRE EXPANSION PROJECT	18/06/2020
Assessor Name	**Report Created**	**BAM Data version ***
Lukas Clews	23/06/2020	29
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS17060	Major Projects	Open
	Assessment Revision	**Date Finalised**
	0	To be finalised

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

List of Species Requiring Survey

Name	Presence	Survey Months
Acacia pubescens Downy Wattle		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cynanchum elegans White-flowered Wax Plant		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Dillwynia tenuifolia Dillwynia tenuifolia	*Survey months are outside of the months specified in Bionet.	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Grevillea juniperina subsp. juniperina Juniper-leaved Grevillea		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Pommerhelix duralensis Dural Land Snail		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Meridolum corneovirens Cumberland Plain Land Snail		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Myotis macropus Southern Myotis		Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

List of Species Not On Site

Name
Acacia bynoeana Bynoe's Wattle
Burhinus grallarius Bush Stone-curlew
Caladenia tessellata Thick Lip Spider Orchid
Cercartetus nanus Eastern Pygmy-possum
Eucalyptus benthamii Camden White Gum
Chalinolobus dwyeri Large-eared Pied Bat
Callocephalon fimbriatum Gang-gang Cockatoo
Hieraaetus morphnoides Little Eagle
Haliaeetus leucogaster White-bellied Sea-Eagle
Dillwynia tenuifolia - endangered population Dillwynia tenuifolia, Kemps Creek
Marsdenia viridiflora subsp. viridiflora - endangered population Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas
Lathamus discolor Swift Parrot
Litoria aurea Green and Golden Bell Frog
Lophoictinia isura Square-tailed Kite
Miniopterus australis Little Bent-winged Bat
Miniopterus orianae oceanensis Large Bent-winged Bat
Ninox connivens Barking Owl
Ninox strenua Powerful Owl
Persoonia bargoensis Bargo Geebung
Petaurus norfolcensis Squirrel Glider

Phascolarctos cinereus Koala
Pimelea curviflora var. curviflora Pimelea curviflora var. curviflora
Pimelea spicata Spiked Rice-flower
Pteropus poliocephalus Grey-headed Flying-fox
Pterostylis saxicola Sydney Plains Greenhood
Pultenaea pedunculata Matted Bush-pea
Thesium australe Austral Toadflax
Tyto novaehollandiae Masked Owl
Anthochaera phrygia Regent Honeyeater

APPENDIX D

FLORISTIC AND VEGETATION INTEGRITY PLOT DATA

Table D.1 Floristic plot data

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			8	6	3	0	2	0	0	1	2	1
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			81.6	1.5	1.2	0	0.2	0	0	0.1	80.1	0.1
Corymbia citriodora	80	50	EX								80	
Corymbia maculata	1	5	TG		1							
Ligustrum sinense	0.1	10	HT									0.1
Paspalidium distans	0.1	4	GG				0.1					
Lomandra multiflora	0.1	2	GG				0.1					
Grevillea robusta	0.1	10	TG		0.1							
Acacia decurrens	0.1	1	TG		0.1							
Glycine tabacina	0.1	2	OG							0.1		

Table D.2 Vegetation integrity plot data as entered into the BAM-C

PLOT	PCT	AREA	PATCHSIZE	CONDITIONCLASS	ZONE	EASTING	NORTHING	BEARING	COMPTREE	COMPSHRUB	COMPGRASS	COMPFORBS	COMPFERNS	COMPOTHER
P1	849	0.50	128	Plantation	56	312342	6266483	328	3	0	2	0	0	1

Table D.3 Vegetation integrity plot data as entered into the BAM-C (continued)

STRUCTREE	STRUCSHRUB	STRUCGRASS	STRUCFORBS	STRUCFERNS	STRUCOTHER	FUNLARGETREES	FUNHOLLOWTREES	FUNLITTERCOVER	FUNLENFALLENLOGS	FUNTREESTEM5TO9	FUNTREESTEM10TO19	FUNTREESTEM20TO29	FUNTREESTEM30TO49	FUNTREESTEM50TO79	FUNTREEREGEN	FUNHIGHTHREATEXOTIC
1.2	0.0	0.2	0.0	0.0	0.1	0	0	96.0	0.0	1	1	1	1	0	1	0.1

APPENDIX E

EPBC ACT SIGNIFICANCE ASSESSMENTS

E1 EPBC ACT LISTED FAUNA SPECIES

The development site is dominated by a dense canopy of *Corymbia citriodora* and this tree species is likely to provide potential winter foraging habitat for the EPBC Act listed species Grey-headed Flying-fox and Swift Parrot. The foraging habitat for the Grey-headed Flying-fox and Swift Parrot that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1). Breeding habitat for these two species is not present.

The habitat within the development site may also provide foraging habitat for EPBC Act listed species including the Regent Honeyeater, Spotted-tail Quoll and Koala. However, the likelihood of these three species occurring is much lower as they are not commonly recorded in the urban areas of Sydney and the habitat within the development site is less than optimal. Still, the potential occurrence of these species on occasion cannot be discounted. The foraging habitat for these species that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1). Breeding habitat for these species is not present.

