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Sydney Metro – Western Sydney Airport

Appendix G
Revised Biodiversity Development Assessment Report

Sydney Metro – Western Sydney Airport

Revised Biodiversity Development Assessment Report

March, 2021

Sydney Metro – Western Sydney Airport

Biodiversity Development Assessment Report

March, 2021

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Glossary and terms of abbreviation

Term	Definition
*	Denotes exotic species
B	
BAM	Biodiversity Assessment Method 2017
BAM-C	Biodiversity Assessment Method Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
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 (OEH, 2017).
BMP	Biodiversity Management Plan
C	
CEEC	Critically Endangered Ecological Community
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIZ	Western Sydney International Stage 1 Construction Impact Zone
Construction footprint	All areas to be directly impacted by the Project. To ensure consistent terminology within this report, the use of *'construction footprint'* replaces *'development site'* as defined in the BAM (OEH, 2017).
Cumulative Impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
D	
DAWE	Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials (OEH, 2017).
DECCW	Department of Environment, Climate Change and Water
DEOH	Defence Establishment Orchard Hills
DPIE	Department of Planning, Industry an Environment
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance 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 (OEH, 2017).

Term	Definition
E	
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT (OEH, 2017).
ECZ	Environment Conservation Zone (ECZ) buffering the environmental values along Badgerys Creek was also established as part of the Airport Plan approval
EEC	Endangered Ecological Community
EES	Environment, Energy and Science Group (EES) – a division of Planning Industry and Environment, supersedes Office of Environment and Heritage.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
F	
FFMP	Flora and Fauna Management Plan
FM Act	Fisheries Management Act
I	
IBRA	Interim Biogeographically Regionalisation of Australia
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 (OEH, 2017).
L	
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH, 2017).
M	
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH, 2014).
Mitigation	Action to reduce the severity of an impact (OEH, 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
O	
OEH	The former Office of Environment and Heritage

Term	Definition
Off-airport construction sites	• St Marys • Claremont Meadows services facility • Orchard Hills • Stabling and maintenance facility • Off-airport construction corridor • Luddenham Road • Bringelly services facility • Aerotropolis Core
On-airport construction sites	• On-airport construction corridor • Airport Business Park • Western Sydney International tunnel portal • Airport Terminal • Airport construction support site
Orchard Hills tunnel portal	• Refers to the tunnel portal at the southern end of the St Marys to Orchard Hills tunnel near Orchard Hills Station
P	
PCT	Plant Community Type
Power routes	• Claremont Meadows construction power route • Kemps Creek construction power route • Permanent power route
S	
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 in accordance with section 6.4. of the BAM
Stabling and maintenance facility	Consisting of the stabling and maintenance facility and operational control centre located to the south of Blaxland Creek, to the east of the project alignment and to the north of Patons Lane.
Stage 1: Biodiversity Assessment	Stage 1 of the Biodiversity Assessment Method. It establishes a single consistent approach to assessing the biodiversity values on land on proposed as a development site.
Stage 2: Impact Assessment	Stage 2 of the Biodiversity Assessment Method. It provides for an impact assessment on biodiversity values where the land is a development site.
Study area	The land to which Stage 1 of the Biodiversity Assessment Method (BAM) has been applied to assess the biodiversity values. Includes the construction footprint, within Off-airport lands, north of Western Sydney International and On-airport lands outside of the Western Sydney International Stage 1 CIZ and any areas identified for potential surface indirect impacts, as well as areas that may be subject to potential groundwater drawdown (e.g. Orchard Hills). To ensure consistent terminology within this report, the use of '*study area*' replaces '*subject land'* as defined in the BAM (OEH, 2017).
T	
TEC	threatened ecological community
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website at www.bionet.nsw.gov.au

Term	Definition
V	
Viaduct and bridges	The location references of proposed bridge and viaduct structures are: • Lansdowne Road (new road-over-rail bridge) • Blaxland Creek (viaduct over Blaxland Creek) • Patons Lane (viaduct over Patons Lane) • Warragamba to Prospect Water Supply Pipelines, Luddenham Road and Cosgrove Creek (viaduct over these locations) • Future M12 Motorway (new rail-over road-bridge) • Elizabeth Drive (bridge structure over drainage swale at Western Sydney International south of Elizabeth Drive)
VIS	Vegetation information system (BioNet Vegetation Classification)
W	
Western Sydney International (Nancy-Bird Walton) Airport	Abbreviated within this Biodiversity Assessment Report to Western Sydney International
Western Sydney International tunnel portal	Refers to the tunnel portal at the northern end of the Western Sydney International to Bringelly tunnel

Executive summary

Sydney Metro – Western Sydney Airport (the project) would involve the construction and operation of a new metro railway line around 23 kilometres in length between the T1 Western Line at St Marys in the north and the Aerotropolis in the south. This would include a section of the alignment which passes through and provides access to Western Sydney International (Nancy-Bird Walton) Airport.

The project is characterised into two main components:

- outside Western Sydney International (off-airport)
- within Western Sydney International (on-airport).

This technical paper (Biodiversity Development Assessment Report (BDAR)) assesses the potential biodiversity impacts of the project in relation to State and Commonwealth legislative requirements for both off-airport and on-airport components.

The off-airport component is comprised of two sections:

- south of Western Sydney International
- north of Western Sydney International.

Staged assessment process

For off-airport land north of Western Sydney International, due to limited access to private residential properties for field surveys, the BDAR utilised a staged assessment process. This process of staging the BDAR enabled the results of targeted seasonal field surveys for threatened species to be incorporated into this updated assessment report with revised credit calculations and offset obligations. This BDAR has also been updated to account for additional access to properties that were unable to be previously surveyed, design changes, and to address submissions received during exhibition of the Sydney Metro – Western Sydney Airport Environmental Impact Statement (Project Environmental Impact Statement) (Sydney Metro, 2020a). For those properties, which were unable to be accessed and have not been subject to field survey, a conservative approach has been applied and species are assumed to be present based on available habitat in accordance with the NSW Biodiversity Assessment Method (BAM) (OEH, 2017a).

Off-airport

In accordance with Part 10 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), the Sydney Growth Centres Strategic Assessment: Program Report (DECCW and DoP 2010 (now Department of Planning, Infrastructure and Environment (DPIE)) provided a strategic assessment for the South West Growth Area, located south of Western Sydney International.

For off-airport land within the proposed corridor of the project located south of Western Sydney International, impacts on Matters of National Environmental Significance (MNES) and Commonwealth Land protected by the EPBC Act have already been assessed and approved. This means the potential impacts of the project on biodiversity within the off-airport land south of Western Sydney International do not require further State or Commonwealth approval and are therefore not subject to further assessment in this BDAR.

The off-airport land north of Western Sydney International is currently subject to strategic biodiversity conservation planning (the ‘Cumberland Plain Conservation Plan’) under preparation by the Department of Planning, Industry and Environment (DPIE). The Cumberland Plain Conservation Plan was exhibited in August 2020 and incorporates a strategic biodiversity certification under the BC Act and EPBC Act. The strategic biodiversity certification incorporates detailed field survey and assessments, and species expert reports required under the BAM. Given uncertainty around the timing of the Cumberland Plain Conservation Plan finalisation and endorsement, the project is not included within the Cumberland Plain Conservation Plan assessment.

As the certification has not yet been achieved, the potential off-airport impacts of the project on biodiversity north of Western Sydney International, are therefore still subject to a separate BDAR (this report) under the BC Act and assessment under the EP&A Act and the EPBC Act.

The off-airport components of the project located to the north of Western Sydney International were referred to the Commonwealth Minister for the Environment. On 14 July 2020, the Minister advised that the referred action, is a controlled action and the Project will be assessed by preliminary documentation.

The BDAR prepared for the project builds upon baseline biodiversity information from the Cumberland Plain Conservation Plan, particularly where field surveys for the project for the off-airport land north of the Western Sydney International were limited by private property access and COVID-19 restrictions.

For off-airport land north of Western Sydney International, the BDAR utilised a staged assessment process. This updated BDAR has incorporated results of targeted field surveys in Spring 2020 and design changes proposed for the project to inform revised credit calculations and offset obligations. These additional targeted surveys have confirmed a reduction in the projects impacts to threatened species previously assumed to be present.

For those remaining areas, which were still not able to be surveyed due to limited access to private properties, a conservative approach has been maintained with species assumed to be present based on available habitat.

The landscape north of Western Sydney International is a mix of rural residential development and farmland, as well as undeveloped land in the northern and eastern parts of the Defence Establishment Orchard Hills. Farmland in Orchard Hills and Luddenham comprises mostly rural industries, rural-residential properties and agricultural land, with interspersed stands of remnant native vegetation generally remaining only along creek lines, low-lying areas and some roadside patches. South Creek forms a north–south green corridor, particularly through St Marys, where parks and recreational facilities are located next to the creek. The majority of the land to the north of the M4 Motorway is residential with a few industrial complexes and some stands of remnant native vegetation.

Delivery of the off-airport component of the project (north of Western Sydney International) would have a residual impact on up to 31.67 hectares of native vegetation (29.86 hectares direct impact and 1.81 hectares of indirect impact) that is consistent with following threatened ecological communities under the BC Act:

- Cumberland Plain Woodland in the Sydney Basin Bioregion – critically endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – endangered
- Shale Gravel Transition Forest in the Sydney Basin Bioregion – endangered
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – endangered.

Of these, two threatened ecological communities meet the criteria for listing under the EPBC Act:

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

Two threatened flora species, *Grevillea juniperina* subsp. *juniperina* and *Dillwynia tenuifolia*, listed as vulnerable under the BC Act were recorded within the study area during project field surveys. A total of 1,225 individuals of *Grevillea juniperina* subsp. *juniperina* were recorded. This species is also considered likely to occur in some parts of the study area not yet accessed for field survey due to landholders denying property access and as such conservative assumed presence approach has been adopted for these areas. The total combined area of habitat for *Grevillea juniperina* subsp. *juniperina* within the study area has been estimated to be about 6.38 hectares. A total of 100 individuals of *Dillwynia tenuifolia* were recorded. The total combined area of habitat for *Dillwynia tenuifolia* within the study area has been estimated to be about 3.05 hectares.

A total of 15 threatened flora species were considered to have a moderate or higher likelihood of occurrence within the off-airport study area. Due to limited access to private residential properties for project field surveys, a conservative assessment has been applied and 12 threatened flora species

have been assumed present based on presence of associated habitat. These species are considered affected by the project and species credits have been assigned for offsetting purposes.

A total of 47 threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the off-airport study area and, following survey and assessment, 18 fauna species have been assigned to ecosystem credit species calculations for offsetting purposes.

Two threatened fauna species (Cumberland Plain Land Snail and Southern Myotis) were recorded or have been assumed present within the off-airport study area and have been assigned to species credit calculations for offsetting purposes.

No threatened fish species listed under *the Fisheries Management Act 1994 (FM Act)* or EPBC Act were recorded or considered likely to occur within the study area and as such the project is unlikely to significantly impact any threatened aquatic species or their habitats.

On-airport

The on-airport land occurs within the area covered by the *Airport Plan for Western Sydney Airport* (the 'Airport Plan').

The Airport Plan was approved in December 2016 under the Commonwealth *Airports Act 1996* (Airports Act) and guides development on the site. Section 160 of the EPBC Act requires that a variation to the Airport Plan must be the subject of advice from the Commonwealth Minister for the Environment. This advice is received through a modified referral process, which involves the assessment of environmental impacts. The Commonwealth Minister for the Environment advised that the on-airport components of the project would be assessed based on the provision of preliminary documentation.

The Airport Plan approved construction within the Western Sydney International Stage 1 Construction Impact Zone (CIZ) and this construction has commenced. An Environment Conservation Zone (ECZ) buffering the environmental values along Badgerys Creek was also established as part of the Airport Plan approval. To address the information requirements of the preliminary documentation, potential biodiversity impacts of the project on-airport (but outside the Stage 1 CIZ), for MNES and EPBC Act have been assessed under the NSW BAM within Section 7 of this BDAR and within the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541).

The environment outside the Stage 1 CIZ and the ECZ consists of remnant patches of grassy woodland and narrow corridors of riparian forest around Badgerys Creek with extensive areas of derived grassland, cropland, cleared and developed land. The condition of native vegetation is generally poor and there is moderate to severe weed infestation.

There were no access restrictions for field surveys within the on-airport section of the project. Delivery of the on-airport component of the project would have a residual impact on up to 42 hectares of native vegetation that is consistent with following threatened ecological communities under the NSW BC Act:

- Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered

Of these, Cumberland Plain Shale Woodlands meets the criteria for listing under the EPBC Act.

A total of 12 threatened flora species and 47 threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the on-airport study area.

No threatened flora species were recorded within the on-airport study area or are considered affected by the project. No threatened flora species have been assigned to species credits for offsetting purposes

A total of two threatened fauna species (Cumberland Plain Land Snail and Southern Myotis) were recorded or assumed present within the on-airport study area and have been assigned to species credit calculations for offsetting purposes.

No threatened fish species listed under the FM Act or EPBC Act were recorded or considered likely to occur within the study area and as such the project is unlikely to significantly impact any threatened aquatic species or their habitats.

Avoidance and design refinement

The project has been refined to avoid and minimise potential impacts on biodiversity including:

- refining the construction footprint at Orchard Hills Station to minimise impacts on threatened ecological communities and to avoid large areas of intact contiguous vegetation that provides fauna habitat and movement corridors
- inclusion of structures (for example viaducts, bridges and culverts) in the design to assist fauna connectivity
- straightening the project alignment (for example at Blaxland Creek) to avoid vegetation impacts
- designing tunnel options to avoid direct impacts on riparian vegetation, Cumberland Plain Woodland and the Badgerys Creek Environment Conservation Zone.

Mitigation and management

The project has included specific performance outcomes with regards to biodiversity including:

- minimising or where possible avoiding impacts to threatened flora and fauna species, and ecological communities listed under the BC Act and EPBC Act
- managing groundwater drawdown at Orchard Hills and Bringelly to avoid or minimise impacts on groundwater dependent ecosystems (for example Shale Gravel Transition Forest in the Sydney Basin Bioregion)
- Offsetting impacts to threatened ecological communities and species.

A Construction Environmental Management Framework (CEMF) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor in developing the CEMP, sub-plans, and other supporting documentation for each specific environmental aspect.

Specific sub-plans from the CEMF that would be developed to address biodiversity values would include a Flora and Fauna Management Plan (FFMP).

Offsetting biodiversity impacts

Residual impacts that are not able to be managed through mitigation would be offset in accordance with BAM based on Biodiversity Assessment Method Calculator (BAMC) calculations for both ecosystem and species credits.

The project offset obligation has been calculated to require the following biodiversity credits:

Off-airport:

- Up to 848 ecosystem credits
- Up to 1,113 species credits.

On-airport:

- Up to 255 ecosystem credits
- Up to 190 species credits.

The final quantification of and delivery of offset liability in accordance with BAM will be determined based on a vegetation clearing report supporting the final design and construction plan. During design development for the project the biodiversity impacts, offset obligations and credit calculations will be reviewed, and if necessary updated.

1 Introduction

1.1 Project context and overview

The *Greater Sydney Region Plan* (Greater Sydney Commission, 2018a) sets the vision and strategy for Greater Sydney to become a global metropolis of three unique and connected cities; the Eastern Harbour City, the Central River City and the Western Parkland City. The Western Parkland City incorporates the future Western Sydney International (Nancy-Bird Walton) Airport (hereafter referred to as Western Sydney International) and Western Sydney Aerotropolis (hereafter referred to as the Aerotropolis).

Sydney Metro – Western Sydney Airport (the project) (see Figure 1.1) is identified in the *Greater Sydney Region Plan* as a key element to delivering an integrated transport system for the Western Parkland City. The project would be located within the Penrith and Liverpool Local Government Areas (LGAs) and would involve the construction and operation of a new metro railway line around 23 kilometres in length between the T1 Western Line at St Marys in the north and the Aerotropolis in the south. This would include a section of the alignment which passes through and provides access to Western Sydney International.

The project is characterised into components that are located outside Western Sydney International (off-airport) and components that are located within Western Sydney International (on-airport), to align with their different planning approval pathways required under State and Commonwealth legislation.

1.2 Key project features

Key operational features of the project are shown on Figure 1.1 and would include:

- around 4.3 kilometres of twin rail tunnels (generally located side by side) between St Marys (the northern extent of the project) and Orchard Hills
- a cut-and-cover tunnel around 350 metres long (including tunnel portal), transitioning to an in-cutting rail alignment south of the M4 Western Motorway at Orchard Hills
- around 10 kilometres of rail alignment between Orchard Hills and Western Sydney International, consisting of a combination of viaduct and surface rail alignment
- around two kilometres of surface rail alignment within Western Sydney International
- around 3.3 kilometres of twin rail tunnels (including tunnel portal) within Western Sydney International
- around three kilometres of twin rail tunnels between Western Sydney International and the Aerotropolis Core
- six new metro stations:
  - four off-airport stations:
    - St Marys (providing interchange with the T1 Western Line)
    - Orchard Hills
    - Luddenham Road
    - Aerotropolis Core
  - two on-airport stations:
    - Airport Business Park
    - Airport Terminal
- grade separation of the track alignment at key locations including:
  - where the alignment interfaces with existing infrastructure such as the Great Western Highway, M4 Western Motorway, Lansdowne Road, Patons Lane, the Warragamba to

Prospect Water Supply Pipelines, Luddenham Road, the future M12 Motorway, Elizabeth Drive, Derwent Road and Badgerys Creek Road

- crossings of Blaxland Creek, Cosgroves Creek, Badgerys Creek and other small waterways to provide flood immunity for the project

- modifications to the existing Sydney Trains station and rail infrastructure at St Marys (where required) to support interchange and customer transfer between the new metro station and the T1 Western Line
- a stabling and maintenance facility and operational control centre located to the south of Blaxland Creek to the east of the project alignment and to the north of Patons Lane
- new pedestrian, cycle, park-and-ride and kiss-and-ride facilities, public transport interchange infrastructure, road infrastructure and landscaping as part of the station precincts.

The project would also include:

- turnback track arrangements (turnbacks) at St Marys and Aerotropolis Core to allow trains to turn back and run in the opposite direction
- additional track stubs to the east of St Marys Station and south of Aerotropolis Core Station to allow for potential future extension of the line to the north and south respectively without impacting future metro operations
- an integrated tunnel ventilation system including services facilities at Claremont Meadows and at Bringelly
- all operational systems and infrastructure such as crossovers, rail sidings, signalling, communications, overhead wiring, power supply, lighting, fencing, security and access tracks/paths
- retaining walls at required locations along the alignment
- environmental protection measures such as noise barriers (if required), on-site water detention, water quality treatment basins and other drainage works.

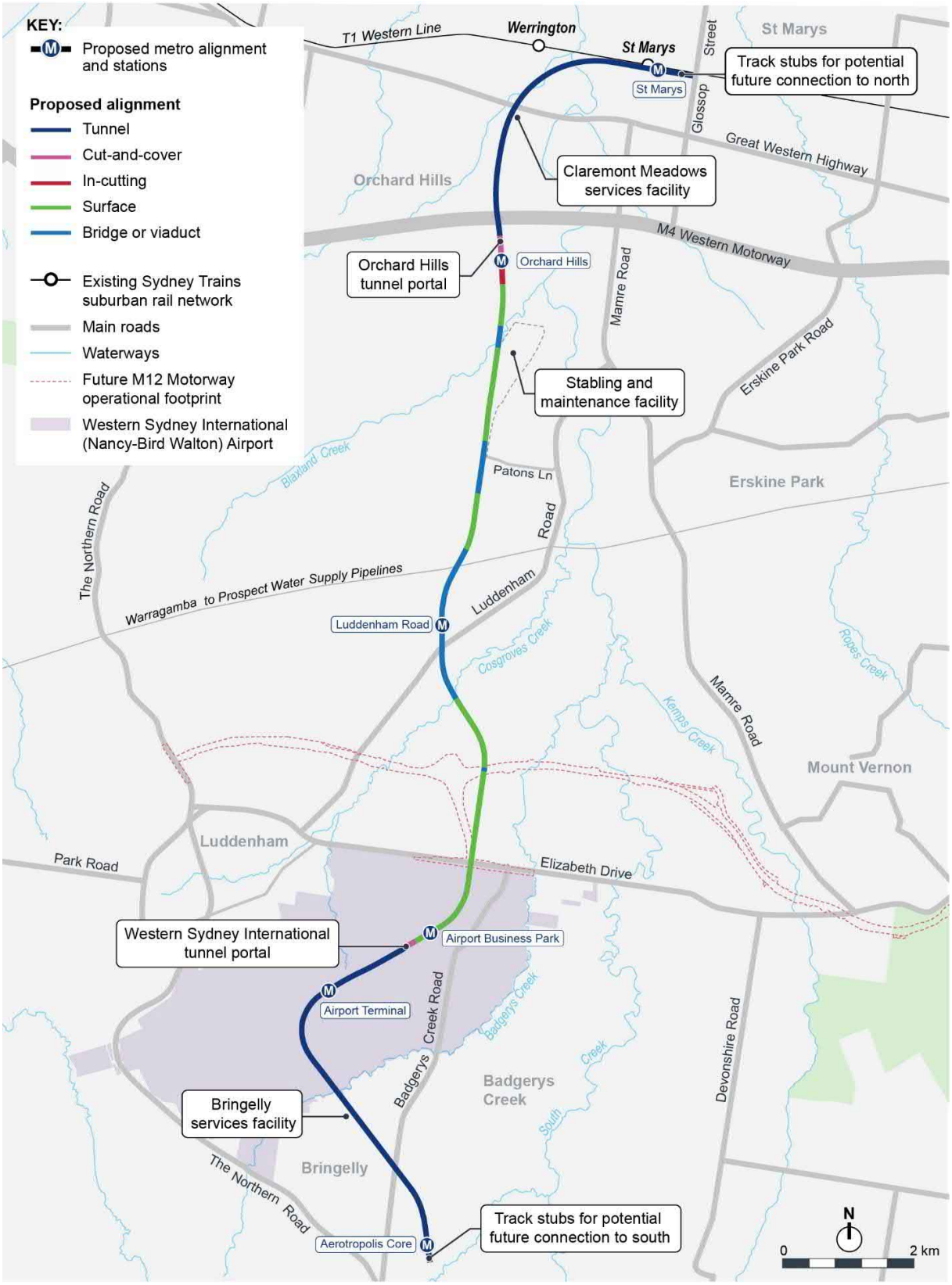
Off-airport project components

The off-airport components of the project would include the track alignment and associated operational systems and infrastructure north and south of Western Sydney International, four metro stations, the stabling and maintenance facility, two service facilities and a tunnel portal.

On-airport project components

The on-airport components of the project would include the track alignment and associated operational systems and infrastructure within Western Sydney International, two metro stations and a tunnel portal.

The key project features and the design development process are described in more detail in Chapter 7 (Project description – operation) of the Project Environmental Impact Statement.



Note: Indicative design only, subject to design development

Figure 1.1 Overview of the project

1.3 Project construction

The construction footprint for the project is shown on Figure 1.2. Construction of the project would involve:

- enabling works
- main construction works, including:
  - tunnelling and associated works
  - corridor and associated works
  - stations and associated works
  - ancillary facilities and associated works
  - construction of ancillary infrastructure including the stabling and maintenance facility
- rail systems fitout
- finishing works and testing and commissioning.

These activities are described in more detail in Chapter 8 (Project description – construction) of the Project Environmental Impact Statement.

Construction of the project is expected to commence in 2021, subject to planning approval, and take around five years to complete. An overview of the construction program is provided in Chapter 8 (Project description – construction) of the Project Environmental Impact Statement.

1.4 Purpose of this Technical Paper

This technical paper is one of several technical documents that forms part of the Project Environmental Impact Statement. The purpose of this technical paper is to assess biodiversity impacts in accordance with State and Commonwealth legislation and to address the requirements outlined in Section 2.1 and Section 2.2.

Section 1.4.2 provides an overview of the structure of this technical paper.

The Secretary's environmental assessment requirements (SEARs) relating to biodiversity, and where these requirements are addressed in this technical paper, are outlined in Table 1.1.

Table 1.1 SEARS relevant to this assessment

SEARs requirements	Where addressed in this document
8. Biodiversity	
Key Issue and desired performance outcome	
The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity.	Chapter 8, Section 8.1
Offsets and/or supplementary measures are assured which are equivalent to any residual impacts of project construction and operation.	Chapter 12, Sections 12.1 and 12.2
Requirement	
1. Where **biodiversity** impacts are not addressed through relevant strategic conservation planning, the assessment must be undertaken in accordance with s7.9 of the *Biodiversity Conservation Act 2016* (BC Act), the Biodiversity Assessment Method (BAM), and be documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must: a. include information in the form detailed in s6.12 of the BC Act, cl6.8 of the *Biodiversity Conservation Regulation 2017* and the BAM;	This BDAR has been prepared in accordance with s7.9 of the BC Act and includes information detailed in s6.12 of the Act, cl6.8 of the Biodiversity Conservation Regulation 2017 and the BAM.

SEARs requirements	Where addressed in this document
8. Biodiversity	
b. be submitted with all digital spatial data associated with the survey and assessment as per Appendix 10 of the BAM; c. be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the BC Act*; and* d. include details of the measures proposed to address offset obligations.	Accredited persons are listed in Chapter 3, Section 3.1, Table 3.1. An offset strategy is presented in Chapter 12, Section 12.2.3
2. Impacts on biodiversity values not covered by relevant strategic conservation planning or the BAM must be assessed, such as threatened aquatic species assessment (Part 7A *Fisheries Management Act 1994*) to address whether there are likely to be any significant impact on listed threatened species, populations or ecological communities listed under the *Fisheries Management Act 1994* (FM Act).	Chapter 6, Section 6.3
3. The EIS must identify whether the project, or any component of the project, would be classified as a **Key Threatening Process (KTP)** in accordance with the listings in the BC Act, FM Act and the *Environment Protection* and *Biodiversity Conservation Act 2000* (EPBC Act).	Chapter 8, Section 8.5.6

1.4.1 Commonwealth agency assessment requirements

The Commonwealth Minister for the Environment advised that the on-airport sections of the project would be assessed based on the provision of preliminary documentation. Further information was requested to guide the assessment of the on-airport components of the project (see Section 7 of this BDAR and summary within the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541)).

The specific Commonwealth assessment requirements for the variation of the Airport Plan related to biodiversity, and where these requirements are addressed in this technical paper, are outlined below in Table 1.2.

Table 1.2 Commonwealth assessment requirements relevant to this assessment

Commonwealth assessment requirement	Where addressed in this document
How the proposed action is not inconsistent with the Australia's international obligations, specifically the Biodiversity Convention, the Apia Convention and CITES	The Convention on Biological Diversity is dedicated to promoting sustainable development. It provides a framework for Australia's integration of natural resources and environment and biodiversity management policies. A key philosophy of sustainable development and the Convention on Biological Diversity is the principle of 'avoid and minimise' impacts to biodiversity, which the project has adopted during the planning and design phase. Avoiding and minimising impacts on biodiversity values is a desired performance outcome for the project and is a mandatory key consideration for biodiversity impact assessment under the BAM. The project's adherence to this is demonstrated in Section 8.1 of this BDAR. The biodiversity assessment for the proposed action has been based on the BAM methodology which

Commonwealth assessment requirement	Where addressed in this document
	addresses the ESD hierarchy of avoid, minimise and offset. This led to the project being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, these have been offset and minimised against Commonwealth requirements. The Convention on Conservation of Nature in the South Pacific (the APIA Convention) obliges States (in general terms) to create protected areas to safeguard representative samples of ecosystems, and places of scenic, geological, aesthetic, historical, cultural or scientific importance. The Convention also prohibits the taking or killing of fauna (including eggs and shells) unless the taking is controlled by the competent authorities of the State concerned or unless in pursuance of 'duly authorised' scientific investigations. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The project will not contribute to or result in an increase in the international trade in specimens of wild animals and plants. The proposed assessment under the BAM is also generally consistent with the Australia's international obligations, specifically the Biodiversity Convention, the Apia Convention and CITES.
Implications of the proposed action with respect to relevant conservation advices	The relevant conservation advices were referenced and considered throughout the preparation of this BDAR including in Chapter 3, Chapter 7, Appendix A - Threatened flora habitat suitability assessment, Appendix B – Threatened fauna habitat suitability assessment and Appendix F - EPBC Act Assessments of Significance.
The actions set out in relevant recovery plans and threat abatement plans in relation to the proposed action, in order to demonstrate an understanding of actions that support recovery of each species or community.	The relevant recovery and threat abatement plans are considered throughout the preparation of this BDAR including in Chapter 3, Chapter 7, Table 8.15, Appendix F - EPBC Act Assessments of Significance.

Any significant residual impacts on EPBC Act MNES within on-airport sections of the project would be offset in accordance with the EPBC Environmental Offsets Policy 2012 and offset assessment guide, or another endorsed offset framework (for example the NSW BAM). The BAM provides a prescribed method to robustly quantify and deliver offsets that provide appropriate environment gains targeted at the biodiversity values to be impacted. Sydney Metro is committed to delivering an offset strategy that meets the quantum of the offsets requirement in accordance with BAM. The offset requirements will be delivered where possible, through retirement of available credits and/or payment into the Biodiversity Conservation Trust (BCT). This obligation, and any timeframes proposed in developing and realising offsets may be refined as further field work is undertaken and design development reduces the impacts of the project. Biodiversity offset obligations for on-airport lands are outlined in Section 12 of this BDAR.

The off-airport components of the project located to the north of Western Sydney International were referred to the Commonwealth Minister for the Environment. On 14 July 2020, the Minister advised that the referred action, being the off-airport elements of the project located to the north of Western Sydney International, is a controlled action and the project will be assessed by preliminary documentation.

1.4.2 Structure of this report

There are three stages to the Biodiversity Assessment Method:

Stage 1 – Biodiversity assessment (establishes a single consistent approach to assessing the biodiversity values on land on proposed as a development site).

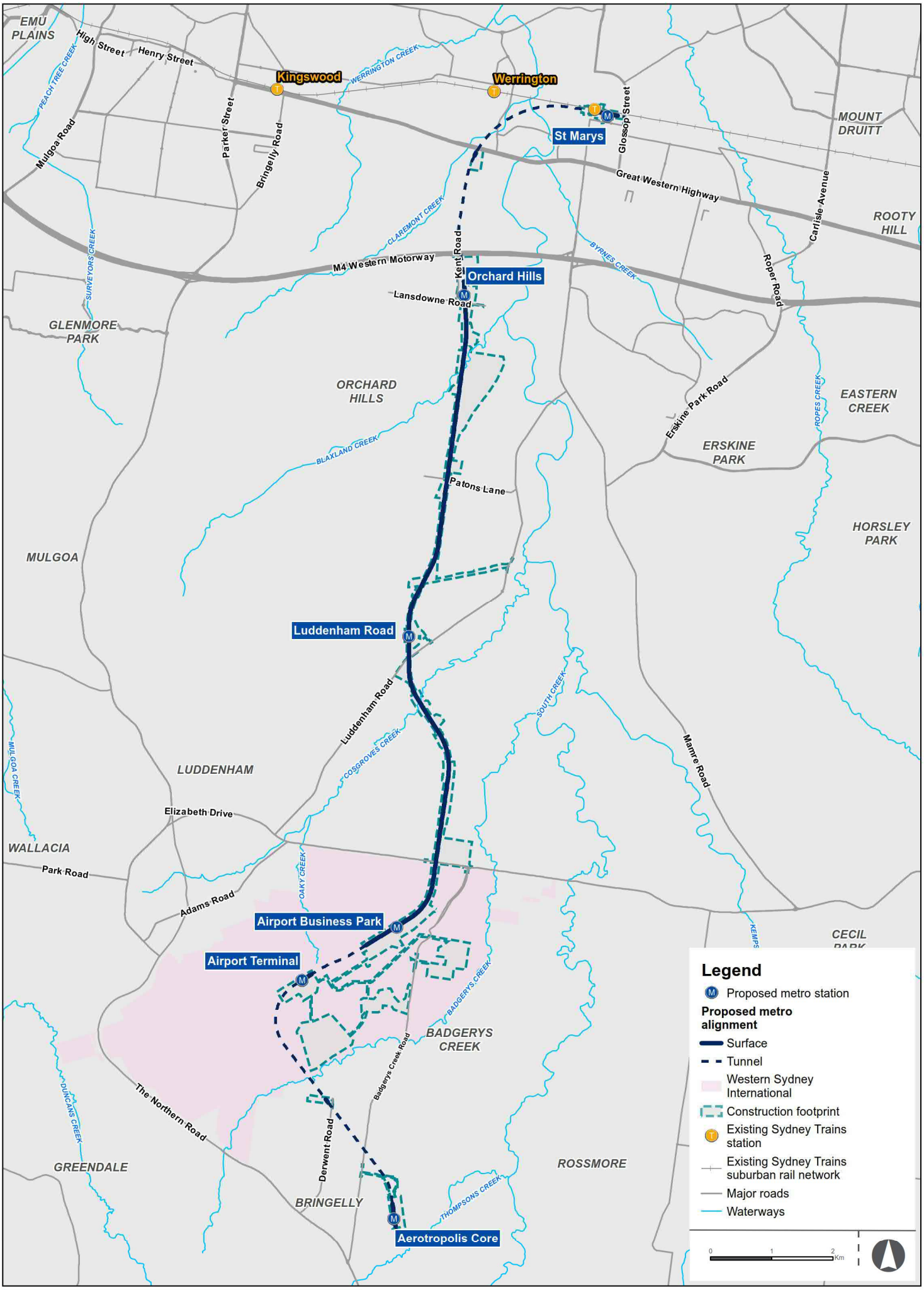
Stage 2 – Impact assessment (provides for an impact assessment on biodiversity values where the land is a development site).

Stage 3 – Improving biodiversity values (provides for the assessment of the management requirements at a proposed biodiversity stewardship site).

Only Stage 1 and Stage 2 of the BAM are relevant to this BDAR.

This report includes the minimum information for a BDAR – Stage 1 Biodiversity Assessment as required by the *Biodiversity Assessment Method Order 2017* and uses the following structure:

- Chapter 1 (Introduction) – an introduction to the report
- Chapter 2 (Legislative and policy context) – describes the legislative and policy context for the assessment, and relevant guidelines
- Chapter 3 (Methodology) – describes the methods and assessment criteria adopted in this report to characterise and assess potential impacts on biodiversity
- Chapter 4 (Landscape context) – addresses Stage 1, Section 4 and Table 25 of the BAM
- Chapter 5 (Native vegetation and threatened ecological communities (TEC)) – addresses Stage 1, Section 5 and Table 25 of the BAM
- Chapter 6 (Threatened species) – addresses Stage 1, Section 6 and Table 25 of the BAM and provides information on assessing the habitat suitability for threatened species
- Chapter 7 (Commonwealth Matters of National Environmental Significance) – addresses matters relating to the EPBC Act
- Chapter 8 (Assessment of construction impacts) – provides an assessment of the impacts of construction activities on biodiversity and addresses Stage 2 of the BAM
- Chapter 9 (Assessment of operation impacts) – provides an assessment of the impacts of the Project operation and operational activities and facilities on biodiversity and addresses Stage 2 of the BAM
- Chapter 10 (Potential cumulative impacts) – provides an assessment of potential cumulative impacts to biodiversity associated with other major projects in the study area and addresses Stage 2 of the BAM
- Chapter 11 (Management and mitigation measures) – details existing management plans, performance outcomes to inform the next stages of design and mitigation measures to minimise the impact of the project
- Chapter 12 (Biodiversity credit report) – addresses Stage 2, Section 11.3 and Table 26 of the BAM
- Chapter 13 (Conclusion) – overview of the key findings of the report.



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Sydney Metro – Western Sydney Airport

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Construction footprint overview

Figure 1-2

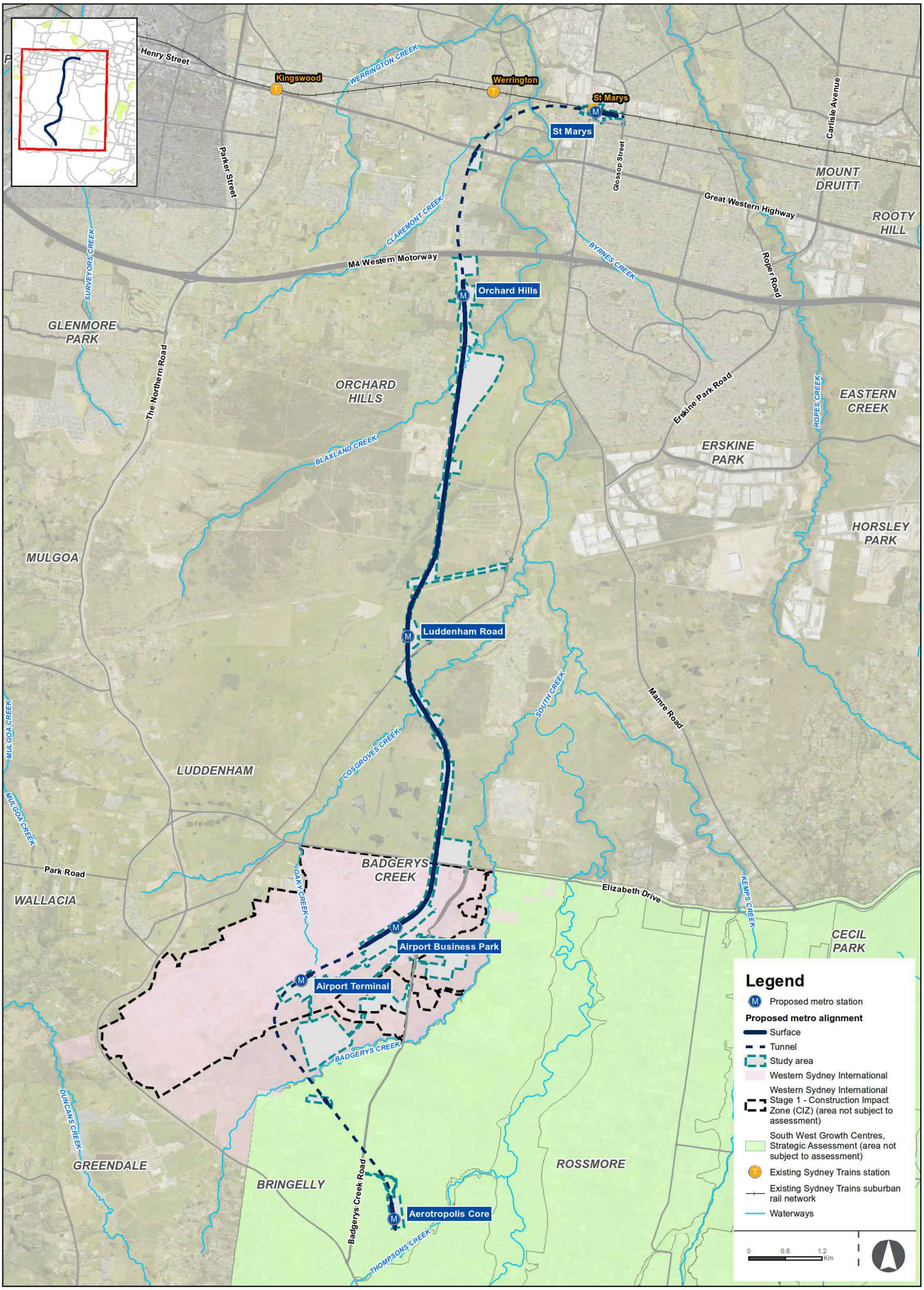
1.5 Study area/project area

The project is located within the Penrith and Liverpool Local Government Areas (LGAs), between the T1 Western Line in the north and the Western Sydney Aerotropolis (Aerotropolis) in the south, via Western Sydney International. The context and location of the project are shown in Figure 1.3.

The project is characterised into components located outside Western Sydney International (off-airport) and components located within Western Sydney International but outside the Stage 1 CIZ (on-airport), to align with the different planning approval pathways required under State and Commonwealth legislation. For more detail on the planning approval pathways see Chapter 4 of the Project Environmental Impact Statement.

The study area is the land to which Stage 1: Biodiversity Assessment of the BAM has been applied to assess the biodiversity values (Chapters 4, 5 and 6). This includes the construction footprint and any areas identified for potential surface indirect impacts, as well as areas that may be subject to potential groundwater drawdown (for example Orchard Hills). To ensure consistent terminology within this technical report, the use of '*study area*' replaces '*subject land'* as defined in the BAM (OEH, 2017).

The construction footprint includes all areas to be directly impacted by the project. To ensure consistent terminology within this report, the use of *'construction footprint'* replaces *'development site'* as defined in the BAM (OEH, 2017a).



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BDAR study area

Figure 1-3

2 Legislative and policy context

There are three overarching statutory frameworks that govern the environmental planning approvals and assessment process for the construction and operation of the project that include biodiversity controls, being the:

- *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Airports Act 1996* (Cth) (the Airports Act).

The relevant legislation, policies and guidelines for biodiversity matters that have been considered during the preparation of this report are outlined further below and have been separated for off-airport and on-airport portions of the project.

2.1 Off-airport legislation and policy context

2.1.1 NSW State legislation and policy

Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory controls that establish a framework governing what development is permitted or prohibited, and the processes for how assessment and gaining approval for development is undertaken in NSW. It is supported by the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) which provides additional detail and gives effect to the legislation.

Of relevance to the project, Part 5 of the EP&A Act deals with infrastructure and environmental impact assessment. Division 5.2 of Part 5 sets out the requirements for the assessment and approval of State significant infrastructure and critical State significant infrastructure.

State significant infrastructure and critical State significant infrastructure

Section 5.12(4) of the EP&A Act provides for the declaration of specified development on specified land as State significant infrastructure and Section 5.13 of the EP&A Act provides for the declaration of State significant infrastructure as critical State significant infrastructure if the project, in the opinion of the Minister of Planning and Public Spaces, is essential for the State for economic, environmental or social reasons. A declaration is being sought for Sydney Metro – Western Sydney Airport as critical State significant infrastructure under Section 5.13 of the EP&A Act. Should the project be declared as critical State significant infrastructure, Schedule 5 of the *State Environmental Planning Policy (State and Regional Development) 2011* (NSW) (SRD SEPP) would be amended to include Sydney Metro – Western Sydney Airport.

The project would be subject to assessment and approval by the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act.

Biodiversity Conservation Act 2016

The Biodiversity Conservation Act 2016 (BC Act), together with the *Biodiversity Conservation Regulation 2017*, outlines the framework for assessment and approval of biodiversity impacts associated with developments that require consent under the EP&A Act. It introduces a Biodiversity Offsets Scheme (BOS), a framework to avoid, minimise and offset impacts on biodiversity from development and clearing. The proponent for a development to which the Division 5.2 of the EP& A Act applies is required to prepare a BDAR in support of an application for approval to undertake that development (see section 7.9 of the BC Act). The BDAR uses the Biodiversity Assessment Method (BAM) established under these biodiversity reforms to provide a methodology for determining the number and type of biodiversity credits required to offset biodiversity impacts.

State significant infrastructure projects are required to prepare a BDAR to identify and assess biodiversity impacts under the provisions of the BC Act and offset those impacts by retiring biodiversity credits, determined using the BAM, through the BOS.

This BDAR has been specifically prepared to address the BAM and associated guidance documents to enable development approval under Part 5 of the EP&A Act.

Environmental planning requirements and project context

Off-airport

The off-airport component is comprised of two sections:

- south of Western Sydney International
- north of Western Sydney International.

In accordance with Part 10 of the EPBC Act, the Sydney Growth Centres Strategic Assessment: Program Report (DECCW and DoP 2010 (now DPIE)) provided a strategic assessment for the South West Growth Area, to the land south of Western Sydney International.

For off-airport land within the proposed corridor of the project located south of Western Sydney International, impacts on MNES and Commonwealth Land protected by the EPBC Act have already been assessed and approved. This means the potential impacts of the project on biodiversity within the off-airport land south of Western Sydney International do not require further State or Commonwealth approval and are therefore not subject to further assessment in this BDAR.

The off-airport land north of Western Sydney International is currently subject to strategic biodiversity conservation planning (the 'Cumberland Plain Conservation Plan') under preparation by the DPIE. The Cumberland Plain Conservation Plan was exhibited in August 2020 and incorporates a strategic biodiversity certification under the BC Act and EPBC Act. The strategic biodiversity certification incorporates detailed field survey and assessments, and species expert reports required under the NSW Biodiversity Assessment Method (BAM) (OEH, 2017a). Given uncertainty around the timing of the Cumberland Plain Conservation Plan finalisation and endorsement, the project is not included within the Cumberland Plain Conservation Plan assessment.

As the certification has not yet been achieved, the potential off-airport impacts of the project on biodiversity north of Western Sydney International, are therefore still subject to a BDAR (this report) under the BC Act and assessment under the EP&A Act and the EPBC Act.

The BDAR prepared for the project builds upon baseline biodiversity information from the Cumberland Plain Conservation Plan, particularly where field surveys for the off-airport land north of the Western Sydney International were limited by private property access and COVID-19 restrictions.

For those properties, which were unable to be accessed and have not been subject to field survey, a conservative approach has been applied and species assumed to be present in accordance with the BAM.

The landscape north of Western Sydney International is a mix of rural residential development and farmland, as well as undeveloped land in the northern and eastern parts of the Defence Establishment Orchard Hills. Farmland in Orchard Hills and Luddenham comprises mostly rural industries, rural-residential properties and agricultural land, with interspersed stands of remnant native vegetation generally remaining only along creek lines, low-lying areas and some roadside patches. South Creek forms a north–south green corridor, particularly through St Marys, where parks and recreational facilities are located next to the creek. Most of the land to the north of the M4 Motorway is residential with a few industrial complexes and some stands of remnant native vegetation.

Prior to the introduction of the BC Act, strategic assessment and conservation planning, as part of *the Sydney Growth Centres Strategic Assessment: Program Report* (DECCW and DoP, 2010) was completed for the South West Growth Area, south of Western Sydney International (excluding the Western Sydney International site). For areas of the project located south of Western Sydney International (but not within Western Sydney International), biodiversity impacts have already been assessed under that biodiversity certification and do not require further assessment under the BC Act.

On-airport

The on-airport land occurs within the area covered by the *Airport Plan for Western Sydney Airport* (the 'Airport Plan').

The Airport Plan was approved in December 2016 under the Commonwealth *Airports Act 1996* (Airports Act) and guides development on the site. Section 160 of the EPBC Act requires that a variation to the Airport Plan must be the subject of advice from the Commonwealth Minister for the

Environment. This advice is received through a modified referral process, which involves the assessment of environmental impacts. The Commonwealth Minister for the Environment advised that the on-airport components of the project would be assessed based on the provision of preliminary documentation (see the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541)).

The Airport Plan approved construction within the Western Sydney International Stage 1 Construction Impact Zone (CIZ) and this construction has commenced. An Environment Conservation Zone (ECZ) buffering the environmental values along Badgerys Creek was also established as part of the Airport Plan approval.

To address the information requirements of the Airport Plan Variation, potential biodiversity impacts of the project on-airport (but outside the Stage 1 CIZ) have been assessed under the NSW BAM within this BDAR.

Further detail on the environmental planning requirements and project context is presented in Chapter 4 of the Project Environmental Impact Statement.

Fisheries Management Act 1994

The Fisheries Management Act 1994 (FM Act) was introduced to conserve, develop and share the fishery resources of the State for the benefit of present and future generations, and applies to all waters within the area occupied by the project. Part 7 of the FM Act relates to the protection of fish and aquatic habitats with the objective of conserving the biodiversity of fish and aquatic vegetation. It provides for the management of certain works located on land that is permanently or intermittently submerged by water.

Pursuant to sections 201, 205 and 219 of the FM Act, works and activities such as those required for the project, may be undertaken under the authority of a permit.

The provisions of the FM Act do not apply to the project as it is State significant infrastructure under section 5.12 of the EP&A Act.

Under the provisions of section 5.23(1) of the EP&A Act, permits that would otherwise be required under sections 201, 205 and 219 of the FM Act are not required for approved State significant infrastructure projects. Similarly, under the provisions of section 5.23(3) of the EP&A Act, directions, orders or notices that could otherwise be issued under Division 7 of Part 7A of the FM Act cannot be issued for approved critical State significant infrastructure.

Nevertheless, this report addresses biodiversity matters relating to threatened aquatic entities listed under the FM Act.

Biosecurity Act 2015

The Biosecurity Act 2015 provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter.

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

Priority weeds recorded in the study area and their control measures are detailed in Section 5.5.

Local Land Services Act 2013

The Local Land Services Act (LLS Act) was introduced to provide direction around programs and services associated with agricultural production, biosecurity, natural resource management and emergency management. It aims to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistent with the principles of ecologically sustainable development. One of the ways that it intends to achieve this is through the regulation of clearing of native vegetation.

Part 5A of the LLS Act sets out the ways in which the regulating of activities (in connection with land management) would occur and the areas of the State to which it would apply. Section 60A applies Part 5A to any area of the State, other than some nominated areas which, relevantly, include urban areas of the State to which the *State Environmental Planning Policy* (*Vegetation in Non-Rural Areas) SEPP 2017* applies. Additionally, section 60O of the LLS Act deals with clearing that is authorised under other legislation.

City of Penrith and City of Liverpool are two of the identified urban areas to which the Vegetation in Non-Rural Areas SEPP applies, thereby excluding them from the provisions of the LLS Act. Furthermore, under the provisions of section 60O of the LLS Act the clearing of native vegetation is authorised if the clearing was authorised by a State significant infrastructure approval under Part 5.1 of the EP&A Act.

The provisions of the LLS Act do not apply to the project. Land management of native vegetation does not apply to the lands on which the project is located.

2.1.2 Commonwealth legislation and policy

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as ‘matters of national environmental significance’ (MNES).

Under the EPBC Act, proposed actions (i.e. activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Commonwealth Minister for the Environment to determine whether they are controlled actions, requiring approval from the Minister. The following matters are defined as protected matters by Part 3 of the EPBC Act:

- MNES
- The environment of Commonwealth Land
- The environment in general if they are being carried out by a Commonwealth Government agency.

The following MNES are of relevance to this BDAR:

- Threatened species and ecological communities
- Migratory species
- Ramsar wetlands
- The environment of Commonwealth Land.

The off-airport components of the project located to the north of Western Sydney International were referred to the Minister in June 2020. On 14 July 2020, the Minister advised that the referred action, is a controlled action and the project will be assessed by preliminary documentation.

The off-airport land south of Western Sydney International is located entirely within the certified lands of the South West Growth Area. Strategic assessment and conservation planning as part of the Sydney Growth Centres Strategic Assessment: Program Report (DECCW and DoP, 2010) was completed and as such, biodiversity impacts have already been assessed and approved under that biodiversity certification. This means the components of the project located on off-airport land south of

Western Sydney International does not require Commonwealth approval for impacts on biodiversity, and is therefore not subject to assessment in this BDAR.

2.2 On-airport legislation and policy context

2.2.1 Airports Act 1996

The Airports Act regulates certain Commonwealth-owned airports, including the development of airport sites to the exclusion of State planning laws. The Airports Act contains a planning framework under which each airport is required to prepare a master plan for approval by the Commonwealth Infrastructure Minister. For Western Sydney International, a transitional planning instrument, the *Airport Plan* for *Western Sydney* (the Airport Plan) has been determined by the Commonwealth Infrastructure Minister in December 2016 following preparation and exhibition of a Project Environmental Impact Statement. It incorporates the conditions specified by the Commonwealth Minister for the Environment. Those conditions include the requirement for preparation and approval of a Construction Plan and CEMPs prior to commencement of main construction works. Initial versions of those plans have been prepared and approved and main construction work on the airport commenced in September 2018.

The on-airport land occurs within the area covered by the *Airport Plan for Western Sydney Airport* (the 'Airport Plan').

While Part 9 of the EPBC Act does not apply in relation on-airport land, section 160 requires that a variation to the Airport Plan must be the subject of advice from the Commonwealth Minister for the Environment. This advice is received through a modified referral process, which involves the assessment of environmental impacts, using one or other of the methods of assessment set out in Part 8 of the EPBC Act. The Commonwealth Minister for the Environment advised that the on-airport components of the project would be assessed based on the provision of preliminary documentation.

The Airport Plan approved construction within the Stage 1 CIZ and this construction has commenced. An ECZ buffering the environmental values along Badgerys Creek was also established as part of the Airport Plan approval. To address the information requirements of the Airport Plan Variation, potential biodiversity impacts of the project on-airport (but outside the Stage 1 CIZ) have been assessed under the NSW BAM within this BDAR.

The development of the project on the airport site would be authorised through a variation of the Airport Plan by the Commonwealth Infrastructure Minister, to include the rail development and any required conditions for the rail development taking account of advice from the Commonwealth Minister for the Environment (see section 160 of the EPBC Act and 96D(7) of the Airports Act). The advice of the Commonwealth Minister for the Environment is supported through the referral of the project and assessment of environmental impacts. If the existing conditions in the Airport Plan for the Stage 1 airport development require variation to accommodate the rail development, the agreement of the Commonwealth Minister for the Environment would also be required. Separate approval of the rail development under the EPBC Act would not be required.

2.2.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance' (MNES).

Under the EPBC Act, proposed actions (i.e. activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Commonwealth Minister for the Environment to determine whether they are controlled actions, requiring approval from the Minister. The following matters are defined as protected matters by Part 3 of the EPBC Act:

- MNES
- The environment of Commonwealth Land

- The environment in general if they are being carried out by a Commonwealth Government agency (noting that Part 3 of the EPBC Act does not apply to Western Sydney International – see section 96G of the Airports Act)
- Ramsar wetlands.

The potential impacts of the project on EPBC Act listed biodiversity on-airport land outside of the approved development of the Airport Plan and off-airport land to the north have been assessed under the NSW BAM as set out in Section 7 of this BDAR and within the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541).

3 Methodology

The following methods have been undertaken in the preparation of this BDAR in accordance with the BAM 2017. All work was carried out under the appropriate licences, including a scientific licence as required under Part 2 of the BC Act (Licence Number: SL100630) and an Animal Research Authority issued by the DPI (Agriculture).

The BDAR has been revised to include the results of additional targeted survey work undertaken within the study area in spring 2020. The BDAR also includes updates to respond to submissions received during the exhibition of the Project Environmental Impact Statement and design changes for on-aiport and off-airport.

3.1 Personnel

The contributors to the preparation for this report, their qualifications and roles are provided in Table 3.1.

Table 3.1 Contributors and their roles

Name	Qualifications	Role
Alex Cockerill	Bachelor of Science (Hons), accredited BAM assessor BAAS17020	National Ecology Team Executive – technical input
Mark Stables	Bachelor of Science (Hons), accredited BAM assessor BAAS18097	Principal Ecologist – field surveys and report preparation
Lukas Clews	Master of Scientific Studies, Graduate Certificate in Applied Science, Diploma Conservation and Land Management, Bachelor of Science BAM accredited assessor 17060	Principal Ecologist - report preparation
Josie Stokes	Bachelor of Science (Conservation Zoology)	Principal Ecologist - technical input, field survey and report preparation
Julia Emerson	Bachelor of Environment, Cert III Conservation and Land Management, accredited BAM assessor BAAS18034	Senior Ecologist – field surveys and report preparation
Lauren Smith	Bachelor of Science (Resource and Environmental Management)	Ecologist – field surveys
Gavin Shelley	Bach Environmental Science and Management	Graduate Ecologist – field surveys
Trent Bowman	Bachelor of Science (Hons), Master of Science in Geoscience	GIS consultant – data management and map preparation
Travis Williamson	Bachelor of Applied Geographic Information Systems	GIS consultant – data management and map preparation

3.2 Nomenclature

Names of vegetation communities used in this report are based on the Plant Community Types (PCTs) used in the NSW BioNet Vegetation Classification Database (EES, 2020). These names are cross-referenced with those used for TECs listed under the BC Act and/or the EPBC Act.

Names of plants used in this document follow PlantNET (Royal Botanic Gardens, 2020). Scientific names are used in this report for species of plant. Scientific and common names (where available) are provided throughout the report, with only scientific names provided in the plot data provided in Appendix C. The names of introduced species are denoted with an asterisk (*).

For threatened species of plants, the names used in the Threatened Biodiversity Data Collection (EES, 2020d) are also provided in Appendix A where these differ from the names used in the PlantNET database.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by DAWE (2020). Common names are used in the report for species of animal. For threatened species of animals, the names used in the Threatened Biodiversity Data Collection (EES 2020d) and NSW Department Primary Industries (Department of Primary Industries, 2020a).

3.3 Background research

3.3.1 Desktop review

The aim of the background research was to identify threatened flora and fauna species, populations and ecological communities, Commonwealth listed migratory species or critical habitat recorded previously or predicted to occur in the locality of the project.

Background research was undertaken to identify:

- landscape-scale features of the study area in accordance with Section 4.2 of the BAM (OEH, 2017a)
- site context of the study area that includes assessing vegetation cover and patch size as required under Subsections 4.3.2 and 5.3.2 of the BAM (OEH, 2017a)
- the likely distribution of native vegetation and threatened ecological communities, based on previous mapping and aerial photograph interpretation, for targeted field verification as required under Section 5 of the BAM (OEH, 2017a)
- a list of predicted and candidate threatened and migratory species and populations of flora and fauna to assess the habitat suitability and threatened biodiversity data collection as required under Section 6 of the BAM (OEH, 2017a), the FM Act and the EPBC Act
- evaluate baseline information to determine whether additional field surveys, mapping and reporting is required to support project approval.

This allowed for known habitat characteristics of to be compared with those present within the study area to determine the likelihood of occurrence of each species or populations. These results informed the identification of appropriate field survey effort and the groups likely to occur.

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the project were obtained from a range of databases as detailed in Table 3.2.

Table 3.2 Threatened and migratory species database searches

Database	Search date	Area searched	Reference
BioNet Atlas of NSW Wildlife	19 May 2020	10 kilometre search radius centred on the study area	Office of Environment and Heritage (2020d)
Protected Matters Search Tool	19 May 2020	10 kilometre search radius centred on the study area	Department of Agriculture, Water and the Environment (2020a)
PlantNet spatial search	19 May 2020	5 kilometre radius centred on the suburb of Badgerys Creek, Orchard Hills and St Marys	Royal Botanical Gardens (2020)
NSW Department of Primary Industries (Fishing and Aquaculture) spatial mapping	19 May 2020	Local waterways	Department of Primary Industries (2020a)

Database	Search date	Area searched	Reference
NSW Department of Primary Industries Critical Habitat register	19 May 2020	Search of the register	Department of Primary Industries (2020b)
NSW Environment, Energy and Science Group Areas of Outstanding Biodiversity Value register	19 May 2020	Search of the register	NSW Environment, Energy and Science Group (2020a)

3.3.2 Spatial data

The background research included analysis of the following information sources:

- Threatened species database searches outlined in Table 3.2 and compiled in Appendix A & B
- Aerial photographic imagery (NSW Spatial Services, 2019a)
- NSW Mitchell Landscapes (OEH, 2016a)
- Descriptions for NSW (Mitchell) Landscapes Version 2 (DECC, 2002)
- Estuaries of NSW database (EES, 2020b)
- Interim Biogeographic Regionalisation of Australia (IBRA version 7.0) (DEE, 2016)
- Atlas of Groundwater Dependent Ecosystems (GDE) (Australian Bureau of Meteorology, 2020)
- Directory of Important Wetlands of Australia (DIWA – DEE, 2020a)
- State Environmental Planning Policy (Coastal Management) 2018 – Coastal Wetlands (DPE, 2018)
- Priority weed listings for the Greater Sydney region (Department of Primary Industries, 2020c)
- The Native Vegetation of the Sydney Metropolitan Area (OEH, 2016b)
- Native vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (Tozer *et al*., 2010)
- Draft Cumberland Plain Conservation Plan – a conservation plan for Western Sydney to 2056 (Department of Planning, Infrastructure and Environment, 2020a)
- Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

3.3.3 Previous surveys and assessments

This BDAR builds upon and compliments previous ecological investigations and reports undertaken across the study area. The previous ecological assessments and surveys that have been undertaken within the study area and surrounds have been considered in the preparation of this report and are provided in Table 3.3.

Table 3.3 Previous ecological investigations undertaken within the study area or immediate surrounds

Ecological Investigation	Reference
Environmental field survey of Commonwealth Land at Badgerys Creek	SMEC, 2014
Western Sydney Airport EIS – Biodiversity Assessment	DIRD 2016e
Western Sydney Airport EIS - Biodiversity Offset Package	DIRD, 2016f
Western Sydney Airport – Biodiversity Assessment Report for land outside Stage 1 Development	DIRD, 2018
Western Sydney Airport – Biodiversity Offsets Delivery Plan	Commonwealth of Australia, 2018

Ecological Investigation	Reference
Strategic assessment for Cumberland Plain Conservation Plan expert report on the Cumberland Plain Land Snail, Meridolum corneovirens (Pfeiffer, 1851) in the Penrith, Western Sydney Aerotropolis, Greater Macarthur and Wilton Growth Areas	Clark, 2018
Strategic Assessment for Cumberland Plain Conservation Plan Greater Macarthur and Wilton Growth Areas - expert Report for Pimelea spicata Spiked Rice-flower	James, 2018
Strategic assessment for Cumberland Plain Conservation Plan *Hibbertia fumana*	Miller, 2018a
Strategic assessment for Cumberland Plain Conservation Plan *Hibbertia puberula* species group	Miller, 2018b
Strategic Assessment for the Little Eagle Hieraaetus morphnoides in the Greater Macarthur Growth Area and the Wilton Growth Area	Saunders and Debus, 2018
Strategic assessment for Cumberland Plain Conservation Plan expert report on the Juniper-leaved Grevillea, *Grevillea juniperina* subsp. *juniperina* in the Greater Macarthur and Wilton Growth Areas	Weston, 2018a
Strategic assessment for Cumberland Plain Conservation Plan expert report on *Pterostylis saxicola*, the Sydney Plains Greenhood, in the Greater Macarthur and Wilton Growth Areas	Weston, 2018b
Strategic assessment for Cumberland Plain Conservation Plan expert report on the Juniper-leaved Grevillea, Grevillea juniperina subsp. juniperina in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area	Weston, 2019a
Strategic assessment for Cumberland Plain Conservation Plan expert report on the Sydney Plains Greenhood, Pterostylis saxicola in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area	Weston, 2019b
Cumberland Plain Conservation Plan - expert report for Dillwynia tenuifolia	Rymer, 2019
M12 Motorway Concept Design and EIS – Biodiversity Assessment	Transport for New South Wales, 2020
M12 Motorway Concept Design and EIS – Submissions Report to the Amendment Report	Transport for New South Wales, 2020
Draft Cumberland Plain Conservation Plan – a conservation plan for Western Sydney to 2056	Department of Planning, Industry and Environment, 2020a
Draft Cumberland Plain Assessment Report	Open Lines and Biosis, 2020

3.4 Native vegetation

3.4.1 Stratification and verification of existing mapping

Preliminary mapping of vegetation community boundaries was undertaken through analysis of existing vegetation mapping and aerial photograph interpretation.

Vegetation within the study area and locality has been mapped at the regional scale in:

- Native vegetation of the Southeast NSW: Revised Classification and Map for the Coast and Eastern Tablelands (Tozer *et al*., 2010)

- The Native Vegetation of the Sydney Metropolitan Area (OEH, 2016b)
- Western Sydney Airport EIS – Biodiversity Assessment (DIRD, 2016e)
- Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

Data on geology, dominant canopy species, native species richness, vegetation structure and condition was collected from areas able to be accessed during field surveys to validate and refine this existing vegetation mapping to determine their associated PCT in accordance with the BioNet Vegetation Classification System (EES, 2020).

In areas that were unable to be surveyed, existing mapping undertaken as part of the Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020) was adopted.

3.4.2 Mapping of vegetation zones

The vegetation within the study area was firstly assessed to a PCT level and then aligned to a vegetation zone which is defined in the BAM as 'an area of native vegetation on the study area that is the same PCT and has a similar broad condition state' (OEH, 2017a).

A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

The vegetation broad condition states which were applied to determine vegetation zones within the study area are summarised in Table 3.4. These factors were defined by using features such as levels of disturbance, weed invasion and resilience.

Justification for PCT selection within the study area was based on a quantitative analysis of vegetation integrity plot data using the Plant Community Identification tool (EES, 2020c) in accordance with section 5.2.1.12 of the BAM.

Table 3.4 Vegetation broad condition states

Condition category	Description
Intact	This condition category was assigned to remnant or regrowth native vegetation with an intact overstorey, mid storey and ground strata. Vegetation in this condition is relatively undisturbed and generally displays limited exotic species diversity and abundance.
Thinned	Vegetation in this condition category included vegetation which has been disturbed i.e. under scrubbing and thinning of overstorey species. Vegetation displayed diversity of ground strata species which formed >50 per cent of the perennial understorey.
Scattered Trees	Native canopy is present in this condition category and occurred as scattered individuals or as a group of remnant trees. Midstorey species were either absent or occurred as scattered individuals. Ground strata was dominated by exotic perennial species comprising >50 per cent of total plant foliage cover.
Low	This condition category was assigned to areas where ground stratum was dominated by native vegetation with exotic perennial species comprising <50 per cent of the ground strata. Native canopy was absent with midstorey was either absent or occurred as scattered individuals.

3.4.3 Paddock trees

Paddock trees are defined as isolated native trees that comprise a ground cover of less than 50 per cent native vegetation and are more than 50 metres from any other tree. BAM (2017) provides a streamlined assessment module for the clearing of paddock trees (Appendix 1) which can be applied to land assessed under the LLS Act. As the Study area falls within two local government areas (Penrith City Council & Liverpool City Council) identified as non-rural in the *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017*, the LLS Act does not apply.

As such, paddock trees have been assessed in accordance with Sections 4.6 of the BAM whereby a vegetation zone was assigned to each paddock tree. All paddock trees were assigned to "scattered tree" condition class as defined in Table 3.4.

PCTs were assigned based on landscape position, canopy species recorded and surrounding PCTs.

3.4.4 Vegetation integrity plots

A total of 40 vegetation integrity plots were completed in accordance with BAM (2017) and as described below. A schematic diagram illustrating the layout of each vegetation integrity plot is provided in Figure 3.1.

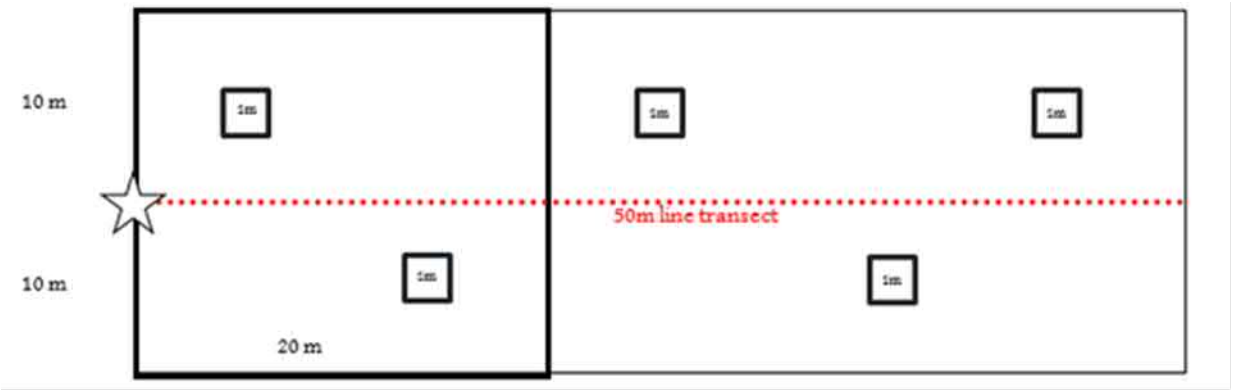


Figure 3.1 Vegetation integrity plot layout

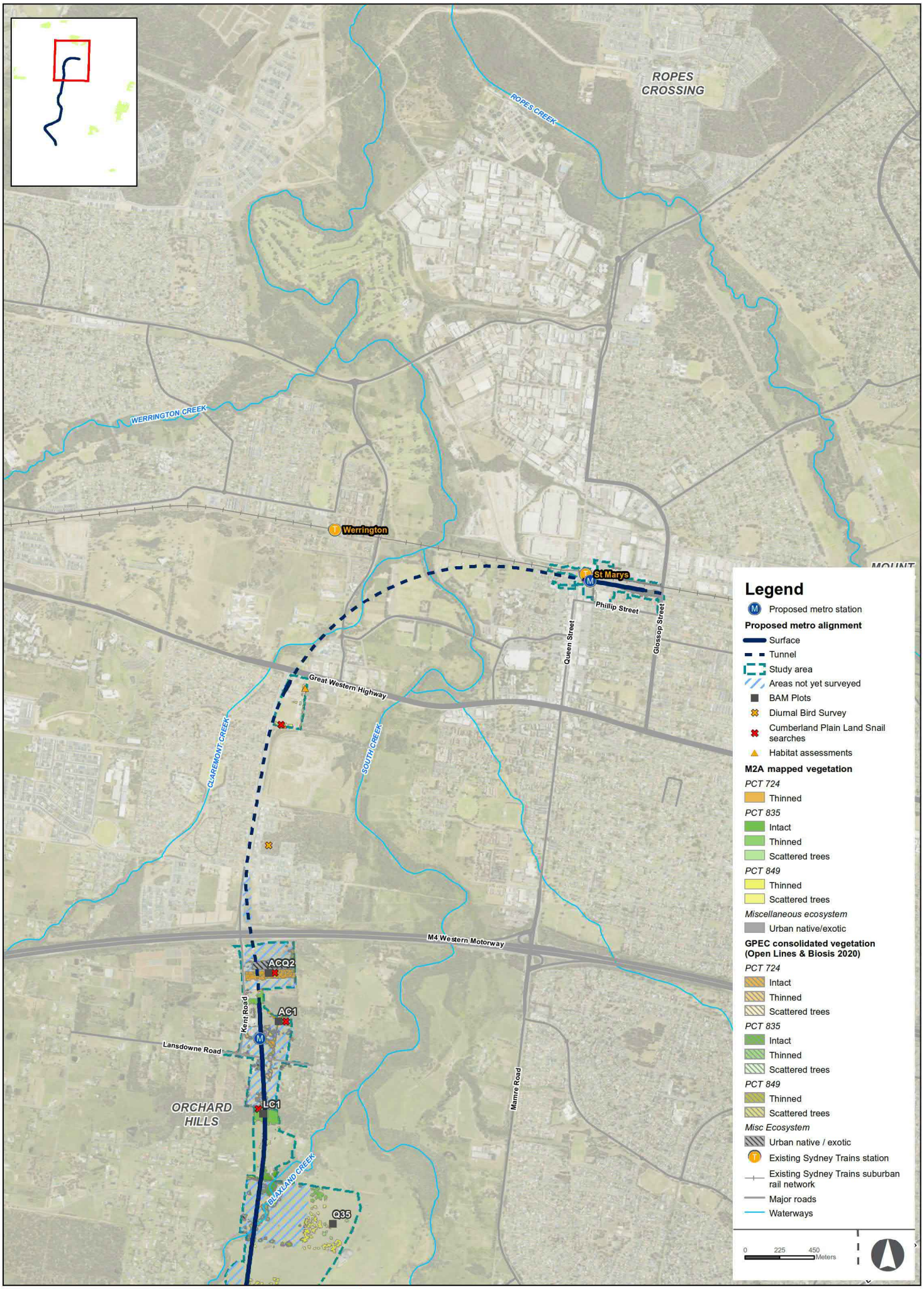
The following site attributes were recorded at each vegetation integrity plot location:

- location (easting – northing grid type MGA 94, Zone 56)
- vegetation structure and dominant species and vegetation condition. Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer
- native and exotic species richness (within a 400-metre squared quadrat): This consisted of recording all species by systematically walking through each 20 metre x 20 metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded
- number of trees with hollows (1000 metre squared quadrat): This was the frequency of hollows within living and dead trees within each 50 metre x 20 metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least 5 centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least 1 metre above the ground and the (e) the centre of the tree was located within the sampled quadrat
- number of large trees and stem size diversity (1000 metre squared quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (>5 centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks
- total length of fallen logs (1000 metre squared quadrat): This was the cumulative total of logs within each 50 metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre
- litter cover: This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter <10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect
- evaluation of regeneration: This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height ≤5 centimetre).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the study area and establishing the required number of plots at some of these waypoints.

Vegetation integrity plots used for BAM calculations for both on-airport and off-airport have been sampled within the broader study area. Given the relatively homogenous broad condition states for vegetation types, plots have been used across the study area rather than individual sampling for each on-airport or off-airport section.

A comparison of the number of BAM survey plots that were completed and the required BAM plots per vegetation zones is provided in Table 3.5 (off-airport) and Table 3.6 (on-airport). Vegetation integrity plot locations and orientations are provided in Table 3.7 and Figure 3.2.



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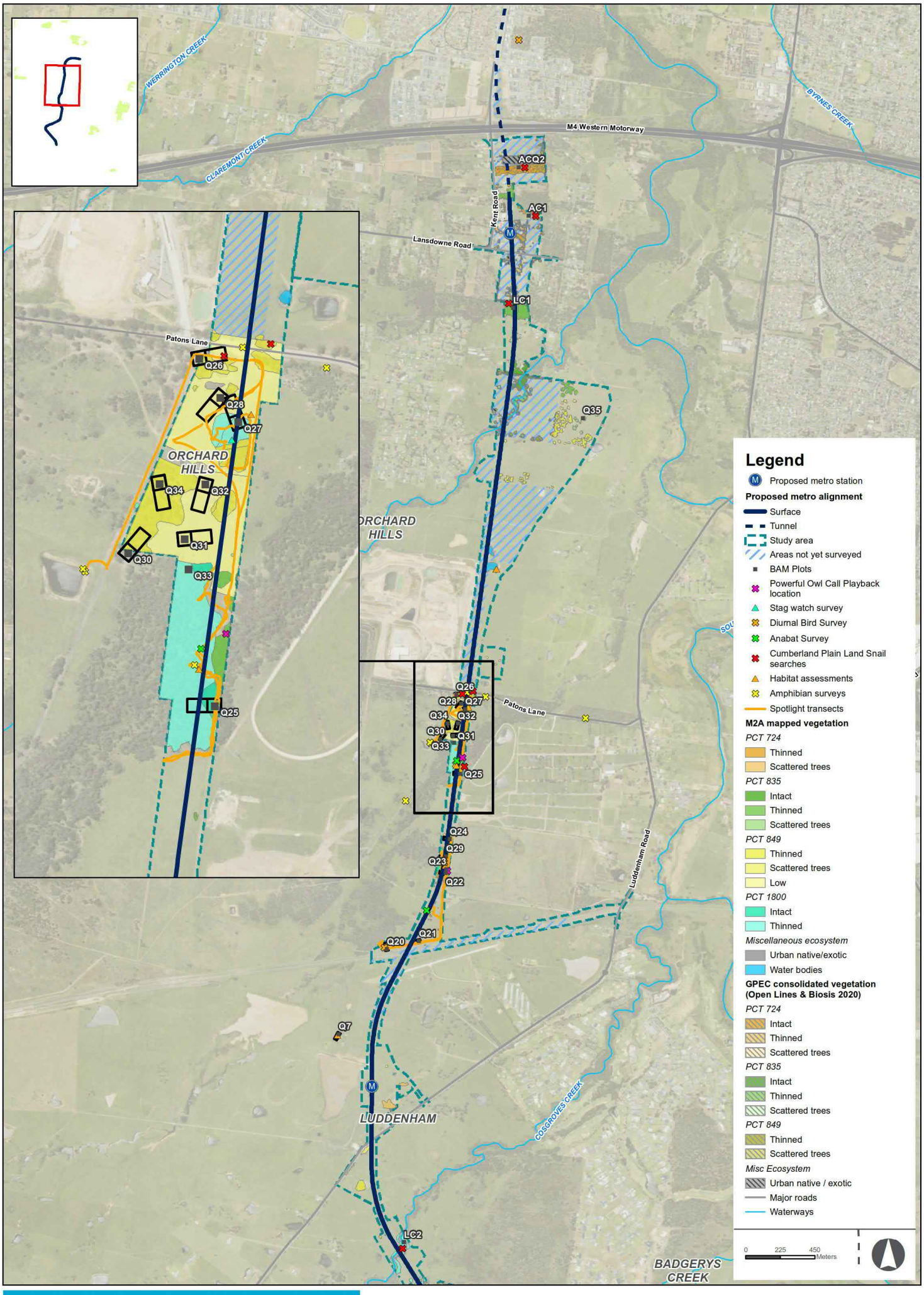
Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

M2A survey effort

Figure 3-2a



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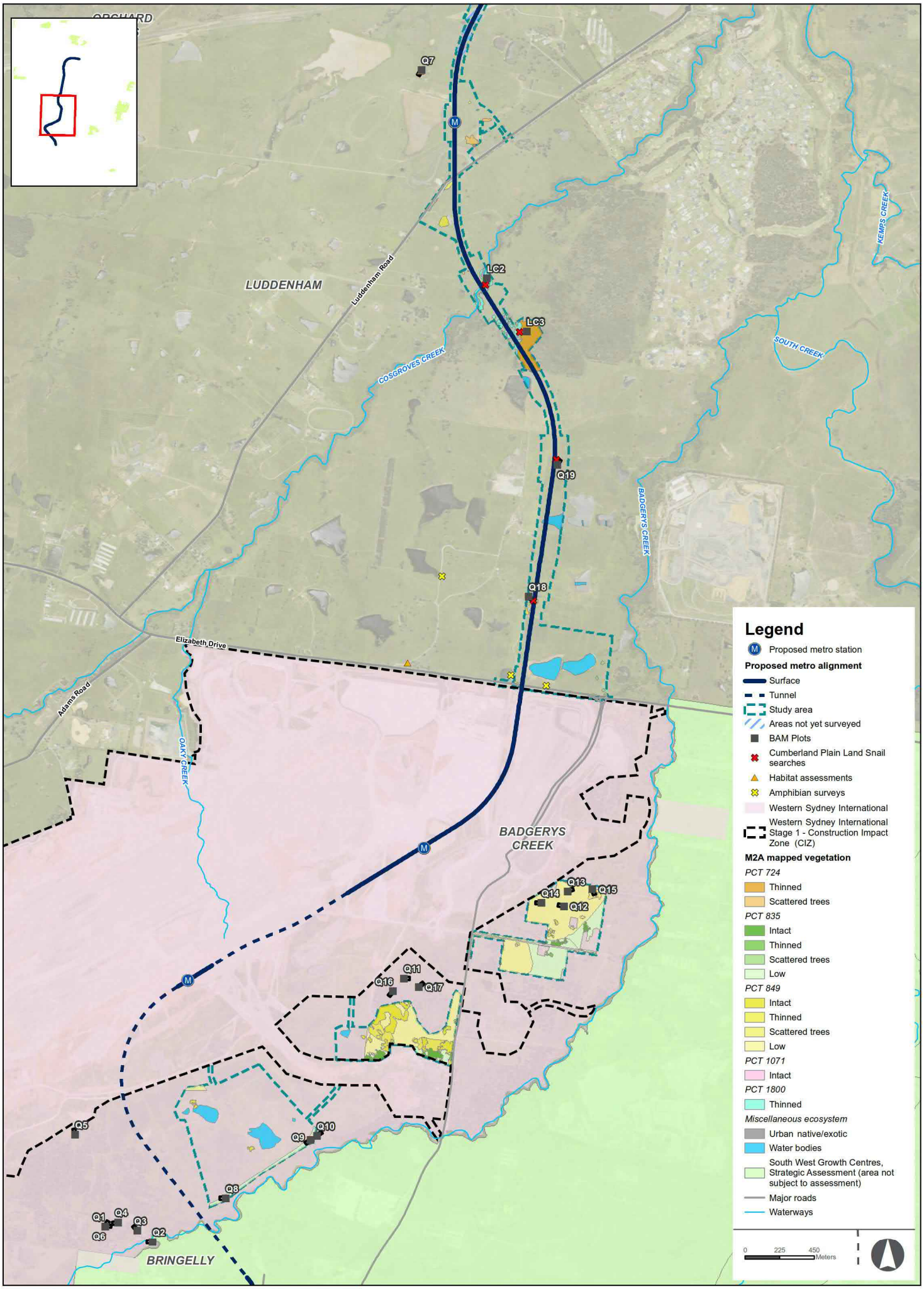
Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

M2A survey effort

Figure 3-2b



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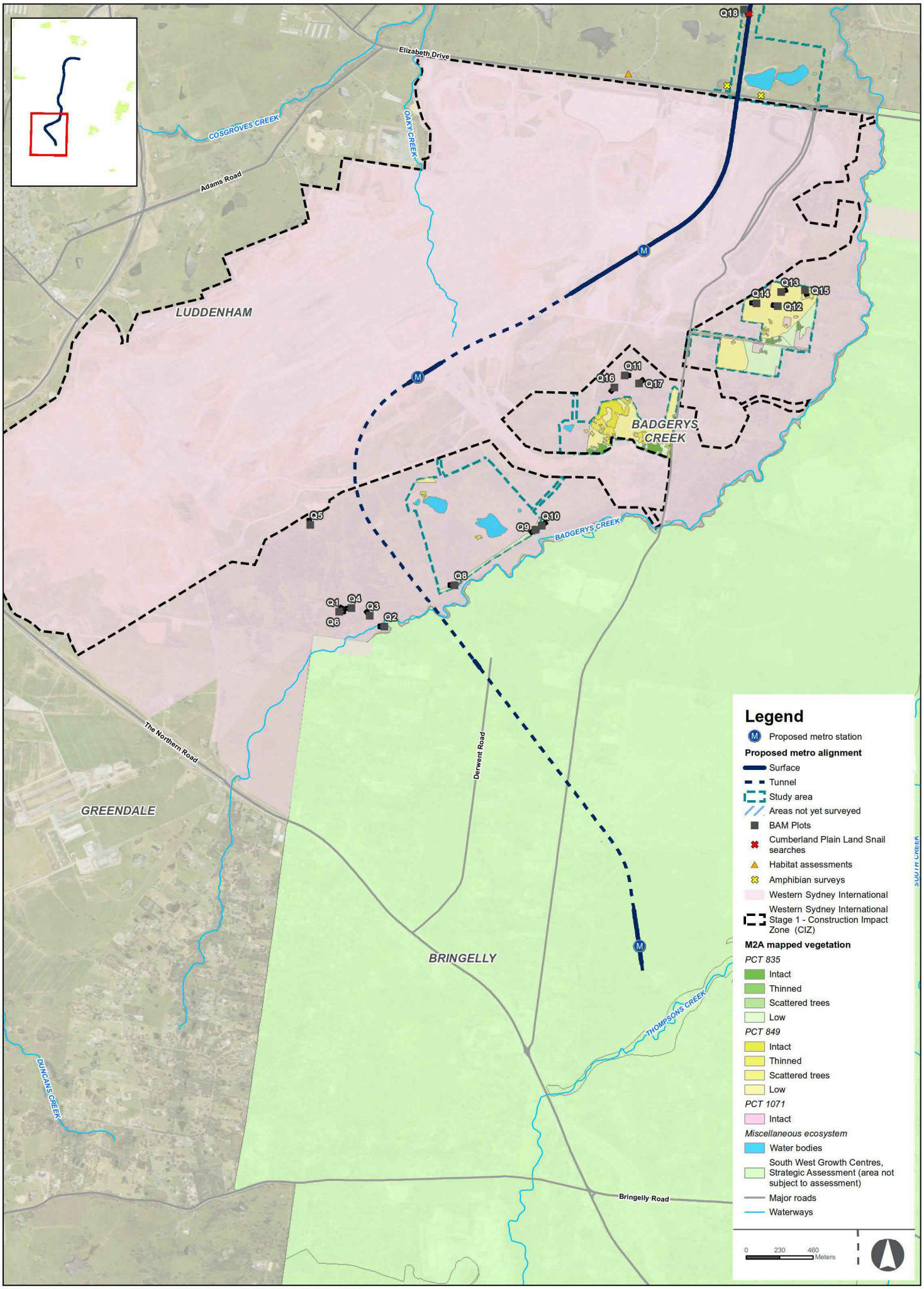
Indicative only, subject to design development

M2A survey effort

Figure 3-2c



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

M2A survey effort

Figure 3-2d

Table 3.5 Comparison of number of plots required under the BAM and completed per vegetation zone for off-airport land

Vegetation type and zone	Condition	Vegetation zone area (Hectares)		Vegetation zone area (hectares) total [2]	BAM plot required	Number of plots completed
		Project field surveys (M2A 2020)	Areas not surveyed (Open Lines and Biosis 2020)			
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.67	0.43	2.10	1	0[1]
	Thinned	6.09	0.82	6.91	3	5 (Q21, Q22, AC1, AC2, LC3)
	Scattered Trees	1.39	0.02	1.41	1	1 (Q19)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	0.53	0.81	1.34	1	1(LC1)
	Thinned	2.80	1.60	4.40	2	2 (Q10, Q23)
	Scattered Trees	0.45	0.04	0.49	1	1 (Q35)
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Thinned	4.09	0.57	4.66	2	4 (Q24, Q26, Q30, Q34)
	Scattered Trees	1.34	0.39	1.73	1	3 (Q5, Q15, Q18)
	Low	3.25		3.25	2	8 (Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32)
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	1.07		1.07	1	3 (Q25, Q29, Q33)
	Thinned	4.31		4.31	2	3 (Q20, Q27, LC2)

Notes:

(1) Vegetation Integrity Score from Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020) has been used to inform BAM-C (see Section 3.8.2)

(2) Indirect impacts included in total area

Table 3.6 Comparison of number of plots required under the BAM and completed per vegetation zone for on-airport land

Vegetation type and zone	Condition	On-airport Vegetation zone area (Hectares)	BAM plot required	Number of plots completed
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.53	1	1 (Q2)
	Thinned	0.09	1	2 (Q10, Q23)
	Low	10.21	3	2 (Q8, Q9)[1]
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	4.05	2	4 (Q1, Q4, Q6, Q16)
	Scattered Trees	2.32	1	3 (Q5, Q15, Q18)
	Low	23.79	3	8 (Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32)
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	0.01	1	1 (Q3)

Notes:

(1) An average of vegetation attributes collected during field survey have been used to inform the BAM-C (see Section 3.8.2)

Table 3.7 Summary of vegetation integrity plots

Plot ID	Vegetation type and zone	Easting	Northing	Orientation (°)
Q1	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288653	6246150	30
Q2	PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288963	6246049	270
Q3	PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Intact)	288862	6246124	320
Q4	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288737	6246177	260
Q5	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	288455	6246750	350
Q6	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	288653	6246150	90
Q7	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Scattered Trees)	290722	6253714	208
Q8	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	289442	6246336	270
Q9	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	289996	6246717	235
Q10	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	290038	6246743	56
Q11	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	290606	6247771	90
Q12	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291654	6248244	280
Q13	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291677	6248341	70
Q14	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291507	6248265	270
Q15	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	291840	6248354	160
Q16	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	290535	6247688	220

Plot ID	Vegetation type and zone	Easting	Northing	Orientation (°)
Q17	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	290705	6247716	50
Q18	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	291423	6250270	130
Q19	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	291609	6251132	33
Q20	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)	291038	6254270	350
Q21	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291259	6254818	260
Q22	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291423	6254767	280
Q23	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291411	625491	10
Q24	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291449	6254988	280
Q25	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Intact)	291516	6255416	270
Q26	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291493	6255933	80
Q27	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)	291551	6255839	340
Q28	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291524	6255875	220
Q29	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Intact)	291425	6254877	260
Q30	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291387	6255644	40
Q31	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291471	6255665	85
Q32	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)	291502	6255746	220
Q33	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Intact)	261477	6255620	195

Plot ID	Vegetation type and zone	Easting	Northing	Orientation (°)
Q34	PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291434	6255747	170
Q35	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)	292320	6257746	234
AC1	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291965	6259070	0
AC2	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291899	6259387	0
LC1	PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)	291863	6258466	263
LC2	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)	291149	6252354	194
LC3	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)	291410	6252006	28

3.5 BAM approach

The study area has been divided into two distinct areas, off-airport and on-airport.

This approach was taken to generate individual credit calculations and offsetting requirements for each area using the BAM-C (version 1.2.7.2). These areas have been delineated throughout this assessment and identified individually in figures and tables.

Vegetation Integrity Plots were undertaken following the methodology outlined in BAM (OEH, 2017) within the study area (areas located both on and off airport). Plots sampled across both areas were entered in the BAM-C in accordance with the minimum number of plots required per zone area (see Table 3.6) for each assessment. This approach was considered appropriate given the proximity between adjoining assessment areas and similar vegetation types and conditions recorded.