The Dural Land Snail was assumed to be present in PCT 849. The dense leaf litter within this habitat may be suitable for this species. The subject land lies at the edge of the distribution of the Dural Land Snail but taking a precautionary approach, the species is assumed to be present. The habitat for the Dural Land Snail that may be impacted is estimated at 0.5 hectares (extent of PCT 849 as illustrated in Figure 4.1).

Tests of significance have been conducted for threatened fauna species that were considered likely to have suitable habitat within the development site. The significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of the Environment, 2013).

E1.1 SWIFT PARROT

The Swift Parrot is listed as critically endangered under the EPBC Act. The Swift Parrot is considered moderately likely to occur based on the presence of suitable winter foraging habitat in the form of the dense stand of *Corymbia citriodora*. This species is known to sporadically occur within and move through the Sydney urban area while on mainland Australia during winter. It is known to forage in street trees and park and garden plantings.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The area of potential foraging habitat impacted by the project is estimated at 0.5 hectares in size. While this area of habitat is not large, the loss of potential feed trees would directly affect the species opportunity to feed in the area. However, the habitat to be impacted would not be considered vital to the long-term maintenance of the population size of the Swift Parrot.

The Swift Parrot may utilise trees in the area impacted by project for foraging intermittently when no other suitable inland (i.e. box ironbark woodlands) or coastal resources (i.e. naturally occurring Spotted Gum and Swamp Mahogany forests) are available. The Swift Parrot is most likely to opportunistically use the trees while moving through the Sydney urban area if they are in flower. The impact will be negligible considering that no high-quality natural foraging habitat for the Swift Parrot will be impacted and given the extent of similar resources in the urban environment. The extent of habitat remaining in the Castle Hill area would provide sufficient resources to sustain future visitation, such that the project is unlikely to lead to a long-term decrease in the size of the Australian population.

Reduce the area of occupancy of the species

The area of occupancy of this species which is estimated at 4,000 square kilometres. As a large-scale migrant, this species can cover vast areas of its winter range to find suitable flowering eucalypt habitat. The small amount of habitat loss that would occur due to the project would result in a negligible reduction in the extent foraging habitat available and

would not reduce the area of occupancy of this species. The extent of habitat remaining in the Castle Hill area would provide sufficient resources to sustain future visitation.

Fragment an existing population into two or more populations

Importantly, the action will not result in the breaking apart of large blocks of high-quality habitat for the Swift Parrot. There would be no habitat fragmentation *per se*. This species is highly mobile and flies long distances over open areas to move between suitable foraging habitats. The project would not affect the movement of the Swift Parrot between habitat patches or fragment the population.

Adversely affect habitat critical to the survival of a species

Key habitats for the Swift Parrot on the coast and coastal plains of New South Wales include large stands of Spotted Gum (*Corymbia maculata*), Swamp Mahogany (*Eucalyptus robusta*), Red Bloodwood (*Corymbia gummifera*) and Forest Red Gum (*Eucalyptus tereticornis*) forests.

The habitat to be impacted by the project is not a naturally occurring habitat but is dominated by the exotic species *Corymbia maculata* which may provide a winter foraging resource for birds passing through the Castle Hill area in winter. The habitat to be impacted by the project is not a primary habitat or a naturally occurring habitat of critical importance to the survival of this species.

Disrupt the breeding cycle of a population

The Swift Parrot breeds only in Tasmania. As such, the project will not impact the breeding cycle of the species.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The Swift Parrot can cover large areas of its winter range. It is an occasional visitor to the region and may utilise trees in the area impacted by the project for foraging intermittently when no other suitable resources are available. The extent of the predicted impact is 0.5 ha of foraging habitat and the magnitude of this impact is considered small in the context of the available habitat that will remain in the area and the project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The main invasive species harmful to the habitat for the swift parrot in NSW are weeds. Noisy Miners and Bell Miners may make the habitat less suitable for the Swift Parrot due to competitive exclusion. The project is unlikely to result in increased weed invasion due to the planned mit5igation measures. The project would also be unlikely to increase the occurrence of Noisy Miners or Bell Miners as the occurrence of these species is most likely driven by other factors.

Introduce disease that may cause the species to decline, or

The activities associated with the project are unlikely to introduce Beak and Feather Disease and as the species does not nest in the development site spread of this disease is unlikely.

Interfere with the recovery of the species.

The *National Recovery Plan for the Swift Parrot* (Saunders and Tzaros, 2011) identifies the following actions for recovery of this species:

- Identify the extent and quality of habitat
- Manage and protect Swift Parrot habitat at the landscape scale
- Monitor and manage the impact of collisions, competition and disease
- Monitor population and habitat.

The project will not interfere with these identified recovery strategies.

Conclusion

The project is unlikely to result in a significant impact to the Swift Parrot. The sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Swift Parrot.

E1.2 REGENT HONEYEATER

The Regent Honeyeater is listed as critically endangered under the EPBC Act. The Regent Honeyeater is considered moderately likely to occur based on the presence of suitable foraging habitat in the form of the dense stand of *Corymbia citriodora*. While this species is increasingly rare, it is known to sporadically occur within and move through the Sydney area. It is known to forage in street trees and park and garden plantings.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The regent honeyeater comprises a single population, with some exchange of individuals between regularly used areas and as of 2010, the total population size of the Regent Honeyeater was estimated at 350–400 mature individuals (Department of the Environment, 2016). Within its current distribution there are four known key breeding areas where the species is regularly recorded which are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria (Department of the Environment, 2016). Breeding was recently recorded in Western Sydney. Important habitats for the Regent Honeyeater have been mapped by the DPIE.

The area of potential foraging habitat impacted by the project is estimated at 0.5 hectares in size. While this area of habitat is not large, the loss of potential feed trees would directly affect the species opportunity to feed in the area. However, the habitat to be impacted would not be considered vital to the long-term maintenance of the population size of the Regent Honeyeater. Breeding habitat or important habitat areas would not be impacted by the project so therefore the project is unlikely to result in a long-term decrease in the size of the Australian population.

Reduce the area of occupancy of the species

The extent of occurrence for the Regent Honeyeater is estimated at 600,000 km^2 and the area of occupancy at 300 km^2 and no extreme fluctuations in the population, extent of occurrence or area of occupancy have been recorded (Department of the Environment, 2015b). The small amount of habitat loss that would occur due to the project would result in a negligible reduction in the extent foraging habitat available and would not reduce the area of occupancy of this species. The extent of habitat remaining in the Castle Hill area would provide sufficient resources to sustain future visitation.

Fragment an existing population into two or more populations

Importantly, the action will not result in the breaking apart of large blocks of high-quality habitat for the Regent Honeyeater. There would be no habitat fragmentation *per se*. The project would not affect the movement of the Regent Honeyeater between habitat patches or fragment the population.

Adversely affect habitat critical to the survival of a species

According to the Department of the Environment (2016), habitat critical to the survival of the regent honeyeater includes:

- Any breeding or foraging areas where the species is likely to occur.
- Any newly discovered breeding or foraging locations.

The habitat to be impacted by the project is not a breeding or foraging area where the species is likely to regularly occur and is not a newly discovered breeding or foraging location. Therefore, the habitat to be impacted is not likely to be of critical importance to the survival of this species.

Disrupt the breeding cycle of a population

Within its current distribution there are four known key breeding areas where the species is regularly recorded which are the Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales, and the Chiltern area in north-east Victoria (Department of the Environment, 2016). Breeding was recently recorded in Western Sydney.

The Regent Honeyeater does not breed in or near the development site, so the breeding cycle will not be impacted.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The extent of the predicted impact is 0.5 ha of foraging habitat and the magnitude of this impact is considered small in the context of the available habitat that will remain in the area. The habitat to be impacted is not critical to the species and therefore the project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The main invasive species harmful to the habitat for the Regent Honeyeater in NSW are weeds. Noisy Miners and Bell Miners may make the habitat less suitable for the Regent Honeyeater due to competitive exclusion. The project is unlikely to result in increased weed invasion due to the planned mit5igation measures. The project would also be unlikely to increase the occurrence of Noisy Miners or Bell Miners as the occurrence of these species is most likely driven by other factors.

Introduce disease that may cause the species to decline, or

There are no known diseases affecting this species and the project is not considered likely to introduce any disease.

Interfere with the recovery of the species.

The *National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia)* (Department of the Environment, 2016), identifies the following strategies to achieve the recovery plan's objectives:

- Improve the extent and quality of regent honeyeater habitat.
- Bolster the wild population with captive-bred birds until the wild population becomes self-sustaining.
- Increase understanding of the size, structure, trajectory and viability of the wild population.
- Maintain and increase community awareness, understanding and involvement in the recovery program.

The project will not interfere with these identified recovery strategies.

Conclusion

The project is unlikely to result in a significant impact to the Regent Honeyeater. The sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Regent Honeyeater.

E1.3 GREY-HEADED FLYING-FOX

The Grey-headed Flying-fox is listed as vulnerable under the EPBC Act. A key consideration in assessing the significance of impacts to a Vulnerable species is whether the project will impact an 'important population'. As defined in the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013), an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal

— populations that are necessary for maintaining genetic diversity, and/or

— populations that are near the limit of the species range.

The Grey-headed Flying-fox is known to forage widely throughout the Sydney urban area and the nearest known breeding camps are located at Ropes Creek, Parramatta Park, and Gordon. This species is considered likely to forage on the *Corymbia citriodora* trees and other species when they are in flower. The Grey-headed Flying-fox exists as a single interconnected population in Australia. As such, it is considered an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population of a species

There would be no direct impact to a breeding camp and the predicted impact to foraging habitat is limited to an area of 0.5 ha in size. The predicted impact is small in magnitude and negligible when the availability of other foraging habitat in the locality is considered. Breeding success is unlikely to be affected given the extent of similar habitat in the Sydney area and the wide-ranging nature of Grey-headed Flying-fox foraging movements. Therefore, the project is considered unlikely to lead to a long-term decrease in the size of an important population of the Grey-headed Flying-fox.