This approach is consistent with section 2.2.2 of the BAM where the use of more appropriate local data which more accurately reflect local environmental conditions is used.

3.6 Terrestrial flora surveys

Threatened terrestrial flora surveys were undertaken over a 18-day period between the 24-26 June 2019, 26 November 2019, 2-4 and 6 March 2020, 22-24 April 2020,10 June 2020, 15 October and 3, 9, 10, 16 and 20 November 2020. On-airport lands were also subject to targeted seasonal field surveys undertaken by Department of Infrastructure and Regional Development (2016e), Department of Infrastructure and Regional Development (2018b) and SMEC (2014), findings from these assessments have been adopted for the assessment of on-airport lands. Limitations to field survey including limited access to private residential property and COVID-19 restrictions are outlined in Section 3.8.

Field surveys focused on the mapping of native and non-native vegetation types and targeting the possible presence of threatened flora species using a combination of vegetation integrity plots, random meanders and parallel field traverses generally in accordance with:

- NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC, 2004)
- NSW Guide to Surveying Threatened Plants (OEH, 2016c)
- Surveying threatened plants and their habitats (Department of Planning, Industry and Environment, 2020) and the BAM (OEH, 2017).

A detailed overview of terrestrial flora survey methods is presented below.

3.6.1 Random meander surveys

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the study area recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Random meander surveys were undertaken in areas of highly disturbed vegetation and urban exotic vegetation as well as in areas of potential habitat for candidate threatened species. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

3.6.2 Parallel field traverses

These involved two people walking a fixed bearing transect at 10 metre intervals over known or high likelihood potential habitat for candidate threatened flora species (see Section 3.6.4). These were restricted to areas of native vegetation.

3.6.3 Threatened flora habitat suitability assessment

The BAM-C was used to derive the list of candidate species for each assessment (on and off airport lands), results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection (EES, 2020d), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the study area and broader locality. Additional species can be added to the BAM-C for further consideration if in the assessors' professional opinion, it is likely that the species would be present and/or the species has been recorded on or near the study area (OEH, 2018).

Section 6.4 of the BAM sets out a process for determining candidate species which require further consideration (i.e. targeted seasonal surveys, expert reports).

A candidate species predicted by the BAM-C may be excluded from needing further assessment because of:

- ecological information about a species provided in Threatened Biodiversity Data Collection (EES 2020d) 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, 2020d)) 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).

Each threatened flora species identified was subject to a habitat suitability assessment which is provided in Appendix A of this technical paper. These assessments considered microhabitats, soils, geologies, landscape position, vegetation types and condition within the study area and informed targeted field survey (i.e. optimal survey months). Species considered to have a low likelihood of occurrence and that did not require survey were dismissed at this habitat suitability assessment stage, (Appendix A of this technical paper).

3.6.4 Candidate terrestrial threatened flora species and survey effort

A total of 35 threatened flora species were identified by the BAM-C across on-airport and off-airport land. Of these, 15 were considered likely to occur on off-airport land based on geographic limitations, habitat constraints and professional opinion, these species were the focus of detailed targeted field surveys.

Targeted survey effort on-airport lands were carried out by Department of Infrastructure and Regional Development (2016e), Department of Infrastructure and Regional Development (2018b) and SMEC (2014) previously and supplemented by M2A 2020. Field surveys in off-airport lands were carried out by M2A in areas with non-restricted access (see Figure 3.2). The assessment of candidate species within areas where access was not available also considered any species expert reports prepared for candidate species within the Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

A summary of survey effort for each candidate threatened flora species and section of the study area is outlined in Table 3.8.

Table 3.8 Candidate threatened flora species and survey effort

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Acacia bynoeana	Bynoe's Wattle	E	V	PCT 724 & 849	All year	24-26 June 2019, 2-4, 5 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	No survey required due to low likelihood of occurrence (DIRD, 2016e) and (DIRD,2018b).
Acacia pubescens	Downy Wattle	V	V	PCT 724 & 849	All year	24-26 June 2019, 2-4, 5 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	4 days: 2-4, 6 March 2020 (M2A, 2020) 18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 5 days March-April 2017 (DIRD,2018b). 3 days: September, 2014 (SMEC, 2014)
Allocasuarina glareicola	-	E	E	PCT 724	All year	24-26 June 2019, 2-4, 5 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	No survey required due to low likelihood of occurrence (DIRD, 2016e).
Cynanchum elegans	White-flowered Wax Plant	E	E	PCT 835 & 849	All year	24-26 June 2019, 2-4, 5 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	4 days: 2-4, 6 March 2020 (M2A, 2020) 18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 5 days March-April 2017 (DIRD,2018b). 3 days: September, 2014 (SMEC, 2014)
Dillwynia tenuifolia	-	V	-	PCT 724 & 849	Aug-Oct	Expert report relied upon for this species in areas not subject to targeted survey (Rumer, 2019). 15 October, 3, 9, 10, 16 and 20 November 2020, surveys were completed following confirmation of flowering at a reference site.	3 days: September, 2014 (SMEC 2014). 5 days March-April 2017 (DIRD,2018b).

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	PCT 724 & 849	All year	24-26 June 2019, 2-4, 5 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020. For sites where access was not available, expert report was relied upon for this species (Weston, 2019)	4 days: 2-4, 6 March 2020 (M2A, 2020) 18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 3 days: September, 2014 (SMEC, 2014) Expert report relied upon for this species (Weston, 2018)
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	PCT 724	Aug-Nov	26 November 2019, 15 October, 3, 9, 10, 16 and 20 November 2020	3 days: September, 2014 (SMEC, 2014)
Hibbertia fumana	-	CE	-	PCT 724	Oct-Dec	26 November 2019. 15 October, 3, 9, 10, 16 and 20 November 2020. Expert report relied upon for this species (Miller, 2018a)	Field surveys not conducted within optimal survey months. Expert report relied upon for this species (Miller, 2018a)
Marsdenia viridiflora subsp. viridiflora - Endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population	E	-	PCT 724, 835, 849 & 1800	Nov-Feb	24-26 June 2019, 26 November 2019, 2-4, 5 March 2020, 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 3 days: September, 2014 (SMEC, 2014) 5 days March-April 2017 (DIRD,2018b).
Micromyrtus minutiflora	-	E	V	PCT 724	All year	24-26 June 2019, 2-4, 5 March 2020; 26 November 2019; 22-24 April 2020; 10 June 2020. 15 October, 3, 9, 10, 16 and 20 November 2020	Potential habitat not recorded.

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Persoonia nutans	Nodding Geebung	E	E	PCT 724	All year	24-26 June 2019, 4 March 2020; 26 November 2019; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	No survey required due to low likelihood of occurrence (DIRD, 2016e).
Pimelea curviflora var. curviflora	-	V	V	PCT 849	Oct-Mar	24-26 June 2019, 4 March 2020; 26 November 2019; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	No survey required due to low likelihood of occurrence (DIRD, 2016e).
Pimelea spicata	Spiked Rice-flower	E	E	PCT 849	All year	24-26 June 2019, 4 March 2020; 26 November 2019; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	4 days: 2-4, 6 March 2020 (M2A, 2020) 18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 5 days March-April 2017 (DIRD,2018b).3 days: September, 2014 (SMEC, 2014)
Pomaderris brunnea	Brown Pomaderris	E	V	PCT 835 & 1800	Aug-Oct	24-26 June 2019, 26 November 2019; 4 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 3 days: September, 2014 (SMEC, 2014)
Pterostylis saxicola	Sydney Plains Greenhood	E	E	PCT 849	Oct	Field surveys not conducted within optimal survey months. Expert report relied upon for this species (Weston, 2019)	Field surveys not conducted within optimal survey months. Expert report relied upon for this species (Weston, 2018)
Pultenaea parviflora	-	E		PCT 724	Sept-Nov	24-26 June 2019, 4 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 3 days: September, 2014 (SMEC, 2014)

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Thesium australe	Austral Toadflax	V		PCT 849	Nov-Feb	24-26 June 2019, 26 November 2019; 4 March 2020; 22-24 April 2020; 10 June 2020, 15 October, 3, 9, 10, 16 and 20 November 2020	18 days: Feb-June 2015; April 2016 (DIRD, 2016e) 3 days: September, 2014 (SMEC, 2014)

Notes:

(1) V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act or Commonwealth EPBC Act
(2) Associated vegetation types were obtained from the Threatened Biodiversity Data Collection (EES, 2020d)
(3) Optimal survey months were obtained from the BAM-C and cross-referenced with the Threatened Biodiversity Data Collection (EES, 2020d)

3.7 Terrestrial fauna surveys

Threatened terrestrial fauna surveys were undertaken over 19 days or evenings in the non-restricted areas of off-airport lands within or nearby the study area on the 24-26 June and 26 November 2019 as well as the 2-6 March, 22-24 April 2020, 10 June 2020, 15 October and 3, 9, 10, 16 and 20 November 2020.

Targeted survey effort within on-airport lands were carried out by DIRD (2016e) and SMEC (2014) whereas field surveys in off-airport lands were carried out by M2A in 2020 in areas where access was available (see Figure 3.2). Candidate species which did not require survey were dismissed during habitat suitability assessments, this is provided in Appendix B. Limitations to field survey including access restrictions are outlined in Section 3.8.

Fauna surveys undertaken through the study area were carried out with reference to various survey guidelines including:

- 'Species Credit' threatened bats and their habitats (Office of Environment and Heritage, 2018b)
- NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (Department of Environment and Conservation, 2004)
- Survey Guidelines for Australia's Threatened Birds (Department of Environment Water Heritage and the Arts, 2010)
- Threatened Species survey and assessment guidelines: field survey and methods for fauna-Amphibians (Department of Environment and Climate Change, 2009)
- Survey guidelines for Australia's threatened frogs (Department of the Environment Water Heritage and the Arts, 2010).

A summary of methods and survey effort is provided below.

3.7.1 Weather conditions

Weather condition observed during the M2A survey period are outlined in Table 3.9.

Table 3.9 Weather conditions observed during M2A survey period

Date	Temperature (°C)		Rainfall (millimetres)
	Minimum	Maximum	
24 June 2019	8.2	17.4	0.0
25 June 2019	8.6	17.8	7.8
26 June 2019	10.7	18.0	2.8
26 November 2019	16.9	34.5	9.4
2 March 2020	15.8	36.4	0.0
3 March 2020	18.4	20.8	0.0
4 March 2020	7.7	22.4	11.2
5 March 2020	18.9	23.2	10.8
6 March 2020	20.2	29.2	24.6
22 April 2020	8.9	25.4	0.0
23 April 2020	7.9	24.2	0.0
24 April 2020	11.7	27.4	0.0
10 June 2020	11.8	17.1	0.6
15 October 2020	11.9	29.5	0.0

Date	Temperature (°C)		Rainfall (millimetres)
	Minimum	Maximum	
3 November 2020	9.7	25.3	0.0
9 November 2020	13.4	25.5	0.0
10 November 2020	11.6	28.2	0.0
16 November 2020	17.1	40.6	0.0
20 November 2020	Data not available	37.3	Data not available

Notes: Climate data was obtained from AWS 067108 - Badgerys Creek NSW

3.7.2 Habitat assessment

Fauna habitat assessments were undertaken throughout the study area, 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.

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.

Evaluation criteria used to assess fauna habitat value is provided in Table 3.10.

Table 3.10 Fauna habitat assessment evaluation criteria

Habitat value	Evaluation criteria
Good	A full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
Moderate	Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
Poor	Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

3.7.3 Herpetofauna searches

Herpetofauna active searches during the day and at night, involved looking for active specimens and eye shine, turning over suitable ground shelter, such as fallen timber, sheets of iron and rubbish, raking debris, and peeling decorticating bark. Specimens were either identified visually, by aural recognition of call (frogs only) or were collected and identified using nomenclature outlined in A Field Guide to Reptiles of New South Wales (Swan et al., 2004).

Herpetofauna surveys were completed by one or two persons over a 30-minute period with all ground shelter returned to their original position. Herpetofauna active searches were completed in conjunction with diurnal and nocturnal field surveys. Frogs and reptiles were also surveyed opportunistically during all other field surveys in the study area.

3.7.4 Active invertebrate searches

Active invertebrate searches involve diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting specific habitat. In relation to threatened invertebrate species (Cumberland Plain Land Snail) specific habitat preferences include under logs and other debris, amongst leaf litter and bark accumulations around bases of trees and sometimes in clumps of grass. Invertebrates are also known to shelter under rubbish, disposed building materials and abandoned car parts (National Parks and Wildlife Service, 2000). The Cumberland Plain Land Snail was also surveyed for after dusk and light rain during spotlighting surveys on 2 - 4 March 2020.

3.7.5 Microchiropteran bat surveys (Ultrasonic Anabat bat detection)

Microbat ultrasonic echolocation call recordings were undertaken to identify the species of microbats foraging across several native vegetation communities in the study area. Passive monitoring of these survey sites was achieved by setting an Anabat Swift bat detector (Titley Scientific) to record continuously throughout the evening within the study area. Active surveys for the Southern Myotis were undertaken at farm dams on the study area with a handheld Echometer Touch (Wildlife Acoustics, USA) and headtorch.

Bat call analysis was completed by Rob Gration (EcoAerial Pty Ltd), with the presentation of data and species nomenclature considering the guidelines of the Australasian Bat Society. Bat calls of the New South Wales Sydney Basin region (Pennay *et al.,* 2004) was used as a reference collection for bat call identification. Bat call analysis sonograms are provided in Appendix E.

3.7.6 Diurnal bird surveys

Formal 20-minute diurnal bird searches were completed within the study area. Bird surveys were completed by actively walking through the study area over a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred during morning hours or evening. Birds were also recorded opportunistically during all other field surveys.

3.7.7 Spotlighting

Spotlighting was used to target arboreal, flying and ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. Spotlighting was completed after dusk (March and April, 2020) and completed on foot using high-powered headlamps and Red X-Beam hand torches (Wolfeyes). Sighted animals were identified to the species level.

3.7.8 Call playback

Call playback was used to survey for frogs (i.e. Green and Golden Bell Frog), nocturnal birds (i.e. Powerful Owl) and nocturnal mammals, using standard methods. Call playback was completed after dusk within several sites in the off-airport non-restricted areas around key fauna habitat such as ephemeral creeks, farm dams or remnant vegetation.

For frog surveys, an initial listening period of 5 minutes was undertaken. The call of the Green and Golden Bell Frog was then played for 1 minute, followed by a 5-minute listening period. Nocturnal call playback surveys were followed by a spotlight search for 10 minutes to detect any frogs present but not calling. Calls from the Australian Museum FrogID App were broadcast using a portable media player and bluetooth speaker.

For threatened owl surveys, an initial listening period of 10 minutes was undertaken. The calls of the target species were then played for three 2 minute intervals followed by three listening periods. A spotlight search was undertaken for 10 minutes after call playback to identify any owls that may have responded by flying quietly to the playback site. Calls were broadcast using a portable media player and bluetooth speaker.

3.7.9 Threatened fauna habitat suitability assessment

The BAM-C was used to derive the list of candidate species for each assessment (on and off airport lands), results were also supplemented with database searches, including a review of the Threatened Biodiversity Data Collection (EES, 2020d), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the study area and broader locality. Additional species can be added to the BAM-C for further consideration if in the assessor's professional opinion, it is likely that the species would be present and/or the species has been recorded on or near the study area (OEH, 2018).

These searches returned a list of threatened fauna species identified as Candidate species and/or Predicted species. Each species was subject to a habitat suitability assessment for on-airport and off-airport land areas of the study area. These are provided in Appendix B.

The BAM does not require further assessment of NSW-listed Predicted species, as these species are associated with specific PCTs and their presence in these PCTs is assumed for the purposes of the BAM. Predicted species are addressed in more detail in Section 6.2 of this technical report.

Section 6.4 of the BAM sets out a process for determining candidate species which require further consideration (i.e. targeted seasonal surveys, expert reports).

A candidate species predicted by the BAM-C may be excluded from needing further assessment because of:

- ecological information about a species provided in Threatened Biodiversity Data Collection (EES, 2020d) 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, 2020d)) 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).

These assessments considered microhabitats, soils, geologies, landscape position, vegetation types and condition within the study area and informed targeted field survey (i.e. optimal survey months).

3.7.10 Candidate terrestrial threatened fauna species and survey effort

A total of 47 threatened fauna species were identified by the BAM-C and Candidate species across off-airport and on-airport land. Of these, 12 were considered likely to occur based on geographic limitations, habitat constraints and professional opinion. These species were the focus of detailed targeted surveys in areas with non-restricted access.

Targeted surveys within on-airport lands were carried out by Department of Infrastructure and Regional Development (2016e), Department of Infrastructure and Regional Development (2018b) and SMEC (2014) whereas field surveys in off-airport lands were carried out by M2A for the project in areas with non-restricted access (see Figure 3.2). Candidate species which did not require survey were dismissed during habitat suitability assessments (see Appendix B) or are predicted species and can be reliably predicted through habitat surrogates.

A summary of survey effort for each candidate threatened fauna species and section of the study area is outlined in Table 3.11.

Table 3.11 Candidate threatened fauna species and survey effort

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Eucalypt tree species with hollows greater than 9 centimetres diameter.	Oct-Jan (Breeding)	Diurnal bird surveys and opportunistic surveys: 2-6 March, 2020 22-24 April, 2020; 10 June 2020, 15 October 2020, 3, 9, 10, 16 and 20 November 2020	Diurnal bird surveys: 17 days; May-June, 2015 (DIRD, 2016e) Opportunistic surveys: 18 days; Feb-June 2015 (DIRD, 2016e)
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Living or dead tree with hollows greater than 15 centimetres diameter and greater than 5 metres above ground.	Mar-Aug (Breeding)	Diurnal bird surveys and opportunistic surveys: 2-6 March, 2020 22-24 April, 2020; 10 June 2020	Diurnal bird surveys: 10 days; May-June, 2015 (DIRD, 2016e) Opportunistic surveys: 18 days; Feb-June 2015 (DIRD, 2016e)
Hieraaetus morphnoides	Little Eagle	V	-	Nest trees - live (occasionally dead) large old trees within vegetation.	Aug-Oct (Breeding)	Diurnal bird surveys and opportunistic surveys: 2 -6 March, 2020 22-24 April, 2020; 10 June 2020, 15 October 2020, 3, 9, 10, 16 and 20 November 2020	Diurnal bird surveys: 10 days; May-June, 2015 (DIRD, 2016e) Opportunistic surveys: 18 days; Feb-June 2015 (DIRD, 2016e)

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Lathamus discolor	Swift Parrot	E	CE	The species is only present during March to September - winter migrant to NSW. Breeding constraint: As per mapped areas in the National Recovery Plan	No survey required	Diurnal bird surveys and opportunistic surveys: 2-6 March, 2020 22-24 April, 2020; 10 June 2020	Diurnal bird surveys: 17 days; May-June, 2015 (DIRD, 2016e)
Litoria aurea	Green and Golden Bell Frog	E	V	Wet areas, swamps, waterbodies or within 1 kilometre of these areas	Nov-Mar	Targeted surveys (including call playback): 2-5 March, 2020 22-24 April, 2020	Four nights of targeted surveys in March, 2015 at the airport site and three nights surveying a reference site (Homebush population) (DIRD, 2016e)
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	-	All year	Targeted surveys: 3 -6 March, 2020 22-24 April, 2020, 15 October 2020, 3, 9, 10, 16 and 20 November 2020	Invertebrate active searches: 11 days: Mar-May, 2015 (DIRD, 2016e)
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	Dec-Feb (Breeding)	Anabat: One unit for 3 nights (22-24 April 2020)	Anabats: two units for 9 nights in March and April, 2015, 3 nights in May (DIRD, 2016e)

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Myotis macropus	Southern Myotis	V	-	Breeding requirements (HBTs within 200 metres of riparian zone and waterbodies within 200 metres of the Study area) not recorded within the Study area	Nov-Mar	Anabat: One unit for 3 nights (22-24 April 2020) Active survey of farm dams with Echometer Touch and headtorch.	Anabats: two units for 9 nights in March and April, 2015, 3 nights in May (DIRD, 2016e)
Ninox connivens	Barking Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Dec (Breeding)	Call playback: 22-24 April 2020	Call-playback: 9 nights: Mar - May 2015 (DIRD, 2016e) Habitat assessments: 18 days Feb – June 2015 (DIRD, 2016e)
Ninox strenua	Powerful Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Aug (Breeding)	Call playback: 22-24 April 2020	Call-playback: 9 nights: Mar - May 2015 (DIRD, 2016e) Habitat assessments: 18 days Feb – June 2015 (DIRD, 2016e)
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Breeding camps	All year	Spotlighting: 2-5 March, 2020 22-24 April, 2020 Habitat assessment: 2 -6 March, 2020 22-24 April, 2020	Bird surveys (nocturnal): 12 nights Mar-May, 2015 (DIRD, 2016e) Habitat assessment: Feb-June 2015 (DIRD, 2016e)

Scientific Name	Common Name	BC Act[1]	EPBC Act[1]	Potential breeding habitat[2]	Survey months[3]	Survey effort	
						Off-airport (M2A)	On-airport
Tyto novaehollandiae	Masked Owl	V	-	Living or dead trees with hollows greater than 20 centimetres diameter and greater than 4 metres above the ground	May-Aug (Breeding)	Call playback: 22-24 April 2020	Call-playback: 9 nights: Mar - May 2015 (DIRD, 2016e) Habitat assessments: 18 days Feb – June 2015 (DIRD, 2016e)

Notes:

(1) V = Vulnerable, E = Endangered under the NSW BC Act or Commonwealth EPBC Act
(2) Breeding habitat constraints were obtained from the Threatened Biodiversity Data Collection (EES, 2020d)
(3) Optimal survey months were obtained from the BAM-C and cross-referenced with the Threatened Biodiversity Data Collection (EES, 2020d)

3.8 Limitations

Detailed desktop assessment was undertaken prior to field surveys to identify the threatened biodiversity likely to occur in the locality and determine the field survey effort required for the scale of the project and its ecological context. However, the precise range of habitats utilised by some species is not well understood. Furthermore, the discovery of unknown populations of threatened species, even well outside their known range, is always present. This applies particularly to cryptic species of plants and animals and easily go undetected despite intensive survey.

No sampling technique can eliminate the possibility that a species is present within the study area. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the study area during survey periods.

3.8.1 Access restrictions

Access was restricted within some locations of the study area (e.g. private properties) and subsequently some of these areas could not be surveyed. Where access on foot was restricted or limited but adjacent areas were accessible, vegetation community boundaries, condition and threatened flora and fauna habitat attributes were extrapolated from a distance with the aid of binoculars. Where the vegetation could not be viewed existing vegetation mapping of the area and aerial photo interpretation was used.

A conservative approach has been adopted in these restricted areas whereby existing vegetation mapping (Open Lines and Biosis 2020) has been adopted and the presence of threatened flora has been assumed in areas of suitable habitat. Fauna presence and habitat attributes were observed from a distance where possible and extrapolated based on habitat assessments.

3.8.2 Use of more appropriate local data

In areas where access was restricted and field verification was not possible, the use of more appropriate data as described in section 2.2.2 of the BAM was adopted. Field data collected during previous ecological assessments (i.e. Open Lines and Biosis, 2020) was used to inform vegetation mapping and Vegetation Integrity Plot data for vegetation zones unable to be sampled. This approach is the preferred approach rather than adopting benchmark data for these vegetation communities. This approach is considered appropriate given the proximity of accessible and non-accessible areas, similar vegetation types, conditions and habitats and has been applied to those areas identified in Figure 3.2.

For vegetation zones where the minimum number of plots were not collected during field surveys (due to access restrictions, change in project design etc.), an average of each attribute was used to determine the vegetation integrity score (i.e. PCT 835-low). For vegetation zones where this was not possible, vegetation integrity score from previous ecological assessments (Open Lines and Biosis, 2020) was adopted to ensure data which was the most representative of site conditions was used to generate credit obligations.

4 Landscape context

This chapter specifically addresses section 4 and table 25 of the BAM and provides information on a range of landscape features that occur on the study area and in surrounding areas.

The landscape features outlined below are used to inform the habitat suitability of the study area for threatened species and the potential movement of species across the landscape.

4.1 Landscape features

The study area is in the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and occurs within the Cumberland IBRA subregion (IBRA version 7.0). Landscape features within the study area as prescribed in section 4.2 of the BAM are summarised in Table 4.1 and shown in Figure 4.1.

Table 4.1 Summary of landscape features in the study area

Landscape features	Study area	
	Off-airport (north of airport)	On-airport
IBRA bioregions and subregions	Sydney Basin Bioregion, Cumberland subregion	Sydney Basin Bioregion, Cumberland subregion
NSW landscape regions (Mitchell landscapes)	Cumberland Plain, Hawkesbury - Nepean Channels and Floodplains	Cumberland Plain, Hawkesbury - Nepean Channels and Floodplains
Local Government Area (LGA)	Penrith City Council	Liverpool City Council
Rivers, streams and estuaries	Blaxland Creek, Cosgroves Creek, South Creek	Badgerys Creek (nearby)
Important and local wetlands	None	None
Connectivity features	Riparian areas of creeklines; Defence Establishment Orchard Hills (DEOH)	Riparian areas of creeklines
Areas of geological significance and soil hazard features	None	None
Areas of outstanding biodiversity value	None	None

4.1.1 Rivers, streams and estuaries

A search of Metropolitan Sydney Estuaries of NSW database (EES, 2020b) revealed that no estuaries occur within the study area. The nearest identified estuaries occur to the east of the study area, being Georges River (23 kilometres) and Cooks River (36 kilometres).

Rivers, streams and their riparian buffers are identified in an assessment as important ecological connectivity and habitat features. Riparian buffers are important for maintaining or improving the shape, stability and ecological functions of the water body as well as providing a diversity of habitat for terrestrial, riparian and aquatic plants and animals.

Rivers and streams which occur on the study area have been mapped on Figure 4.1 and are summarised in Table 4.2. Riparian buffers have been mapped according to Strahler order in accordance with Appendix 3 of the BAM.

Table 4.2 Rivers and streams within the study area

Study area	Rivers and streams	Strahler order	Riparian buffer (metres)
Off-airport	Blaxland Creek	4	40
	Cosgroves Creek	4	40
	Unnamed Creek	1	10
	Unnamed Creek	2	20
	Unnamed Creek	3	30
	Unnamed Creek	4	40
On-airport	Unnamed Creek	1	10
	Unnamed Creek	2	20
	Unnamed Creek	3	30

4.1.2 Connectivity

Significant biodiversity links are those that connect different areas of habitat, facilitating movement of threatened species across their distribution. The presence of significant biodiversity links within a site contributes to the biodiversity value of that study area at the landscape scale (Office of Environment and Heritage, 2018).

The study area encompasses a highly fragmented landscape with areas of agricultural, residential and commercial land use. Generally, habitat connectivity was limited to riparian corridors (particularly Badgerys Creek, Cosgrove Creek and Blaxland Creek). These riparian corridors are mapped as regional corridors within draft Priority Investment Areas of the Biodiversity Investment Opportunities Map as they have connectivity to Wianamatta Regional Park near Ropes Crossing (OEH, 2015). All riparian corridors have been subject to varying levels of clearing and disturbance.

DEOH (off-airport) is located between Warragamba to Prospect Water Supply Pipelines and Patons Lane and has connectivity to a large bushland patch to the west. This large patch (about 700 hectares) is isolated in the locality.

4.1.3 Areas of geological significance and soil hazard

Areas of geological significance generally include karst, caves, crevices and cliffs. During field survey, these features were not recorded within areas within non-restricted access and are considered unlikely to occur in areas that have not been surveyed.

Acid sulfate soils were not recorded during field survey or are identified in the Acid Sulfate Soils Risk Maps (Department of Planning, Industry and Environment, 2011). See Technical Paper 7 (Groundwater) of the project Environmental Impact Statement for further detail.

Salinity refers to the amount of dissolved salt in the soil. A large concentration of salt gives high salinity and increasing salinity makes it difficult for plant roots to absorb water. The Western Sydney Hydrogeological Landscape maps show much of Western Sydney as having high land salinity (Office of Environment and Heritage, 2011; Open Lines and Biosis, 2020).

4.1.4 Areas of outstanding biodiversity value

Areas of declared critical habitat that were listed under the now repealed *Threatened Species Conservation Act 1995* have become the first declared areas of outstanding biodiversity value in NSW with the commencement of the BC Act.

To date, there are only four declared areas of outstanding biodiversity value and these areas are not located in or near the study area for the project. The proposed construction footprint does not contain any areas of outstanding biodiversity value listed on the register of declared areas of outstanding biodiversity value (NSW Environment, Energy and Science Group, 2020a).

4.2 Determining the site context

To determine site context as required under section 4.3 of the BAM, an assessment of native vegetation cover and patch size in accordance with subsections 4.3.2 and 5.3.2 of the BAM have been undertaken and are outlined below.

4.2.1 Percent native vegetation cover

Native vegetation cover within the study area and a 500-metre buffer area along each side of the centre line of the study area was determined in accordance with subsection 4.2.2 of the BAM and is summarised in Table 4.3 and shown in Figure 4.2.

Table 4.3 Native vegetation cover

Project location	Assessment area	Total assessment area (hectares)	Area of native vegetation cover (hectares)	Native vegetation percentage cover (per cent)
Off-airport (north of airport)	500 metres along each side of the centre line of the proposed construction footprint	1877	300	16
On-airport		1068	369	35

4.2.2 Patch size

Patch size is defined under the BAM (OEH, 2017) as an area of native vegetation that:

- occurs on the study area
- includes native vegetation that has a gap of less than 100 metres from the next area of moderate to good native vegetation (or ≤ 30 metres for non-woody ecosystems).

Patch size may extend onto adjoining land that is not part of the study area. Patch size area is assigned to each vegetation zone as a class, being < 5 hectares, 5-24 hectares, 25-100 hectares or ≥ 100 hectares.

Within on-airport lands, vegetation zones were assigned to a patch size class of 25-100 hectares, this is due to the derived native grasslands (low condition vegetation) encompassing patches of woody vegetation. These areas of native vegetation (both woody and non-woody) were assigned to a single patch.

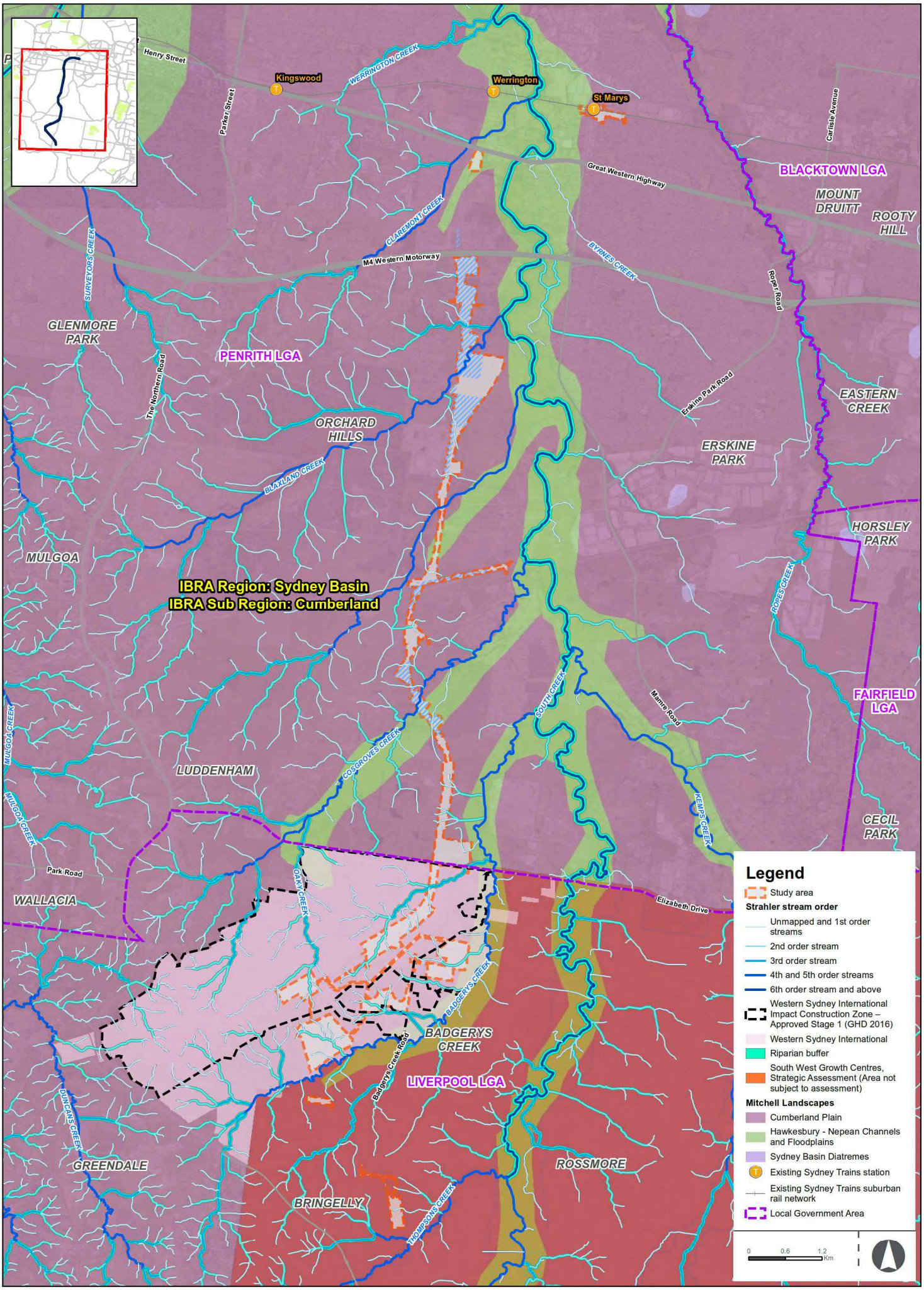
Within off-airport lands patch size classes varied between <5 hectares, 5-24 hectares, 25-100 hectares and >100 hectares. Patches of <5 hectares were generally scattered trees surrounded by non-native vegetation. Patch size classes of >100 hectares were recorded on DEOH where there is habitat connectivity to large bushland patches in Orchard Hills.

Patch size classes for each vegetation zone are outlined in Table 4.4.

Table 4.4 Patch size classes for each vegetation zone

PCT condition	Condition	Patch size class (hectares)	
		Off-airport	On-airport
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	25-100	-
	Thinned	25-100	-
	Scattered Trees	5-24	-
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	>100	25-100
	Thinned	>100	25-100
	Scattered Trees	<5	-
	Low	-	25-100

PCT condition	Condition	Patch size class (hectares)	
		Off-airport	On-airport
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	-	25-100
	Thinned	>100	-
	Scattered Trees	5-24	25-100
	Low	>100	>100
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	-	25-100
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	>100	-
	Thinned	>100	-



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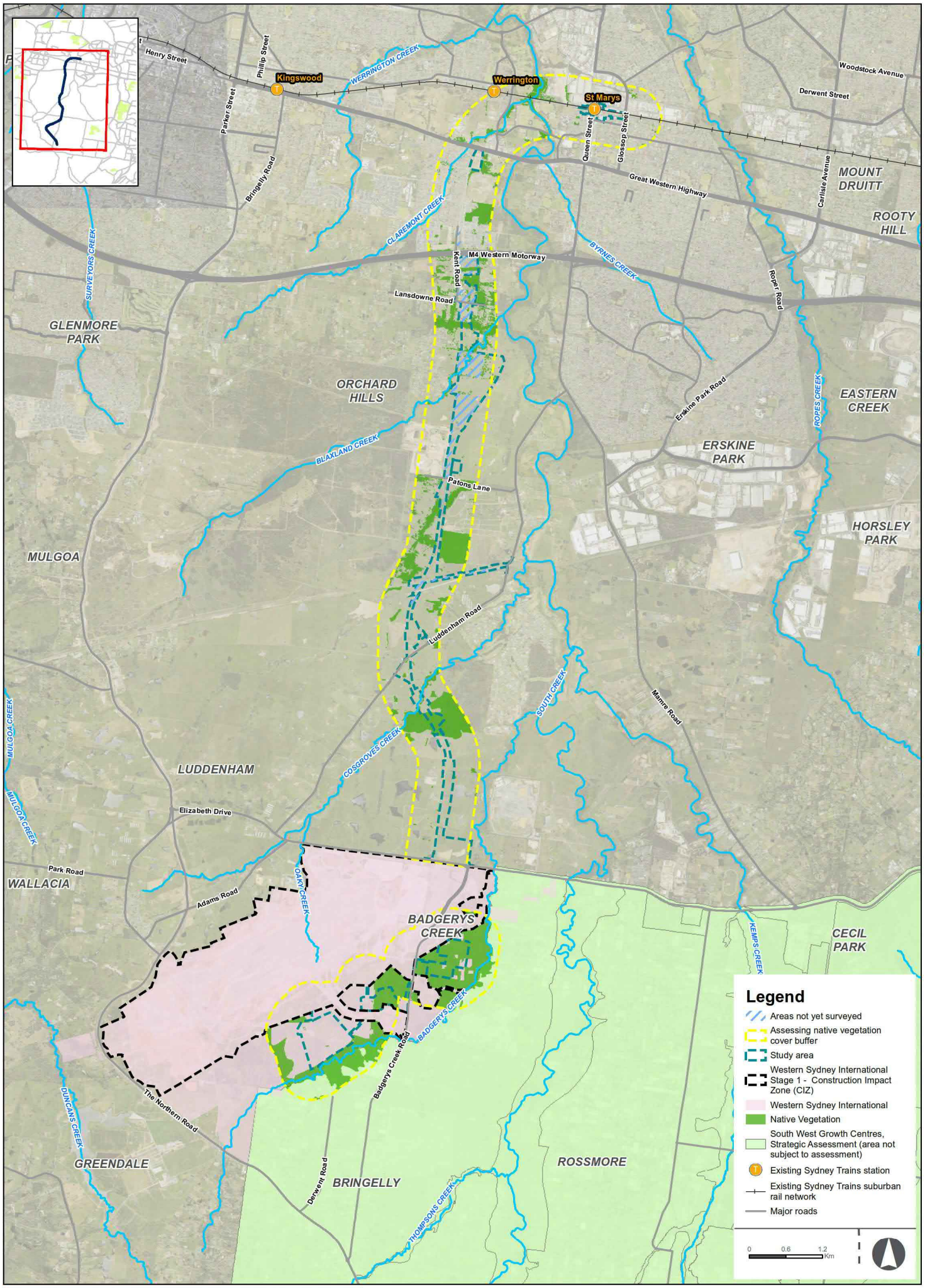
Landscape features

Figure 4-1



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Determining site context

Figure 4-2

5 Native vegetation and threatened ecological communities

The section has been prepared to address section 5 and table 25 of the BAM and provides information on native vegetation, threatened ecological communities (TECs) and vegetation integrity.

Specifically, this section maps and identifies all native and non-native vegetation types within the study area and provides an assessment of vegetation integrity and whether any recorded vegetation types correspond to TECs listed under the BC Act.

5.1 Native vegetation

Five PCTs were recorded in the study area:

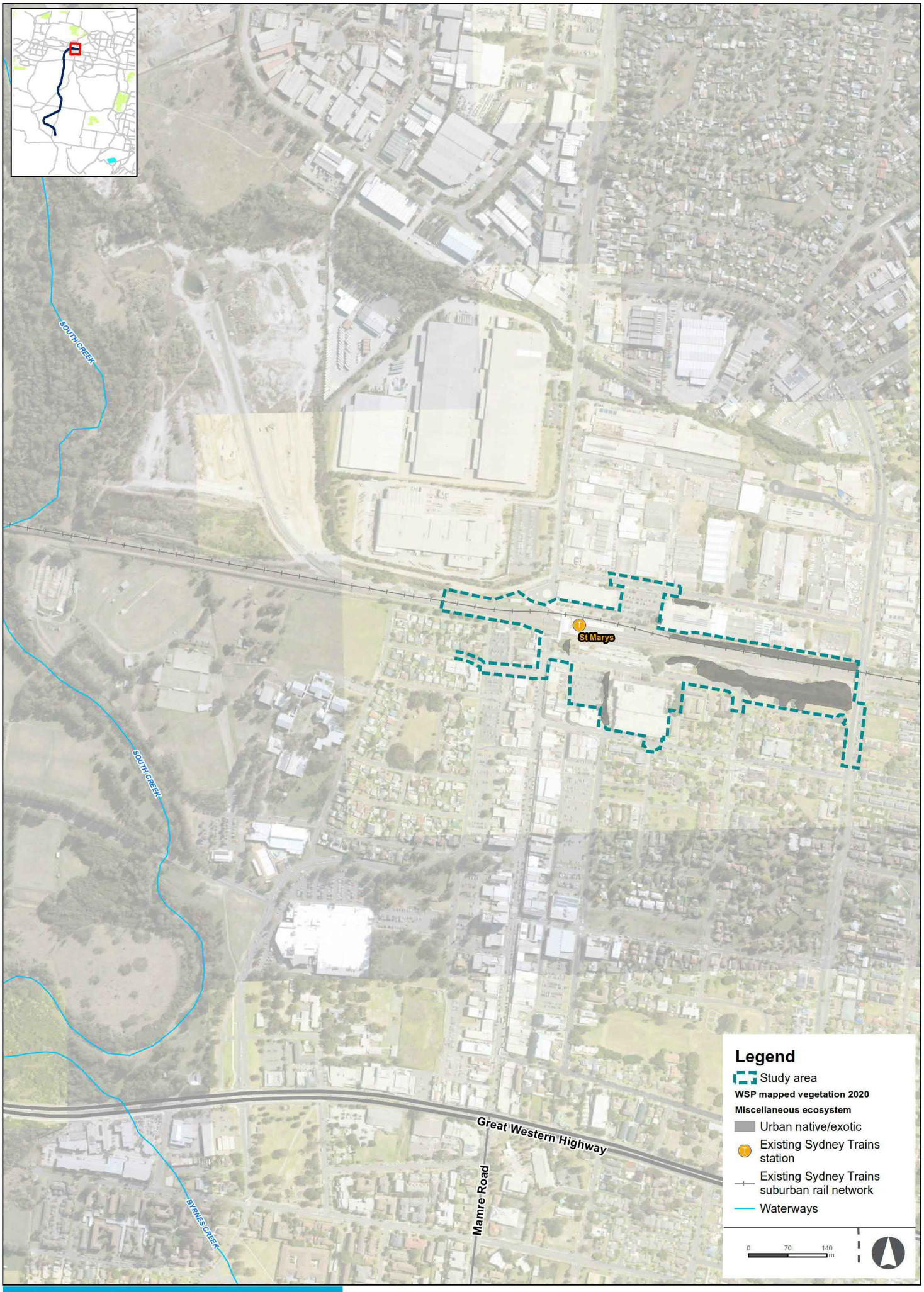
- PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley.

In addition, three non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

- Miscellaneous ecosystem - highly disturbed areas with no or limited native vegetation
- Miscellaneous ecosystem - urban exotic/native landscape plantings
- Miscellaneous ecosystem - water bodies, rivers, lakes, streams (not wetlands).

The five native vegetation types (listed above) were assigned to discrete vegetation zones based on broad vegetation condition class criteria as outlined in Section 3.4.2. A summary of PCTs and associated vegetation zones along with non-native vegetation types is presented in Table 5.1. The extent and distribution of each vegetation type and zone is shown in Figure 5.1.

Detailed descriptions and selection justification for each PCT and vegetation zone is provided Section 5.2. A summary and description of non-native vegetation types is presented in Section 5.4.



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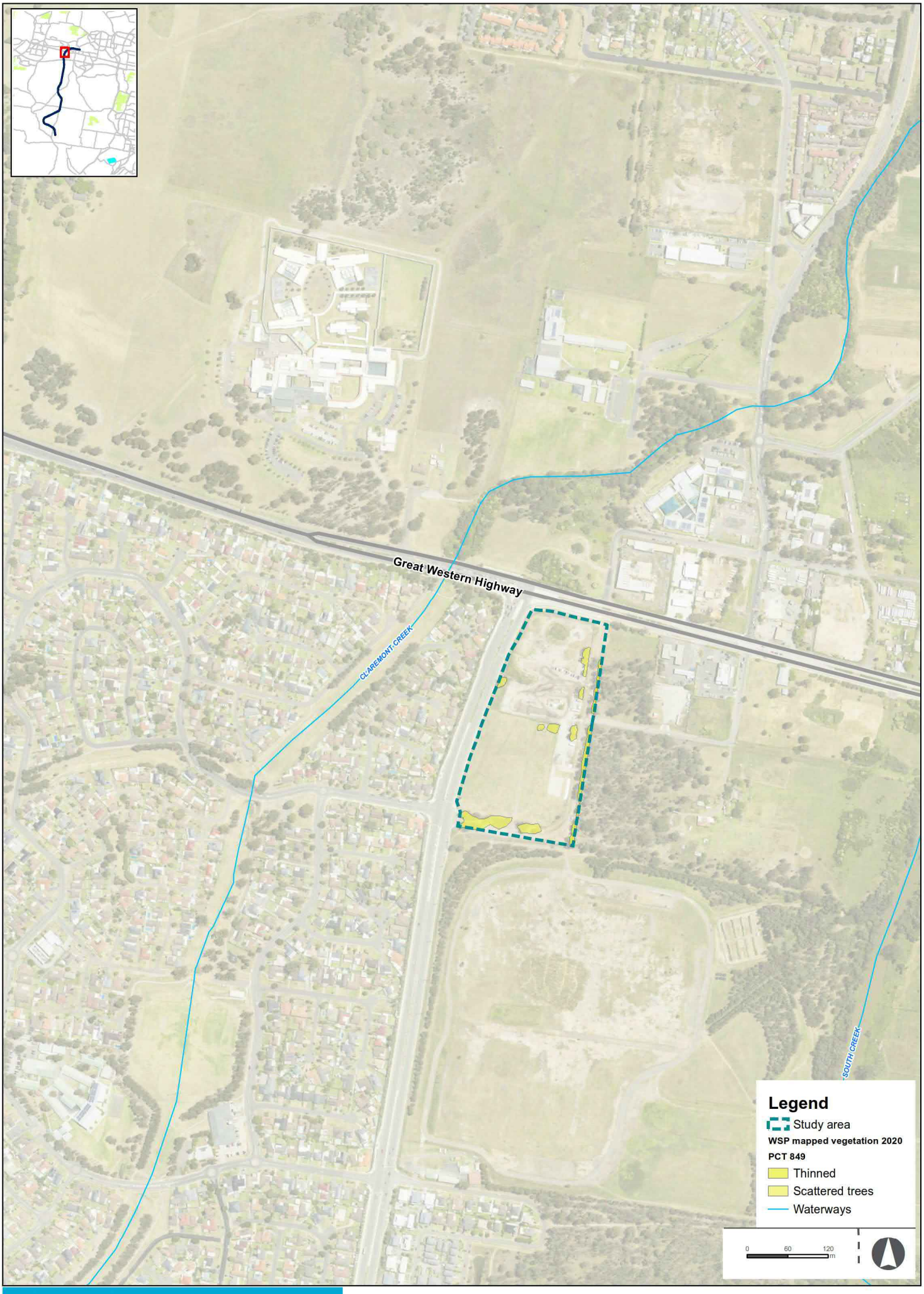
Vegetation types and zones

Figure 5-1a



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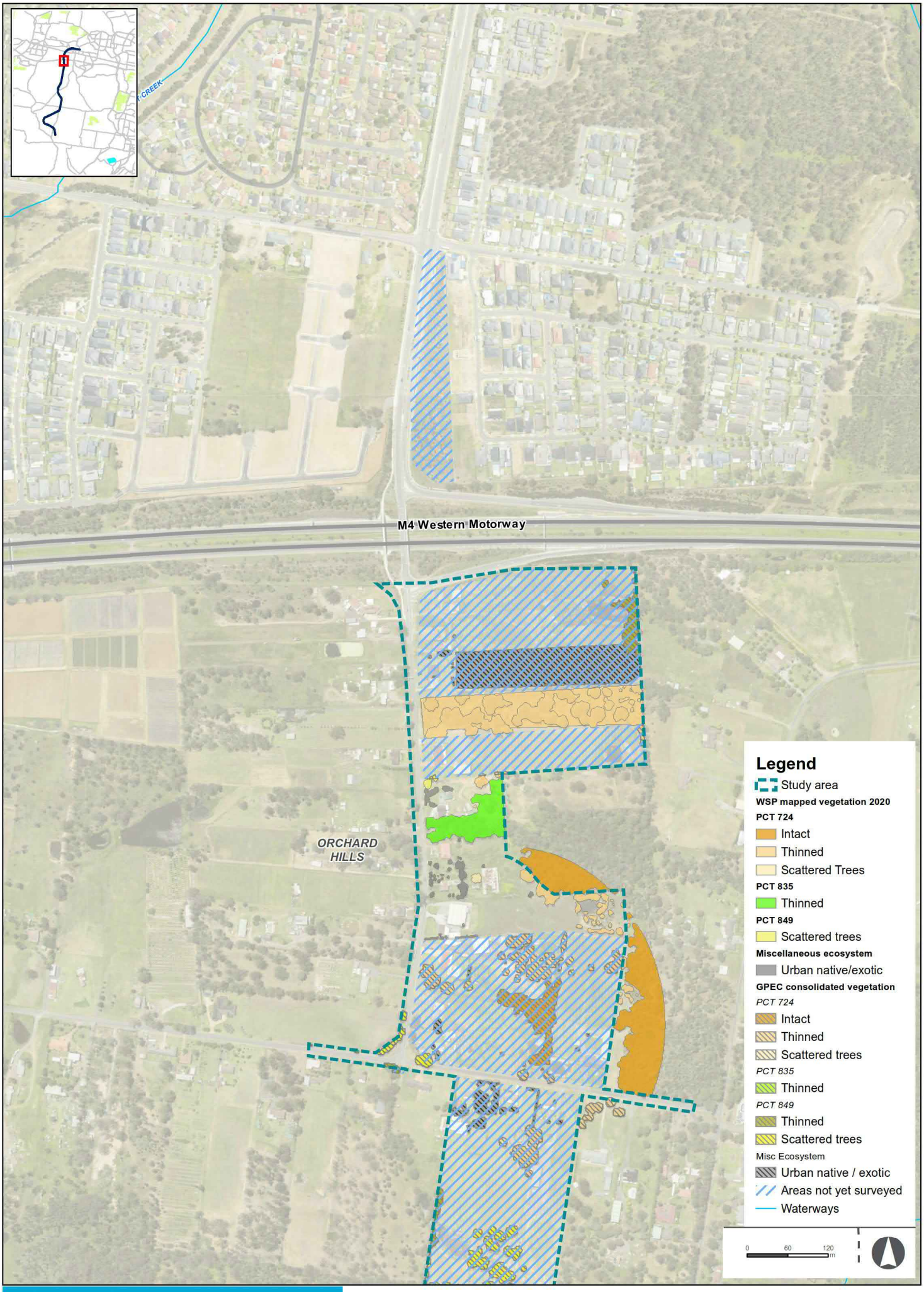
Vegetation types and zones

Figure 5-1b



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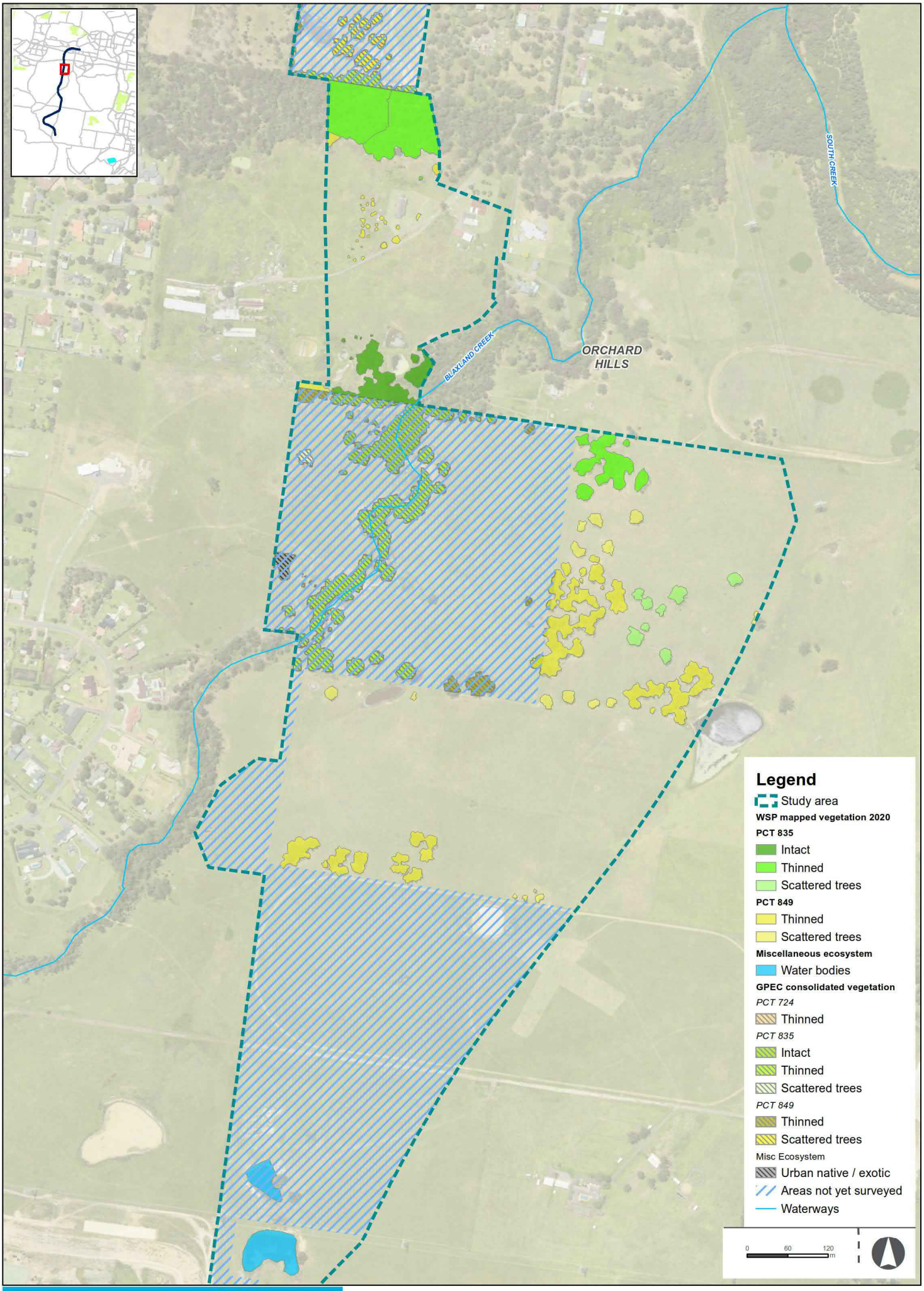
Vegetation types and zones

Figure 5-1c



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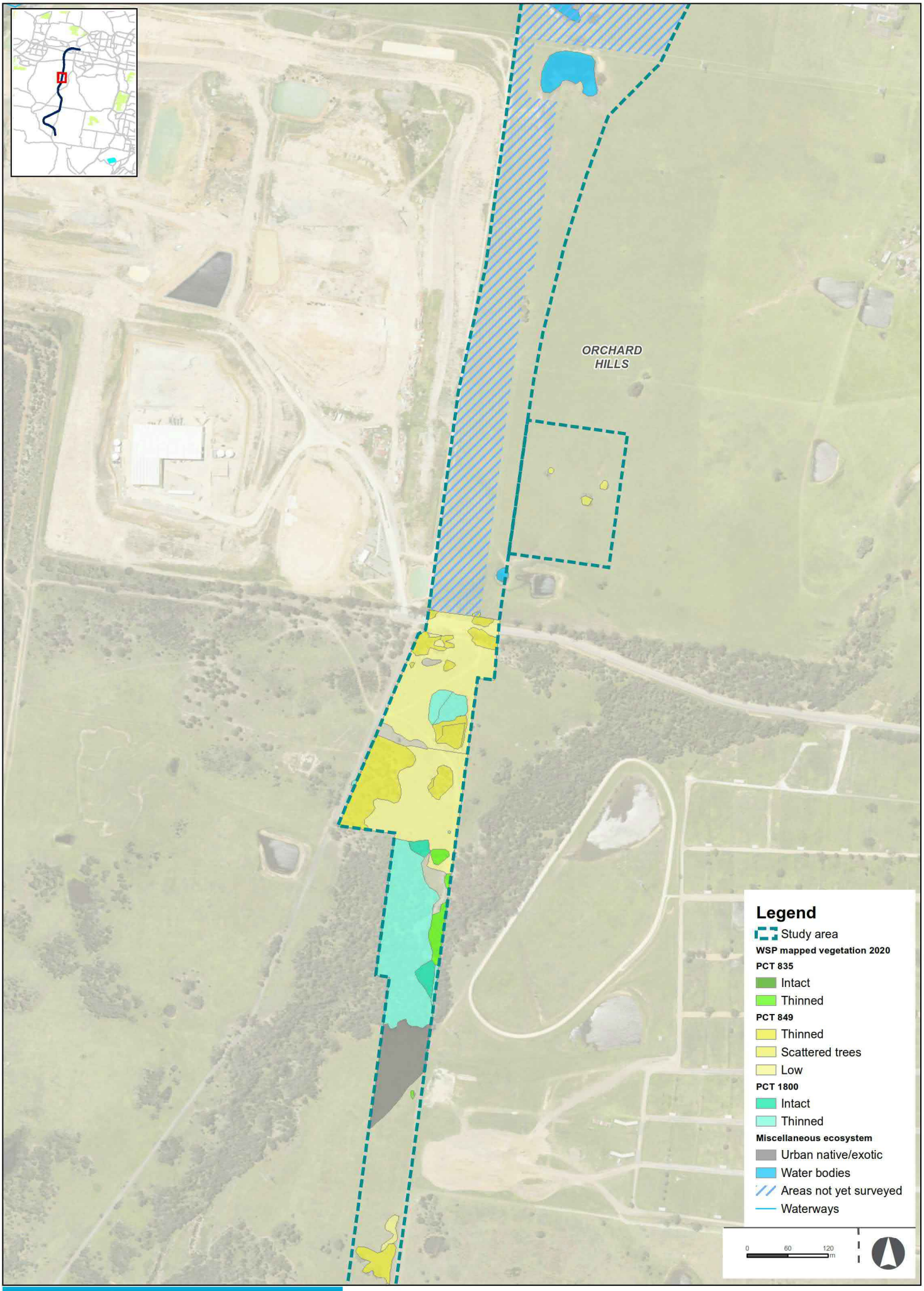
Vegetation types and zones

Figure 5-1d



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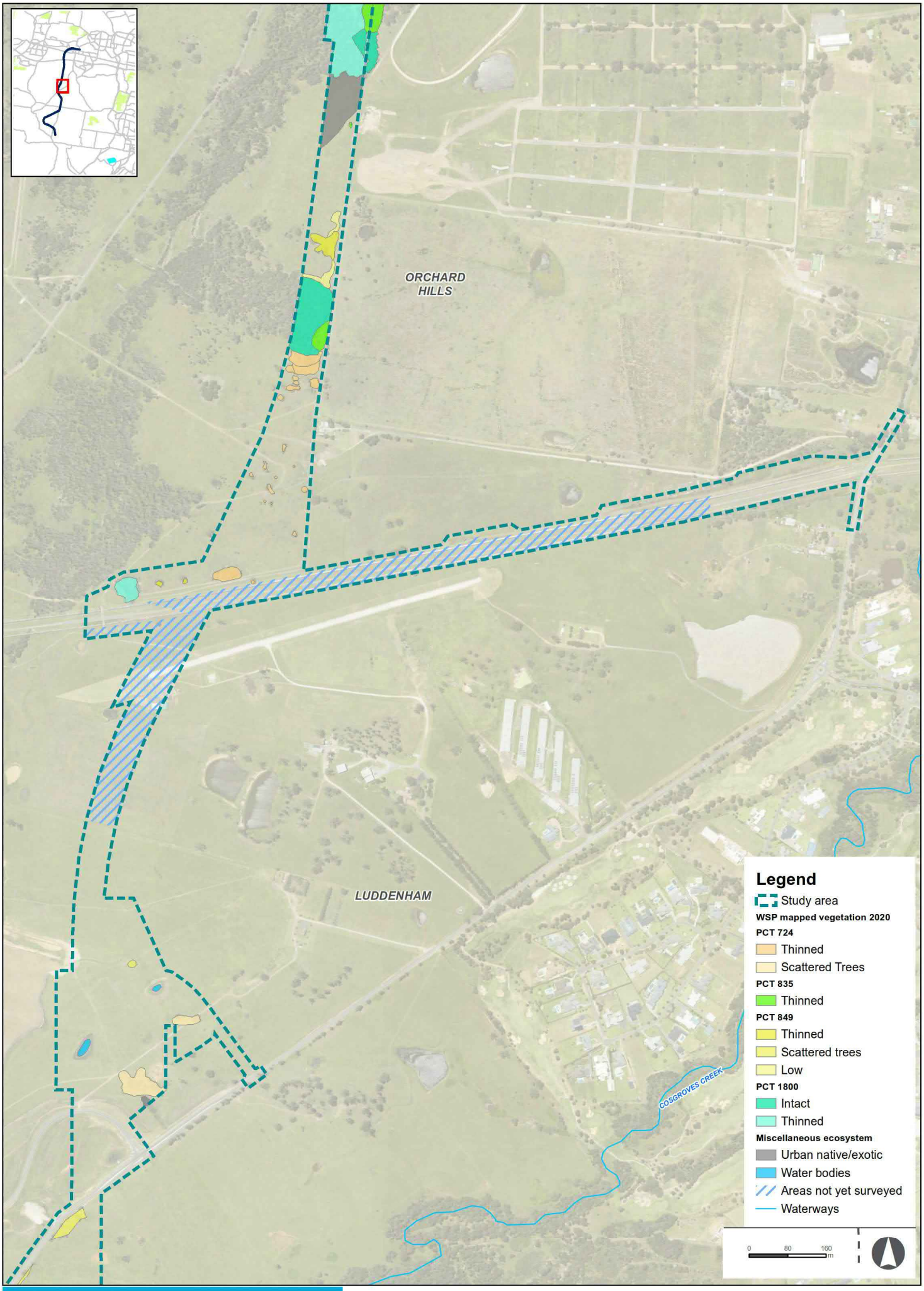
Vegetation types and zones

Figure 5-1e



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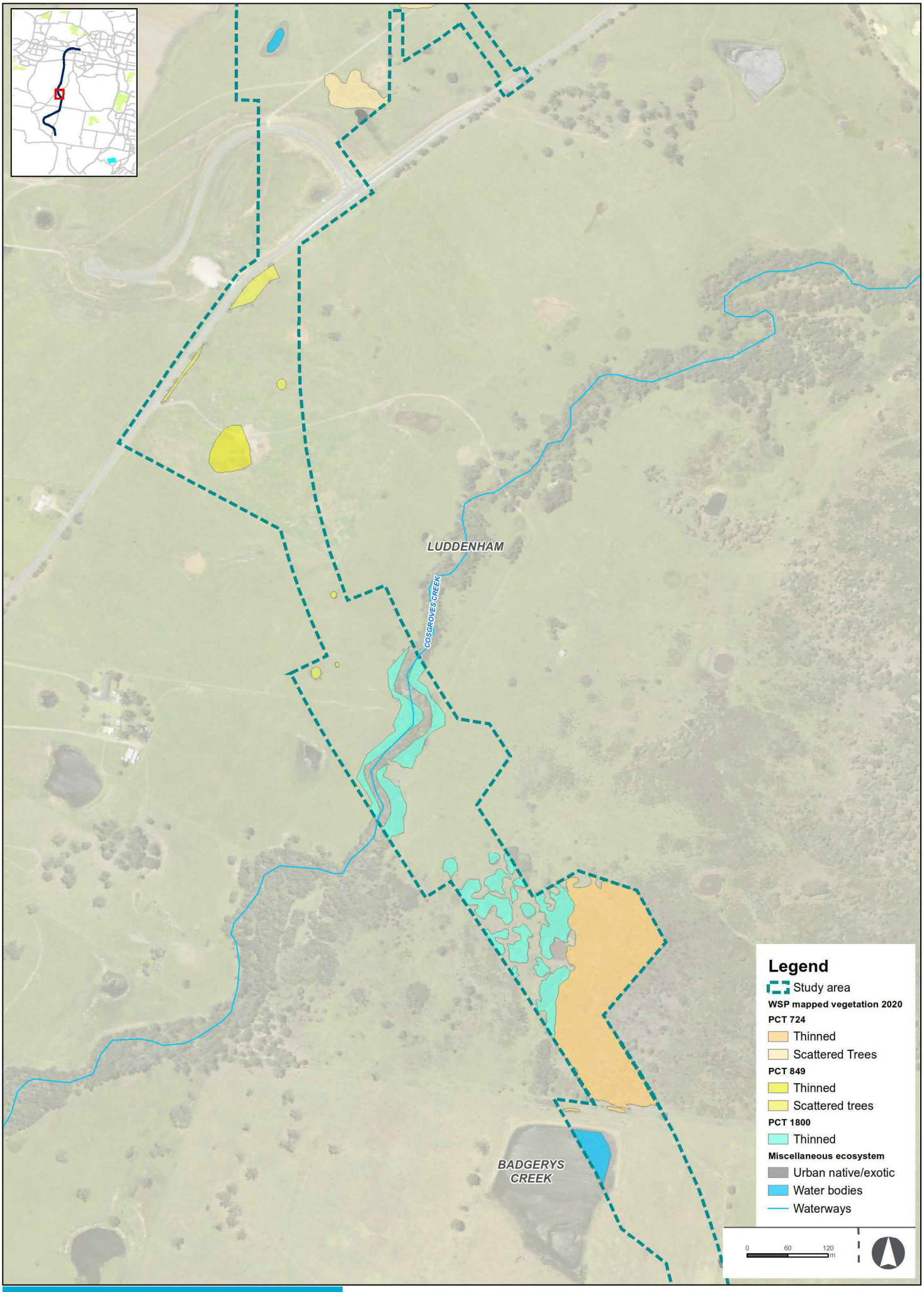
Vegetation types and zones

Figure 5-1f



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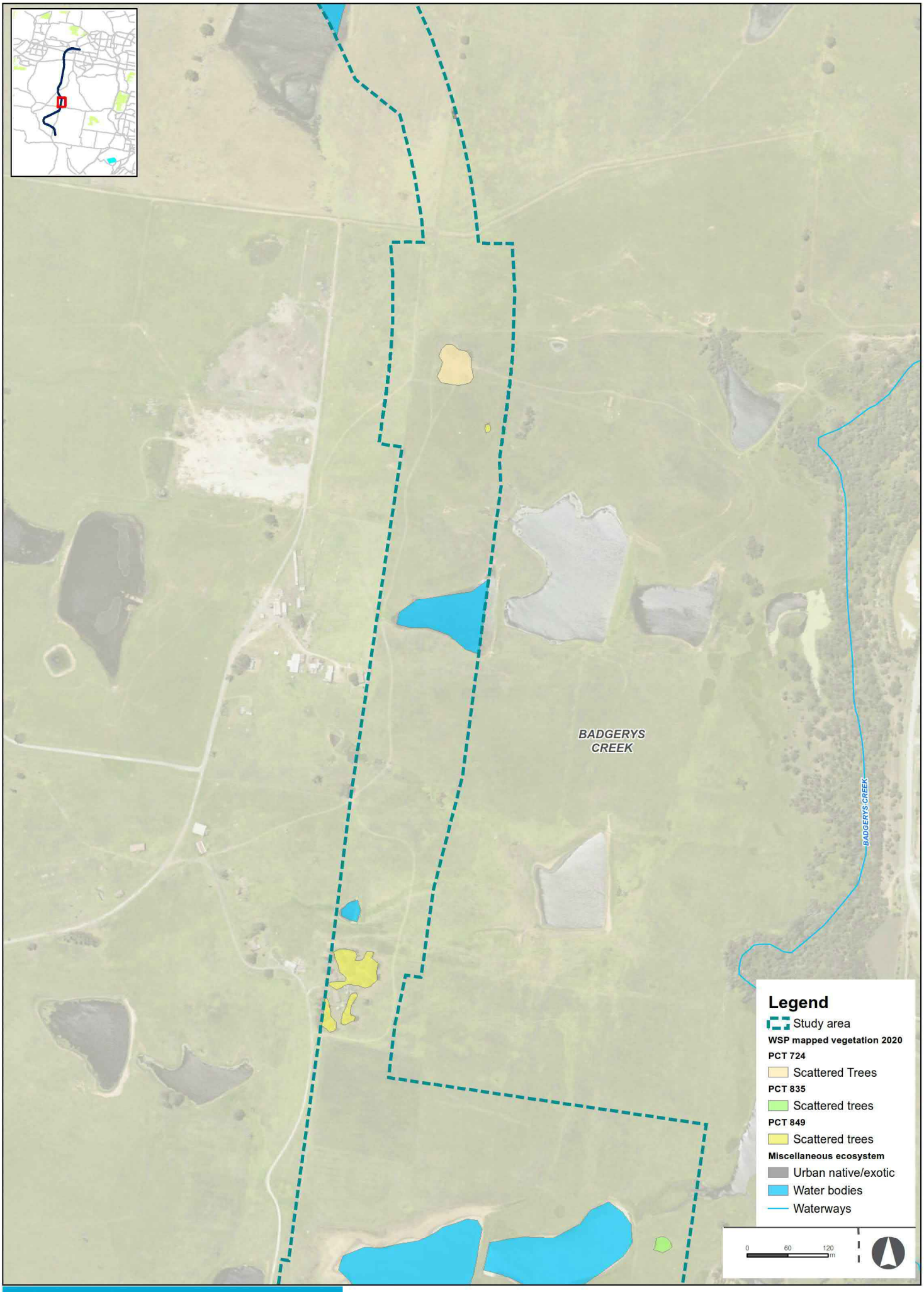
Vegetation types and zones

Figure 5-1g



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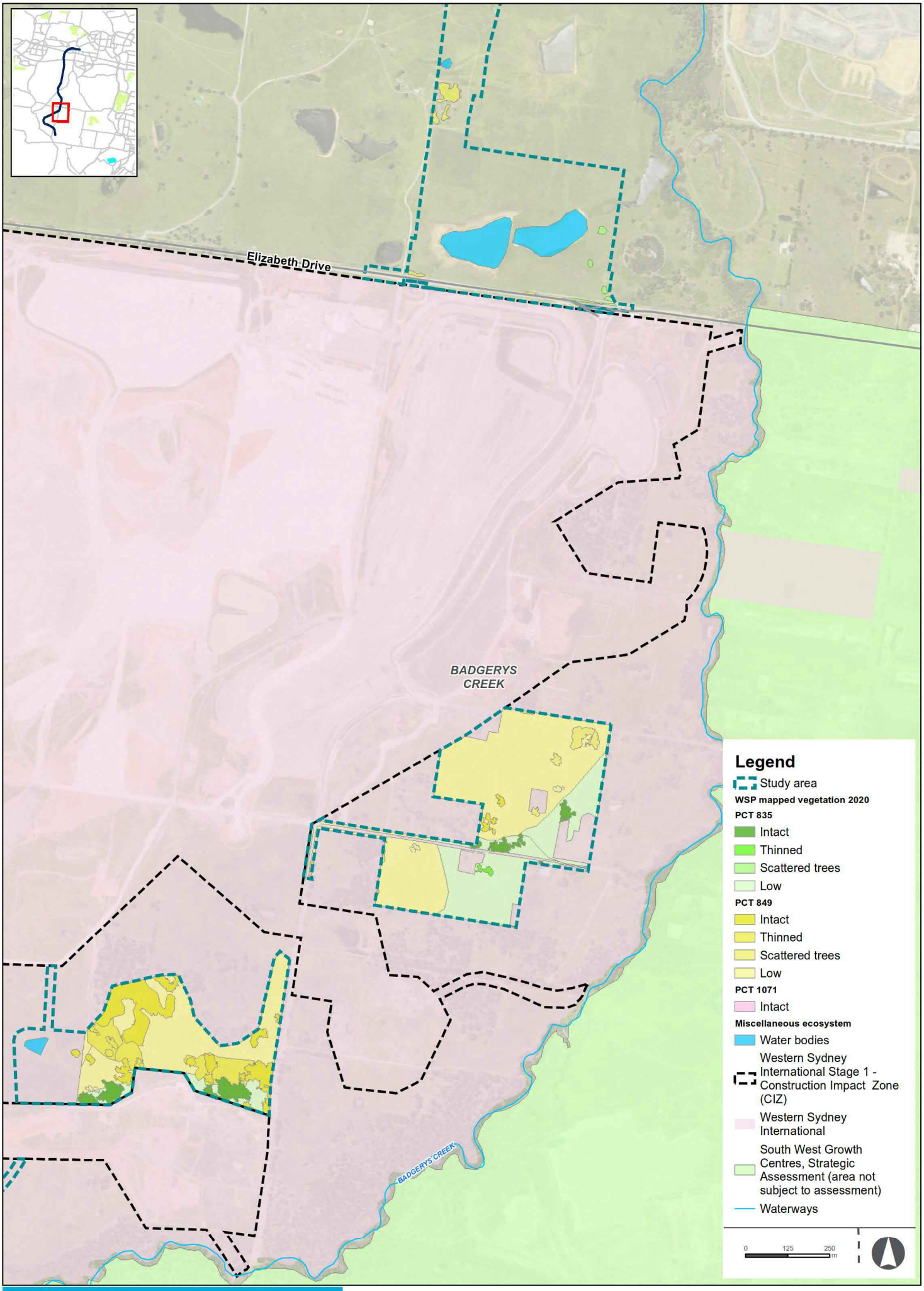
Vegetation types and zones

Figure 5-1h



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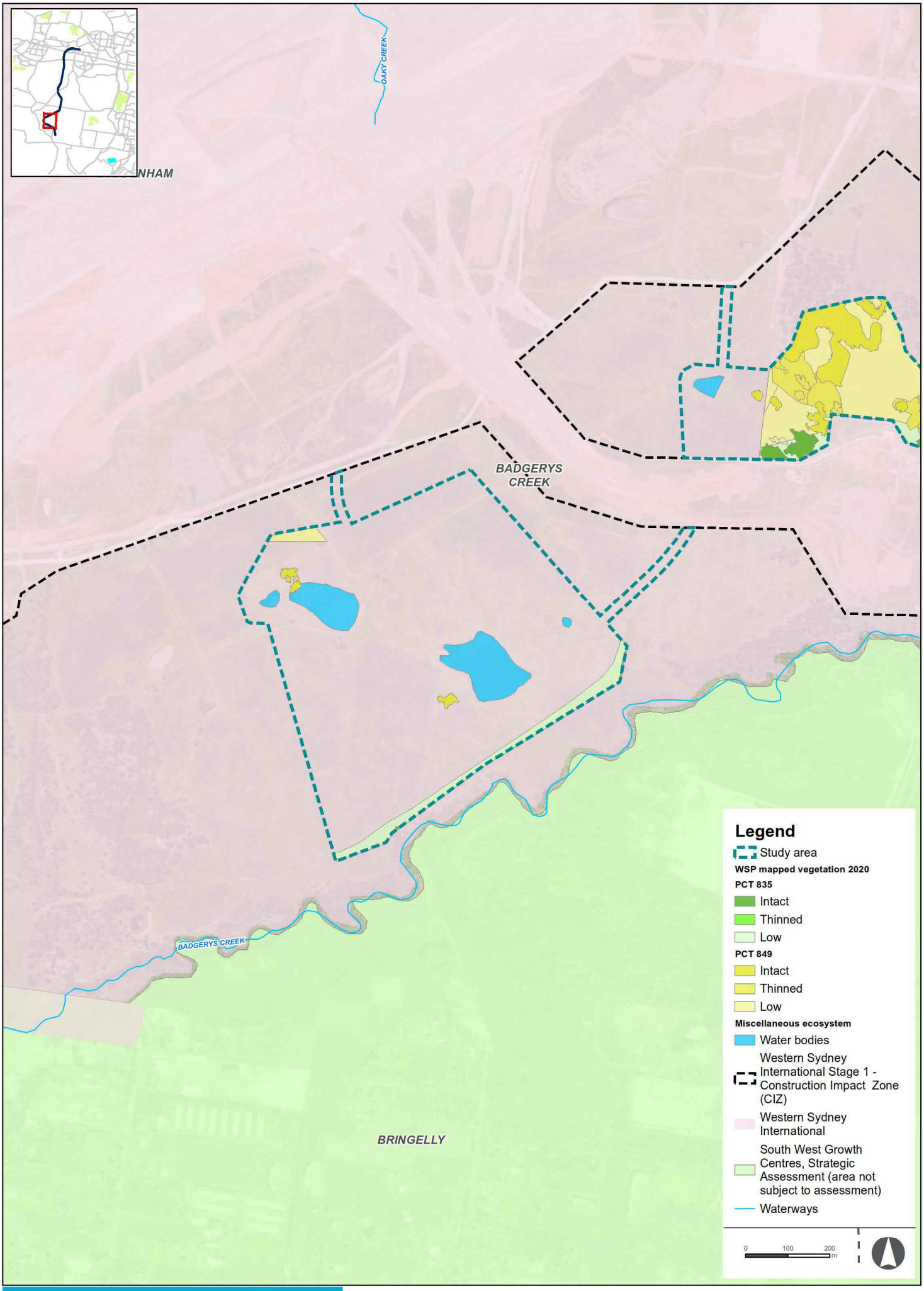
Vegetation types and zones

Figure 5-1i



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Indicative only, subject to design development

Vegetation types and zones

Figure 5-1j

Table 5.1 Overview of native vegetation types and zones (off-airport)

Vegetation type	Vegetation formation	Vegetation class	PCT % cleared	Condition	Threatened ecological community (BC Act)	Patch size (hectares)	Vegetation integrity score	Extent off-airport land (hectares)		Total area (hectares)
								Field surveys	Non-surveyed areas	
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Cumberland Dry Sclerophyll Forests	75	Intact	Shale Gravel Transition Forest[1]	25-100	61.7*	1.67	0.43	2.10
				Thinned		25-100	39.7	6.09	0.82	6.91
				Scattered Trees		5-24	44.3	1.39	00.02	1.41
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	93	Intact	River-Flat Eucalypt Forest[2]	>100	76.6*	0.53	0.81	1.34
				Thinned		>100	71.2	2.80	1.60	4.40
				Scattered Trees		<5	36.7	0.45	0.04	0.49
PCT 849 - Grey Box - Forest Red Gum grassy woodland on	Grassy Woodlands	Coastal Valley Grassy Woodlands	93	Thinned	Cumberland Plain Woodland[3]	>100	62.4	4.09	0.57	4.66
				Scattered Trees		5-24	20.3	1.34	0.39	1.73
				Low		>100	7.8	3.25	0	3.25

Vegetation type	Vegetation formation	Vegetation class	PCT % cleared	Condition	Threatened ecological community (BC Act)	Patch size (hectares)	Vegetation integrity score	Extent off-airport land (hectares)		Total area (hectares)
								Field surveys	Non-surveyed areas	
flats of the Cumberland Plain, Sydney Basin Bioregion										
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Forested Wetlands	Coastal Floodplain Wetlands	60	Intact	Swamp Oak Floodplain Forest[4]	>100	66.4	1.07	0	1.07
				Thinned		>100	67.5	4.31	0	4.31
Total								**26.99**	**4.68**	**31.67**

Notes:

(1) Shale Gravel Transition Forest in the Sydney Basin Bioregion
(2) River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
(3) Cumberland Plain Woodland in the Sydney Basin Bioregion
(4) Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

* Vegetation Integrity Scores were obtained from Open Lines and Biosis (2020)

+Areas of indirect impact have been included

Table 5.2 Overview of native vegetation types and zones (on-airport)

Vegetation type	Vegetation formation	Vegetation class	PCT % cleared	Condition	Threatened ecological community (BC Act)	Patch size (hectares)	Vegetation integrity score	Extent on-airport land (hectares)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Forested Wetlands	Coastal Floodplain Wetlands	93	Intact	River-Flat Eucalypt Forest[1]	25-100	65.9*	1.53
				Thinned		25-100	71.2	0.09
				Low		25-100	2.4*	10.21
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Grassy Woodlands	Coastal Valley Grassy Woodlands	93	Intact	Cumberland Plain Woodland[2]	25-100	67.8	4.05
				Scattered Trees		25-100	20.3	2.32
				Low		>100	7.8	23.79
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Lagoons	75	Intact	Not listed	25-100	57.4	0.01
Total								**42.00**

Notes:

(1) River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

(2) Cumberland Plain Woodland in the Sydney Basin Bioregion

(3) Vegetation integrity was calculated based on a single plot (Q2) that was sampled during drought

* Vegetation Integrity Scores were calculated using an average of attributes collected during field survey

5.2 Native vegetation types

A description of recorded attributes for each native vegetation PCT are provided below.

5.2.1 PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 5.1 with photographic representation provided in Photo 5.1 to Photo 5.4. A profile of PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion is provided in Table 5.3 and a comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 5.4.

Table 5.3 Summary of PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion

PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion			
Vegetation formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)		
Vegetation class	Cumberland Dry Sclerophyll Forests		
Conservation status	Aligns to Shale Gravel Transition Forest, listed as Endangered under the BC Act and Critically Endangered under the EPBC Act.		
SAII entity	No		
Percent cleared	75 per cent		
Location	off-airport		
Condition	Intact	Thinned	Scattered Trees
Patch size class	25-100 hectares	25-100 hectares	5-24 hectares
Vegetation integrity plots	0* (see section 3.8.2)	Q21, Q22, AC1, AC2, LC3	Q19
Composition condition score:	-	34.6	38.2
Structure condition score:	-	46	46.7
Function condition score:	-	54.8	35
Vegetation Integrity score	61.7	44.3	39.7
Extent	2.10 hectares	6.91 hectares	1.41 hectares
PCT justification			
Landscape position	This vegetation type was recorded in slightly elevated areas associated with tertiary alluvial gravels between Orchard Hills and Luddenham within the study area.		
Dominant canopy species	Dominant canopy species included *Eucalyptus fibrosa* (Red Ironbark), *Melaleuca decora* (White Feather Myrtle) with *Eucalyptus moluccana* (Grey Box) being recorded in transitional and ecotonal areas.		
Characteristic midstorey species	Midstorey vegetation was sparse with species including *Acacia decurrens* (Green Wattle) and *Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea).		

PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	
Characteristic ground cover species	Ground cover vegetation was generally dominated by *Microlaena stipoides* (Weeping Grass) with a diverse range of native grasses and forbs including *Aristida vagans* (Three-awn Speargrass), *Austrostipa verticillata* (Slender Bamboo Grass), *Cheilanthes sieberi* (Rock Fern), *Commelina cyanea, Dichondra repens* (Kidney Weed), *Einadia hastata* (Berry Saltbush), *Einadia trigonos* (Fishweed), *Eragrostis brownii* (Brown's Lovegrass), *Eragrostis leptostachya* (Paddock Lovegrass), *Hypericum gramineum* (Small St John's Wort), *Lobelia purpurascens* (Whiteroot), *Oxalis perennans, Sporobolus creber* (Slender Rat's Tail Grass) and *Wahlenbergia gracilis* (Sprawling Bluebell). Exotic species included *Bidens pilosa** (Cobbler's Pegs), *Sida rhombifolia** (Paddys Lucerne), *Solanum pseudocapsicum** (Madeira Winter Cherry).
Other diagnostic features	Vegetation occurred on soils with evidence of iron-indurated gravels recorded on the soil surface and re-surfaced around ant nests.
PCT quantitative analysis	Justification for PCT 724 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q21, Q22) using the Plant Community Identification tool (EES Group, 2020c) in accordance with section 5.2.1.12 of the BAM. Plot data collected from thinned condition vegetation was considered the most representative of the floristics and dominant species were entered in the Plant Community Identification tool for each stratum along with IBRA region and field observations. PCT 724 produced the most matches (9). A review of existing vegetation mapping identified that PCT 724 has been mapped previously by Open Lines and Biosis (2020) and Tozer *et al.* (2010). Based on floristic, geographic and geological characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (EES, 2020).

Photo 5.1 PCT 724 Thinned condition displaying a *Melaleuca decora* canopy (Q21)

Photo 5.2 *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea). recorded in the shrub layer of PCT 724 thinned (Q22)

Photo 5.3 PCT 724 – Scattered Trees condition (Q19)

Photo 5.4 PCT 724 – Scattered Trees showing a mature *Eucalyptus fibrosa* (Red Ironbark) specimen (Q19)

Table 5.4 Comparison of PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion vegetation integrity plot data against PCT condition benchmarks

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Large tree	Holl-ows	Leaf litter	Length timber	High threat weed	VI score
BM[1]	6	12	13	13	2	5	44	40	47	6	1	3	3(50)	-	60	68	-	100
Thinned																		
Q21	1	1	2	6	0	1	1.0	52.0	15.0	4.2	0.0	0.4	5	0	48.0	17.0	0.3	44.3
Q22	1	2	11	8	1	1	10.0	14.0	22.0	7.1	3.0	0.1	3	0	19.0	0.0	1.4	
LC3	2	7	6	6	1	1	0.6	61.2	13.6	1.3	0.3	0.1	0	0	11	0	15.2	
Scattered Trees																		
19	1	0	8	7	0	1	15.0	0.0	42.9	16.8	0.0	1.0	3	1	3.0	0.0	8.1	39.7

Notes:

(1) Benchmark data for equivalent community in NSW Sydney Basin IBRA Bioregion; Vegetation Type - PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion; Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation); Vegetation Class: Cumberland Dry Sclerophyll Forests; source (NSW BioNet Vegetation Classification database accessed April, 2020 and cross referenced with BAM Credit Calculator).

5.2.2 PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 5.1 with photographic representation provided in Photo 5.5 and Photo 5.8. A profile of PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion is provided in Table 5.5 and a comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 5.6.

Table 5.5 Summary of PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion						
Vegetation formation	Forested Wetlands					
Vegetation class	Coastal Floodplain Wetlands					
Conservation status	BC Act: forms part of the River-flat Eucalypt Forest on Coastal Floodplain on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as Endangered. Aligns to River-flat Eucalypt Forest on Coastal Floodplain listed as Critically Endangered under the EPBC Act.					
SAII entity	No					
Percent cleared	93 per cent					
Location	off-airport			on-airport		
Vegetation condition	Intact	Thinned	Scattered Trees	Intact	Thinned	Low
Patch size class	>100 hectares	>100 hectares	<5 hectares	25-100 hectares	25-100 hectares	25-100 hectares
Vegetation integrity plots	LC1	Q10, Q23	Q35	Q2	Q10, Q23	Q8, Q9
Composition condition score	85.3	52.1	11.5	63.3	52.1	48.2
Structure condition score	54.4	82.2	59.2	78.3	82.2	23.6
Function condition score	96.9	84.3	73.1	57.7	84.3	0
Vegetation Integrity score	76.6	71.2	36.7	65.9* plot recorded during drought	71.2	2.4
Extent	1.34	4.40	0.49	1.53	0.09	10.21
PCT justification						
Landscape position	This vegetation occurred on alluvial soils which drained Wianamatta shale soils in riparian and floodplain areas.					
Dominant canopy species	Dominated by *Eucalyptus tereticornis* (Forest Red Gum) and *Angophora subvelutina* (Broad-leaved Apple) with scattered occurrences of *Eucalyptus moluccana* (Grey Box) and *Casuarina glauca* (Swamp Oak)					

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	
Characteristic midstorey species	Shrubs were present at varying densities and included species such as *Acacia decurrens* (Green Wattle), *Bursaria spinosa* (Native Blackthorn*), Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea) and *Melaleuca decora* (White Feather Myrtle). Exotic species *Olea europaea** (African Olive) was sub-dominant in some patches.
Characteristic ground cover species	Ground cover was generally grassy and dominated by *Microlaena stipoides* (Weeping Grass) and *Echinopogon caespitosus* (Tufted Hedgehog Grass) with a range of other native herbs and grasses included *Asperula conferta* (Common Woodruff), *Brunoniella australis* (Blue Trumpet*), Chloris ventricosa* (Tall Chloris), *Dichondra repens* (Kidney Weed*), Desmodium gunnii* (Slender Tick Trefoil), *Glycine tabacina, Hypericum gramineum* (Small St John's Wort) and *Sporobolus creber* (Slender Rats Tail Grass). Dominant exotic species included *Conyza sumatrensis** (Fleabane), *Rubus fruticosus agg. ** (Blackberry), *Senecio madagascarensis** (Fireweed) and *Solanum sisymbriifolium** (Viscid Nightshade).
Other diagnostic features	Alluvial soils subject to periodic inundation during heavy rainfall and flooding events
PCT quantitative analysis	Justification for PCT 835 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q2, Q23) using the Plant Community Identification tool (EES, 2020c) in accordance with section 5.2.1.12 of the BAM. Plot data from intact and thinned condition vegetation was considered the most representative of the floristics and dominant species were entered in the Plant Community Identification tool from each stratum along with IBRA region, vegetation formation and field observations. The following PCTs which are classified at forested wetlands were identified: PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (8 matches). The distinguishing feature of this vegetation type is the prominent stands of *Casuarina glauca* (Swamp Oak) found along or near streams. Often these are relatively young trees, swarming amongst a mix of old and young eucalypts such as *Angophora floribunda* (Rough-barked Apple), *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box) (EES Group, 2020). Vegetation was not dominated by *Casuarina glauca* (Swamp Oak) which featured as scattered occurrences only. PCT 85 River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion (5 matches). This vegetation type occurs on gravels, sands and loams on various substrates along major watercourses in the NSW South-western Slopes Bioregion and western edge of the South-East Highlands Bioregion and is not known from the Study area (Sydney Basin Bioregion). PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (5 matches). The vegetation type is an open eucalypt forest situated on broad alluvial flats of the Hawkesbury and Nepean river systems and typically the canopy includes one of either *Angophora floribunda* (Rough-barked Apple) or *Angophora subvelutina* (Broad-leaved apple) and one or both of *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus amplifolia* (Cabbage Gum) (EES, 2020). This vegetation description is consistent with vegetation recorded within the study area.

PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	
	A review of existing vegetation mapping identified that PCT 835 has been mapped previously by Open Lines and Biosis (2020), Tozer *et al.* (2010) and DIRD (2016e). Based on floristic, geographic and geological characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (EES, 2020).

Photo 5.5 PCT 835 recorded in Intact condition (Q2)

Photo 5.6 PCT 835 thinned displaying a grassy understorey dominated by *Micolaena stipoides* (Q23)

Photo 5.7 PCT 835 Thinned condition dominated by *Angophora subvelutina* (Broad-leaved Apple)

Photo 5.8 PCT 835 recorded as Scattered Ttrees parallel to Elizabeth Drive

Table 5.6 Comparison of PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion vegetation integrity plot data against PCT condition benchmarks

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	large tree	Hollows	leaf litter	Length timber	High threat weed	VI score
BM[1]	4	8	8	7	2	3	21	21	73	3	1	1	1(50)	-	40	12	-	100
Thinned																		
Q2	3	1	6	15	1	1	19.0	15.0	40.4	10.2	0.5	1.0	0	1	18.4	40.0	3.7	71.2
Q10	1	0	6	10	0	0	4.0	0.0	53.0	3.4	0.0	0.0	0	0	2.0	12.0	2.4	
Q23	2	2	5	9	1	2	42.4	9.0	76.7	4.7	0.6	1.0	3	1	37.0	101.0	1.4	
Q8	0	0	7	6	0	0	0.0	0.0	19.5	3.3	0.0	0.0	0	0	1.6	0.0	5.0	
Q9	0	0	10	5	0	2	0.0	0.0	34.7	1.5	0.0	0.7	0	0	0.8	0.0	8.0	
Q35	1	0	3	1	0	0	25	0	40.4	0.2	0	0	3	2	7	35	31.9	
Intact																		
LC1	4	1	9	10	1	2	71.3	20	26.5	16.9	0.1	0.4	0	0	82	109	42.6	76.6

Notes:

(1) Benchmark data for equivalent community in NSW Sydney Basin IBRA Bioregion; Vegetation Type - PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion; Vegetation Formation: Forested Wetlands; Vegetation Class: Coastal Floodplain Wetlands; source (NSW BioNet Vegetation Classification database accessed April 2020 and cross referenced with BAM-C).

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

The occurrence of this vegetation type within the study area is illustrated in Figure 5.1 with photographic representation provided in Photo 5.9 to Photo 5.14. A profile of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion is provided in Table 5.7. A comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 5.8.

Table 5.7 PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion						
Vegetation formation	Grassy Woodlands					
Vegetation class	Coastal Valley Grassy Woodlands					
Conservation status	Aligns to Cumberland Plain Woodland listed as Critically Endangered under the BC Act and EPBC Act.					
SAII entity	Yes					
Percent cleared	93 per cent					
Location	off-airport			on-airport		
Vegetation condition	Thinned	Scattered Trees	Low	Intact	Scattered Trees	Low
Patch size class	>100 hectares	<5 hectares	>100 hectares	25-100 hectares	25-100 hectares	>100 hectares
Vegetation integrity plots	Q24, Q26, Q30, Q34	Q5, Q15, Q18	Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32	Q1, Q4, Q6, Q16	Q5, Q15, Q18	Q11, Q12, Q13, Q14, Q17, Q28, Q31, Q32
Composition condition score	68.7	27.9	24.7	70.5	27.9	24.7
Structure condition score	72.2	17.7	17.1	71.4	17.7	17.1
Function condition score	49	16.8	1.1	61.9	16.8	1.1
Vegetation Integrity score	62.4	20.3	7.8	67.8	20.3	7.8
Extent	4.66	1.73	3.25	4.05	2.32	23.79
PCT justification						
Landscape position	This PCT was recorded on a flat and/or undulating landscape and graded into PCT 1800 or PCT 835 downslope in areas associated with streams/watercourses and PCT 724 in areas higher in the landscape where laterites were observed.					
Dominant canopy species	*Eucalyptus moluccana* (Grey Box) was the dominant canopy species occurring with *Eucalyptus tereticornis* (Forest Red Gum) either as a co-dominant or sub-dominant and scattered occurrences of *Eucalyptus fibrosa* (Red Ironbark).					
Characteristic midstorey species	Shrub cover varied between patches however often displayed wattles *Acacia decurrens* (Green Wattle) and *Acacia falcata* along with *Bursaria spinosa* (Native Blackthorn). Less commonly occurring shrubs species included *Dodonaea viscosa subsp. cuneata, Exocarpos cupressiformis* (Native Cherry), *Ozothamnus diosmifolius* (Dogwood) and exotic species *Olea europaea** (African Olive).					

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	
Characteristic ground cover species	Ground cover was dominated by native grasses including *Aristida vagans* (Three Awn Speargrass), *Eragrostis brownii* (Browns Love Grass), *Microlaena stipoides var. stipoides* (Weeping grass)*, Paspalidium distans, Themeda triandra (Kangaroo Grass)* and exotic *Eragrostis curvula** (African Love Grass). Forb and fern species included *Arthropodium milleflorum* (Vanilla Lily), *Brunoniella australis* (Blue Trumpet), *Cheilanthes sieberi subsp. sieberi* (Mulga Fern), *Desmodium gunnii* (Slender Tick Trefoil), *Einadia hastata* (Berry Saltbush), *Glycine tabacina, Lomandra filiformis subsp. filiformis, Opercularia varia* (Variable Stinkweed), *Oxalis perennans, Solanum prinophyllum* (Forest Nightshade).
Other diagnostic features	This vegetation was recorded as a grassy woodland on Wianamatta shale/clay soils.
PCT quantitative analysis	A quantitative analysis was undertaken for plots which sampled Intact vegetation (Q1, Q4, Q6 and Q16) within the study area as this condition class best represented the PCT. A total of eighteen search criteria including IBRA region, dominant species in the canopy, middle and ground stratum were entered in the Plant Community Identification Tool (EES, 2020c). PCT 849 has the most number of matches (12) and was considered most the most representative PCT. A review of existing vegetation mapping identified that PCT 849 has been mapped previously by Open Lines and Biosis (2020), Tozer *et al.* (2010) and DIRD (2016e). Based on floristic, geographic and geological characteristics, this vegetation type is considered consistent with the scientific description and distribution information outlined for PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (EES, 2020).

Photo 5.9 PCT 849 recorded in Intact condition at Q4

Photo 5.10 PCT 849 recorded in Intact condition near Q1

Photo 5.11 PCT 849 thinned condition (Q24)

Photo 5.12 PCT 849 thinned condition (Q43)

Photo 5.13 PCT 849 recorded as Scattered Trees on-airport land

Photo 5.14 PCT 849 in low condition recorded as derived native grasslands

Table 5.8 Comparison of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion vegetation integrity plot data against PCT condition benchmarks

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Large tree	Hollows	Leaf litter	Length timber	High threat weed	VI score
BM[1]	5	8	12	15	2	5	52	18	62	10	1	5	3(50)	-	35	40	0	100
Intact																		
Q1	4	7	9	15	1	2	40.4	18.2	65	15.9	1.0	0.8	2	2	68.0	23.0	4.2	67.8
Q4	2	2	14	13	1	2	20.0	10.5	64.2	3.9	2.0	1.2	0	0	26.0	6.0	8.8	
Q6	2	1	10	5	0	2	25.0	4.0	64.1	4.7	0.0	1.1	2	1	40.0	7.0	2.6	
Q16	1	2	10	15	1	2	1.0	2.1	75.6	39.2	1.0	2.2	1	1	43.0	12.5	3.2	
Thinned																		
Q24	3	2	7	8	1	1	17.5	10.2	61.7	4.3	2.0	0.7	2	0	15.0	12.0	7.7	62.4
Q26	4	3	16	13	1	2	36.3	6.6	74.1	6.9	0.1	1.8	0	0	46.0	2.0	0.8	
Q30	1	0	16	19	0	2	28.0	0.0	79.1	9.4	0.0	2.0	0	0	20.0	1.0	1.0	
Q34	1	0	14	13	1	3	20.0	0.0	82.6	2.9	0.7	202.0	1	1	30.0	3.0	6.1	
Scattered Trees																		
Q5	1	0	9	3	0	1	7.0	0.0	8.7	3.3	0.0	2.0	0	0	3.2	4.0	15.0	20.3
Q15	2	1	7	7	0	1	22.0	0.4	20.5	5.3	0.0	0.2	2	0	4.0	2.0	9.1	
Q18	1	0	5	3	0	1	16.0	0.0	7.7	14.1	0.0	2.0	0	1	15.0	12.0	9.2	
Low																		
Q11	0	0	11	7	0	2	0.0	0.0	38.2	3.2	0.0	1.5	0	0	1.8	0.0	16.4	7.8
Q12	0	0	5	0	0	0	0.0	0.0	3.8	0.0	0.0	0.0	0	0	2.2	0.0	36.1	
Q13	0	0	1	0	0	0	0.0	0.0	0.1	0.0	0.0	0.0	0	0	0.0	0.0	30.5	
Q14	0	0	4	2	0	0	0.0	0.0	4.0	0.2	0.0	0.0	0	0	0.0	0.0	20.6	
Q17	0	0	8	5	0	0	0.0	0.0	10.2	2.1	0.0	0.0	0	0	0.6	0.0	10.9	
Q28	0	2	13	6	0	1	0.0	3.1	23.5	1.1	0.0	0.1	0	0	13.0	0.0	7.2	

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Large tree	Hollows	Leaf litter	Length timber	High threat weed	VI score
Q31	0	0	6	4	0	0	0.0	0.0	61.3	0.9	0.0	0.0	0	0	14.0	0.0	5.4	
Q32	1	3	8	9	1	0	0.1	1.1	52.4	1.3	15.0	0.0	0	0	12.0	0.0	5.0	

Notes:

(1) Benchmark data for equivalent community in NSW Sydney Basin IBRA Bioregion; Vegetation Type - PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion; Vegetation Formation Grassy Woodlands; Vegetation Class: Coastal Valley Grassy Woodlands; source (NSW BioNet Vegetation Classification database accessed April 2020 and cross referenced with BAM-C).

5.2.4 PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion

The occurrence of this vegetation type within the study area is illustrated in Figure 5.1 with photographic representation provided in Photo 5.15 and Photo 5.16. A profile of PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion is provided in Table 5.9 and a comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 5.10.

Table 5.9 Summary of PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion

PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
Conservation status	Does not form part of Freshwater Wetlands on Coastal Floodplains, listed as Endangered under the BC Act, due to this community occurring because of human influence (see Section 5.6).
SAII entity	No
Percent cleared	75 per cent
Location	on-airport
Vegetation condition	Intact
Patch size class	25-100 hectares
Vegetation integrity plots	Q3
Composition condition score	67.3
Structure condition score	49
Function condition score	N/A
Vegetation Integrity score	57.4
Extent	0.01
PCT justification	
Landscape position	Vegetation was recorded in a man-made waterbody (agricultural farm dam)
Dominant canopy species	Absent
Characteristic midstorey species	Absent
Characteristic ground cover species	*Eleocharis sphacelata* (Tall Spike Rush), *Juncus usitatus* (Common Rush), *Marselea drummondii* (Common Nardoo), *Persicaria decipiens* (Slender Knotweed), *Philydrum lanuginosum* (Frogsmouth), *Senecio madagascariensis** (Fireweed), *Typha orientalis* (Broad-leaved Cumbungi)
Other diagnostic features	Occurs in areas subject to periodic or semi-permanent inundation by freshwater.
PCT quantitative analysis	Justification for PCT 1071 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q3) using the Plant Community Identification tool (EES, 2020c) in accordance with 5.2.1.12 of the BAM. The IBRA region, vegetation formation and dominant species were used as search criteria. Freshwater wetlands in the vegetation class 'coastal freshwater lagoons' were considered further. Due to the low

PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	
	species diversity recorded, six PCTs were identified during the search and have been considered further: • PCT 783 Coastal freshwater swamps of the Sydney Basin Bioregion This vegetation type is restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains and is not considered further. • PCT 1736 Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter and PCT 1740 Tall Spike Rush freshwater wetland This vegetation type occurs outside of the locality (Cumberland Plain) and are not considered further. • PCT 1742 Jointed Twig-rush sedgeland This vegetation type is dominated by Baumea occasionally with Melaleuca emergent. No Baumea species were recorded, this vegetation type is not considered further. • PCT 781 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion PCT 781 was dismissed based on the absence of a freshwater or brackish coastal lagoons below 10 metre in elevation as described in the PCT vegetation description. • PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion This vegetation type is known to occur in or near artificially made waterbodies across a range of environments and is dominated by *Phragmites australis* and *Typha orientalis*. Vegetation within the study area was recorded in a constructed waterbody and was dominated by *Typha orientalis*. A review of existing vegetation mapping identified that PCT 1071 has been mapped previously by DIRD (2016e). Based on floristic, geographic and landscape characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 1071 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (EES, 2020).

Photo 5.15 PCT 1071 dominated by *Typha orientalis*

Photo 5.16 PCT 1071 recorded on the edge of a dam (Q3)

Table 5.10 Comparison of PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion vegetation integrity plot data against PCT condition benchmarks

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	large tree	Hollows	leaf litter	Length timber	High threat weed	VI score
BM[1]	1	2	5	4	1	1	0	0	122	2	0	0	-	-	-	-	-	100
Q3	0	0	4	3	1	0	0	0	54	7.1	3	0	-	-	-	-	-	57.4

Notes:

(1) Benchmark data for equivalent community in NSW Sydney Basin IBRA Bioregion; Vegetation Type - PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion; Vegetation Formation: Freshwater Wetlands; Vegetation Class: Coastal Freshwater Lagoons; source (NSW BioNet Vegetation Classification database accessed April 2020 and cross referenced with BAM-C).

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

The occurrence of this vegetation type within the study area is illustrated in Figure 5.1 with photographic representation provided in Photo 5.17 to Photo 5.20. A profile of PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley is provided in Table 5.11 and a comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 5.12.

Table 5.11 Summary of PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley		
Vegetation formation	Forested Wetlands	
Vegetation class	Coastal Floodplain Wetlands	
Conservation status	Aligns to Swamp Oak Floodplain Forest listed as Endangered under Endangered under the BC Act and EPBC Act	
SAII entity	No	
Percent cleared	60 per cent	
Location	off-airport	
Vegetation condition	Intact	Thinned
Patch size class	>100 hectares	>100 hectares
Vegetation integrity plots	Q25, Q29, Q33	Q20, Q27, LC2
Composition condition score	63.1	48.7
Structure condition score	71.8	67.2
Function condition score	64.5	93.8
Vegetation Integrity score	66.4	67.5
Extent	1.07 hectares	4.31 hectares
PCT justification		
Landscape position	Vegetation was recorded fringing watercourses or on surrounding low-lying floodplains	
Dominant canopy species	*Casuarina glauca* (Swamp Oak) dominated the canopy, often as monospecific stands. Scattered *Eucalyptus amplifolia subsp. amplifolia* (Cabbage Gum) was also recorded.	
Characteristic midstorey species	Midstorey species generally occurred at low abundances and included *Acacia decurrens* (Green Wattle), *Alphitonia excelsa* (Red Ash), *Bursaria spinosa* (Native Blackthorn) and *Melaleuca decora* (White Feature Myrtle).	
Characteristic ground cover species	Ground cover was generally sparse however where present was dominated by native grasses including *Echinopogon caespitosus* (Tufted Hedgehog Grass), *Microlaena stipoides* (Weeping Grass), *Oplismenus aemulus* (Basket Grass) and *Paspalidium distans* with scattered herbs at low abundances including *Commelina cyanea* and *Lobelia purpurascens* (White Root). Exotic species included *Asparagus asparagoides** (Bridal Creeper), *Bidens pilosa** (Cobbler's Pegs), *Setaria parviflora*, Sida rhombifolia** (Paddys Lucerne) and *Solanum pseudocapsicum** (Madeira Winter Cherry).	
Other diagnostic features	Vegetation was recorded on river flats on the Cumberland Plain	

PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	
PCT quantitative analysis	Justification for PCT 1800 recorded within the study area was based on a quantitative analysis of vegetation integrity plot data (Q33) using the Plant Community Identification tool (EES, 2020c) in accordance with section 5.2.1.12 of the BAM. Plots from Intact vegetation were used and these are considered the most representative of the vegetation community. Dominant species for each stratum, vegetation formation, IBRA region and field observations were entered in the Plant Community Identification tool. PCT 1800 had the highest number of matches (8). A review of existing vegetation mapping identified that PCT 1800 has been mapped previously by Open Lines and Biosis (2020) and Tozer *et al.* (2010). Based on floristic, geographic and geological characteristics, this vegetation is considered consistent with the scientific description and distribution information outlined for PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (EES, 2020).

Photo 5.17 PCT 1800 Intact (Q33)

Photo 5.18 PCT 1800 Intact

Photo 5.19 PCT 1800 Thinned (Q20)

Photo 5.20 PCT 1800 Scattered Trees (Q7)

Table 5.12 Comparison of PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley vegetation integrity plot data against PCT condition benchmarks

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Large tree	Hollows	leaf litter	Length timber	High threat weed	VI score
BM[1]	4	8	8	7	2	3	21	21	73	3	1	1	1(50)	-	40	12	-	100
Intact																		
Q25	3	0	4	9	0	2	33.5	0.0	50.2	16.6	0.0	0.3	0	0	75.0	420.0	3.2	
Q29	4	1	7	10	1	2	32.1	6.0	70.4	4.2	0.7	0.3	0	0	19.0	83.0	0.8	66.4
Q33	1	0	5	6	0	4	30.0	0.0	24.4	5.9	0.0	1.0	0	0	66.0	138.0	2.5	
Thinned																		
Q20	1	0	3	4	0	1	30.0	0.0	35.9	1.8	0.0	0.2	7	3	57.0	33.0	3.6	
Q27	3	1	4	7	1	3	32.0	0.5	50.8	14.6	3.0	4.3	0	3	22.0	118.0	1.4	67.5
LC2	1	2	3	7	0	2	60	20.5	60.4	2	0	0.2	1	1	34	31	40.3	

Notes:

(1) Benchmark data for equivalent community in NSW Sydney Basin IBRA Bioregion; Vegetation Type - PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley; Vegetation Formation: Forested Wetlands; Vegetation Class: Coastal Floodplain Wetlands; source (NSW BioNet Vegetation Classification database accessed April 2020 and cross referenced with BAM-C).

5.3 Native vegetation summary

All native vegetation types, condition categories and aligned threatened ecological communities recorded within the study area are summarised in Table 5.13.

Table 5.13 Native vegetation summary

Vegetation type	Condition	Threatened ecological community (BC Act)	Extent off-airport land (hectares)	Extent on-airport land (hectares)	Total area (hectares)
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	Shale Gravel Transition Forest[1]	2.10	0	2.10
	Thinned		6.91	0	6.91
	Scattered Trees		1.41	0	1.41
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest[2]	1.34	1.53	2.87
	Thinned		4.40	0.09	4.49
	Scattered Trees		0.49	0	0.49
	Low		0	10.21	10.21
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Cumberland Plain Woodland[3]	0.00	4.05	4.05
	Thinned		4.66	0	4.66
	Scattered Trees		1.73	2.32	4.05
	Low		3.25	23.79	27.04
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	Not listed	0	0.01	0.01
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	Swamp Oak Floodplain Forest[4]	1.07	0	1.07
	Thinned		4.31	0	4.31
Total area (hectares)			**31.67**	**42.00**	**73.67**

Notes:

(1) Shale Gravel Transition Forest in the Sydney Basin Bioregion
(2) River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
(3) Cumberland Plain Woodland in the Sydney Basin Bioregion
(4) Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

5.4 Non-native vegetation types

Vegetation which was not able to be assigned to a recognised NSW PCT was recorded as Miscellaneous ecosystem. Three non-native vegetation types were recorded within the study area including highly disturbed areas with no or limited native vegetation, urban exotic/native landscape plantings and water bodies, rivers, lakes, streams (not wetlands). A description of each non-native vegetation type is described below.

5.4.1 Miscellaneous ecosystem – non-native

Highly disturbed areas within no or limited native vegetation was recorded in areas where exotic perennial grasses dominated the understorey and covered more than 50 per cent of total plant foliage cover. Overstorey vegetation was absent due to historic clearing. Within the study area, this vegetation type was recorded in paddocks used for agriculture (Photo 5.21 - Photo 5.22) and in disturbed areas such as roadsides.

Photo 5.21 Highly disturbed areas with no or limited native vegetation recorded in a paddock

Photo 5.22 Highly disturbed areas with no or limited native vegetation

5.4.2 Miscellaneous ecosystem – urban exotic/native landscape plantings

Urban exotic/native landscape plantings were recorded in areas where exotic perennial grasses dominated the understorey and overstorey species were planted. These areas have been subject to historic land clearing and replanted using a combination or indigenous and non-indigenous native species (such as *Corymbia citridora* (Lemon-scented Gum), *Corymbia maculata* (Spotted Gum) and *Ficus microcarpa var. hillii* (Hills Weeping Fig)) and exotic species. Exotic species recorded include *Nerium oleander** (Oleander) and *Schinus molle** (Pepper Tree).

Photo 5.23 An example of planted non-native vegetation within the study area

Photo 5.24 Planted *Corymbia maculata* (Spotted Gum) recorded near St Marys Station

5.4.3 Miscellaneous ecosystem - water bodies, rivers, lakes, streams (not wetlands)

Water bodies, rivers, lakes, streams (not wetlands) were recorded predominately as man-made features (i.e. agricultural dams) that were void of native vegetation. These areas occurred throughout the study area (Photo 5.25 and Photo 5.26).

Photo 5.25 Constructed agricultural dam

Photo 5.26 Constructed agricultural dam

5.4.4 Summary of non-native vegetation types

A summary of the non-native vegetation types recorded on airport land and off airport land and presented in Table 5.14.

Table 5.14 Summary of non-native vegetation types

Non-native vegetation types	Area within study area (hectares)	
	Off-airport	On-airport
Miscellaneous ecosystem – non-native	76.5	45.14
Miscellaneous ecosystem - urban exotic/native landscape plantings	3.63	0
Miscellaneous ecosystem - water bodies, rivers, lakes, streams (not wetlands)	6.19	3.48

5.5 Priority weeds and Weeds of National Significance

During field surveys, exotic species listed as High Threat weeds under the *Biodiversity Conservation Act 2016,* Priority Weeds for the Greater Sydney region under the *Biosecurity Act 2015* (Department of Primary Industries, 2019a) and Weeds of National Significance (WoNS) (Australian Weeds Committee, 2020) were noted. Each species is outlined in Table 5.15.

Table 5.15 Priority weeds identified within the study area

Scientific name	Common name	BAM	Priority weed listing	WONS	Off-airport	On-airport
*Acetosella vulgaris**	Sheep sorrel	HT	-	No	x	-
*Alternanthera pungens**	Khaki weed	HT	General Biosecurity Duty	No	x	-
*Araujia sericifera**	Moth Vine	HT	General Biosecurity Duty	No	x	x
*Asparagus aethiopicus**	Asparagus Fern	HT	Regional Recommended Measure	Yes	x	-
*Asparagus asparagoides**	Bridal Creeper	HT	General Biosecurity Duty	Yes	x	-
*Axonopus fissifolius**	Narrow-leaved Carpet Grass	HT	-	No	x	-
*Chloris gayana**	Rhodes grass	HT	-	No	x	-
*Cyperus eragrostis**	Tall flatsedge	HT	-	No	x	-
*Eragrostis curvula**	African Love Grass	HT	General Biosecurity Duty	No	x	x
*Cestrum parqui**	Green Cestrum	HT	General Biosecurity Duty Regional Recommended Measure	No	x	x
*Ehrharta erecta**	Panic veldtgrass	HT	-	No	x	-
*Lantana camara**	Lantana	HT	General Biosecurity Duty Prohibition on dealings	Yes	-	x
*Ligustrum sinense**	Small-leaved Privet	HT	General Biosecurity Duty	No	x	x
*Ligustrum lucidum**	Broad-leaved Privet	-	General Biosecurity Duty	No	-	x
*Lycium ferocissimum**	African Box Thorn	HT	General Biosecurity Duty Prohibition on dealings	Yes	x	x

Scientific name	Common name	BAM	Priority weed listing	WONS	Off-airport	On-airport
*Olea europaea**	African Olive	HT	General Biosecurity Duty Regional Recommended Measure	No	x	x
*Opunita sp.**	Prickly Pear		General Biosecurity Duty Prohibition on dealings	Yes	-	x
*Paspalum dilatatum**	-	HT	-	No	x	-
*Ricinus communis**	Castor Oil Plant		General Biosecurity Duty	No	x	x
*Rubus fruticosus complex**	Blackberry	HT	General Biosecurity Duty Prohibition on dealings	Yes	x	x
*Senecio madagascariensis**	Fireweed	HT	General Biosecurity Duty Prohibition on dealings	Yes	x	x
*Xanthium spinosum**	Bathurst burr	HT	General Biosecurity Duty	No	x	-

5.6 NSW Threatened ecological communities

A total of four TECs listed under the BC Act were recorded within the study area, being:

- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Shale Gravel Transition Forest in the Sydney Basin Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

A summary of each TECs, associated PCT and extent within the study area is presented in Table 5.16.

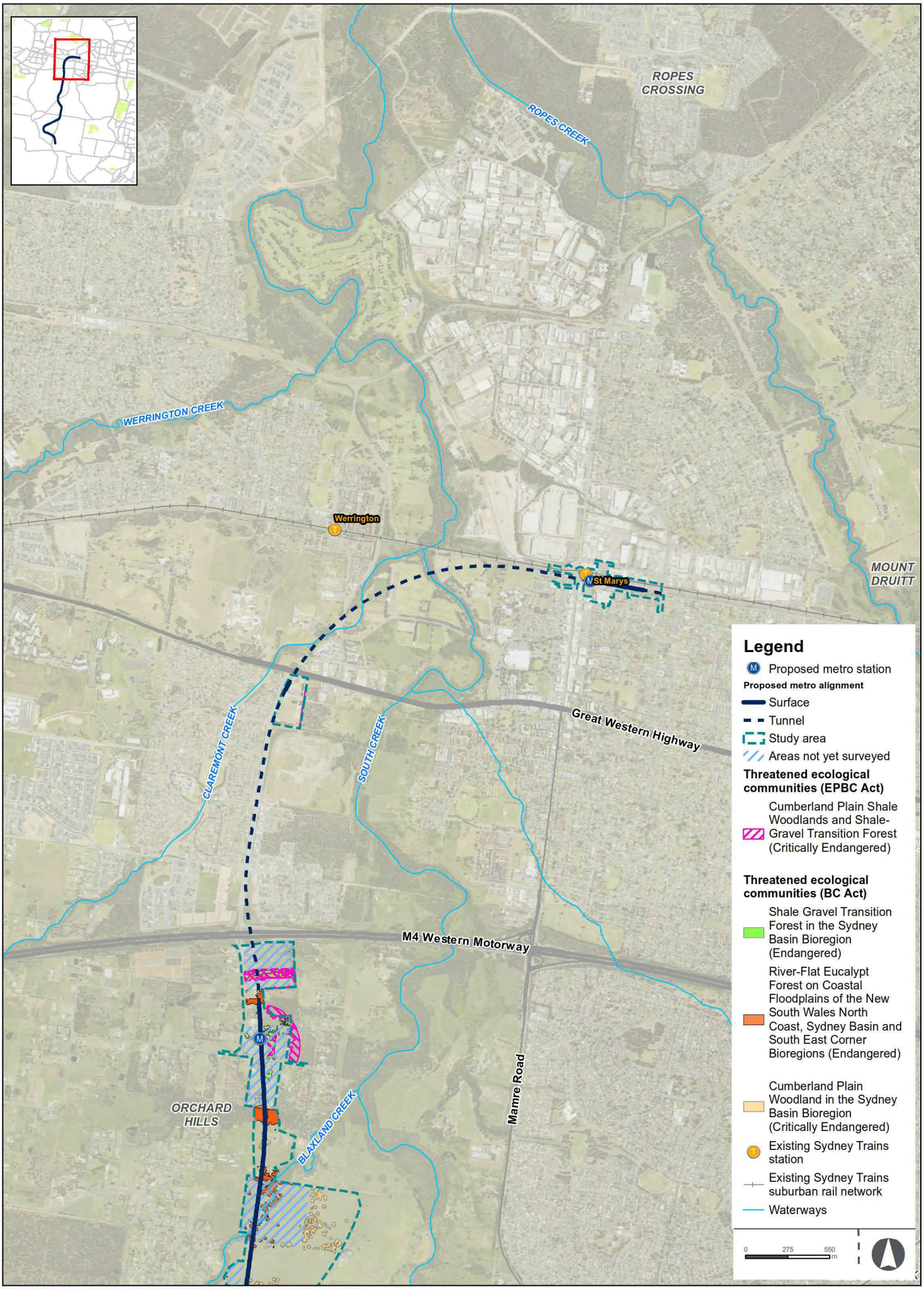
Details of how each PCT meets each element of the scientific determination, including geographical location, characteristic species, soils and geology are presented in Table 5.17 to Table 5.20.

The location of each TEC in relation to the study area is shown in Figure 5.2.

An additional TEC, Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions was considered as a candidate based on associated PCT although this vegetation type did not meet listing advice for the TEC.

Table 5.16 Summary of BC Act threatened ecological communities within the study area

Threatened Ecological Community	BC Act status	Associated PCT within the study area	Condition	Extent off-airport (hectares)	Extent on-airport (hectares)
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered	PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Does not occur	4.05
			Thinned	4.66	Does not occur
			Scattered Trees	1.73	2.32
			Low	3.25	23.79
Total area of Cumberland Plain Woodland in the Sydney Basin Bioregion				**9.64**	**30.16**
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.34	1.53
			Thinned	4.40	0.09
			Scattered Trees	0.49	Does not occur
			Low	Does not occur	10.21
Total area of River-Flat Eucalypt Forest on Coastal Floodplains				**6.23**	**11.83**
Shale Gravel Transition Forest in the Sydney Basin Bioregion	Endangered	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	2.10	Does not occur
			Thinned	6.91	Does not occur
			Scattered Trees	1.41	Does not occur
Total area of Shale Gravel Transition Forest in the Sydney Basin Bioregion				**10.42**	**0**
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Endangered	PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	1.07	Does not occur
			Thinned	4.31	Does not occur
Total area of Swamp Oak Floodplain Forest				**5.38**	**0**

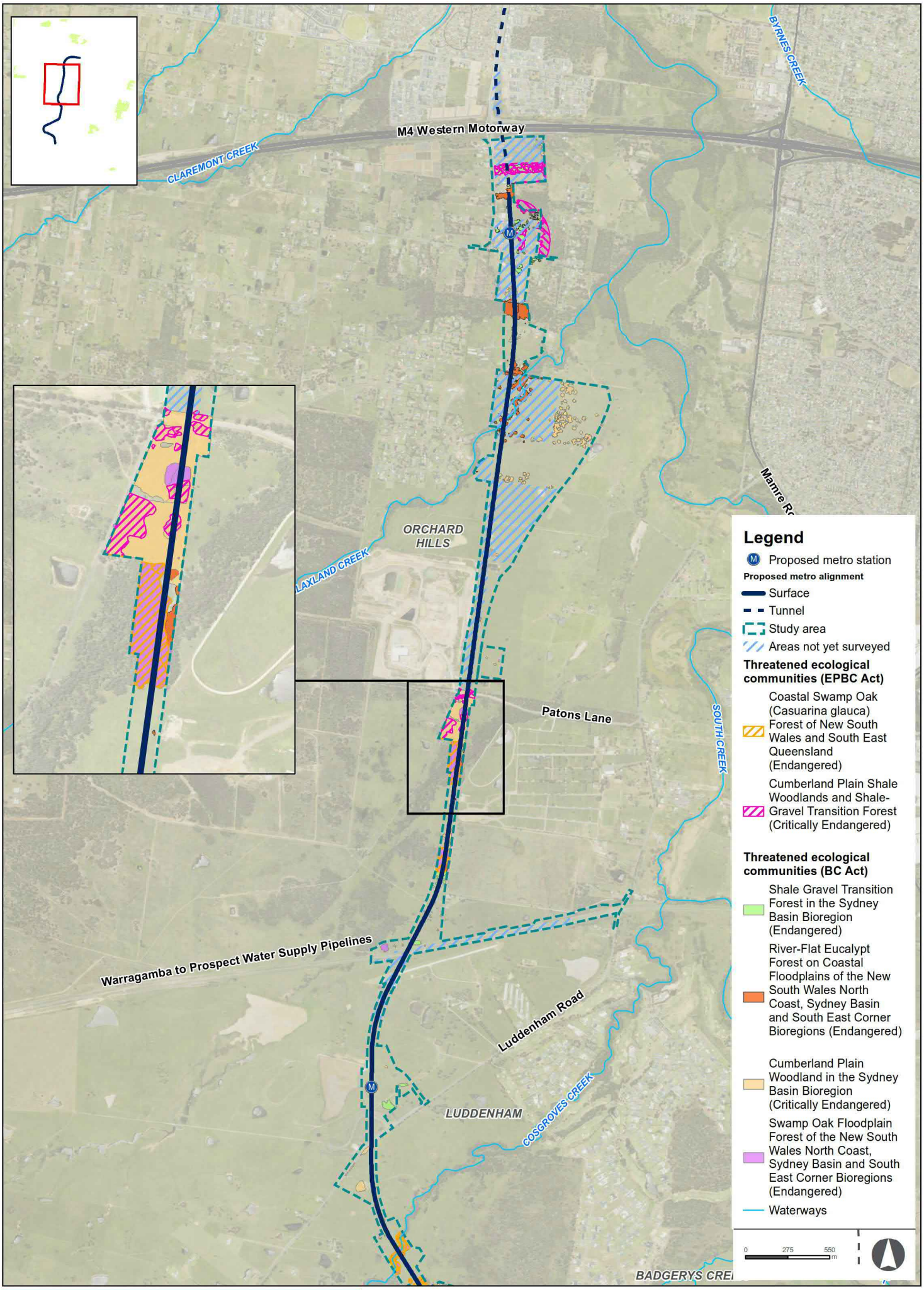


Sydney Metro – Western Sydney Airport

NSW Threatened Ecological Communities

Figure 5-2a

Indicative only, subject to design development



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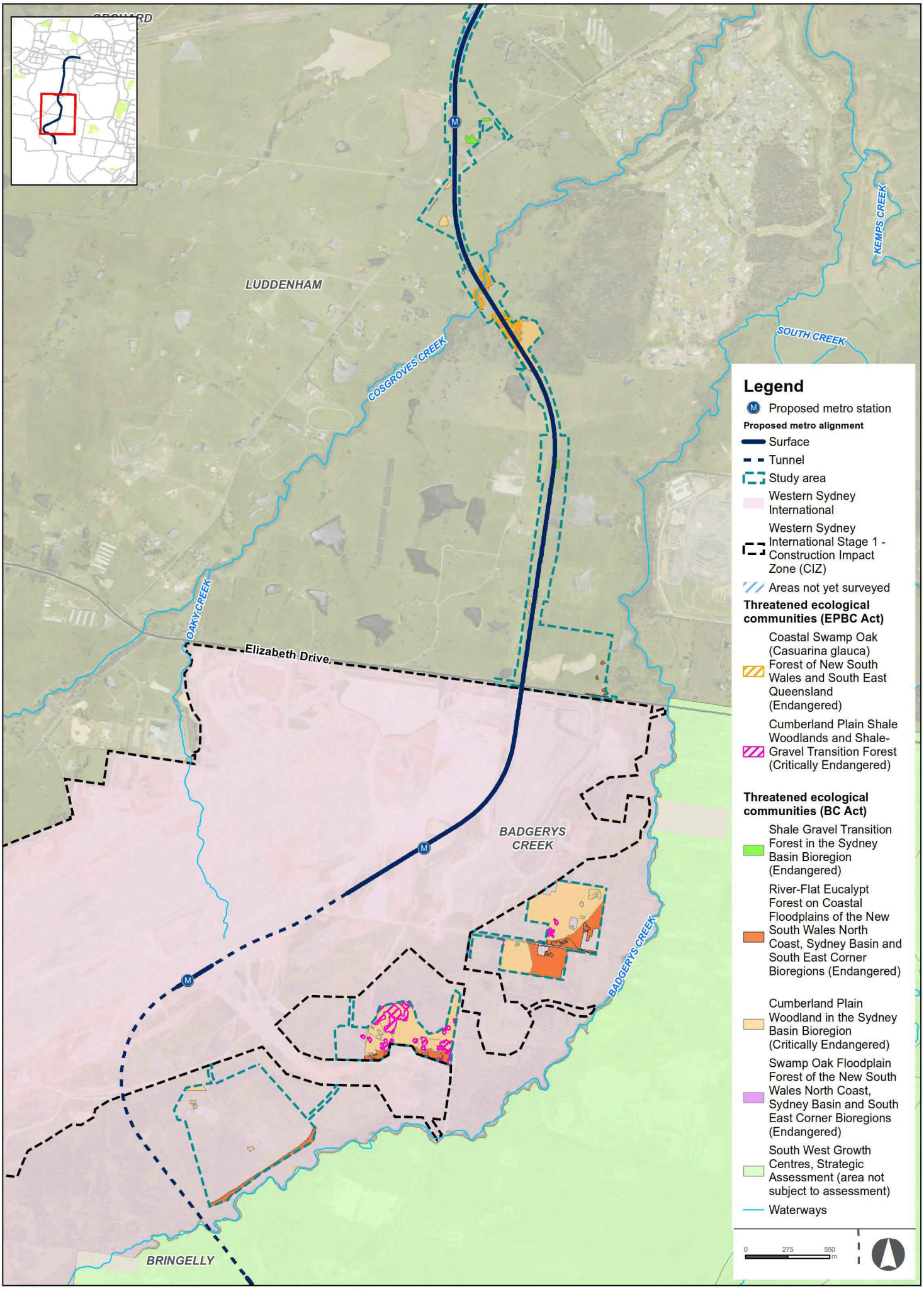
Sydney Metro – Western Sydney Airport

NSW Threatened Ecological Communities

Figure 5-2b

Indicative only, subject to design development

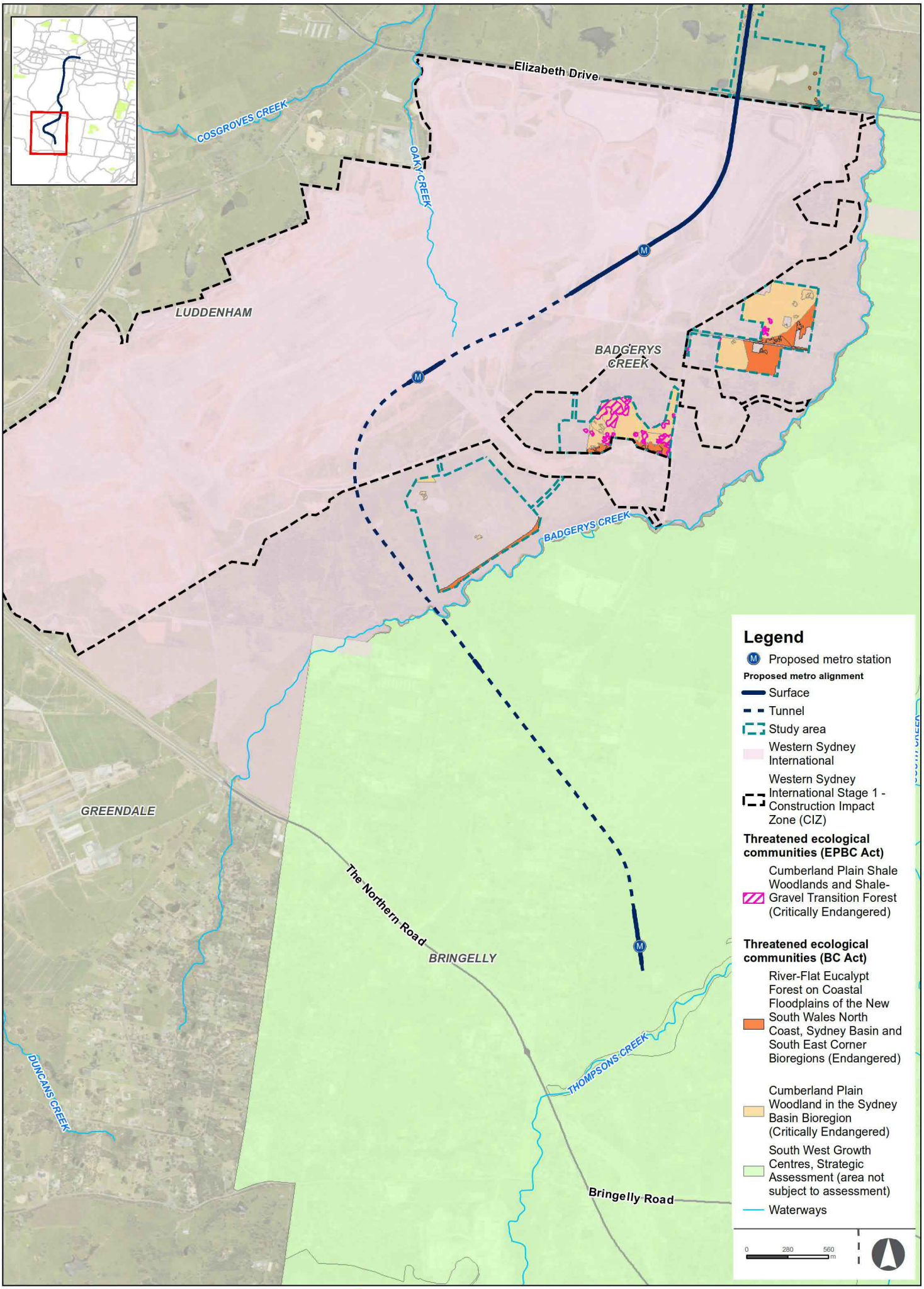


Sydney Metro – Western Sydney Airport

NSW Threatened Ecological Communities

Figure 5-2c

Indicative only, subject to design development



Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

NSW Threatened Ecological Communities

Figure 5-2d

5.6.1 Cumberland Plain Woodland in the Sydney Basin Bioregion

Table 5.17 Correlation of BC Act-listed Cumberland Plain Woodland Community and associated PCT 849

Attributes	Cumberland Plain Woodland in the Sydney Basin Bioregion Threatened Ecological Community[1]	PCT 849			
		Intact	Thinned	Scattered Trees	Low
Location	Cumberland Plain Woodland is an ecological community from the Sydney Basin bioregion associated with clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates, on the Cumberland Plain (Paragraph 2).	The study area is located to the west of the Sydney Central Business District.			
Bioregion	Restricted to the Sydney Basin and known from local government areas of Penrith and Liverpool (Paragraph 11).	This vegetation type was recorded in the Sydney Basin within the Penrith and Liverpool LGAs.			
Landform and altitudinal range	Typically occurs on flat to undulating or hilly terrain up to about 350 metres elevation but may also occur on locally steep sites and at slightly higher elevations (Paragraph 2).	Occurs on flat to slightly undulating land at <50 metres elevation across the Study area.			
Soil/geology	Clay soils derived from Wianamatta Group geology, or more rarely alluvial substrates	Clay soils were recorded within this vegetation type which are derived from Wianamatta Group geology.			
Structure	In relatively undisturbed condition, it has an open tree canopy, a near-continuous groundcover dominated by grasses and herbs, sometimes with layers of shrubs and/or small trees. May also occur as regrowth dominated by shrubs and saplings or as derived grassland (Paragraph 2).	Structure of the community within the study area is variable, consisting of open woodland, woodland and open forest was recorded this condition type with a continuous ground layer comprised of native grasses and herbs.	Vegetation recorded as Thinned has a native open canopy with a continuous ground layer comprised of native grasses and herbs. Vegetation structure was altered due to under scrubbing,	An open tree canopy was recorded in this condition type with an understorey dominated by exotic species due to historical disturbances.	Low condition was recorded in areas where canopy has been historically cleared and occurred as derived grasslands. A continuous ground layer of native grasses and herbs with scattered shrubs was recorded.

Attributes	Cumberland Plain Woodland in the Sydney Basin Bioregion Threatened Ecological Community[1]	PCT 849			
		Intact	Thinned	Scattered Trees	Low
			thinning of overstorey species, regrowth vegetation etc.		
Floristic assemblage	There are 112 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance (Paragraph 3).	All vegetation assigned to this PCT was floristically characteristic of Cumberland Plain Woodland community.			
Characteristic species	Characterised by an upper-storey that is usually dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Grey Ironbark), *E. eugenioides* (Narrow-leaved Stringybark), *Corymbia maculata* (Spotted Gum) or other less frequently occurring eucalypts, including *Angophora floribunda*, *A. subvelutina* (Broad-leaved Apple), *E. amplifolia* (Cabbage Gum) and *E. fibrosa* (Broad-leaved Ironbark). (Paragraph 5).	Vegetation assigned to this PCT had an upper storey dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum).	Vegetation assigned to this PCT had an upper storey dominated by *Eucalyptus moluccana* (Grey Box) and/or *E. tereticornis* (Forest Red Gum).	Vegetation assigned to this PCT had an upper storey dominated by *Eucalyptus moluccana* (Grey Box) and *Eucalyptus microcorys* (Tallowwood).	Upper-storey vegetation was cleared in this condition type with ground cover vegetation being floristically representative of CUMBERLAND PLAIN WOODLAND.
Relationship to surrounding EECs	Cumberland Plain Woodland may intergrade with Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion; Moist Shale Woodland in the Sydney Basin Bioregion; Shale/ Sandstone Transition Forest; Shale Gravel Transition Forest in the Sydney Basin Bioregion; and Sydney Turpentine-Ironbark Forest (Paragraph 8).	Cumberland Plain Woodland was recorded grading into Shale Gravel Transition forest in areas of slightly higher elevation where laterites were observed on the soil surface and *Eucalyptus moluccana* (Grey Box) generally becomes co-dominant with *Eucalyptus fibrosa* (Broad-leaved Ironbark).			

Attributes	Cumberland Plain Woodland in the Sydney Basin Bioregion Threatened Ecological Community[1]	PCT 849			
		Intact	Thinned	Scattered Trees	Low
Condition thresholds	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community (Paragraph 9).	This vegetation was recorded as Intact, thinned, Scattered Trees and low (derived native grasslands). In each of these condition types, characteristic native species dominated at least one structural layer.			
Outcome		**Meets listing**	**Meets listing**	**Meets listing**	**Meets listing**

Notes:

(1) Threatened Species Scientific Committee, 2009

5.6.2 River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Table 5.18 Correlation of BC Act-listed River-Flat Eucalypt Forest Community and associated PCT 835

Attributes	River-flat eucalypt forest Threatened Ecological Community[1]	PCT 835			
		Intact	Thinned	Scattered Trees	Low
Bioregion	North Coast, Sydney Basin and South East Corner bioregions (Paragraph 1).	The study area is within the Sydney Basin bioregion.			
Local Government Areas	This TEC is known from parts of the Local Government Areas of Penrith and Liverpool (Paragraph 3).	Vegetation was recorded in Liverpool and Penrith LGAs.			
Landform and Altitudinal range	Found on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally, occurs below 50 metres elevation, but may occur on localised river flats up to 250 metre above sea level (Paragraph 1).	Vegetation was recorded on alluvial flats either in riparian situations or on the broader floodplain.			
Soil/geology	Alluvium; silts, clay-loams and sandy loams (Paragraph 1).	Vegetation was recorded on alluvial clay/loam soils.			

Attributes	River-flat eucalypt forest Threatened Ecological Community[1]	PCT 835			
		Intact	Thinned	Scattered Trees	Low
Structure	The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees (Paragraph 1).	Vegetation occurred as a tall open woodland.	Vegetation occurred as a tall woodland with historical thinning and regrowth observed.	An open tree canopy was recorded in this condition type with an understorey dominated by exotic species due to historical disturbances.	Low condition was recorded in areas where canopy has been historically cleared and occurred as derived grasslands. A continuous ground layer of native grasses and herbs with scattered shrubs was recorded.
Species assemblage	There are 88 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance (Paragraph 1).	All vegetation assigned to this PCT was floristically characteristic of Cumberland Plain Woodland community.			
Condition thresholds	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.	Characteristic species formed all structural layers of this vegetation.	Characteristic species formed all structural layers of this vegetation.	Characteristic species were limited to the upper canopy of this vegetation.	Characteristic species were limited to the ground strata (and occasionally mid-strata) of this vegetation.
Outcome		**Meets listing**	**Meets listing**	**Meets listing**	**Meets listing**

Notes:

(1) Threatened Species Scientific Committee, 2004a

5.6.3 Shale gravel transition forest in the Sydney Basin Bioregion

Table 5.19 Correlation of BC Act-listed Shale Gravel Transition Forest and associated PCT 724

Attribute	Shale Gravel Transition Forest in the Sydney Basin Bioregion	PCT 724		
		Intact	Thinned	Scattered Trees
Bioregion	Is or has been known to occur in the Liverpool and Penrith Local Government Areas, but may occur elsewhere in the Sydney Basin Bioregion (Paragraph 7).	Vegetation was recorded in the Liverpool and Penrith Local Government Areas in the Sydney Basin Bioregion.		
Landform and geology	Occurs primarily in areas where shallow deposits of Tertiary alluvium overlie shale soils but may also occur in association with localised concentrations of iron-indurated gravel (Paragraph 5).	Vegetation was recorded in areas with evidence of iron-indurated gravels recorded either on the soil surface and re-surfaced around ant nests. These gravels overlaid shale clay soils.		
Associations	Shale Gravel Transition Forest grades into Cumberland Plain Woodland as alluvial and ironstone influences decline (Paragraph 5).	Vegetation was recorded grading into Cumberland Plain Woodland in areas where gravels were less evident, *Eucalyptus fibrosa* and *Melaleuca decora* became less dominant and elevation decreased slightly.		
Species assemblage	Shale Gravel Transition Forest is predominantly of open-forest structure, usually with trees of *Eucalyptus fibrosa* sometimes with *E. moluccana* and *Eucalyptus tereticornis. Melaleuca decora* is frequently present in a small tree stratum. A sparse shrub stratum is usually present with species such as *Bursaria spinosa, Daviesia ulicifolia and Lissanthe strigosa. Ground-layer species include Microlaena stipoides subsp. stipoides, Cheilanthes sieberi subsp. sieberi, Themeda australis, Opercularia diphylla, Lomandra multiflora subsp. multiflora, Aristida vagans, Pratia purpurascens* and *Wahlenbergia gracilis (*Paragraph 4).	Vegetation was recorded with an open forest structure with characteristics trees *Eucalyptus fibrosa* and *Melaleuca decora* forming the upper stratum sometimes with *E. moluccana* and *Eucalyptus tereticornis.* Shrub and ground strata species were characteristics of Shale Gravel Transition Forest.	Vegetation recorded as Thinned had a native open canopy often with Eucalyptus species occurring and emergent and *Melaleuca decora* forming the upper stratum. Ground layer comprised of native grasses and herbs characteristic of Shale Gravel Transition Forest.	An open tree canopy of *Eucalyptus fibrosa* and *Melaleuca decora* was recorded in this condition type with an understorey dominated by exotic species due to historical disturbances.

Attribute	Shale Gravel Transition Forest in the Sydney Basin Bioregion	PCT 724		
		Intact	Thinned	Scattered Trees
Characteristic species	There are 43 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance (Paragraph 2).	All vegetation assigned to this PCT was floristically characteristic of Shale Gravel Transition Forest in at least one structural layer		
Condition thresholds	Disturbed Shale Gravel Transition Forest remnants are considered to form part of the community including where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact (Paragraph 8).	Native canopy and understorey species were recorded indicating an intact seed bank in all condition types. It is considered likely that the vegetation would respond to assisted natural regeneration.		
Outcome		**Meets listing**	**Meets listing**	**Meets listing**

Notes:

(1) Threatened Species Scientific Committee, 2011

5.6.4 Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Table 5.20 Correlation of BC Act-listed Swamp Oak Floodplain Community and associated PCT 1800

Attribute	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	PCT 1800	
		Intact	Thinned
Bioregion	Only occurs in the NSW North Coast, Sydney Basin and South East Corner bioregions and is known from Liverpool and Penrith local government areas (Paragraph 3)	Vegetation was recorded in the Penrith and Liverpool Local Government Areas within the Sydney Basin Bioregion	
Landform and soil/geology	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains (Paragraph 1).	Recorded in riparian areas and periodically inundated flats in proximity to waterways and drainage lines. Soils recorded were grey-black clay-loams.	
Structure	The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees (Paragraph 1).	Vegetation occurred as an open forest structure.	
Floristics	Dominated by a tree canopy of either *Casuarina glauca* or, more rarely, *Melaleuca ericifolia* with or without subordinate tree species; the relatively low abundance of Eucalyptus species; and the prominent groundcover of forbs and graminoids (Paragraph 6).	Vegetation was dominated by *Casuarina glauca* with *Eucalyptus amplifolia subsp. amplifolia* being recorded as a sub-dominant in some patches. Ground cover was dominated by grasses with some forbs and graminoids being recorded.	
Species assemblage	There are 45 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance (Paragraph 1).	All vegetation assigned to PCT 1800 was floristically characteristic of Swamp Oak Floodplain Forest.	
Condition thresholds	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.	Native characteristic species dominated the upper, mid and ground stratum of vegetation	
Outcome		**Meets listing**	**Meets listing**

(1) Threatened Species Scientific Committee, 2004b

5.6.5 Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Table 5.21 Correlation of BC Act-listed Freshwater Wetlands Community and associated PCT 1071

Threatened ecological community and PCT comparison[1]	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	PCT 1071 (Intact)
Bioregion	North Coast, Sydney Basin and South East Corner bioregions (Paragraph 1)	Vegetation was recorded in the Sydney Basin
Local Government Area	Known from parts of the Local Government Areas Liverpool and Penrith City Council (Paragraph 3).	The study area is within the Liverpool and Penrith City Council Local Government Areas
Landform and Altitudinal range	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. (Paragraph 1)	Recorded in man-made dams where vegetation is permanently inundated by freshwater.
Soil/geology	Typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains (Paragraph 1).	Recorded in silt soils in moist alluvial depressions (man-made dams).
Structure	The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce. (Paragraph 1)	The vegetation is recorded as reedland dominated by *Typha orientalis*.
Species assemblage	There are 66 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance (Paragraph 1).	All vegetation assigned to this PCT was floristically characteristic of Freshwater Wetlands.
Exceptions	Artificial wetlands created on previously dry land specifically for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of this community. (Paragraph 4)	PCT 1071 was recorded in man-made dams on previously dry land used for agriculture
Outcome		**Does not meet listing and as such does not form part of the TEC**

Notes:

(1) Threatened Species Scientific Committee, 2004c

5.7 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are defined as ecosystems that require access to groundwater to meet all or some of their water requirements to maintain their communities of plants and animals, ecological processes and ecosystem services' (Department of Planning, Industry and Environment, 2020).

Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater may include native plant communities. GDEs which are surface expressions of groundwater within the locality of the study area (<10 kilometres) include South Creek and associated tributaries. Other GDEs which are reliant on subsurface groundwater in the study area include:

- Cumberland Plain Woodland in the Sydney Basin Bioregion
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Shale Gravel Transition Forest in the Sydney Basin Bioregion
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Potential impacts on GDEs resulting from the project include groundwater drawdown. Although the majority of groundwater drawdown with the potential to affect GDEs is predicted to occur within the project's construction footprint, potential impacts outside of the construction footprint have been considered.

The resulting groundwater drawdown impact has been restricted to about 1.81 hectares of Shale Gravel Transition Forest in the Sydney Basin Bioregion within the Orchard Hills locality. This impact on GDEs is assessed further in Section 8.2.2.

To determine this, conservative modelling of these impacts has identified potential drawdown of between 1-4 metres, with the zone of greatest predicted change (more than 2 metres) located within around 100 metres of Orchard Hills Station as shown in Figure 5-1c and Chapter 15 of the Project Environmental Impact Statement and Technical paper 7 (Groundwater). This maximum change, if it eventuated, would occur at the base of the cut. Moving away from the cut, the magnitude of the change in groundwater level would reduce. Mitigation measures to minimise impacts on GDE's during construction (e.g. undrained station at Orchard Hills) are described further in Technical paper 7 (Groundwater) in the Project Environmental Impact Statement.

Any area of mapped native vegetation outside of the construction footprint within the >2 metre groundwater drawdown contour is shown on Figure 8.1. Within the Orchard Hills locality, localised impacts on groundwater levels associated with the proposed rail cutting and station construction are considered likely.

6 Threatened species

This chapter addresses section 6 of the BAM and provides information on assessing the habitat suitability for threatened species within the study area. The Biodiversity Assessment Calculator (OEH, 2017) was used to derive the list of ecosystem credit (predicted species) and species credit species (candidate species) for on-airport and off-airport lands. The results of the Biodiversity Assessment Calculator were added to where necessary with the results of database searches (see Table 3.2) and findings from previous ecological assessments (see Table 3.3), specifically the results of Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e) and Biodiversity Assessment Report for land outside Stage 1 development (DIRD, 2018).

All threatened species were subject to habitat suitability assessments, provided in Appendix A and Appendix B. Separate habitat suitability assessments have been completed for on-airport and off-airport lands.

6.1 Ecosystem credit species

Ecosystem credit species are those that can be predicted by vegetation surrogates and landscape features or are those species for which targeted survey has a low probability of detection. Targeted survey is not required for ecosystem credit species. Ecosystem credit threatened species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the Threatened Biodiversity Data Collection (EES, 2020d) as required by sections 6.1.1.3 and 6.2.1.2 of the BAM.

The Biodiversity Assessment Calculator was used to generate a list of the predicted threatened species for the study area. Separate Biodiversity Assessment Calculators were used for on-airport and off-airport lands. Threatened species data from the surveys undertaken for the Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020), Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e) and environmental field survey of Commonwealth Land at Badgerys Creek (SMEC, 2014) were reviewed and one species, the Blue-billed Duck was added to the Biodiversity Assessment Calculator as a predicted species and considered further for assessment. The initial list of predicted ecosystem credit species is provided in Table 6.1.

Once the initial list of ecosystem credit species had been generated, the geographic limitations of each species were assessed and where the study area was outside of the geographic limitation described for a species it was removed from the assessment. The habitat assessments and vegetation integrity surveys conducted during the field survey allowed for the identification of any specific habitat constraints or presence absence of suitable microhabitats within the study area. Habitat suitability assessment in accordance with section 6.2 of the BAM was completed to support the inclusion or exclusion of ecosystem credit species from the assessment. The full threatened species habitat suitability assessment is provided in Appendix A and Appendix B with a summary of predicted threatened species presented in Table 6.2.

Table 6.1 Summary of predicted ecosystem credit species that were predicted by the BAM-C

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations	
					Off-airport	On-airport
Anthochaera phrygia	Regent Honeyeater	CE	CE	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849;
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Botaurus poiciloptilus	Australasian Bittern	E	CE	Moderate	PCT 835	PCT 835; PCT 1071
Calidris ferruginea	Curlew Sandpiper	E	-	High	No associated habitat recorded.	PCT 1071
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Moderate	PCT 724; PCT 835; PCT 849	PCT 835; PCT 849
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	High	PCT 724	No associated habitat recorded.
Chthonicola sagittata	Speckled Warbler	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Circus assimilis	Spotted Harrier	V	-	Moderate	PCT 849	PCT 849; PCT 1071
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Dasyurus maculatus	Spotted-tailed Quoll	V	E	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Moderate	No associated habitat recorded.	PCT 1071
Epthianura albifrons	White-fronted Chat	E	-	Moderate	No associated habitat recorded.	PCT 1071
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations	
					Off-airport	On-airport
Glossopsitta pusilla	Little Lorikeet	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Grantiella picta	Painted Honeyeater	V	V	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Hieraaetus morphnoides	Little Eagle	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Irediparra gallinacea	Comb-crested Jacana	V	-	Moderate	No associated habitat recorded.	PCT 1071
Ixobrychus flavicollis	Black Bittern	V	-	Moderate	PCT 835: PCT 1800	PCT 835; PCT 1071
Lathamus discolor	Swift Parrot	E	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Limicola falcinellus	Broad-billed Sandpiper	V	-	High	No associated habitat recorded.	PCT 1071
Limosa limosa	Black-tailed Godwit	V	-	High	No associated habitat recorded.	PCT 1071
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Miniopterus australis	Little Bent-winged Bat	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations	
					Off-airport	On-airport
Neophema pulchella	Turquoise Parrot	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Ninox connivens	Barking Owl	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Ninox strenua	Powerful Owl	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Oxyura australis	Blue-billed Duck	V	-	Moderate	No associated habitat recorded.	PCT 1071
Pandion cristatus	Eastern Osprey	V	-	Moderate	PCT 724; PCT 835; PCT 1800	PCT 835
Petaurus australis	Yellow-bellied Glider	V	-	High	PCT 724; PCT 849	PCT 849
Petroica boodang	Scarlet Robin	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Petroica phoenicea	Flame Robin	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Phascolarctos cinereus	Koala	V	V	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Rostratula australis	Australian Painted Snipe	E	E	Moderate	No associated habitat recorded.	PCT 1071
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849; PCT 1071
Stagonopleura guttata	Diamond Firetail	V	-	Moderate	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Stictonetta naevosa	Freckled Duck	V	-	Moderate	No associated habitat recorded.	PCT 1071

Species name	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	PCT associations	
					Off-airport	On-airport
Tyto novaehollandiae	Masked Owl	V	-	High	PCT 724; PCT 835; PCT 849; PCT 1800	PCT 835; PCT 849
Varanus rosenbergi	Rosenberg's Goanna	V	-	High	PCT 724	No associated habitat recorded.

Notes:

(1) V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act Commonwealth EPBC Act. M= Migratory/Marine under the Commonwealth EPBC Act

Table 6.2 Summary of predicted ecosystem credit species that were assessed

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Anthochaera phrygia	Regent Honeyeater	CE	CE	No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga Ironbark) not present within study area. Excluded	No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga Ironbark) not present within study area. Excluded
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Foraging and potential breeding habitat present in study area. **Included as an ecosystem credit**	Foraging habitat present in study area **Included as an ecosystem credit**
Botaurus poiciloptilus	Australasian Bittern	E	E	Marginal, degraded habitat occurs within the study area. Most of the artificial wetlands lack dense aquatic vegetation which is preferred by the species. Excluded	Marginal, degraded habitat occurs within the study area. Most of the artificial wetlands lack dense aquatic vegetation which is preferred by the species. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Calidris ferruginea	Curlew Sandpiper	E	CE	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Preferred foraging habitat not present within the study area. Excluded	Preferred foraging habitat not present within the study area. Excluded
Chthonicola sagittata	Speckled Warbler	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded
Circus assimilis	Spotted Harrier	V	-	No large inland wetlands within study area. Some marginal foraging habitat present so could occasionally forage within the vicinity of the study area. Excluded	No large inland wetlands within study area. Some marginal foraging habitat present so could occasionally forage within the vicinity of the study area. Excluded
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	Preferred habitat not within study area. Excluded	Preferred habitat not within study area. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Daphoenositta chrysoptera	Varied Sittella	V	-	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Preferred habitat is not present. Excluded	Preferred habitat is not present. Excluded
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Outside usual range for this species and preferred habitat not within study area. Excluded	Outside usual range for this species and preferred habitat not within study area. Excluded
Epthianura albifrons	White-fronted Chat	E	-	Preferred habitat not within study area Excluded	Preferred habitat not within study area Excluded
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Glossopsitta pusilla	Little Lorikeet	V	-	Suitable foraging habitat present within the study area. **Included as an ecosystem credit**	Suitable foraging habitat present within the study area. **Included as an ecosystem credit**
Grantiella picta	Painted Honeyeater	V	V	Large patches of woodland with Mistletoe generally absent in study area. Rare or intermittent occurrences cannot be discounted. Excluded	Large patches of woodland with Mistletoe generally absent in study area. Rare or intermittent occurrences cannot be discounted. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**
Hieraaetus morphnoides	Little Eagle	V	-	Suitable foraging and breeding habitat present within the study area. **Included as an ecosystem credit**	Suitable foraging and breeding habitat present within the study area. **Included as an ecosystem credit**
Ixobrychus flavicollis	Black Bittern	V	-	Habitat within the study area is degraded and limited to farm dams without emergent vegetation. This species was recorded in Penrith Weir in December 2019, approximately 9 kilometres to the NW of the study area. **Included as an ecosystem credit**	Habitat within the study area is degraded and limited to farm dams without emergent vegetation. Recorded on airport land by DIRD (2016e). **Included as an ecosystem credit**
Lathamus discolor	Swift Parrot	E	CE	May occur over the study area intermittently during seasonal migration movements. Winter-flowering resources (e.g. Spotted Gum) absent from the study area. No recent records within the vicinity of the study area. Excluded	May occur over the study area intermittently during seasonal migration movements. Winter-flowering resources (e.g. Spotted Gum) absent from the study area. No recent records within the vicinity of the study area. Excluded
Lophoictinia isura	Square-tailed Kite	V	-	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**	Living and dead trees and paddock trees present within the study area. Would forage within study area as part of a larger home range. **Included as an ecosystem credit**

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Few large patches of woodland present on study area but not preferred habitat. Rare or intermittent occurrences cannot be discounted. Excluded	Large patches of woodland generally absent on study area. Rare or intermittent occurrences cannot be discounted. Excluded
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Potential roosting and foraging habitat available within the study area. Recorded on study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. Recorded in study area (DIRD, 2016e) **Included as an ecosystem credit**
Miniopterus australis	Little Bent-winged Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Neophema pulchella	Turquoise Parrot	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Ninox connivens	Barking Owl	V	-	Moderate - Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**	Moderate - Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**
Ninox strenua	Powerful Owl	V	-	Suitable foraging and breeding habitat recorded within the study area. **Included as an ecosystem credit**	Suitable foraging and breeding habitat recorded within the study area. **Included as an ecosystem credit**
Pandion cristatus	Eastern Osprey	V	-	Preferred habitat not within study area. Excluded	Preferred habitat not within study area. Excluded
Petaurus australis	Yellow-bellied Glider	V	-	Preferred habitat not within study area. Excluded	Preferred habitat not within study area. Excluded
Petroica boodang	Scarlet Robin	V	-	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**	Suitable foraging habitat recorded within the study area. Likely to be non-breeding migrant to the study area. **Included as an ecosystem credit**
Petroica phoenicea	Flame Robin	V	-	Habitat within study area is degraded. Some potential foraging habitat within study area, but patches fallen timber and woody debris are limited. Excluded	Habitat within study area is degraded. Some potential foraging habitat within study area, but patches fallen timber and woody debris are limited. Excluded
Phascolarctos cinereus	Koala	V	V	Habitat degraded and unlikely to be considered important habitat. Excluded	Habitat degraded and unlikely to be considered important habitat. Excluded

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Foraging habitat present within the study area. No known roost sites or established camps within the study area. **Included as an ecosystem credit**	Foraging habitat present within the study area. No known roost sites or established camps within the study area. **Included as an ecosystem credit**
Rostratula australis	Australian Painted Snipe	E	E	Habitat within the study area is degraded and limited to farm dams without emergent vegetation Excluded	Habitat within the study area is degraded and limited to farm dams without emergent vegetation Excluded
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**	Potential roosting and foraging habitat available within the study area. **Included as an ecosystem credit**
Stagonopleura guttata	Diamond Firetail	V	-	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded	No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area. Excluded
Stictonetta naevosa	Freckled Duck	V	-	Several degraded farm dams present in study area that this species may use on occasion (e.g. during periods of drought). Excluded	Several degraded farm dams present in study area that this species may use on occasion (e.g. during periods of drought). Excluded
Tyto novaehollandiae	Masked Owl	V	-	Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**	Suitable foraging and breeding habitat (hollows >20 centimetres in diameter and 4 metres above ground) recorded within the study area. **Included as an ecosystem credit**

Species name	Common name	BC Act[1]	EPBC Act[1]	Justification for exclusion/inclusion	
				Off-airport	On-airport (DIRD, 2016e)
Varanus rosenbergi	Rosenberg's Goanna	V	-	Preferred habitat not within study area Excluded	Preferred habitat not within study area Excluded

Notes:

(1) V = Vulnerable, E = Endangered, CE = Critically Endangered under the NSW BC Act or Commonwealth EPBC Act. M = Marine/Migratory under the Commonwealth EPBC Act

6.2 Species credit species

Species credit species are those species that cannot be confidently predicted to occur based on habitat surrogates and landscape features. These species can also be reliably detected by survey. Species credit species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the Threatened Biodiversity Data Collection (EES, 2020d) as required by section 6.3.1.1 of the BAM in conjunction with a habitat assessment. Threatened species survey results from the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e), Western Sydney Airport Biodiversity Assessment Report for land outside Stage 1 development (DIRD, 2018) and Environmental field survey of Commonwealth Land at Badgerys Creek (SMEC, 2014) were also used in the assessment.

The Biodiversity Assessment Calculator was used to generate a list of the candidate species for the study area. Separate Biodiversity Assessment Calculators were used for on-airport and off-airport lands. The survey results for the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e) and environmental field survey of Commonwealth Land at Badgerys Creek (SMEC, 2014) were also used to inform the candidate species list for on-airport lands.

Where appropriate, a combination of available expert reports, vegetation mapping and survey results from off-airport lands (prepared for the *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis, 2020) have been used to inform areas where access was restricted, and field survey was not possible. The initial list of species credit species as returned from the Biodiversity Assessment Calculator is provided in Table 6.3. The full threatened species habitat suitability assessment is provided in Appendix B.

Table 6.3 Summary of candidate threatened species credit species returned by the Biodiversity Assessment Calculator

Species	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	Off-airport	On-airport
Flora						
Acacia bynoeana	Bynoe's Wattle	E	V	High	✓	✓
Acacia pubescens	Downy Wattle	V	V	High	✓	✓
Allocasuarina glareicola	Allocasuarina glareicola	E	E	High	✓	-
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Moderate	✓	✓
Callistemon linearifolius	Netted Bottle Brush	V	-	Moderate	✓	✓
Commersonia prostrata	Dwarf Kerrawang	E	E	High	-	✓
Cynanchum elegans	White-flowered Wax Plant	E	E	High	✓	✓
Deyeuxia appressa	Deyeuxia appressa	E	E	High	✓	-
Dillwynia tenuifolia - Endangered population	Dillwynia tenuifolia, Kemps Creek	E	-	High	✓	✓
Dillwynia tenuifolia	Dillwynia tenuifolia	V	-	Moderate	✓	✓
Eucalyptus benthamii	Camden White Gum	V	V	High	✓	✓
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	Moderate	✓	✓

Species	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	Off-airport	On-airport
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	High	✓	-
Gyrostemon thesioides	Gyrostemon thesioides	E	-	High	✓	-
Haloragis exalata subsp. exalata	Square Raspwort	V	V	Moderate	-	✓
Hibbertia fumana	Hibbertia fumana	CE	-	Very High	✓	-
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	CE	CE	High	✓	✓
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	E	-	Moderate	✓	✓
Maundia triglochinoides	Maundia triglochinoides	V	-	High	✓	✓
Melaleuca biconvexa	Biconvex Paperbark	V	V	High	-	✓
Micromyrtus minutiflora	Micromyrtus minutiflora	E	V	High	✓	-
Persicaria elatior	Tall Knotweed	V	V	High	✓	✓
Persoonia bargoensis	Bargo Geebung	E	V	High	✓	✓
Persoonia hirsuta	Hairy Geebung	E	E	High	✓	✓
Persoonia nutans	Nodding Geebung	E	E	Moderate	✓	-
Pilularia novae-hollandiae	Austral Pillwort	E	-	High	✓	✓
Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	V	V	High	✓	✓
Pimelea spicata	Spiked Rice-flower	E	E	High	✓	✓
Pomaderris brunnea	Brown Pomaderris	E	V	High	✓	✓
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Moderate	✓	✓
Pultenaea parviflora	Pultenaea parviflora	E	V	Moderate	✓	Added
Pultenaea pedunculata	Matted Bush-pea	E	-	High	✓	✓
Thesium australe	Austral Toadflax	V	V	Moderate	✓	✓

Species	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	Off-airport	On-airport
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E	-	High	✓	✓
Zannichellia palustris	Zannichellia palustris	E	-	High	-	✓
Fauna						
Anthochaera phrygia	Regent Honeyeater	CE	CE	High	✓	✓
Burhinus grallarius	Bush Stone-curlew	E	-	High	✓	✓
Calidris ferruginea	Curlew Sandpiper	E	CE	High	-	✓
Callocephalon fimbriatum - endangered population	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	High	✓	✓
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	High	✓	✓
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	High	✓	-
Cercartetus nanus	Eastern Pygmy-possum	V	-	High	✓	✓
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Very High	✓	✓
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	M	High	✓	✓
Heleioporus australiacus	Giant Burrowing Frog	V	V	Moderate	✓	✓
Hieraaetus morphnoides	Little Eagle	V	-	Moderate	✓	✓
Lathamus discolor	Swift Parrot	E	CE	Moderate	✓	✓
Limicola falcinellus	Broad-billed Sandpiper	V	-	High	-	✓
Limosa limosa	Black-tailed Godwit	V	-	High	-	✓
Litoria aurea	Green and Golden Bell Frog	E	V	High	✓	✓
Lophoictinia isura	Square-tailed Kite	V	-	Moderate	✓	✓
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	High	✓	✓
Miniopterus australis	Little Bent-winged Bat	V	-	Very High	✓	✓
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Very High	✓	✓
Myotis macropus	Southern Myotis	V	-	High	✓	✓
Ninox connivens	Barking Owl	V	-	High	✓	✓

Species	Common name	BC Act[1]	EPBC Act[1]	Sensitivity to gain class	Off-airport	On-airport
Ninox strenua	Powerful Owl	V	-	High	✓	✓
Pandion cristatus	Eastern Osprey	V	-	Moderate	✓	✓
Petaurus norfolcensis	Squirrel Glider	V	-	High	✓	✓
Phascolarctos cinereus	Koala	V	V	High	✓	✓
Pommerhelix duralensis	Dural Land Snail	E	E	High	✓	✓
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	High	✓	✓
Tyto novaehollandiae	Masked Owl	V	-	High	✓	✓

Notes:

(1) V = Vulnerable, E = Endangered, CE = Critically Endangered under the BC Act or Commonwealth EPBC Act. M Marine/Migratory

Once the initial list of predicted candidate species credit species was generated, the geographic limitations of each species were examined and where the study area is not within the geographic limitation described for a species, the species was removed from the assessment (see section 6.4.1.9 – 6.4.1.16 of the BAM).

The habitat assessments and vegetation integrity surveys conducted during the field survey allowed for the identification of any specific habitat constraints or presence or absence of suitable microhabitats within the study area. Species were excluded from the assessment if the habitat was degraded or if the species is a vagrant (section 6.4.1.17 – 6.4.1.19 of the BAM).

A species was also excluded from the assessment based on the advice provided in expert reports prepared for the *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis, 2020) (section 6.5.2 of the BAM). The candidate species excluded from the assessment on geographic or habitat constraints are outlined below in Table 6.4. A conservative approach has been taken for the Cumberland Plain Land Snail as the expert report predicts the species would potentially be found in any remaining Intact PCTs 724 and 849 especially if there is a well-developed leaf litter layer, plenty of woody debris on the ground and few exotic/invasive species (Clarke, 2018). The species has therefore been assumed present in any Intact areas of PCT 724 and 849 in the study area.

Table 6.4 Candidate threatened species removed from assessment

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Flora						
Caladenia tessellata	Thick Lip Spider Orchid	E	V	-	Though associated vegetation types PCT 724 and 849 was recorded, all *Caladenia tessellata* records occur to the east of Prospect Reservoir.	
Callistemon linearifolius	Netted Bottle Brush	V	-	-	Scattered records in Western and South-Western Sydney area with majority of the western records being centred around Bankstown. Though associated vegetation type, PCT 835, was recorded this species is considered unlikely to occur.	
Commersonia prostrata	Dwarf Kerrawang	E	E	-	Not identified as a candidate species	Preferred habitat, sandy/peaty soils and associated species not recorded within the study area.
Deyeuxia appressa	Deyeuxia appressa	E	E	-	Though associated vegetation type, PCT 1800, was recorded within the study area, this species is only known to occur to the south of Bankstown and Killara, NSW.	Not identified as a candidate species
Dillwynia tenuifolia - endangered population	Dillwynia tenuifolia, Kemps Creek	E	-	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool LGA	Study area does not occur within geographic limitations of species.	
Eucalyptus benthamii	Camden White Gum	V	V	-	This species is known to occur on the alluvial flats of the Nepean River and its tributaries with all historic records to the west of the alignment. Associated vegetation types PCT 835 and 849 were recorded within the study area. Although unlikely based on known distributional limits.	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Gyrostemon thesioides	Gyrostemon thesioides	E	-	Sandy, alluvial or colluvial soil within 50 metres of a water course	Though associated vegetation types, PCT 724 were recorded, this species has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers within NSW. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches.	Not identified as a candidate species
Haloragis exalata subsp. exalata	Square Raspwort	V	V	Waterbodies: Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100 metres	Not identified as a candidate species	This species is known from four disjunct populations, none of which are known to occur within locality of the study area.
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	CE	CE	-	Though associated vegetation type PCT 835 was recorded within the study area, this species is known from one population at Bankstown Airport.	
Maundia triglochinoides	Maundia triglochinoides	V	-	Riparian areas/drainage lines, water ponding, man-made dams and drainage channels, shallow swamps, waterbodies up to 1 metres deep or semi-permanent/ephemeral wet areas	Though associated vegetation type, PCT 1800, was recorded, this species is restriction to coastal NSW with Sydney populations considered to be extinct.	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Melaleuca biconvexa	Biconvex Paperbark	V	V	-	Not identified as a candidate species	This species is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.
Persoonia bargoensis	Bargo Geebung	E	V	-	This species is not known to occur on the Cumberland Plain with the nearest population being recorded south of Picton.	
Persoonia hirsuta	Hairy Geebung	E	E	-	Preferred habitat, sandy soils and sandstone geologies, not recorded within the study area. Though associated vegetation type, PCT 835, was recorded, this species is generally not recorded on the Cumberland Plain. Within locality of the study area, historic records generally restricted to the east of Westlink M7 motorway and in Windsor Downs Nature.	
Pilularia novae-hollandiae	Austral Pillwort	E	-	-	Though associated vegetation types, PCT 835 and 1800, were recorded, preferred habitats being shallow swamps and waterways, were limited within the study area. This species has one record within locality, near Bungarribee, from 1966.	
Pultenaea pedunculata	Matted Bush-pea	E	-	-	Though associated vegetation types, PCT 724 and 849 were recorded within the study area, this species distribution is generally restricted to the Liverpool area and South of Menangle with one record (2015) from Cobbitty.	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Wahlenbergia multicaulis - endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E	-	Auburn (Cumberland Council), Bankstown and Canterbury (City of Canterbury – Bankstown), Baulkham Hills (The Hills Shire Council), Hornsby, Parramatta and Strathfield Local Government Areas	The study area does occur within geographic limitations.	
Zannichellia palustris	Zannichellia palustris	E	-	Waterbodies: Freshwater or slightly brackish estuarine areas (10per cent)	Not identified as a candidate species	Though potential habitat was recorded within the study area, this species is not known to occur within locality of with one small population being recorded at Sydney Olympic Park.
Fauna						
Anthochaera phrygia	Regent Honeyeater (mapped important areas)	CE	CE	As per mapped areas	No key breeding areas or other breeding areas mapped in the National Recovery Plan occur within the study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga Ironbark) not present within study area. Excluded from further assessment	
Burhinus grallarius	Bush Stone-curlew	E	-	Fallen/standing dead timber including logs	Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited. Excluded from further assessment	
Calidris ferruginea	Curlew Sandpiper (Breeding habitat)	E	CE	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Callocephalon fimbriatum - endangered population	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	E	-	Hollow bearing trees: Eucalypt tree species with hollows greater than 9 centimetres diameter; Hornsby and Ku-ring-gai LGAs	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded from further assessment	
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding habitat)	V	-	-	Preferred habitat of mature/old growth eucalypt forest not present Marginal foraging and breeding habitat within the study area. Excluded from further assessment	
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding habitat)	V	-	Hollow bearing trees Living or dead tree with hollows greater than 15 centimetre diameter and greater than 5 metres above ground	Preferred foraging habitat not present within the study area. Excluded from further assessment	
Cercartetus nanus	Eastern Pygmy-possum	V	-	-	Preferred habitat not within study area. Excluded from further assessment	
Heleioporus australiacus	Giant Burrowing Frog	V	V	-	Sandstone geology not recorded. Habitat requirements not recorded within the study area. Excluded from further assessment.	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Lathamus discolor	Swift Parrot (mapped important areas)	E	CE	As per mapped areas	The Swift Parrot only breeds in Tasmania. It may fly over the study area intermittently during seasonal migration movements. Winter-flowering resources (e.g. Spotted Gum) absent from the study area. No recent records within the vicinity of the study area. Excluded from further assessment	
Limicola falcinellus	Broad-billed Sandpiper (Breeding habitat)	V	-	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment	
Limosa limosa	Black-tailed Godwit (Breeding habitat)	V	-	-	Marginal habitat, preferred habitat of shallow mud flats not present in study area Excluded from further assessment	
Litoria aurea	Green and Golden Bell Frog	E	V	Semi-permanent/ephemeral wet areas- within 1kilometre of wet areas Swamps - within 1kilometre of swamp Waterbodies -Within 1kilometre of waterbody	Potential habitat for this species within the study area is heavily degraded. Farm dams are polluted and contain the predatory Mosquito Fish (*Gambusia holbrooki*). A low number of OEH records occur within the locality, and the study area contains no known historic populations. Expert report prepared for *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis, 2020) predicted GGBF population likely to occur near St Marys in Ropes Creek. The	Potential habitat for this species within the study area is heavily degraded. Farm dams are polluted and contain the predatory Mosquito Fish (*Gambusia holbrooki*). A low number of OEH records occur within the locality, and the study area contains no known historic populations. Excluded from further assessment

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
					project is in tunnel at St Marys so it is unlikely to impact any GGBF that may be present. Excluded from further assessment	
Miniopterus australis	Little Bent-wing bat (Breeding habitat)	V	-	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	Preferred breeding habitat not within study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species so it is excluded from further assessment.	
Miniopterus orianae oceanensis	Large Bent-wing Bat (Breeding habitat)	V	-	Caves - Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	Breeding habitat for the Large Bent-winged Bat is highly specific to their territorial range (Churchill 2008; Lumsden and Jemison, 2015). In late spring, pregnant females disperse from Sydney and migrate to one of three known maternity roosts in NSW: Willi caves near Kempsey, Church Cave at Wee Jasper and Drum Cave near Bungonia (Hamilton Smith and Dwyer, 1965; Hoye and Spence, 2004). These maternity roosts are at least 200 kilometres from the study area. They roost in known overwintering roost sites within Sydney include disused military tunnels at Henry's Head and Malabar Headland (White, 2011), Balls Head Coal Loader, Gore Cove and Tunks Park (Gonslaves and Law, 2018).	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
					Hoye and Spence (2004) report on all current roost sites within the Sydney Basin and none of those structures are buildings, only caves, military or railway tunnels and very large stormwater drains. These structures are absent from the study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not present for this species in the study area so it is has been excluded from further assessment in accordance with Section 6.4.1.13 of the BAM.	
Ninox strenua	Powerful Owl (Breeding habitat)	V	-	Hollow bearing trees Living or dead trees with hollow greater than 20 centimetre diameter	Marginal foraging habitat within the study area. Expert report prepared for *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis, 2020) determined unlikely to be breeding in the study area. Excluded from further assessment	Marginal foraging habitat within the study area. Excluded from further assessment
Pandion cristatus	Eastern Osprey (Breeding habitat)	V	-	Other Presence of stick-nests in living and dead trees (>15 metres) or artificial structures within 100 metres of a floodplain for nesting)	The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species so it is excluded from further assessment.	
Petaurus norfolcensis	Squirrel Glider (Breeding habitat)	V	-	-	Preferred habitat not within study area. Excluded from further assessment	

Species	Common name	BC Act[1]	EPBC Act[1]	Habitat constraints/ Geographic limitations	Justification for exclusion	
					Off-airport	On-airport
Phascolarctos cinereus	Koala (Breeding habitat)	V	V	Areas identified via survey as important habitat (see comments)	Habitat degraded and unlikely to be considered important habitat. Excluded from further assessment	
Pommerhelix duralensis	Dural Land Snail	E	E	Other Leaf litter and shed bark or within 50 metres of litter or bark| Rocky areas Rocks or within 50 metres of rocks| Fallen/standing dead timber including logs Including logs and bark or within 50 metres of logs or bark	Study area is outside distribution Excluded from further assessment	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Camp	A breeding camp was not recorded within study area. The habitat constraints for breeding as identified in the Threatened Biodiversity Data Collection are not met for this species so it is excluded from further assessment.	
Tyto novaehollandiae	Masked Owl (Breeding habitat)	V	-	Hollow bearing trees Living or dead trees with hollows greater than 20 centimetre diameter	Suitable foraging habitat within the study area. Expert report prepared for Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020) determined unlikely to be breeding in the study area. Excluded from further assessment	Marginal foraging habitat within the study area. Excluded from further assessment

Notes:

V = Vulnerable, E = Endangered, CE = Critically Endangered under the BC Act and EPBC Act

6.2.1 NSW threatened flora survey results

For the on-airport study area, threatened species survey results from the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e), Western Sydney Airport Biodiversity Assessment Report for land outside Stage 1 development (DIRD, 2018) and Environmental field survey of Commonwealth Land at Badgerys Creek (SMEC, 2014) were used to inform this assessment.

Targeted field surveys were undertaken in off-airport areas accessible to the M2A project team. During field surveys three threatened flora species were recorded, *Grevillea juniperina subsp. juniperina, Dillwynia tenuifolia* and *Pultenaea parviflora*. *Grevillea juniperina subsp. juniperina* and *Dillwynia tenuifolia* were found within the study area and are discussed further below. *Pultenaea parviflora* was found adjacent to the study area and would not be impacted by the project.

Grevillea juniperina subsp. juniperina

Grevillea juniperina subsp. *juniperina* is a threatened shrub listed as vulnerable under the BC Act. This species is not listed under the EPBC Act.

The Threatened Biodiversity Data Collection (EES, 2020d) lists the following vegetation types recorded within the study area as associated habitat for this species:

- PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

This species is readily recognised by its form, being a low spreading shrub 0.5-1.5 metres tall (Photo 6.1). Flowers are variable occurring as red, yellow, pale orange, or rarely greenish (Photo 6.2). Adult leaves are clustered along major branches creating a dense appearance. Leaves are needle-like (1–2.2 centimetres long, 0.6-0.8 millimetres wide), deltoid to trigonous in cross-section and pungent with margins of leaves revolute or refracted. Upper leaf surface has 3 prominent longitudinal veins. The main identification feature of *Grevillea juniperina* subsp. *juniperina* is the margins being strongly recurved, usually completely concealing the lower surface of most leaves (Royal Botanical Gardens, 2020).

Grevillea juniperina subsp. juniperina is endemic to Western Sydney and known to occur on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels (EES, 2020). The species appears to tolerate physical disturbance of the soil that may often result in an increase in seedling recruitment or colonisation of mechanically disturbed areas (EES, 2020).