Reduce the area of occupancy of an important population

The area of occupancy of the Grey-headed Flying-fox is not known but the species exists as one interconnected population along the eastern Australian coastal belt from Rockhampton in central Queensland to Melbourne in Victoria. The area occupied by this species would remain the same after construction. No impact to area of occupancy is expected.

Fragment an existing important population into two or more populations

No breaking apart of large blocks of intact habitat would occur due to the project so habitat fragmentation *per se* would not occur. The Grey-headed Flying-fox is well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom in differing parts of the landscape. The project would not fragment an important population of the Grey-headed Flying-fox and individuals would still be able to disperse between roosts and foraging grounds along the east Australian coast once the project has been built.

Adversely affect habitat critical to the survival of a species

The *Draft National Recovery Plan for the Grey-headed Flying-fox* (Department of Environment, Climate Change and Water NSW, 2009), identifies critical habitat for this species as:

— Productive during winter and spring, when food bottlenecks have been identified

— Known to support populations of greater than 30,000 individuals, within an area of 50-kilometre radius of a camp site

— Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)

— Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes

— Known to be continuously occupied as a camp site.

Breeding camps will not be affected. The foraging habitat to be impacted by the project is a small area (0.5 ha) of planted vegetation and does not constitute critical foraging habitat given the relative widespread nature of similar, and higher quality, naturally occurring native vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of the population. As such, the project is not expected to adversely affect foraging habitat critical to the survival of this species.

Disrupt the breeding cycle of an important population

There will be no impacts to a breeding camp and the impact on foraging habitat is considered to be negligible in the context of regional habitat availability. Consequently, a disruption to the breeding cycle of the Grey-headed Flying-fox is not likely.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The Grey-headed Flying-fox can cover large areas of its range seeking suitable flowering eucalypts and fruits for foraging. The species is likely to utilise trees in the development site for foraging intermittently when no other suitable resources are available. However, the impact to foraging habitat from the project would be negligible and the project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of foraging habitat to the extent that the species is likely to decline.

Importantly, critical roosting and breeding habitat will not be impacted.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The project is unlikely to result in an invasive species harmful to the Grey-headed Flying-fox becoming established in the habitat. The management of invasive species would be managed under the construction environmental management plan using best practice methods.

Introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the project. Activities associated with the project would be unlikely to increase the potential for significant disease vectors to affect the local populations.

Interfere substantially with the recovery of the species

There is no adopted or made Recovery Plan for this species.

However, the *Draft National Recovery Plan for the Grey-headed Flying-fox* (Department of Environment, Climate Change and Water NSW, 2009), identifies the following recovery actions for this species:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan.

The project would not interfere with any of these identified actions.

Conclusion

The project is unlikely to result in a significant impact to the Grey-headed Flying-fox. The population of the Grey-headed Flying-fox that may use the habitats within the development site would meet the definition of an 'important population'. However, the habitat to be impacted is unlikely to be considered important or critical to the survival of the species. The

sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Breeding camps will not be impacted and given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Grey-headed Flying-fox.

E1.4 SPOTTED-TAIL QUOLL (SE MAINLAND POPULATION)

The Spotted-tailed Quoll (southeastern mainland population) is listed as Endangered under the EPBC Act.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The population size of the Spotted-tail Quoll within the locality is not known. The Spotted-tail Quoll occurs at low densities and individuals have a large home range, so it is possible that the development site lies within the home range of one or more Spotted-tail Quolls. The development site does not contain any suitable breeding habitat. There are no potential den sites such as areas with boulders, rocky outcrops, small caves, large woody debris or suitable hollow-bearing trees. The development site is highly disturbed and unlikely to provide a significant foraging resource. If the development site was to be used by the Spotted-tail Quoll it would most likely be by dispersing males.

The project is considered unlikely to disrupt the breeding cycle of a population or impact a significant foraging resource, so the project is unlikely to lead to a long-term decrease in the size of a population.

Reduce the area of occupancy of the species

Declines in the extent of occurrence and area of occupancy for the Spotted-tail Quoll have been observed and are projected to continue, however no accurate numerical data are available (Department of the Environment, 2020a). Within NSW this species is generally confined to within 200 km of the coast and range from the Queensland border to Kosciuszko National Park. The development site is unlikely to house a resident population and is likely to only be used on rare occasion by dispersing animals. As such, the current area of occupancy is unlikely to be affected by the project.

Fragment an existing population into two or more populations

The NSW populations of the Spotted-tail Quoll are already highly fragmented and according to the Department of the Environment (2020a) the main populations are centred on the following areas:

- Hunter Valley, Taree, Port Macquarie and Coffs Harbour through to the gorges and escarpments of the New England Tableland)
- locally abundant populations occur in the south of the state (i.e. Kosciuszko NP and coastal national parks)
- isolated records near Hay
- several disjunct populations between the Border Ranges and the Blue Mountains/Illawarra area.

Importantly, the action will not result in the breaking apart of large blocks of high-quality habitat for the Spotted-tail Quoll. There would be no habitat fragmentation *per se*.

Adversely affect habitat critical to the survival of a species

The maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the species, as the distribution of males appear to be largely influenced by the presence of breeding adult females (Department of the Environment, 2020a). The development site does not contain any breeding habitat, so it is unlikely to be critical to the survival of the species.