Within the study area *Grevillea juniperina* subsp. *juniperina* was recorded from three separate patch areas being:

- north of Patons Lane associated with a constructed dam on Lot 5 DP521268
- corner of Patons Lane and Stockdale Road (entrance gate area to Defence Establishment Orchard Hills)
- the central eastern portion of DEOH land being Lot 4 DP242968.

These three recorded occurrences of *Grevillea juniperina* subsp. *juniperina* are separated by less than one kilometre of physical distance and would likely be expected to be cross pollinated by mobile insect and bird vectors and as such are considered to form a single population. This population forms part of a larger local occurrence that extends east on lands adjoining Luddenham Road, west on lands within the DEOH and north within habitat associated with South Creek.

At this occurrence, mechanical disturbance of the soil profile has historically occurred with most individuals recorded colonising the wall of a constructed dam and surrounding disturbed areas. The recorded vegetation type at this site was PCT 724 (Scattered Trees).

At the corner of Patons Lane and Stockdale Road (entrance gate area to Defence Establishment Orchard Hills) a small number of individuals were recorded within the road verge. The recorded vegetation type at this area comprises of PCT 724 (thinned) and PCT 849 (thinned).

The largest occurrence of *Grevillea juniperina* subsp*. juniperina* within the study area occurs on the central eastern portion of DEOH land being Lot 4 DP242968 (Photo 6.3). The largest number of individuals were recorded from this area where they were observed growing in a north/south band extending about 350 metres in length. The recorded individuals within this band were associated with PCT 724 (thinned), PCT 835 (thinned), PCT 849 (thinned, Scattered Trees) and PCT 1800 (Intact). The occurrence of *Grevillea juniperina* subsp*. juniperina* within this area has been recorded from two vegetation types typically not associated with the species, being:

- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

In respect to PCT 835, River-flat Eucalypt Woodland, this vegetation type is recognised by Weston (2019) in his expert report for this species as forming habitat for the *Grevillea juniperina* subsp. *juniperina*, in ecotonal areas. It is further acknowledged that although the species distribution is heavily influenced by soil geology, the occurrence of *Grevillea juniperina* subsp. *juniperina* within associated vegetation types is not clear-cut (Weston 2019). Within the study area this appears to be the case with the species also being recorded from part of PCT 1800 (Intact) to the west of South Creek.

Given the above field observations and literature surrounding the species, the following vegetation types in all condition types form associated habitat for *Grevillea juniperina* subsp. *juniperina*:

- PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

Whilst some individuals of *Grevillea juniperina* subsp*. juniperina* were recorded from PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley this plant community type is not generally known to provide associated habitat for this species and as such has not been included for assumed habitat species polygon calculations for areas not surveyed.

Within off-airport land, a total of 1225 *Grevillea juniperina subsp. juniperina* individuals were recorded. The unit of measure for this species under BAM is by area and as such a 30-metre buffer area was applied to individual plants (section 6.4.1.29 of the BAM). PCT 724, PCT 835, PCT 849 and PCT 1800 within buffer areas became species polygons and were used to generate credit requirements. For areas not yet surveyed, all condition types of PCT 724, PCT 835 and PCT 849 formed species polygons in accordance with section 6.4.1.30 of the BAM.

Within 10 kilometres of the study area, there is approximately 1,980 hectares of mapped habitat available for this species (Weston, 2019). Potential impacts of the project on potential habitat for this species is limited to the removal of approximately 18 hectares. This represents under 1 per cent of mapped habitat available for the species within the locality.

This species is securely reserved in both the northern and southern buffer areas of the Department of Defence Orchard Hills Offset Areas (GHD, 2020). The offset area covers about 950 hectares of managed vegetation including potential and mapped habitat for *Grevillea juniperina subsp. juniperina.* The offset plan (GHD, 2020) provides monitoring and management recommendations that will benefit existing populations of *Grevillea juniperina subsp. juniperina* on the Defence Orchard Hills Offset Areas.

Photo 6.1 *Grevillea juniperina subsp. juniperina* habit

Photo 6.2 Flowers and foliage

Photo 6.3 *Grevillea juniperina subsp. juniperina* shrub recorded in PCT 724 (thinned)

Dillwynia tenuifolia

Within the study area *Dillwynia tenuifolia* was recorded from a single patch off Kent Road, Orchard Hills with an estimated population of approximately 100 individuals (Photo 6.1).

This recorded occurrence is separated by less than two kilometres of physical distance and would likely be expected to be cross pollinated by mobile insect and bird vectors and as such are considered to form a single population. This population forms part of a larger local occurrence that extends east, and southwest on lands within the Defence Establishment Orchard Hills.

At this occurrence, mechanical disturbance of the soil profile has historically occurred with most individuals recorded colonising the wall of a constructed dam and surrounding disturbed areas. The recorded vegetation type at this site was PCT 724 (thinned).

Photo 6.4 *Dillwynia tenuifolia* habit

Photo 6.5 *Dillwynia tenuifolia* shrub recorded in PCT 724 (thinned)

6.2.2 Candidate NSW threatened flora species (off-airport)

Candidate threatened flora species subject to further assessment in accordance with 6.4.1.21 of the BAM for off-airport land are outlined in Table 6.5.

Table 6.5 Candidate threatened flora species (off-airport)

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	Areas not yet surveyed
Acacia bynoeana	Bynoe's Wattle	No (surveyed) *Acacia bynoeana* was subject to targeted seasonal surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (assumed present) This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities (including PCT 724), this is not preferred habitat. Given, this species is known to occupy (and possibly prefer) disturbed habitats (Department of the Environment, 2013) both Thinned and Intact vegetation in considered potential habitat. Scattered tree condition was not considered further given these areas are dominated by exotic species and unlikely to support *Acacia bynoeana*.
Acacia pubescens	Downy Wattle	No (surveyed) *Acacia pubescens* was subject to targeted seasonal surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (assumed present) *Acacia pubsecens* occurs in Shale Gravel Transition Forest (PCT 724) and Shale Plain Woodland (PCT 849) (Threatened Species Scientific Committee, 2016). Given this species is known to occur in open, disturbed areas surrounded by exotic species (National Parks and Wildlife Service, 2003), all condition types of PCT 724 & 849 are considered potential habitat.

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	**Areas not yet surveyed**
Allocasuarina glareicola	-	No (surveyed) *Allocasuarina glareicola* was subject to targeted seasonal surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (Assumed present) *Allocasuarina glareicola* is known to grow on tertiary, alluvial gravels (Department of the Environment, Water, Heritage and the Arts, 2008). Though Castlereagh Woodland is preferred habitat, PCT 724 has been considered further given similar geologies. Given many of the known associated species for *Allocasuarina glareicola* are native grasses and herbs, patches of PCT 724 recorded as Scattered Trees was considered unlikely to support this species. As such, PCT 724 in Intact and Thinned condition is considered potential habitat.
Cynanchum elegans	White-flowered Wax Plant	No (surveyed) *Cynanchum elegans* was subject to targeted seasonal surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (Assumed present) *Cynanchum elegans* is twiner/climber known to occur in Cumberland Plain Woodland (PCT 849) (Department of the Environment, Water, Heritage and the Arts, 2008). Given this species growth form, PCT 849 occurring in low condition (derived native grasslands) and as Scattered Trees are not considered likely to support this species. As such, PCT 849 in Thinned condition is considered potential habitat.
Dillwynia tenuifolia	-	Yes (surveyed) A single population of this species was observed in Orchard Hills associated with disturbed areas of PCT 724.	Yes (expert report). An expert report was prepared for this species as part of the draft Cumberland Plain Conservation Plan (Rumer, 2019). This report outlines that PCT 724 and 849 in all condition types (including Intact and degraded condition) form associated habitat for this species. Figure 8 outlines known populations and potential habitat for *Dillwynia tenuifolia.* These areas occur within the study area. As such, PCT 724 and PCT 849 in all condition types is considered likely habitat for this species.

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	**Areas not yet surveyed**
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	Yes (surveyed) Targeted seasonal field surveys were conducted within optimal survey months. A total of 1225 *Grevillea juniperina* subsp. *juniperina* individuals were recorded within DEOH and areas north of Patons Lane.	Yes (expert report) An expert report for this species outlines that the presence of *Grevillea juniperina* subsp. *juniperina* in the Penrith to Eastern Creek Growth Investigation Area (which encompasses the off-airport lands of the study area) is widely acknowledged (Weston, 2019). Figure 7 of this report illustrated areas of suitable habitat for this species, some on which occur within the study area. Weston (2019) has formed these areas from five plant community types known to provide habitat including PCT 724, 835 & 849. As this species is known to occupy both Intact and disturbed habitats (Weston, 2019), all condition types of PCT 724, 835 & 849 are considered likely habitat.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	No (surveyed) Targeted seasonal field surveys were predominately conducted outside of recommended months of survey (Aug-Nov). It should be noted that survey months for this species was identified in the Biobanking Calculator as 'All year' and was changed to Aug-Nov to coincide with known flowering times (July-Dec) (DIRD, 2016e; RBG, 2020). During field surveys, no *Grevillea parviflora* subsp. *parviflora* candidates (i.e. low open to erect Grevillea shrub) were recorded. This species is considered unlikely to be affected.	Yes (Assumed present) *Grevillea parviflora* subsp. *parviflora* is known to occur on gravelly clay and has been recorded in disturbed sites (i.e. along tracks) and within open areas of habitat (Department of the Environment, Water, Heritage and the Arts, 2008). Within the study area, PCT 724 forms associated habitat and all condition forms are considered potential habitat for this species.
Hibbertia fumana	-	No (expert report) An expert report was prepared for this species as part of the Cumberland Plain Assessment Report (Miller, 2018a). This report identified no areas of study area as containing likely habitat for this species.	

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	**Areas not yet surveyed**
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	No (surveyed) Targeted seasonal field surveys were predominately conducted outside of recommended months of survey (Nov-Feb). It should be noted that survey months for this species was identified in the Biobanking Calculator as 'All year' and was changed to Nov-Feb to coincide with known flowering times (DIRD 2016e; RBG 2020). During field surveys, no *Marsdenia viridiflora* subsp. *viridiflora* candidates (i.e. native vines/climbers in Apocynaceae family) were recorded. This species is considered unlikely to be affected.	Yes (Assumed present) Associated habitat for *Marsdenia viridiflora* subsp. *viridiflora* includes PCT 724, 835, 849 and 1800 (EES, 2020). Given this species growth form, PCT 849 occurring in low condition (derived native grasslands) and as Scattered Trees are not considered likely to support this species. As such, PCT 724, 835, 849 and 1800 in Intact and Thinned condition is considered potential habitat.
Micromyrtus minutiflora	-	No (surveyed) *Micromyrtus minutiflora* was subject to targeted seasonal field surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (Assumed present) *Micromyrtus minutiflora* is known to occur on sandy clay or gravelly soils of tertiary alluvium (Department of the Environment, Water, Heritage and the Arts, 2008). PCT 724 is considered potential habitat. Scattered tree condition is considered unlikely to support this species given the degraded nature of this condition type. As such, PCT 724 in Intact and Thinned condition is considered potential habitat.

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	**Areas not yet surveyed**
Persoonia nutans	Nodding Geebung	No (surveyed) *Persoonia nutans* was subject to targeted seasonal field surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	No (knowledge based) *Persoonia nutans* is known to prefer tertiary alluvium geologies including shale sandstone and cook river/ Castlereagh ironbark forest in southern populations and are restricted to aeolian and alluvial sediments in the northern populations with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River/Castlereagh Ironbark Forests (EES Group, 2020). EES Group identified PCT 724 as associated habitat for this species (2020). Restricted areas in off-airport lands where associated habitat occurred would form part of the northern meta-population which has mostly been recorded around Richmond, Londonderry, Agnes Banks and Cranebrook (ALA, 2020). This population is known to be restricted to aeolian and alluvial sediments, which were not recorded within the study area. As such, this species is considered not affected.
Pimelea curviflora var. curviflora	-	No (surveyed) Targeted seasonal field surveys were predominately conducted outside of recommended months of survey (November). It should be noted that survey months for this species was identified in the Biobanking Calculator as 'All year' and was changed to Oct-March to coincide with known flowering times (Oct-Jan) (DIRD, 2016e; Department of the Environment, Water, Heritage and the Arts, 2008). During field surveys, no *Pimelea* candidates were recorded. This species is considered unlikely to be affected.	Yes (Assumed present) *Pimelea curviflora* var. *curviflora* is known to occur in Cumberland Plain Woodland (PCT 849). This species often grows amongst a dense layer of grasses and sedges in open forest and/or woodland (Department of the Environment, Water, Heritage and the Arts, 2008). Given this, low condition (derived native grasslands) and Scattered Trees are considered unlikely to support this species. PCT 849 recorded in Intact and Thinned condition area considered potential habitat for this species.

Species name	Common name	Presence/Affected? (off airport)	
		Surveyed areas	**Areas not yet surveyed**
Pimelea spicata	Spiked Rice-flower	No (surveyed) *Pimelea spicata* was subject to targeted seasonal field surveys during recommended months. No individuals were recorded. As such, this species is not considered affected.	Yes (Assumed present) An expert report prepared for the Greater Macarthur and Wilton Growth areas (James, 2018) identifies potential habitat for *Pimelea spicata* as PCT 849 on the Cumberland Plain. James (2018) outlines that this species can occur in degraded habitat and derived grasslands. As such all condition types of PCT 849 are considered potential habitat.
Pterostylis saxicola	Sydney Plains Greenhood	No (expert report) An expert report was prepared for this species as part of the draft Cumberland Plain Conservation Plan (Weston, 2018). This report identified no areas of study area as containing likely habitat for this species.	
Pultenaea parviflora	-	Yes (surveyed) Targeted seasonal field surveys were predominately conducted outside of recommended months of survey (Nov). It should be noted that survey months for this species was identified in the Biobanking Calculator as 'All year' and was changed to Sept-Dec to coincide with known flowering times (DIRD 2016e; EES 2020). During field surveys, no *Pultenaea* candidates were recorded. This species is considered unlikely to be affected.	Yes (Assumed present) *Pultenaea parviflora* is to occur in scrubby or dry heath areas of Shale Gravel Transition Forest on tertiary alluvium or laterised clays (EES 2020; Department of the Environment, Water, Heritage and the Arts, 2008). Within the study area PCT 724 forms associated habitat. Given this small shrub prefers habitat with midstorey, low condition and scattered tree condition vegetation is not considered likely to support this species. PCT 724 Intact and Thinned is considered potential habitat

(1) Survey months were obtained from the BAM-C

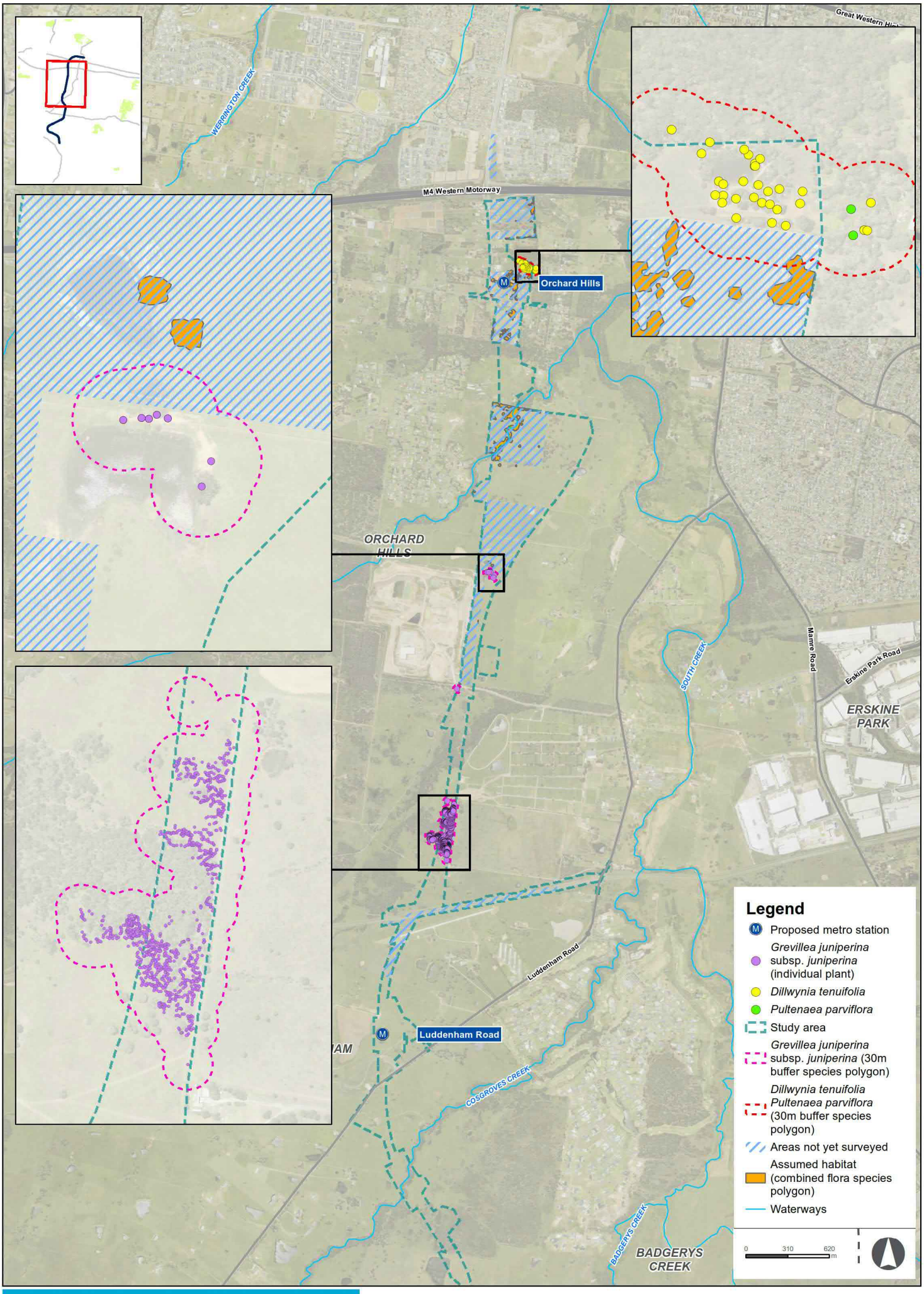
6.2.3 Candidate NSW threatened flora species (on-airport)

Candidate threatened flora species subject to further assessment in accordance with 6.4.1.21 of the BAM for on-airport land are outlined in Table 6.6.

Table 6.6 Candidate threatened flora species (on-airport)

Scientific Name	Common name	Presence	Affected? (on-airport)
Acacia pubescens	Downy Wattle	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted field surveys within recommended survey months (all year) (DIRD, 2016e; WSP, 2020).
Cynanchum elegans	White-flowered Wax Plant	No (surveyed)	No. This species was subject to multiple rounds of targeted field surveys within recommended survey months (All year) and was not recorded (DIRD, 2016e; WSP, 2020).
Dillwynia tenuifolia	Dillwynia tenuifolia	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted field surveys (DIRD, 2016e; DIRD, 2018, WSP, 2020).
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	No (surveyed)	No. This species was subject to multiple rounds of targeted field surveys within recommended survey months (All year) and was not recorded (DIRD 2016e; SMEC 2014; WSP 2020). An expert report for this species outlines that the present of this species in the Western Sydney Aerotropolis growth area appears to be marginal with one observational record occurring outside of the study area (Weston, 2018). This species is not considered affected.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	No (surveyed)	No. GHD conducted surveys for this species between February and June 2016. At this time, the BioBanking Credit Calculator identified optimal survey months for this species to be all year. August to November is now acknowledged as the optimal survey period due to flowering. No *Grevillea parviflora* subsp. *parviflora* individuals were recorded during targeted seasonal surveys. SMEC (2014) conducted targeted surveys in September and did not record this species. As such, this species is not considered likely to be affected.
Hibbertia fumana	Hibbertia fumana	No (expert report)	No. An expert report was prepared for this species as part of the draft Cumberland Plain Conservation Plan (Miller, 2018a). This report identified no areas of study area as containing likely habitat for this species.
Marsdenia viridiflora subsp. viridiflora - endangered population	Marsdenia viridiflora subsp. viridiflora	No (surveyed)	No. Not recorded during targeted field surveys within on-airport study area undertaken by M2A for the project. This species was recorded by Department of Infrastructure and Regional Development (2016e) during targeted seasonal surveys within recommended survey months (Nov-Feb). A total of 145 stems were recorded none of which occurred within the study area.
Pimelea spicata	Spiked Rice-flower	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted surveys within recommended survey months (all year) (DIRD 2016e; WSP 2020).

Scientific Name	Common name	Presence	Affected? (on-airport)
Pomaderris brunnea	Brown Pomaderris	No (surveyed)	No. GHD conducted surveys for this species between March and May, 2016. The BioBanking Credit Calculator identifies the optimal survey months for this species to be all year. August to October is not acknowledged as the optimal survey period due to flowering. No Pomaderris individuals were recorded during targeted seasonal surveys or in sampling plots by GHD (2016) or WSP (2019/20). This species is not considered likely to be affected.
Pterostylis saxicola	Sydney Plains Greenhood	No (expert report)	No. An expert report was prepared for this species as part of the draft Cumberland Plain Conservation Plan (Weston, 2018). This report identified no areas of study area as containing likely habitat for this species.
Pultenaea parviflora	Pultenaea parviflora	No (surveyed)	No. This species was subject to targeted survey outside of optimal months (Sept-Nov) (DIRD, 2016e). Despite this, four individuals were recorded within the Western Sydney International land. None of these individuals occur within the study area. This species is not considered affected.
Thesium australe	Austral Toadflax	No (surveyed)	No. This species was not recorded despite multiple rounds of targeted surveys with recommended survey months (Nov-Feb) (DIRD, 2016e).



Sydney Metro – Western Sydney Airport

Threatened flora species polygons

Figure 6-1

Indicative only, subject to design development

6.2.4 NSW threatened fauna survey results

Detailed targeted fauna field surveys were undertaken for all threatened fauna species within the on-airport land.

Where access was limited in the off-airport land, the assessment of threatened fauna (ecosystem and credit species) was primarily based on habitat assessments, expert reports, aerial photographic interpretation, vegetation mapping and survey results from the Draft Cumberland Plain Assessment Report (Open Lines and Biosis, 2020).

Fauna habitat assessment

Vegetation communities recorded within the study area were broadly grouped into fauna habitats based on general similarities in vegetation type and structure, connectivity and fauna habitat values. These fauna habitats include woodland, riparian forest, grassland and wetlands. The fauna habitat value within the study area ranged from poor to good dependent on levels of current and historic disturbance.

Woodland

Woodland habitat across the study area covered about 16.82 hectares off-airport and 6.37 ha on-airport and generally corresponded with Intact, thinned, and scattered tree PCTs 724 and 849 (excluding Low condition).

Woodland habitats of the study area provide shelter, foraging and potential breeding habitat for a range of common and threatened fauna species. The canopy was dominated by *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum). These myrtaceous species provide blossom resources for birds, possums and flying-foxes. Understorey grasses, coarse woody debris and leaf litter provide shelter habitat for small terrestrial amphibians and reptiles. Stags, decorticating bark and hollow-bearing trees provide roosting and potentially breeding habitat for microbats and woodland birds.

Most of the woodland habitat was in moderate to poor condition with some fauna habitat components missing or greatly reduced (for example, old-growth trees), fragmented tree canopies and linkages with other remnant ecosystems in the landscape compromised by extensive clearing in the past (see Photo 6.6).

Photo 6.6 Woodland with sparse canopy and habitat trees

Several microbat species (including the threatened East Coast Freetail Bat and Eastern False Pipistrelle) were recorded from some areas of woodland habitat where larger hollow-bearing trees were present. These species are all likely to use tree hollows within the study area as diurnal roosting or breeding habitat.

Many small birds typically associated with woodland habitats were largely absent from the woodland habitat of the study area. Smaller birds such as the Grey Faintail (*Rhipidura albiscapa*), Willie Wagtail (*Rhipidura leucophrys)* and Superb Fairy-wren (*Malurus cyaneus)* were commonly recorded from small areas within woodland habitats, especially if a shrub layer was present.

The Noisy Miner (*Manorina melanocephala*) and other disturbance-tolerant species dominated the woodland habitat in low condition that typically lacked a shrub layer and understorey.

Riparian Forest

Riparian forest habitat across the study area covered about 11.61 hectares off-airport and 1.62 hectares on-airport and generally corresponded with Intact, thinned and scattered tree PCT's 835 and 1800. Riparian forest habitat across the study area ranged from poor to moderate condition with most fauna habitat components missing or greatly reduced (see Photo 6.7).

Riparian forest habitats of the study area provide foraging and roosting habitat for a range of common and threatened fauna species. The canopy was dominated by *Casuarina glauca* (Swamp Oak), often as monospecific stands. Scattered *Eucalyptus amplifolia subsp. amplifolia* (Cabbage Gum) were also recorded, some with limb and trunk hollows.

Riparian forest habitats occurred along the riparian corridors of Badgerys Creek, Cosgrove Creek and Blaxland Creek. These riparian corridors are mapped as regional corridors within draft Priority Investment Areas of the Biodiversity Investment Opportunities Map as they have connectivity to Wianamatta Regional Park near Ropes Crossing (OEH, 2015). All riparian corridors have been subject to varying levels of clearing and disturbance.

Understorey grasses, coarse woody debris and leaf litter provide shelter habitat for small terrestrial amphibians and reptiles. Some areas of riparian forest within the study area included creeklines, but these were in poor condition and degraded by vegetation clearing, erosion and sedimentation.

Photo 6.7 Riparian forest habitat within the study area

Grassland

Grassland habitat across the study area covered about 3.25 hectares off-airport and 27.04 hectares on-airport, some of which corresponded with low condition PCT's 724 and 849, most of which was miscellaneous/non-native vegetation. Grassland habitat areas were highly disturbed with none or limited native vegetation and water bodies. The condition of grassland habitat was poor (see Photo 6.8).

Dead trees and tree hollows within grassland habitat were observed to be used as roosting and nesting habitat by common bird species typically associated with grassland or more tolerant of disturbance. This species included the Sulphur-crested Cockatoo *(Cacatua galerita)*, Little Corella (*Cacatua sanguinea)*, Eastern Rosella (*Platycercus eximius)* and Rainbow Lorikeet (*Trichoglossus moluccanus)*. Approximately 25 hollow-bearing trees and dead trees (stags) were recorded on the off-airport lands within the DEOH site (Figure 6.2). Hollows were recorded on limbs and trunks and their size ranged from small (<5 centimetres), medium (6-15 centimetres), large (16-25 centimetres) and very large (>25 centimetres). The majority of hollows recorded were in the medium size class.

Hollows in scattered paddock trees within grassland habitat, particularly on the DEOH site would provide roosting habitat for common, adaptable microbats such as Gould's Wattled Bat *Chalinolobus gouldii* and the threatened East Coast Freetail Bat (*Micronomus norfolkensis*), which was the most commonly recorded species across the study area. It is unlikely that hollows in scattered paddock trees within grassland habitat would provide suitable roosting or nesting hollows for large forest owls as they are usually associated with Intact forest and woodland habitats.

Photo 6.8 Grassland within the study area

Wetland

Wetland habitat within the study area was comprised of several scattered agricultural dams and were mainly devoid of vegetation and considered to be in poor condition (see Photo 6.9).

Most dams are located within cleared grazing lands and provide limited habitat value for most wetland-dependent fauna as they lack emergent vegetation. The wetland habitat within the study area is degraded and rarely contains habitat features such as rocks or coarse woody debris.

Notwithstanding, these dams provide suitable habitat for some frog and reptile species. The Common Eastern Froglet (*Crinia signifera*) was the most commonly recorded frog species calling from farm dams. Where wetland habitat was less polluted and contained macrophytes, the Whistling Tree Frog (*Litoria verreauxii*) and Eastern Sedge Frog (*Litoria fallax*) were commonly recorded.

Wetland habitat across the study area also provides a water resource for birds, macropods and microbats.

Photo 6.9 Wetland habitat within the study area

Threatened fauna species

Southern Myotis (Myotis macropus)

The Southern Myotis is assumed to be present within suitable habitat on-airport. The Southern Myotis was recorded on-airport by DIRD (2016e) at Badgery's Creek. Foraging habitat is present within several farm dams across the study area. Some potential roosting or breeding habitat is present in dead trees, but this species is most likely to use larger, under-road structures such as concrete culverts and bridges. Impacts to the habitat for the Southern Myotis are outlined in Chapter 8 (Assessment of construction impacts). In accordance with section 6.4 of the BAM, species polygon boundaries for the Southern Myotis are aligned with PCTs that are within 200 metres of mapped waterbodies including Badgerys Creek, Blaxland Creek and farm dams within the study area.

The species polygon for the Southern Myotis is estimated at 11.04 hectares and is shown in Figure 6.2.

Cumberland Plain Land Snail (Meridolum corneovirens)

The Cumberland Plain Land Snail was recorded by DIRD (2016e) within woodland in the on-airport section of the study area. The Cumberland Plain Land Snail was detected in two areas at Orchard Hills during the survey (see Figure 6.2). A conservative approach has been taken for the Cumberland Plain Land Snail as the expert report for the Cumberland Plain Assessment Report predicts the species would potentially be found in any Intact remnant especially if there is a well-developed leaf litter layer, plenty of woody debris on the ground and few exotic/invasive species (Clarke, 2018). The species has therefore been assumed present within Intact areas of PCT 724, 835 and 849 in the study area. Impacts to the habitat for the Cumberland Plain Land Snail are outlined in Chapter 8 (Assessment of construction impacts). The species polygon for the Cumberland Plain Land Snail is estimated at 10.88 hectares and is shown in Figure 6.2.

Other threatened fauna recorded (ecosystem credit species)

Other threatened fauna species recorded during the field surveys included the Eastern False Pipistrelle (*Falsistrellus tasmanianesis*) and the East Coast Freetail Bat (*Micronomus norfolkensis*) both of which are listed as Vulnerable under the BC Act and are considered in this assessment as ecosystem credit species.

6.2.5 Candidate NSW threatened fauna species (off-airport)

Candidate threatened fauna species subject to further assessment in accordance with 6.4.1.21 of the BAM for off-airport land are outlined in Table 6.7.

Table 6.7 Candidate NSW threatened fauna (off-airport)

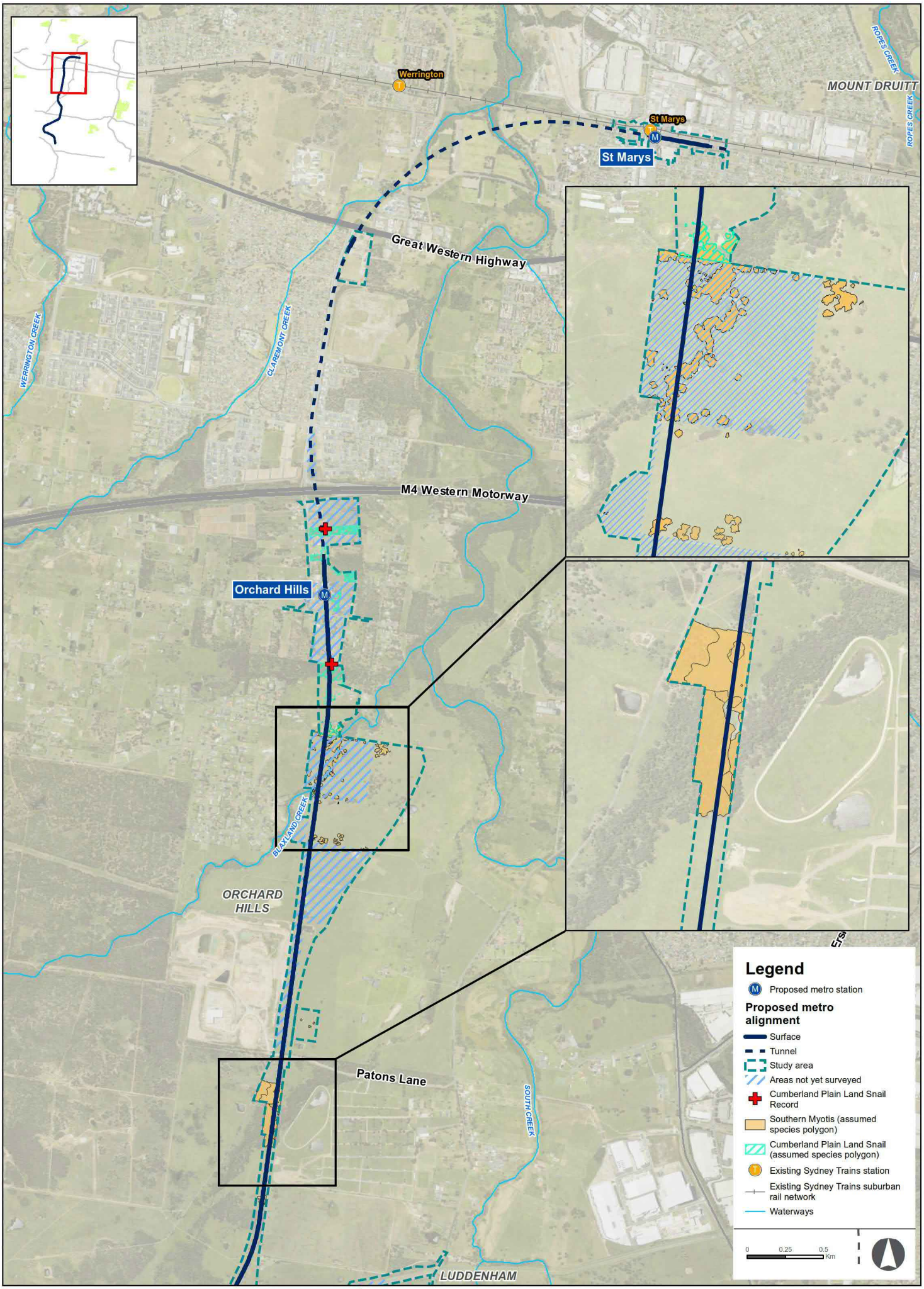
Scientific name	Common name	Affected? (off-airport)		Outcome
		Surveyed areas	Areas not yet surveyed	
Hieraaetus morphnoides	Little Eagle	No (surveyed)	No (surveyed)	Excluded from further assessment
Meridolum corneovirens	Cumberland Plain Land Snail	Yes (assumed present - expert report, Open Lines and Biosis, 2020	Yes (assumed present - expert report, Open Lines and Biosis, 2020	**Considered further for offset obligations**
Myotis macropus	Southern Myotis	Yes (assumed present)	Yes (assumed present)	**Considered further for offset obligations**
Ninox connivens	Barking Owl	No (expert report, Open Lines and Biosis, 2020)	No (expert report, Open Lines and Biosis, 2020)	Excluded from further assessment
Ninox strenua	Powerful Owl	No (expert report, Open Lines and Biosis, 2020)	No (expert report, Open Lines and Biosis, 2020)	Excluded from further assessment
Tyto novaehollandiae	Masked Owl	No (expert report, Open Lines and Biosis, 2020)	No (expert report, Open Lines and Biosis, 2020)	Excluded from further assessment

6.2.6 Candidate NSW threatened fauna species (on-airport)

Candidate threatened fauna species subject to further assessment in accordance with 6.4.1.21 of the BAM for on-airport land are outlined in Table 6.8.

Table 6.8 Candidate NSW threatened fauna (on-airport)

Scientific name	Common name	Affected? (on-airport) (DIRD, 2016e)	Outcome
Hieraaetus morphnoides	Little Eagle	No (surveyed) This species was recorded during targeted surveys mid-flight above the on-airport lands. No nest trees were observed.	Excluded from further assessment
Meridolum corneovirens	Cumberland Plain Land Snail	Yes (surveyed) Targeted surveys were carried out for this species during recommended survey months. CPLS was recorded in larger remnant patches of Cumberland Plain Woodland with deep leaf litter. River Flat Eucalypt Forest ecotonal areas considered potential habitat.	**Considered further for offset obligations**
Myotis macropus	Southern Myotis	Yes (surveyed) Colony of bats observed under the bridge over Badgerys Creek (Badgerys Creek Road) is likely to include breeding individuals. Hollow-bearing trees recorded within 200 metres of riparian areas.	**Considered further for offset obligations**
Ninox connivens	Barking Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment
Ninox strenua	Powerful Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment
Tyto novaehollandiae	Masked Owl	No (surveyed) Though breeding habitat was recorded within the subject Land, observations required to confirm the utilisation of breeding habitat were not made despite targeted surveys undertaken.	Excluded from further assessment



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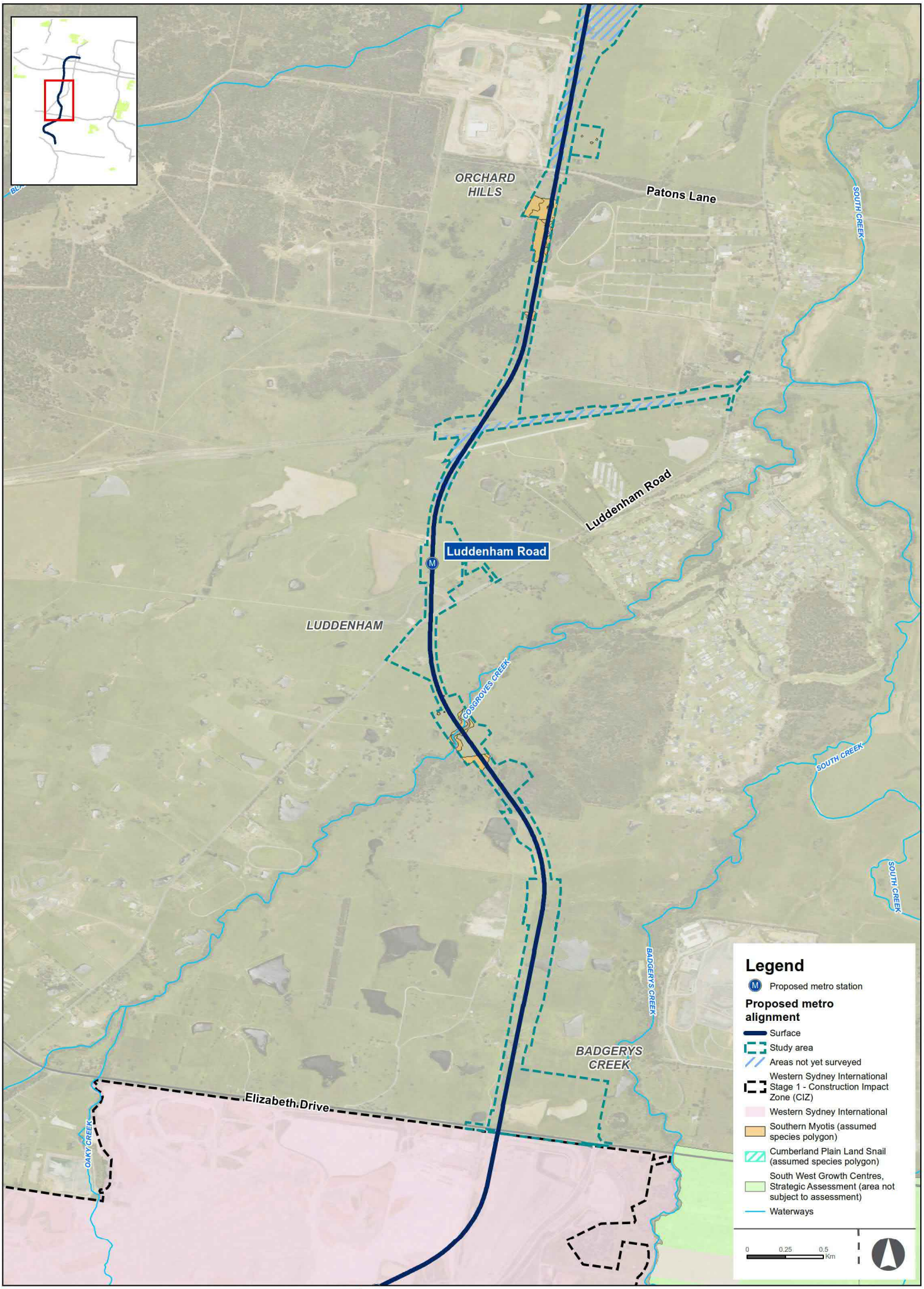
Threatened fauna species polygons

Figure 6-2a



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Threatened fauna species polygons

Figure 6-2b

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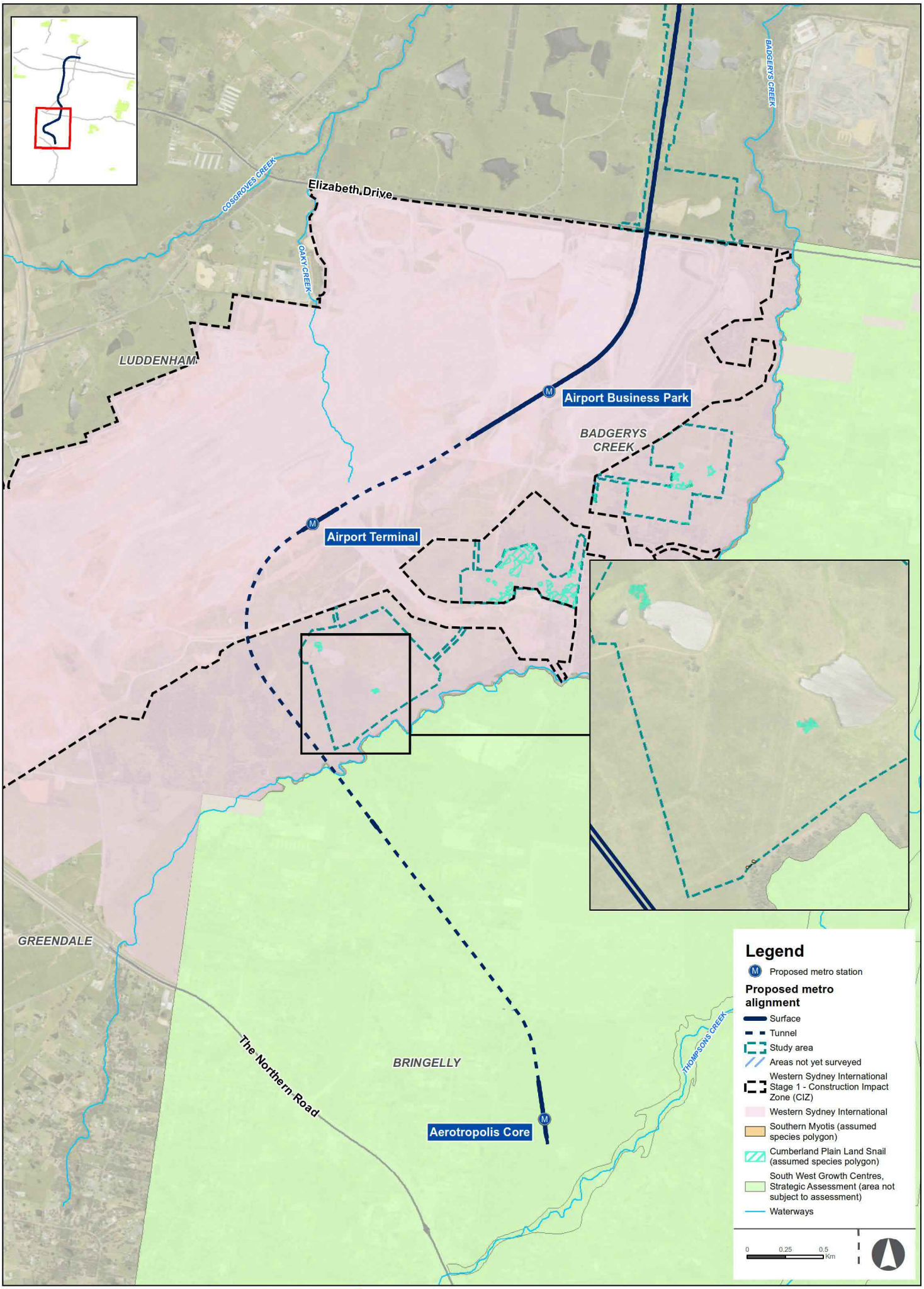

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Threatened fauna species polygons

Figure 6-2c

6.3 Aquatic ecology assessment

Aquatic habitats within the study area were assessed against the policy and guidelines for fish habitat conservation and management – Update 2013 (NSW Department of Primary Industries, 2013) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Lincoln Smith, 2003) was used to guide the level of aquatic assessment required. There is sufficient existing information from previous studies to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments potentially impacted.

Searches of databases, existing mapping and other literature were used to identify aquatic biodiversity values. The sources reviewed included:

- Fisheries Spatial Data Portal (freshwater threatened species maps)
- Protected Matters Search Tool
- Key Fish Habitat mapping.

The aquatic ecology assessment for the project incorporates a desktop assessment and field verified aquatic habitat assessments (where access was available). The desktop assessment for the project incorporates results from detailed existing aquatic assessments undertaken for on-airport (DIRD, 2016e) and off-airport for the future M12 Motorway (Transport for NSW, 2019b).

The aquatic ecology assessment undertaken for the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (DIRD, 2016e) provides sufficient information for assessment of the on-airport lands. It should be noted that Badgerys Creek forms the boundary of Western Sydney International and does not fall directly within the study area. For the purposes of this BDAR, Badgerys Creek is considered further within the on-airport assessment as it is within 200 metres of the project study area and could be subject to potential indirect impacts.

The future M12 Motorway Concept Design and Environmental Impact Statement Biodiversity Assessment Report (Transport for NSW, 2019b) and M12 Motorway Concept Design and Environmental Impact Statement Submissions to Amendment Report (Transport for NSW, 2020)

contains an aquatic ecology assessment that covers a section of Cosgroves Creek upstream from the study area.

6.3.1 Previous aquatic ecology assessments

Western Sydney International EIS Biodiversity Assessment

The aquatic ecology assessment undertaken for the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development, 2016e) identifies the habitat quality and in-stream physical habitat of the waterways on and adjacent to the airport land that are relevant to this BDAR including Badgerys Creek, Oaky Creek, Cosgroves Creek, South Creek and Thompsons Creek.

The habitat assessment of in-stream physical habitat was conducted at survey sites upstream and downstream of the airport land and involved detailed assessments of the substrata and water channel and an on-site assessment of hydraulic habitat features and suitability for threatened aquatic species (DIRD, 2016e). Water quality sampling was also conducted using a water quality meter to record in-situ parameters and alkalinity was tasted via the use of in field titration kits (DIRD, 2016e).

Water quality grab samples were also collected to test for conductivity and to test for the presence of metals, nutrients, BTEX (benzene, toluene, ethylbenzene and xylenes), hydrocarbons and other constituents (DIRD, 2016e). Macroinvertebrates were sampled in accordance with AUSRIVAS sampling protocols (DIRD, 2016e). Fish surveys were undertaken using fyke netting and bait trapping (DIRD, 2016e).

The waterways within the airport land and surrounds (i.e. Badgerys Creek, Cosgroves Creek, Oaky Creek, South Creek, Thompsons Creek and their tributaries) are highly modified and in poor condition as a result of historical and current land use and disturbance. The waterways are small and ephemeral. Water quality is poor, and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats.

Fish habitat was considered to be minimal at most sample sites and the habitats that are present were not suitable for threatened species of fish or invertebrates (i.e. Adam's Emerald Dragonfly or Sydney Hawk Dragonfly) (see DIRD, 2016e). A detailed description of the aquatic habitats within the airport land and upstream and downstream locations is provided in the Western Sydney Airport – Environmental Impact Statement (DIRD, 2016e).

The future M12 Motorway Concept Design and Environmental Impact Statement Biodiversity Assessment Report

The future M12 Motorway Concept Design and Environmental Impact Statement Biodiversity Assessment Report (Transport for NSW, 2019b) contains an aquatic ecology assessment that covers a section of Cosgroves Creek upstream from the study area. A description of the waterway was undertaken which included notes on channel width, substrate, riparian and instream vegetation and instream features such as coarse woody debris, pools, riffles (where present) (Jacobs Arcadis Joint Venture, 2019).

The upstream section of Cosgroves Creek was identified as a Type 2 - moderately sensitive key fish habitat (see NSW Department of Primary Industries 2013) due to the variety of habitats present and was identified as Class 2 (moderate fish habitat) (Fairfull and Witheridge 2003) (Jacobs Arcadis Joint Venture 2019). Upstream of the study area, Cosgroves Creek is an ephemeral stream, with an average channel width was five metres consisting of a silty clay substrate. Active erosion and undercutting occurred along the banks, particularly within channel meanders, suggesting a high potential for erosion at this site. A variety of aquatic habitat is present, with woody snags greater than three meters and the aquatic macrophyte *Typha orientalis* present throughout the site (Jacobs Arcadis Joint Venture 2019).

6.3.2 Existing aquatic environment in the study area

The study area is located entirely within the South Creek catchment within the larger Hawkesbury catchment. South Creek, a major tributary of the Hawkesbury-Nepean catchment, flows in a generally northerly direction from its headwaters near Narellan through to Windsor where it joins the Hawkesbury River. As the study area is long and linear, it crosses sections of Claremont Creek, South Creek, Blaxland Creek, Cosgroves Creek, and Badgerys Creek (located within the airport site), and a number of smaller intermittent unnamed drainage lines and depressions (see Table 6.9).

The study area also contains the catchment areas (but does not cross the main channel) for Byrnes Creek (at the northeast of the project), Oaky Creek (within the Western Sydney International site, to the west of the project), Moore Gully, Thompsons Creek (at the southern end of the project, within the Western Sydney International site and toto the southwest of the project). South Creek is the receiving waterway for creeks within the study area.

The catchment is highly impacted with a mix of rural and urbanised areas and major infrastructure including roads and rail and has been altered from its natural state. The catchment of South, Badgerys, Cosgrove and Blaxland Creeks consists of gently sloping rural residential land that is largely cleared. Land use in the study area between the proposed Orchard Hills Station and St Marys Metro Station is low density residential, including schools and recreational infrastructure such as the Kingsway sports fields. The density of development increases near St Marys and includes areas of higher density residential and mixed-use development.

Existing land use in the study area to the south of proposed Orchard Hills Station is predominantly cleared agricultural land, including grazing pastures, horticultural land and some rural residential land. There are some pockets of remnant vegetation, particularly surrounding the waterways. South of the Western Sydney International site at the south of the project footprint near Bringelly features a higher percentage of small rural residential lots. There are small farm dams scattered across the catchment and the creek banks are vegetated and there are a few areas of urban development that would impact catchment runoff characteristics. There are numerous farm dams and reservoirs within the study area that are likely to be used for irrigation.

The study area is dominated by surface runoff from rainfall which concentrates into defined watercourse catchments. Many of the watercourses are interrupted by storages used for grazing and cropping which is a reflection of the current land uses across the study area. The flood modelling of the regular rainfall events indicates that these regular events are confined to the main channels and relatively quickly flow away to the lower portions of the South Creek catchment. North of The M4 Western Motorway were the land use becomes more urbanised the catchment is highly affected by development of the land such that rainfall does not infiltrate into the ground and all surface runoff is concentrated into channels that are directed to the nearest watercourse.

Water quality and quantity and velocity of flows within the catchment have been influenced by development. Vegetation removal, agriculture, de snagging, and construction of in-stream dams has affected the physical stability of the waterways within the study area. Bank erosion is common. The hydrological and sediment regimes have been dramatically altered by vegetation clearing and increasing urbanisation in the catchment. See Technical paper 10 (Hydrology) of the Project Environmental Impact Statement for further information.

The major water quality issues in South Creek are related to high nutrient concentrations derived from both point and diffuse pollution sources and subsequent algal and aquatic weed growth. Historically point pollution sources that impact South Creek's water quality include effluent released from five sewage treatment plants in the lower parts of the catchment. These plants are generally located downstream of the study area. Diffuse pollution sources are often more difficult to quantify and manage than point sources, but in the Hawkesbury-Nepean catchment it has been established that diffuse sources such as urban and agricultural runoff have just as great if not greater effect on water quality than point sources. Diffuse sources of pollutants include market gardens, cattle and sheep grazing intensive agriculture such as poultry farming as well as both urban and industrial land uses (Sydney Water, 2018).

6.3.3 Fish habitat and waterway classification

There are a number of smaller 1st and 2nd order streams within the study area that would be classified as Class 3 (minimal fish habitat) or Class 4 (unlikely fish habitat) (see Fairfull and Witheridge 2003) as they have intermittent flow and lack any permanent refuge in the form of permanent or semi-permanent pools or aquatic vegetation. The riparian vegetation along these smaller 1st and 2nd order streams has generally been cleared and most of these smaller waterways have been dammed in multiple locations along their length.

The larger waterways within or adjacent to the study area are outlined below in Table 6.9. These larger 3rd, 4th and 5th order waterways are mapped as Key Fish Habitat by the NSW DPI and would be classified as Type 2 – Moderately sensitive key fish habitat (see NSW Department of Primary Industries, 2013) with the exception of South Creek which has been assessed as a Type 1 – Highly sensitive key fish habitat (see NSW Department of Primary Industries, 2013) as it is known to contain woody debris and aquatic vegetation (see DIRD, 2016e). South Creek is illustrated in Photographs 6.10 and 6.11.

In terms of waterway classification for fish passage, these waterways would generally be classified as Class 2 (moderate fish habitat) (see Fairfull and Witheridge, 2003) as they are named permanent or intermittent streams, creeks or waterways with clearly defined bed and banks with semi - permanent to permanent waters in pools with freshwater aquatic vegetation.

The unnamed tributary of South Creek (DEOH) land, Lot 1 DP242968) would be a Class 3 (minimal fish habitat) and the unnamed tributary of Badgerys Creek (present in the study area on Lot 26 DP2650) which would be classified as Class 4 (unlikely fish habitat) (see Fairfull and Witheridge, 2003). A summary of waterway classification within the study area is provided in Table 6.9.

Table 6.9 Habitat assessment of the main mapped waterways within the study area

Study area	Rivers and streams	Strahler order	Mapped Key Fish Habitat?	Habitat sensitivity (NSW Department of Primary Industries 2013)	Waterway classification (fish passage) (Fairfull and Witheridge 2003)
Off-airport	Blaxland Creek	4th	Yes	Type 2 – Moderately sensitive key fish habitat	Class 2 (moderate fish habitat)
	Unnamed tributary of South Creek (DEOH land, Lot 1 DP242968)	4th	Yes	Type 2 – Moderately sensitive key fish habitat	Class 3 (minimal fish habitat)
	Claremont Creek	4th	Yes	Type 2 – Moderately sensitive key fish habitat	Class 2 (moderate fish habitat)
	Cosgroves Creek	4th	Yes	Type 2 – Moderately sensitive key fish habitat	Class 2 (moderate fish habitat)
	Unnamed tributary of Badgerys Creek (Lot 26 DP2650)	3rd	Yes	Type 3 – Minimally sensitive key fish habitat	Class 4 (unlikely fish habitat)
	South Creek	5th	Yes	Type 1 – Highly sensitive key fish habitat	Class 2 (moderate fish habitat)
On-airport	Badgerys Creek[1]	4th	Yes	Type 2 – Moderately sensitive key fish habitat	Class 2 (moderate fish habitat)

[1] Badgerys Creek forms the boundary of Western Sydney International and does not fall within the study area. For the purposes of this BDAR, Badgerys Creek is considered further within the on-airport assessment as it is within 200 metres of the project study area and could be subject to potential indirect impacts.

Photo 6.10 South Creek immediately downstream of Luddenham Road

Photo 6.11 South Creek downstream of Luddenham Road bridge looking north

6.3.4 Aquatic biota

No macroinvertebrate surveys or fish surveys were conducted during the field surveys undertaken for the project as the aquatic ecology of the waterways within and adjacent to the study area is well known from previous surveys, particularly those undertaken for the Western Sydney Airport – Environmental Impact Statement (DIRD, 2016e).

The macroinvertebrate communities within Badgerys Creek, Cosgroves Creek, Oaky Creek, South Creek, Thompsons Creek and their tributaries are known to be dominated by Dipterans (true flies), Acarina (water mites), and Odonata (Dragonflies) with lower numbers of other taxa including Bivalvia, Coleoptera, Decapoda, Ephemeroptera, Gastropoda, Hemiptera, Hirudinea, Lepidoptera, Oligochaeta, Trichoptera, and Turbellaria (see DIRD, 2016e). The macroinvertebrate communities in these waterways are composed of taxonomic groups that have a high tolerance to severe pollution levels with an absence of taxa sensitive to poor water quality (DIRD, 2016e).

A study by Chessman and Williams (1999) showed that a tributary of Blaxland Creek within the heavily vegetated area of DEOH upstream to the west of the study area contained a high representation of pollution-sensitive macroinvertebrate taxa. This tributary of Blaxland Creek is upstream from the study area and retains remnant vegetation in the catchment, so these data are not directly relevant to the portion of Blaxland Creek within the study area. The section of Blaxland Creek within the study area contains a thin strip of riparian vegetation with cleared agricultural land either side and urban development nearby (to the west) and is more comparable to Cosgroves Creek or Badgerys Creek in that regard and is likely to contain similar macrofaunal assemblages and water quality in this area.

The fish communities in Badgerys Creek and in upstream and downstream habitats are indicative of disturbed habitats (DIRD, 2016e). Eight fish species were caught during the surveys undertaken for the Western Sydney Airport – Environmental Impact Statement (DIRD, 2016e). Five native fish species including Long-finned Eel, Firetail Gudgeon, Western Carp Gudgeon, an unidentified Gudgeon species, and Australian Smelt were recorded, with exotic species including Goldfish, Common Carp, and Eastern Gambusia forming the bulk of individuals that were captured (DIRD, 2016e).

Given these results and the similar nature of the other waterways in the study area including Blaxland Creek, the unnamed tributary of South Creek (DEOH land, Lot 1 DP242968), Claremont Creek, the unnamed tributary of Badgerys Creek (Lot 26 DP2650), and Moore Gully, the macroinvertebrate and fish communities are likely to be similar to those assessed for the Western Sydney Airport – Environmental Impact Statement (DIRD (2016e).

6.3.5 Threatened aquatic species

The desktop searches returned three threatened fish listed under the EPBC Act as having the potential to occur within the locality: Australian Grayling, Macquarie Perch and Murray Cod. The Australian Grayling and Macquarie Perch are also listed as threatened species under the FM Act. A further two threatened invertebrate species listed under the FM Act, Adam's Emerald Dragonfly or the Sydney Hawk Dragonfly may also occur in the locality, as identified in the Western Sydney Airport – Environmental Impact Statement (DIRD, 2016e).

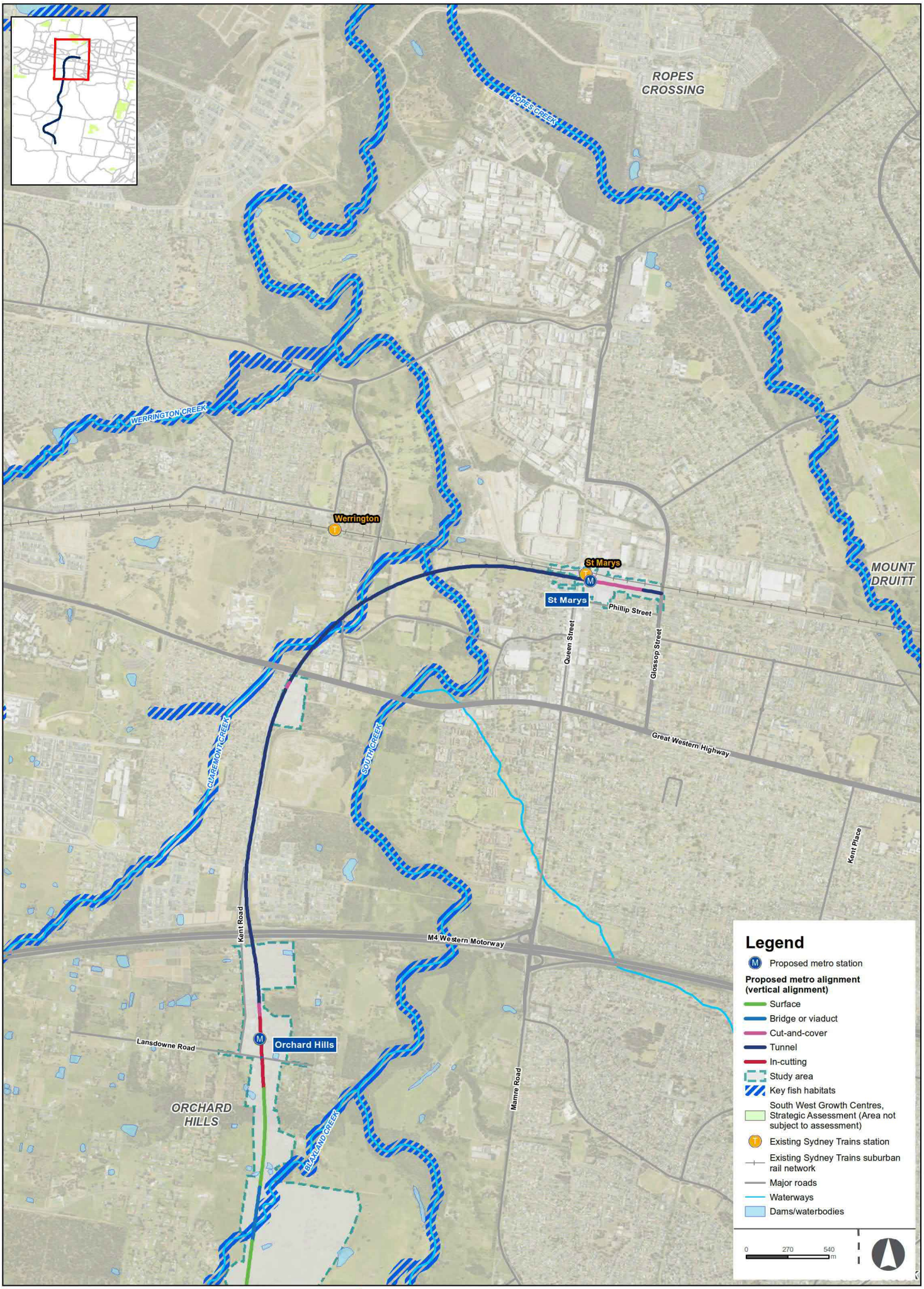
A search of Department of Primary Industries (DPI) Fisheries Spatial Data Portal on 19 May 2020 found that none of the waterways contain mapped habitat for threatened aquatic species listed under the FM Act, based on predicted occupancy extents. An assessment of the likelihood of occurrence of all threatened species was undertaken to determine the potential for these species to occur within the development site (see Appendix B).

No threatened fish species listed under the EPBC Act or FM Act were caught during the aquatic surveys undertaken for the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e). The level of habitat disturbance, low surface flows, poor water quality, and creation of farm dams have resulted in reductions in native fish populations (DIRD, 2016e).

The intermittent nature of the waterways is likely a natural inhibitor to threatened species occurrence and the habitat disturbance that has occurred with the associated flow on effects of erosion, poor water quality, and high abundance of exotic species suggest that the habitat quality for threatened species is poor (DIRD, 2016e). These results are also applicable to the other waterways in the study

area including Blaxland Creek, the unnamed tributary of South Creek (DEOH land, Lot 1 DP242968), Claremont Creek, and the unnamed tributary of Badgerys Creek (Lot 26 DP2650). Furthermore, the study area is outside of the known distribution of the Australian Grayling, Macquarie Perch and Murray Cod suggesting that these species are unlikely to occur.

The macroinvertebrate sampling undertaken for the Western Sydney Airport – Environmental Impact Statement (Department of Infrastructure and Regional Development (2016e) indicates that the Odonata (Dragonflies) composed approximately 10 per cent of the total number of individuals collected with the majority of individual being nymphs (so species could not be determined). However, no nymphs from the families to which the threatened species Adam's Emerald Dragonfly or the Sydney Hawk Dragonfly were captured (DIRD, 2016e). These results are also applicable to the other waterways in the study area including Blaxland Creek, the unnamed tributary of South Creek (DEOH land, Lot 1 DP242968), Claremont Creek, and the unnamed tributary of Badgerys Creek (Lot 26 DP2650) as the habitats are in a similar state.



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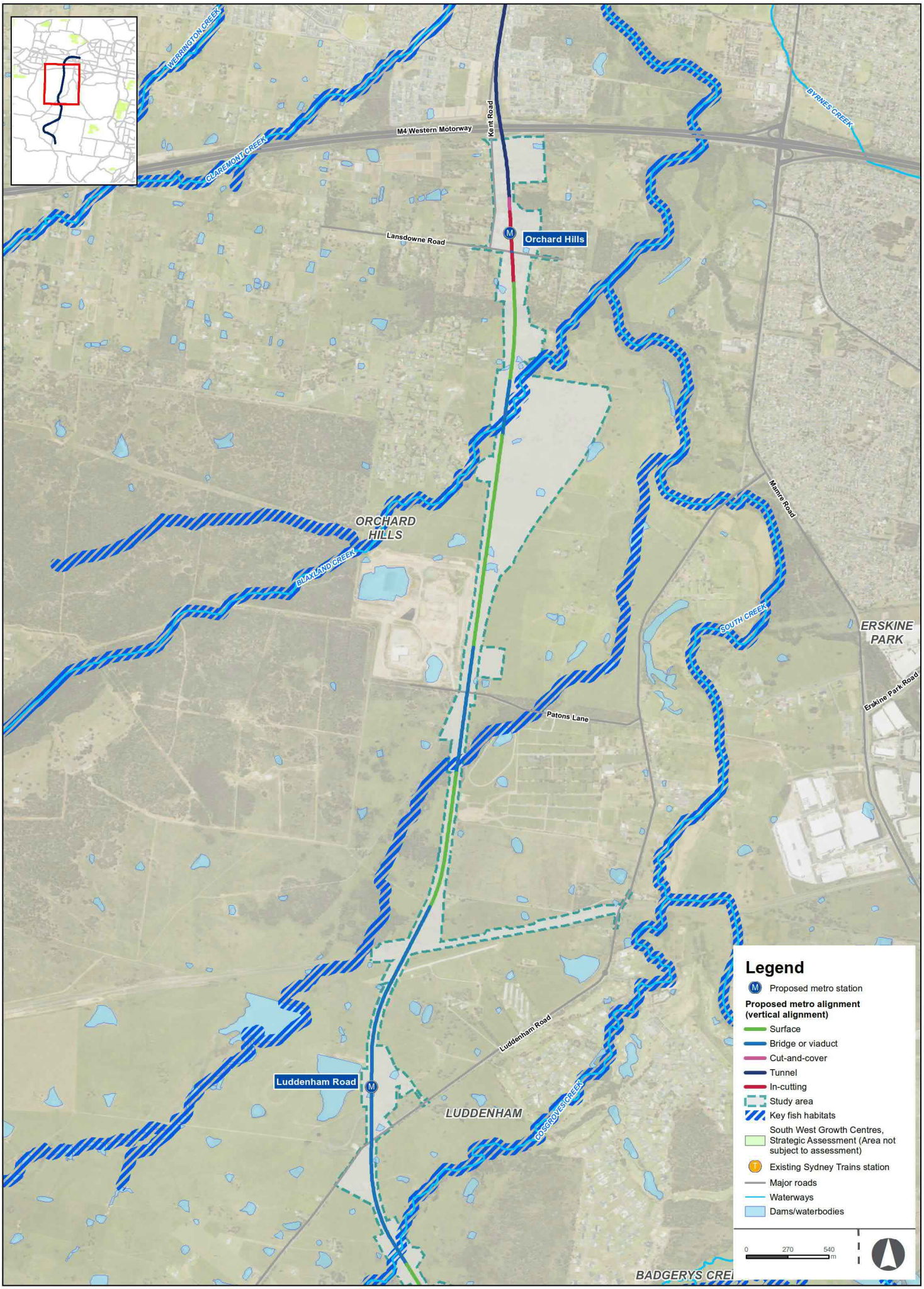
Aquatic habitats

Figure 6-3a



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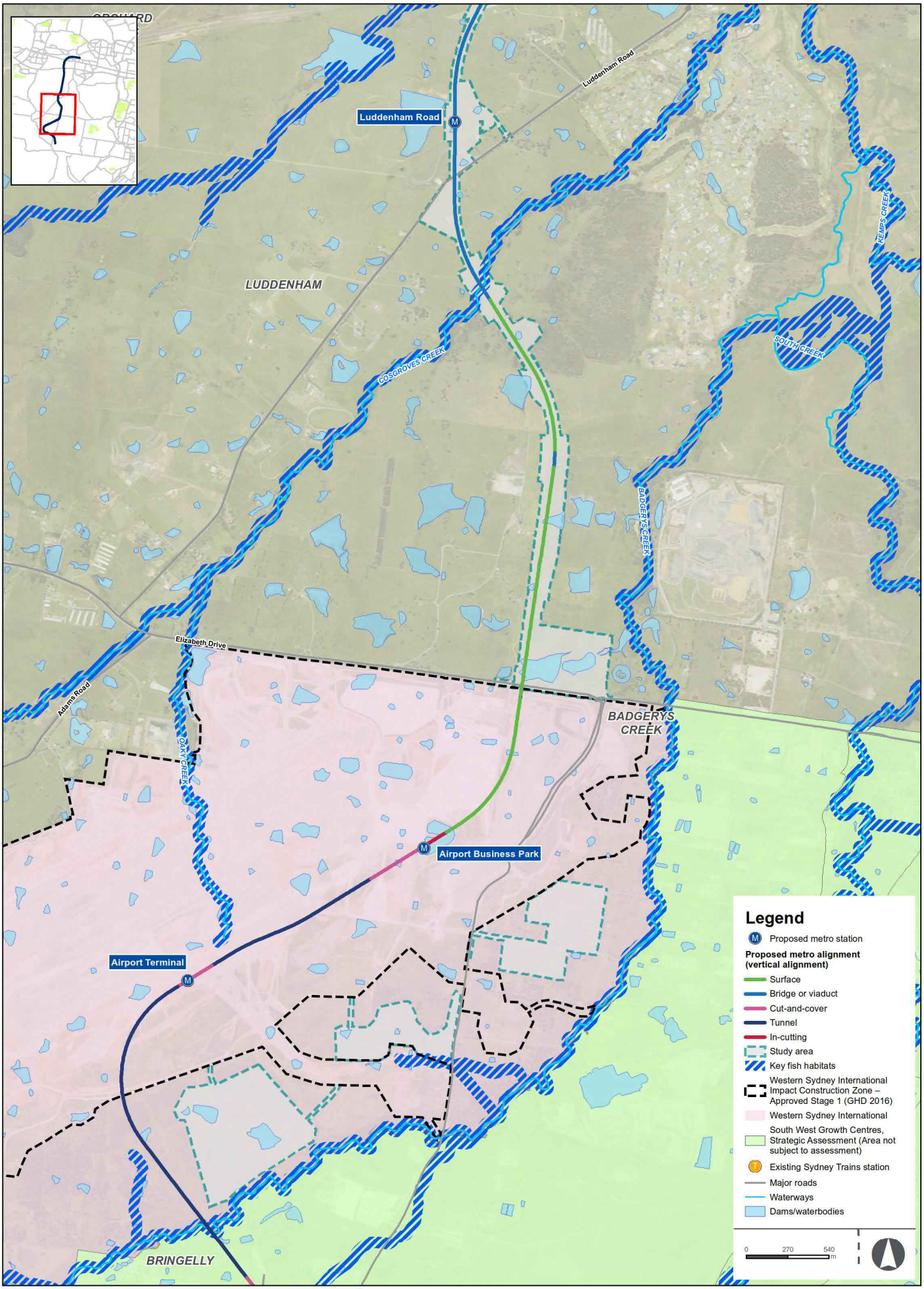
Aquatic habitats

Figure 6-3b



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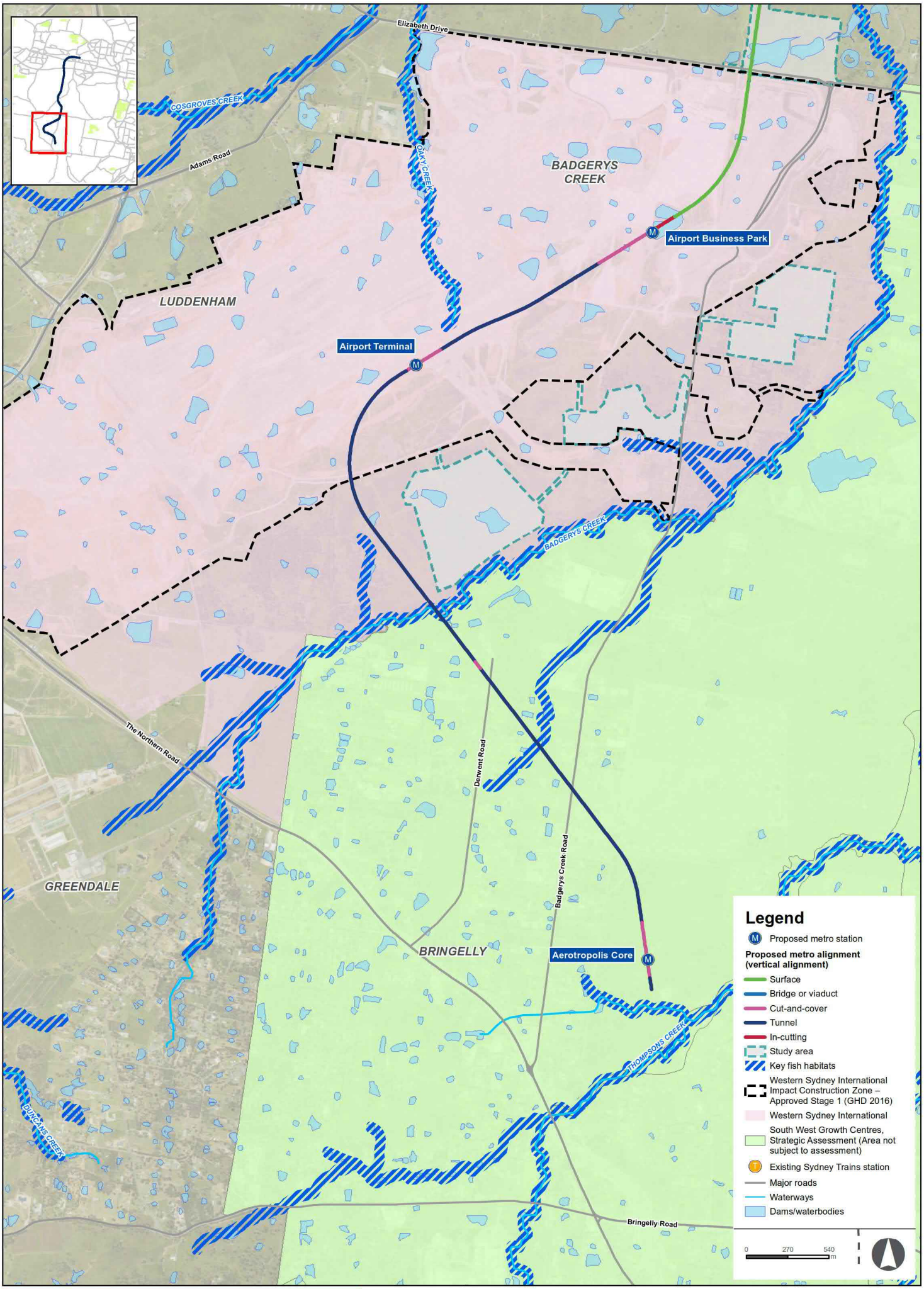
Aquatic habitats

Figure 6-3c



Sydney Metro – Western Sydney Airport

Aquatic habitats

Figure 6-3d

Indicative only, subject to design development

7 Commonwealth Matters of National Environmental Significance

Matters of National Environmental Significance (MNES), listed under the EPBC Act, are addressed in this section. The following biodiversity MNES protected under the EPBC Act were considered for their relevance to the project:

- Wetlands of international importance (sections 16 and 17B)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A)
- Commonwealth Land (for actions outside Commonwealth Land that may impact on the environment on Commonwealth Land) (section 26 and 27A).

An updated search of the EPBC Act Protected Matters Search Tool on 19 May 2020 was completed for an area within 10 kilometres of the study area. Results from database searches and habitat suitability assessments are provided below and in Appendices A and B.

7.1 Wetland of international importance

No wetlands of international importance occur within the study area or broader locality.

7.2 Listed threatened species and communities

7.2.1 Commonwealth threatened ecological communities

The protected matters search undertaken for this project identified nine predicted threatened ecological communities as potentially occurring within the locality. These communities are:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
- Western Sydney Dry Rainforest and Moist Woodland on Shale.

Of these, two threatened ecological communities that meet the criteria for listing under the EPBC Act were recorded during field surveys:

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

It should be noted that River-flat eucalypt forest on coastal floodplains of NSW was under EPBC Act listing assessment at the time the Project referral was prepared and assessment process determined by the Commonwealth Minister for the Environment on 14 July 2020. The assessment timeframe for this ecological community was extended from 30 April 2019 to 31 October 2019 to allow adequate time to undertake further consultation and finalise the assessment. A further extension was granted from 31 October 2019 to 31 July 2020 to enable the outcomes of public consultation to be fully considered (DAWE 2020).

On the 15 December 2020, the Minister of the Environment approved the listing assessment of *'River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria'*. As of this date, this community is now listed as Critically Endangered under the EPBC Act.

As this community was not listed prior to the project's EPBC referral and determination by the Commonwealth Minister for the Environment as a controlled action on 14 July 2020, it has not been considered further as an MNES in this assessment.

For vegetation to be commensurate with the EPBC-listing for these communities both key diagnostic features and condition thresholds must be met. An assessment of each candidate PCT and condition class against the relevant criteria has been undertaken for each patch of vegetation within the study area. A summary of each threatened ecological community, associated PCT and extent within the study area which is commensurate with EPBC listing is summarised in Table 7.1 and shown in Appendix F.

Table 7.1 Summary of EPBC-listed Threatened Ecological Community

Threatened Ecological Community	Status	Associated PCT recorded	Condition	Off-airport extent (hectares)[1]	On-airport extent (hectares)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	1.08	Not recorded
			Thinned	3.35	Not recorded
			Scattered Trees	Not commensurate	Not recorded
		PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	0.00	3.89
			Thinned	1.44	0.05
			Scattered Trees	Not commensurate	Not commensurate
			Low	Not commensurate	Not commensurate
Total area for EPBC-listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest				**5.87**	**3.94**
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland	Endangered	PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	1.07	Not recorded
			Thinned	3.87	Not recorded
Total area for EPBC-listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland				**4.94**	**0.00**

[1] Includes areas of indirect impact to the TEC

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest is listed as critically endangered under the EPBC Act.

Within the study area, two native plant community types recorded were considered candidates to from part of this TEC:

- PCT 724 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.

To be considered to form part of this community, both the key diagnostic characteristics and condition thresholds outlined in the Approved Conservation Advice (Department of the Environment, 2015) must be met.

For consistency with the draft Cumberland Plain Assessment Report prepared for the Strategic Assessment (Open Lines and Biosis, 2020), the field verified vegetation mapping for the Penrith to Eastern Creek Growth Investigation Area (Biosis, 2018) and EPBC TEC Mapping (Biosis, 2019) has been used to inform this BDAR where access was unable to be accessed for field surveys on off-airport land north of Western Sydney International. For areas not yet surveyed, it has been assumed that all patches of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest are 'Intact' and a small proportion of 'thinned' as mapped by the Strategic Assessment would meet relevant TEC listing criteria (Biosis, 2019).

In addition, non-restricted areas have been subject to detailed field survey where plot based data has been collected to assist with condition threshold assessment. A comparison of candidate Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest patches and recorded condition class against condition thresholds is provided in Table 7.2. An overview of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest condition threshold listing advice is presented in Figure 7.1 whilst vegetation type descriptions and plot data is provided in Chapter 5 (Native vegetation and threatened ecological communities) and Appendix C (BAM plot data).

Table 7.2 Candidate patches for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

Project area	Approx. location	PCT/Condition	Threshold/reasoning	Outcome
Off-airport – surveyed area				
Defence Establishment Orchard Hills	Off-airport construction corridor (Lot 2 DP242968)	PCT 849 - Thinned	Combined Patch is <0.5 hectares	Threshold not met. Not considered further
	Off-airport construction corridor (Lot 1 DP242968; Lot 1 DP1099147)	PCT 849 - Thinned	A. Combined Patch is >0.5 hectares; ≥50per cent of the perennial understorey vegetation cover is made natives of native species.	Meets patch threshold (1.32 hectares)
Orchard Hills	Orchard Hills construction site (see Figure 8.2)	PCT 724 – Intact	Combined Patch size is <0.5 hectares and ≥50per cent of the perennial understorey vegetation cover is made up of native species	Meets patch threshold[1]

Project area	Approx. location	PCT/Condition	Threshold/reasoning	Outcome
Off-airport – area not surveyed				
Orchard Hills	Various patches	PCT 849 - Thinned	EPBC TEC Mapping (Biosis 2019) Combined Patch is <0.5 hectares and ≥50per cent of the perennial understorey vegetation cover is made up of native species	Meets patch threshold (1.72 hectares)
Orchard Hills	Orchard Hills construction site (see Figure 8.2)	PCT 724 – Intact	EPBC TEC Mapping (Biosis 2019) Combined Patch is <0.5 hectares and ≥50per cent of the perennial understorey vegetation cover is made up of native species	Meets patch threshold (2.82 hectares)[1]
Total area for off-airport land				**5.87 hectares**
On-airport				
Airport construction support site	Tunnel and viaduct segment production and storage	PCT 849 - Intact	A. Minimum patch size is ≥0.5ha; ≥50per cent of the perennial understorey vegetation cover is made up of native species	Meets patch threshold (3.94 hectares)
		PTC 849 – Thinned	A. Minimum patch size is ≥0.5ha; ≥50per cent of the perennial understorey vegetation cover is made up of native species	
		PCT 849 – Scattered Trees	<30per cent of perennial understorey is made up of native species	Threshold not met. Not considered further
Total area for on-airport land				**3.94 hectares**

[1] Area of patch combines contiguous area across both surveyed and non-surveyed area of Orchard Hills construction site.

Table 1. Condition Thresholds for Patches[3] that meet the Description for the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community.

Category and rationale	Thresholds
A. Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applied in NSW.	Minimum patch[3] size is ≥0.5ha; **AND** ≥50% of the perennial understorey vegetation cover[4] is made up of native species.
OR	
B. Larger patches which are inherently valuable due to their rarity.	The patch size is ≥5ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species.
OR	
C. Patches with connectivity to other large native vegetation remnants in the landscape.	The patch size is ≥0.5 ha; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** The patch is contiguous[5] with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥5ha in area.
OR	
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥0.5 ha in size; **AND** ≥30% of the perennial understorey vegetation cover is made up of native species; **AND** The patch has at least one tree with hollows per hectare or at least one large tree (≥80 cm dbh) per hectare from the upper tree layer species outlined in the Description and Appendix A.

[3] A *patch* is defined as a discrete and continuous area that comprises the ecological community, outlined in the Description. Patches should be assessed at a scale of 0.04 ha or equivalent (e.g. 20m x 20m plot). The number of plots (or quadrats or survey transects) per patch must take into consideration the size, shape and condition across the site. Permanent man-made structures, such as roads and buildings, are typically excluded from a patch but a patch may include small-scale disturbances, such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community, for instance the easy movement of wildlife or dispersal of spores, seeds and other plant propagules.

[4] *Perennial understorey vegetation cover* includes vascular plant species of the ground and shrub layers (as outlined in the *Description* and Appendix A) with a life-cycle of more than two growing seasons (Australian Biological Resources Study, 2007). Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, leaf litter or exposed soil (although these are included in a patch of the ecological community when they do no alter functionality as per footnote 3 and the *Description* and *Condition Thresholds* are met).

[5] *Contiguous* means the woodland patch is continuous with, or in close proximity (within 100 m), of another patch of vegetation that is dominated by native species in each vegetation layer present.

Figure 7.1 Condition thresholds for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland

Within the study area, one native community type was considered a candidate to from part of this TEC:

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

To be considered to form part of this community, both the key diagnostic characteristics and condition thresholds outlined in the Conservation Advice (Department of the Environment and Energy, 2018) must be met. Where access was restricted EPBC TEC Mapping (Biosis, 2019) was relied upon for patch assessment.

A comparison of candidate PCT 1800 against the key diagnostics is provided in Table 7.3. The candidate patches considered for EPBC listing are outlined in Table 7.4 with the condition criteria provided in Figure 7.2.

Table 7.3 Key diagnostics for Coastal Swamp Oak (Casuarina glauca) Forest of NSW and South East Queensland TEC

Key diagnostic characteristics[1]	PCT 1800
Occurs from south-east Queensland to southern NSW within the South-Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	The study area occurs within the Sydney Basin Bioregion
Occurs in coastal catchments at elevations up to 50 metres ASL, typically less than 20 metres ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks	Recorded in drainage lines and on floodplains on soils that were water-logged. It is questionable if the Cumberland Plain could be considered a coastal catchment although for this assessment recorded vegetation is assumed to meet this characteristic to maintain consistency with the Strategic Assessment mapping and analysis (Open Lines and Biosis 2020)
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates	Alluvial soils were recorded in areas of PCT 1800
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 per cent	The crown cover of PCT 1800 was at least 10 per cent
Has a canopy of trees dominated by *Casuarina glauca* (swamp-oak, swamp she-oak)	*Casuarina glauca* (Swamp Oak) was the dominant canopy species recorded

[1] Department of the Environment and Energy, 2018

Table 7.4 Candidate patches for Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland TEC listing

Suburb	Approx. location	PCT/Condition	Threshold/ reasoning	Outcome
Luddenham: Riparian areas of Cosgrove Creek (Biosis 2019)	Lot 11 DP594600; Lot 12 DP594600; Lot 29 DP209399	PCT 1800 – Thinned	Large Patch (The patch is > 5 hectares): Predominately native understorey. Non-native species comprise less than 20per cent of total understorey vegetation cover.	Meets patch threshold (2.32 hectares)
DEOH (WSP 2020)	Lot 1 DP629326	PCT 1800 – Thinned	Patch is <0.5 hectares and >30 metres from another patch	Threshold not met. Not considered further
	Lot 3 DP242968	PCT 1800 - Intact	Large Patch: A large or medium patch that meets key diagnostics and has some native understorey	Meets patch threshold (1.85 hectares)
	Lot 1 DP242968	PCT 1800 - Intact	Large Patch: A large or medium patch that meets key diagnostics and has some native understorey	Meets patch threshold (0.92 hectares)
		PCT 1800 - Thinned	Patch is <0.5 hectares and >30 metres from another patch,	Threshold not met. Not considered further
Total area				**4.94 hectares**

Condition thresholds Patch size classes➔ 🡻 Vegetation quality classes	**Large patch** The patch is at least 5 ha	**Medium patch** The patch is at least 2 ha and less than 5 ha	**Small contiguous** patch** The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha	**Small patch** The patch is at least 0.5 ha and less than 2 ha
HIGH QUALITY **Predominantly native understorey** Non-native species comprise **less than 20%** of total understorey vegetation cover*	CATEGORY A A large patch that meets **key diagnostics** and has a predominantly native understorey	CATEGORY B A medium patch that meets **key diagnostics** and has a predominantly native understorey OR A small patch that meets **key diagnostics** and has a predominantly native understorey and is contiguous** with another large area of native vegetation		CATEGORY C A small patch that meets **key diagnostics** and has a predominantly native understorey
GOOD QUALITY **Mostly native understorey** Non-native species comprise **less than 50%** of total understorey vegetation cover* AND transformer species*** comprise **less than 30%** of total understorey vegetation cover*	CATEGORY B A large patch that meets **key diagnostics** and has a mostly native understorey	CATEGORY C A medium patch that meets **key diagnostics** and has a mostly native understorey OR A small patch that meets **key diagnostics** and has a mostly native understorey and is contiguous** with another large area of native vegetation		
MODERATE QUALITY **Some native understorey** Non-native species comprise **less than 80%** of total understorey vegetation cover* AND transformer species*** comprise **less than 50%** of total understorey vegetation cover*	CATEGORY C A large or medium patch that meets **key diagnostics** and has some native understorey			

*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.
**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.
***Transformer species (e.g. *Chrysanthemoides monilifera*, *Asparagus* spp, *Pennisetum* spp, *Ipomoea* spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as *Symphyotrichum subulatum* (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.

Figure 7.2 Condition thresholds for Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland TEC listing

7.2.2 Provisional list of EPBC Act listed species and vegetation communities following 2019-2020 bushfires

On 11 February 2020, DAWE released a provisional list of 113 animal species that have been identified as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia (DAWE, 2020a). This list was revised to a total of 119 species in an updated assessment on 24 March 2020 (DAWE, 2020b). Most of these animals have potentially had at least 30 per cent of their range lost to bushfires, and many have lost substantially more. DAWE further released an initial list of TECs which have lost more than 10 per cent of their estimated distribution in areas affected by those same bushfires. Threatened flora high priority lists were released on 23 April 2020 (DAWE, 2020c).