Disrupt the breeding cycle of a population

The development site does not contain any suitable breeding habitat. There are no potential den sites such as areas with boulders, rocky outcrops, small caves, large woody debris or suitable hollow-bearing trees. The project is therefore

considered unlikely to disrupt the breeding cycle of a population. If the development site was to be used by the Spotted-tail Quoll it would most likely be by dispersing males.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The development site is unlikely to form part of the territory of a female Spotted-tail Quoll. Maintenance of territories of female Spotted-tail Quolls (particularly their prey items, breeding dens and connectivity between these dens) are of critical importance to the conservation of the species, as the distribution of males appear to be largely influenced by the presence of breeding adult females (Department of the Environment, 2020a). The development site is not a prey-rich habitat and is not in a large area of relatively intact vegetation, so the project is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Predation from Red Foxes, Dingos and Domestic Dogs, are current threats to Spotted-tail Quolls (Department of the Environment, 2020a). Given the dietary and habitat overlap between the Spotted-tail Quolls and introduced carnivores, particularly Cats and foxes, competitive effects may also be occurring (Department of the Environment, 2020a).

These invasive species are already established in the broader locality and the project will not result in these invasive species becoming more abundant.

Introduce disease that may cause the species to decline, or

There are no known diseases affecting this species.

Interfere with the recovery of the species.

The *National Recovery Plan for the Spotted-tailed Quoll Dasyurus maculatus* (Department of Environment, Land, Water and Planning, 2016), have identified the specific objectives as necessary to guide the recovery of the Spotted-tail Quoll:

2 Determine the distribution and status of Spotted-tailed Quoll populations throughout the range and identify key threats and implement threat abatement management practices.

3 Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery.

4 Reduce the rate of habitat loss and fragmentation on private land.

5 Evaluate and manage the risk posed by silvicultural practices.

6 Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations.

7 Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations.

8 Reduce deliberate killings of Spotted-tailed Quolls.

9 Reduce the frequency of Spotted-tailed Quoll road mortality.

10 Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary.

11 Determine the likely impact of climate change on Spotted-tailed Quoll populations.

12 Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program.

The project will not interfere with these identified recovery strategies. The project will remove a small proportion of potential habitat on private land, but the habitat loss is negligible and the habitat to be removed is not high quality or critical to the survival or recovery of this species.

Conclusion

The project is unlikely to result in a significant impact to the Spotted-tail Quoll. The sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Spotted-tail Quoll.

E1.5 KOALA (COMBINED POPULATIONS OF QUEENSLAND, NEW SOUTH WALES AND THE AUSTRALIAN CAPITAL TERRITORY)

The Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) is listed as vulnerable under the EPBC Act. A key consideration in assessing the significance of impacts to a Vulnerable species is whether the project will impact an 'important population'. As defined in the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment, 2013), an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The population of the Koala that may use the habitats within the development site would not meet the definition of an 'important population'. There is no adopted or made recovery plan for the Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) so 'important populations' have not been identified in this manner. It is unlikely that the population that may be affected by the project would be a key source population or a stronghold of genetic diversity as the population is likely to be low in numbers and is not a resident breeding or source population. The population that may be affected by the project is not at the limit of the species range.

The DPIE Koala Habitat Information Base identifies areas of regional koala significance (ARKS) that are mapped as having key koala populations with potential for long-term viability. The development site is not within a mapped ARKS, so the population is unlikely to be considered important.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population of a species

The development site does not provide habitat for an important population of the Koala.

Reduce the area of occupancy of an important population

The development site does not provide habitat for an important population of the Koala.

Fragment an existing important population into two or more populations

The development site does not provide habitat for an important population of the Koala.

Adversely affect habitat critical to the survival of a species

The DPIE Koala Habitat Information Base identifies areas of regional koala significance (ARKS) that are mapped as having key koala populations with potential for long-term viability. The development site is not within a mapped ARKS, so the population is unlikely to be considered important or critical to the survival of the species.

Disrupt the breeding cycle of an important population

The development site does not provide habitat for an important population of the Koala.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In the Sydney Basin bioregion, Koalas occur around the Central Coast, Blue Mountains and the fringes of the Cumberland Plain and given that large areas in the Sydney region are reserved as national parks, forests and woodland in these areas may support several hundred individuals at low densities (Department of the Environment, 2020b).

The 0.5 ha of potential habitat that would be impacted by the project is not considered important for this species and a resident population is not present. The habitat may on rare occasion be used by dispersing animals. The project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Predation from Dingos and Domestic Dogs are current threats to the Koala (Department of the Environment, 2020b).

These invasive species are already established in the broader locality and the project will not result in these invasive species becoming more abundant.

Introduce disease that may cause the species to decline, or

The most well-known disease present in the Koala population is associated with particular strains of Chlamydia and another recently discovered disease that may have significant implications for Koala conservation is Koala Retrovirus (Department of the Environment, 2020b). The project would not introduce Chlamydia or Koala Retrovirus as none of the proposed activities would spread these diseases.

Interfere substantially with the recovery of the species

There is no adopted or made Recovery Plan for this species.