The Critically-endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest was listed as having less than 10 per cent of its estimated distribution affected by bushfire and is therefore not identified in the initial list of highest priority threatened ecological communities by the Department (DAWE, 2020b). Furthermore, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest is a dry sclerophyll eucalypt forest that are relatively resilient to the impacts of wild fires and burning if fire intervals of greater than 4-12 years are maintained. The areas of this community that were subject to the recent bushfires are considered likely to recover in time, further mitigating the fires' impacts.

A total of 5.87 hectares of unburnt Critically-endangered Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest would be potentially impacted by the project. Within the locality (10 kilometres) no Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest has been affected by recent bushfires. Therefore, following consideration of the recent bushfire impacts to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest the project is considered unlikely to significantly impact upon this threatened ecological community.

The Endangered Coastal Swamp-Oak Forest was listed as having less than 10-30 per cent of its estimated distribution affected by bushfire and is therefore not identified in the initial list of highest priority threatened ecological communities by the Department (DAWE, 2020b). Furthermore, the majority of the Coastal Swamp-Oak Forest affected by bushfire is associated with coastal floodplains on the mid north coast and south coast regions of NSW and not within the Sydney Basin bioregion. The areas of this community that were subject to the recent bushfires are considered likely to recover in time, further mitigating the fires' impacts.

A total of 4.94 hectares of unburnt Coastal Swamp-Oak Forest would be potentially impacted by the project. The impacts of the recent bushfires to Coastal Swamp-Oak Forest within the Sydney basin is largely restricted to the Hawkesbury river catchment, with generally no impacts to Coastal Swamp-Oak Forest within the locality (10 kilometres) of the project. Therefore, following consideration of the recent bushfire impacts to Coastal Swamp-Oak Forest the project is considered unlikely to significantly impact upon this threatened ecological community.

Commonwealth threatened ecological community summary

Commonwealth-listed threatened ecological communities affected by the project have been considered further with respect to Significant Impact Guidelines 1.1 (Department of the Environment, 2013). An assessment has been carried out for each species outlined in Table 7.5 in accordance with Significant Impact Guidelines 1.1 (Department of the Environment, 2013) and is provided in Appendix F of this technical paper.

Table 7.5 Commonwealth listed threatened ecological communities

Threatened Ecological Community	Status	Off-airport extent (hectares)	On-airport extent (hectares)	Total (hectares)	Significant impact assessment outcome?
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	5.87	3.94	9.81	Unlikely

Threatened Ecological Community	Status	Off-airport extent (hectares)	On-airport extent (hectares)	Total (hectares)	Significant impact assessment outcome?
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland	E	4.94	0.00	4.94	Unlikely

Notes:

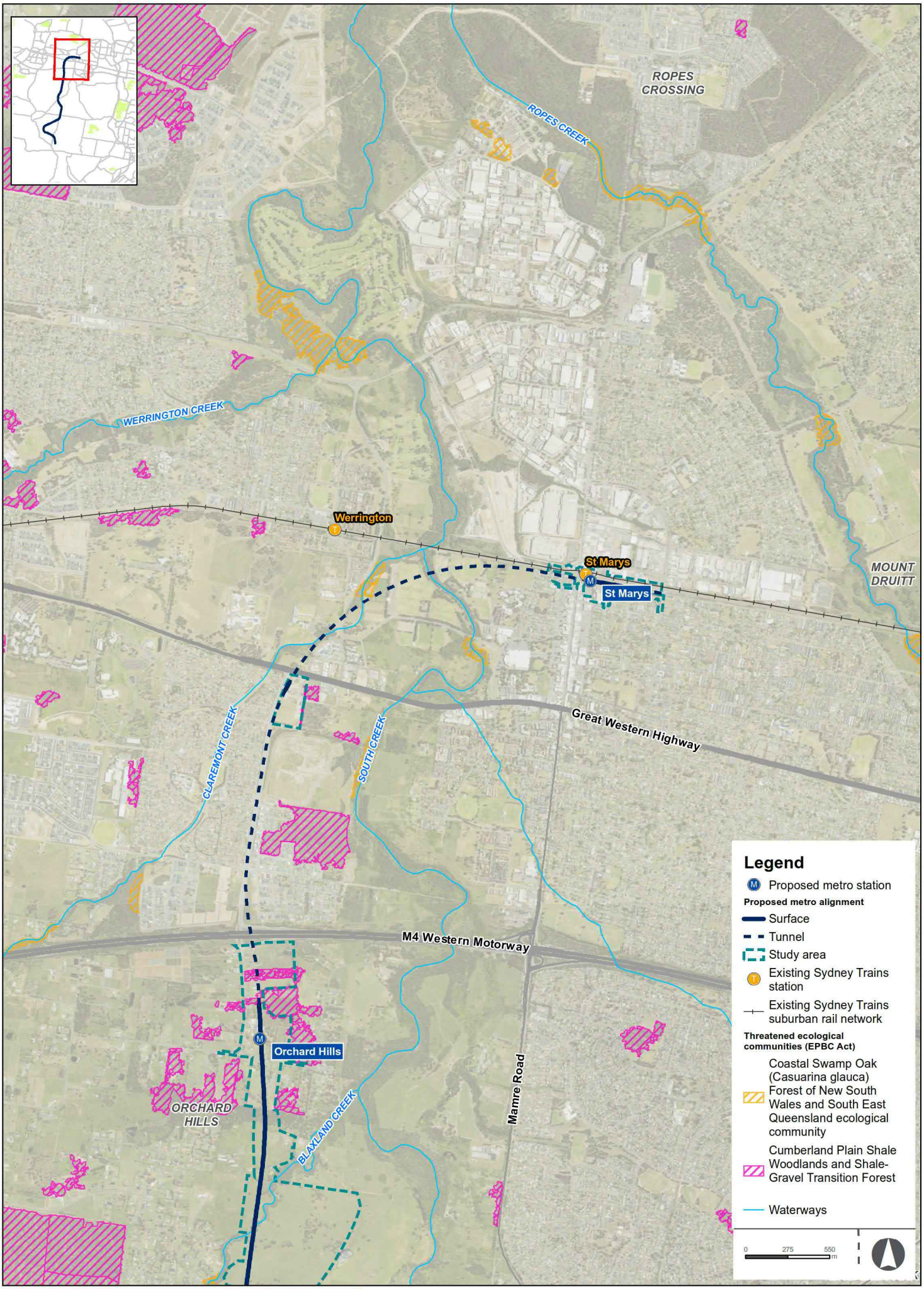
(1) E = Endangered, CE = Critically Endangered under the EPBC Act.

The potential impacts of the project on the TECs Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest and Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland outlined above is based on a worst-case scenario. Opportunities throughout design development and construction management would aim to further minimise these impacts. Most of the potential impacts of the project on vegetation are associated with small fragmented areas of disturbed condition and/or fringing edges of Intact condition areas like those at the proposed Orchard Hills station (see Figure 7.3).

Within the locality there are 1366 hectares of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, including the substantial 375 hectares that is securely conserved within the DEOH offset areas (GHD, 2020) located approximately 800 metres to the west of the project. The impacts to TECs within the DEOH are restricted to three small isolated fragments providing limited connectivity to the adjoining significant stands within the proposed offsets area.

There are also approximately 90 hectares of the TEC Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland within the locality associated with larger riparian zones of South Creek, Werrington Creek, Ropes Creek and Kemps Creek. There is also approximately 40 hectares of this TEC within the DEOH offset areas.

The project would not create new areas of fragmentation to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest TEC and only relatively small areas of additional fragmentation to the TEC Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland, associated with the crossing of the small, unnamed riparian corridors already subject to disturbances and edge effects. The project is considered unlikely to cause a substantial change in the species composition of TECs or exacerbate invasive species such that it would substantially reduce the quality or integrity of these TECs occurrence.

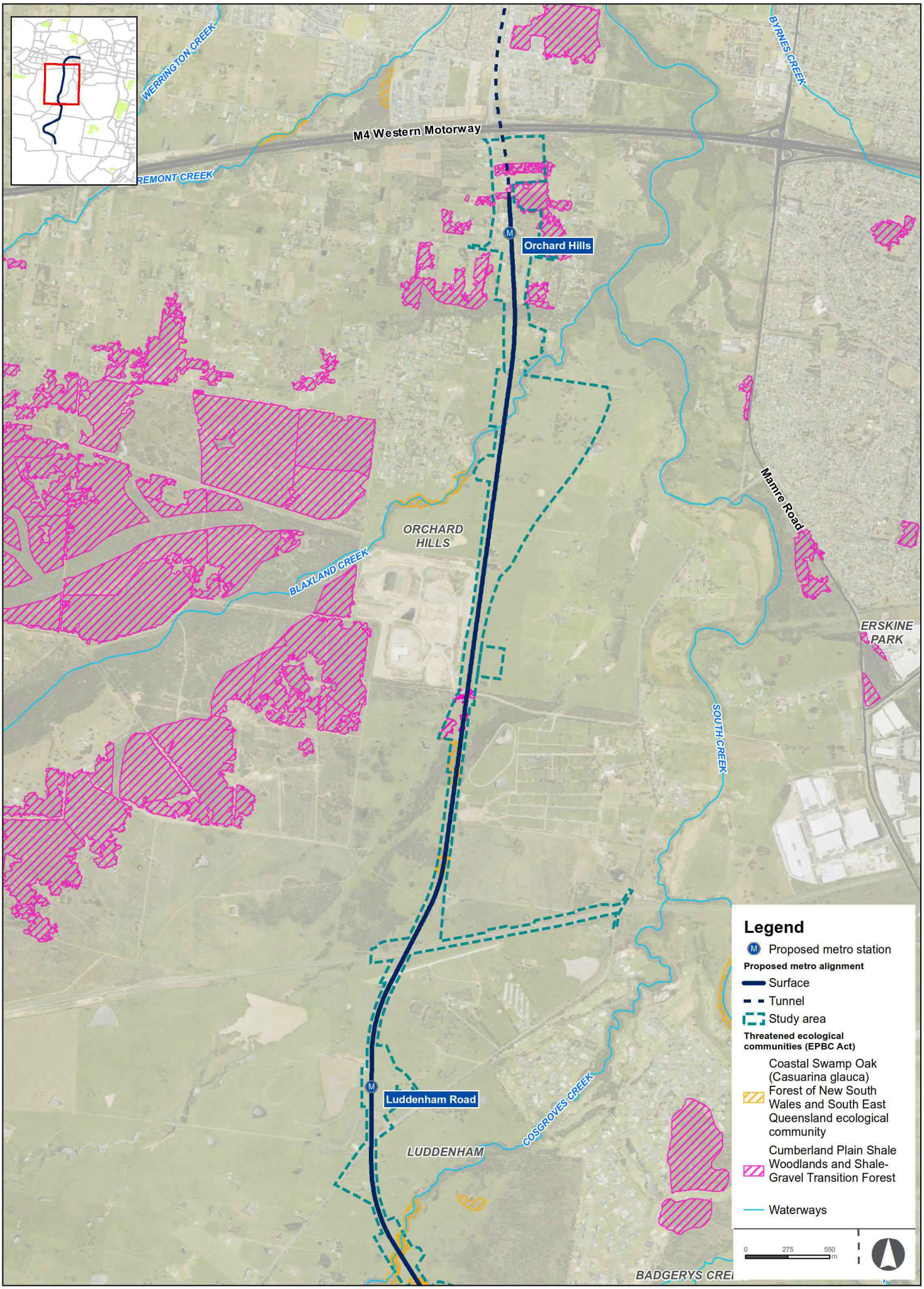


Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

TEC patch size and connectivity within the locality

Figure 7-3a

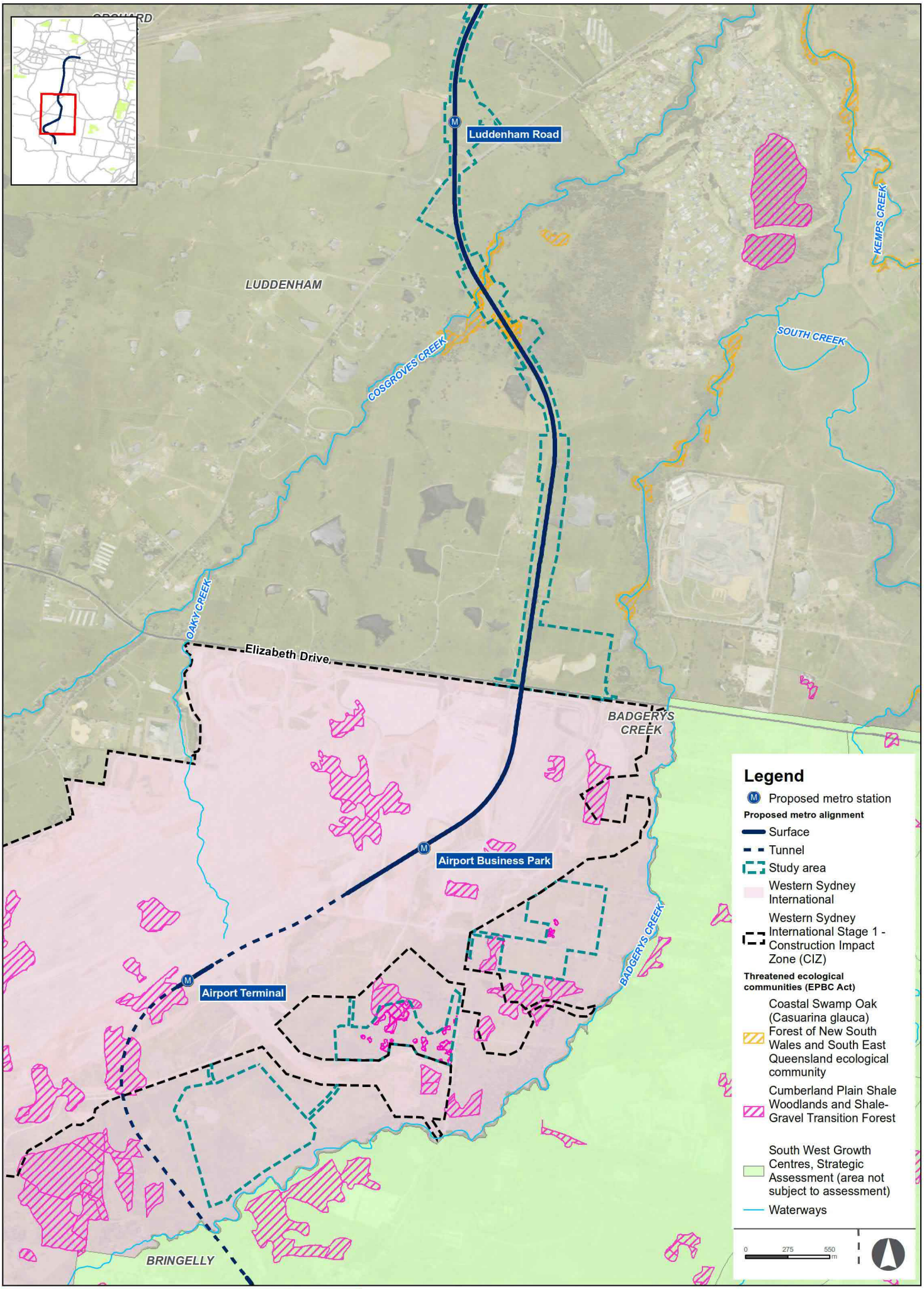


Sydney Metro – Western Sydney Airport

TEC patch size and connectivity within the locality

Indicative only, subject to design development

Figure 7-3b



Sydney Metro – Western Sydney Airport

TEC patch size and connectivity within the locality

Indicative only, subject to design development

Figure 7-3c

7.2.3 Commonwealth threatened flora

No commonwealth threatened flora was recorded during field surveys or in previous ecological assessments within the study area. Areas of potential habitat, including areas with not yet surveyed, are considered further in terms of assessments of significance. An assessment has been carried out for each species outlined in Table 7.6 in accordance with Significant Impact Guidelines 1.1 (Department of the Environment, 2013) and is provided in Appendix F of this technical paper.

Table 7.6 Commonwealth listed affected flora

Scientific name	Common name	EPBC Act[1]	Off-airport area of potential habitat (hectares)	Significant impact assessment outcome
Acacia bynoeana	Bynoe's Wattle	V	1.25	Unlikely
Acacia pubescens	Downy Wattle	V	2.23	Unlikely
Allocasuarina glareicola	-	E	1.25	Unlikely
Cynanchum elegans	White-flowered Wax Plant	E	0.57	Unlikely
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	1.27	Unlikely
Micromyrtus minutiflora	-	V	1.25	Unlikely
Pimelea curviflora var. curviflora	-	V	0.57	Unlikely
Pimelea spicata	Spiked Rice-flower	E	0.96	Unlikely
Pultenaea parviflora	-	V	1.25	Unlikely

Notes:

(1) V = Vulnerable, E = Endangered under the EPBC Act

7.2.4 Commonwealth threatened fauna

Twenty-four fauna species threatened under the EPBC Act were predicted to occur in the Predicted Matters Search Tool. Of these, 21 species were excluded from further consideration based on lack of suitable habitat, recent records or because the study area is outside the known distribution.

One fauna species, the Grey-headed Flying-fox was recorded foraging in the study area. As there are no roosting camps within the study area it has been considered further as an ecosystem credit species.

On 11 February 2020, DAWE released a provisional list of 113 animal species that have been identified as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia (DAWE, 2020a). This list was revised to a total of 119 species in an updated assessment on 24 March 2020 (DAWE, 2020b). Most of these animals have potentially had at least 30 per cent of their range lost to bushfires, and many have lost substantially more.

None of the high priority ‘Provisional list of animals requiring urgent management intervention’ are considered to occur, or likely to occur, within the Study area except for the vulnerable Grey-headed Flying-fox, which has been ‘provisionally included as a high priority whilst more information is gathered’ (DAWE, 2020b). The Grey-headed Flying-fox has a range that extends from south east Queensland along the east coast of NSW and Victoria. Approximately 10-30 per cent of the Grey-headed Flying-fox range has been impacted by bushfires, which has coincided with a significant heat stress event over summer 2019-2020. The combination of the events are behind the provisional inclusion on the high priority list.

In the locality, the extent of Grey-headed Flying-fox habitat impacted by the bushfire has been limited to relatively small proportion of the available foraging habitat. The nearest fire affected habitat occurred approximately 10 kilometres to the west of the study area in the lower Blue Mountains.

The project would result in the removal of about 32.78 hectares across the project (which includes up to 7.99 hectares on-airport) of potential Grey-headed Flying-fox foraging habitat in the form of Myrtaceous canopy species including Cumberland Plain Woodland.

Approximately 1,700 hectares of potential foraging habitat in the form of unburnt native vegetation has been mapped within 10 kilometres of the study area which is accessible to this species. The removal of 32.78 hectares across the project (which includes up to 7.99 hectares on-airport) would represent 1.9 per cent of available foraging habitat for this species. This is unlikely to significantly impact on this species, given the abundance of higher quality myrtaceous foraging habitat within the locality.

7.3 Migratory species

Eighteen species listed as migratory under the EPBC Act were predicted to occur in the PMST. Fourteen species were excluded from further consideration based on lack of suitable habitat, recent records or because the study area is outside the known distribution.

Four migratory species were considered to have suitable foraging habitat within the study area:

- Latham's Snipe
- White-bellied Sea-eagle
- White-throated Needletail
- Satin Fly-catcher.

The White-bellied Sea-eagle was recorded flying over both the on-airport and off-airport lands within the study area during the field surveys undertaken by M2A for this BDAR. DIRD (2016e) recorded Latham's Snipe in a large, vegetated farm dam on-airport (but not within the study area).

7.4 Commonwealth Land

Within the study area two areas of Commonwealth Land occur at:

- Western Sydney International (Australian Government Property Register ID: AGPR 4877)
- DEOH(AGPR499)

These areas would be impacted by the project. Impacts to biodiversity on this land have been considered further in assessments of significance provided in (EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541) and EPBC Act Final Environmental Impact Assessment of off-airport proposed action (EPBC 2020/8687).

A list of all plant species recorded at DEOH(AGPR499) is provided in Appendix C. Quadrats number 20 to 34 were completed on Defence Establishment Orchard Hills. One threatened flora species, *Grevillea juniperina* subsp. *juniperina*, listed as vulnerable under the BC Act was recorded within the Defence Establishment Orchard Hills land during M2A field surveys undertaken for the project in 2020.

A list of all fauna species recorded at DEOH(AGPR499) is provided in Appendix D.

There are no non-listed species of flora or fauna, considered to be sensitive, rare, or otherwise valuable recorded within the study area.

A detailed discussion of this species as it occurs on the portion of DEOH land impacted by the project is provided in Section 6.2.1 and discussion on impacts is provided in Section 8.

Other areas of Commonwealth Land within proximity of the study area include:

- Army Reserve Depot (AGPR466) in Blacktown, NSW
- Lancer Barracks (AGPR777) in Parramatta, NSW
- Lot 2 DP874120 (AGPR4609) in Parramatta, NSW
- Lot 10 DP1159973 (AGPR425) in Penrith, NSW
- Royal Australian Air Force Base (AGPR829) in Richmond, NSW.

These properties would not be affected by the project.

7.5 Consistency with conventions, conservation advice and recovery plans

The assessment of the proposed action under the Biodiversity Assessment Method (BAM) is consistent with Australia's international obligations (specifically the Biodiversity Convention, the Apia Convention and CITES), conservation advices and recovery and threat abatement plans.

7.5.1 Biodiversity Convention

The Convention on Biological Diversity is dedicated to promoting sustainable development. It provides a framework for Australia's integration of natural resources and environment and biodiversity management policies.

A key philosophy of sustainable development and the Convention on Biological Diversity is the principal of 'avoid and minimise impacts to biodiversity', which the project has adopted during the planning and design phase. Avoiding and minimising impacts on biodiversity values is a desired performance outcome for the project and is a mandatory key consideration for biodiversity impact assessment under the BAM.

The project's adherence to this is demonstrated throughout Section 8.1.

The biodiversity assessment for the proposed action has been based on the BAM methodology which addresses the ecologically sustainable development hierarchy of avoid, minimise and offset. This has led to the project being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, identifying offsets and a strategy to minimise impacts against Commonwealth requirements.

7.5.2 Apia Convention

The Convention on Conservation of Nature in the South Pacific (the Apia Convention) obliges States (in general terms) to create protected areas to safeguard representative samples of ecosystems, and places of scenic, geological, aesthetic, historical, cultural or scientific importance. The Convention also prohibits the taking or killing of fauna (including eggs and shells) unless the taking is controlled by the competent authorities of the State concerned, or unless in pursuance of 'duly authorised' scientific investigations.

The biodiversity assessment for the proposed action has been based on the BAM methodology which addresses the ecologically sustainable development hierarchy of avoid, minimise and offset. This has led to the project being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, identifying offsets and a strategy to minimise impacts against Commonwealth requirements.

7.5.3 CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The project would not contribute to or result in an increase in the international trade in specimens of wild animals and plants.

7.5.4 Conservation advices

The relevant conservation advices for MNES species and communities to be impacted by the proposed action were referenced and considered throughout the preparation of the BDAR and specifically, Appendix A - Threatened flora habitat suitability assessment, Appendix B – Threatened fauna habitat suitability assessment and Appendix F - EPBC Act Assessments of Significance.

7.5.5 Recovery and threat abatement plans

The relevant recovery and threat abatement plans are considered throughout the preparation of this BDAR including Table 8.15, Appendix F - EPBC Act Assessments of Significance.

There is no recovery plan for *Acacia bynoeana* under the EPBC Act. The proposed action would not interfere with any Regional/Local priority actions outlined in the Approved Conservation Advice (Department of the Environment, 2013).

There is currently no recovery plan for *Allocasuarina glareicola*. The proposed action is unlikely to lead to a decline outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008a).

There is currently no recovery plan for *Cynanchum elegans*. The proposed action is unlikely to lead to a decline outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008a).

Currently there is no recovery plan for *Grevillea parviflora subsp. parviflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the proposed action (Department of the Environment, Water, Heritage and the Arts, 2008c).

Currently there is no recovery plan for *Micromyrtus minutiflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the proposed action (Department of the Environment, Water, Heritage and the Arts, 2008d).

There is currently no recovery plan for *Pimelea curviflora var. curviflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the proposed action (Department of the Environment, Water, Heritage and the Arts, 2008e).

There is no recovery plan for *Pultenaea parviflora* under the EPBC Act. The proposed action would not interfere with any Regional/Local priority actions outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008f).

The Recovery Plan for Acacia pubescens (NSW National Parks and Wildlife Service, 2003) outlines 13 recovery actions. The proposed action would not interfere with any of these recovery actions.

The Recovery Plan for *Pimelea spicata* outlines six specific recovery objectives which focus on conserving known populations of *Pimelea spicata* (s 9) (Threatened Species Scientific Committee, 2016b). Given this species has not been recoded within the study area, the proposed action is not likely to interfere with any recovery objectives for *Pimelea spicata.*

The Recovery Plan for Large-eared Pied Bat identifies sandstone escarpments as critical to this species recovery. It is unlikely that any Large-eared Pied Bat foraging in the study area would be part of an important population or impact on critical habitats listed within the Recovery Plan.

The Action Plan for Australian Birds (Garnett and Crowley 2000) notes pressure on Swift Parrot breeding areas from forestry and firewood collection in Tasmania. On the mainland though, pressures relate to the loss of foraging habitats due to clearing for agriculture and residential development (Garnett and Crowley 2000). A National Recovery Plan for the Swift Parrot Lathamus discolor was prepared in 2011 (Saunders 2011). Recovery actions outlined in this plan include:

- 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 impacts of the proposed action on the marginal potential foraging habitat for the Swift Parrot is likely to be in conflict with the second recovery action above, to manage and protect Swift Parrot habitat at the landscape scale. However, the extent of native vegetation clearing and potential foraging habitat associated with the proposed action is considered to be small in terms of available habitat for the species within the Region (<1% in 10 km^2).

The NSW Draft Recovery Plan (DECCW 2009) for the Grey-headed Flying-fox outlines criteria for foraging habitat that can be considered critical to survival of the Grey-headed Flying-fox, being:

- productive during winter and spring
- known to support populations of > 30,000 individuals within an area of 50 km radius.

With reference to DAWE's National Flying-fox monitoring viewer, there are no recorded Flying-fox camps within the study area (DAWE, 2020c). The closest existing camp to the study area is located at Ropes Creek, approximately 5 km to the northeast of the study area, with anywhere from 500 to 10,000 individuals counted during surveys between 2013 and 2019. Based on a review of the National Flying-fox monitoring viewer, there are therefore likely to be >30,000 individuals of the species within a 50 km radius of the study area.

Occurrences of this species within the study area are not at the limits of the species' distribution, nor are any maternity camps present. As such, the study area can only be considered to represent a part of the foraging range of widely occurring individuals.

An abundance of similar or high quality foraging habitat occurs in the wider locality (>1,700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1,700 hectares of potential foraging habitat in the form of native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of up to 32.78 hectares across the project (which includes up to 7.99 hectares on-airport) would represent 1.9% of available foraging habitat for this species within the locality.

The project is unlikely to substantially interfere with the recovery of the White-throated Needletail due to the lack of hollow bearing trees that the species may roost in, and it would not exacerbate other threats to the species (collision with wind farm turbines, secondary poisoning).

The Cumberland Plain Recovery Plan (Department of Environment Climate Change and Water, 2010) lists the activities to assist the community's recovery. The referred action is likely to interfere with one activity OEH has listed being *protect habitat by minimising further clearing*.

Currently there is no recovery plan for COSF. The Approved Conservation Advice outlined four priority conservation actions (Section 6.2, Department of the Environment and Energy, 2018). The referred action is likely to interfere with one priority conservation action being *conserve remaining patches.*

8 Assessment of construction impacts

This chapter has been prepared in accordance with sections 8 and 9 of the BAM and follows the BAM Operation Manual Stage 2 (Department of Planning, Industry and Environment, 2019) and addressed direct, indirect and prescribed impacts of the project during the construction phase.

Prior to determining project construction impacts, the philosophy of avoid and minimise has been adopted during the planning and design phase. Avoiding and minimising impacts on biodiversity values is a desired performance outcome for the project and is a mandatory key consideration for biodiversity impact assessment under the BAM.

8.1 Avoid and minimise impacts

The following provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the project. This information is provided to directly address section 8 of the BAM.

8.1.1 Avoiding and minimising impacts on native vegetation and habitat

Consideration of a 'do nothing' option

In assessing measures to avoid impacts the project also gave initial consideration of a 'do nothing' option, consistent with the requirements of BAM. A do-nothing option would avoid all impacts to biodiversity resulting from the project. However, to ensure the success of the Western Parkland City and Western Sydney International, a high capacity and frequent transport solution must be provided. If the project does not proceed, the sustainable and successful growth of the Western Parkland City would be compromised and the targets for population and employment growth would not be met. In addition, the lack of high quality public transport connection to Western Sydney International would compromise the success of Sydney's newest airport Given the linear nature and scale of the project and the distribution of biodiversity values within the locality, the project cannot completely avoid or proceed without impacting on biodiversity. Therefore, a 'do nothing' option is not considered a viable option.

Project planning and location

The project is an integrated transport system which involves the construction and operation of a new rail line connecting the T1 Western Line at St Marys in the north and the Aerotropolis in the south. Complete avoidance of impacts to biodiversity values is not practicable, but impacts have been minimised as outlined below.

Avoidance and minimisation of impacts have been considered at all project stages, including the route options analysis stage, location of temporary disturbance areas and selection of the preferred impact footprint. Details about the route options development and preferred option are summarised in Chapter 6 of the Project Environmental Impact Statement.

Constraints assessments undertaken through the project development were informed initially by previous ecological assessments (DIRD, 2016e; Open Lines and Biosis, 2020), initial desktop assessments and preliminary field surveys undertaken by M2A in June 2019. These constraints assessments were used to guide route selection and design development and construction planning. Avoidance and minimisation of impact to areas of highest biodiversity values were priorities. These included:

- Commonwealth biodiversity matters (MNES)
- Serious and Irreversible Impacts
- Threatened Ecological Communities
- areas that contain known threatened flora/fauna populations
- areas containing potential habitat for threatened flora and fauna species
- avoidance of wildlife and riparian corridors and Key Fish Habitat.

In accordance with section 8.1.1.3-4 of the BAM, efforts to avoid and minimise potential direct impacts on native vegetation and threatened species habitat during project design have been addressed in Section 8.2. The construction planning and design of the project was influenced by a number of factors including environmental and transport constraints.

Key environmental aspects that have influenced the project, together with how the project has been refined to avoid/minimise potential environmental impacts include:

- the positioning of the station at Orchard Hills and the associated construction footprint has been refined to minimise impacts on threatened ecological communities and to avoid large areas of higher quality (Intact) contiguous vegetation that provides fauna habitat and movement corridors
- vertical and horizontal alignment optimisation has resulted in improved fauna connectivity, due to improved clearances underneath bridge and viaduct structures that improve light penetration and encourage fauna movement (such as at Blaxland Creek and Cosgroves Creek) and provision of tunnel alignments (such as the crossing under Badgerys Creek)
- areas of ecological sensitivity have been avoided (where feasible) as a result of straightening of the project alignment (for example the area south of Lansdowne Road, resulting in a more perpendicular crossing of Blaxland Creek, minimising the infrastructure footprint around the creek and associated vegetation impacts)
- the project would cross Claremont Creek and South Creek (to the west of St Marys) in tunnel to avoid impacts on riparian vegetation along these creek corridors
- Claremont Meadows services facility is proposed on cleared land at the corner of the Great Western Highway/Gipps Street to avoid impacts on nearby areas of existing vegetation
- reduced impacts to Cumberland Plain Woodland and the Badgerys Creek Environment Conservation Zone due to the tunnel alignment from Western Sydney International to the Aerotropolis Core.

Design features that extend beyond the study area for this BDAR that avoid potential biodiversity impacts include the tunnel from on-airport to Aerotropolis Core Station. The airport tunnel avoids permanent surface impacts to the Badgerys Creek Environment Conservation Zone. An overview of project elements and construction features that contribute to reduced biodiversity impacts are provided in Table 8.1.

Table 8.1 Efforts to avoid and minimise impacts on native vegetation and habitat during project design

Measures to avoid and minimise impact	Project
(a) reducing the clearing footprint of the project	The impact of the project on native vegetation has been decreased by about 29 hectares through implementing avoid and minimise principles. This includes avoiding areas of intact vegetation near Orchard Hills Station.
(b) locating ancillary facilities in areas where there are no biodiversity values	An analysis of sites for temporary disturbance areas (temporary spoil stockpiles and viaduct segment precast facilities) have been designed to avoid areas of intact native vegetation and utilise exotic grasslands. An example of this is the Claremont Meadows services facility which has been relocated to cleared land at the corner of the Great Western Highway/Gipps Street to avoid impacts on nearby areas of existing vegetation (Cumberland Plain Woodland).
(c) locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	Utilisation of Scattered Tree and Low condition vegetation was prioritised over Intact and Thinned condition as well as avoidance of any areas with connectivity to larger bushland patches and/or riparian vegetation. The project has a higher utilisation of areas with lower biodiversity value (i.e. PCT 835 Derived Native Grasslands utilisation has increased by around 3.5ha during design development). These areas are not considered likely to provide core areas of habitat for threatened species. In seeking to avoid or minimise biodiversity impacts, design development has included a net avoidance of about 19 hectares of native vegetation in Intact and thinned condition. These condition types provide habitat areas for threatened flora (i.e. candidate flora species and threatened fauna listed in Chapter 6 (Threatened species)).
(d) locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	

Measures to avoid and minimise impact	Project
(e) providing structures to enable species and genetic material to move across barriers or hostile gaps	The location references of proposed bridge and viaduct structures are: • Lansdowne Road (new road-over-rail bridge) • Blaxland Creek (viaduct over Blaxland Creek) • Patons Lane (viaduct over Patons Lane) • Warragamba to Prospect Water Supply Pipelines, Luddenham Road and Cosgrove Creek (viaduct over these locations) • Future M12 Motorway (new rail-over road-bridge) Bridges have been designed for areas of higher biodiversity value including riparian vegetation (Blaxland Creek/Cosgrove Creek) and areas with connectivity (Lansdowne Road/Patons Lane). Additional culvert locations have been identified to encourage the movement of fauna (south of Cosgroves Creek). Enabling connectivity in these areas prevent habitat and genetic material fragmentation including for less mobile threatened fauna species (i.e. Cumberland Plain Land Snail).
(f) making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	Proposed mitigation measures for the project (see Chapter 11 (Management and mitigation)) include a commitment to minimise or where possible avoid impacts to threatened flora and fauna species, and ecological communities. This commitment applies to the *Grevillea juniperina* subsp. *juniperina* plants that will be retained adjacent to the construction footprint.

8.1.2 Project planning and location

In accordance with section 8.2.2.1 of the BAM, efforts to avoid and minimise direct impact on prescribed biodiversity have been addressed in Table 8.2.

Table 8.2 Efforts to avoid and minimise impacts on prescribed biodiversity during project planning and project location

Measures to avoid and minimise impact	Project
Project planning	
(a) locating the envelope of surface works to avoid direct impacts on the habitat features	The project has not been designed to avoid impacts to non-native vegetation and abandoned houses which may provide foraging and roosting habitat for threatened bats. The project has been adjusted within design limitations to prioritise the avoidance of intact native vegetation which provides core foraging and/or breeding habitat for these species and has a higher biodiversity value overall.
(b) locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating longwall panels away from geological features of significance or water dependent plant communities and their supporting aquifers	Potential groundwater drawdown because of the project may result in indirect impacts to native vegetation off-airport, including Shale Gravel Transition Forest. This impact is unavoidable given the nature of the project design, but has been minimised to the extent possible by incorporating an undrained station design. Potential indirect impacts have been quantified using the BAM-C to generate biodiversity offsets. This is discussed further in Chapter 12 (Biodiversity offsetting and credit report).
(c) locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or local movement pathways	The project has been designed to avoid the severing of wildlife corridors using bridges and viaducts which span over higher biodiversity value areas including riparian vegetation (Blaxland Creek/Cosgrove Creek) and areas within connectivity (Lansdowne Road/Patons Lane). Additional culvert locations have been identified to encourage the movement of fauna (south of Cosgroves Creek). The tunnel underneath Badgerys Creek provides an opportunity for fauna to utilise the existing habitat, as opposed to potential impacts from surface tracks which would have severed connectivity and removed breeding habitat in this highly environmentally sensitive area.
(d) optimising project layout to minimise interactions with threatened species and ecological communities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies	
(e) locating the project to avoid direct impacts on water bodies.	Where possible, waterbodies such as farm dams have been avoided as part of the project alignment on-airport and off-airport. Tunnels, bridges and viaducts have been used to limit impact to habitat connectivity and riparian environments. The project has further reduced impacts at Badgerys Creek through tunnelling under Badgerys Creek as opposed to bridging at grade/surface level.

Measures to avoid and minimise impact	Project
Project location	
(a) an analysis of alternative modes or technologies that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed mode or technology	Tunnels, bridges and viaducts have been used to limit impact to habitat connectivity and riparian environments. All other prescribed impacts can be managed through the mitigation measures outlined in Chapter 11 (Management and mitigation measures).
(b) an analysis of alternative routes that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed route	The project has not been designed to avoid impact to non-native vegetation and abandoned houses which may provide foraging and roosting habitat for threatened bats. The project has been adjusted within design limitations to prioritise the avoidance or intact native vegetation which provides core foraging and/or breeding habitat for these species and has a higher biodiversity value overall. Impact to groundwater off-airport is not avoidable (but has been minimised through the use of waterproof (undrained) structures), as such this impact has been quantified using the BAM-C and is discussed further in Chapter 12 (Biodiversity offsetting and credit report).
(c) an analysis of alternative locations that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed location	
(d) an analysis of alternative sites within a property on which the project is proposed that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed site.	

8.1.3 Avoiding and minimising prescribed biodiversity impacts during project planning

This section addressed prescribed biodiverse impacts which may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical in accordance with Section 8.2.1.2 of the BAM. Prescribed biodiversity impacts relevant to the project have been identified below in Table 8.3.

Table 8.3 Prescribed biodiversity impacts relevant to the project

Prescribed biodiversity impacts	Project
(a) impacts of development on the habitat of threatened species or ecological communities associated with: (i) karst, caves, crevices, cliffs and other geological features of significance, or (ii) rocks, or (iii) human made structures, or (iv) non-native vegetation	Abandoned structures including houses may provide roosting habitat for threatened microbat species such as the East Coastal Free-tailed Bat or Eastern False Pipistrelle. A risk based assessment of the potential for these two threatened microbat species to use structures within the study area identified a single isolated abandoned house with moderate potential within off-airport land and multiple low potential dwelling associated with existing occupied dwelling at Orchard Hills and the St Marys town centre.(see Figure 8.3) The low potential human made structures are either occupied, surrounded by high levels of urban disturbance and or isolated from substantial areas of habitats for these species and as such are not considered further. The single unoccupied human made structure with moderate potential is within a rural setting and is less likely to be subject to these urban disturbances. Removal of any man-made structure especially that is within 100 metres of water may be breeding habitat for the Southern Myotis (i.e. culverts and concrete bridges). The likelihood of occurrence of the Southern Myotis in these structures is considered moderate to high. Removal of 3.61 hectares of urban exotic/native landscape plantings which provide foraging habitat for the Grey-headed flying-fox.
(b) impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Limited to areas of surface disturbance within the construction footprint where bushland patches occur within off-airport land i.e. areas South of Cosgroves Creek and DEOH
(c) impacts of development on movement of threatened species that maintains their life cycle	
(d) impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	About 1.70 hectares of native vegetation which sustains Shale Gravel Transition Forest in the Sydney Basin Bioregion TEC outside the off-airport construction footprint and may potentially be impacted by groundwater drawdown.
(e) impacts of wind turbine strikes on protected animals	Not applicable

Prescribed biodiversity impacts	Project
(f) impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	Limited to areas of surface disturbance within the construction footprint where bushland patches occur within off-airport land i.e. areas South of Cosgrove Creek and DEOH. Temporary fencing would surround the construction site and minimise impacts of vehicle strike on fauna. The rail corridor would be fenced when at grade and the design of that fencing would consider any specific requirements for fauna exclusion. The location and extent of any fauna fencing would be finalised in consultation with an ecologist.

8.1.4 Project design

Designing a project to avoid and minimise impact on prescribed biodiversity is addressed in this section in accordance with section 8.2.3 of the BAM. Efforts to avoid and minimise impacts to prescribed biodiversity through project design have been addressed in Table 8.4

Table 8.4 Efforts to avoid and minimise impacts on prescribed biodiversity during project design

Measures to avoid and minimise impact	Project
(a) engineering solutions, e.g. proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers, proven engineering solutions to restore connectivity and favoured movement pathways	Reduced impacts to on-airport Badgerys Creek Environment Conservation Zone due to the tunnel alignment from Western Sydney International to the Aerotropolis.
(b) design of project elements to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbines to dissuade perching and minimise the diameter of the rotor swept area, designing fencing to prevent animal entry to transport corridors	The rail corridor would be fenced when at grade and the design of that fencing would consider any specific requirements for fauna exclusion. The location and extent of any fauna fencing would be finalised in consultation with an ecologist.
(c) design of the project to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation	Impacts to rivers, streams and creek lines has been avoided to the extent possible using bridges and viaducts. These landscape features are critical to aquatic biodiversity not reliant on native vegetation.

Measures to avoid and minimise impact	Project
(d) design of the project to maintain hydrological processes that sustain threatened species and TECs	Groundwater drawdown is a potential indirect impact of the project that may impact on native vegetation, namely Shale Gravel Transition Forest within off-airport land. This potential impact has been assumed as realised for the purposes of assessment and quantified using the BAM-C. It forms part of the biodiversity offsets requirements for this project.
(e) design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	Impacts on rivers and streams are largely avoided using bridges and viaducts over these environments. Indirect impacts have been identified in Chapter 9 (Assessment of operational impacts) with mitigation measures provided in Chapter 11 (Management and mitigation measures).

8.2 Construction impacts (off-airport)

8.2.1 Direct impacts (off-airport)

Direct impacts of the project as a result of construction are outlined in this section for the off-airport environment and include the following biodiversity values:

- clearing of native vegetation
- clearing of TECs
- removal of threatened species and/or their habitat.

Offsets for direct impacts were calculated by assuming total clearing and reassigning the vegetation integrity score of all vegetation zones to zero in accordance with section 9.1.2.5 of the BAM. Mitigation measures and offset liabilities are discussed further in Chapter 11 (Management and mitigation measures) and Chapter 12 (Biodiversity offsetting and credit report).

Direct impacts on clearing of native vegetation

Direct impacts on clearing of native vegetation for off-airport works are presented in Table 8.5 and Figure 8.2.

Table 8.5 Direct impact to native vegetation (off-airport)

Plant community type	Condition	VI score	Change in VI score	Future VI score	Area (hectares)
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	61.7	-61.7	0	2.10
	Thinned	39.7	-39.7	0.0	6.91
	Scattered Trees	44.3	-44.3	0.0	1.41
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	76.6	-76.6	0.0	1.34
	Thinned	71.2	-71.2	0.0	4.40
	Scattered Trees	36.7	-36.7	0.0	0.49
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Thinned	62.4	-62.4	0.0	4.66
	Scattered Trees	20.3	-20.3	0.0	1.73
	Low	7.8	-7.8	0.0	3.25
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	66.4	-66.4	0.0	1.07
	Thinned	67.5	-67.5	0.0	4.31
Total					**31.67**

Direct impacts on threatened ecological communities

Direct impacts on TECs listed under the BC Act for off-airport works are presented in Table 8.6.

Table 8.6 Direct impact to TECs BC Act (off-airport)

Threatened Ecological Community	BC Act[1]	Area (hectares)
Cumberland Plain Woodland in the Sydney Basin Bioregion	CE	9.64
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	6.23
Shale Gravel Transition Forest in the Sydney Basin Bioregion	E	10.42
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	5.38
Total		**31.67**

Notes:
(1) E = Endangered, CE = Critically Endangered under the BC Act.

Direct impacts on TECs listed under the EPBC Act are presented in 8.7.

Table 8.7 Direct impact to TECs EPBC Act (off-airport)

Threatened Ecological Community	EPBC Act[1]	Area (hectares)[2]
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	5.87
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland	E	4.94
Total		**10.81**

Notes:

(1) E = Endangered, CE = Critically Endangered under the EPBC Act.

(2) Includes indirect impact to Intact PCT 724 (1.66 hectares)

Direct impacts on threatened species and/or their habitats

Direct impacts on threatened species and/or their habitats listed under the BC Act and EPBC Act for off-airport works are presented in Table 8.8.

Table 8.8 Direct impact to threatened species habitat (off-airport)

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	PCT	Condition	Impact (hectares)
Threatened flora						
Acacia bynoeana	Bynoe's Wattle	E	V	724	Intact, thinned	1.25
Acacia pubescens	Downy Wattle	V	V	724, 849	All	2.23
Allocasuarina glareicola	-	E	E	724	Intact, thinned	1.25
Cynanchum elegans	White-flowered Wax Plant	E	E	849	Thinned	0.57
Dillwynia tenuifolia	-	V	-	724, 849	All	100 individuals 0.82 (recorded) 2.23 (assumed)

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	PCT	Condition	Impact (hectares)
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	724, 835, 849 (1800) where recorded	All	1225 individuals 1.70 (recorded) 4.68 (assumed)
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	724	All	1.27
Marsdenia viridiflora subsp. viridiflora - Endangered population	Marsdenia viridiflora R. Br. subsp. viridiflora population	E	-	724, 835, 849, 1800	Intact, thinned	4.23
Micromyrtus minutiflora	-	E	V	724	Intact, thinned	1.25
Pimelea curviflora var. curviflora	-	V	V	849	Thinned	0.57
Pimelea spicata	Spiked Rice-flower	E	E	849	All	0.96
Pultenaea parviflora	-	E	V	724	Intact, thinned	1.25
Threatened fauna						
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	724, 835 and 849	Intact and thinned	5.31
Myotis macropus	Southern Myotis	V	-	835, 849, 1800	All	10.68

Notes:

(1) V = Vulnerable, E = Endangered under the BC Act.

(2) V = Vulnerable, E = Endangered under the EPBC Act.

8.2.2 Indirect impacts (off-airport)

Most of the study area and construction footprint within the off-airport section of the project contain patches of native vegetation that are relatively small, degraded and fragmented. The project is likely to increase the potential for edge effects in larger or connected areas including DEOH, Cosgrove Creek and Blaxland Creek. Within the off-airport section of the study area, the project has the potential for several indirect impacts including inadvertent impacts on adjacent habitat or vegetation and increase in weeds and pathogens. These are detailed in Section 8.4.

Groundwater drawdown at Orchard Hills Station has the potential to indirectly affect groundwater dependent ecosystems and is assessed further below.

Potential indirect impacts on groundwater dependent ecosystems (GDEs)

Of the four TECs that are reliant on subsurface groundwater in the study area, Shale Gravel Transition Forest in the Sydney Basin Bioregion could potentially be affected by reduced groundwater levels (see Section 5.7).

Potential impacts on GDEs resulting from the project include groundwater drawdown at Orchard Hills.

In this location, groundwater inflow into the drained cutting south of the station would occur, causing a lowering of adjacent groundwater levels and progressive ingress of water into the surrounding shale. Changes to the groundwater level would develop during construction (as excavation takes place) but may continue to occur into the operational phase of the project.

The predicted changes to groundwater level from the undrained station box, dive structure and drained cutting south of Orchard Hills Station are presented in Figure 8.1.

Although the majority of groundwater drawdown with the potential to affect GDEs is predicted to occur within the project's construction footprint, potential impacts outside of the construction footprint have been considered.

To determine this, conservative modelling of these impacts has identified potential drawdown of between 1-4 metres, with the zone of greatest predicted change (more than 2 metres) located within around 100 metres of the Orchard Hills Station (refer to Technical paper 7 (Groundwater) of the Project Environmental Impact Statement). This maximum change, if it eventuated, would occur at the base of the cut. Moving away from the cut, the magnitude of the change in groundwater level would reduce.

The process for determining the project's impact on surrounding native vegetation and habitat for threatened species involved the following geospatial analysis of the overlayed data sets:

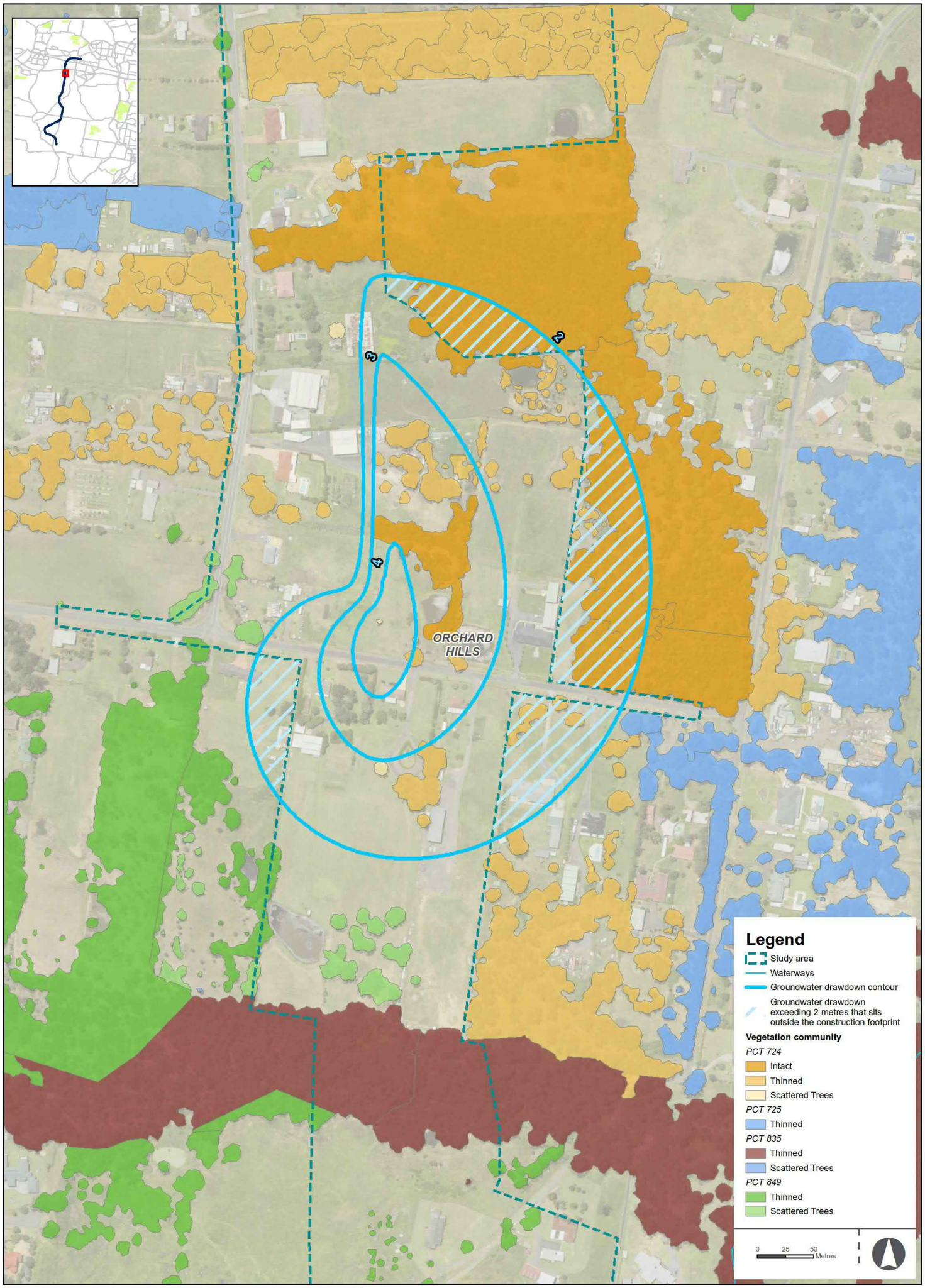
- existing vegetation mapping on surveyed areas within off-airport lands (Open Lines and Biosis, 2020)
- geospatial data set for the predicted >2 metre groundwater drawdown contour at Orchard Hills (ARUP, 2019).

Any area of mapped native vegetation outside of the construction footprint within the >2 metres groundwater drawdown contour is shown on Figure 8.1. Within the Orchard Hills locality, localised impacts on groundwater levels associated with the proposed rail cutting and station construction are considered likely, and have been minimised to the extent possible through a waterproof (undrained) station design. The impact on very shallow soil water is unlikely due to its intermittent and localised nature.

Potential impacts resulting from groundwater drawdown at Orchard Hills that are outside of the project construction footprint are considered further as additional impacts (Table 8.9) and measures recommended to address these potential impacts is discussed in Chapter 11 (Management and mitigation measures). The indirect impacts on native vegetation are considered likely for large deep rooted tree species and are considered unlikely to affect smaller shallow rooted shrub and groundcover species reliant on surface and soil moisture.

Table 8.9 Potential groundwater drawdown impacts

Native vegetation type	TEC under BC Act	TEC under EPBC Act	Condition	Area (hectares)
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Shale Gravel Transition Forest in the Sydney Basin Bioregion	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Intact	1.67
		NA	Thinned	0.14
Total				**1.81**



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Sydney Metro – Western Sydney Airport

Indicative only, subject to design development

Potential impacts from groundwater drawdown

Figure 8-1

8.3 Construction impacts (on-airport)

8.3.1 Direct impacts (on-airport)

Direct impacts of the project have been determined only for those areas outside of the approved Western Sydney International Stage 1 CIZ. Direct impacts as a result of on-airport construction are outlined in this section and include the following biodiversity values:

- clearing of native vegetation
- clearing of threatened ecological communities
- removal of threatened species and/or their habitat.

Offsets for direct impacts were calculated by assuming total clearing and reassigning the vegetation integrity score of all vegetation zone to zero in accordance with section 9.1.2.5 of the BAM (refer to Section 12 of this BDAR). Offsets are not required for the direct impacts to PCTs 835 and PCT 849 in 'low' condition as their vegetation integrity falls below the specific thresholds within Section 10.3 of the BAM.

The impact assessment and offset calculations are being used for the purposes of the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541) and the section 160 preliminary documentation (see Table 12.5). Mitigation measures and offset liabilities are discussed further in Chapter 11 (Management and mitigation measures) and Chapter 12 (Biodiversity offsetting and credit report).

Table 8.10 Direct impact to native vegetation (on-airport)

Plant community type	Condition	VI score	Change in VI score	Future VI score	Area (hectares)
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	65.9	-65.9	0.0	1.53
	Thinned	71.2	-71.2	0.0	0.09
	Low	2.4	-2.4	0.0	10.21
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	67.8	-67.8	0.0	4.05
	Scattered Trees	20.3	-20.3	0.0	2.32
	Low	7.8	-7.8	0.0	23.79
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	57.4	-57.4	0.0	0.01
Total					**42.00**

Direct impacts on threatened ecological communities

Direct impacts on threatened ecological communities listed under the BC Act for on-airport works are presented in Table 8.11. Direct impacts on TECs listed under the EPBC Act are presented in Table 8.12.

Table 8.11 Direct impact to TECs BC Act (on-airport)

Threatened Ecological Community	BC Act[1]	Area (hectares)
Cumberland Plain Woodland in the Sydney Basin Bioregion	CE	30.16
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	11.83
Total		**41.99**

Notes:

(1) E = Endangered, CE = Critically Endangered under the BC Act.

Table 8.12 Direct impact to TECs EPBC Act (on-airport)

Threatened Ecological Community	EPBC Act[1]	Area (hectares)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	3.94
Total		**3.94**

Notes:

(1) E = Endangered, CE = Critically Endangered under the EPBC Act.

Direct impacts on threatened species and/or their habitats

Direct impacts on threatened species and/or their habitats listed under the BC Act and EPBC Act for on-airport works are presented in Table 8.13.

Table 8.13 Direct impact to threatened species habitat (on-airport)

Scientific name	Common name	BC Act[1]	EPBC Act[2]	PCT	Condition	Impact
Threatened fauna						
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	835, 849	Intact and Scattered Trees	5.57 hectares
Myotis macropus	Southern Myotis	V	-	835	Intact	0.05 hectares

Notes:

(1) V = Vulnerable, E = Endangered under the BC Act.

8.3.2 Indirect impacts (on-airport)

Construction of Stage 1 of Western Sydney International has commenced, and substantial vegetation clearing has been approved and is underway within the Stage 1 CIZ. As a result, the landscape within Stage 1 Western Sydney International reflects its status as a construction site. There is unlikely to be any indirect impacts from the on-airport section of the project as the site would support the construction and fit-out of the surface section of the alignment within Western Sydney International.

8.4 Other indirect impacts applicable to both off-airport and on-airport

8.4.1 Inadvertent impacts on adjacent habitat or vegetation

Inadvertent impacts on adjacent vegetation can include a range of indirect impacts including soil disturbance, erosion, sedimentation, enriched run-off and water quality.

Construction of the project has the potential to result in sedimentation and erosion and mobilisation of contaminants within the construction footprint and into adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. Sediment laden runoff and spills affect water quality and adversely affect aquatic life particularly during construction near creeklines and Key Fish Habitats. These impacts have the potential to reduce the viability of habitat for aquatic and semi aquatic species temporarily.

The project has been carefully designed to minimise impact to these sensitive environmental receivers using bridges and viaducts over creeklines (Cosgrove and Blaxland Creek). The mobilisation of sediments would be contained within the construction footprint as sediment containment measures would be implemented to minimise impacts.

8.4.2 Reduced viability of adjacent habitat due to edge effects

'Edge effects' include increased noise, dust and light, erosion and sedimentation, and introduction of weeds, and the associated degradation of vegetation at the interface of intact vegetation and cleared areas as part of the study area. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants or avoidance of habitat by native fauna. Altered

environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals.

Edge effects have the potential to impact on a range of flora and fauna species identified as occurring or having the potential to occur within the study area. The severity of the impact edge effects can have vary with species, but have the greatest impact on sensitive species, such as those that have specific micro-habitat requirements and are less tolerant of disturbance (e.g. some plants, ground-dwelling mammals and small woodland birds) (Jacobs, 2019).

The construction footprint used to calculate impact is larger than the direct impact of the project. As such, most edge effects are considered unlikely to extend beyond the project's construction footprint and/or would be avoided through mitigation and management measures.

8.4.3 Reduced viability of adjacent habitat due to noise, dust or light spill

Noise, dust and light spill can impact surrounding biodiversity during both construction and operation of the project, this impact is considered unlikely to extend beyond the construction footprint. The proximity of the project to the DEOH offset areas (1.7 kilometres in the southern offset and 800 metres to northern offsets) is unlikely to result in any indirect edge effects associated with noise, dust or light spill pollution impacting flora or fauna within these areas.

Noise and vibration

During all stages of the project increased noise and vibration levels in the study area and immediate surrounds are likely due to construction activities including vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. The noise and vibration from activities associated with the project would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. This impact would be ongoing however highest during construction phase.

Dust

Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to the construction activities. This has the potential to reduce photosynthesis and transpiration and cause abrasion and heating of leaves resulting in reduced growth rates and decreases in overall health of the vegetation. Dust is likely to be generated throughout the lifecycle of the project, although dust pollution is likely to be greatest during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and during adverse weather conditions (i.e. high winds). However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary and is therefore not considered likely to be a major impact of the project.

Ecological light pollution

Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from passing vehicles), that can have potentially adverse effects on wildlife. It has been assumed that some night works would be required during construction. As such, the immediate area surrounding the project activities, would be subject to artificial lighting, essentially creating permanent 'daylight' conditions. Ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle.

Most of the study area north of the M4 Motorway is residential and is already subject to light impacts. There may be some increase in light disturbance around riparian corridors (e.g. Blaxland Creek) but this may benefit fast-flying microbats due to increased food availability (insects attracted to lights) around these areas. Due to the low impact of the lighting, it is unlikely that animals would alter their behaviour in response to the light disturbance. Lighting associated with the project would be designed to minimise 'light spill' for the benefit of surrounding residents and this would also reduce potential impacts on fauna populations.

The proximity of the project to the DEOH offset areas (1.7 kilometres to the southern offset area and 800 metres to northern offset area) is unlikely to result in light pollution impacting flora or fauna within these areas.

8.4.4 Transport of weeds and pathogens from the site to adjacent vegetation

Pathogens

Construction activities, in general, have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into native vegetation and habitats.

Phytophthora infects root systems whereas Myrtle Rust deforms leaves and leads to heavy defoliation. Both pathogens are associated with damage and death to native plants and may be dispersed over large distances. Phytophthora can be spread through flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of Phytophthora may also be dispersed by vehicles (e.g. cars and earth moving equipment), animals, walkers and movement of soil. Myrtle rust spores can be spread easily via contaminated clothing, hair, skin and personal items, infected plant material, equipment as well as by insect/animal movement and wind dispersal.

Chytrid fungus is known to occur in the East Coast of Australia and affect frog populations including the threatened Green and Golden Bell Frog. The fungus lives in water or soil and invades the surface layers of the frog's skin leading to death of individuals and extinction of local populations. Currently there are no proven methods to control this disease however limiting the spread of preventing the introduction of the disease through contaminated soil and water (Department of the Environment and Energy, 2016).

Weeds

The clearing of native vegetation would increase the potential for weed invasion into native vegetation adjacent to the construction footprint.

Within the study area 19 exotic species listed as High Threat weeds, 16 Priority Weeds for the Greater Sydney region and 7 weeds of national significance were recorded (see Section 5.5). These weed species pose a biosecurity risk, have a high capability of spreading and altering environmental conditions.

The potential impact of pathogens and/or weeds are unlikely to extend beyond the construction footprint and/or would be avoided through mitigation and management controls.

8.4.5 Increased risk of starvation, exposure and loss of shade or shelter

Landscape context of the study area on and off airport give context to the impact the project may have on the risk of starvation, exposure and loss of shade or shelter for biodiversity. Landscape context has been determined using the landscape assessment area outlined in Section 4.2.

Within on-airport areas, native vegetation covers approximately 369 hectares of the landscape. The project would impact 42.00 hectares of native vegetation. This is equivalent to approximately 11 per cent of native vegetation.

Within off-airport areas, native vegetation covers approximately 300 hectares of the landscape. The project would impact on 31.98 hectares of native vegetation. This is equivalent to approximately 9 per cent of native vegetation.

The increase the risk of starvation, exposure and loss of shade or shelter for flora and fauna species are considered unlikely to extend beyond the project's construction footprint and/or would be avoided through mitigation and management measures. The project's credit liability is considered appropriate to offset this impact within the local landscape.

8.4.6 Loss of breeding habitats

The loss of breeding habitat such as hollow-bearing trees has the potential to affect native animals such as:

- hollow-dependent bats
- hollow-nesting and canopy-nesting birds
- arboreal mammals
- reptiles.

The loss of breeding habitats is unlikely to extend beyond the project's construction footprint. Impacts beyond this area would be avoided through mitigation and management measures.

8.5 Prescribed biodiversity impacts

Prescribed impacts have been addressed in accordance with section 9.1.1.2 and 9.2 of the BAM and are addressed in this section including:

- prescribed biodiversity impacts during construction and operation
- predictions where prescribed biodiversity impacts are uncertain
- evaluating the consequence of prescribed biodiversity impacts.

Prescribed biodiversity impacts not relevant to the project include:

- karst, caves. crevices, cliffs and other areas of geological significance
- threatened species habitats associated with rocks
- wind turbines.

A summary of prescribed biodiversity impacts is presented in Table 8.14 and discussed further below.

Table 8.14 Summary of prescribed biodiversity impacts

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
Threatened species reliant on human made structures	Abandoned houses may create roosting and breeding habitat for threatened microbat species such as the East Coast Free-tailed Bat or Eastern False Pipistrelle. Potential for breeding habitat structures (e.g. culverts) within areas not surveyed for Southern Myotis	Removal of abandoned houses and any man-made structure which may create breeding habitat for the Southern Myotis, East Coast Free-tailed Bat and Eastern False Pipistrelle	Short term	One-off event	Construction
Threatened species which reply on non-native vegetation	Foraging habitat for blossom nomads such as the Grey-headed flying Fox	Removal of 3.63 hectares of urban exotic/native landscape plantings within off-airport lands	Long term	One-off event	Construction
Habitat connectivity	All threatened and non-threatened species	Limited to areas of surface disturbance within the construction footprint where bushland patches occur i.e. areas South of Cosgrove Creek and DEOH	Long term	Ongoing	Construction/ operation
Movement of threatened species that maintains their life cycle	Any species with breeding habitat within the study area or habitat which support juveniles and/or breeding adults	Limited to areas of surface disturbance within the construction footprint where bushland patches occur i.e. areas South of Cosgrove Creek and DEOH	Short term	Ongoing	Construction/ operation
Impact to water quality and hydrological processes that sustain and interact with the rivers, streams and wetlands	Groundwater Dependent Ecosystems	About 1.81 hectares of native vegetation outside the construction footprint	Short term	During construction	Construction

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
Vehicle strikes	Terrestrial fauna species	Limited to areas of surface disturbance within the construction footprint where bushland patches occur i.e. areas South of Cosgrove Creek and DEOH	Short term	During construction	Construction

8.5.1 Threatened species reliant on human made structures

Human-made structures identified within the study area include abandoned houses which may form roosting habitat for threatened microbats such as the East Coast Free-tailed Bat or Eastern False Pipistrelle.

A risk based assessment of the potential for these two threatened microbat species to use structures within the study area identified a single isolated abandoned house with moderate potential within off-airport land and multiple low potential dwelling associated with existing occupied dwelling at Orchard Hills and the St Marys town centre(see Figure 8.3). The low potential human made structures are either occupied, surrounded by high levels of urban disturbance and or isolated from substantial areas of habitats for these species and as such are not considered further.

No human-made structures were identified within the on-airport land.

Culverts and other under-road structures that may be present within non-surveyed areas may also provide roosting and breeding habitat for threatened microbats, particularly the Southern Myotis. If the Southern Myotis is found roosting within any of these structures, it should be assumed to be a breeding population and that structure should be considered a maternity site.

Mitigation measures surrounding the removal of these structures is considered further in Chapter 11 (Management and mitigation measures).

8.5.2 Threatened species which reply on non-native vegetation

Non-native vegetation within the construction footprint which may provide habitat for threatened species include Miscellaneous Ecosystems – Urban Exotic/Native Landscape Plantings.

This vegetation was recorded in off-airport lands and included species such as *Corymbia citridora* (Lemon-scented Gum) and *Corymbia maculata* (Spotted Gum) which may provide foraging habitat for blossom nomads such as the Grey-headed Flying Fox.

8.5.3 Habitat connectivity and movement of threatened species that maintains their life cycle

The removal of native vegetation and splitting of habitat patches can result in habitat fragmentation which is the ‘physical dividing up of once continuous habitats into separate smaller ‘fragments’’ (Fahrig, 2002). Project design has avoided impact to habitat connectivity where possible and would provide opportunities for movement of some fauna species through the use of bridges, culverts and viaducts. Chapter 7 of the EIS (Project description – operation) provides a detailed description of project infrastructure and key features including indicative locations of proposed bridges and viaducts. In summary the following are proposed:

- proposed bridge structures in the vicinity of Blaxland Creek and Cosgroves Creek
- proposed viaduct structure that maximise the span over the two existing vegetation corridors at Patons Lane and the unnamed watercourse to the south of Patons Lane
- a culvert measuring around 1.5 metres in diameter providing connectivity for wildlife at Blaxland Creek to the east of Orchard Hills
- a culvert measuring around 1.5 metres in diameter providing connectivity for the wildlife link around 600 metres north of the Warragamba to Prospect Water Supply Pipelines.

The Biodiversity Investment Opportunities Map (BIO Map); (https://www.environment.nsw.gov.au/conservationprograms/biomap.htm), shows that there are mapped biodiversity corridors of regional significance, known as Regional Corridor 18 along Blaxlands Creek and Regional Corridor 20 which leads along Patons Lane, within the study area. Viaducts are proposed in these two areas which would minimise potential impacts to these two identified regional corridors. Figure 7-4b in Chapter 7 of the EIS shows that the proposed viaducts would span Regional Corridor 18 along Blaxlands Creek and Regional Corridor 20 which leads along Patons Lane. The indicative length of the viaduct over Blaxlands Creek is 360 metres and the indicative length of the viaduct over Patons Lane is 830 metres. The locations of the viaducts as shown in the EIS is indicative.

The design of viaduct structures over the wildlife/riparian corridors at Blaxland Creek, the unnamed tributary south of Patons Lane and Cosgroves Creek would seek to:

- maximise the span over the wildlife/riparian corridor
- minimise native vegetation removal within the wildlife/riparian corridors
- maintain opportunities for fauna movement along the wildlife/riparian corridors
- provide opportunities to enhance fauna movement where possible.

This has been included as a new mitigation measure in Chapter 11.

8.5.4 Impact to water quality and hydrological processes that sustain and interact with the rivers, streams and wetlands

Any impact to water quality (i.e. sedimentation etc.) is likely to be contained within the construction footprint, this is discussed further in section 8.4.1.

Impact to Groundwater Dependent Ecosystems because of groundwater drawdown is unlikely to impact local rivers, streams and wetlands as these landscape features are more likely to be in-flow dependent ecosystem (DIRD, 2016e). Impacts on groundwater dependent ecosystems and aquatic habitats are discussed further in Technical Paper 7 (Groundwater) in the Project Environmental Impact Statement.

8.5.5 Vehicle strikes

All roads have potential to result in the mortality (roadkill) of native animals. The risk of vehicle strike and roadkill is higher where roads and/or associated landscaped areas:

- traverse areas of substantial animal habitat
- are located near natural or artificial water bodies
- contain food sources (e.g. Mown grass verges, nectar-producing shrubs) which attract animals to the road edge
- have high speed limits
- provide poor visibility of wildlife (e.g. due to bends, crests and poor lighting).

Major roads (M4 Western Motorway), high speed roads (i.e. Elizabeth Drive) and local roads (i.e. Patons Lane) all occur within the construction footprint. Due to the land-use surrounding the project, vehicle strike is an existing impact and many of the native and threatened fauna species that have habitat within the construction footprint are highly mobile.

Vehicle strike is most likely during construction as the operation of the project generally does not involve vehicle use. While it is not possible to eliminate the risk of vehicle strike occurring, it is possible to minimise roadkill through consideration of the above factors in the design of access roads and associated landscaping and infrastructure (i.e. wildlife fencing).

8.5.6 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. KTPs are listed under the BC Act, FM Act and EPBC Act. At present, there are currently 39 listed KTPs under the BC Act, eight KTPs listed under the *Fisheries Management Act 1994*, and 21 KTPs listed under the EPBC Act. Of the listed KTPs, the project may directly or indirectly contribute to the following KTPs as outlined in Table 8.15.

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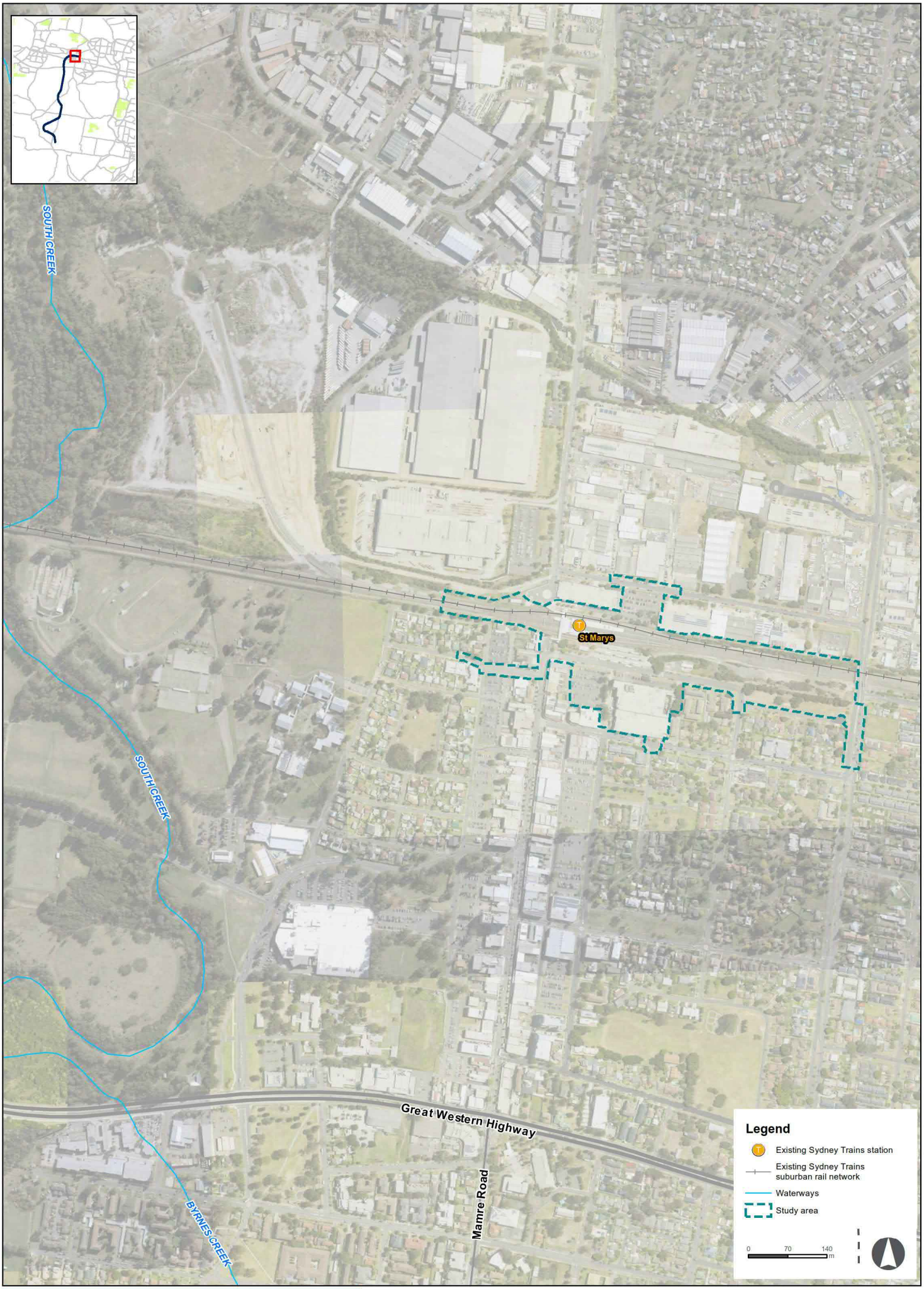
Table 8.15 Relevant Key Threatening Processes

Relevant Key Threatening Process	BC Act, EPBC Act, FM Act	Likelihood of the project directly or indirectly contributing to the KTP
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	Moderate – Blaxland Creek and Cosgrove Creek are already highly disturbed environments. The project proposes restoration of these areas post construction.
Clearing of native vegetation	BC Act	High – clearing of native vegetation would occur.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	BC Act 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 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 Exotic 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	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	BC Act	Low – mitigation measures would be implemented to prevent the spread of weeds.
Degradation of native riparian vegetation along New South Wales water courses	FM Act	High – Blaxland Creek, Cosgroves Creek and associated native riparian vegetation would be modified and cleared.



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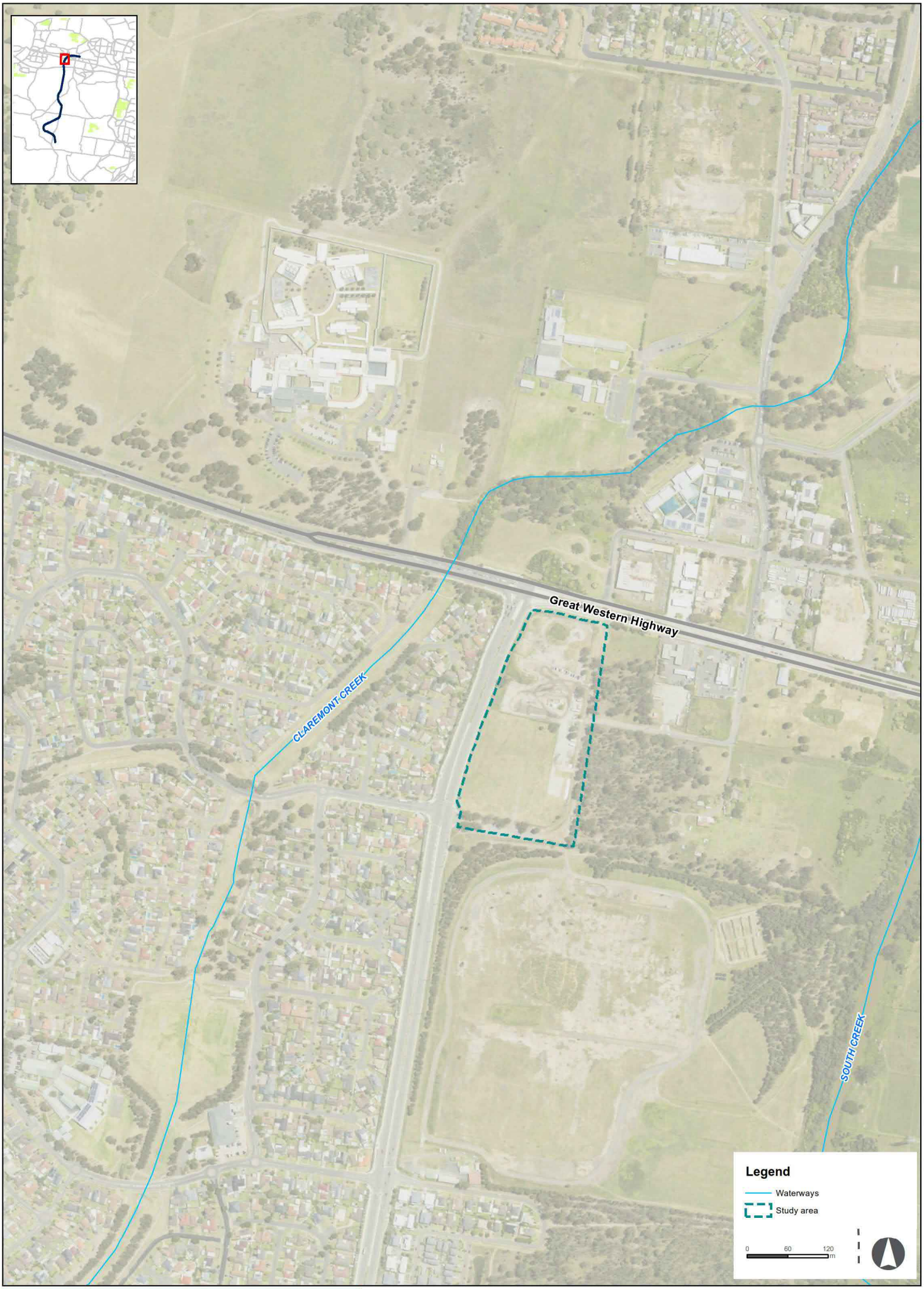
Impacts on biodiversity values

Figure 8-2a



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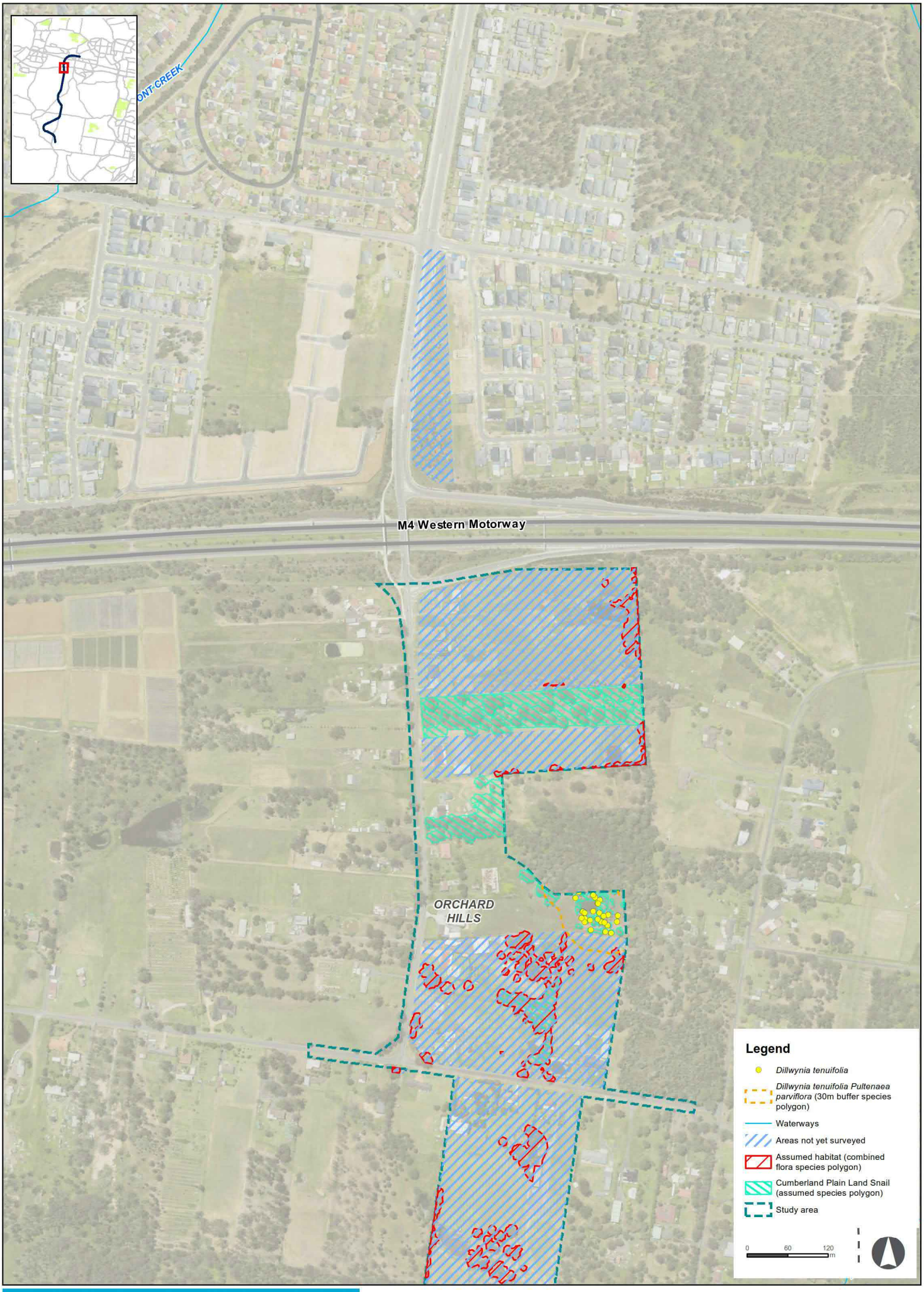
Impacts on biodiversity values

Figure 8-2b



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Impacts on biodiversity values

Figure 8-2c

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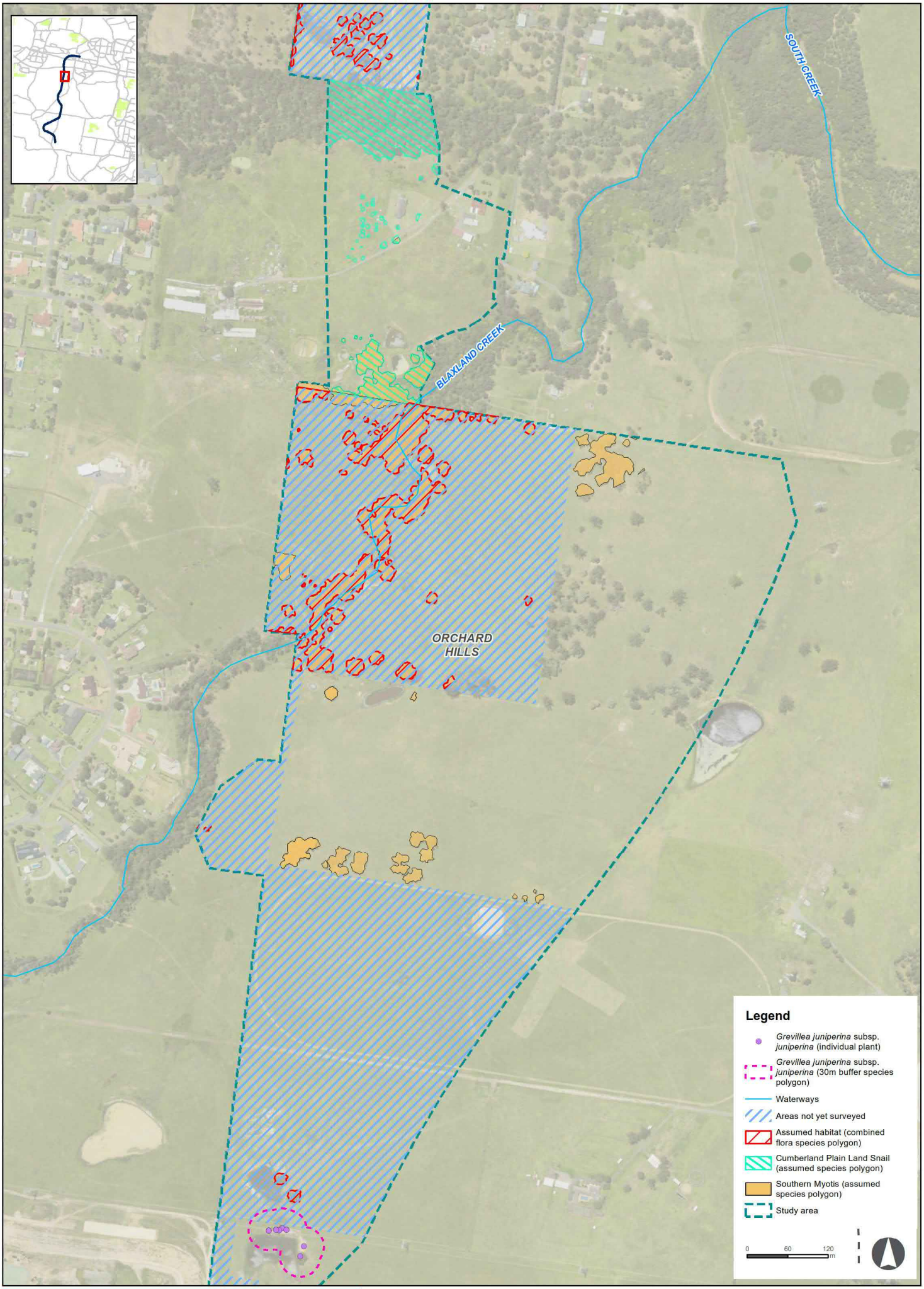

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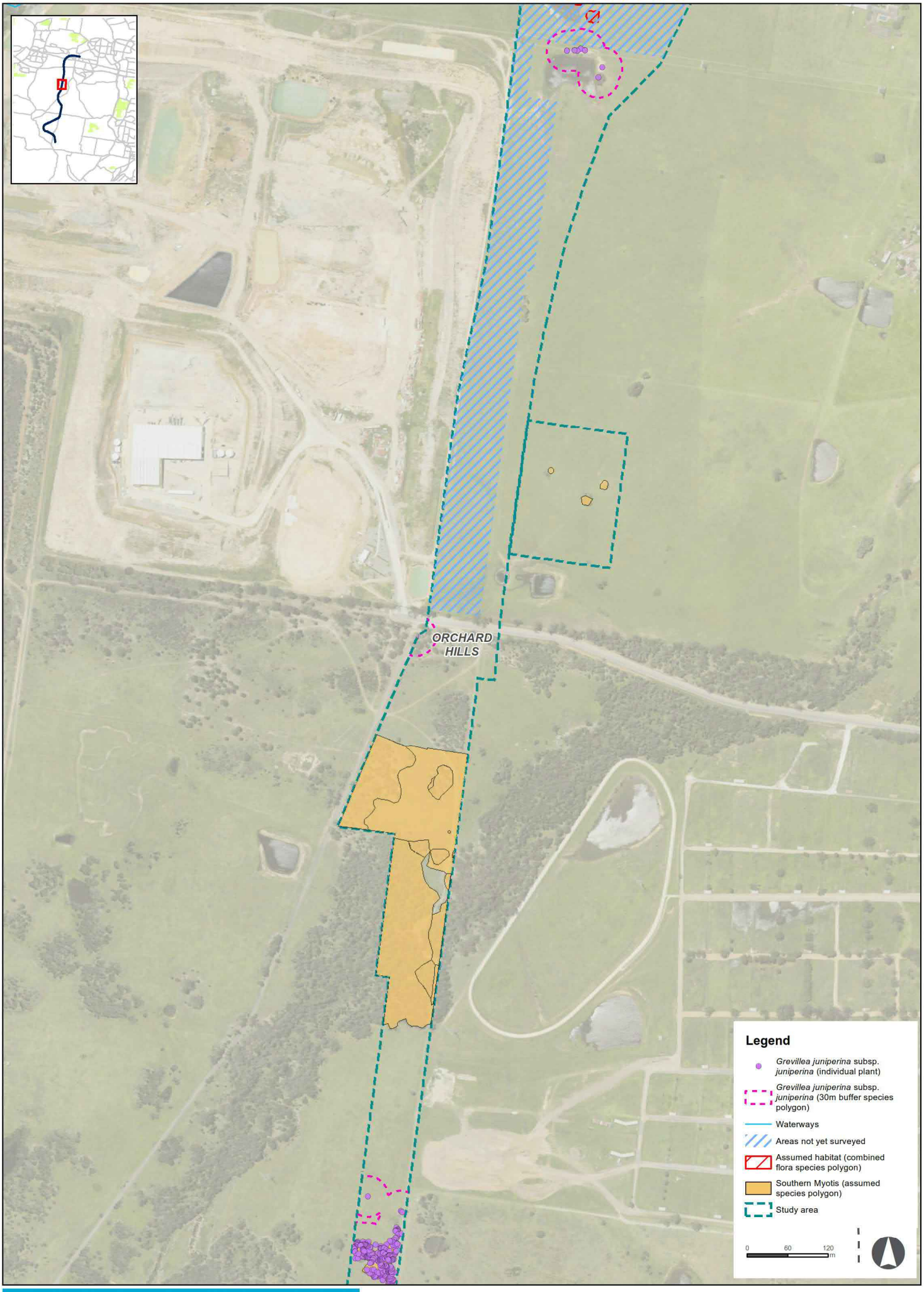
Impacts on biodiversity values

Figure 8-2d



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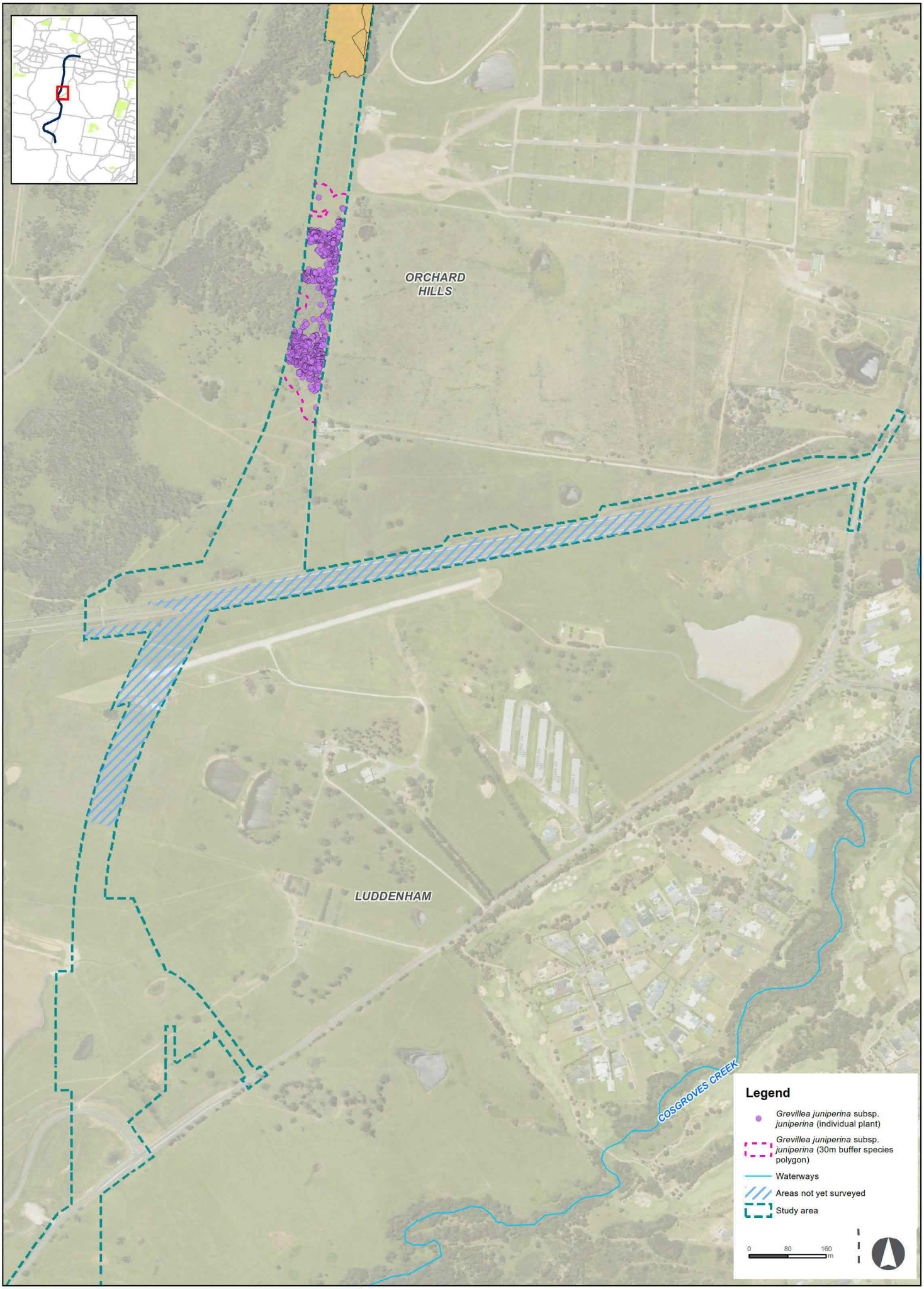
Impacts on biodiversity values

Figure 8-2e



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Impacts on biodiversity values

Figure 8-2f

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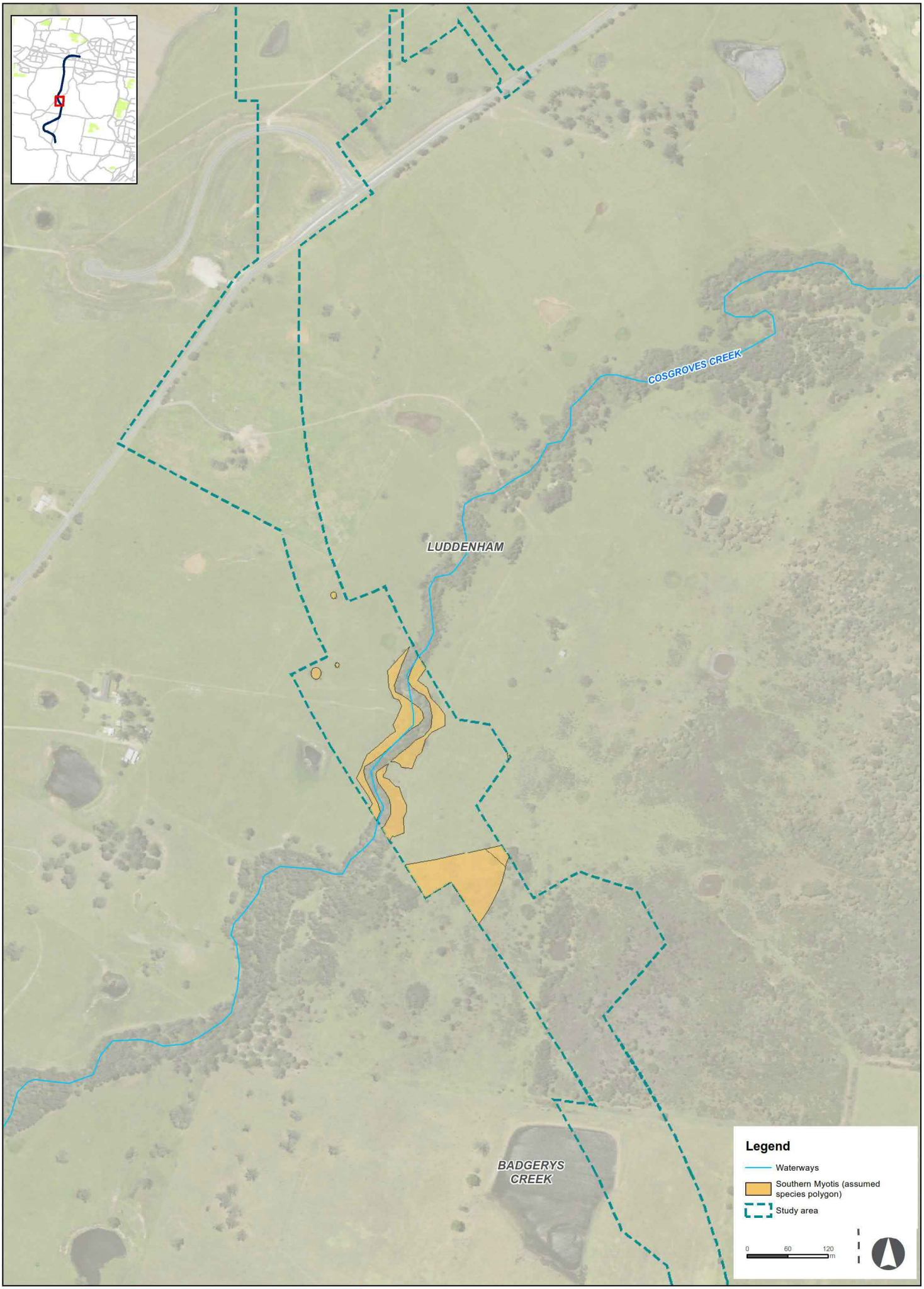

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Impacts on biodiversity values

Figure 8-2g

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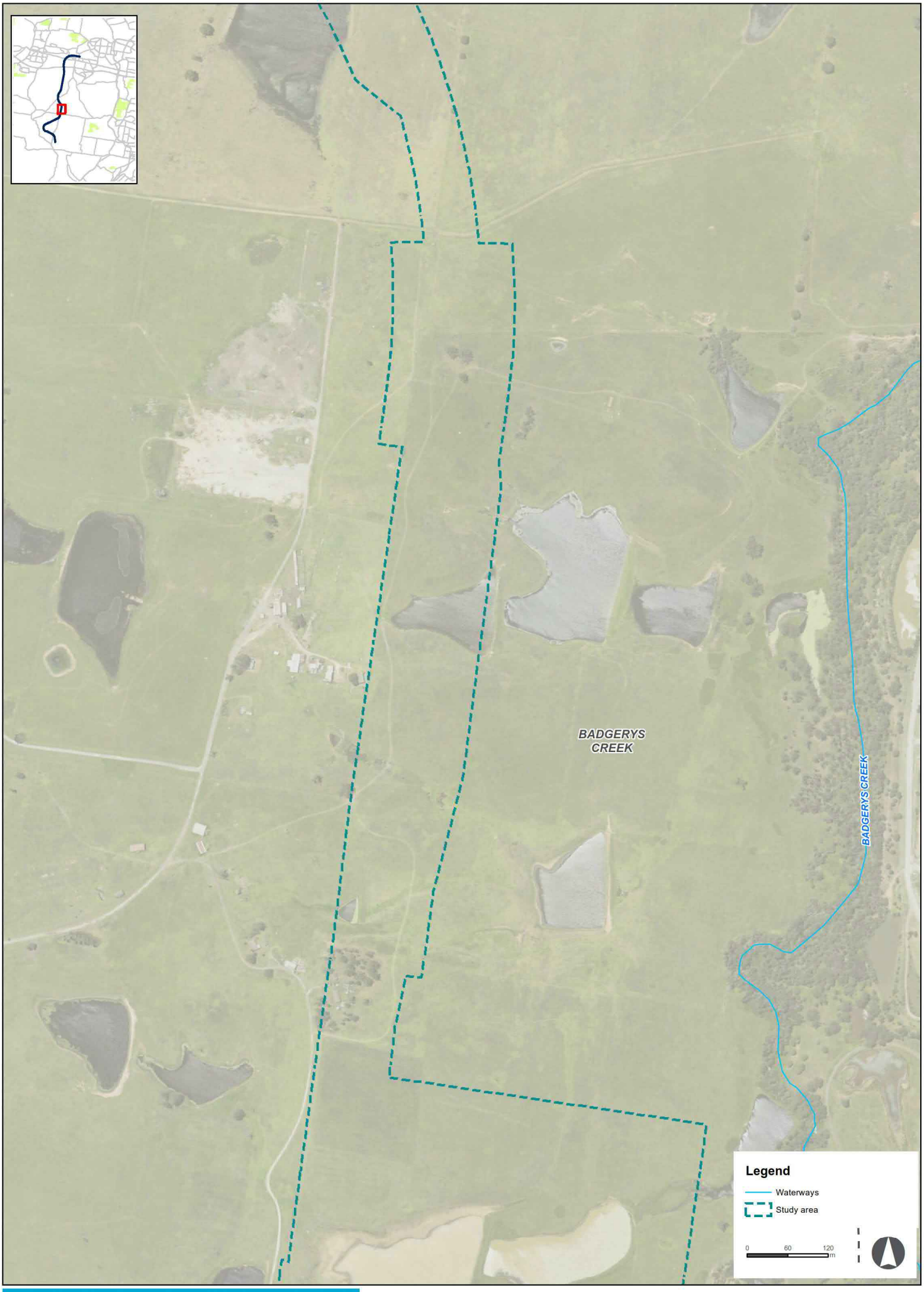

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Impacts on biodiversity values

Figure 8-2h

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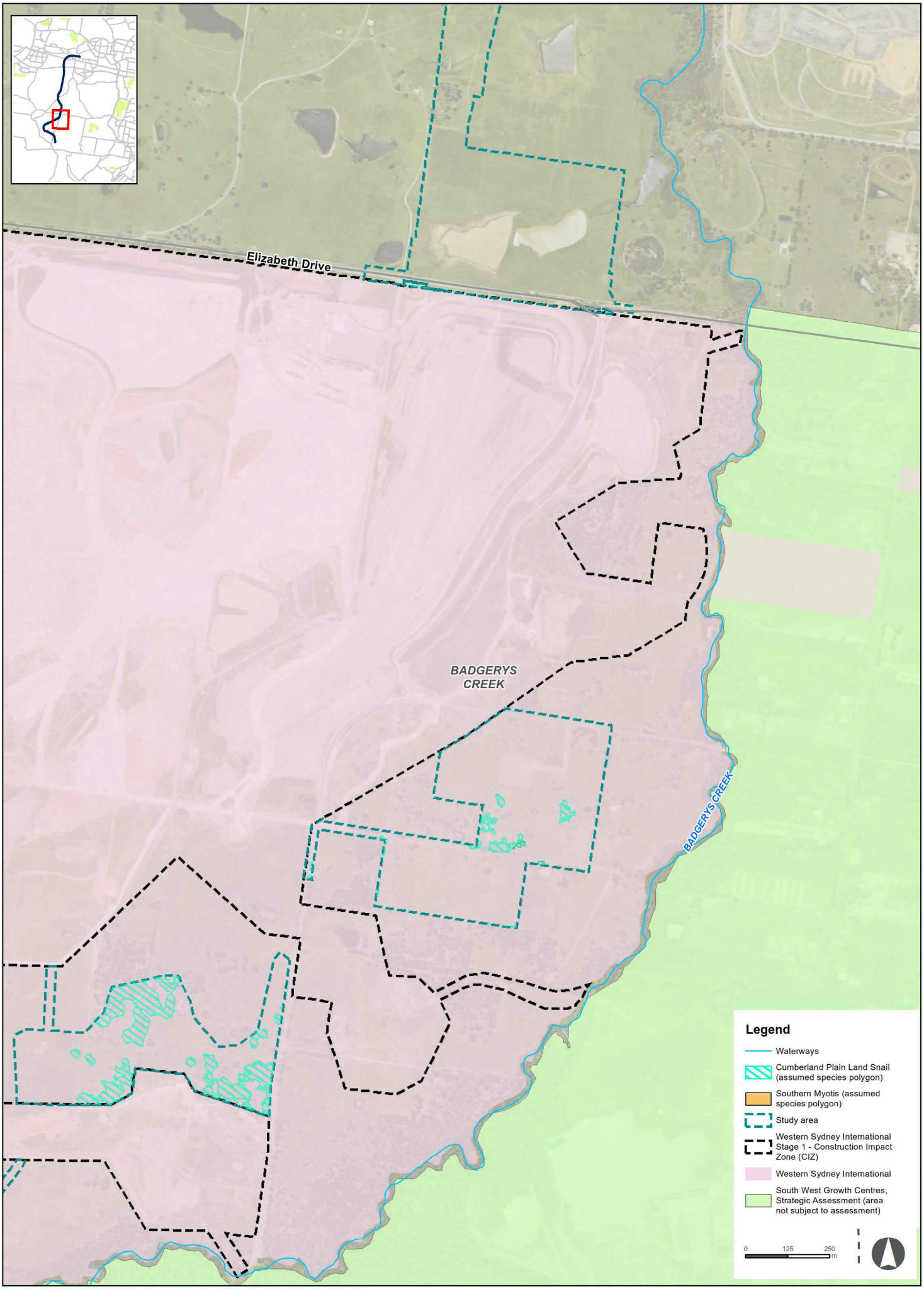

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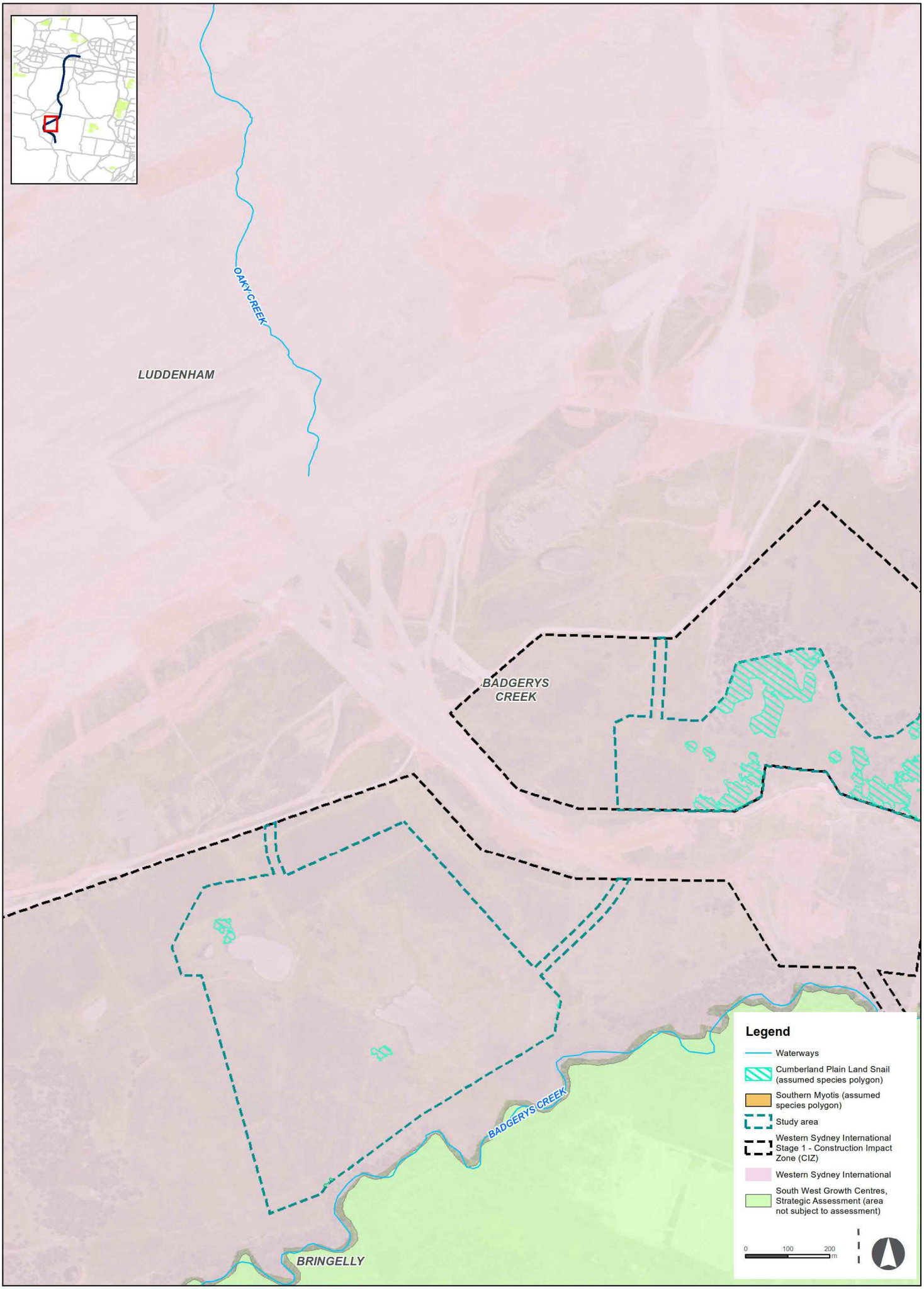
Impacts on biodiversity values

Figure 8-2i



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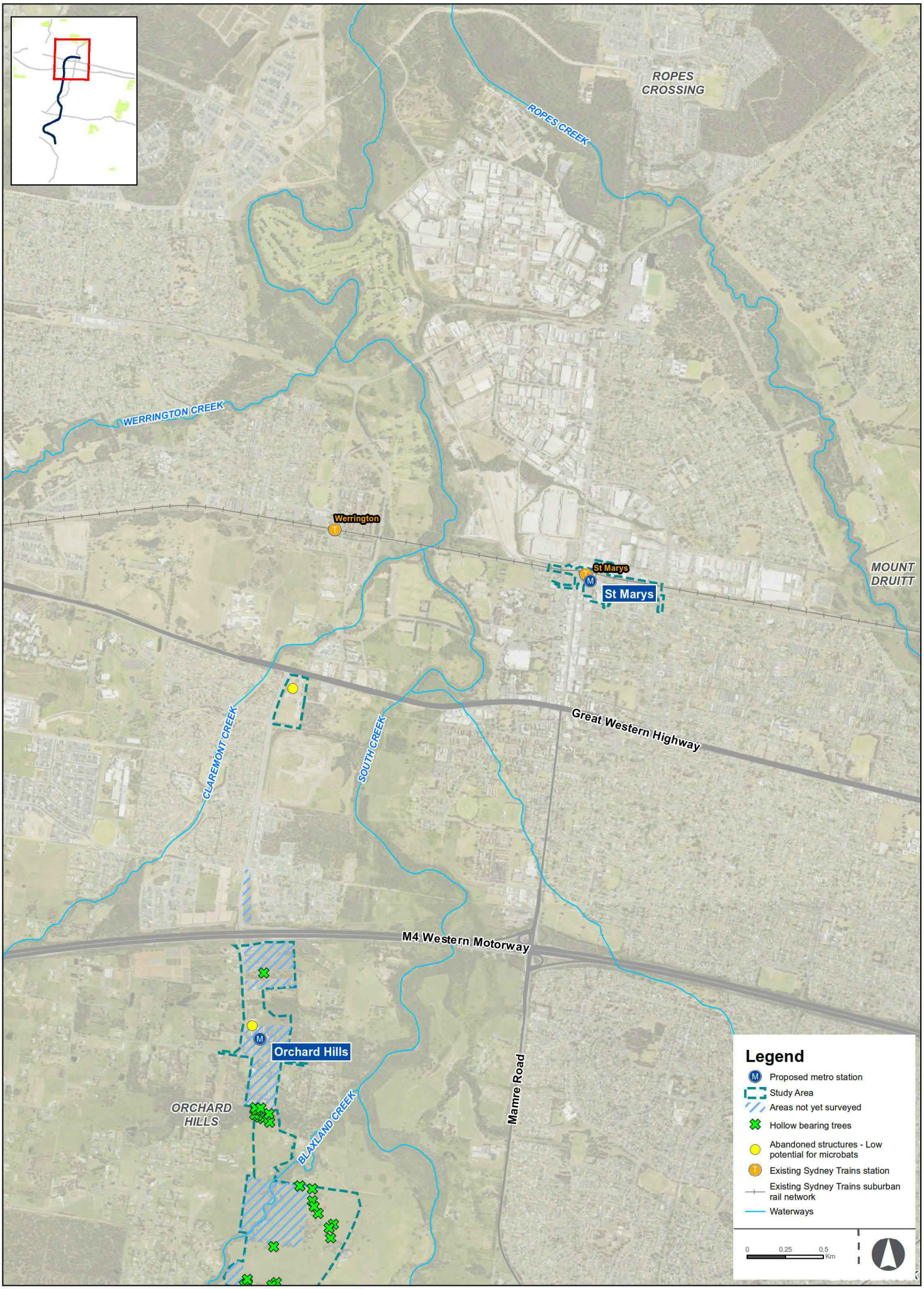
Impacts on biodiversity values

Figure 8-2j



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Hollow bearing tree and human made structures locations

Figure 8-3a

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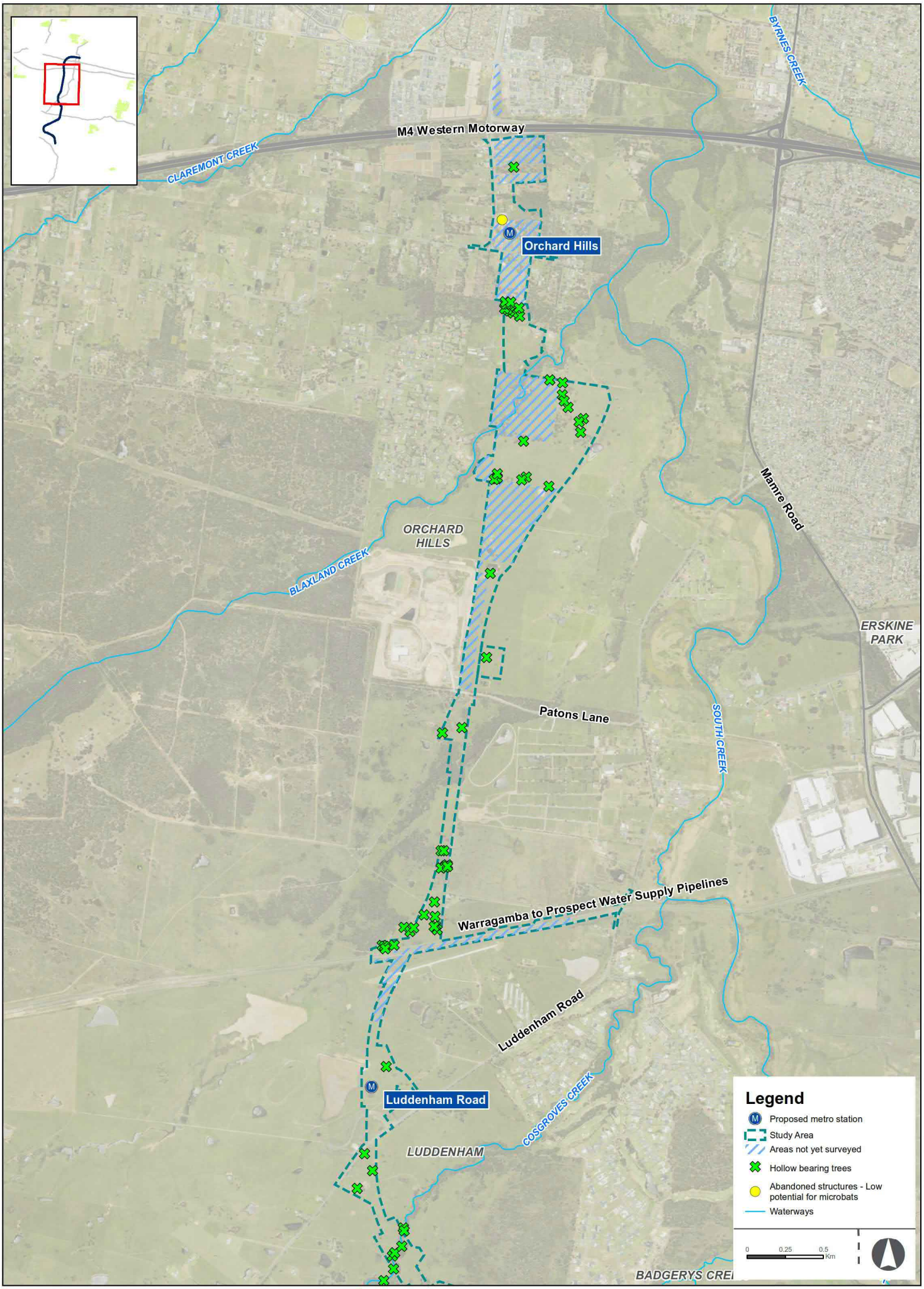

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Hollow bearing tree and human made structures locations

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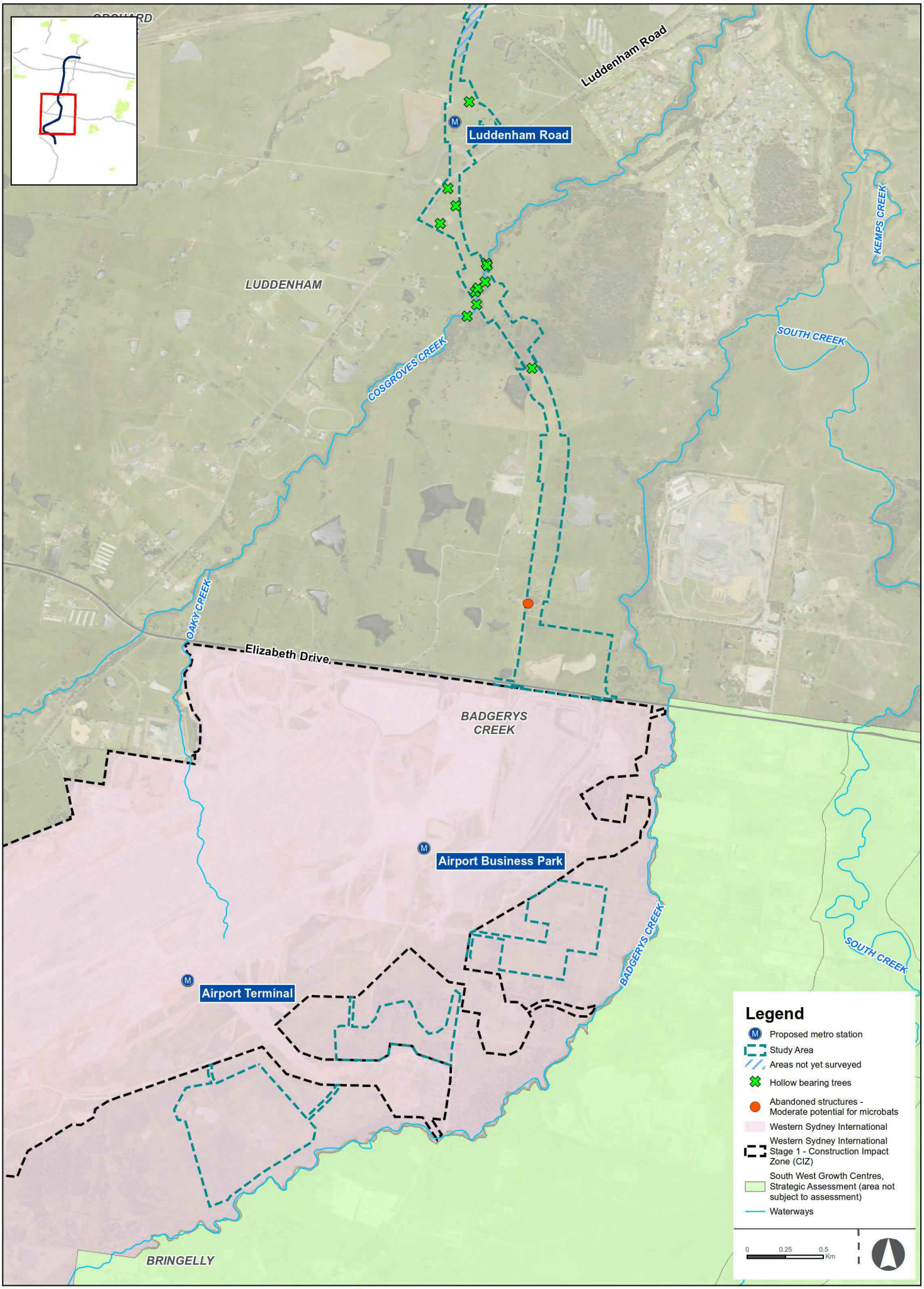
Figure 8-3b



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Hollow bearing tree and human made structures locations

Figure 8-3c

Indicative only, subject to design development

9 Assessment of operational impacts

Operational impacts include both the potential direct and indirect impacts of the project that affect native vegetation, threatened ecological communities and threatened species habitat post completion of construction of the project. Operational impacts may also result from changes to land-use patterns due to the project, such as an increase in vehicular access and human activity on native vegetation, TECs and threatened species habitat. Operational impacts are considered likely to extend beyond the proposed construction footprint.

Impacts have been addressed in accordance with section 9.1.1.2 and 9.1.4 of the BAM and include:

- indirect impacts on adjacent vegetation and habitat during operation
- impacts on adjacent vegetation and habitat arising from a change in land-use patterns
- prescribed biodiversity impacts during operation.

9.1 Operation impacts (off-airport)

A summary of potential operational impacts (off-airport) on biodiversity values considered likely due to the project are outlined in Table 9.1.

9.2 Operation impacts (on-airport)

A summary of potential operational impacts (on-airport) on biodiversity values considered likely due to the project are outlined in Table 9.2.

Table 9.1 Biodiversity operational impacts (off-airport)

Operational biodiversity impact	Nature	Extent
Reduced viability of adjacent habitat due to noise	During the operation of project increased noise and vibration levels in the study area and immediate surrounds are likely due train movements, increases in vehicle movements and general human presence around stations.	The noise and vibration from activities associated with operation of the project such as stabling and maintenance facility operations and rail operations would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours.
Reduced viability of adjacent habitat due to light pollution	Most of the study area north of the M4 Motorway is residential and is already subject to light impacts. There may be some increase in light disturbance around riparian corridors (e.g. Blaxland Creek) but this may benefit fast-flying microbats due to increased food availability (insects attracted to lights) around these areas. Due to the low impact of the lighting, it is unlikely that animals would alter their behaviour in response to the light disturbance.	There would be requirements for lighting at stations and for rail operations associated with the project. Lighting associated with the project would be designed to minimise 'light spill' for the benefit of surrounding residents and this would also reduce potential impacts on fauna populations.
Habitat connectivity	At surface sections (including embankment cut and fill areas), the rail corridor would be fenced to minimise potential wildlife collisions. Fauna connectivity to existing waterways is already limited and viaducts, bridges and culverts incorporated into the project design to support fauna habitat connectivity. Used in conjunction with rail corridor fencing, fauna movements are unlikely to be greatly limited as a result of the project. The DEOH is fenced around the perimeter and is currently a partial barrier to large terrestrial species such as the Eastern Grey Kangaroo. The project will not further limit habitat connectivity for fauna species.	Areas associated with remnant vegetation.
Aquatic ecology - change in peak velocities	Increases in flow velocities can lead to increased potential for scour and erosion and need to be managed to prevent this occurring. Scour protection is incorporated within the design of proposed culvert crossings to reduce localised increase in velocities. Incorporation of appropriate design (such as rock protection) to reduced flow velocities would prevent scour and erosion impacts at the proposed culvert locations.	Areas associated with waterways and water bodies.

Operational biodiversity impact	Nature	Extent
Aquatic ecology - changes to duration of inundation	The predicted changes in duration of inundation are generally minimal and comply with the design criteria (of limiting the change to no more than ten per cent) for storm events up to and including the 1 percent AEP event across the study area. There are several localised areas which are noted to occur in isolation for which duration of inundation would increase by greater than ten per cent. These areas are at localised areas constricted by farm dams, or within waterway areas.	Areas associated with waterways and water bodies.
Aquatic ecology - Catchment and watercourse health impact	The project has been designed to include cross drainage structures (viaducts and culverts) to allow flood flows to be maintained which would minimise interruption to flows within the watercourses. The potential changes to baseflow contribution from groundwater would influence the creek geomorphic condition. See Technical Paper 6 – Flooding, hydrology and water quality of the Project Environmental Impact Statement for further information. The project would require the removal and or relocation of several farm dams but the removal of these farm dams would not impact the availability of surface water for downstream catchments. The impact of the project on catchment and watercourse health is deemed minimal but some localised changes may occur due to viaducts, culverts and baseflow contributions.	Areas associated with waterways and water bodies.
Aquatic ecology - Water quality	The operation of the project has the potential to impact and potentially degrade the water quality of the waterways within the study area and downstream. The most likely source of pollutants from completion and operation of the project would be the concentrated flows from impervious surfaces associated with the stabling and maintenance facility south of Blaxland Creek. See Technical Paper 6 – Flooding, hydrology and water quality of the Project Environmental Impact Statement for further information. An increase in impervious surfaces such as roofs and paved areas would have the potential to cause impacts to the water quality of the receiving waterways through increased runoff volumes and increased sedimentation or erosion.	Areas associated with waterways and water bodies. Specifically, Blaxland Creek and Cosgroves Creek

Operational biodiversity impact	Nature	Extent
Aquatic ecology - Viaduct impacts	Provided piers are not located in waterways, the proposed viaducts over Blaxland Creek and Cosgroves Creek will be unlikely to cause localised changes in flow behaviour. Changes to flow velocity and distribution may cause changes to scour and sedimentation characteristics of waterways. Runoff generated by viaducts would be controlled in discrete locations by the construction of grass swales. Water quality treatment measures would be included in each downpipe from viaducts. Where a viaduct crosses a major creek, water quality treatment has been included in the adjacent detention basins. See Technical Paper 6 – Flooding, hydrology and water quality of the Project Environmental Impact Statement for further information.	Areas associated with waterways and water bodies. Specifically, Blaxland Creek, Cosgroves Creek.
Aquatic ecology - Geomorphology impacts	Geomorphic impacts are predicted to be negligible because there would be minimal change to contributing catchment areas and therefore no change to flood flows. The piers have been located out of the main flow paths for each watercourse and the impact would not propagate downstream. The removal of several farm dams to construct the project is likely to result in a change to the frequency of low flow events. These changes may be counteracted by the inclusion of on-site detention basins which have been designed to Penrith Council requirements and therefore would be designed to match existing runoff characteristics.	Areas associated with waterways and water bodies.

Table 9.2 Biodiversity operational impacts (on-airport)

Operational biodiversity impact	Nature	Extent
Reduced viability of adjacent habitat due to light pollution	The immediate area surrounding the project would have areas lit during operation and subject to artificial lighting, essentially creating permanent 'daylight' conditions as a result of the Western Sydney International. The on-airport construction corridor is located within the Western Sydney International Stage 1 CIZ. The site would support the construction and fit-out of the surface section of the alignment within Western Sydney International. No additional light impacts are anticipated from the on-airport section of the Project, as the whole area will be an operational 24-hour Airport.	No light impacts expected as a result of the project.
Aquatic ecology - Changes to duration of flood inundation	Changes to duration of inundation within Western Sydney International as a result of the project are predicted to be minimal. There are localised areas along Badgerys Creek where durations have increased, but these are small areas that correlate with the newly inundated areas and are not considered a significant impact.	Areas associated with waterways and water bodies, specifically Badgerys Creek
Aquatic ecology – change in flood level and extent (afflux)	The change in flood level and extent (afflux) on-airport resulting from the project are not substantial and isolated to one location within Western Sydney International. The potential permanent spoil placement area to the west is located across a main overland flow path that discharges to Badgerys Creek, causing changes to flood behaviour through redistribution of floodwaters. The potential permanent spoil placement area to the east is located across two minor overland flow paths that combine beyond this spoil placement area and discharge into Badgerys Creek. These overland flow paths are currently influenced by the adjacent land uses and while the spoil placement areas would impact these overland flow paths, flood compatible design would minimise the impacts.	Areas associated with waterways and water bodies, specifically Badgerys Creek
Aquatic ecology - Water quality	Environmental performance during operation of the project would be managed by the implementation of an operational environmental management plan or system. The plan would detail how the performance outcomes and mitigation measures would be implemented and achieved during operation and specify the environmental management practices and procedures to be followed.	Design of waterbodies (e.g. operational sediment basins) would consider the National Airports Safeguarding Framework Principles and Guidelines including Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports (Australian Government, 2014).

10 Cumulative impacts

The NSW DPIE is currently developing a guideline on cumulative impact assessment for State significant projects. The SEARs refers to the need to undertake an assessment of the relevant cumulative impacts of the off-airport components of the project that take into account other projects that have been approved but where construction has not commenced, projects that have commenced construction, and projects that have recently been completed.

Cumulative impacts are impacts that, when considered together, have different and/or greater impacts than a single impact on its own. Cumulative impacts can result from the successive, incremental and/or combined effects of a project when added to another project.

The extent to which another project could interact with the construction and/or operation of the project would depend on its scale, location and/or timing of construction and/or operation. Generally, cumulative impacts would be expected to occur in situations where multiple long-duration construction activities are undertaken close to, and over a similar timescale to, construction activities for the project. Cumulative impacts would also be expected to occur in situations where projects are operating at a similar scale and/or location to the project.

A cumulative impact assessment has been addressed in this section as there would be a cumulative impact to biodiversity from the project and other proposed developments in Western Sydney. The projects that have the potential to have a cumulative impact with the project were considered Chapter 26 (Cumulative Impacts) of the Project Environmental Impact Statement. The projects considered to be relevant for the cumulative biodiversity impact assessment include:

- Western Sydney International
- future M12 Motorway project
- The Northern Road
- St Marys Intermodal Facility.

A summary of the projects considered to be relevant to this biodiversity assessment and each projects impact on NSW threatened ecological communities and native vegetation is provided in Table 10.1. A brief description of these projects, future developments and associated potential cumulative impacts is provided below. It is likely that the project has, at minimum, moderate cumulative biodiversity impacts associated with the project and the development associated with other planned developments in the area.

Table 10.1 Summary of cumulative impact on threatened ecological communities and native vegetation

Projects	Western Sydney International*	Future M12 Motorway project	The Northern Road	St Marys Intermodal Facility	SM-Western Sydney Airport	Total
Vegetation type	**Area (hectares)[1]**					
Cumberland Plain Woodland (CEEC)	272.80	66.86	30.87	0	39.80	410.33
River-flat Eucalypt Forest (EEC)	47.6	3.18	3.86	0.72	18.06	73.42
Shectaresle-Gravel Transition Forest (EEC)	5.90	6.91	0.00	0.00	10.42	23.23

Projects	Western Sydney International*	Future M12 Motorway project	The Northern Road	St Marys Intermodal Facility	SM-Western Sydney Airport	Total
Vegetation type	**Area (hectares)[1]**					
Swamp oak floodplain forest (EEC)	0.00	2.82	0.00	0.00	5.38	8.20
Moist Shale Woodland (EEC)	0.00	0.44	0.00	0.00	0.00	0.44
Other non-threatened native vegetation	37.20	0.57	6.06	1.51	0.01	45.35
Total	363.50	80.78	40.79	2.23	73.67	560.97

(1) Areas subject to change

* impacts are derived from the Western Sydney International Biodiversity Offsets Delivery Plan (Commonwealth of Australia, 2018)

10.1 Western Sydney International

Western Sydney International covers an approximately 1,780-hectare area that is being developed to service the Greater Western Sydney region and the continued need for aviation services. Stage 1 of Western Sydney International would include a single 3,700 metre runway, terminal and other relevant facilities for an operational capacity of approximately 10 million passengers annually, as well as freight traffic. Other facilities would include a business park to provide offices for government agencies, service providers and airport-related businesses.

Construction activities for Stage 1 are occurring in two major phases:

- site preparation activities including clearing and earthworks (currently underway)
- aviation infrastructure activities such as construction of the runway, internal road network, terminal, air traffic control tower and maintenance facilities.

Stage 1 is expected to be constructed from 2018 to 2026 with operations commencing in 2026.

10.2 Future M12 Motorway project

Transport for NSW is proposing the construction of a new east–west motorway between the M7 Motorway near Cecil Hills and The Northern Road at Luddenham over a distance of about 16 kilometres. The M12 Motorway would serve as the major access route to Western Sydney International and connect to Sydney's motorway network. The project intersects and is located adjacent to the future M12 Motorway in the area between Luddenham Road and Elizabeth Drive. Construction period is expected to start in 2022 and be open to traffic before the opening of Western Sydney International in 2026.

10.3 The Northern Road ugrade

Transport for NSW has commenced the upgrade and realignment of 35 kilometres of the Northern Road, a key north–south arterial link, as part of the Western Sydney Infrastructure Plan road investment program. The project received NSW State significant infrastructure approval in May 2018 and Commonwealth approval in June 2018.The upgrade is being delivered in six stages. Concurrent construction of the project with Stage 5 of the Northern Road upgrade is considered possible. Other stages will be operational when the project construction commences.

The Northern Road upgrade will impact on a mapped regional east-west biodiversity corridor (Regional Corridor 17). This corridor connects Mulgoa Nature Reserve to DEOH. The Biodiversity

Investment Opportunities Map (BIO Map) shows that there are mapped biodiversity corridors of regional significance, known as Regional Corridor 18 along Blaxlands Creek and Regional Corridor 20 which leads along Patons Lane, within the study area to the east of DEOH. The Northern Road upgrade and the project have the potential to impact mapped regional corridors that lead to and from DEOH. Cumulative impacts within this area would be managed during detailed design and construction (refer to Section 8.5.3 for measures that would be taken to limit impacts to these biodiversity corridors).

10.4 St Marys Intermodal

St Marys Intermodal is a State Significant Development for the construction and operation of an Inland Container Terminal and associated container handling operations. An application for the development (Application Number SSD-7308) was lodged with Department of Planning and Environment (DP&E). The project EIS was lodged in September 2018 and approved on 7 May 2020. It is possible that the Intermodal construction works would be completed in late 2020 or early 2021 and prior to the commencement of the project, however a conservative approach has been taken and there is potential for concurrent construction impacts.

10.5 Future development considerations

There are several planned and potential infrastructure upgrade projects in the Western Sydney area that have the potential to contribute to cumulative biodiversity impacts. These potential projects include:

- Elizabeth Drive upgrade – consisting of an upgrade to Elizabeth Drive directly in front of Western Sydney International. Elizabeth Drive will be upgraded and separated over the Metro (Western Sydney Airport) and M12 Motorway entry to Western Sydney International. No defined biodiversity impacts have been established to date for this project
- Mamre Road upgrade – Stage 1 of the upgrade includes the section of road between the M4 Motorway in St Clair and Erskine Park Road in Erskine Park. Stage 2 of the upgrade includes the section of road from Erskine Park Road to Kerrs Road in Kemps Creek. The NSW Government has committed $220 million to Stage 1 and investigations to inform the concept design are currently underway. No defined biodiversity impacts have been established to date for this project.
- Cumberland Plain Conservation Plan 2020-2056 – discussed in Section 10.6 below.

10.6 Cumberland Plain Conservation Plan – a conservation plan for Western Sydney to 2056

As discussed in Chapter 2 (Strategic need and justification) of the Project Environmental Impact Statement, the population of Western Sydney will continue to grow, requiring services and infrastructure to support the Western Parkland City. Major transport infrastructure planned for Western Sydney includes road, rail and airport developments. While new or upgraded infrastructure is essential to support planned growth in Western Sydney, multiple developments being undertaken at the same time and in the same geographic area have the potential for cumulative impacts.

The project located off-airport land north of Western Sydney International is currently subject to strategic biodiversity conservation planning (the ‘Cumberland Plain Conservation Plan’) under preparation by the DPIE. The draft Cumberland Plain Conservation Plan was exhibited in August 2020 and incorporates a strategic biodiversity certification under the BC Act and EPBC Act. The strategic biodiversity certification incorporates detailed field survey and assessments, and species expert reports required under the BAM. While the Cumberland Plain Conservation Plan has not been used for the assessment of project impacts specifically, it will provide the appropriate mechanism for the long-term management of cumulative biodiversity impacts for land north of Western Sydney International.

The project is generally consistent with the objectives of the Cumberland Plain Conservation Plan, particularly to avoid and minimise impacts on biodiversity and to mitigate prescribed and indirect impacts.

The Cumberland Plain Conservation Plan conservation program includes commitments to secure more 5,000 hectares of native vegetation in conservation lands. As part of this commitment, the Cumberland Plain Conservation Plan has established offset targets for specific biodiversity values to ensure that the commitment addresses the biodiversity values being impacted.

The project will not prevent or preclude offset targets for NSW/Commonwealth listed TEC's from being realised. Further, the project will not prevent or preclude offset targets for species that are SAII entities, or that are critically endangered, endangered or endemic to the Cumberland subregion.

10.7 Summary of cumulative impacts

Potential cumulative impacts include:

- increased removal of native vegetation and fauna habitat resources
- increase in displacement of native fauna and flora species
- increase in edge effects and habitat fragmentation
- increase in noise, light, vibration and other disturbance for fauna that may inhabit or use resources near the project area
- increase in the impact of Key Threatening Processes.

The project is located within Western Sydney, an area already subject to historic environmental pressures which encompasses a highly fragmented landscape with areas of agricultural, residential and commercial land use. Losses in biodiversity from these projects and developments are also likely to be restricted in area, given their location in a highly modified environment. Together these projects and other developments would result in the further loss of habitat from an already modified environment with fragmented natural biodiversity values.

The proposed developments would result in cumulative impacts to threatened ecological communities and threatened species across the Cumberland Plain. However, if mitigation measures are applied consistently across projects, the increase in cumulative impacts on biodiversity because of this project is not considered to be substantial.

11 Proposed management and mitigation measures

11.1 Approach to management and mitigation

This chapter describes the environmental management approach and framework for Biodiversity for the project during construction and operation. The environmental management approach and framework has been developed to be consistent with the regulatory requirements for the on-airport and off-airport environment, including the existing environmental management framework established under the Airport Plan. Further details on the environmental management approach for the project are provided in Chapter 25 (Environmental mnagement and mitigation) of the Project Environmental Impact Statement.

The primary document to manage potential impacts during construction is the Sydney Metro – Western Sydney Airport Construction Environmental Management Framework (CEMF). The CEMF provides a whole-of-project approach to construction environmental management and includes a range of requirements including the preparation of specific environmental management plans and sub-plans to implement the framework. The CEMF has been prepared to be consistent with the Sydney Metro project framework and the environmental management framework at Western Sydney International.

The CEMF for the project describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractors in developing environmental management documentation (including the CEMPs), sub-plans and other supporting documentation for each specific environmental aspect which would be developed prior to construction.

The CEMF also identifies protocols for environmental monitoring, inspections, auditing and reporting.

The proposed mitigation measures would be implemented during construction to manage the potential impacts of the project on biodiversity values. These mitigation measures would be outlined in a Biodiversity Management Plan (BMP) that would form part of the CEMF.

11.2 Performance outcomes

Performance outcomes have been developed consistent with the requirements of the SEARs for the project. The performance outcomes for the project are summarised below in Table 11.1 and identify measurable, performance-based standards for environmental management.

Table 11.1 Performance outcomes for the project in relation to biodiversity

SEARS desired performance outcome	Project performance outcome	Timing
The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity	Minimise or where possible avoid impacts on threatened flora and fauna species, and ecological communities listed under the *Biodiversity Conservation Act 2016* (NSW) and *Environment Protection and Biodiversity Conservation Act 1999* (Cth)	Construction
	Manage groundwater drawdown at Orchard Hills to avoid or minimise impacts on groundwater dependent ecosystems	Construction
	No removal of any vegetation within the Thompsons Creek riparian zone or any adjacent areas that are non-certified under the South West Growth Area	Construction
	Culverts and bridges would be appropriately sized to maintain fauna habitat connectivity	Operation
	Maintain integrity and functionality of rail corridor fencing to minimise wildlife-train collision while providing opportunities for cross-corridor wildlife movement	Operation

SEARS desired performance outcome	Project performance outcome	Timing
	Re-establish native vegetation in accordance with the National Airports Safeguarding Framework Principles and Guidelines including *Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports* (Australian Government, 2014).	Operation
Offsets and/or supplementary measures are assured which are equivalent to any residual impacts of project construction and operation	Impacts on threatened ecological communities and threatened species are offset in accordance with the requirements of the NSW Biodiversity Assessment Method (OEH, 2017).	Construction

11.3 Proposed mitigation measures

In addition to the development and implementation of the management plans described in the CEMF, specific mitigation measures have been identified for inclusion in a BMP to be prepared for the project.

The proposed measures have been identified to manage both construction and operational impacts and some measures have been identified to manage impacts in a site-specific location. The location/s applicable to each mitigation measure are identified in the table where relevant.

The proposed mitigation measures have been revised in response to submissions received during public exhibition and/or any minor changes made following exhibition.

Proposed mitigation measures for pre-construction, construction and operation are detailed below in Table 11.2. This includes water quality and groundwater mitigation measures which are relevant to managing potential biodiversity impacts.

Table 11.2 Proposed mitigation measures in relation to biodiversity

ID	Potential impact	Proposed mitigation measure	Applicable location/s
Construction			
FF1	Vegetation clearance and habitat	The Biodiversity Construction Environmental Management Plan (on-airport) and Flora and Fauna Management Plan (off-airport) would be prepared by a suitably qualified and experienced person to minimise and manage the clearing of native vegetation and habitat by: • seeking to locate site offices, site compounds and ancillary facilities in areas where there are limited biodiversity values (e.g. cleared land) • delaying the removal of vegetation until absolutely necessary • avoiding the removal of hollow-bearing trees, where possible • using a qualified surveyor and suitably qualified ecologist to mark out exclusion zones and clearing/project boundaries prior to construction • providing contractors with regularly updated sensitive area maps (showing clearing boundaries and exclusion zones) • investigating opportunities for salvage and storage of felled native trees for potential use in landscape design. The Biodiversity Construction Environmental Management Plan (on-airport) and Flora and Fauna Management Plan (off-airport) would be implemented throughout construction	Orchard Hills construction site Off-airport construction corridor Stabling and maintenance facility construction site Luddenham Road construction site Airport construction support site Bringelly services facility construction site Aerotropolis Core construction site
FF2	Habitat loss for hollow-dependent fauna	A Nest Box Strategy would be prepared to minimise habitat loss to hollow-dependent fauna in accordance with the Flora and Fauna Management Plan and would include the following requirements: • hollow-bearing trees would be marked/tagged and mapped prior to their removal. The size, type, number and location of nest boxes required would be based on the results of the pre-clearing survey. • about 70 per cent of nest boxes would be installed about one month prior to any vegetation removal to provide alternate habitat for hollow-dependent fauna displaced during clearing	Claremont Meadows services facility Off-airport construction corridor

ID	Potential impact	Proposed mitigation measure	Applicable location/s
FF3	Habitat loss for hollow-dependent fauna	Works on-airport would be undertaken in consultation with Western Sydney Airport subject to the wildlife hazard management requirements.	On-airport.
FF4	Habitat loss for threatened species reliant on human made structures	A targeted microbat survey (including Eastern Coastal Free-tailed Bat, Large Bent-winged Bat and Eastern False Pipistrelle) of dwellings and structures proposed for demolition, removal or modification would be undertaken in accordance with 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH, 2018), during design development or as soon as feasible prior to disturbance. Other human-made structures such as culverts and other under-road structures within the construction footprint would be surveyed for threatened microbats (e.g. particularly the Southern Myotis) in accordance with OEH (2018). If threatened microbats are detected, a Microbat Management Plan would be developed as part of the Flora and Fauna Management Plan and implemented by a suitably qualified bat specialist.	Claremont Meadows Off-airport construction corridor
FF5	Impacts to microbats from shading and artificial lights	Works on-airport would be managed in accordance with the *Western Sydney Airport Microbat Management Plan* and in consultation with Western Sydney Airport.	On-airport.
FF6	Impacts to microbats from shading and artificial lights	During construction, shading and artificial light impacts would be minimised in areas adjoining remnant bushland that is in intact condition.	Claremont Meadows services facility construction site Orchard Hills construction site Off-airport construction corridor On-airport construction support site

ID	Potential impact	Proposed mitigation measure	Applicable location/s
FF7	Impacts to fish passage and habitat that sustain and interact with the rivers, streams and wetlands	Fish passage and fish habitat associated with Cosgrove and Blaxland Creek would be protected in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI (Fisheries NSW), 2013)	Off-airport construction corridor.
FF8	Impacts to fauna during dewatering of rural dams	A Dewatering Plan would be prepared and implemented for the dewatering of rural dams which are impacted as a result of the construction of the project. This would include measures to manage the transfer of native aquatic fauna, if required, prior to dewatering and removing of dams	Off-airport
FF9	Impacts to fauna during dewatering of rural dams	A Dewatering Plan would be prepared and implemented for the dewatering of rural dams which are impacted as a result of the construction of the project. This would include measures to manage the transfer of native aquatic fauna, if required, prior to dewatering and removing of dams. The plan would be consistent with the *Western Sydney Airport Biodiversity Construction Environmental Management Plan* (on-airport)	On-airport
FF10	Key Threatening Processes during construction	The impact of Key Threatening Processes as a result of the project would be managed and minimised where possible through: • implementation of weed management measures to prevent the introduction and spread of weeds including exotic vines and scramblers, *Olea europaea* (African Olive), *Chrysanthemoides monilifera*, *Lantana camara*, and exotic perennial grasses • implementation of pathogen management measures to prevent the introduction and spread of pathogens including amphibian chytrid, *Phytophthora implementa*, and Exotic Rust Fungi of the order Pucciniales • implementation of management measures to protect the riparian zone to ensure fish passage and protect fish habitat in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI (Fisheries NSW), 2013), and minimisation of vegetation removal within the riparian zone where possible	All

ID	Potential impact	Proposed mitigation measure	Applicable location/s
FF11	Loss of local genetic plant stock	A native vegetation seed collection and salvage program would be developed prior to the commencement of construction and implemented during construction. The seed collection and salvage program would target native species prioritising the Cumberland Plain Woodland species to be utilised in landscaping for the project where possible. Opportunities for use of collected and salvaged seed outside of the project would also be investigated	All
WQ1	Aquatic ecology	A surface water quality monitoring program would be implemented to monitor water quality during construction. The program would be developed in consultation with (as relevant) Western Sydney Airport, NSW Environment Protection Authority, relevant sections of Department of Planning, Industry and Environment and relevant local councils. The program would consider monitoring being undertaken as part of other infrastructure projects such as the M12 Motorway and Western Sydney International On-airport, the water quality monitoring program would ensure that works meet the requirements under Schedule 2 of the Airports (Environment Protection) Regulations 1997 The program would monitor all construction discharge locations	All
WQ2	Aquatic ecology	Water treatment plants would be designed to ensure that wastewater is treated to a level that is compliant with the ANZECC/ARMCANZ (2000), ANZG (2018) and draft ANZG (2020) default guidelines for 95 per cent species protection and 99 per cent species protection level for toxicants that bioaccumulate unless other discharge criteria are agreed with relevant authorities	All
WQ3	Aquatic ecology and riparian zones	The design and construction of the project would take into account the former NSW Office of Water's Guidelines for controlled activities on waterfront land	Off-airport
GW5	Groundwater dependant ecosystems	Detailed hydrogeological and geotechnical models for the project would be developed and progressively updated during design and construction These models would: • be informed by the results of groundwater monitoring undertaken before and during construction • identify predicted changes to groundwater levels, including at nearby water supply works and at groundwater dependent ecosystems or other sensitive groundwater receptors	All

		Where changes to groundwater levels are predicted at nearby water supply works, groundwater dependent ecosystems or other sensitive groundwater receivers, an appropriate groundwater monitoring program would be developed and implemented Where changes to groundwater level are close to the ground surface, dryland salinity monitoring would be implemented to allow for management of any identified impacts The groundwater monitoring program would aim to confirm no adverse impacts on the receiver during construction or to effectively manage any impacts with the implementation of appropriate mitigation measures. Monitoring at any specific location would be subject to the status of the water supply work and agreement with the landowner	
GW6	Groundwater dependant ecosystems	A Groundwater Management Plan would be prepared and implemented. The plan must include the following trigger-action-response measures in relation to groundwater levels in areas identified as subject to potential drawdown (at groundwater dependent ecosystems or other sensitive receivers) but outside the construction footprint and Western Sydney International Stage 1 Construction Impact Zone: a. target criteria, set with reference to relevant standards and site specific parameters b. trigger values and corresponding corrective actions to prevent recurring or long-term exceedance of the target criteria described in (a) c. corrective actions to compensate for any recurring or long-term exceedance of the target criteria described in (a) Response measures may include: • targeted ground improvement and grouting to limit groundwater inflows into station excavations, tunnels and cross-passage to reduce groundwater drawdown • design of undrained temporary retention systems to minimise groundwater inflow into station excavations and reduce groundwater drawdown • supplementing groundwater supply at affected groundwater dependent ecosystems or watercourses • make good provisions for groundwater supply wells impacted by changes in groundwater level or quality	All

ID	Potential impact	Proposed mitigation measure	Applicable location/s
Operation			
OFF1	Fauna habitat connectivity	Wildlife connectivity would be maintained (where possible) through the installation of viaduct/bridge structures designed in accordance with the following: • height and width of the area under a bridge to be maximised for all species, noting a minimum height of approximately 3 metres of dry passage will provide connectivity for most terrestrial species • bridges wide enough to encompass water flow, stream bank and riparian vegetation, preferably on both sides of the water course • for small and medium sized mammals, provide fauna furniture as shelter (e.g. vegetation, logs, rocks, leaf-litter, refuge pipes, escape poles, roofing tiles, and roofing iron) • height and carriageway separation designed to allow sufficient light and moisture to enhance growth of vegetation under the structure • if used for multiple purposes (e.g. pathways or access roads) aim to provide the 3 metre of natural passage for fauna • relocation or adjustment of the stream bed avoided where possible • the structure to tie in with the natural hydrology of the surrounding habitat such that the width, depth and gradient of the watercourse are maintained in the structure • consistent with the *Policy and Guidelines for Fish Friendly Waterway Crossings* (DPI (Fisheries NSW), 2013).	Off-airport
OFF2	Fauna habitat connectivity	The design of viaduct structures over the wildlife/riparian corridors at Blaxland Creek, the unnamed tributary south of Patons Lane and Cosgroves Creek would seek to: • maximise the span over the wildlife/riparian corridor • minimise native vegetation removal within the wildlife/riparian corridors • maintain opportunities for fauna movement along the wildlife/riparian corridors and • provide opportunities to enhance fauna movement where possible	Off-airport

12 Biodiversity offsetting and credit report

This chapter addresses section 10 of the BAM and provides information on:

- impacts on a potential entity that are serious and irreversible impacts
- impacts for which the assessor is required to determine an offset requirement
- impacts for which the assessor is not required to determine an offset requirement
- impacts that do not require further assessment by the assessor.

This chapter also address section 11 of the BAM and provides information on the application of the no net loss standard and the project biodiversity offset obligations. Credit calculations were quantified using the BAM-C version 1.2.7.2.

12.1 Thresholds for the assessment and offsetting of impacts of development

12.1.1 Serious and irreversible impacts

This section addresses section 10.2 of the BAM and following the *Guidance to assist a decision-maker to determine a serious and irreversible impact* (Department of Planning, Industry and Environment, 2019).

All threatened entities impacted by the project have been considered if they form or have potential to be Serious and Irreversible Impact (SAII) entities. Criteria for listing as an SAII entity are those species which:

- are in a rapid rate of decline
- have a very small population size
- are severely degraded or disrupted
- have a very limited geographic distribution
- are unlikely to respond to measures to improve habitat.

Entities currently listed as SAIIs are provided in the Threatened Biodiversity Data Collection (EES, 2020d) and have been outlined below in Table 12.1.

Threatened ecological communities have been assessed in accordance with section 10.2.2 of the BAM in Table 12.2 and threatened species have been assessed in accordance with section 10.2.3 of the BAM in Table 12.3.

Table 12.1 SAII entities affected by the project

SAII entity	Threshold	Project impact	
		Off-airport	On-airport
Cumberland Plain Woodland in the Sydney Basin Bioregion	Not listed	9.64 hectares	30.16 hectares
Allocasuarina glareicola	Not listed	1.25 hectares of direct impacts	0.00 hectares

Additional impact assessment provisions for ecological communities

Table 12.2 Additional impact assessment provisions for SAII TECs

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	Efforts to avoid and minimise impacts on native vegetation are outlined in Table 10.3. Avoidance was primarily designed to minimise impacts of higher quality patches of Cumberland Plain Woodland including Intact and thinned condition classes. An example of avoidance through design is the relocation of services facility at the corner of the Great Western Highway/Gipps Street to avoid impacts on Cumberland Plain Woodland.
(b) the area (hectares) 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	**Direct impacts are:** **Off-airport** PCT 849 (Intact) 0 hectares – VI 67.8 PCT 849 (thinned) 4.66 hectares – VI 62.4 PCT 849 (Scattered Trees) 1.73 hectares – VI 20.3 PCT 849 (low) 3.25 hectares – VI 7.8. **On-airport** PCT 849 (Intact) 4.05 hectares – VI 67.8 PCT 849 (thinned) 0 hectares – VI 62.4 PCT 849 (Scattered Trees) 2.32 hectares – VI 20.3 PCT 849 (low) 23.79 hectares – VI 7.8. **Indirect impacts are:** **On-airport** No indirect impacts have been calculated for on-airport land as adjacent areas would be subject to assessment and offsets under separate Western Sydney International approval.
(c) 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	To date no thresholds have been issued for this SAII entity.
(d) the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint	The subject land occurs within a mix of land uses from high density residential and commercial development to rural residential that was historically cleared for rural agricultural. The extent of Cumberland Plain Woodland has been greatly reduced in the locality. The current known extent within 100 metres is 97.6 hectares and 1000 metres is 590.1 hectares

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
(e) 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	Estimated total extent of Cumberland Plain Woodland (PCT 849 & PCT 850) within the Sydney Basin Bioregion has been identified to be 11,200 hectares (Office of Environment and Heritage, 2020a). Within the Cumberland subregion the current extent of Cumberland Plain Woodland is <11,200. Given the exiting small patch sizes within the project and highly urbanised surrounding environment, the project is unlikely to result in a substantial reduction in extent and overall condition of Cumberland Plain Woodland at the subregion level.
(f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion	It is estimated that within the Cumberland subregion about 1,289 hectares of Cumberland Plain Woodland is protected within land reserved under the NPW Act (Open Lines and Biosis, 2020). Under the Draft Cumberland Plain Conservation Plan to 2056 an additional commitment of 3,568 hectares of Cumberland Plain Woodland would be added to the reserve system within the Cumberland subregion (DPIE, 2020a).
(g) 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 would 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	Potential impact resulting from the project on Cumberland Plain Woodland within on-airport land has been mostly limited to low condition patches that are unlikely to led to a reduction in abiotic factor critical to the long-term survival of the TEC in the Cumberland subregion. Potential impact to this TEC on off-airport land would be mostly restricted to small patches although some larger areas near Patons Lane occur. Mitigation measures outlined in Chapter 11 (Management and mitigation measures) would ensure invasive flora and fauna species are not further increased because of the project. Further, appropriate management of fertilisers, herbicides or other chemicals or pollutants would be controlled minimising any potential harm to this TEC. Given this, indirect impacts are considered unlikely to extend beyond the construction footprint for this TEC.

Impact assessment provisions	Cumberland Plain Woodland in the Sydney Basin Bioregion
(h) direct or indirect fragmentation and isolation of an important area of the potential TEC	Within on-airport lands impacts include 6.37 ha of Intact and Scattered Trees with the remaining areas mostly restricted to low condition patches of Cumberland Plain Woodland and would unlikely result in direct or indirect fragmentation and isolation of an important area of the potential TEC. The project would tie into the Western Sydney International and is unlikely to led to additional fragmentation of Cumberland Plain Woodland within this area. In respect to off-airport, the project has avoided most patches of Intact condition although would directly impact 4.66 hectares of thinned condition Cumberland Plain Woodland. Potential fragmentation of this TEC may occur within the off-airport corridor construction site near Patons Lane although this impact is considered unlikely to isolate an important area of Cumberland Plain Woodland.
(i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.	The project is committed to providing biodiversity offsets required for impacts to Cumberland Plain Woodland as calculated using the BAM-C. In addition to this, commitment 7.2 of the Draft Cumberland Plain Conservation Plan to 2056 would ensure a further 3,568 hectares of Cumberland Plain Woodland would be protected and managed within the Cumberland subregion to contribute to the recovery of this TEC (DPIE, 2020a).

Additional impact assessment provisions for threatened species

Table 12.3 Additional impact assessment provisions for SAII threatened species

Impact assessment provisions	*Allocasuarina glareicola*
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	Efforts to avoid and minimise impacts on native vegetation are outlined in Table 10.3.
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	The project would not directly impact on any known population of *Allocasuarina glareicola.* Potential direct impacts on assumed habitat is estimated to be about 1.25 hectares and is wholly located on off-airport lands. **Direct impacts are:** **Off-airport (Areas not yet surveyed)** PCT 724 (Intact) 0.43 hectares – VI 61.7 PCT 724 (thinned) 0.82 hectares – VI 39.7 **On-airport** Not recorded.
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact	To date no thresholds have been issued for this SAII entity.
(d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification would have on the habitat of the local population, including but not limited to: (i) an estimate of the change in habitat available to the local population as a result of the proposed development (ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and (iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.	The likely impact of the project on assumed habitat for *Allocasuarina glareicola* isabout 1.25 hectares. This potential impact would not result in the loss of any known occurrence of this species in the Cumberland subregion. Assumed habitat for this species occurs in the form of PCT 724 (Intact and thinned conditions) with most patches occurring as small isolated occurrences that are not directly connected to any known population of this species. The project would not result in a change to available habitat located within protected areas in the subregion for this species. Whilst the project would result in a small loss of potential habitat associated with mostly small isolated patches, modification of habitat is unlikely to play an important role in the long-term evolutionary development for *Allocasuarina glareicola* for any local population or the species recovery within the Cumberland subregion.

Impact assessment provisions	*Allocasuarina glareicola*
(e) the likely impact on the ecology of the local population. At a minimum, address how the proposal is likely to affect the ecology and biology of any residual plant population that would remain post development including where information is available: • pollination cycle • seedbanks • recruitment, and • interactions with other species (e.g. pollinators, host species, mycorrhizal associations)	Assumed habitat to be affected by the proposal is not directly connected to any known occurrence of this species. The local population is considered to occur from a single location to the east of the study area at St Marys. The current pollination vectors biological life cycle is unknown for this species given the existing fragmented nature of assumed habitat for *Allocasuarina glareicola* in the study area, it is considered unlikely that this habitat would play an important role in the ecology and biology of any residual plant population that would remain post development.
(f) a description of the extent to which the local population would become fragmented or isolated as a result of the proposed development	The local population is currently only known from a single record at St Marys to the east of the project. Impacts on assumed habitat do not have direct connection to this population and are considered unlikely to further fragment or isolate this occurrence.
(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	The local population occurs as an outlier to most known occurrences of this species that occur in the Castlereagh and Londonderry areas. Whilst assumed habitat for this species has been identified within the study area it is considered unlikely that this habitat would be important for breeding, dispersal and genetic viability/diversity for a local population of the species viability more broadly in the subregion.
(h) the extent to which the proposed development would lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The project would incrementally increase threats and impacts on potential habitat for *Allocasuarina glareicola.* Project specific mitigation measure would minimise indirect impacts and would ensure the project is unlikely to further decrease the viability of the local population. In addition, this project is consistent with the Draft Cumberland Plain Conservation Plan to 2056 that would outline key commitments to contribute to the recovery of this species in the Cumberland subregion (DPIE, 2020a).

Impact assessment provisions	*Allocasuarina glareicola*
(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	Currently it is estimated that about 1,160 hectares of potential habitat is protected within the subregion (Open Lines and Biosis, 2020). This included potential habitat within the following reserves: • Wianamatta Regional Park • Wianamatta Nature Reserve • Castlereagh Nature Reserve • Agnes Banks Nature Reserve • Windsor Downs Nature Reserve
(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion.	The Draft Cumberland Plain Conservation Plan to 2056 outlines key commitments that would contribute to the recovery of *Allocasuarina glareicola* in the Cumberland subregion (DPIE, 2020a). Specific key commitments for this species include: • A commitment to secure 1 population of *Allocasuarina glareicola* in conservation lands • Protect about 33 hectares of potential habitat for the species • Prepare a Weed Control Implementation Strategy • Manage fire in strategic locations.

12.1.2 Offsetting requirements

Section 10.3 of the BAM outlines that an offset is not required for impacts on native vegetation where the vegetation integrity:

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

All vegetation integrity scores above those specified above for each group require biodiversity offsets in the form of ecosystem credits. Table 12.4 and Table 12.5 outlines each vegetation type and condition and determine if offsets are required.

Table 12.4 Offsetting requirement for ecosystem credits (off-airport)

Vegetation type	Condition	TEC (BC Act)	TEC (EPBC Act)	Vegetation integrity score	Extent off-airport land (hectares)	Offsets required?
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	Shale Gravel Transition Forest (Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	61.7	2.10 (0.43 + 1.67)	Yes
	Thinned		Not commensurate	39.7	6.91 (6.77 + 0.14)	Yes
	Scattered Trees			44.3	1.41	Yes
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered)	Not listed	76.6	1.34	Yes
	Thinned			71.2	4.40	Yes
	Scattered Trees			36.7	0.49	Yes

Vegetation type	Condition	TEC (BC Act)	TEC (EPBC Act)	Vegetation integrity score	Extent off-airport land (hectares)	Offsets required?
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Thinned	Cumberland Plain Woodland (Critically Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	62.4	4.66	Yes
	Scattered Trees		Not commensurate	20.3	1.73	Yes
	Low			7.8	3.25	No
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	Swamp Oak Floodplain Forest (Endangered)	Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland (Endangered)	66.4	1.07	Yes
	Thinned		Not commensurate	67.5	4.31	Yes

Table 12.5 Offsetting requirement for ecosystem credits (on-airport)

Vegetation type	Condition	TEC (BC Act)	TEC (EPBC Act)	Vegetation integrity score	Extent on-airport land (hectares)	Offsets required?
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered)	Not listed	65.9	1.53	Yes
	Thinned			71.2	0.09	Yes
	Low			2.4	10.21	No[1]

Vegetation type	Condition	TEC (BC Act)	TEC (EPBC Act)	Vegetation integrity score	Extent on-airport land (hectares)	Offsets required?
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Cumberland Plain Woodland (Critically Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	67.8	4.05	Yes
	Scattered Trees		Not commensurate	20.3	2.32	Yes
	Low			7.8	23.79	No[1]
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	Not listed	Not listed	57.4	0.01	Yes

Notes [1] Offsets are not required for the direct impacts to PCTs 835 and PCT 849 in 'low' condition as their vegetation integrity falls below the specific thresholds within Section 10.3 of the BAM.

12.1.3 Impacts that do not require further assessment

Section 10.4 of the BAM outlines that an assessor is not required to assess areas of land impacted by the project for ecosystem credits without native vegetation. Within the study area, this applied to vegetation not assigned to recognised NSW Plant Community Types and are outlined in Table 12.6.

Table 12.6 Summary of non-native vegetation types

Non-native vegetation types	Area within study area (hectares)	
	Off-airport	On-airport
Miscellaneous ecosystem – non-native	76.50	45.14
Miscellaneous ecosystem - urban exotic/native landscape plantings	1.76	0.00
Miscellaneous ecosystem - water bodies rivers, lakes, streams (not wetlands)	6.19	3.48

12.2 Biodiversity credit report

This chapter specifically addresses section 11 of the BAM and provides information on the application of the no net loss standard and the project biodiversity offset obligations. Credit calculations were quantified using the BAM-C Version 1.2.7.2.

12.2.1 Ecosystem credit offset

Ecosystem credits required by the project for off-airport and on-airport impacts are outlined in Table 12.7 and Table 12.8.

Ecosystem credit offset obligation (off-airport)

Table 12.7 Ecosystem credit offset obligation (off-airport)

Vegetation type	Condition	Threatened ecological community (BC Act)	Vegetation integrity loss	Biodiversity Risk Weighting	Extent off-airport land (hectares)	Ecosystem credits required
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Intact	Shale Gravel Transition Forest (Endangered)	-61.7	2	2.10	65
	Thinned		-44.3	2	6.91	153
	Scattered Trees		-39.7	2	1.41	28
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered	-76.6	2	1.34	51
	Thinned		-71.2	2	4.40	157
	Scattered Trees		-36.7	2	0.49	9
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Thinned	Cumberland Plain Woodland (Critically Endangered)	-62.4	2.5	4.66	182
	Scattered Trees		-20.3	2.5	1.73	22
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Intact	Swamp Oak Floodplain Forest (Endangered)	-66.4	2	1.07	36
	Thinned		-67.5	2	4.31	145
Total					**28.42**	**848**

Ecosystem credit offset obligation (on-airport)

Table 12.8 Ecosystem credit offset obligation (on-airport)

Vegetation type	Condition	Threatened ecological community (BC Act)	Vegetation integrity Loss	Biodiversity Risk Weighting	Extent on-airport land (hectares)	Ecosystem credits required
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	River-Flat Eucalypt Forest (Endangered)	-65.9	2	1.53	50
	Thinned		-71.2	2	0.09	3
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Intact	Cumberland Plain Woodland (Critically Endangered)	-67.8	2	4.05	172
	Scattered Trees		-20.3	2.5	2.32	29
PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion	Intact	Not listed	-57.4	2	0.01	1
Total					**8.00**	**255**

12.2.2 Species credit offset

Species credits required by the project for off-airport and on-airport impacts are outlined in Table 12.9 and Table 12.10.

Species credit offset obligation (off-airport)

Table 12.9 Species credit offset obligation (off-airport)

Vegetation zone	Habitat condition loss	Area/count	SAII	Species credits
***Acacia bynoeana* (Bynoe's Wattle) – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	0.82 hectares	No	18
Total		**1.25 hectares**	**-**	**31**
***Acacia pubescens* (Downy Wattle) – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	0.82 hectares	No	18
PCT 724_Scattered Trees	-39.6	0.03 hectares	No	1
PCT 849_thinned	-62.4	0.57 hectares	No	18
PCT 849_Scattered Trees	-20.3	0.39 hectares	No	4
Total		**2.24 hectares**	**-**	**54**
***Allocasuarina glareicola* – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	Yes	20
PCT 724_thinned	-44.3	0.82 hectares	Yes	27
Total		**1.25 hectares**	**-**	**47**
***Cynanchum elegans* (White-flowered Wax Plant) – Flora**				
PCT 849_thinned	-62.4	0.57 hectares	No	18
Total		**0.57 hectares**	**-**	**18**
***Dillwynia tenuifolia* – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	1.6 hectares	No	36
PCT 724_Scattered Trees	-39.7	0.02 hectares	No	1
PCT 849_thinned	-62.4	0.57 hectares	No	18
PCT 849_Scattered Trees	-20.3	0.39 hectares	No	4
Total		**3.05 hectares**	**-**	**72**
***Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea) – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	10
PCT 724_thinned	-44.3	0.82 hectares	No	14
PCT 724_Scattered Trees	-39.6	0.02 hectares	No	1
PCT 835_Intact	-76.6	0.81 hectares	No	23
PCT 835_thinned	-71.2	3.30 hectares	No	88
PCT 835_Scattered Trees	-36.7	0.04 hectares	No	1

Vegetation zone	Habitat condition loss	Area/count	SAII	Species credits
PCT 849_thinned	-62.4	0.57 hectares	No	13
PCT 849_Scattered Trees	-20.3	0.39 hectares	No	3
Total		**6.38 hectares**	**-**	**153**
***Grevillea parviflora subsp. parviflora* (Small-flower Grevillea) - Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	0.82 hectares	No	18
PCT 724_Scattered Trees	-39.6	0.02 hectares	No	1
Total		**1.27hectares**	**-**	**32**
***Marsdenia viridiflora subsp. viridiflora* – (Endangered population *Marsdenia viridiflora* R. Br. subsp. *viridiflora*) – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	0.82 hectares	No	18
PCT 835_Intact	-76.6	0.81 hectares	No	31
PCT 835_thinned	-71.2	31.6 hectares	No	57
PCT 849_thinned	-62.4	0.57 hectares	No	18
Total		**4.23 hectares**	**-**	**137**
***Micromyrtus minutiflora* – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	20
PCT 724_thinned	-44.3	0.82 hectares	No	27
Total		**1.25 hectares**	**-**	**47**
***Pimelea curviflora var. curviflora* – Flora**				
PCT 849_thinned	-62.4	0.57hectares	No	18
Total		**0.57 hectares**	**-**	**18**
***Pimelea spicata* (Spiked Rice-flower) – Flora**				
PCT 849_thinned	-62.4	0.577 hectares	No	18
PCT 849_Scattered Trees	-20.3	0.39 hectares	No	4
Total		**3.66hectares**	**-**	**22**
***Pultenaea parviflora* – Flora**				
PCT 724_Intact	-61.7	0.43 hectares	No	13
PCT 724_thinned	-44.3	0.82 hectares	No	18
Total		**1.25 hectares**	**-**	**31**
***Meridolum corneovirens* (Cumberland Plain Land Snail) - Fauna**				
PCT 724_Intact	-61.7	0.57 hectares	No	18
PCT 724_thinned	-44.3	2.10 hectares	No	47
PCT 835_Intact	-76.6	0.53 hectares	No	20
PCT 835_thinned	-71.2	2 hectares	No	71
PCT 849_thinned	-62.4	0.11 hectares	No	3

Vegetation zone	Habitat condition loss	Area/count	SAII	Species credits
Total		**5.31 hectares**	**-**	**159**
***Myotis macropus* (Southern Myotis) - Fauna**				
PCT 835_Intact	-76.6	0.81 hectares	No	31
PCT 835_thinned	-71.2	1.52 hectares	No	54
PCT 835_Scattered Trees	-36.7	0.05 hectares	No	1
PCT 849_thinned	-62.4	1.2 hectares	No	38
PCT 849_Scattered Trees	-20.3	0.03 hectares	No	1
PCT 849_low	-7.8	2.4 hectares	No	9
PCT 1800_Intact	-66.4	1.07 hectares	No	36
PCT 1800_thinned	-67.5	3.6 hectares	No	122
Total		**10.68 hectares**	**-**	**292**
Total combined species credit offset (off-airport)				**1,113**

Species credit offset obligation (on-airport)

Table 12.10 Species credit offset obligation (on-airport)

Vegetation zone	Habitat condition loss	Area/count	SAII	Species credits
***Meridolum corneovirens* (Cumberland Plain Land Snail) - Fauna**				
PCT 849_Intact	-67.8	4.00 hectares	No	137
PCT 835_Intact	-65.9	1.50 hectares	No	50
PCT 849_Scattered Trees	-20.3	0.07 hectares	No	1
Total		**5.57 hectares**	**-**	**188**
***Myotis macropus* (Southern Myotis) - Fauna**				
PCT 835_Intact	-65.9	0.05 hectares	No	2
Total				**2**
Total combined species credit offset (on-airport)				**190**

Table 12.11 Summary of ecosystem credits required

Credit obligations	Off-airport	On-airport
Ecosystem credits		
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	246	-
PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	217	53
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	204	201
PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0	1
PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	181	-
Total number of ecosystem credits	**848**	**255**
Species credits		
Acacia bynoeana (Bynoe's Wattle) – Flora	31	-
Acacia pubescens (Downy Wattle) – Flora	54	-
Allocasuarina glareicola – Flora	47	-
Cynanchum elegans (White-flowered Wax Plant) – Flora	18	-
Dillwynia tenuifolia – Flora	72	-
Grevillea juniperina subsp. juniperina (Juniper-leaved Grevillea) - Flora	153	-
Grevillea parviflora subsp. parviflora (Small-flower Grevillea) - Flora	32	-
Marsdenia viridiflora subsp. viridiflora – (Endangered population *Marsdenia viridiflora R. Br. subsp. viridiflora*) - Flora	137	-
Meridolum corneovirens (Cumberland Plain Land Snail) - Fauna	159	188
Micromyrtus minutiflora – Flora	47	-
Myotis macropus (Southern Myotis) - Fauna	292	2
Pimelea curviflora var. curviflora – Flora	18	-
Pimelea spicata (Spiked Rice-flower) – Flora	22	-

Credit obligations	Off-airport	On-airport
Pultenaea parviflora – Flora	31	-
Total number of species credits	**1,113**	**190**

12.2.3 Offsetting strategy

The biodiversity offset strategy for this project, that would enable the credit obligations to be met, comprises two options. These options are:

- the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register
- through making a payment into the Biodiversity Conservation Fund.

Existing biodiversity credits

The purchase and retirement of existing biodiversity credits is required to be undertaken based on like for like trading rules as outlined under the Biodiversity Conservation Regulation 2017 and as identified by the BAM calculator output for the project (see Appendix H). The like for like ecosystem credit class options for each biodiversity offset credit obligation is summarised in Table 12.12 (off-airport) and Table 12.13 (on-airport).

Table 12.12 Like for like trading ecosystem credit classes (off-airport)

Any PCT within the below TEC	HBT	In the below IBRA subregion
Credit classes for PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion		
Shale Gravel Transition Forest in the Sydney Basin Bioregion This includes PCTs: 724, 808	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion		
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCTs: 686, 828, 835, 839, 941, 971, 1064, 1108, 1109, 1212, 1228, 1232, 1293, 1318, 1326, 1386, 1522, 1556, 1594, 1618, 1646, 1648, 1720, 1794	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion		
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCTs: 849, 850	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley		
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCTs: 915, 916, 917, 918, 919, 1125, 1230, 1232, 1234, 1235, 1236, 1726, 1727, 1728, 1729, 1731, 1800, 1808	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.

Table 12.13 Like for like trading ecosystem credit classes (on-airport)

Any PCT within the below TEC	HBT	In the below IBRA subregion
Credit classes for PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion		
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCTs: 686, 828, 835, 839, 941, 971, 1064, 1108, 1109, 1212, 1228, 1232, 1293, 1318, 1326, 1386, 1522, 1556, 1594, 1618, 1646, 1648, 1720, 1794	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion		
Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCTs: 849, 850	Yes	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.
Credit classes for PCT 1071 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion		
Coastal Freshwater Lagoons This includes PCTs: 781, 783, 1071, 1735, 1736, 1737, 1740, 1741, 1742 Coastal Freshwater Lagoons - ≥ 70per cent - <90per cent cleared group (including Tier 4 or higher)	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometres of the outer edge of the project.

In relation to like for like species credit trading options, the offset for species credits can be sourced from anywhere in NSW.

Sydney Metro are committed to delivering offsets for any residual impacts as a result of the project in accordance with BAM.

The final quantification and delivery of offset liability will be determined based on a vegetation clearing report and delivered within 12 months of the final design and construction plan. During design development for the project the biodiversity impacts, offset obligations and credit calculations will be reviewed, and if necessary updated.

13 Conclusion

Sydney Metro – Western Sydney Airport would involve the construction and operation of a new metro railway line around 23 kilometres in length between the T1 Western Line at St Marys in the north and the Aerotropolis in the south. This would include a section of the alignment which passes through and provides access to Western Sydney International.

The project is characterised into two main components:

- outside Western Sydney International (off-airport)
- within Western Sydney International (on-airport).

The off-airport component is comprised of two sections:

- south of Western Sydney International
- north of Western Sydney International.

For off-airport land south of Western Sydney International, impacts on MNES and Commonwealth Land protected by the EPBC Act have already been assessed and approved under the *Sydney Growth Centres Strategic Assessment: Program Report* (DECCW and DoP 2010). This means the potential impacts of the project on biodiversity within the off-airport land south of Western Sydney International do not require State or Commonwealth approval and are therefore not subject to further assessment in this BDAR.

The off-airport land north of Western Sydney International is currently subject to strategic biodiversity conservation planning (the 'Cumberland Plain Conservation Plan') under preparation by the DPIE. The Cumberland Plain Conservation Plan was exhibited in August 2020 and incorporates a strategic biodiversity certification under the BC Act and EPBC Act. The strategic biodiversity certification incorporates detailed field survey and assessments, and species expert reports required under the NSW BAM. Given uncertainty around the timing of the Cumberland Plain Conservation Plan finalisation and endorsement, the project is not included within the Cumberland Plain Conservation Plan assessment.

As the certification has not yet been achieved, the potential off-airport impacts of the project on biodiversity north of Western Sydney International, are therefore still subject to a separate BDAR (this report) under the BC Act and assessment under the EP&A Act and the EPBC Act.

Delivery of the off-airport component of the project (north of Western Sydney International) would have a residual impact on up to 31.67 hectares of native vegetation (29.86 hectares direct impact and 1.81 hectares indirect impact) that is consistent with following TECs under the BC Act:

- Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered
- Shale Gravel Transition Forest in the Sydney Basin Bioregion – Endangered
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.