The Conservation Advice for the Koala (Department of Sustainability, Environment, Water, Population and Communities, 2012) identifies threat abatement actions that would support the recovery of the Koala in Queensland, NSW and the ACT, including:

- Develop and implement a development planning protocol to be used in areas of Koala sub-populations or sub-population fragments to prevent loss of Koala sub-populations, habitat critical to the survival of the species and vital habitat connectivity.
- Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat.
- Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them, if necessary.
- Identify populations of high conservation priority.
- Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and, for both Crown and private land, investigate and/or secure inclusion of habitat critical to the survival of the Koala in reserve tenure, if possible.
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.

— Manage any other known, potential or emerging threats such a Bell Miner (Manorina melanophrys) Associated Dieback or Eucalyptus rust.

The project would not interfere with any of these identified actions.

Conclusion

The project is unlikely to result in a significant impact to the Koala. The population of the Koala that may use the habitats within the development site would not meet the definition of an 'important population'. The development site is not within a mapped ARKS, so the population is unlikely to be considered important or critical to the survival of the species. The sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Koala.

E1.6 DURAL LAND SNAIL

The Dural Land Snail is listed as Endangered under the EPBC Act.

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population

The total population size of the Dural Land Snail is unknown but is estimated at approximately 191,400 individuals (Department of the Environment, 2015c). The maximum recorded density of the Dural Land Snail is three individuals per hectare (Department of the Environment, 2015c). Using this as a baseline, the 0.5 hectares of potential habitat in the development site may contain one or two snails. Given the lack of large woody debris and disturbance of the ground layer this may be a good estimate. Given the estimates total population size, removal of the habitat within the development site would not lead to a long-term decrease in the size of the population as only 0.001% of the estimated population would potentially be impacted.

Reduce the area of occupancy of the species

The total extent of occurrence of the Dural land snail is estimated to be approximately 2,400 km² with the estimated area of occupancy being approximately 638 km² (Department of the Environment, 2015c). The habitat to be impacted is approximately 0.5 hectares in size. This represents approximately 0.0008% of the current estimated area of occupancy and as such the project is not considered likely to reduce the area of occupancy for this species.

Fragment an existing population into two or more populations

The Dural Land Snail's habitat is severely fragmented due to past land clearance and a number of populations are now isolated into remnants under five hectares in size (Department of the Environment, 2015c). Importantly, the action will not result in the breaking apart of blocks of high-quality habitat. There would be no habitat fragmentation *per se*.

Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Dural Land Snail has not been identified. It is however unlikely that the disturbed habitat within the development site would be critical to this species when compared to larger more intact areas of habitat within the distribution of this species.

Disrupt the breeding cycle of a population

If this species is present within the development site, then the breeding cycle would be disrupted by the habitat removal. The population, of present, is however likely to be small so the magnitude of this impact is likely to be low.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 0.5 ha of potential habitat would be removed by the project. This is a very small amount when compared to the predicted extent of occurrence and therefore the project is not likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Predation by the introduced common blackbird is a potential threat to the Dural land snail (Department of the Environment, 2015c). This species is already established in the broader locality and the project will not result in this species becoming more abundant.

Introduce disease that may cause the species to decline, or

There are no known diseases affecting this species.

Interfere with the recovery of the species.

There is no adopted or made Recovery Plan for this species.

The priority actions outlined in the approved conservation advice (Department of the Environment, 2015c) include:

1. Implement an ongoing monitoring program to monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
2. Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.
3. Engage local Bushcare groups, such as the Ellerman Park Bushcare Group, to implement recovery actions for the species.
4. Undertake appropriate maintenance of habitat in which the species may occur e.g. avoid underscrubbing in areas where the species is known to occur and maintain and/or recover coarse woody debris in habitat for this species.
5. Limit use of pile burning (burning composted material) and/or manage pile burning in areas where the species is known to occur.
6. Investigate formal conservation arrangements, management agreements and covenants on private land with known occurrences.
7. Provide advice to developers, consultants and approval authorities about the existence of the species and its significance.
8. Develop and implement a management plan for the control of weeds currently occurring in the region.
9. Where necessary and appropriate, restrict access to important sites by installing gates, fencing and educational signs.

The project will not interfere with these identified recovery actions.

Conclusion

The project is unlikely to result in a significant impact to the Dural Land Snail. The sensitivity, value, and quality of the environment to be affected is low when compared to larger more intact habitats that form the core of this species current distribution. Given the low magnitude and localised impact of the development site, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Dural Land Snail.

E2 EPBC ACT MIGRATORY SPECIES

The results of the PMST indicate that 19 listed migratory species may occur in the locality (see Appendix F). These 19 species include migratory marine birds (one species), migratory terrestrial species (seven species), and migratory wetlands species (nine species).

Of these listed migratory species, the following species are considered moderately likely to occur in, or fly over, the development site based on the presence of suitable habitats:

- Migratory marine birds – Fork-tailed Swift (Bonn, CAMBA, ROKAMBA)
- Migratory terrestrial species – White-throated Needletail (Bonn, CAMBA, ROKAMBA).

The Fork-tailed Swift and White-throated Needletail spend the non-breeding season in Australia and are primarily aerial. As such, they may fly over the development site as part of normal movement patterns.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify, destroy or isolate an area of important habitat for a migratory species, or
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.

Defining important habitats for the Fork-tailed Swift and White-throated Needletail is problematic as these two species are almost exclusively aerial in Australia. According to the guidance provided in the *Referral guideline for 14 birds listed as migratory species under the EPBC Act Draft* (Department of the Environment, 2015a), important habitat for the Fork-tailed Swift and White-throated Needletail is identified as follows:

- Fork-tailed Swift - Non-breeding habitat only: Found across a range of habitats, from inland open plains to wooded areas, where it is exclusively aerial.
- White-throated Needletail - Non-breeding habitat only: Found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial. Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites.

As these two species are almost exclusively aerial within Australia, and as the project will not impact large intact natural habitats, it is unlikely that the project will impact an important habitat for these two species. The invasive species harmful to the Fork-tailed Swift and White-throated Needletail are unknown (see Department of the Environment, 2015a).

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. An internationally important proportion of the Fork-tailed Swift and White-throated Needletail population would be 1,000 and 100 birds respectively (see Department of the Environment, 2015a). These are the identified thresholds for when a significant impact to these two species is likely to occur. There are no roost sites in the development site and the development site does not contain enough resources for an interracially significant proportion of the population of either species to use. As such, the project is unlikely to impact an ecologically significant proportion of the population or substantially modify, destroy or isolate an area of important habitat for a migratory species.

APPENDIX F

PROTECTED MATTERS SEARCH TOOL RESULTS

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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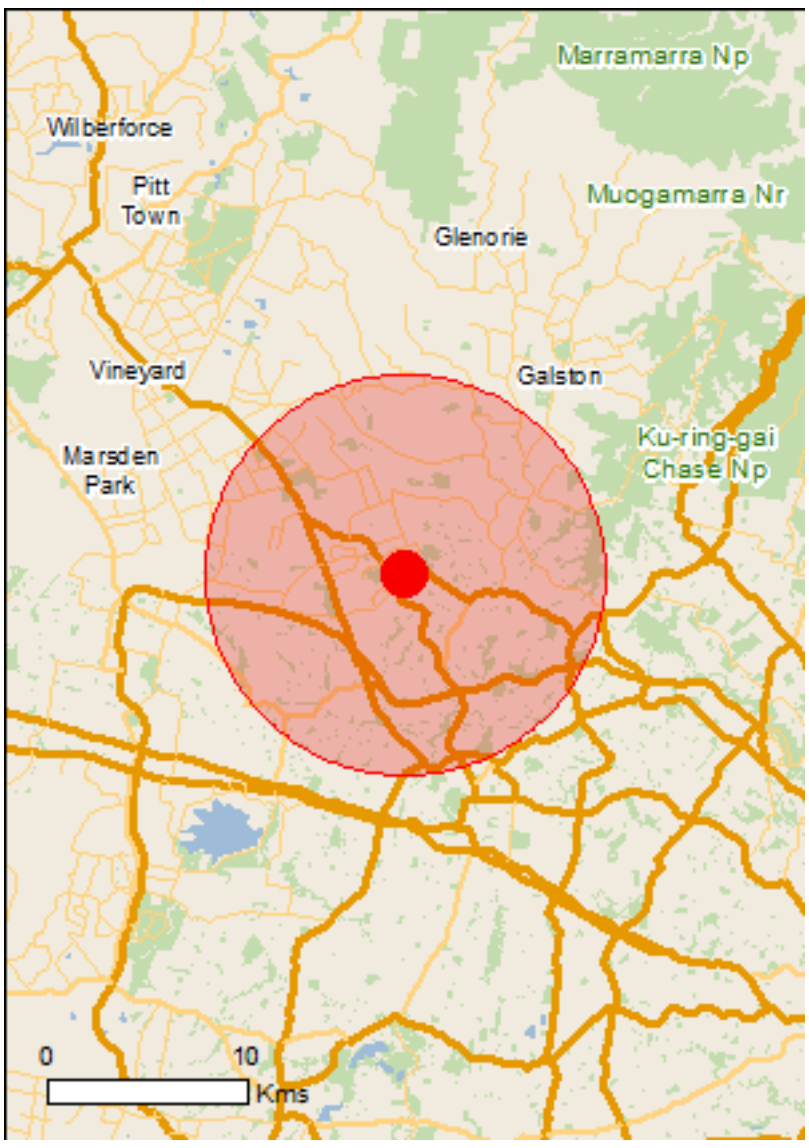

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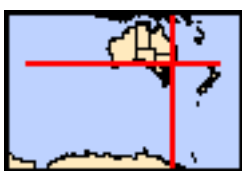

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	2
National Heritage Places:	2
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	9
Listed Threatened Species:	58
Listed Migratory Species:	17

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	12
Commonwealth Heritage Places:	None
Listed Marine Species:	25
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	4
Regional Forest Agreements:	None
Invasive Species:	52
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties		[Resource Information]
Name	State	Status
Australian Convict Sites (Old Government House and Domain Buffer Zone)	NSW	Buffer zone
Australian Convict Sites (Old Government House and Domain)	NSW	Declared property