Two threatened flora species, *Grevillea juniperina* subsp. *juniperina* and *Dillwynia tenuifolia*, listed as vulnerable under the BC Act were recorded within the study area during project field surveys. A total of 1,225 individuals of *Grevillea juniperina* subsp. *juniperina* were recorded. This species is also considered likely to occur in parts of the study area not yet accessed for field survey and as such assumed presence has been adopted for these areas. The total combined area of habitat for *Grevillea juniperina* subsp. *juniperina* within the study area has been estimated to be about 6.38 hectares. There were 100 individuals of *Dillwynia tenuifolia* recorded. The total combined area of habitat for *Dillwynia tenuifolia* within the study area has been estimated to be about 3.05 hectares.

A total of 12 threatened flora species were considered to have a moderate or higher likelihood of occurrence within the off-airport study area. Due to limited access to private residential properties for project field surveys, a conservative assessment has been applied and 12 threatened flora species have been assumed present based on presence of associated habitat. These species are considered affected by the project and species credits have been assigned for offsetting purposes.

A total of 47 threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the off-airport study area and, following survey and assessment, 18 fauna species have been assigned to ecosystem credit species calculations for offsetting purposes.

Two threatened fauna species (Cumberland Plain Land Snail and Southern Myotis) were recorded or have been assumed present within the off-airport study area and have been assigned to species credit calculations for offsetting purposes.

No threatened fish species listed under *the Fisheries Management Act 1994 (FM Act)* or EPBC Act were recorded or considered likely to occur within the study area and as such the project is unlikely to significantly impact any threatened aquatic species or their habitats.

On-airport

The on-airport land occurs within the area covered by the *Airport Plan for Western Sydney Airport* (the 'Airport Plan').

The Airport Plan was approved in December 2016 under the Commonwealth *Airports Act 1996* (Airports Act) and guides development on the site. Section 160 of the EPBC Act requires that a variation to the Airport Plan must be the subject of advice from the Commonwealth Minister for the Environment. This advice is received through a modified referral process, which involves the assessment of environmental impacts. The Commonwealth Minister for the Environment advised that the on-airport components of the project would be assessed based on the provision of preliminary documentation (see the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541)).

The Airport Plan approved construction within the Western Sydney International Stage 1 CIZ and this construction has commenced. An ECZ buffering the environmental values along Badgerys Creek was also established as part of the Airport Plan approval. To address the information requirements of the Airport Plan Variation, potential biodiversity impacts of the project on-airport (but outside the Stage 1 CIZ) have been assessed under the NSW BAM in this BDAR and summarised within the EPBC Act Final Environmental Impact Assessment of the on-airport proposed action (EPBC 2019/8541)).

There were no access restrictions for field surveys within the on-airport section of the project. Delivery of the on-airport component of the project would have a residual impact on up to 42 hectares of native vegetation that is consistent with following threatened ecological communities under the NSW BC Act:

- Cumberland Plain Woodland in the Sydney Basin Bioregion – Critically Endangered
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.

Of these, only Cumberland Plain Shale Woodlands meets the criteria for listing under the EPBC Act.

No threatened flora species were recorded or are considered affected within the on-airport study area. As such, no threatened flora species have been assigned as species credit species for offsetting purposes in accordance with BAM.

A total of 17 threatened fauna species were considered to have a moderate or higher likelihood of occurrence within the on-airport study area have been assigned as ecosystem credit species.

A total of two threatened fauna species listed under the BC Act (Cumberland Plain Land Snail and Southern Myotis) and one species Grey-headed Flying-fox as listed under the EPBC Act (were recorded or assumed present within the on-airport study area. Cumberland Plain Land Snail and Southern Myotis have been assigned to species credit calculations and the Grey-headed Flying-fox to ecosystem credit calculations for offsetting purposes.

No threatened fish species listed under the FM Act or EPBC Act were recorded or considered likely to occur within the study area and as such the project is unlikely to significantly impact any threatened aquatic species or their habitats.

Avoidance and design refinement

The project has been refined to avoid and minimise potential impacts on biodiversity including:

- refining the construction footprint to minimise impacts on TECs and to avoid vegetation that provides fauna habitat and movement corridors
- providing fauna connectivity structures (for example viaducts, bridges and culverts) to assist fauna habitat connectivity
- straightening the project alignment to avoid vegetation impacts
- designing tunnel options to avoid direct impacts on ecologically sensitive environments (e.g. riparian vegetation, Cumberland Plain Woodland and the Badgerys Creek Environment Conservation Zone).

Mitigation and management

The proposed specific performance outcomes for the project with regard to biodiversity including:

- minimising or where possible avoiding impacts to threatened flora and fauna species, and ecological communities listed under the BC Act and EPBC Act
- managing groundwater drawdown at Orchard Hills and Bringelly to avoid or minimise impacts on groundwater dependent ecosystems (for example Shale Gravel Transition Forest in the Sydney Basin Bioregion)
- offsetting impacts to threatened ecological communities and species.

A Construction Environmental Management Framework (CEMF) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor in developing the CEMP, sub-plans, and other supporting documentation for each specific environmental aspect.

Specific sub-plans from the CEMF that would be developed to address biodiversity values would include a Flora and Fauna Management Plan (FFMP). Recommendations to be included in a FFMP have been included in this BDAR.

Offsetting biodiversity impacts

Residual impacts that are not able to be managed through mitigation would be offset in accordance with BAM based on Biodiversity Assessment Method Calculator (BAMC) calculations for both ecosystem and species credits.

The project offset obligation has been calculated to require the following biodiversity credits:

Off-airport:

- up to 848 ecosystem credits
- up to 1,113 species credits.

On-airport:

- up to 255 ecosystem credits
- up to 190 species credits.

For off-airport land north of Western Sydney International, this BDAR has incorporated additional targeted field surveys for threatened species with seasonal requirements undertaken in Spring 2020.

The results of these field surveys are incorporated into the revised biodiversity offset obligation and revised credit calculation for the project. During design development and construction planning for the project the biodiversity impacts, offset obligations and credit calculations will be reviewed, and if necessary updated.

14 References

Bureau of Meteorology (2020). "Bureau of Meteorology - Groundwater Dependent Ecosystems Atlas." 2020, from http://www.bom.gov.au/water/groundwater/gde/.

Chessman, B. (2003). "New sensitivity grades for Australian river macroinvertebrates." Marine and Freshwater Research 54(2): 95-103.

Clark, S. (2018). Strategic assessment for Cumberland Plain Conservation Plan. expert report on the Cumberland Plain Land Snail, *Meridolum corneovirens* (Pfeiffer, 1851) in the Penrith, Western Sydney Aerotropolis, Greater Macarthur and Wilton Growth Areas. Faulconbridge, NSW, Prepared for the New South Wales Department of Planning & Environment.

Churchill, S. (2008). Australian Bats. Allen and Unwin, Crows Nest, NSW.

Commonwealth of Australia (2018). Western Sydney Airport – Biodiversity Offsets Delivery Plan.

Cropper, S. C. (1993). Management of Endangered Plants. Melbourne, CSIRO Australia.

Department of Agriculture, Water and the Environment (2020a). Rapid analysis of impacts of the 2019-20 fires on animal species, and prioritisation of species for management response – preliminary report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel. Canberra.

Department of Agriculture, Water and the Environment (2020b). Provisional list of plants requiring urgent management intervention– preliminary report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel. Canberra.

Department of Agriculture, Water and the Environment (2020c). National Flying-fox monitoring viewer

Department of Environment and Climate Change (2002). *Descriptions for NSW (Mitchell) Landscapes Version 2.*

Department of Environment and Climate Change (2009). Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians.

Department of Environment, Climate Change and Water NSW (2009b). Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment and Conservation. (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft). Hurstville

Department of Environment and Conservation (2005b). *Recovering bushland on the Cumberland Plain - Best practice guidelines for the management and restoration of bushland. Hurstville, Department of Environment and Conservation*

Department of Environment and Energy (2020). "Australian Faunal Directory." 2020, from https://biodiversity.org.au/afd/home.

Department of Environment and Energy (2020). "Directory of Important Wetlands in Australia." from http://www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands.

Department of Environment and Energy (2020a). *Protected Matters Search Tool*, from https://www.environment.gov.au/epbc/protected-matters-search-tool.

Department of Environment and Energy (2020). "Register of Critical Habitat." 2020, from https://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl.

Department of Environment Water Heritage and the Arts (2010). *Survey guidelines for Australia's threatened bats - Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.*

Department of Environment Water Heritage and the Arts (2010). *Survey guidelines for Australia's threatened birds - Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.*

Department of Environment Water Heritage and the Arts (2010). *Survey guidelines for Australia's threatened frogs - Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.*

Department of Environment and Water Resources (2007). *Cumberland Plain Woodlands. Advice to the Minister for the Environment and Water Resources from the Endangered Species Scientific Subcommittee (ESSS) on a project to add an ecological community to Schedule 2 of the Endangered Species Protection Act 1992 (ESP Act). Department of Environment and Water Resources*

Department of Infrastructure and Regional Development (2016e). *Western Sydney Airport - Environmental Impact Statement, Biodiversity Assessment,* Prepared by GHD

Department of Infrastructure and Regional Development (2018). Western Sydney Airport – Biodiversity Assessment Report for land outside Stage 1 Development. Prepared by GHD

Department of Planning, Industry and Environment (2020a). *Draft Cumberland Plain Conservation Plan to 2056*. Sydney, NSW Government. Department of Primary Industries 2013, *Policy and guidelines for fish habitat conservation and management – Update 2013*

Department of Primary Industries (2019). "NSW WeedWise." from https://weeds.dpi.nsw.gov.au/.

Department of Primary Industries (2020a). "Fisheries NSW Spatial Data Portal." 2020, from https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal.

Department of Primary Industries (2020b). "Critical Habitat Register", from https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what/register

Department of Primary Industries (2020c). "Priority Weed Listings for the Greater Sydney Region", from https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=3

Department of the Environment and Energy (2016). An Interim Biogeographic Regionalisation of Australia (IBRA) - Version 7. Canberra, Department of the Environment and Energy.

Department of the Environment Water Heritage and the Arts (2010). Survey guidelines for Australia's threatened frogs - guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

Environment Energy and Science (EES) Group (2020). "ASMS database threatened species information." from https://www.environment.nsw.gov.au/asmslightprofileapp/account/login?ForceLogin=1.

Fairfull, S. and G. Witheridge (2003). Why do fish need to cross the road? Fish passage requirements for waterway crossings. Cronulla, NSW Fisheries.

GHD (2020). Department of Defence Orchard Hills Offset Area Offset Plan,

Gonsalves, L. and law, B. (2018). "Seasonal activity patterns of bats in North Sydney, New South Wales: implications for urban bat monitoring programs". Australian Mammalogy 40(2) 220-229.

Hamilton Smith, E. and Dwyer PD. (1965). "Breeding Caves and Maternity Colonies of the Bent-winged Bat in South-Eastern Australia".

Hoye, G. and Spence, J. (2004). The Large Bent-wing Bat *Miniopteris schreibersii* in Urban Environments: a survivor? Pp 138-147 in *Urban Wildlife: more than meets the eye*. Royal Zoological Society of New South Wales, Mosman, NSW.

James, T. (2018). Strategic Assessment for Cumberland Plain Conservation Plan Greater Macarthur and Wilton Growth Areas - expert report for *Pimelea spicata* Spiked Rice-flower Prepared for NSW Department of Planning & Environment.

Landcom (2004). Soils and construction: managing urban stormwater.

Lemckert, F. (2019) *Strategic assessment for Cumberland Plain Conservation Plan - expert report for the Green and Golden Bell Frog (Litoria aurea).*

Lumsden, L. F. and Jemison, M. L. (2015). National Recovery Plan for the Southern Bent-wing Bat *Miniopterus schreibersii bassanii*. Department of Environment, Land, Water and Planning.

Marcus Lincoln Smith (2003). Aquatic Ecology in Environmental Impact Assessment. Prepared on behalf of Department of Planning. Sydney, The Ecology Lab P/L.

Miller, R. (2018a). Strategic assessment for Cumberland Plain Conservation Plan - Hibbertia fumana Report prepared for Department of Planning and Environment Cumberland Flora & Fauna Interpretive Services

Miller, R. (2018b). Strategic assessment for Cumberland Plain Conservation Plan - Hibbertia puberula species group Report prepared for Department of Planning and Environment Cumberland Flora & Fauna Interpretive Services.

National Parks and Wildlife Service (2000). Cumberland Plain Land Snail (Meridolum corneovirens Pfeiffer, 1851) Environmental Impact Assessment Guidelines. Hurstville, National Parks and Wildlife Service.

NSW Department of Planning and Environment (2020). "State Environmental Planning Policy (Coastal Management) 2018 - maps spatial viewer." 2020, from http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=SEPP_CoastalManagement.

NSW Fisheries (2013). Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). NSW Department of Primary Industries, Fisheries NSW.

NSW Environment, Energy and Science Group (2020a), Areas of Outstanding Biodiversity Value register, from https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register

NSW Environment, Energy and Science Group (2020b), Estuaries of NSW Database, from https://www.environment.nsw.gov.au/topics/water/estuaries/estuaries-of-nsw/search-nsw-estuary-profiles

NSW Environment, Energy and Science Group (2020c), Plant Community Identification Tool, from https://www.environment.nsw.gov.au/research/Visclassification.htm

NSW Environment, Energy and Science Group (2020d), Threatened Biodiversity Data Collection, from http://www.bionet.nsw.gov.au/

NSW Government (2016). "Land and Property Information."

NSW Scientific Committee (1997). Final determination to list Cumberland Plain Woodland as an endangered ecological community. Hurstville, NSW National Parks and Wildlife Service

NSW Scientific Committee (2008). "Preliminary determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from http://www.environment.nsw.gov.au/determinations/cumberlandplainpd.htm

NSW Scientific Committee (2011). "Final determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm

NSW Spatial Services (2020). Aerial Photographic Imagery from https://maps.six.nsw.gov.au/

Office of Environment & Heritage (2016). NSW Mitchell Landscapes Version 3.1.

Office of Environment and Heritage (2016b). The Native Vegetation of the Sydney Metropolitan Area. Version 3.0. Sydney, Office of Environment and Heritage, Department of Premier and Cabinet.

Office of Environment & Heritage (2016c). NSW Guide to Surveying Threatened Plants. Sydney, Office of Environment and Heritage.

Office of Environment & Heritage (2017a). Biodiversity Assessment Method: 1-126.

Office of Environment and Heritage (2017b). "Cumberland Plain Woodland in the Sydney Basin Bioregion - Profile.".

Office of Environment & Heritage (2018). "SEED | Sharing and Enabling Environmental Data."

Office of Environment & Heritage (2018b). ‘Species credit’ threatened bats and their habitats – NSW survey guide for the biodiversity assessment method

Office of Environment and Heritage (2020). "Acid sulfate soils." from https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/acid-sulfate-soils.

Office of Environment & Heritage (2020). "Biodiversity Assessment Calculator." from https://www.lmbc.nsw.gov.au/bamcalc/home/AssessmentCal.

Office of Environment & Heritage (2020). "BioNet Vegetation Classification Database." 2019, from http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx.

Office of Environment Energy and Science (2020). "BioNet Atlas of NSW Wildlife." from http://www.bionet.nsw.gov.au/.

Open Lines and Biosis (2020). Draft Cumberland Plain Assessment Report

Pennay, M., et al. (2004). Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats. Sydney, New South Wales Department of Environment and Conservation and State Forests of New South Wales.

Smith, Lincoln (2003), *The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline*

Transport for New South Wales (2011). Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects.

Transport for New South Wales (2019b). M12 Motorway Concept Design and Environmental Impact Statement - Biodiversity assessment report. Sydney, Prepared by Jacobs and Arcadis Joint Venture.

Transport for New South Wales (2020). M12 Motorway Concept Design and Environmental Impact Statement – Amendment Report. Sydney, Prepared by Jacobs and Arcadis Joint Venture.

Royal Botanic Gardens (2020). "Plantnet - The Plant Information Network System of Botanic Gardens Trust Version 2.0." 2020, from http://plantnet.rbgsyd.nsw.gov.au/.

Rymer, P. (2019). Cumberland Plain Conservation Plan - expert report for *Dillwynia tenuifolia*. Report prepared for Department of Planning and Environment, Hawkesbury Institute for the Environment - Western Sydney University.

Saunders; T. and S. Debus; (2018). Strategic Assessment for the Little Eagle (*Hieraaetus morphnoides*) in the Greater Macarthur Growth Area and the Wilton Growth Area Report prepared for the Department of Environment and Planning

SMEC (2014). Environmental field survey of Commonwealth Land at Badgerys Creek. Report prepared for Western Sydney Unit Department of Infrastructure and Regional Development.

Swan, G., et al. (2004). A Field Guide to Reptiles of New South Wales. Sydney, Reed New Holland.

Sydney Metro (2020a), Sydney Metro – Western Sydney Airport Environmental Impact Statement

Tozer, M., et al. (2010). "Native Vegetation of southeast NSW: a revised classification and map for the coast and tablelands." Cunninghamia 11(3).

Weston, P. (2018a). Strategic assessment for Cumberland Plain Conservation Plan - expert report on the Juniper-leaved Grevillea, *Grevillea juniperina subsp. juniperina* in the Greater Macarthur and Wilton Growth Areas. Lindfield, NSW.

Weston, P. (2018b). Strategic assessment for Cumberland Plain Conservation Plan - expert report on *Pterostylis saxicola*, the Sydney Plains Greenhood, in the Greater Macarthur and Wilton Growth Areas Lindfield, NSW.

Weston, P. (2019a).Strategic assessment for Cumberland Plain Conservation Plan - expert report on the Juniper-leaved Grevillea, Grevillea juniperina subsp. juniperina in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area

Weston, P. (2019b). Strategic assessment for Cumberland Plain Conservation Plan - expert report on the Sydney Plains Greenhood, *Pterostylis saxicola* in the Western Sydney Aerotropolis Growth Area, and Greater Penrith to Eastern Creek Urban Release Investigation Area Lindfield, NSW, Prepared for the Department of Planning and Environment.

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Appendix A

Threatened flora habitat suitability assessment

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Acacia bynoeana	Bynoe's Wattle	E	V	22	BAM-C, BioNet, PMST	-	Low. Preferred habitat (sandy soils) were not recorded.	**Moderate.** Though preferred habitat (sandy soils) was not recorded, vegetation type PCT 724, is known to form associated habitat.
Acacia pubescens	Downy Wattle	V	V	247	BAM-C, BioNet, PMST	-	**High.** *Acacia pubescens* has been frequently recorded in Western Sydney and is known to occur in Cumberland Plain Woodland and Shale/Gravel Transition Forest. Associated vegetation type PCT 849 was recorded within the Subject Land.	**High.** *Acacia pubescens* has been frequently recorded in Western Sydney and is known to occur in Cumberland Plain Woodland and Shale/Gravel Transition Forest. Associated vegetation types PCT 724 and 849 were recorded within the Subject Land.
Allocasuarina diminuta subsp. mimica - Endangered population	Allocasuarina diminuta subsp. mimica population in the Sutherland Shire and Liverpool City local government areas	E	-	7	BioNet	-	Low. This populations occurs along sandstone ridges and upper hillsides in the region northwest from Heathcote, towards Menai and Holsworthy, in heathy and low open woodland communities. No associated vegetation types recorded within the Subject Land.	
Allocasuarina glareicola	-	E	E	1	BAM-C, BioNet, PMST	-	Low. Associated geology, tertiary alluvial gravels, not recorded.	**Moderate.** This species is known to occur in Castlereagh Woodland in the Western Sydney area. Associated vegetation types PCT 724 was recorded.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Asterolasia elegans	Asterolasia elegans	E	E	0	PMST	-	Low. Preferred habitat, Hawkesbury sandstone substrates, not recorded within the Subject Land. Associated vegetation types not recorded.	
Astrotricha crassifolia	Thick-leaf Star-hair	V	V	1	BioNet, PMST	-	Low. Preferred habitat, Hawkesbury sandstone substrates, not recorded within the Subject Land. Associated vegetation types not recorded.	
Caladenia tessellata	Thick Lip Spider Orchid	E	V	0	BAM-C, PMST	-	Low**.** Though associated vegetation type PCT 849 was recorded, all *Caladenia tessellata* records occur to the east of Prospect Reservoir.	Low**.** Though associated vegetation types PCT 724 and 849 was recorded, all *Caladenia tessellata* records occur to the east of Prospect Reservoir.
Callistemon linearifolius	Netted Bottle Brush	V	-	4	BAM-C, BioNet	-	Low. Scattered records in Western and South-Western Sydney area with majority of the western records being centred around Bankstown. Though associated vegetation type, PCT 835, was recorded this species is considered unlikely to occur.	
Commersonia prostrata	Dwarf Kerrawang	E	E	0	BAM-C	-	Low. Preferred habitat, sandy / peaty soils and associated species not recorded within the Subject Land.	
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	0	PMST	-	Low. Preferred habitat, swamp-heath and drier forest on sandy soils on granite & sandstone, not recorded within the Subject Land.	
Cynanchum elegans	White-flowered Wax Plant	E	E	8	BAM-C, BioNet, PMST	**-**	**Moderate.** Previously recorded as a small population near Cobbitty. Associated vegetation types PCT 835 and 849 recorded.	**Moderate.** Previously recorded as a small population near Cobbitty. Associated vegetation types PCT 835 and 849 recorded.
Darwinia biflora	-	V	V	0	PMST	-	Low. Preferred habitat, shale-capped ridges and Hawkesbury sandstone geology, and associated vegetation types not recorded within the Subject Land.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Deyeuxia appressa	Deyeuxia appressa	E	E	0	BAM-C	-	Low. Though associated vegetation type, PCT 1800, was recorded within the Subject Land, this species is only known to occur to the south of Bankstown and Killara, NSW.	
Dillwynia tenuifolia	-	V	-	1074	BAM-C, BioNet, PlantNet	-	**High.** *Dillwynia tenufolia* is known to occur on the Cumberland Plain has been frequently recorded within locality. Rymer (2019) identified the Kemps Creek area as the most southerly extent of *Dillwynia tenuifolia,* some of which will form the Endangered population. This is roughly in line with the most northern extent of WSA (Western Sydney Airport). As such, this species is predicted occur from the north of the WSA to the end of the alignment in associated vegetation types PCT 724 and 849.	
Dillwynia tenuifolia - Endangered population	*Dillwynia tenuifolia*, Kemps Creek	E	-	68	BAM-C, BioNet	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool LGA	Low. The Endangered population occurs in the area bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. The Subject Land is not located within this area.	
Diuris aequalis	Buttercup Doubletail	E	V	1	BioNet	-	Low. Preferred habitat, forest and low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands (especially on the Great Dividing Range), not recorded. Associated vegetation types not recorded within the Subject Land.	
Epacris purpurascens var. purpurascens	-	V	-	1	BioNet	-	Low. No associated vegetation types within the Subject Land. This species is not known to occur to the West of Westlink M7 motorway.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Eucalyptus benthamii	Camden White Gum	V	V	169	BAM-C, BioNet, PMST	-	Low**.** This species is known to occur on the alluvial flats of the Nepean River and its tributaries with all historic records to the west of the alignment. Associated vegetation types PCT 835 and 849 were recorded within the Subject Land. Although unlikely based on known distributional limits.	
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	3	BioNet	Survey: Easily confused with *E. acaciiformis* and *E. radiata* and is often planted well outside range.	Low. The natural distribution of this species does not occur within the Sydney Basin Bioregion. *Eucalyptus nicholii* has been widely distributed by the horticultural industry as ornamental landscape plantings.	
Eucalyptus scoparia	Wallangarra White Gum	E	V	2	BioNet	Cliffs or Rocky areas or within 100m This species is frequently planted well outside range.	Low. The natural distribution of this species does not occur within the Sydney Basin Bioregion. *Eucalyptus scoparia* has been widely distributed by the horticultural industry as ornamental landscape plantings.	
Eucalyptus sp. Catti	Eucalyptus sp. Catti	CE	CE	0	PMST	-	Low. Preferred habitat, sandy soils, and associated vegetation types not recorded within the Subject Land.	
Genoplesium baueri	Bauer's Midge Orchid	E	E	1	BioNet, PMST	-	Low. No preferred habitat (dry sclerophyll forest, moss gardens over sandstone) or associated vegetation types recorded within the Subject Land.	
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V	-	1657	BAM-C, BioNet, PlantNet	**-**	**Moderate.** This species is known to occur on the Cumberland Plain and in Shale/Gravel Transition Forest and has been frequently recorded within locality. Associated vegetation types PCT 724 and 849 were recorded within the Subject Land.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	944	BAM-C, BioNet, PMST	-	**Moderate.** Though associated habitat, Shale Gravel Transition Forest (PCT 724) was not recorded, this species is considered further due to the high number of recorded within locality.	**High.** This species has been frequently recorded within locality of the Subject Land with two small populations recorded to the west of Westlink M7 motorway, at Kemps Creek and Colyton. Associated vegetation types PCT 724 was recorded.
Gyrostemon thesioides	-	E	-	31	BAM-C, BioNet	-	Low. Though associated vegetation types, PCT 724 were recorded, this species has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers within NSW. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches.	
Haloragis exalata subsp. exalata	Square Raspwort	V	V	0	BAM-C, PMST	-	Low. This species is known from four disjunct populations, none of which are known to occur within locality of the Subject Land.	
Hibbertia fumana	-	CE	-	882	BAM-C, BioNet	-	Low. Associated vegetation type, PCT 724 was not recorded.	**Moderate.** Though associated vegetation types, PCT 724 was recorded, this species is known from Moorebank area, east of the Westlink M7 motorway. This is a recently re-discovered species which is potentially elsewhere is the Greater Sydney area.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Hibbertia puberula	-	E	-	957	BioNet	-	Low. Associated vegetation, PCT 724, not recorded.	Low. Though preferred habitat, sandy soils, and associated vegetation types not recorded within the Subject Land. This species was recently recorded (2018) within proximity to the Subject Land near Ropes Crossing. This species will be targeted as part of broader *Hibbertia fumana* surveys in PCT 724.
Hibbertia sp. Bankstown	Hibbertia sp. Bankstown	CE	CE	0	BAM-C	-	Low. Though associated vegetation type PCT 835 was recorded within the Subject Land, this species is known from one population at Bankstown Airport.	
Isotoma fluviatilis subsp. fluviatilis	-	-	X	10	BioNet	-	Low. This species is presumed to be extinct.	
Leucopogon exolasius	Woronora Beard-heath	V	V	13	BioNet, PMST	-	Low. Preferred habitat, woodland on sandstone geology, and associated vegetation types were not recorded. Historic records are generally restricted to the east of the Westlink M7 motorway and south of Picton. One outlier individual was recorded near Camden in 1843.	
Leucopogon fletcheri subsp. fletcheri	-	E	-	4	BioNet	Slopes nearby rocky areas or within 50 m Rocky areas: Weathered laterite over sandstone on sandstone ridges, outcrops	Low. This species is restricted to north-western Sydney and is known to occur in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. No preferred habitat or associated vegetation types recorded within the Subject Land.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
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	E	-	311	BAM-C, BioNet	Blacktown, Camden, Campbelltown, Canterbury-Bankstown, Cumberland, Fairfield, Liverpool and Penrith LGAs (as amended from the Determination))	**High.** This species is known to occur and has been recently recorded at Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. A total of 142 stems were previously recorded at WSA in 2016 (GHD, 2016). All vegetation types recorded form associated habitat.	
Maundia triglochinoides	Maundia triglochinoides	V	-	0	BAM-C	Riparian areas/drainage lines, water ponding, man-made dams and drainage channels, shallow swamps, waterbodies up to 1 m deep or semi-permanent/ephemeral wet areas	Low. Though associated vegetation type, PCT 1800, was recorded, this species is restriction to coastal NSW with Sydney populations considered to be extinct.	
Melaleuca biconvexa	Biconvex Paperbark	V	V	0	BAM-C	-	Low. This species is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	
Melaleuca deanei	Deane's Paperbark	V	V	21	BioNet, PMST	-	Low. This species is generally not recorded from the Cumberland Plain with coastal populations restricted to Campbelltown as the western limit and occurrences in the Blue Mountains area.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Micromyrtus minutiflora	-	E	V	58	BAM-C, BioNet, PMST, PlantNet	-	Low. Associated habitat, PCT 724, was not recorded.	**Moderate.** This species is generally restricted between Richmond and Penrith a small population at Ropes Crossing (within close proximity to the Subject Land). Associated vegetation type PCT 724 was recorded.
Persicaria elatior	Tall Knotweed	V	V	0	BAM-C	Semi-permanent/ephemeral wet areas, swamps, waterbodies (or wetlands) or within 50 m of these areas.	Low. Though associated vegetation types, PCT 835 and 1800, were recorded within the Subject Land, this species is not known to occur in the Cumberland Plain with the nearest records being at Picton and Tahmoor.	
Persoonia bargoensis	Bargo Geebung	E	V	0	BAM-C, PMST	-	Low. This species is not known to occur on the Cumberland Plain with the nearest population being recorded south of Picton.	
Persoonia hirsuta	Hairy Geebung	E	E	6	BAM-C, BioNet, PMST	-	Low. Preferred habitat, sandy soils and sandstone geologies, not recorded within the Subject Land. Though associated vegetation type, PCT 835, was recorded, this species is generally not recorded on the Cumberland Plain. Within locality of the Subject Land, historic records generally restricted to the east of Westlink M7 motorway and in Windsor Downs Nature.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Persoonia nutans	Nodding Geebung	E	E	336	BAM-C, BioNet, PMST, PlantNet	-	Low. Associated habitat, PCT 724, not recorded.	**Moderate.** This species is known to occur on the Cumberland Plain between Richmond and Macquarie Fields. Associated vegetation types PCT 724 was recorded. This species has been recently recorded in the northern sections of the Subject Land.
Pilularia novae-hollandiae	Austral Pillwort	E	-	1	BAM-C, BioNet	-	Low. Though associated vegetation types, PCT 835 and 1800, were recorded, preferred habitats being shallow swamps and waterways, were limited within the Subject Land. This species has one record within locality, near Bungarribee, from 1966.	
Pimelea curviflora var. curviflora	-	V	V	1	BAM-C, BioNet, PMST	-	Low. This species is known to prefer shale sandstone transition soils. These soil types were not recorded.	**Moderate.** Though this species is known to prefer shale sandstone transition soils which were not recorded, two recent records (2010, 2018) exist in the northern sections of the Subject Land near Mount Druitt and Arndell Park. As such, this species is considered further
Pimelea spicata	Spiked Rice-flower	E	E	991	BAM-C, BioNet, PMST, PlantNet	-	**Moderate.** This species is known to occur on the Cumberland Plain with scattered records along the entire Subject Land. Associated vegetation types, PCT 849 recorded.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Pomaderris brunnea	Brown Pomaderris	E	V	39	BAM-C, BioNet, PMST	- NOTE: Check was GHD has done Page: 273	**Moderate.** This species is known to prefer moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Associated vegetation types, PCT 835 and 1800, were recorded. Records within locality are generally restricted to Nepean River near Camden.	Low. Off-airport lands are outside of this species known distribution which is generally restricted to the South and East of Camden.
Pterostylis gibbosa	Illawarra Greenhood	E	E	0	PMST	-	Low. This species is known from the Hunter, Illawarra and Shoalhaven regions. Western Sydney populations are considered extinct. No associated vegetation types recorded within the Subject Land.	
Pterostylis nigricans	Dark Greenhood	V	-	1	BioNet	-	Low. Two records occur within the Sydney district, from near Liverpool (1967) and Hornsby (1969). No associated vegetation types recorded within the Subject Land.	
Pterostylis saxicola	Sydney Plains Greenhood	E	E	17	BAM-C, BioNet, PMST	-	**Moderate.** This species has a scattered distribution across the Cumberland Plain and is known to prefer shale/sandstone and shale soils. Associated habitat, PCT 849, was recorded within the Subject Land.	
Pultenaea aristata	Prickly Bush-pea	V	V	1	BioNet, PMST	-	Low. This species is known to occur from Helensburgh to Mt Keira where it grows in moist, dry sclerophyll woodland to heath on sandstone. No associated vegetation types recorded within the Subject Land.	

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Pultenaea parviflora	-	E	V	827	BAM-C, BioNet, PMST, PlantNet	--	**High.** Four individuals were recorded at WSA in 2014 and confirmed in 2016 (GHD, 2016).	**Moderate.** This species is known to occur in scrubby or dry heath areas of Shale Gravel Transition Forest on tertiary alluvium or laterised clays. Associated habitat, PCT 724 was recorded.
Pultenaea pedunculata	Matted Bush-pea	E	-	17	BAM-C, BioNet		Low. Though associated vegetation types, PCT 724 and 849 were recorded within the Subject Land, this species distribution is generally restricted to the Liverpool area and South of Menangle with one record (2015) from Cobbitty.	
Syzygium paniculatum	Magenta Lilly Pilly	E	V	9	BioNet, PMST	-	Low. Preferred geology and associated vegetation types not recorded within the Subject Land.	
Thelymitra kangaloonica	-	-	CE	0	PMST	Swamps or within 200 m of swamp	Low. Preferred habitat, swamps in sedge lands, and associated vegetation types not recorded within the Subject Land.	
Thesium australe	Austral Toadflax	V	V	1	BAM-C, BioNet, PMST	-	**Moderate.** Associated vegetation type, PCT 849. One record near Campbelltown (1803) exists with locality. GHD (2016) recorded derived native grasslands being dominated by *Themeda triandra* (Kangaroo Grass), this species is known to host *Thesium australe.*	Low. This species is a root parasite and is associated with *Themeda triandra* (Kangaroo Grass). This species was recorded with a low cover (ranging from 0.2-2%). Given this and lack of historical records, this species is considered unlikely to occur.

Scientific Name	Common Name	BC Act[1]	EPBC Act[2]	BioNet records	Source[3]	Habitat constraints and geographic limitations[4]	Habitat suitability	
							On-airport	Off-airport
Wahlenbergia multicaulis - Endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E	-	0	BAM-C	Auburn (Cumberland Council), Bankstown and Canterbury (City of Canterbury – Bankstown), Baulkham Hills (The Hills Shire Council), Hornsby, Parramatta and Strathfield Local Government Areas	Low. This Endangered population is only recognised in the Auburn (Cumberland Council), Bankstown and Canterbury (City of Canterbury – Bankstown), Baulkham Hills (The Hills Shire Council), Hornsby, Parramatta and Strathfield Local Government Area. The Subject Land does not fall within these areas.	
Zannichellia palustris	Zannichellia palustris	E	-	0	BAM-C	Waterbodies: Freshwater or slightly brackish estuarine areas (10%))	Low. Though potential habitat was recorded within the Subject Land, this species is not known to occur within locality of with one small population being recorded at Sydney Olympic Park.	

1. V = Vulnerable, E = Endangered, CE = Critically Endangered as listed under the *Biodiversity Conservation Act 2016* (BC Act)
2. V = Vulnerable, E = Endangered, CE = Critically Endangered, X = Presumed Extinct as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
3. BAM-C = Biodiversity Assessment Calculator (BAM-C) version 1.2.7.2, BioNet = BioNet Atlas of NSW spatial search tool, PlantNet = Royal Botanic Gardens spatial search tool, PMST = Commonwealth Protected Matters Search Tool
4. Geographical limitations and habitat constraints have been obtained from the Biodiversity Assessment Calculator (BAM-C) version 1.2.7.2 and/or the Threatened Biodiversity Data Collection (ESS Group, 2020)

Appendix B

Threatened fauna habitat suitability assessment

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
Amphibians												
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	BAM-C, BioNet (15), PMST	No	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 300m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Breeding habitat of this species is generally soaks or pools within first or second order streams. Males call from burrows in sandy banks close to water. They are generally associated with crayfish burrows and breed where crayfish are present.	(None) However. species is dependent on hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features in the Sydney Basin.	Habitat requirements not recorded within the study area.	Low Sandstone geology not recorded.	Not considered further	Low Sandstone geology not recorded.	Not considered further
Green and Golden Bell Frog	*Litoria aurea*	E	V	BAM-C, BioNet (39), PMST	No	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal	Semi-permanent/ ephemeral wet areas, within 1km of wet areas; swamps; within 1km of	Marginal breeding habitat (e.g. farm dams and drainage lines) within the study area	Low - Potential habitat for this species within the Study area is heavily	Considered further as candidate (species credit)	Low – Potential habitat for this species within the Study area is heavily	Considered further as candidate (species credit)

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						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- Broughton Island). Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha spp.)* Or spike rushes (*Eleocharis spp.).* Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as plague minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	swamps; waterbodies; within 1km of waterbodies		degraded. Farm dams are polluted and contain the predatory Mosquito Fish (*Gambusia holbrooki*). A low number of OEH records occur within the locality, and the study area contains no known historic populations.	See Chapter 6	degraded. Farm dams are polluted and contain the predatory Mosquito Fish (*Gambusia holbrooki*). A low number of OEH records occur within the locality, and the study area contains no known historic populations.	See Chapter 6
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V	PMST	No	Has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan state forest (90 km	This species breeds in the upper reaches of permanent streams and in	Suitable breeding habitat not recorded within study area.	Low – Suitable breeding habitat not recorded	Not considered further	Low- Suitable breeding habitat not recorded	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						north of Sydney) south to Buchan in Victoria. The majority of records are from within the Sydney basin bioregion. Records are isolated and tend to be at high altitude. 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.	perched swamps.		within study area.		within study area.	
Red-crowned Toadlet	*Pseudophryne australis*	V	-	BioNet (35)	No	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. The species occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones and inhabits periodically wet drainage lines below sandstone ridges that often have	N/A	Hawkesbury and Narrabeen Sandstone geology not recorded within the study area.	Low - Hawkesbury and Narrabeen Sandstone geology not recorded within the study area.	Not considered further	Low- Hawkesbury and Narrabeen Sandstone geology not recorded within study area.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						shale lenses or cappings. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.						
Southern Bell Frog	*Litoria raniformis*	E	V	PMST	No	In NSW the species was once distributed along the Murray and Murrumbidgee Rivers and their tributaries, the southern slopes of the Monaro district and the central southern tablelands as far north as Tarana, near Bathurst. Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river	N/A	Study area is outside of this species known distribution.	Low – No Bionet records and study area is outside of this species known distribution.	Not considered further	Low – No Bionet records and study area is outside of this species known distribution.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.						
Stuttering Frog	*Mixophyes balbus*	E	V	PMST	Yes	Stuttering Frog is considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	Occupies streams in rainforest or tall open wet forest in foothills and escarpment on the eastern side of the Great Dividing Range	Study area is outside distribution of species, only known from populations north of Sydney. Study area does not provide suitable habitat i.e. (rocky rainforest streams and wet sclerophyll forest).	Low - Study area is outside distribution of species. Study area does not provide suitable habitat i.e. (rocky rainforest streams and wet sclerophyll forest).	Not considered further	Low - Study area is outside distribution of species. Study area does not provide suitable habitat i.e. (rocky rainforest streams and wet sclerophyll forest).	Not considered further
Birds												
Australasian Bittern	*Botaurus poiciloptilus*	E	E	BAM-C, BioNet (1), PMST	No	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW, they may be found over most of the state	Waterbodies; brackish or freshwater wetlands	Wetlands and brackish swamps, in which it forages and breeds not recorded. Marginal habitat	Low - Marginal, degraded habitat occurs within the study area. Most of	Not considered further	Low - Marginal, degraded habitat occurs within the study area. Most of	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp.)* and spikerushes (*Eleocharis spp.)*. Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.		occurs within the vicinity of the study area; majority of artificial wetlands lack dense aquatic vegetation which is preferred by the species.	the artificial wetlands lack dense aquatic vegetation which is preferred by the species.		the artificial wetlands lack dense aquatic vegetation which is preferred by the species.	
Australian Painted Snipe	*Rostratula australis*	E	E	BioNet (1), PMST	No	In NSW, many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. This species prefers fringes of swamps, dams and nearby marshy areas where	N/A	Marginal habitat within the study area. Preferred habitat, swamp/dams/wetlands with bank side vegetation. Has been recorded within locality <5yrs. Rare occurrences cannot be discounted.	Low - Habitat within the study area is degraded and limited to farm dams without emergent vegetation.	Not considered further	Low - Habitat within the study area is degraded and limited to farm dams without emergent vegetation.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.						
Barking Owl	*Ninox connivens*	V	-	BAM-C, BioNet (5)	No	The Barking Owl is found throughout continental Australia except for the central arid regions. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Habits 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. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	Intermittent occurrences within the study area may occur, however, more known to occur in woodlands to the west of the divide. Limited breeding habitat recorded.	Moderate - Suitable foraging and breeding habitat (hollows >20cm in diameter and 4m above ground) recorded within the Study area. Surveys required to confirm the utilisation of breeding habitat.	Considered further as a candidate (dual credit species) See Chapter 6	Moderate - Suitable foraging and breeding habitat (hollows >20cm in diameter and 4m above ground) recorded within the Study area. Surveys required to confirm the utilisation of breeding habitat.	Considered further as a candidate (dual credit species) See Chapter 6

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						on these fertile riparian soils.						
Black Bittern	*Ixobrychus flavicollis*	V	-	BAM-C, BioNet (2)	No	In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Waterbodies: Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation	The study area does not provide suitable foraging habitat. i.e. dense water-edge vegetation. This species was recorded in Penrith Weir in December 2019, approximately 9km to the NW of the study area.	Moderate - Habitat within the study area is degraded and limited to farm dams without emergent vegetation. Recorded on airport land by GHD 2016.	Considered further as an ecosystem credit species	Moderate - Habitat within the study area is degraded and limited to farm dams without emergent vegetation. This species was recorded in Penrith Weir in December 2019, approximately 9km to the NW of the study area.	Considered further as an ecosystem credit species
Black Falcon	*Falco subniger*	V	-	BioNet (3)	No	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales, there is	N/A	The study area is unlikely to be utilised by the Black Falcon. Given this species travels hundreds of kilometres sightings cannot be discounted.	Low- The study area is unlikely to be utilised by the Black Falcon. Given this species travels hundreds of kilometres, rare sightings	Not considered further	Low- The study area is unlikely to be utilised by the Black Falcon. Given this species travels hundreds of kilometres, rare sightings	Not considered further

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						assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres sightings cannot be discounted.			cannot be discounted.		cannot be discounted.	
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	-	BAM-C, BioNet (7)	No	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. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. 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	N/A	The Black-chinned Honeyeater is a western woodlands species that rarely occurs in near coastal locations. Closest record along the Georges River at Liverpool. Some large patches of woodland containing Eucalyptus tereticornis and Grey Box.	Low Large patches of woodland generally absent on study area. Rare or intermittent occurrences cannot be discounted.	Not considered further	Low Few large patches of woodland present on study area but not preferred habitat. Rare or intermittent occurrences cannot be discounted.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*).						
Black-faced Monarch	*Monarcha melanopsis*	-	MT	PMST	No	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	N/A	Preferred habitat not within study area. Rare and intermittent occurrences during migration cannot be discounted.	Low Preferred habitat not within study area.	Not considered further	Low Preferred habitat not within study area.	Not considered further
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	BioNet (3)	No	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps,	Swamps and shallow, open freshwater or saline wetlands or shallow edges of deeper wetlands within 300m of these swamps; waterbodies and shallow lakes, lake margins and estuaries within 300m of these waterbodies	Preferred foraging habitat, shallow lakes and lake margins, not present within study area. Degraded farm dams present in study area.	Low Outside usual range for this species and preferred habitat not within study area.	Not considered further	Low Outside usual range for this species and preferred habitat not within study area.	Not considered further

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						billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.						
Blue-billed Duck	*Oxyura australis*	V	-	BioNet (1)	No	The Blue-billed Duck is endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge	N/A	Preferred foraging habitat, deep water in large permanent wetlands and swamps with dense aquatic vegetation is limited study area.	Moderate Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought). Recorded at Western Sydney Airport site (GHD, 2016).	Considered further as candidate (ecosystem credit)	Moderate Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought).	Considered further as candidate (ecosystem credit)

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						of dense cover. It will fly if disturbed, but prefers to dive if approached.						
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-	BAM-C, BioNet (2)	Not provided	The Brown Treecreeper is 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	N/A	Preferred habitat not within study area.	Preferred habitat not within study area.	Not considered further	Preferred habitat not within study area.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						bordering wetlands also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.						
Bush Stone-curlew	*Burhinus grallarius*	E	-	BAM-C, BioNet (7)	No	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	N/A	Habitat within the study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Not considered further	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Not considered further
Common Greenshank	*Tringa nebularia*	-	MW	PMST	Not provided	In NSW the species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes,	N/A	Marginal habitat, preferred habitat of shallow mud flats not present in study area.	Low- Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low- Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further

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						and north-west regions. The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.						
Common Sandpiper	*Actitis hypoleucos*	-	MW	PMST	Not provided	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands.	N/A	Marginal habitat, preferred habitat of shallow mud flats not present in study area.	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further

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Curlew Sandpiper	*Calidris ferruginea*	E	CE; MW	PMST	Yes	The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts.	Other: As per mapped areas (contact OEH for maps)	Marginal habitat, preferred habitat of shallow mud flats not present in study area.	Low- Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low- Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further
Diamond Firetail	*Stagonopleura guttata*	V	-	BAM-C, BioNet (6)	Not provided	It is widely distributed in NSW. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow	N/A	Preferred habitat not within study area.	Low- No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area.	Not considered further	Low- No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						Gum *Eucalyptus pauciflora* Woodlands.						
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	BAM-C, BioNet (150)	No	The species occurs throughout most of New South Wales. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	N/A	Potential foraging habitat available. This species has been recorded within the study area.	Moderate Foraging habitat present in study area.	Considered further as an ecosystem credit species	Moderate Foraging and potential breeding habitat present in study area.	Considered further as an ecosystem credit species
Eastern Bristlebird	*Dasyornis brachypterus*	E	E	BioNet (1), PMST	No	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern	N/A	No preferred habitat within the study area. No records within the study area.	Low- No heath present	Not considered further	Low- No heath present	Not considered further

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						- 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.						
Eastern Curlew	*Numenius madagascariensis*	-	CE; MW	PMST	Yes	Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mud flats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in	N/A	Marginal habitat, preferred habitat of shallow mud flats absent from study area.	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further

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						northern china, Korea and Russia.						
Eastern Osprey	*Pandion cristatus*	V	M	BAM-C	No	Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia.	N/A	Preferred habitat not within study area.	Preferred habitat not within study area.	Not considered further	Preferred habitat not within study area.	Not considered further
Flame Robin	*Petroica phoenicea*	V	-	BAM-C, BioNet (12)	No	Breeds in elevated woodland habitats of the Great Dividing Range and its foothills. Disperses from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds.	N/A	Habitat within the study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland with fallen timber and woody debris are extremely limited.	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but patches fallen timber and woody debris are limited.	Not considered further	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but patches fallen timber and woody debris are limited.	Not considered further
Freckled Duck	*Stictonetta naevosa*	V	-	BioNet (4)	No	Prefer permanent freshwater swamps and creeks with	N/A	Preferred foraging habitat, deep water in	Moderate	Not considered further	Moderate	Not considered further

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						heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.		large permanent wetlands and swamps with dense aquatic vegetation is limited study area.	Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought).		Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought).	
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-	BAM-C, BioNet (12)	No	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	Hollow bearing trees Eucalypt tree species with hollows greater than 10 cm diameter and 9m above the ground.	Preferred habitat of mature/old growth eucalypt forest not present within study area	Low - Marginal foraging and breeding habitat within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6	Low - Marginal foraging and breeding habitat within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6
Gang-gang Cockatoo (population	*Callocephalon fimbriatum-*	V	-	BAM-C	No	In spring and summer, generally found in tall mountain	N/A	Preferred habitat of mature/old growth eucalypt	Low - Marginal foraging and	Not considered further	Low - Marginal foraging and	Not considered further

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in the Hornsby and Ku-ring-gai LGAs)	endangered population					forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.		forest not within study area.	breeding habitat within the Study area.		breeding habitat within the Study area.	
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-	BAM-C, BioNet (9)	No	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. They prefer to nest in the hollows of large, old eucalypt trees, alive or dead. The typical nest site will be	N/A	Preferred habitat not within study area. Limited foraging habitat available.	Low - Preferred foraging habitat not present within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6	Low - Preferred foraging habitat not present within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						around 3 to 30 metres above the ground, and the nest hollow is generally lined with decayed debris.						
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	BAM-C, BioNet (3)	No	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.	N/A	Preferred habitat not within study area.	Low- No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area.	Not considered further	Low- No recent records on the Cumberland Plain. Foraging habitat present, but degraded on study area.	Not considered further
Latham's Snipe	*Gallinago hardwickii*	-	M	PMST	No	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	N/A	Wetlands and artificial wetlands provide marginal habitat. Prefers wetlands with abundant aquatic vegetation for protection, this is limited within study area. Rare and intermittent occurrences cannot be discounted.	Moderate Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought).	Considered further as a candidate (ecosystem credit)	Moderate Several degraded farm dams present in study area that this species may use on occasion (eg during periods of drought).	Considered further as a candidate (ecosystem credit)

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
Little Eagle	*Hieraaetus morphnoides*	V	-	BAM-C, BioNet (63)	No	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. It occupies open eucalypt forest, woodland or open woodland. She-oak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Nest trees - live (occasionally dead) large old trees within vegetation.	Potential habitat within study area. May intermittently forage within study area as part of a larger home range.	Moderate - Suitable foraging and breeding habitat present within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6)	Moderate - Suitable foraging and breeding habitat present within the Study area.	Considered further as candidate (ecosystem credit) See Chapter 6
Little Lorikeet	*Glossopsitta pusilla*	V	-	BAM-C, BioNet (78)	No	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	N/A	Potential habitat within study area. May intermittently forage within study area as part of a larger home range.	Moderate - Suitable foraging habitat present within the study area.	Considered further as a candidate (ecosystem credit species)	Moderate - Suitable foraging habitat present within the study area.	Considered further as a candidate (ecosystem credit species)
Masked Owl	*Tyto novaehollandiae*	V	-	BAM-C, BioNet (9)	No	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the	N/A	Intermittent occurrences within the study area may occur, however, more known to occur	Moderate - Suitable foraging and breeding habitat (hollows	Considered further as candidate (ecosystem credit)	Moderate - Suitable foraging and breeding habitat (hollows	Considered further as candidate (ecosystem credit)

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						edges of forests, including roadsides. Living or dead trees with hollows greater than 20cm diameter required for breeding.		in woodlands to the west of the divide. Limited breeding habitat recorded.	>20cm in diameter and 4m above ground) recorded within the study area. Surveys required to confirm the utilisation of breeding habitat.	See Chapter 6	>20cm in diameter and 4m above ground) recorded within the study area. Surveys required to confirm the utilisation of breeding habitat.	See Chapter 6
Oriental Cuckoo	*Cuculus opatus*	-	M	PMST	No	Oriental Cuckoos are winter visitors to Australia and do not breed here. Mainly seen in northern Australia, occasionally they are sighted as far south as Sydney (March 2017 at Eastlakes Golf Course). They are more widespread in the Top End and coastal Queensland with the odd vagrant records south to the Pilbara. In many respects, Oriental Cuckoos resemble Pallid Cuckoos in their habits, but instead of inhabiting the drier and open country preferred by	No	Wetlands and artificial wetlands provide marginal habitat. Rare and intermittent occurrences cannot be discounted.	Low Preferred habitat not present.	Not considered further	Low Preferred habitat not present.	Not considered further

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						the Pallid Cuckoo, Oriental Cuckoos are found in more humid habitats such as monsoon forest, wet eucalypt forest, river margins and near mangroves. They feed in tree foliage infested with caterpillars.						
Painted Honeyeater	*Grantiella picta*	V	V	BAM-C, BioNet (3), PMST	No	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the Winter it is more likely to be found in the north of its distribution. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*.	N/A	In December 2019, 3 individuals were recorded at Nepean Weir, approximately 9km to the north-west of the study area. The individuals were observed eating spiders from a stag and feeding on the female flowers of Castor Oil plants (*Ricinus communis*)	Moderate- The study area provides potential foraging habitat.	Considered further as an ecosystem credit species	The study area provides potential foraging habitat with mistletoe found on Grey Box (*Eucalyptus mollucana*).	Considered further as an ecosystem credit species

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Pectoral Sandpiper	*Calidris melanotos*	-	M	PMST	No	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	N/A	Marginal habitat, preferred habitat of shallow mud flats absent from study area.	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further
Powerful Owl	*Ninox strenua*	V	-	BAM-C, BioNet (53)	No	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range		Intermittent occurrences within the study area may occur. Likely to forage within study	Moderate - Suitable foraging and breeding habitat recorded	Considered further as candidate (ecosystem credit)	Moderate - Suitable foraging and breeding habitat recorded	Considered further as candidate (ecosystem credit)

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						from Mackay to south-western Victoria. 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.		area as part of a larger home range.	within the Study area. Surveys required to confirm the utilisation of breeding habitat.	See Chapter 6	within the Study area. Surveys required to confirm the utilisation of breeding habitat.	See Chapter 6
Red Knot	*Calidris canutus*	-	EM	BioNet (8)	No	The Red Knot is common in all the main suitable habitats around the coast of Australia but is less numerous in south-west Australia than elsewhere. Very large numbers are regularly recorded in north-west Australia. The only places it is not found in significant numbers are the northern part of the Great Australian Bight	N/A	Marginal habitat, preferred habitat of shallow mud flats absent from study area.	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further	Low-Marginal habitat, preferred habitat of shallow mud flats not present in study area	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						in South Australia and Western Australia, and along much of the NSW coast, where wader habitat is rather scarce. The Red Knot breeds in North America, Russia, north-west and east Greenland, north Alaska round the Seward Peninsula, the De Long Mountains and, rarely, at Point Barrow and Cooper Island.						
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	BAM-C, BioNet (13), PMST	Yes	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra Barraba region. In NSW, the distribution is very patchy and mainly confined to the	As per mapped areas (refer to National Recovery Plan)	Preferred habitat not within study area. Records within locality > 40 years old. No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the study area.	Low - No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the Study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga	Not considered further	Low - No key breeding areas or other breeding areas identified in the National Recovery Plan occur within the Study area. Preferred foraging habitat (Spotted Gum, Swamp Mahogany, Mugga	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						two main breeding areas and surrounding fragmented woodlands. It inhabits dry open forest and woodland, particularly box-ironbark woodland, and riparian forests of river sheoak. Regent honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. It feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include mugga ironbark, yellow box, white box and swamp mahogany.			Ironbark) not present within study area.		Ironbark) not present within study area.	
Rufous Fantail	*Rhipidura rufifrons*	-	M	PMST	No	The Rufous Fantail occurs in coastal and near coastal districts of northern and	N/A	Associated flora species known to form habitat not recorded	Low- Associated flora species known to	Not considered further	Low- Associated flora species known to	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						eastern Australia. *Rhipidura rufifrons rufifrons* has breeding populations occurring from about the South Australia-Victoria border, through south and central Victoria, on and east of the Great Divide in New South Wales (NSW), and north to about the NSW-Queensland border. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby		within the study area.	form habitat not recorded within the Study area.		form habitat not recorded within the Study area.	

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						understorey often including ferns.						
Satin Flycatcher	*Myiagra cyanoleuca*	-	M	PMST	No	The Satin Flycatcher is widespread in eastern Australia and vagrant to New Zealand. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers are mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts such as Brown Barrel, *Eucalypt fastigata*, Mountain Gum, *E. dalrympleana*, Mountain Grey Gum, Narrow-leaved Peppermint, Messmate or Manna Gum, or occasionally Mountain Ash, *E. regnans.* Such forests usually have a tall	N/A	Preferred habitat within study area limited. Rare and intermittent occurrences cannot be discounted.	Moderate - Preferred habitat within study area limited to open woodlands and creeklines.	Considered further as a MNES	Moderate - Preferred habitat within study area limited to open woodlands and creeklines.	Considered further as a MNES

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						shrubby understorey of tall acacias, for example Blackwood, *Acacia melanoxylon*. In higher altitude Black Sallee, *E. stellulata,* woodlands, they are often associated with tea-trees and tree-ferns.						
Scarlet Robin	*Petroica boodang*	V	-	BAM-C, BioNet (26)	N/A	The scarlet robin is found from south east Queensland to south east South Australia and also in Tasmania and south west western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some scarlet robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The scarlet robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	N/A	Eucalyptus woodland (with some woody debris) present within the study area.	Moderate - Suitable foraging habitat recorded within the Study area. Likely to be non-breeding migrant to the Study area.	Considered further as an ecosystem credit species.	Moderate - Suitable foraging habitat recorded within the Study area. Likely to be non-breeding migrant to the Study area.	Considered further as an ecosystem credit species.

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						This species lives in both mature and regrowth vegetation. It occasionally occurs in Mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The scarlet robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.						
Sharp-tailed Sandpiper	*Calidris acuminata*	-	M	PMST		The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and	N/A	Marginal foraging habitat, preferred habitat of shallow mud flats not present.	Low - Study area is unlikely to provide suitable habitat.	Not considered further	Low - Study area is unlikely to provide suitable habitat.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						in both freshwater and saline habitats. Many inland records are of birds on passage. They are widespread in most regions of New South Wales (NSW) and Victoria, especially in coastal areas, but they are sparse in the south-central Western Plain and east Lower Western Regions of NSW, and north-east and north-central Victoria. In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They also occur in saltworks and						

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						sewage farms. They use flooded paddocks, sedge lands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season.						
Sooty Owl	*Tyto tenebricosa*	V	-	BioNet (3)	Yes	Occupies the eastern most one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground	Marginal foraging and breeding habitat (hollows >20cm in diameter and 4m above ground) present within the study area.	Low - This species prefers rainforest or moist gully type habitats, both of which do not occur within the study area.	Not considered further	Low - This species prefers rainforest or moist gully type habitats, both of which do not occur within the study area.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the common ringtail possum (*Pseudocheirus peregrinus*) or sugar glider (*Petaurus breviceps*). Nests in very large tree-hollows.						
Speckled Warbler	*Chthonicola sagittata*	V	-	BAM-C, BioNet (35)	No	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than	N/A	Habitat within the study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Not considered further	Low - Habitat within study area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						100ha survive. 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 regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees.						
Spectacled Monarch	*Monarcha trivirgatus*	-	M	PMST	No	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed.	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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Spotted Harrier	*Circus assimilis*	V	-	BAM-C, BioNet (3)	No	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.	N/A	Low - Preferred habitat of large inland wetlands not within study area. Some marginal foraging habitat present within the study area.	Low - No large inland wetlands within study area. Could occasionally forage within the vicinity of the subject site, so flyover occurrences cannot be entirely discounted.	Not considered further	Low - No large inland wetlands within study area. Could occasionally forage within the vicinity of the subject site, so flyover occurrences cannot be entirely discounted.	Not considered further
Square-tailed Kite	*Lophoictinia isura*	V	-	BAM-C, BioNet (12)	No	The square-tailed kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state	Nests in living or dead trees, Paddock trees are important to the species.	Living and dead trees and paddock trees present within the study area. Timbered watercourses are limited within the study area.	Moderate-living and dead trees and paddock trees present within the study area. Foraging habitat is degraded	Considered further as an ecosystem credit species.	Moderate-living and dead trees and paddock trees present within the study area. Foraging habitat is degraded	Considered further as an ecosystem credit species.

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by march. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a preference for timbered watercourses Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.			within the study area. However, may intermittently forage within study area as part of a larger home range.		within the study area. However, may intermittently forage within study area as part of a larger home range.	
Swift Parrot	*Lathamus discolor*	E	CE	BAM-C, BioNet (89), PMST	Yes	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria	The species is only present during March to September - winter migrant to NSW.	*Eucalyptus tereticornis* is the dominant Eucalypt species within patches of native	This species does not breed in NSW. May occur over the Study area	Not considered further See Chapter 6	This species does not breed in NSW. May occur over the Study area	Not considered further See Chapter 6

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						and the eastern parts of south Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. 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 swamp mahogany *Eucalyptus robusta,* spotted gum *Corymbia maculata*, red bloodwood *C. gummifera*, mugga ironbark *E. sideroxylon*, and white box *E. albens.* Commonly used lerp infested trees include inland grey box *E. microcarpa,* grey box *E. moluccana* and blackbutt *E. pilularis.*		vegetation in the study area.	intermittently during seasonal migration movements. Winter-flowering resources (eg Spotted Gum) absent from the subject site. No recent records within the vicinity of the study area.		intermittently during seasonal migration movements. Winter-flowering resources (eg Spotted Gum) absent from the subject site. No recent records within the vicinity of the study area.	
Turquoise Parrot	*Neophema pulchella*	V	-	BAM-C, BioNet (4)	No	The Turquoise Parrot's range extends from	N/A	Habitat within study area is primarily	Low - Habitat within study	Not considered further	Low - Habitat within study	Not considered further

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						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.		degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.		area is degraded. Some potential foraging habitat within study area, but large, undisturbed patches of woodland are extremely limited.	
Varied Sittella	*Daphoenositta chrysoptera*	V	-	BAM-C, BioNet (121)	No	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	N/A	Eucalyptus woodland (with some woody debris) present within the study area.	Moderate - Suitable foraging habitat recorded within the Study area. Likely to be non-breeding migrant to the Study area.	Considered further as an ecosystem credit species.	Moderate - Suitable foraging habitat recorded within the Study area. Likely to be non-breeding migrant to the Study area.	Considered further as an ecosystem credit species.

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						bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.						
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	Ma	BAM-C, BioNet (52)	No	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines (Breeding habitat) Waterbodies within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines (Foraging habitat)	Foraging habitat and potential breeding habitat present within the study area.	Moderate-living and dead trees and paddock trees present within the study area. Foraging habitat is degraded within the study area. Would forage within study area as part of a larger home range.	Considered further as an ecosystem credit species.	Moderate-living and dead trees and paddock trees present within the study area. Foraging habitat is degraded within the study area. Would forage within study area as part of a larger home range.	Considered further as an ecosystem credit species.

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						habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion.						
White-fronted Chat	*Epthianura albifrons*	V	-	BioNet (1)	No	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.						
White-fronted Chat (population in the Sydney Metro Catchment Management Area)	*Epthianura albifrons*	E	-	BioNet (1)	No	Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly. The nearest extant populations outside Sydney Metropolitan CMA are at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong. White-fronted Chats were previously recorded at Penrith Lakes (2001), Hawkesbury Swamps (2002), Tuggerah Lake (1997) and Lake Macquarie (1998).						
White-throated Needletail	*Hirundapus caudacutus*	-	MT	PMST	No	Widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. It is almost	N/A	Potential foraging habitat present within the study area.	Moderate - may occur over the study area on a seasonal basis, unlikely to use terrestrial habitats within the study site.	Considered further as a MNES	Moderate - may occur over the study area on a seasonal basis, unlikely to use terrestrial habitats within the study site.	Considered further as a MNES

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						exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable, but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps. When flying above farmland, they are more often recorded above partly cleared pasture, plantations					

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						or remnant vegetation at the edge of paddocks. In coastal areas, they are sometimes seen flying over sandy beaches or mudflats and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes						
Yellow Wagtail	*Motacilla flava*	-	MT	PMST	No	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						in QLD and the north of NT and WA						
Fish												
Australian Grayling	*Prototroctes maraena*	-	-	PMST	No	Occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons, from Shoalhaven River in NSW to Ewan Ponds in South Australia. The Australian Grayling is diadromous, spending part of its lifecycle in freshwater and at least part of the larval and/or juvenile stages in coastal seas. Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and	N/A		Low- Outside the species distribution, no habitat within study area.	Not considered further		Not considered further

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						riffle zones such as the Tambo River, which is also known to have granite outcrops. The species has also been associated with clear, gravel-bottomed habitats in the Mitchell and Wonnangatta Rivers (Victoria) and in a muddy-bottomed, heavily silted habitat in the Tarwin River (Victoria). The species has been found over 100 km upstream from the sea.						
Macquarie Perch	*Macquaria australasica*	-	-	PMST	No	Macquarie Perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. Macquarie Perch are found in both river and lake habitats;	N/A		Low- Outside the species distribution, no habitat within study area.	Not considered further		Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						especially the upper reaches of rivers and their tributaries. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks. Spawning occurs just above riffles (shallow running water).						
Murray Cod	*Maccullochella peelii*	-	-	PMST	No	The Murray Cod was historically distributed throughout the Murray-Darling Basin (the Basin), which extends from southern Queensland, through New South Wales (NSW), the Australian Capital Territory (ACT) and Victoria to South Australia, with the exception of the upper reaches of some tributaries. The species still occurs in most parts of this natural distribution, up to approximately 1000 m above sea level. It utilises a	N/A		Low- Outside the species distribution, no habitat within study area.	Not considered further		Not considered further

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						diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW (including the ACT), to slow-flowing, turbid lowland rivers and billabongs. Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures.						
Invertebrates												
Adam's Emerald Dragonfly	*Archaeophya adamsi*	E	-	DPI Fisheries	No	The Adam's Emerald Dragonfly (*Archaeophya adamsi* Fraser) is one of Australia's rarest dragonflies. Only five adults have ever been collected, and the species is only known from a few sites in the greater Sydney region.	N/A	There are some small areas within creeks that possess sandy bottoms. However, the waterways within the Study area are considerably degraded and previous detailed	Low likelihood of occurrence within the Study area.	Not considered further. There is enough existing survey information and habitat quality information available to	Low likelihood of occurrence within the Study area.	Not considered further. There is enough existing survey information and habitat quality information available to

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						Adam's Emerald Dragonfly larvae have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms. Adult dragonflies generally fly away from the water to mature before returning to breed. Males fly actively at breeding sites and often guard a territory. Females probably lay their eggs into the water. This species seem to have a low natural rate of recruitment and limited dispersal abilities.		macroinvertebrate surveys conducted for the Western Sydney Airport EIS did not find any evidence of this species.		assess this species.		assess this species.
Cumberland Plain Land Snail	*Meridolum corneovirens*	E	-	BAM-C, BioNet (879)	No	*Meridolum corneovirens* is wholly restricted to western Sydney and is primarily associated with the critically endangered Cumberland Plain Woodland ecological community. It can be	N/A	Cumberland Plain Woodland present within the study area.	High - Potential habitat in larger patches of Cumberland Plain Woodland with deep leaf litter	Considered further as candidate (species credit) See Chapter 6	High - Potential habitat in larger patches of Cumberland Plain Woodland with deep leaf litter	Considered further as candidate (species credit) See Chapter 6

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						found in leaf litter, grass tussocks, under logs and non-natural debris such as cardboard and old furniture etc. Where conditions permit it will bury into loose soil up to 10 cm such as under logs and around the bases of trees.			within study area.		within study area.	
Dural Land Snail	*Pommerhelix duralensis*	E	E	BAM-C, PMST	No	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species is definitely found within the Local Government Areas of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species. The species has a strong affinity for communities in the	Leaf litter and shed bark or within 50m of litter or bark. Rocks or within 50m of rocks Fallen/standing dead timber including logs or logs and bark within 50m	Study site is outside distribution.	Low – Study area is outside distribution.	Not considered further	Low – Study area is outside distribution.	Not considered further

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						interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris. Migration and dispersal is limited, with overnight straight-line distances of under 1 metre identified in the literature and studies. The main food sources are hyphae and fruiting bodies of native fungi. It is possible other detritus may be consumed.						
Sydney Hawk Dragonfly	*Austrocordulia leonardi*	E	Not listed	DPI Fisheries	No	The Sydney Hawk Dragonfly, Austrocordulia	N/A	There are no suitable riverine pool habitats	Low likelihood of occurrence	Not considered further.	Low likelihood of occurrence	Not considered further.

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						leonardi, is an extremely rare species of dragonfly. The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages. The species was discovered in 1968 from Woronora River and Kangaroo Creek, south of Sydney and later recorded from the Nepean River at the Maldon Bridge near Wilton. Following its disappearance from Woronora River and the Nepean River site, leaving the site near Audley as the only locality where there were regular observations of larvae. Recent surveys recorded Sydney Hawk Dragonfly north of Sydney and north of		present in the Study area. The waterways within the Study area are considerably degraded and previous detailed macroinvertebrate surveys conducted for the Western Sydney Airport EIS did not find any evidence of this species.	within the Study area.	There is enough existing survey information and habitat quality information available to assess this species.	within the Study area.	There is enough existing survey information and habitat quality information available to assess this species.

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						the Hunter Valley, almost 200 km further north than previously recorded.						
Mammals												
Brush-tailed Rock-wallaby	*Petrogale penicillata*	E	V	PMST	Yes	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.						
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	BAM-C, BioNet (69)	No	The eastern false pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. 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.	N/A	Potential foraging and roosting habitat available within the vicinity of the study area. Closest record is about 5km to the west of northern section of the study area at Glenmore Park.	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)
Eastern Freetail-bat	*Micronomus*	V	-	BAM-C, BioNet (188)	No	The eastern freetail-bat is found along the east coast from south	N/A	Potential foraging and roosting habitat	Moderate - Potential roosting and	Considered further as candidate	Moderate - Potential roosting and	Considered further as candidate

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	norfolkensis					Queensland to southern NSW. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.		available within the vicinity of the study area.	foraging habitat available within the study area.	(ecosystem credit)	foraging habitat available within the study area.	(ecosystem credit)
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	BAM-C, BioNet (8)	No	Found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. 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	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.						
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	BAM-C, BioNet (104)	No	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	N/A	Potential foraging and roosting habitat available within the vicinity of the study area.	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)

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						Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3-6m.						
Greater Glider	*Petauroides volans*	-	V	BioNet (1), PMST	No	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal	Hollow bearing trees	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						variation in food abundance						
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	BAM-C, BioNet (1119), PMST	No	Grey-headed flying-foxes are generally found within 200km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in south Australia. 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 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50km from the camp to forage; commuting distances are more often <20km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of	Breeding camps	Foraging habitat present within the study area. No known roost sites or established camps within the subject	High - Foraging habitat present within the study area. No known roost sites or established camps within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6	High - Foraging habitat present within the study area. No known roost sites or established camps within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						rainforest trees and vines						
Koala	*Phascolarctos cinereus*	V	V	BAM-C, BioNet (1479), PMST	No	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, but it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands. 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	Areas identified via survey as important habitat - 'Important' habitat (however this is not a mapped important habitat area) is defined by the density of koalas and quality of habitat determined by on-site survey.	Study area is disturbed, and disjunct from major patches of intact vegetation. Closest records are at Oxley Park in 2016 in association with Campbelltown LGA population.	Low- Habitat degraded and unlikely to be considered important habitat.	Not considered further.	Low- Habitat degraded and unlikely to be considered important habitat.	Not considered further.

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						preferred browse species. Some preferred species include Forest Red Gum, Grey Gum. In coastal areas, Tallowwood and Swamp Mahogany are important food species, while in inland areas White Box, Bimble Box and River Red Gum are favoured. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.						
Large Bent-winged Bat	*Miniopterus orianae oceanensis*	V	-	BAM-C, BioNet (213)	Yes	This species is found along the east coast of Australia from cape York in Queensland to Castlemaine in Victoria. Habitat includes rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, melaleuca forests and open grasslands. Roosts in caves, road structures (culverts and bridges) old mines, stormwater	Caves - Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding with numbers of individuals >500	Potential foraging available within the vicinity of the study area. Records within the study area in <5 years. No known breeding habitat within the locality.	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6

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						channels and sometimes buildings. Populations are centred on maternity caves that are used annually for the birth and development of young.						
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	BAM-C, BioNet, PMST (12)	Yes	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been	Cliffs - Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	No roosting habitat (i.e. cliffs and sandstone rocky outcrops/caves) recorded within study area. Potential foraging available within the of the study area. Closest record to the west in Mulgoa	Moderate - Potential foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)	Moderate - Potential foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)

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						recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies						
Little Bentwing-bat	*Miniopterus australis*	V	-	BAM-C, BioNet (27)	Yes	Found along east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. 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	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding	Potential foraging and roosting habitat available within the vicinity of the study area.	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit)

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						canopy of densely vegetated habitats. Only five nursery sites /maternity colonies are known in Australia.						
New Holland Mouse	*Pseudomys novaehollandiae*	-	V	PMST	No	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Genetic evidence indicates that the New Holland Mouse once formed a single continuous population on mainland Australia and the distribution of recent subfossils further suggest that the species has undergone a large range contraction since European settlement. Total population size of mature individuals is now estimated to be less than 10,000 individuals although, given the number of sites from which the species is known to have disappeared between 1999 and	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						2009, it is likely that the species' distribution is actually smaller than current estimates. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.						
Southern Brown Bandicoot	*Isoodon obesulus*	E	E	PMST	No	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates	Other - Requires dense ground cover in a variety of habitats.	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Males have a home range of approximately 5-20 hectares whilst females forage over smaller areas of about 2-3 hectares.						
Southern Myotis	*Myotis macropus*	V	-	BAM-C, BioNet (131)	No	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking	Hollow bearing trees - Within 200 m of riparian zone Bridges, caves or artificial structures within 200 m of riparian zone Waterbodies - rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	Potential foraging and roosting habitat available within the vicinity of the study area.	Moderate - Potential roosting and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6	Moderate - Potential breeding and foraging habitat available within the study area.	Considered further as candidate (ecosystem credit) See Chapter 6

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						their feet across the water surface.						
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	BAM-C, BioNet (14), PMST	No	Found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines	N/A	Study area is reasonably disturbed, and disjunct from major patches of intact vegetation This species is unlikely to occur within the study area.	Low – Preferred habitat is not present.	Not considered further.	Low – Preferred habitat is not present.	Not considered further.
Squirrel Glider	*Petaurus norfolcensis*	V	-	BAM-C, BioNet (5)	No	The species is widely though sparsely distributed in eastern Australia, from	N/A	Preferred habitat not within study area	Low Preferred habitat not	Not considered further	Low Preferred habitat not	Not considered further

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						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. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.			within study area		within study area	
Yellow-bellied Glider	*Petaurus australis*	V	-	BAM-C, BioNet (1)	No	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in	Hollow-bearing trees - Hollows > 25cm diameter	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

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						areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.						
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	BAM-C, BioNet (35)	No	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia.	N/A	Potential foraging and roosting habitat available within	Moderate - Potential roosting and foraging habitat	Considered further as candidate (ecosystem credit)	Moderate - Potential roosting and foraging habitat	Considered further as candidate (ecosystem credit)

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						In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.		the vicinity of the study area.	available within the study area.		available within the study area.	
Reptiles												
Broad-headed Snake	*Hoplocephalus bungaroides*	E	V	BioNet (4), PMST	Yes	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area	Rocky areas - Including escapments, outcrops and pogodas within the Sydney Sandstone geologies	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						within approximately 250km of Sydney. 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 crevieces or hollows in large trees within 500m of escarpments in summer.						
Rosenberg 's Goanna	*Varanus rosenbergi*	V	-	BAM-C, BioNet (6)	No	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite	N/A	Preferred habitat not within study area	Low Preferred habitat not within study area	Not considered further	Low Preferred habitat not within study area	Not considered further

Common name	Scientific name	BC Act[1]	EPBC Act[2]	Source[3]	SAII	Habitat, ecology & distribution	Geographical limitations & habitat constraints	Habitat present in study area	Habitat Suitability On Airport	Outcome	Habitat Suitability Off Airport	Outcome
						mounds are a critical habitat component. Individuals require large areas of habitat. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.						