National Heritage Properties		[Resource Information]
Name	State	Status
Historic		
Old Government House and the Government Domain	NSW	Listed place
Parramatta Female Factory and Institutions Precinct	NSW	Listed place

Listed Threatened Ecological Communities		[Resource Information]

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

Name	Status	Type of Presence
Blue Gum High Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community may occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat may occur within area
Fish		
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Synemon plana Golden Sun Moth [25234]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat likely to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Other		
Pommerhelix duralensis		
Dural Land Snail [85268]	Endangered	Species or species habitat known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat known to occur within area
Acacia gordonii		
[5031]	Endangered	Species or species habitat likely to occur within area
Acacia pubescens		
Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat known to occur within area
Allocasuarina glareicola		
[21932]	Endangered	Species or species habitat likely to occur within area
Asterolasia elegans		
[56780]	Endangered	Species or species habitat may occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat may occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans		
White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Darwinia biflora		
[14619]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus camfieldii		
Camfield's Stringybark [15460]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Eucalyptus sp. Cattai (Gregson s.n., 28 Aug 1954) [89499]	Critically Endangered	Species or species habitat known to occur within area
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat known to occur within area
Leptospermum deanei Deane's Tea-tree [21777]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat likely to occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat likely to occur within area
Olearia cordata [6710]	Vulnerable	Species or species habitat may occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat likely to occur within area
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat known to occur within area
Persoonia mollis subsp. maxima [56075]	Endangered	Species or species habitat known to occur within area
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat may occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat known to occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat likely to occur within area
Pultenaea parviflora [19380]	Vulnerable	Species or species habitat known to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Zieria involucrata [3087]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
[Hoplocephalus bungaroides](#) Broad-headed Snake [1182]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Cuculus optatus](#) Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		Species or species habitat known to occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat likely to occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -
Commonwealth Land - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Australian Telecommunications Corporation
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - BLACKTOWN TRAINING DEPOT

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis rubricollis Hooded Plover (eastern) [66726]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Berowra Valley	NSW
Berowra Valley	NSW
Dural	NSW
Rouse Hill	NSW

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax,		Species or species

Name	Status	Type of Presence
Florist's Smilax, Smilax Asparagus [22473]		habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding		Species or species

Name	Status	Type of Presence
Pine [20780]		habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-33.72475 150.97437

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

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APPENDIX G

BIODIVERSITY CREDIT REPORT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00020561/BAAS17060/20/00020562	Proposal Name POWERHOUSE MUSEUM DISCOVERY CENTRE EXPANSION PROJECT	BAM data last updated * 18/06/2020
Assessor Name Lukas Clews	Assessor Number BAAS17060	BAM Data version * 29
Proponent Names	Report Created 29/06/2020	BAM Case Status Open
Assessment Revision 0	Assessment Type Major Projects	Date Finalised To be finalised

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

BAM Biodiversity Credit Report (Like for like)

No Changes

Predicted Threatened Species Not On Site

Name
Grantiella picta / Painted Honeyeater
Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.5	0.00

849-Cumberland shale plains woodland	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Area	Credits
Meridolum corneovirens / Cumberland Plain Land Snail	0.5	0.00
Myotis macropus / Southern Myotis	0.5	0.00
Pommerhelix duralensis / Dural Land Snail	0.5	0.00

Meridolum corneovirens/ Cumberland Plain Land Snail	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Meridolum corneovirens/Cumberland Plain Land Snail	Any in NSW
Myotis macropus/ Southern Myotis	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Myotis macropus/Southern Myotis	Any in NSW
Pommerhelix duralensis/ Dural Land Snail	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Pommerhelix duralensis/Dural Land Snail	Any in NSW

Pommerhelix duralensis/ Dural Land Snail	849_Plantation	

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00020561/BAAS17060/20/00020562	Proposal Name POWERHOUSE MUSEUM DISCOVERY CENTRE EXPANSION PROJECT	BAM data last updated * 20/08/2020
Assessor Name Lukas Clews	Assessor Number BAAS17060	BAM Data version * 30
Proponent Names	Report Created 21/09/2020	BAM Case Status Open
Assessment Revision 0	Assessment Type Major Projects	Date Finalised To be finalised

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

BAM Biodiversity Credit Report (Like for like)

No Changes

Predicted Threatened Species Not On Site

Name
Grantiella picta / Painted Honeyeater
Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	0.5	0.00

849-Cumberland shale plains woodland	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Area	Credits
Meridolum corneovirens / Cumberland Plain Land Snail	0.5	1.00
Myotis macropus / Southern Myotis	0.5	1.00
Pommerhelix duralensis / Dural Land Snail	0.5	1.00

Meridolum corneovirens/ Cumberland Plain Land Snail	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Meridolum corneovirens/Cumberland Plain Land Snail	Any in NSW
Myotis macropus/ Southern Myotis	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Myotis macropus/Southern Myotis	Any in NSW
Pommerhelix duralensis/ Dural Land Snail	849_Plantation	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Pommerhelix duralensis/Dural Land Snail	Any in NSW

Pommerhelix duralensis/ Dural Land Snail	849_Plantation	