Appendix C

Plot data

Q1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)			45	38	4	7	9	15	1	2	7	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			147.4	**141.3**	40.4	18.2	65	15.9	1	0.8	**6.1**	4.2
Acacia decurrens	0.4	1	TG		0.4							
Acacia falcata	1	1	SG			1						
Aristida vagans	20	200	GG				20					
Arthropodium milleiflorum	0.5	4	FG					0.5				
Asparagus asparagoides *	0.2	1	HT									0.2
Austrostipa verticillata	1	4	GG				1					
Bidens pilosa *	0.7	10	EX								0.7	
Brunoniella australis	2	25	FG					2				
Bursaria spinosa	3	7	SG			3						
Caesia parviflora var. parviflora	1	10	FG					1				
Calotis cuneifolia	2	8	FG					2				
Calotis lappulacea	0.2	1	FG					0.2				
Cheilanthes sieberi subsp. sieberi	1	18	EG						1			
Cymbopogon refractus	3	50	GG				3					
Daviesia ulicifolia	0.1	2	SG			0.1						
Desmodium brachypodum	0.3	6	FG					0.3				
Desmodium gunnii	0.2	6	FG					0.2				
Dianella revoluta var. revoluta	1	4	FG					1				
Dichondra sp. A	5	200	FG					5				
Dillwynia sieberi	10	10	SG			10						
Dodonaea viscosa subsp. cuneata	0.1	1	SG			0.1						
Einadia hastata	0.6	10	FG					0.6				
Entolasia stricta	5	70	GG				5					
Eragrostis curvula *	4	20	HT									4
Eucalyptus fibrosa	5	3	TG		5							
Eucalyptus moluccana	20	17	TG		20							
Eucalyptus tereticornis	15	12	TG		15							
Exocarpos cupressiformis	2	1	SG			2						
Glycine clandestina	0.4	8	OG							0.4		
Glycine tabacina	0.4	15	OG							0.4		
Juncus usitatus	0.6	6	GG				0.6					
Lobelia purpurascens	0.9	50	FG					0.9				
Lomandra filiformis subsp. filiformis	5	200	GG				5					
Lomandra multiflora	0.4	5	GG				0.4					
Microlaena stipoides var. stipoides	20	190	GG				20					
Opercularia varia	0.6	30	FG					0.6				
Opuntia stricta *	0.1	1	EX								0.1	
Oxalis perennans	0.4	20	FG					0.4				
Ozothamnus diosmifolius	2	2	SG			2						
Paspalidium distans	10	100	GG				10					
Setaria parviflora *	0.4	15	EX								0.4	
Sida rhombifolia *	0.6	4	EX								0.6	
Solanum prinophyllum	0.9	8	FG					0.9				
Taraxacum officinale *	0.1	1	EX								0.1	
Vernonia cinerea var. cinerea	0.3	4	FG					0.3				

Easting	288653
Northing	6246150
Orientation	30
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	2
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m	7
Attributes 1x1 plot (%)	
Litter (%)	40

Q2			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)			44	27	3	1	6	15	1	1	17	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			101.4	**86.1**	19	15	40.4	10.2	0.5	1	**15.3**	3.7
Anagallis arvensis *	0.2	20	EX								0.2	
Araujia sericifera *	0.1	1	HT									0.1
Asperula conferta	0.8	50	FG					0.8				
Brunoniella australis	3	100	FG					3				
Burchardia umbellata	0.2	20	FG					0.2				
Bursaria spinosa	15	25	SG			15						
Casuarina glauca	1	1	TG		1							
Centella asiatica	0.4	20	FG					0.4				
Cheilanthes sieberi subsp. sieberi	0.5	40	EG						0.5			
Chloris ventricosa	1	35	GG				1					
Conyza sumatrensis *	0.4	20	EX								0.4	
Crassula sieberiana	0.2	6	FG					0.2				
Cynodon dactylon	0.4	10	GG				0.4					
Desmodium gunnii	1	40	FG					1				
Dichondra repens	1	50	FG					1				
Einadia hastata	0.1	2	FG					0.1				
Einadia nutans subsp. nutans	0.2	15	FG					0.2				
Eucalyptus moluccana	5	4	TG		5							
Eucalyptus tereticornis	13	18	TG		13							
Glycine tabacina	1	80	OG							1		
Hypericum gramineum	2	100	FG					2				
Hypochaeris radicata *	1	100	EX								1	
Lomandra filiformis subsp. coriacea	0.8	50	GG				0.8					
Microlaena stipoides var. stipoides	35	500	GG				35					
Modiola caroliniana *	0.3	10	EX								0.3	
Olea europaea *	2	4	HT									2
Onopordum acanthium *	0.2	6	EX								0.2	
Oxalis perennans	0.2	10	FG					0.2				
Paspalum dilatatum *	0.6	30	HT									0.6
Plantago lanceolata *	0.6	30	EX								0.6	
Senecio madagascariensis *	1	40	HT									1
Setaria parviflora *	5	100	EX								5	
Sida rhombifolia *	2	100	EX								2	
Solanum nigrum *	0.1	1	EX								0.1	
Solanum pseudocapsicum *	0.5	6	EX								0.5	
Solanum sisymbriifolium *	0.1	2	EX								0.1	
Solka sessilis *	0.2	10	EX								0.2	
Spondobolus creber	3	80	GG				3					
Spondobolus elongatus	0.2	2	GG				0.2					
Tetragonia tetragonioides	0.2	4	FG					0.2				
Tricoryne spp.	0.4	10	FG					0.4				
Verbena bonariensis *	1	15	EX								1	
Veronica plebeia	0.4	8	FG					0.4				
Wahlenbergia stricta	0.1	1	FG					0.1				

Easting	288963
Northing	6246049
Orientation	270
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m	40
Attributes 1x1 plot (%)	
Litter (%)	18.4

Q3			Covers	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count
PCT 1071 Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (Intact)			13	0	4	3	1	0	5	2
Species	**Cover**	**Abundance**	**Sum cover**	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			65	0	54	7.1	3	0	0.9	0.5
Aster subulatus *	0.1	1	EX						0.1	
Conyza sumatrensis *	0.2	4	EX						0.2	
Cynodon dactylon	2	60	GG		2					
Eleocharis sphacelata	2	200	GG		2					
Juncus usitatus	10	50	GG		10					
Marsilea drummondii	3	100	EG				3			
Paspalum dilatatum *	0.4	10	HT							0.4
Persicaria decipiens	6	100	FG			6				
Philydrum lanuginosum	1	40	FG			1				
Polygonum aviculare *	0.1	1	EX						0.1	
Ranunculus spp.	0.1	1	FG			0.1				
Senecio madagascariensis *	0.1	2	HT							0.1
Typha orientalis	40	400	GG		40					

Easting	288862
Northing	6246124
Orientation	320
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m	0
Attributes 1x1 plot (%)	
Litter (%)	0

Q4			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)			43	32	2	1	14	13	1	1	11	6
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			112.1	101.1	20	10	64.2	3.9	2	1	11	8.8
Erodium crinitum	0.1	1	FG					0.1				
Eucalyptus moluccana	15	10	TG		15							
Eucalyptus tereticornis	5	4	TG		5							
Glycine tabacina	1	35	OG							1		
Lomandra filiformis subsp. coriacea	0.7	40	GG				0.7					
Microlaena stipoides var. stipoides	50	600	GG				50					
Olea europaea *	5	10	HT									5
Opercularia varia	0.3	10	FG					0.3				
Oxalis perennans	0.5	20	FG					0.5				
Paspalidium distans	0.4	6	GG				0.4					
Paspalum dilatatum *	2	35	HT									2
Richardia stellaris *	0.2	3	EX								0.2	
Senecio madagascariensis *	0.4	10	HT									0.4
Setaria parviflora *	0.5	20	EX								0.5	
Sida rhombifolia *	1	50	EX								1	
Solanum prinophyllum	0.2	2	FG					0.2				
Solanum sisymbriifolium *	0.4	4	EX								0.4	
Sonchus oleraceus *	0.1	4	EX								0.1	
Sporobolus creber	0.3	10	GG				0.3					
Themeda triandra	0.1	3	GG				0.1					
Veronica plebeia	0.8	25	FG					0.8				
Wahlenbergia gracilis	0.4	8	FG					0.4				

Easting	288737
Northing	6246177
Orientation	260
Plot size	20 x 20, 20 x 50

ttributes 20x50m plot

Q5			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)			36	14	1	0	9	3	0	1	22	9
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			106.7	21	7	0	8.7	3.3	0	2	85.7	15
Alternanthera pungens *	0.3	10	HT									0.3
Asparagus asparagoides *	0.3	10	HT									0.3
Bidens pilosa *	0.1	3	EX								0.1	
Bothriochloa macra	1	50	GG				1					
Carex inversa	0.5	40	GG				0.5					
Cenchrus clandestinus *	55	500	EX								55	
Chloris ventricosa	0.4	10	GG				0.4					
Cirsium vulgare *	5	100	EX								5	
Conyza sumatrensis *	4	200	EX								4	
Cynodon dactylon	2	50	GG				2					
Dichondra repens	0.2	10	FG					0.2				
Ehrharta erecta *	1	40	HT									1
Einadia hastata	3	80	FG					3				
Eragrostis curvula *	1	10	HT									1
Eriochloa pseudoacrotricha	3	80	GG				3					
Eucalyptus moluccana	7	4	TG		7							
Geranium homeanum	0.1	3	FG					0.1				
Glycine tabacina	2	90	OG							2		
Gomphocarpus fruticosus *	0.1	1	EX								0.1	
Lomandra filiformis subsp. filiformis	0.3	8	GG				0.3					
Lycium ferocissimum *	10	10	HT									10
Microlaena stipoides var. stipoides	0.8	30	GG				0.8					
Nothoscordum gracile *	0.4	15	EX								0.4	
Olea europaea *	0.5	1	HT									0.5
Oxalis corniculata *	1	100	EX								1	
Paspalidium distans	0.3	10	GG				0.3					
Paspalum dilatatum *	1	40	HT									1
Plantago lanceolata *	1	40	EX								1	
Rytidosperma caespitosum	0.4	20	GG				0.4					
Senecio madagascariensis *	0.8	30	HT									0.8
Setaria parviflora *	1	30	EX								1	
Sida rhombifolia *	2	80	EX								2	
Solika sessilis *	0.1	4	EX								0.1	
Verbena officinalis *	0.5	10	EX								0.5	
Vicia sativa *	0.5	30	EX								0.5	
Xanthium spinosum *	0.1	2	HT									0.1

Easting	288455
Northing	6246750
Orientation	350
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	No
5-9	No
<5	Yes
Hollows	0
Length logs (m)	4
Attributes 1x1 plot (%)	
Litter (%)	3.2

Q6			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 25/06/2019			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)			29	20	2	1	10	5	0	2	9	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			107.9	**98.9**	25	4	64.1	4.7	0	1.1	**9**	2.6
*Araujia sericifera**	1	4	HT									1
Aristida vagans	3	80	GG				3					
Bothriochloa macra	0.2	4	GG				0.2					
Brunoniella australis	0.5	25	FG					0.5				
Bursaria spinosa	4	8	SG			4						
Chloris divaricata var. divaricata	0.6	25	GG				0.6					
Chloris ventricosa	6	60	GG				6					
Cyperus gracilis	0.1	2	GG				0.1					
Dichondra repens	0.5	25	FG					0.5				
Einadia hastata	3	40	FG					3				
Eragrostis leptostachya	1	40	GG				1					
Eucalyptus moluccana	15	7	TG		15							
Eucalyptus tereticornis	10	3	TG		10							
Glycine microphylla	0.1	3	OG							0.1		
Glycine tabacina	1	35	OG							1		
Lomandra filiformis subsp. filiformis	0.2	6	GG				0.2					
*Lycium ferocissimum**	0.6	4	HT									0.6
Microlaena stipoides var. stipoides	50	500	GG				50					
*Modiola caroliniana**	0.2	3	EX								0.2	
*Olea europaea**	1	6	HT									1
*Oxalis corniculata**	0.2	6	EX								0.2	
Oxalis perennans	0.6	50	FG					0.6				
Paspalidium distans	2	40	GG				2					
*Setaria parviflora**	1	30	EX								1	
*Sida rhombifolia**	4	40	EX								4	
Solanum prinophyllum	0.1	1	FG					0.1				
*Solanum pseudocapsicum**	0.5	8	EX								0.5	
*Solanum sisymbriifolium**	0.5	10	EX								0.5	
Sporobolus creber	1	30	GG				1					

Easting	288653
Northing	6246150
Orientation	90
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	2
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	7
1 Attributes 1x1 plot (%)	
Litter (%)	40

Q7			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 26/11/19			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Scattered Trees)			22	8	1	0	3	4	0	0	14	2
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			81.9	26.6	15	0	10.3	1.3	0	0	55.3	6
*Avena fatua**	1	40	EX								1	
*Bromus catharticus**	2	30	EX								2	
Casuarina glauca	15	6	TG		15							
*Cenchrus clandestinus**	40	250	EX								40	
*Chloris gayana**	1	40	HT									1
Cynodon dactylon	10	100	GG				10					
Einadia hastata	0.4	20	FG					0.4				
Einadia nutans subsp. nutans	0.3	6	FG					0.3				
Eragrostis brownii	0.2	10	GG				0.2					
*Gamochaeta americana**	0.6	10	EX								0.6	
Lachnagrostis filiformis	0.1	1	GG				0.1					
*Lepidium bonariense**	2	45	EX								2	
*Lolium perenne**	0.4	15	EX								0.4	
*Lotus subbiflorus**	0.1	1	EX								0.1	
*Onopordum acanthium**	0.4	6	EX								0.4	
*Plantago lanceolata**	0.4	8	EX								0.4	
*Polygonum aviculare**	2	30	EX								2	
Portulaca oleracea	0.4	6	FG					0.4				
*Senecio madagascariensis**	5	70	HT									5
*Sida rhombifolia**	0.1	2	EX								0.1	
*Solanum sisymbriifolium**	0.3	8	EX								0.3	
Wahlenbergia gracilis	0.2	4	FG					0.2				

Easting	290722
Northing	6253714
Orientation	208
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	Yes
10-19	No
5-9	No
<5	No
Hollows	1
Length logs (m)	43
Attributes 1x1 plot (%)	
Litter (%)	11

Q8			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 02/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			33	13	0	0	7	6	0	0	20	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			67.7	22.8	0	0	19.5	3.3	0	0	49.7	5
*Amaranthus viridis**	0.1	1	EX								0.1	
*Anagallis arvensis**	0.5	100	EX								0.5	
*Bidens subalternans**	0.2	10	EX									5
*Capsella bursa-pastoris**	0.5	50	EX								0.5	
*Cenchrus clandestinus**	1	20	EX								1	
*Chenopodium album**	0.1	3	EX								0.1	
Commelina cyanea	0.5	15	FG					0.5				
Cotula australis	0.1	5	FG					0.1				
Cynodon dactylon	18	200	GG				18					
*Cyperus brevifolius**	0.1	5	EX								0.1	
*Digitaria sanguinalis**	4	100	EX								4	
Einadia hastata	0.4	10	FG					0.4				
Einadia nutans subsp. nutans	0.1	2	FG					0.1				
Eriochloa pseudoacrotricha	0.4	10	GG				0.4					
Fimbristylis dichotoma	0.1	5	GG				0.1					
*Hypochaeris radicata**	0.1	5	EX								0.1	
Juncus usitatus	0.3	8	GG				0.3					
*Malva parviflora**	0.2	10	EX								0.2	
*Medicago polymorpha**	0.2	20	EX								0.2	
Microlaena stipoides var. stipoides	0.4	20	GG				0.4					
*Modiola caroliniana**	0.1	5	EX								0.1	
*Oxalis corniculata**	1	100	EX								1	
Phyllanthus virgatus	0.2	10	FG					0.2				
*Plantago lanceolata**	0.1	5	EX								0.1	
Portulaca oleracea	2	100	FG					2				
*Setaria parviflora**	20	500	EX								20	
*Sida rhombifolia**	0.5	40	EX								0.5	
*Solanum sisymbriifolium**	15	60	EX								15	
*Soliva sessilis**	0.1	5	EX								0.1	
*Sonchus oleraceus**	0.1	4	EX								0.1	
Sporobolus creber	0.1	3	GG				0.1					
Sporobolus elongatus	0.2	10	GG				0.2					
*Verbena bonariensis**	1	80	EX								1	

Easting	289442
Northing	6246336
Orientation	270
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
1 Attributes 1x1 plot (%)	
Litter (%)	1.6

Q9			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 02/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			39	17	0	0	10	5	0	2	22	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			87.9	**36.9**	0	0	34.7	1.5	0	0.7	**51**	8
*Ambrosia artemisiifolia**	0.2	10	EX								0.2	
*Anagallis arvensis**	0.8	100	EX								0.8	
Aristida ramosa	0.4	10	GG				0.4					
Aristida vagans	0.6	20	GG				0.6					
Asperula conferta	0.1	5	FG					0.1				
*Aster subulatus**	0.1	1	EX								0.1	
*Axonopus fissifolius**	3	60	HT									3
Bothriochloa macra	15	300	GG				15					
*Chenopodium album**	0.2	10	EX								0.2	
*Cirsium vulgare**	0.1	1	EX								0.1	
*Conyza bonariensis**	0.1	5	EX								0.1	
Cynodon dactylon	15	200	GG				15					
*Cyperus brevifolius**	0.3	20	EX								0.3	
Desmodium gunnii	0.6	50	FG					0.6				
*Digitaria sanguinalis**	2	60	EX								2	
*Echinochloa crus-galli**	0.5	15	EX								0.5	
Fimbristylis dichotoma	0.2	20	GG				0.2					
Glycine microphylla	0.1	10	OG							0.1		
Glycine tabacina	0.6	50	OG							0.6		
Hydrocotyle laxiflora	0.1	10	FG					0.1				
*Hypochaeris radicata**	0.5	30	EX								0.5	
*Lepidium africanum**	0.1	1	EX								0.1	
Microlaena stipoides var. stipoides	1	60	GG				1					
*Modiola caroliniana**	0.8	20	EX								0.8	
Oxalis perennans	0.1	5	FG					0.1				
Paspalidium distans	0.3	10	GG				0.3					
*Paspalum dilatatum**	5	100	HT									5
*Plantago lanceolata**	0.6	40	EX								0.6	
Portulaca oleracea	0.6	30	FG					0.6				
*Setaria parviflora**	35	500	EX								35	
*Sida rhombifolia**	0.4	20	EX								0.4	
*Solanum sisymbriifolium**	0.1	1	EX								0.1	
*Soliva sessilis**	0.1	5	EX								0.1	
*Sonchus oleraceus**	0.1	5	EX								0.1	
Sporobolus creber	2	90	GG				2					
Sporobolus elongatus	0.1	5	GG				0.1					
Themeda triandra	0.1	1	GG				0.1					
*Verbena bonariensis**	0.4	20	EX								0.4	
*Verbena officinalis**	0.6	10	EX								0.6	

Easting	289996
Northing	6246717
Orientation	235
Plot size	20 x 20, 20 x 50
1 Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
1 Attributes 1x1 plot (%)	
Litter (%)	0.8

Q10			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date:02/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			41	17	1	0	6	10	0	0	24	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			89	**60.4**	4	0	53	3.4	0	0	**28.6**	2.4
*Amaranthus viridis**	0.1	1	EX								0.1	
*Anagallis arvensis**	0.2	50	EX								0.2	
*Bidens pilosa**	0.2	20	EX								0.2	
Bothriochloa macra	0.5	40	GG				0.5					
Carex inversa	0.8	70	GG				0.8					
*Cirsium vulgare**	0.1	1	EX								0.1	
Commelina cyanea	1	60	FG					1				
*Conyza bonariensis**	0.1	1	EX								0.1	
Cotula australis	0.6	100	FG					0.6				
Cynodon dactylon	6	200	GG				6					
*Cyperus brevifolius**	0.1	1	EX								0.1	
*Digitaria sanguinalis**	2	50	EX								2	
*Echinochloa crus-galli**	1	50	EX								1	
Einadia hastata	0.2	10	FG					0.2				
*Eragrostis curvula**	0.2	5	HT									0.2
Eucalyptus tereticornis	4	1	TG		4							
Geranium homeanum	0.2	10	FG					0.2				
Hydrocotyle laxiflora	0.1	10	FG					0.1				
Hypericum gramineum	0.1	10	FG					0.1				
*Hypochaeris radicata**	0.8	40	EX								0.8	
Juncus usitatus	0.1	1	GG				0.1					
*Leotodon saxatilis**	0.1	5	EX								0.1	
Microlaena stipoides var. stipoides	45	1000	GG				45					
*Modiola caroliniana**	0.1	5	EX								0.1	
*Onopordum acanthium**	0.8	60	EX								0.8	
*Oxalis corniculata**	0.4	60	EX								0.4	
Oxalis perennans	0.1	5	FG					0.1				
*Paronychia brasiliana**	0.1	5	EX								0.1	
Paspalidium distans	0.6	30	GG				0.6					
*Paspalum dilatatum**	2	80	HT									2
*Plantago lanceolata**	0.8	100	EX								0.8	
Portulaca oleracea	0.6	40	FG					0.6				
*Rubus fruticosus complex**	0.1	1	HT									0.1
Rumex brownii	0.1	1	FG					0.1				
*Senecio madagascariensis**	0.1	2	HT									0.1
*Setaria parviflora**	15	300	EX								15	
*Sida rhombifolia**	1	80	EX								1	
*Solanum sisymbriifolium**	3	20	EX								3	
Tricoryne elatior	0.4	30	FG					0.4				
*Verbena officinalis**	0.2	5	EX								0.2	
*Verbena rigida**	0.1	5	EX								0.1	

Easting	290038
Northing	6246743
Orientation	56
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	Yes
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	12
Attributes 1x1 plot (%)	
Litter (%)	2

Q11			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 02/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			33	20	0	0	11	7	0	2	13	3
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			88.1	42.9	0	0	38.2	3.2	0	1.5	45.2	16.4
*Anagallis arvensis**	0.1	10	EX								0.1	
Aristida ramosa	4	100	GG				4					
Asperula conferta	2	10	FG					2				
Bothriochloa macra	15	300	GG				15					
*Briza subaristata**	0.8	40	EX								0.8	
*Capsella bursa-pastoris**	0.1	3	EX								0.1	
Carex inversa	3	200	GG				3					
*Chloris gayana**	1	20	HT									1
Cynodon dactylon	3	80	GG				3					
Cyperus gracilis	2	300	GG				2					
Dichondra repens	0.3	40	FG					0.3				
Einadia nutans subsp. nutans	0.2	10	FG					0.2				
Fimbristylis dichotoma	0.1	2	GG				0.1					
Glycine clandestina	0.5	70	OG							0.5		
Glycine tabacina	1	80	OG							1		
*Hypochaeris radicata**	0.3	20	EX								0.3	
Juncus usitatus	0.1	5	GG				0.1					
*Oxalis corniculata**	0.6	40	EX								0.6	
Oxalis perennans	0.4	40	FG					0.4				
Paspalidium criniforme	0.6	20	GG				0.6					
Paspalidium distans	8	80	GG				8					
*Paspalum dilatatum**	15	200	HT									15
*Plantago lanceolata**	1	80	EX								1	
Rumex brownii	0.1	1	FG					0.1				
Rytidosperma caespitosum	0.4	10	GG				0.4					
*Senecio madagascariensis**	0.4	10	HT									0.4
*Setaria parviflora**	25	500	EX								25	
*Sida rhombifolia**	0.2	10	EX								0.2	
*Sporobolus africanus**	0.6	20	EX								0.6	
Sporobolus creber	2	100	GG				2					
Tricoryne elatior	0.1	5	FG					0.1				
*Verbena officinalis**	0.1	3	EX								0.1	
Wahlenbergia gracilis	0.1	2	FG					0.1				

Easting	290606
Northing	6247771
Orientation	90
Plot size	20x20, 20x50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	1.8

Q12			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			21	5	0	0	5	0	0	0	16	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			101.8	**3.8**	0	0	3.8	0	0	0	**98**	36.1
*Acetosella vulgaris**	0.1	5	HT									0.1
*Aster subulatus**	0.1	1	EX								0.1	
*Briza subaristata**	20	500	EX								20	
Carex inversa	0.1	25	GG				0.1					
*Cirsium vulgare**	0.1	1	EX								0.1	
*Conyza bonariensis**	4	200	EX								4	
*Cyclospermum leptophyllum**	0.1	4	EX								0.1	
Cynodon dactylon	3	80	GG				3					
*Eragrostis curvula**	3	40	HT									3
*Hypochaeris radicata**	0.2	20	EX								0.2	
Microlaena stipoides var. stipoides	0.5	40	GG				0.5					
*Oxalis corniculata**	0.4	50	EX								0.4	
Panicum effusum	0.1	5	GG				0.1					
*Paspalum dilatatum**	25	500	HT									25
*Plantago lanceolata**	0.6	30	EX								0.6	
Schoenoplectus validus	0.1	1	GG				0.1					
*Senecio madagascariensis**	8	200	HT									8
*Setaria parviflora**	35	1000	EX								35	
*Solanum sisymbriifolium**	0.4	20	EX								0.4	
*Verbena officinalis**	0.2	10	EX								0.2	
*Verbena rigida**	0.8	20	EX								0.8	

Easting	291654
Northing	6248244
Orientation	280
Plot size	20x20, 20x50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	2.2

Q13			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			13	1	0	0	1	0	0	0	12	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			95.1	**0.1**	0	0	0.1	0	0	0	**95**	30.5
*Briza subaristata**	1	100	EX								1	
Carex inversa	0.1	20	GG				0.1					
*Cenchrus clandestinus**	45	1000	EX								45	
*Cirsium vulgare**	0.4	10	EX								0.4	
*Conyza bonariensis**	15	500	EX								15	
*Hypochaeris radicata**	0.2	10	EX								0.2	
*Lactuca serriola**	0.1	5	EX								0.1	
*Oxalis corniculata**	0.6	50	EX								0.6	
*Paspalum dilatatum**	30	500	HT									30
*Plantago lanceolata**	2	80	EX								2	
*Senecio madagascariensis**	0.5	60	HT									0.5
*Sida rhombifolia**	0.1	1	EX								0.1	
*Verbena bonariensis**	0.1	2	EX								0.1	

Easting	291677
Northing	6248341
Orientation	70
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	0

Q14			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			21	6	0	0	4	2	0	0	15	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			94.8	4.2	0	0	4	0.2	0	0	90.6	20.6
*Briza subaristata**	12	200	EX								12	
*Bromus cartharticus**	0.1	2	EX								0.1	
Carex inversa	0.4	50	GG				0.4					
*Cenchrus clandestinus**	15	100	EX								15	
*Conyza bonariensis**	0.8	50	EX								0.8	
*Cyclospermum leptophyllum**	0.1	3	EX								0.1	
Cynodon dactylon	3	80	GG				3					
*Eragrostis curvula**	0.2	5	HT									0.2
*Hypochaeris radicata**	0.1	5	EX								0.1	
*Juncus cognatus**	1	200	EX								1	
Microlaena stipoides var. stipoides	0.4	30	GG				0.4					
*Oxalis corniculata**	0.6	40	EX								0.6	
Paspalidium distans	0.2	10	GG				0.2					
*Paspalum dilatatum**	20	200	HT									20
Phyllanthus virgatus	0.1	5	FG					0.1				
*Plantago lanceolata**	0.1	5	EX								0.1	
*Senecio madagascariensis**	0.4	30	HT									0.4
*Setaria parviflora**	40	1000	EX								40	
*Verbena officinalis**	0.1	5	EX								0.1	
*Verbena rigida**	0.1	1	EX								0.1	
Wahlenbergia gracilis	0.1	3	FG					0.1				

Easting	291507
Northing	6248265
Orientation	270
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	0

Q15			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)			48	18	2	1	7	7	0	1	30	8
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			81.8	**48.4**	22	0.4	20.5	5.3	0	0.2	**33.4**	9.1
*Ambrosia artemisiifolia**	0.8	60	EX								0.8	
*Araujia sericifera**	0.1	1	HT									0.1
*Asparagus asparagoides**	0.1	1	HT									0.1
*Bidens pilosa**	0.1	10	EX								0.1	
*Bromus cartharticus**	0.4	10	EX								0.4	
Bursaria spinosa	0.4	2	SG			0.4						
Callistemon sp. (Cultivar)	0.5	2	EX								0.5	
Carex inversa	0.8	100	GG				0.8					
*Cenchrus clandestinus**	10	100	EX								10	
*Cestrum parqui**	0.5	4	HT									0.5
*Chamaecyparis sp.**	5	3	EX								5	
Chloris ventricosa	0.2	10	GG				0.2					
Commelina cyanea	1	40	FG					1				
*Conyza sumatrensis**	0.5	10	EX								0.5	
Cynodon dactylon	3	80	GG				3					
Cyperus gracilis	0.8	80	GG				0.8					
Dichondra repens	0.3	20	FG					0.3				
*Dietes bicolor**	0.1	1	EX								0.1	
Einadia hastata	0.8	20	FG					0.8				
Einadia nutans subsp. nutans	2	100	FG					2				
Einadia trigonos subsp. trigonos	1	40	FG					1				
*Eleusine tristachya**	0.7	40	EX								0.7	
*Eragrostis curvula**	1	30	HT									1
Eragrostis leptostachya	0.2	10	GG				0.2					
Eucalyptus microcorys	12	1	TG		12							
Eucalyptus moluccana	10	2	TG		10							
Glycine clandestina	0.2	10	OG							0.2		
Juncus usitatus	0.5	30	GG				0.5					
*Ligustrum sinense**	0.1	1	HT									0.1
Microlaena stipoides var. stipoides	15	200	GG				15					
*Olea europaea**	0.1	1	HT									0.1
*Opuntia stricta**	0.1	2	EX								0.1	
*Oxalis corniculata**	0.4	20	EX								0.4	
*Paronychia brasiliana**	0.1	5	EX								0.1	
*Paspalum dilatatum**	7	100	HT									7
*Passiflora edulis**	0.1	2	EX								0.1	
*Passiflora subpeltata**	0.4	4	EX								0.4	
*Plantago lanceolata**	1	40	EX								1	
Portulaca oleracea	0.1	5	FG					0.1				
*Senecio madagascarensis**	0.2	10	HT									0.2
*Sida rhombifolia**	2	80	EX								2	
Solanum americanum*	0.1	1	FG					0.1				
Solanum sisymbriifolium*	0.5	20	EX								0.5	
Soliva sessilis*	0.1	10	EX								0.1	
Sporobolus africanus*	0.1	5	EX								0.1	
Taraxacum officinale*	0.6	10	EX								0.6	
Verbena bonariensis*	0.4	5	EX								0.4	
Verbena officinalis*	0.4	15	EX								0.4	

Easting	291840
Northing	6248354
Orientation	160
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	2
30-49	Yes
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	2
Attributes 1x1 plot (%)	
Litter (%)	4

Q16			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Intact)			37	31	1	2	10	15	1	2	6	3
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			125.5	121.4	1	2.1	75.6	39.5	1	2.2	4.1	3.2
Alternanthera denticulata	0.4	10	FG					0.4				
*Araujia sericifera**	2	80	HT									2
Aristida vagans	10	500	GG				10					
Brunoniella australis	35	80	FG					35				
Bursaria spinosa	2	100	SG			2						
Carex inversa	0.1	2	GG				0.1					
Cheilanthes sieberi subsp. sieberi	1	90	EG						1			
Cyperus gracilis	2	100	GG				2					
Desmodium gunnii	0.1	3	FG					0.1				
Dianella longifolia var. longifolia	0.2	5	FG					0.2				
Dichelachne micrantha	1	100	GG				1					
Dichondra repens	0.1	5	FG					0.1				
Einadia hastata	0.4	10	FG					0.4				
Einadia nutans subsp. nutans	0.4	5	FG					0.4				
Einadia trigonos subsp. trigonos	0.4	20	FG					0.4				
Eragrostis leptostachya	2	60	GG				2					
Eremophila debilis	0.1	3	SG			0.1						
Eriochloa pseudoacrotricha	36	14	GG				36					
Eucalyptus moluccana	1	100	TG		1							
Glycine clandestina	2	100	OG							2		
Glycine tabacina	0.2	10	OG							0.2		
Lomandra filiformis subsp. filiformis	15	500	GG				15					
Microlaena stipoides var. stipoides	9	10	GG				9					
*Olea europaea**	0.8	90	HT									0.8
Oxalis perennans	0.8	20	FG					0.8				
*Paspalum dilatatum**	0.4	20	HT									0.4
Phyllanthus virgatus	0.2	10	FG					0.2				
Plantago varia	0.8	80	FG					0.8				
*Richardia stellaris**	0.6	15	EX								0.6	
Rytidosperma caespitosum	0.4	20	GG				0.4					
*Sida rhombifolia**	0.1	5	EX								0.1	
Sigesbeckia orientalis subsp. orientalis	0.1	3	FG					0.1				
*Solanum americanum**	0.2	5	FG					0.2				
Solanum prinophyllum	0.1	2	FG					0.1				
*Solanum sisymbriifolium**	0.2	10	EX								0.2	
Themeda triandra	0.1	1	GG				0.1					
Veronica plebeia	0.3	10	FG					0.3				

Easting	290535
Northing	6247688
Orientation	220
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	1
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	12.5
Attributes 1x1 plot (%)	
Litter (%)	43

Q17			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 03/03/20			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			35	13	0	0	8	5	0	0	22	4
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			81	12.3	0	0	10.2	2.1	0	0	68.7	10.9
*Anagallis arvensis**	0.2	10	EX								0.2	
*Axonopus fissifolius**	0.5	40	HT									0.5
*Briza subaristata**	5	100	EX								5	
*Capsella bursa-pastoris**	0.1	5	EX								0.1	
Carex inversa	1	80	GG				1					
Chloris divaricata var. divaricata	0.4	10	GG				0.4					
*Chloris gayana**	5	100	HT									5
Chloris ventricosa	0.6	20	GG				0.6					
Cynodon dactylon	3	80	GG				3					
*Digitaria sanguinalis**	0.4	10	EX								0.4	
*Echinochloa crus-galli**	0.4	20	EX								0.4	
Einadia nutans subsp. nutans	1	50	FG					1				
Einadia trigonos subsp. trigonos	0.8	30	FG					0.8				
*Eleusine tristachya**	0.3	10	EX								0.3	
Eriochloa pseudoacrotricha	4	100	GG				4					
*Hypochaeris radicata**	0.8	50	EX								0.8	
*Juncus cognatus**	0.8	60	EX								0.8	
*Leotodon saxatilis**	0.4	30	EX								0.4	
Microlaena stipoides var. stipoides	0.1	3	GG				0.1					
*Modiola caroliniana**	0.1	3	EX								0.1	
*Oxalis corniculata**	2	100	EX								2	
Paspalidium distans	0.6	15	GG				0.6					
*Paspalum dilatatum**	5	100	HT									5
*Plantago lanceolata**	0.8	80	EX								0.8	
*Polygonum aviculare**	0.1	3	EX								0.1	
Portulaca oleracea	0.1	5	FG					0.1				
Rumex brownii	0.1	1	FG					0.1				
*Rumex crispus**	0.2	5	EX								0.2	
*Senecio madagascariensis**	0.4	20	HT									0.4
*Setaria parviflora**	45	1000	EX								45	
*Sida rhombifolia**	0.7	60	EX								0.7	
*Soliva sessilis**	0.1	10	EX								0.1	
*Sporobolus africanus**	0.4	10	EX								0.4	
Sporobolus creber	0.5	30	GG				0.5					
Wahlenbergia gracilis	0.1	2	FG					0.1				

Easting	290705
Northing	6247716
Orientation	50
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	0.6

Q18			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 4/3/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)			30	11	1	0	6	3	0	1	19	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			98.4	**40.2**	16	0	8.1	14.1	0	2	**58.2**	9.2
*Amaranthus viridis**	0.1	1	EX								0.1	
*Axonopus fissifolius**	5	90	HT									5
*Capsella bursa-pastoris**	0.2	6	EX								0.2	
Carex inversa	1	20	GG				1					
*Cenchrus clandestinus**	15	100	EX								15	
*Chenopodium album**	0.1	1	EX								0.1	
Chloris ventricosa	0.4	20	GG				0.4					
Cynodon dactylon	5	45	GG				5					
Cyperus gracilis	1	50	GG				1					
*Digitaria sanguinalis**	1	40	EX								1	
Einadia hastata	10	90	FG					10				
Eriochloa pseudoacrotricha	0.2	4	GG				0.2					
Eucalyptus moluccana	16	6	TG		16							
Glycine tabacina	2	100	OG							2		
*Lepidium africanum**	10	90	EX								10	
*Lycium ferocissimum**	2	1	HT									2
*Malva parviflora**	3	100	EX								3	
Microlaena stipoides var. stipoides	0.5	20	GG				0.5					
*Oxalis corniculata**	0.5	30	EX								0.5	
*Paronychia brasiliana**	0.2	4	EX								0.2	
*Plantago lanceolata**	1	30	EX								1	
Portulaca oleracea	4	200	FG					4				
Rumex brownii	0.1	1	FG					0.1				
*Senecio madagascarensis**	2	70	HT									2
*Setaria parviflora**	0.8	10	EX								0.8	
*Sida rhombifolia**	10	90	EX								10	
*Solanum sisymbriifolium**	2	40	EX								2	
*Soliva sessilis**	5	100	EX								5	
*Verbena bonariensis**	0.1	1	EX								0.1	
*Xanthium spinosum**	0.2	4	HT									0.2

Easting	291423
Northing	6250270
Orientation	130
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	No
5-9	No
<5	No
Hollows	1
Length logs (m)	12
Attributes 1x1 plot (%)	
Litter (%)	15

Q19			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 06/03/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 724 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)			31	17	1	0	8	7	0	1	14	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			96.5	**75.7**	15	0	42.9	16.8	0	1	**20.8**	8.1
Alternanthera denticulata	0.1	2	FG					0.1				
*Ambrosia artemisiifolia**	0.1	1	EX								0.1	
*Arctotheca calendula**	0.1	5	EX								0.1	
Bothriochloa macra	4	50	GG				4					
Carex inversa	0.5	30	GG				0.5					
*Cenchrus clandestinus**	5	100	EX								5	
Commelina cyanea	1	35	FG					1				
Cynodon dactylon	10	170	GG				10					
Cyperus gracilis	0.4	20	GG				0.4					
Dysphania pumilio	2	59	FG					2				
Einadia nutans subsp. linifolia	0.6	30	FG					0.6				
Einadia nutans subsp. nutans	9	120	FG					9				
Eragrostis leptostachya	10	200	GG				10					
Eucalyptus fibrosa	15	1	TG		15							
Glycine clandestina	1	60	OG							1		
*Lepidium africanum**	1	45	EX								1	
*Lycium ferocissimum**	2	5	HT									2
Microlaena stipoides var. stipoides	4	70	GG				4					
*Oxalis corniculata**	0.3	15	EX								0.3	
*Paronychia brasiliana**	0.1	10	EX								0.1	
Paspalidium distans	8	160	GG				8					
*Paspalum dilatatum**	6	100	HT									6
*Plantago lanceolata**	0.6	25	EX								0.6	
Portulaca oleracea	4	90	FG					4				
Rumex brownii	0.1	1	FG					0.1				
*Senecio madagascarensis**	0.1	1	HT									0.1
*Setaria parviflora**	3	45	EX								3	
*Sida rhombifolia**	1	50	EX								1	
*Solanum sisymbriifolium**	1	8	EX								1	
*Soliva sessilis**	0.5	37	EX								0.5	
Sporobolus creber	6	90	GG				6					

Easting	291609
Northing	6251132
Orientation	33
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	2
50-79	1
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	1
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	3

Q20			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 22/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)			28	9	1	0	3	4	0	1	19	5
	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			115.7	67.9	30	0	35.9	1.8	0	0.2	47.8	3.6
Araujia sericifera	2	50	HT									2
Asparagus aethiopicus	1	20	HT									1
Austrostipa verticillata	0.3	10	GG				0.3					
Bidens pilosa	15	500	EX								15	
Bidens subalternans	5	100	EX								5	
Casuarina glauca	30	50	TG		30							
Chloris gayana	0.3	10	HT									0.3
Cirsium vulgare	0.1	1	EX								0.1	
Commelina cyanea	0.8	40	FG					0.8				
Dichondra repens	0.1	5	FG					0.1				
Echinopogon caespitosus	0.6	10	GG				0.6					
Einadia trigonos	0.5	30	FG					0.5				
Eragrostis curvula	0.1	1	HT									0.1
Glycine tabacina	0.2	10	OG							0.2		
Hypochaeris radicata	0.1	1	EX								0.1	
Lobelia purpurascens	0.4	20	FG					0.4				
Microlaena stipoides	35	1000	GG				35					
Oxalis corniculata	0.1	2	EX								0.1	
Plantago lanceolata	0.2	10	EX								0.2	
Senecio madagascarensis	0.2	10	HT									0.2
Senecio pterophorus	0.2	5	EX								0.2	
Setaria parviflora	1	40	EX								1	
Sida rhombifolia	0.6	30	EX								0.6	
Solanum nigrum	1	30	EX								1	
Solanum pseudocapsicum	20	300	EX								20	
Solanum sisymbriifolium	0.7	20	EX								0.7	
Sonchus oleraceus	0.1	1	EX								0.1	
Verbena rigida	0.1	5	EX								0.1	

Easting	291038
Northing	6254270
Orientation	350
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	7
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	3
Length logs (m)	33
Attributes 1x1 plot (%)	
Litter (%)	57

Q21			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 22/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			27	11	1	1	2	6	0	1	16	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			141.5	**72.6**	1	52	15	4.2	0	0.4	**68.9**	0.3
Alternanthera denticulata	0.1	3	FG					0.1				
Austrostipa verticillata	10	200	GG				10					
Bidens pilosa	15	500	EX								15	
Bidens subalternans	5	100	EX								5	
Caesia parviflora	0.1	1	FG					0.1				
Cerastium glomeratum	0.8	80	EX								0.8	
Cirsium vulgare	0.1	5	EX								0.1	
Commelina cyanea	3	80	FG					3				
Dichondra repens	0.1	5	FG					0.1				
Einadia hastata	0.1	1	FG					0.1				
Einadia trigonos	0.8	40	FG					0.8				
Eucalyptus moluccana	1	1	TG		1							
Galinsoga parviflora	0.8	70	EX								0.8	
Glycine tabacina	0.4	20	OG							0.4		
Hypochaeris radicata	0.1	5	EX								0.1	
Melaleuca decora	52	25	SG			52						
Microlaena stipoides	5	100	GG				5					
Plantago lanceolata	0.2	10	EX								0.2	
Senecio madagascarensis	0.3	5	HT									0.3
Setaria parviflora	0.5	60	EX								0.5	
Sida rhombifolia	10	300	EX								10	
Solanum nigrum	0.4	10	EX								0.4	
Solanum pseudocapsicum	35	500	EX								35	
Soliva sessilis	0.1	10	EX								0.1	
Sonchus oleraceus	0.1	2	EX								0.1	
Taraxacum officinale	0.4	20	EX								0.4	
Verbena officinalis	0.1	5	EX								0.1	

Easting	291259
Northing	6254818
Orientation	260
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	2
50-79	3
30-49	Yes
20-29	Yes
10-19	Yes
5-9	No
<5	No
Hollows	0
Length logs (m)	17
Attributes 1x1 plot (%)	
Litter (%)	48

Q22			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 22/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 724 - Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			42	24	1	2	11	8	1	1	18	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			108.5	**56.2**	10	14	22	7.1	3	0.1	**52.3**	1.4
Acacia decurrens	10	60	TG		10							
Aristida vagans	0.3	20	GG				0.3					
Austrostipa verticillata	0.6	40	GG				0.6					
Bidens pilosa	30	1000	EX								30	
Bidens subalternans	0.5	150	EX								0.5	
Bothriochloa macra	0.4	20	GG				0.4					
Cheilanthes sieberi	3	100	EG						3			
Commelina cyanea	1	80	FG					1				
Cyperus gracilis	0.1	10	GG				0.1					
Ehrharta erecta	0.1	5	HT									0.1
Einadia hastata	0.3	10	FG					0.3				
Einadia trigonos	0.6	20	FG					0.6				
Eragrostis brownii	0.8	60	GG				0.8					
Eragrostis curvula	0.1	3	HT									0.1
Eragrostis leptostachya	0.8	40	GG				0.8					
Eragrostis tenuifolia	0.8	30	EX								0.8	
Eriochloa pseudoacrotricha	0.2	10	GG				0.2					
Fimbristylis dichotoma	0.4	20	GG				0.4					
Glycine clandestina	0.1	5	OG							0.1		
Grevillea juniperina subsp. juniperina	6	15	SG			6						
Hypericum gramineum	4	200	FG					4				
Hypochaeris radicata	6	200	EX								6	
Lobelia purpurascens	0.4	10	FG					0.4				
Lomandra filiformis subsp. filiformis	0.4	20	GG				0.4					
Melaleuca decora	8	2	SG			8						
Microlaena stipoides	15	500	GG				15					
Oxalis corniculata	0.3	30	EX								0.3	
Oxalis perennans	0.2	10	FG					0.2				
Paspalum dilatatum	0.6	10	HT									0.6
Plantago lanceolata	0.5	20	EX								0.5	
Schkuhria pinnata	0.4	20	EX								0.4	
Senecio madagascarensis	0.6	40	HT									0.6
Setaria parviflora	5	100	EX								5	
Sida rhombifolia	0.8	50	EX								0.8	
Solanum pseudocapsicum	1	70	EX								1	
Solanum sisymbriifolium	2	20	EX								2	
Soliva sessilis	0.5	30	EX								0.5	
Sonchus oleraceus	0.1	3	EX								0.1	
Sporobolus creber	3	100	GG				3					
Tagetes minuta	3	80	EX								3	
Tricoryne elatior	0.1	5	FG					0.1				
Wahlenbergia gracilis	0.5	50	FG					0.5				

Easting	291423
Northing	6254767
Orientation	280
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	3
30-49	Yes
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
Attributes 1x1 plot (%)	
Litter (%)	19

Q23			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 22/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			38	21	2	2	5	9	1	2	17	3
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			152.9	134.4	42.4	9	76.7	4.7	0.6	1	18.5	1.4
Acacia decurrens	0.4	2	TG		0.4							
Anagallis arvensis	0.5	50	EX								0.5	
Angophora subvelutina	42	50	TG		42							
Aristida vagans	0.8	30	GG				0.8					
Asparagus aethiopicus	0.3	10	HT									0.3
Austrostipa verticillata	0.4	30	GG				0.4					
Bidens pilosa	6	200	EX								6	
Bidens subalternans	0.6	40	EX								0.6	
Brunoniella australis	0.1	10	FG					0.1				
Cheilanthes sieberi	0.6	30	EG						0.6			
Cirsium vulgare	0.1	3	EX								0.1	
Commelina cyanea	2	80	FG					2				
Conyza sumatrensis	0.1	1	EX								0.1	
Dichondra repens	0.5	50	FG					0.5				
Echinopogon caespitosus	5	100	GG				5					
Einadia hastata	0.4	10	FG					0.4				
Eriochloa pseudoacrotricha	0.5	40	GG				0.5					
Glycine clandestina	0.2	10	OG							0.2		
Glycine tabacina	0.8	30	OG							0.8		
Grevillea juniperina subsp. juniperina	7	20	SG			7						
Hydrocotyle sibthorpioides	0.3	40	FG					0.3				
Hypericum gramineum	0.1	5	FG					0.1				
Hypochaeris radicata	0.8	50	EX								0.8	
Hypoxis hygrometrica	0.4	30	FG					0.4				
Lobelia purpurascens	0.8	100	FG					0.8				
Melaleuca decora	2	1	SG			2						
Microlaena stipoides	70	1000	GG				70					
Oxalis corniculata	0.4	30	EX								0.4	
Rubus fruticosus agg.	0.1	1	HT									0.1
Senecio madagascarensis	1	50	HT									1
Setaria parviflora	4	100	EX								4	
Sida rhombifolia	1	40	EX								1	
Solanum nigrum	0.1	1	EX								0.1	
Solanum pseudocapsicum	0.8	30	EX								0.8	
Solanum sisymbriifolium	2	40	EX								2	
Sonchus oleraceus	0.1	2	EX								0.1	
Tricoryne elatior	0.1	1	FG					0.1				
Verbena rigida	0.6	10	EX								0.6	

Easting	291411
Northing	625491
Orientation	10
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	1
50-79	2
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	101
Attributes 1x1 plot (%)	
Litter (%)	37

Q24			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 23/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			37	22	3	2	7	8	1	1	15	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			143.3	**96.4**	17.5	10.2	61.7	4.3	2	0.7	**46.9**	7.7
Acacia decurrens	0.5	2	TG		0.5							
Acacia stricta	0.2	1	SG			0.2						
Araujia sericifera	0.1	3	HT									0.1
Asperula conferta	2	100	FG					2				
Bidens pilosa	8	200	EX								8	
Bothriochloa macra	3	100	GG				3					
Centella asiatica	0.6	50	FG					0.6				
Cheilanthes sieberi	2	80	EG						2			
Conyza bonariensis	0.6	20	EX								0.6	
Dichondra repens	1	80	FG					1				
Echinopogon ovatus	0.4	20	GG				0.4					
Einadia trigonos	0.3	10	FG					0.3				
Eragrostis curvula	0.6	20	HT									0.6
Eragrostis elongata	0.1	1	GG				0.1					
Eucalyptus moluccana	7	4	TG		7							
Eucalyptus tereticornis	10	1	TG		10							
Facelis retusa	0.4	20	EX								0.4	
Fimbristylis dichotoma	1	100	GG				1					
Gamochaeta spp.	0.8	100	EX								0.8	
Glycine tabacina	0.7	40	OG							0.7		
Grevillea juniperina subsp. juniperina	10	30	SG			10						
Hypochaeris albiflora	0.5	30	EX								0.5	
Hypochaeris radicata	2	100	EX								2	
Hypoxis hygrometrica	0.1	5	FG					0.1				
Microlaena stipoides	55	1000	GG				55					
Paspalidium distans	0.2	10	GG				0.2					
Paspalum dilatatum	1	30	HT									1
Phyllanthus virgatus	0.1	1	FG					0.1				
Plantago lanceolata	0.4	20	EX								0.4	
Senecio madagascarensis	6	100	HT									6
Setaria parviflora	3	100	EX								3	
Sida rhombifolia	15	500	EX								15	
Solanum pseudocapsicum	0.5	10	EX								0.5	
Solanum sisymbriifolium	8	60	EX								8	
Sporobolus creber	2	80	GG				2					
Tricoryne elatior	0.1	2	FG					0.1				
Wahlenbergia gracilis	0.1	10	FG					0.1				

Easting	291449
Northing	6254988
Orientation	280
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	2
30-49	Yes
20-29	No
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	12
Attributes 1x1 plot (%)	
Litter (%)	15

Q25			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 23/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)			32	18	3	0	4	9	0	2	14	3
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			145.5	100.6	33.5	0	50.2	16.6	0	0.3	44.9	3.2
Acacia decurrens	0.5	2	TG		0.5							
Alphitonia excelsa	3	2	TG		3							
Alternanthera denticulata	1	40	FG					1				
Asparagus asparagoides	3	60	HT									3
Bidens pilosa	5	100	EX								5	
Bidens subalternans	8	200	EX								8	
Brunonia australis	5	300	FG					5				
Casuarina glauca	30	100	TG		30							
Centella asiatica	1	50	FG					1				
Cirsium vulgare	0.4	10	EX								0.4	
Commelina cyanea	2	80	FG					2				
Cyperus eragrostis	0.1	3	HT									0.1
Cyperus gracilis	0.1	1	GG				0.1					
Daucus glochidiatus	0.1	3	FG					0.1				
Desmodium gunnii	0.1	2	FG					0.1				
Dichondra repens	3	200	FG					3				
Entolasia marginata	0.1	5	GG				0.1					
Glycine clandestina	0.1	5	OG							0.1		
Hypochaeris radicata	0.8	30	EX								0.8	
Lobelia purpurascens	4	200	FG					4				
Microlaena stipoides	40	100	GG				40					
Oplismenus aemulus	10	200	GG				10					
Oxalis corniculata	0.3	70	EX								0.3	
Oxalis perennans	0.4	10	FG					0.4				
Paspalum dilatatum	0.1	3	HT									0.1
Passiflora subpeltata	0.2	10	EX								0.2	
Polymeria calycina	0.2	10	OG							0.2		
Setaria parviflora	5	100	EX								5	
Sida rhombifolia	10	200	EX								10	
Solanum pseudocapsicum	5	100	EX								5	
Solanum sisymbriifolium	6	80	EX								6	
Sonchus oleraceus	1	50	EX								1	

Easting	291516
Northing	6255416
Orientation	270
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	420
Attributes 1x1 plot (%)	
Litter (%)	75

Q26			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 23/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			48	39	4	3	16	13	1	2	7	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			131.5	**125.8**	36.3	6.6	74.1	6.9	0.1	1.8	**2.7**	0.8
Acacia decurrens	1	5	TG		1							
Acacia falcata	0.1	1	SG			0.1						
Allocasuarina littoralis	3	1	TG		3							
Aristida ramosa	0.4	10	GG				0.4					
Aristida vagans	15	300	GG				15					
Asparagus asparagoides	0.1	1	HT									0.1
Bidens pilosa	0.5	10	EX								0.5	
Bursaria spinosa	6	30	SG			6						
Carex inversa	0.1	2	GG				0.1					
Cheilanthes sieberi	4	100	GG				4					
Chorizema parviflorum	0.1	5	EG						0.1			
Desmodium gunnii	0.5	30	SG			0.5						
Dichelachne micrantha	0.8	30	FG					0.8				
Dichondra repens	1	40	GG				1					
Dichondra sp. A	0.1	5	FG					0.1				
Echinopogon caespitosus	2	60	FG					2				
Eragrostis brownii	0.6	30	GG				0.6					
Eragrostis leptostachya	1	50	GG									
Eriochloa pseudoacrotricha	0.1	5	GG				0.1					
Eucalyptus moluccana	6	3	GG				6					
Eucalyptus tereticornis	32	30	TG		32							
Fimbristylis dichotoma	0.3	20	TG		0.3							
Glycine clandestina	0.2	5	GG				0.2					
Glycine tabacina	1	50	OG							1		
Goodenia hederacea	0.8	40	OG							0.8		
Hypericum gramineum	0.1	10	FG					0.1				
Hypochaeris radicata	0.4	10	FG					0.4				
Hypoxis hygrometrica	0.1	10	EX								0.1	
Lobelia purpurascens	1	80	FG					1				
Lomandra filiformis	0.2	10	FG					0.2				
Lomandra filiformis subsp. filiformis	0.2	10	GG				0.2					
Lomandra multiflora	0.4	10	GG				0.4					
Microlaena stipoides	40	500	GG				40					
Opercularia varia	3	100	GG				3					
Paspalidium distans	2	80	FG									
Phyllanthus virgatus	0.1	5	GG				0.1					
Poranthera microphylla	0.1	5	FG					0.1				
Senecio madagascarensis	0.5	10	FG					0.5				
Setaria parviflora	0.7	30	HT									0.7
Solanum pseudocapsicum	0.5	5	EX								0.5	
Solanum sisymbriifolium	0.6	10	EX								0.6	
Sonchus oleraceus	0.2	5	EX								0.2	
Sporobolus creber	1	50	GG				1					
Themeda triandra	2	60	GG				2					
Vernonia cinerea	0.8	20	FG					0.8				
Veronica plebeia	0.4	20	FG					0.4				
Vittadinia cuneata	0.4	10	FG					0.4				
Wahlenbergia gracilis	0.1	5	FG					0.1				

Easting	291493
Northing	6255933
Orientation	80
Plot size	20 x 20, 20 x 50
Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	2
Attributes 1x1 plot (%)	
Litter (%)	46

Q27			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 23/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)			33	19	3	1	4	7	1	3	14	2
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			126.6	105.2	32	0.5	50.8	14.6	3	4.3	21.4	1.4
Alphitonia excelsa	1	1	TG		1							
Anagallis arvensis	0.1	5	EX								0.1	
Aristida ramosa	0.1	5	GG				0.1					
Asparagus asparagoides	1	10	HT									1
Asperula conferta	0.2	10	FG					0.2				
Austrostipa verticillata	0.6	30	GG				0.6					
Bidens pilosa	2	80	EX								2	
Bidens subalternans	1	50	EX								1	
Brunoniella australis	4	100	FG					4				
Bursaria spinosa	0.5	6	SG			0.5						
Casuarina glauca	28	50	TG		28							
Centella asiatica	0.8	50	FG					0.8				
Cheilanthes sieberi	3	200	EG						3			
Cirsium vulgare	0.3	10	EX								0.3	
Desmodium gunnii	0.1	2	FG					0.1				
Dichondra repens	6	100	FG					6				
Eucalyptus amplifolia subsp. amplifolia	3	2	TG		3							
Fimbristylis dichotoma	0.1	5	GG				0.1					
Glycine clandestina	0.2	10	OG							0.2		
Glycine tabacina	4	200	OG							4		
Hypochaeris radicata	0.8	50	EX								0.8	
Hypoxis hygrometrica	0.5	40	FG					0.5				
Lobelia purpurascens	3	100	FG					3				
Microlaena stipoides	50	1000	GG				50					
Oxalis corniculata	0.8	50	EX								0.8	
Polymeria calycina	0.1	1	OG							0.1		
Senecio madagascarensis	0.4	20	HT									0.4
Setaria parviflora	4	100	EX								4	
Sida rhombifolia	6	200	EX								6	
Solanum nigrum	0.4	3	EX								0.4	
Solanum pseudocapsicum	2	80	EX								2	
Solanum sisymbriifolium	2	40	EX								2	
Sonchus oleraceus	0.6	30	EX								0.6	

Easting	291551
Northing	6255839
Orientation	340
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	No
Hollows	3
Length logs (m)	118
BAM Attributes 1x1 plot (%)	
Litter (%)	22

Q28			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 23/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			38	22	0	2	13	6	0	1	16	4
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			95.7	**27.8**	0	3.1	23.5	1.1	0	0.1	**67.9**	7.2
Acacia falcata	0.1	1	SG			0.1						
Anagallis arvensis	0.4	30	EX								0.4	
Aristida ramosa	0.6	20	GG				0.6					
Aristida vagans	10	300	GG				10					
Axonopus fissifolius	0.6	20	HT									0.6
Bidens pilosa	1	50	EX								1	
Bidens subalternans	0.5	10	EX								0.5	
Bidens subalternans	0.5	30	EX								0.5	
Bothriochloa macra	0.4	10	GG				0.4					
Bursaria spinosa	3	15	SG			3						
Cymbopogon refractus	0.1	1	GG				0.1					
Cynodon dactylon	3	80	GG				3					
Desmodium varians	0.1	3	OG							0.1		
Dichondra sp. A	0.4	30	FG					0.4				
Eragrostis curvula	1	5	HT									1
Eragrostis elongata	0.5	20	GG				0.5					
Eragrostis leptostachya	1	60	GG				1					
Facelis retusa	0.4	30	EX								0.4	
Fimbristylis dichotoma	1	100	GG				1					
Gamochaeta calviceps	0.8	40	EX								0.8	
Haloragis heterophylla	0.3	5	FG					0.3				
Hypericum gramineum	0.1	10	FG					0.1				
Hypochaeris radicata	0.5	40	EX								0.5	
Hypoxis hygrometrica	0.1	5	FG					0.1				
Linum trigynum	0.4	20	EX								0.4	
Lomandra filiformis subsp. filiformis	0.1	3	GG				0.1					
Microlaena stipoides	3	80	GG				3					
Oxalis corniculata	0.2	20	EX								0.2	
Paspalidium distans	1	60	GG				1					
Paspalum dilatatum	5	100	HT									5
Phyllanthus virgatus	0.1	5	FG					0.1				
Senecio madagascarensis	0.6	40	HT									0.6
Setaria parviflora	55	1000	EX								55	
Solanum sisymbriifolium	0.8	10	EX								0.8	
Sonchus oleraceus	0.2	5	EX								0.2	
Sporobolus creber	2	60	GG				2					
Themeda triandra	0.8	30	GG				0.8					
Wahlenbergia gracilis	0.1	5	FG					0.1				

Easting	291524
Northing	6255875
Orientation	220
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	Yes
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	13

Q29			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)			39	25	4	1	7	10	1	2	14	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			131.7	**113.7**	32.1	6	70.4	4.2	0.7	0.3	**18**	0.8
Acacia decurrens	0.1	1	TG		0.1							
Alphitonia excelsa	1	1	TG		1							
Araujia sericifera	0.1	1	HT									0.1
Austrostipa verticillata	4	100	GG				4					
Bidens pilosa	3	100	EX								3	
Bidens subalternans	0.5	50	EX								0.5	
Brunoniella australis	0.2	20	FG					0.2				
Casuarina glauca	23	60	TG		23							
Cheilanthes sieberi	0.7	60	EG						0.7			
Commelina cyanea	0.5	40	FG					0.5				
Conyza sumatrensis	0.1	2	EX								0.1	
Desmodium gunnii	0.1	5	FG					0.1				
Dichondra repens	0.1	5	FG					0.1				
Digitaria parviflora	0.2	20	GG				0.2					
Echinopogon caespitosus	0.2	10	GG				0.2					
Einadia hastata	0.1	3	FG					0.1				
Einadia trigonos	0.2	10	FG					0.2				
Entolasia marginata	0.1	3	GG				0.1					
Eragrostis leptostachya	0.1	10	GG				0.1					
Eucalyptus amplifolia subsp. amplifolia	8	1	TG		8							
Facelis retusa	0.1	3	EX								0.1	
Glycine clandestina	0.1	5	OG							0.1		
Glycine tabacina	0.2	30	OG							0.2		
Hydrocotyle laxiflora	0.3	50	FG					0.3				
Hypochaeris radicata	0.8	50	EX								0.8	
Lobelia purpurascens	2	100	FG					2				
Melaleuca decora	6	3	SG			6						
Microlaena stipoides	65	1000	GG				65					
Oplismenus aemulus	0.8	40	GG				0.8					
Oxalis perennans	0.6	50	FG					0.6				
Paspalum dilatatum	0.1	2	HT									0.1
Poranthera microphylla	0.1	5	FG					0.1				
Senecio madagascarensis	0.6	50	HT									0.6
Setaria parviflora	10	100	EX								10	
Sida rhombifolia	0.4	30	EX								0.4	
Solanum nigrum	0.1	1	EX								0.1	
Solanum pseudocapsicum	0.1	2	EX								0.1	
Solanum sisymbriifolium	2	40	EX								2	
Taraxacum officinale	0.1	5	EX								0.1	

Easting	291425
Northing	6254877
Orientation	260
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	Yes
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	83
BAM Attributes 1x1 plot (%)	
Litter (%)	19

Q30			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/4/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			50	38	1	0	16	19	0	2	12	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			125.1	**118.5**	28	0	79.1	9.4	0	2	**6.6**	1
Anagallis arvensis	0.2	30	EX								0.2	
Aristida ramosa	7	200	GG				7					
Aristida vagans	5	100	GG				5					
Asperula conferta	2	100	FG					2				
Bidens pilosa	0.5	50	EX								0.5	
Bothriochloa macra	15	200	GG				15					
Brunoniella australis	2	100	FG					2				
Calotis cuneifolia	0.1	3	FG					0.1				
Centella asiatica	0.4	100	FG					0.4				
Chloris truncata	0.1	2	GG				0.1					
Chloris ventricosa	0.4	50	GG				0.4					
Commelina cyanea	0.3	10	FG					0.3				
Cymbopogon refractus	1	40	GG				1					
Cyperus gracilis	0.1	5	GG				0.1					
Daucus glochidiatus	0.1	5	FG					0.1				
Desmodium varians	1	100	OG							1		
Dichondra repens	2	100	FG					2				
Dichondra sp. A	0.5	60	FG					0.5				
Einadia trigonos	0.1	3	FG					0.1				
Eragrostis curvula	0.5	15	HT									0.5
Eragrostis leptostachya	2	80	GG				2					
Eriochloa pseudoacrotricha	3	100	GG				3					
Eucalyptus moluccana	28	40	TG		28							
Fimbristylis dichotoma	0.1	5	GG				0.1					
Glycine tabacina	1	90	OG							1		
Hypericum gramineum	0.1	10	FG					0.1				
Hypochaeris radicata	0.1	5	EX								0.1	
Hypoxis hygrometrica	0.1	10	FG					0.1				
Linum trigynum	0.6	80	EX								0.6	
Lomandra confertifolia	0.1	10	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	5	GG				0.1					
Microlaena stipoides	35	500	GG				35					
Opercularia diphylla	0.4	20	FG					0.4				
Oxalis perennans	0.6	80	FG					0.6				
Panicum simile	0.2	20	GG				0.2					
Paspalidium distans	8	200	GG				8					
Phyllanthus virgatus	0.1	10	FG					0.1				
Plantago gaudichaudii	0.1	10	FG					0.1				
Plantago lanceolata	0.2	10	EX								0.2	
Portulaca oleracea	0.2	30	FG					0.2				
Rumex brownii	0.1	1	FG					0.1				
Senecio madagascarensis	0.5	60	HT									0.5
Setaria parviflora	0.4	60	EX								0.4	
Sida rhombifolia	3	300	EX								3	
Solanum pseudocapsicum	0.1	3	EX								0.1	
Solanum sisymbriifolium	0.4	20	EX								0.4	
Themeda triandra	2	80	GG				2					
Tricoryne elatior	0.1	1	FG					0.1				
Verbena rigida	0.1	3	EX								0.1	
Vittadinia cuneata	0.1	5	FG					0.1				

Easting	291387
Northing	6255644
Orientation	40
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	1
	.
BAM Attributes 1x1 plot (%)	
Litter (%)	20

Q31			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			22	10	0	0	6	4	0	0	12	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			128.5	**62.2**	0	0	61.3	0.9	0	0	**66.3**	5.4
Aristida ramosa	0.1	10	GG				0.1					
Asperula conferta	0.4	60	FG					0.4				
Bidens pilosa	3	100	EX								3	
Bidens subalternans	0.2	20	EX								0.2	
Cirsium vulgare	0.3	20	EX								0.3	
Conyza bonariensis	0.6	40	EX								0.6	
Cynodon dactylon	60	1000	GG				60					
Cyperus brevifolius	0.5	90	EX								0.5	
Eragrostis curvula	0.4	10	HT									0.4
Fimbristylis dichotoma	0.5	80	GG				0.5					
Hypochaeris radicata	0.6	50	EX								0.6	
Hypoxis hygrometrica	0.1	3	FG					0.1				
Linum trigynum	0.2	40	EX								0.2	
Lomandra confertifolia	0.1	5	GG				0.1					
Lomandra filiformis subsp. filiformis	0.1	2	GG				0.1					
Microlaena stipoides	0.5	40	GG				0.5					
Oxalis perennans	0.3	20	FG					0.3				
Paspalum dilatatum	2	80	HT									2
Phyllanthus virgatus	0.1	10	FG					0.1				
Senecio madagascarensis	3	100	HT									3
Setaria parviflora	55	1000	EX								55	
Solanum sisymbriifolium	0.5	30	EX								0.5	

Easting	291471
Northing	6255665
Orientation	85
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	14

Q32			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low)			32	22	1	3	8	9	1	0	10	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			95.5	**69.9**	0.1	1.1	52.4	1.3	15	0	**25.6**	5
Acacia decurrens	0.1	1	TG		0.1							
Anagallis arvensis	0.5	100	EX								0.5	
Aristida vagans	15	200	GG				15					
Bidens pilosa	1	80	EX								1	
Bidens subalternans	0.4	50	EX								0.4	
Bursaria spinosa	0.1	1	SG			0.1						
Calotis cuneifolia	0.1	3	FG					0.1				
Cheilanthes sieberi	15	200	EG						15			
Chorizema parviflorum	0.4	20	SG			0.4						
Eragrostis brownii	5	100	GG				5					
Eragrostis curvula	4	60	HT									4
Eragrostis leptostachya	5	100	GG				5					
Facelis retusa	0.8	100	EX								0.8	
Fimbristylis dichotoma	1	100	GG				1					
Goodenia paniculata	0.4	40	FG					0.4				
Hydrocotyle sibthorpioides	0.1	10	FG					0.1				
Hypericum gramineum	0.1	100	FG					0.1				
Hypochaeris radicata	2	100	EX								2	
Hypoxis hygrometrica	0.1	10	FG					0.1				
Kunzea ambigua	0.6	2	SG			0.6						
Laxmannia gracilis	0.1	10	FG					0.1				
Linum trigynum	0.8	100	EX								0.8	
Lomandra confertifolia	0.3	10	GG				0.3					
Lomandra multiflora	0.1	1	GG				0.1					
Microlaena stipoides	25	300	GG				25					
Poranthera microphylla	0.1	2	FG					0.1				
Senecio madagascarensis	1	80	HT									1
Setaria parviflora	15	200	EX								15	
Sonchus oleraceus	0.1	2	EX								0.1	
Themeda triandra	1	30	GG				1					
Tricoryne elatior	0.1	10	FG					0.1				
Wahlenbergia gracilis	0.2	30	FG					0.2				

Easting	291502
Northing	6255746
Orientation	220
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	No
10-19	No
5-9	No
<5	No
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	12

Q33			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Intact)			30	16	1	0	5	6	0	4	14	2
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			138.4	**61.3**	30	0	24.4	5.9	0	1	**77.1**	2.5
Anagallis arvensis	0.4	50	EX								0.4	
Asparagus asparagoides	2	10	HT									2
Asperula conferta	0.1	5	FG					0.1				
Austrostipa verticillata	0.6	20	GG				0.6					
Bidens pilosa	25	500	EX								25	
Bidens subalternans	3	80	EX								3	
Casuarina glauca	30	60	TG		30							
Cirsium vulgare	0.6	30	EX								0.6	
Commelina cyanea	0.5	40	FG					0.5				
Convolvulus erubescens	0.1	2	OG							0.1		
Daucus glochidiatus	0.1	10	FG					0.1				
Dichondra repens	0.1	5	FG					0.1				
Echinopogon caespitosus	0.8	40	GG				0.8					
Einadia trigonos	0.1	2	FG					0.1				
Glycine clandestina	0.2	10	OG							0.2		
Glycine tabacina	0.6	30	OG							0.6		
Lobelia purpurascens	5	200	FG					5				
Lotus corniculatus	0.1	1	EX								0.1	
Microlaena stipoides	20	200	GG				20					
Oplismenus aemulus	1	80	GG				1					
Oxalis corniculata	1	100	EX								1	
Oxalis purpurea	0.1	1	EX								0.1	
Paspalidium distans	2	80	GG				2					
Polymeria calycina	0.1	5	OG							0.1		
Senecio madagascarensis	0.5	40	HT									0.5
Setaria parviflora	10	200	EX								10	
Sida rhombifolia	15	200	EX								15	
Solanum pseudocapsicum	15	100	EX								15	
Solanum sisymbriifolium	4	70	EX								4	
Sonchus oleraceus	0.4	30	EX								0.4	

Easting	261477
Northing	6255620
Orientation	195
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	No
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	0
Length logs (m)	138
BAM Attributes 1x1 plot (%)	
Litter (%)	66

Q34			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 24/04/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			47	32	1	0	14	13	1	3	15	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			128.8	**108.4**	20	0	82.6	2.9	0.7	2.2	**20.4**	6.1
Eucalyptus moluccana	20	18	TG		20							
Paspalidium distans	10	200	GG				10					
Microlaena stipoides	45	500	GG				45					
Aristida ramosa	5	100	GG				5					
Sporobolus creber	10	300	GG				10					
Bothriochloa macra	5	100	GG				5					
Setaria parviflora	10	300	EX								10	
Oxalis perennans	0.4	40	FG					0.4				
Desmodium varians	0.6	30	OG							0.6		
Sida rhombifolia	0.8	50	EX								0.8	
Lomandra filiformis subsp. filiformis	0.5	30	GG				0.5					
Phyllanthus virgatus	0.1	5	FG					0.1				
Lotus corniculatus	0.1	20	EX								0.1	
Hypoxis hygrometrica	0.1	10	FG					0.1				
Glycine tabacina	0.8	50	OG							0.8		
Anagallis arvensis	0.1	4	EX								0.1	
Araujia sericifera	0.1	2	HT									0.1
Asperula conferta	0.3	20	FG					0.3				
Austrostipa verticillata	0.7	30	GG				0.7					
Bidens pilosa	1	80	EX								1	
Carex inversa	0.1	1	GG				0.1					
Centella asiatica	0.1	5	FG					0.1				
Cheilanthes sieberi	0.7	40	EG						0.7			
Chloris truncata	0.1	5	GG				0.1					
Chloris ventricosa	5	100	GG				5					
Commelina cyanea	0.4	30	FG					0.4				
Cyperus gracilis	0.2	30	GG				0.2					
Dichondra sp. A	0.1	1	FG					0.1				
Einadia trigonos	0.6	50	FG					0.6				
Eragrostis curvula	5	80	HT									5
Eragrostis leptostachya	0.8	40	GG				0.8					
Facelis retusa	0.3	40	EX								0.3	
Fimbristylis dichotoma	0.1	10	GG				0.1					
Hypochaeris albiflora	0.1	5	EX								0.1	
Hypochaeris radicata	0.3	20	EX								0.3	
Laxmannia gracilis	0.1	5	FG					0.1				
Opercularia diphylla	0.4	30	FG					0.4				
Oplismenus aemulus	0.1	3	GG				0.1					
Plantago lanceolata	0.6	40	EX								0.6	
Polymeria calycina	0.8	50	OG							0.8		
Poranthera microphylla	0.1	3	FG					0.1				
Senecio madagascarensis	1	80	HT									1
Solanum pseudocapsicum	0.4	10	EX								0.4	
Solanum sisymbriifolium	0.5	20	EX								0.5	
Soliva sessilis	0.1	20	EX								0.1	
Tricoryne elatior	0.1	5	FG					0.1				
Wahlenbergia gracilis	0.1	3	FG					0.1				

Easting	291434
Northing	6255747
Orientation	170
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	1
30-49	No
20-29	Yes
10-19	Yes
5-9	Yes
<5	Yes
Hollows	1
Length logs (m)	3
BAM Attributes 1x1 plot (%)	
Litter (%)	30

Q35			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 10/06/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Scattered Trees)			18	5	1	0	3	1	0	0	13	5
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			128.7	65.6	25	0	40.4	0.2	0	0	63.1	31.9
Carex appressa	0.2	1	GG				0.2					
Cenchrus clandestinum	30	200	HT									30
Chloris gayana	0.1	1	HT									0.1
Cynodon dactylon	40	200	GG				40					
Cyperus brevifolius	0.1	10	EX								0.1	
Eucalyptus amplifolia	25	50	TG		25							
Hypochaeris radicata	0.1	10	EX								0.1	
Juncus usitatus	0.2	4	GG				0.2					
Lotus australis	0.2	20	FG					0.2				
Lycium ferocissimum	0.5	1	HT									0.5
Modiola caroliniana	0.1	1	EX								0.1	
Paspalum dilatatum	1	20	HT									1
Senecio madagascarensis	0.3	20	HT									0.3
Setaria parviflora	30	200	EX								30	
Sida rhombifolia	0.5	50	EX								0.5	
Solanum sisymbriifolium	0.2	5	EX								0.2	
Sonchus oleraceus	0.1	1	EX								0.1	
Taraxacum officinale	0.1	2	EX								0.1	

Easting	292320
Northing	6257746
Orientation	234
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	2
50-79	1
30-49	No
20-29	No
10-19	No
5-9	Yes
<5	Yes
Hollows	2
Length logs (m)	35
BAM Attributes 1x1 plot (%)	
Litter (%)	7

LC1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 10/11/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 835 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			44	27	4	1	9	10	1	2	17	7
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			180.7	**135.2**	71.3	20	26.5	16.9	0.1	0.4	**45.5**	42.6
Eucalyptus tereticornis	60	80	TG		60							
Eucalyptus moluccana	10	6	TG		10							
Olea europaea	40	200	HT									40
Lycium ferocissimum	2	5	HT									2
Cestrum parqui	0.2	5	HT									0.2
Bursaria spinosa	20	50	SG			20						
Sida rhombifolia	2	20	EX								2	
Einadia hastata	10	100	FG					10				
Passiflora spp.	0.1	1	EX								0.1	
Entolasia marginata	0.3	10	GG				0.3					
Solanum prinophyllum	0.5	20	FG					0.5				
Solanum linnaeanum	0.1	1	EX								0.1	
Commelina cyanea	0.2	10	FG					0.2				
Desmodium varians	0.2	20	OG							0.2		
Plectranthus parviflorus	0.5	20	FG					0.5				
Microlaena stipoides	25	200	GG				25					
Glycine tabacina	0.2	20	OG							0.2		
Bidens pilosa	0.1	1	EX								0.1	
Lomandra filiformis	0.3	20	GG				0.3					
Paspalidium distans	0.2	20	GG				0.2					
Brunoniella australis	0.2	20	FG					0.2				
Solanum nigrum	0.1	1	EX								0.1	
Dichondra repens	5	200	FG					5				
Chloris ventricosa	0.1	1	GG				0.1					
Lomandra longifolia	0.3	20	GG				0.3					
Einadia nutans	0.1	1	FG					0.1				
Asparagus asparagoides	0.1	1	HT									0.1
Oplismenus aemulus	0.1	2	GG				0.1					
Araujia sericifera	0.1	1	HT									0.1
Sonchus oleraceus	0.1	5	EX								0.1	
Senecio madagascarensis	0.1	5	HT									0.1
Senecio pterophorus	0.1	1	EX								0.1	
Oxalis spp.	0.1	1	EX								0.1	
Rytidosperma tenuius	0.1	10	GG				0.1					
Hypochaeris radicata	0.1	5	EX								0.1	
Cheilanthes sieberi	0.1	10	EG						0.1			
Wahlenbergia spp.	0.1	2	FG					0.1				
Acacia decurrens	0.3	1	TG		0.3							
Angophora floribunda	1	1	TG		1							
Cyperus gracilis	0.1	2	GG				0.1					
Veronica plebeia	0.2	10	FG					0.2				
Poranthera microphylla	0.1	10	FG					0.1				
Tradescantia fluminensis	0.1	10	HT									0.1
Lactuca serriola	0.1	10	EX								0.1	

Easting	291914
Northing	6258427
Orientation	263
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	1
20-29	1
10-19	1
5-9	1
<5	1
Hollows	0
Length logs (m)	109
BAM Attributes 1x1 plot (%)	
Litter (%)	82

LC2			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 09/11/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Thinned)			31	15	1	2	3	7	0	2	16	3
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			185	143.1	60	20.5	60.4	2	0	0.2	41.9	40.3
Casuarina glauca	60	100	TG		60							
Melaleuca styphelioides	20	3	SG			20						
Solanum linnaeanum	0.2	20	EX								0.2	
Solanum pseudocapsicum	0.2	20	EX								0.2	
Solanum prinophyllum	0.2	20	FG					0.2				
Solanum nigrum	0.2	20	EX								0.2	
Ehrharta erecta	40	1000	HT									40
Oplismenus aemulus	0.2	20	GG				0.2					
Hypochaeris radicata	0.1	1	EX								0.1	
Conyza bonariensis	0.1	1	EX								0.1	
Lobelia purpurascens	0.2	10	FG					0.2				
Microlaena stipoides	60	1000	GG				60					
Dichondra repens	1	20	FG					1				
Plantago lanceolata	0.1	2	EX								0.1	
Cyclospermum leptophyllum	0.1	1	EX								0.1	
Cirsium vulgare	0.1	1	EX								0.1	
Gamochaeta spp.	0.1	1	EX								0.1	
Clematis aristata	0.1	1	OG							0.1		
Echinopogon caespitosus	0.2	10	GG				0.2					
Verbena bonariensis	0.1	1	EX								0.1	
Senecio madagascarensis	0.1	1	HT									0.1
Facelis retusa	0.1	2	EX								0.1	
Bursaria spinosa	0.5	7	SG			0.5						
Plectranthus parviflorus	0.3	10	FG					0.3				
Hypericum gramineum	0.1	1	FG					0.1				
Olea europaea	0.2	1	HT									0.2
Oxalis perennans	0.1	10	FG					0.1				
Sonchus oleraceus	0.1	1	EX								0.1	
Brunoniella australis	0.1	10	FG					0.1				
Glycine clandestina	0.1	10	OG							0.1		
Senecio pterophorus	0.1	10	EX								0.1	

Easting	291110
Northing	6252195
Orientation	194
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	1
50-79	1
30-49	1
20-29	1
10-19	1
5-9	1
<5	1
Hollows	1
Length logs (m)	31
BAM Attributes 1x1 plot (%)	
Litter (%)	34

LC3			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
Date: 09/11/2020			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
PCT 724 Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Thinned)			31	23	2	7	6	6	1	1	8	3
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			132.8	**77.1**	0.6	61.2	13.6	1.3	0.3	0.1	**55.7**	15.2
Kunzea ambigua	60	100	SG			60						
Lissanthe strigosa	0.2	2	SG			0.2						
Themeda triandra	10	100	GG				10					
Hypochaeris radicata	0.2	20	EX								0.2	
Cheilanthes sieberi	0.3	100	EG						0.3			
Solanum linnaeanum	0.1	2	EX								0.1	
Centaurium erythraea	0.1	10	EX								0.1	
Briza subaristata	40	200	EX								40	
Laxmannia gracilis	0.1	10	FG					0.1				
Poranthera microphylla	0.2	200	FG					0.2				
Hypericum gramineum	0.1	10	FG					0.1				
Hibbertia obtusifolia	0.2	10	SG			0.2						
Gamochaeta spp.	0.1	10	EX								0.1	
Senecio madagascarensis	0.2	10	HT									0.2
Lomandra multiflora	1	100	GG				1					
Centella asiatica	0.5	100	FG					0.5				
Paspalum dilatatum	10	200	HT									10
Astroloma humifusum	0.3	20	SG			0.3						
Schoenus spp.	0.1	3	GG				0.1					
Lomandra filiformis	0.2	10	GG				0.2					
Casuarina glauca	0.3	1	TG		0.3							
Acacia decurrens	0.3	10	TG		0.3							
Chorizema parviflorum	0.1	1	SG			0.1						
Glycine tabacina	0.1	20	OG							0.1		
Stackhousia viminea	0.1	1	FG					0.1				
Bursaria spinosa	0.1	1	SG			0.1						
Eragrostis curvula	5	20	HT									5
Gonocarpus tetragynus	0.3	40	FG					0.3				
Dichelachne spp.	0.3	1	GG				0.3					
Hakea sericea	0.3	1	SG			0.3						
Aristida vagans	2	30	GG				2					

Easting	291401
Northing	6251983
Orientation	28
Plot size	20 x 20, 20 x 50
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	0
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	11

Appendix D

Recorded fauna

GROUP	COMMON NAME	SCIENTIFIC NAME	EPBC ACT[1]	BC ACT[1]	DEOH SITE	ON-AIRPORT[2]	OFF-AIRPORT
Amphibian	Common Eastern Froglet	*Crinia signifera*			✓	✓	✓
Amphibian	Peron's Tree Frog	*Litoria peronii*			✓	✓	✓
Amphibian	Spotted Marsh Frog	*Limnodynastes tasmaniensis*			✓	✓	✓
Amphibian	Striped Marsh Frog	*Limnodynastes peronii*					✓
Amphibian	Whistling Tree Frog	*Litoria verreauxii*				✓	✓
Amphibian	Smooth Toadlet	*Uperoleia laevigata*					✓
Amphibian	Broad-palmed frog	*Litoria latopalmata*					✓
Amphibian	Eastern Dwarf Tree Frog	*Litoria fallax*				✓	✓
Bird	Australasian Darter	*Anhinga novaehollandiae*				✓	✓
Bird	Australian Hobby	*Falco longipennis*					✓
Bird	Australian Magpie	*Cracticus tibicen*			✓	✓	✓
Bird	Australian Pelican	*Pelecanus conspicillatus*					✓
Bird	Australian Raven	*Corvus coronoides*			✓	✓	✓
Bird	Australian Wood Duck	*Chenonetta jubata*			✓		✓
Bird	Black Swan	*Cygnus atratus*					✓
Bird	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			✓	✓	✓
Bird	Brown Thornbill	*Acanthiza pusilla*			✓	✓	✓
Bird	Cattle Egret	*Bubulcus ibis*			✓	✓	✓
Bird	Common Bronzewing	*Phaps chalcoptera*			✓		✓
Bird	Common Myna*	*Acridotheres tristis**			✓	✓	✓
Bird	Common Starling*	*Sturnus vulgaris**			✓	✓	✓
Bird	Crested Pigeon	*Ocyphaps lophotes*			✓	✓	✓
Bird	Eastern Rosella	*Platycercus eximius*				✓	✓
Bird	Eastern Yellow Robin	*Eopsaltria australis*			✓	✓	✓
Bird	Eurasian Coot	*Fulica atra*				✓	✓
Bird	Fairy Martin	*Petrochelidon ariel*				✓	✓
Bird	Fan-tailed Cuckoo	*Cacomantis flabelliformi*			✓		✓
Bird	Galah	*Eolophus roseicapilla*			✓	✓	✓
Bird	Golden Whistler	*Pachycephala pectoralis*			✓	✓	✓
Bird	Great Egret	*Ardea alba*			✓		✓
Bird	Grey Butcherbird	*Cracticus torquatus*			✓	✓	✓
Bird	Grey Fantail	*Rhipidura albiscapa*			✓	✓	✓

GROUP	COMMON NAME	SCIENTIFIC NAME	EPBC ACT[1]	BC ACT[1]	DEOH SITE	ON-AIRPORT[2]	OFF-AIRPORT
Bird	Grey Shrike-thrush	*Colluricincla harmonica*			✓	✓	✓
Bird	Grey Teal	*Anas gracilis*			✓	✓	✓
Bird	Jacky Winter	*Microeca fascinans*			✓	✓	✓
Bird	Pied Cormorant	*Phalacrocorax varius*			✓	✓	✓
Bird	Laughing Kookaburra	*Dacelo novaeguineae*			✓	✓	✓
Bird	Little Black Cormorant	*Phalacrocorax sulcirostris*			✓	✓	✓
Bird	Little Corella	*Cacatua sanguinea*			✓	✓	✓
Bird	Little Pied Cormorant	*Microcarbo melanoleucos*			✓	✓	✓
Bird	Magpie Lark	*Grallina cyanoleuca*			✓	✓	✓
Bird	Masked Lapwing	*Vanellus miles*			✓	✓	✓
Bird	Musk Lorikeet	*Glossopsitta concinna*			✓		✓
Bird	Nankeen Kestrel	*Falco cenchroides*					✓
Bird	Noisy Miner	*Manorina melanocephala*			✓	✓	✓
Bird	Pacific Black Duck	*Anas superciliosa*			✓	✓	✓
Bird	Pied Currawong	*Strepera graculina*			✓	✓	✓
Bird	Purple Swamphen	*Porphyrio porphyrio*				✓	✓
Bird	Rainbow Lorikeet	*Trichoglossus haematodus*			✓	✓	✓
Bird	Red-rumped Parrot	*Psephotus haematonotus*			✓	✓	✓
Bird	Rock Dove	*Columba livia*			✓	✓	✓
Bird	Royal Spoonbill	*Platalea regia*				✓	✓
Bird	Silvereye	*Zosterops lateralis*			✓	✓	✓
Bird	Spotted Pardalote	*Pardalotus punctatus*			✓	✓	✓
Bird	Straw-necked Ibis	*Threskiornis spinicollis*				✓	✓
Bird	Sulphur-crested Cockatoo	*Cacatua galerita*			✓	✓	✓
Bird	Superb Fairy-wren	*Malurus cyaneus*			✓	✓	✓
Bird	Torresian Crow	*Corvus orru*			✓	✓	✓
Bird	Welcome Swallow	*Hirundo neoxena*			✓	✓	✓
Bird	White-bellied Sea-eagle	*Haliaeetus leucogaster*	M	V	✓	✓	✓
Bird	White-faced Heron	*Egretta novaehollandiae*			✓	✓	✓
Bird	White-winged Chough	*Corcorax melanorhamphos*			✓	✓	✓
Bird	Willie Wagtail	*Rhipidura leucophrys*			✓	✓	✓
Bird	Yellow Spoonbill	*Platalea flavipes*				✓	✓
Bird	Yellow Thornbill	*Acanthiza nana*			✓	✓	✓

GROUP	COMMON NAME	SCIENTIFIC NAME	EPBC ACT[1]	BC ACT[1]	DEOH SITE	ON-AIRPORT[2]	OFF-AIRPORT
Bird	Yellow-faced Honeyeater	*Lichenostomus chrysops*			✓		✓
Fish	Mosquito Fish	*Gambusia holbrooki**			✓	✓	✓
Mammal	East Coast free-tailed Bat	*Mormopterus norfolkensis* (Def)		V	✓	✓	✓
Mammal	Eastern Grey Kangaroo	*Macropus giganteus*			✓	✓	✓
Mammal	Eastern False Pipistrelle	*Falsistrellus tasmaniensis* (Po)		V	✓		✓
Mammal	European Fox*	*Vulpes vulpes**			✓		✓
Mammal	European Hare*	*Lepus europaeus**			✓	✓	✓
Mammal	Gould's Wattled Bat	*Chalinolobus gouldii*			✓		✓
Mammal	Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V		✓	✓
Mammal	Large Forest Bat	*Vespadelus darlingtoni*			✓		✓
Mammal	Southern Myotis	*Myotis macropus*	-	V		✓	
Mammal	White-striped Free-tailed Bat	*Tadarida australis*			✓	✓	✓
Reptile	Eastern Long-necked Turtle	*Chelodina longicollis*			✓	✓	✓
Reptile	Eastern Water Skink	*Eulamprus quoyii*			✓	✓	✓
Reptile	Lace Monitor	*Varanus varius*			✓	✓	✓
Reptile	Wall Lizard	*Cryptoblepharus virgatus*			✓	✓	✓
Invertebrate	Cumberland Plain Land Snail	*Meridolum corneovirens*	-	E		✓	

Note: * Introduced species

1) Listed as Vulnerable (V); Migratory (M) under the Commonwealth *Environment Protection and Biodiversity Conservation* Act 1999 and/or the NSW *Biodiversity Conservation* Act 2016;

2) Includes species recorded by GHD 2017.

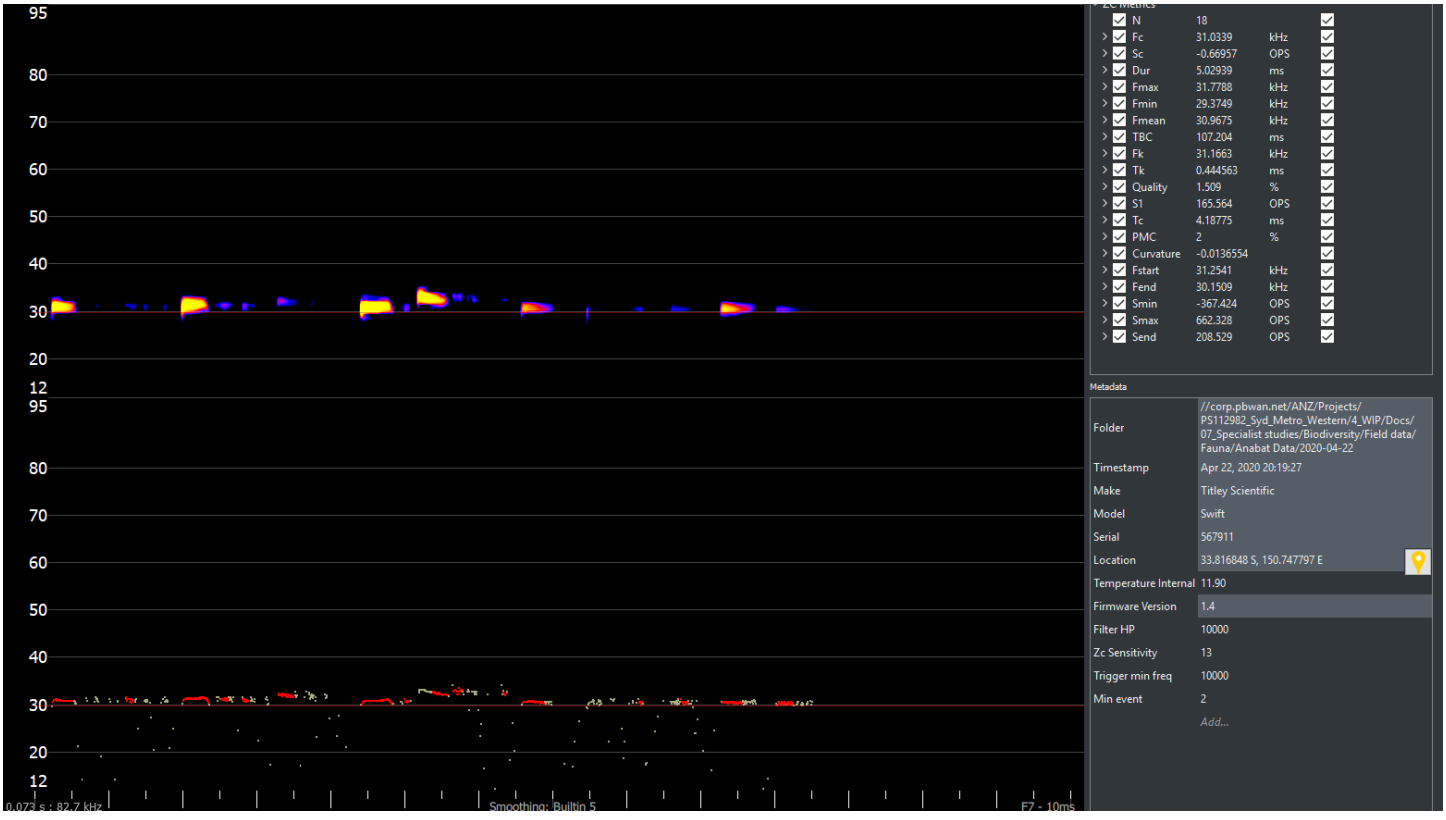
Appendix E

Microbat call sonogram

Gould's Wattled Bat (*Chalinolobus gouldii*) – **Definite**. Calls identified based on call shape (down-sweeping tail), regular alternating pulses and characteristic frequencies (average 32kHZ)

Large Forest Bat (*Vespadelus darlingtoni*) – Probable. Short call sequence but characteristics of call present. Fc average = 43

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Vulnerable, BC Act) -Possible. The calls of Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Broad-nosed Bat (*Scotorepens orion*) are difficult to distinguish based on overlapping frequency (35kHz) and similar call shape.



East coast Free-tailed Bat (*Micronomus norfolkensis*) (Vulnerable, BC Act)– **Definite**. Calls identified based on call shape (similar shape to *Rhinolophus* but a much lower frequency band), generally near-flat (qCF) and characteristic frequencies (average 31-32kHZ).

Appendix F

EPBC Act Assessments of Significance

Assessments of Significance

1 Threatened Ecological Communities

1.1 Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

1.1.1 Status

Cumberland Plain Woodland (CPW) is listed as a threatened ecological community under the EPBC Act, with a status of Critically Endangered.

1.1.2 Description

CPW ecological community occurs on soils derived from Wianamatta Shale. The community has a characteristically woodland structure but may include both more open and dense areas of vegetation, and derived grasslands (NSW Scientific Committee 1997, Department of Environment and Water Resources 2007). *Eucalyptus moluccana* and *Eucalyptus tereticornis* are the dominant canopy trees, with *Eucalyptus crebra* and *Eucalyptus eugenioides* occurring less frequently. The shrub layer is dominated by *Bursaria spinosa*. Diversity is highest in the ground stratum with a high diversity of grasses and other small shrubs and herbaceous species occurring. The species composition is a good indicator of condition, with native groundcover species, including less common and slower-growing native grasses and herbs, being good indicators of regeneration potential resilience (Department of Environment and Conservation, 2005b).

The original extent of this ecological community is highly reduced with estimates ranging from 6% to 9% remaining (NSW Scientific Committee, 2008).

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

Critically-endangered Cumberland Plain Woodlands and Shale-Gravel Transition Forest was listed as having less than 10% of its estimated distribution affected by bushfire and is therefore not identified in the initial list of highest priority threatened ecological communities by the Department (DAWE 2020a). Furthermore, CPW is a dry sclerophyll eucalypt forests that is relatively resilient to the impacts of wild fires and burning if fire intervals of greater than 4-12 years are maintained. The areas of this community that were subject to the recent bushfires are considered likely to recover in time, further mitigating the fires impacts.

This significant impact assessment has been updated to include reference to the intent of the provisional lists, revised impacts from the Biodiversity Development Assessment Report (BDAR) (WSP 2020) and is based on the proposed construction footprint of July 2020.

1.1.3 Specific impacts

The referred action would directly impact on approximately 4.20 hectares and potentially indirectly impact a further 1.67 hectares of CPW within off-airport land (totalling 5.87 hectares).

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About 3.94 hectares of CPW would be impacted within on-airport land (see Appendix J of the Environmental Impact Assessment).

1.1.4 EPBC Act significance assessment

Only the Western Sydney Strategic Assessment (SA) mapped areas of 'Intact' and, in isolated occurrences, 'Thinned' condition class were identified as meeting the EPBC Act listing of CPW condition requirements (Biosis 2019). The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- *reduce the extent of an ecological community*
- *fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines*

The referred action would impact on 5.87 hectares (4.20 hectares of direct impact and 1.67 hectares of indirect impact) of Cumberland Plain Woodland within off-airport land. An additional 3.94 hectares of CPW would be impacted within on-airport land (see Appendix J of the Environmental Impact Assessment).

Within the study area, existing fragmentation occurs in the form of existing roads and historic clearing associated with agricultural and rural residential land use. Habitat connectivity is fragmented by Kent Road, Lansdowne Road, M4 Western Motorway, substantial areas of agricultural land use and rural residential lands at Orchard Hills. These existing disturbances disconnect potential habitat for terrestrial fauna and flora species with limited seed dispersal (including threatened species such as *Pimelea spicata*). Gene flow (seed dispersal) of remnant canopy species, wind-dispersed flora species, arboreal mammals and highly mobile species such as birds and bats are considered uninhibited by these roads and fences.

The referred action would not create new areas of fragmentation. Fragmentation created by existing disturbances would be increased, however this increase is considered unlikely to have a significant impact on CPW.

- *adversely affect habitat critical to the survival of an ecological community*

There is no critical habitat listed under the EPBC Act for CPW. Within the Cumberland Plain Recovery Plan (Section 12), Priority Conservation Lands are considered to contain habitat critical to the survival of threatened entities, including CPW (Department of Environment Climate Change and Water, 2010). No part of the study area has been identified as Priority Conservation Land.

- *modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns*

Though the referred action would modify the soil profile in the areas that require clearing of vegetation, this impact is unlikely to significantly modify abiotic factors such as the soil profile and surface water drainage patterns beyond those areas to be directly impacted by clearing necessary to the survival of vegetation surrounding the study area.

A conservative assessment of the referred action's potential localised impact on groundwater drawdown levels at Orchard Hills predicted relatively minor additional indirect impact to CPW beyond the areas of direct clearing. These indirect impacts have been incorporated in the total areas of CPW to be impacted by the referred action.

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- *cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting*

CPW within the study area is located proximate to urban development, commercial land use and agricultural lands. As such, the CPW recorded is subject to associated edge effects and a disturbed state. Whilst the referred action may introduce edge effects to the remaining CPW within the study area, these would be reduced and managed through recommended mitigation measures.

The referred action does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods, or flora/fauna harvesting.

The referred action is considered unlikely to cause a substantial change in the species composition of CPW.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- *assisting invasive species, that are harmful to the listed ecological community, to become established.*
- *causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community*

The referred action has potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing CPW occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species.

As such, the referred action is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence. The referred action does not involve other processes that are likely to reduce the quality or integrity of CPW other than those described above.

Interfere with the recovery of an ecological community

The Cumberland Plain Recovery Plan (Department of Environment Climate Change and Water, 2010) lists the activities to assist the community's recovery. The referred action is likely to interfere with one activity OEH has listed being *protect habitat by minimising further clearing*.

Conclusion

The referred action would impact on (5.87 hectares (4.20 hectares of direct impact and 1.67 hectares of indirect impact) of Cumberland Plain Woodland within off-airport land. An additional 3.94 hectares of CPW would be impacted within on-airport land (see Appendix J of the Environmental Impact Assessment).

The ecological community is unlikely to be significantly impacted by the referred action.

A total of 9.81 hectares of unburnt CPW will be potentially impacted by the Project. The impacts of the recent bushfires to CPW is largely restricted to the south west Cumberland Plain with generally no impacts to CPW within the locality (10 kilometres) of the Project. Therefore, following consideration of the recent bushfire impacts to CPW the Project is considered unlikely to significantly impact upon this threatened ecological community.

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1.2 Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland

1.2.1 Status

Coastal Swamp Oak (Casuarina glauca) Forest (CSOF) of New South Wales and South East Queensland is listed as a threatened ecological community under the EPBC Act, with a status of Endangered.

1.2.2 Description

The ecological community occurs in coastal catchments, mostly at elevations of less than 20 m above sea-level (ASL) that are typically found within 30 km of the coast. The canopy layer is dominated by *Casuarina glauca* (swamp oak, swamp she-oak). This often occurs as a relatively uniform upper layer of swamp oak, with height and density dependent on the local environmental conditions. The ground layer is typically a continuous to semi-continuous cover of either forbs, ferns, sedges, grasses and/or plant litter (including swamp-oak branchlets/needles), but can also often be 'patchy', particularly where the ecological community is regenerating. The composition of the ground layer is also influenced by groundwater salinity. The ecological community overall has undergone an estimated decline of between 64 per cent and 79 per cent in its geographic distribution since 1750 (Department of the Environment and Energy, 2018).

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

The CSOF was listed as having less than 10-30% of its estimated distribution affected by bushfire and is therefore not identified in the initial list of highest priority threatened ecological communities by the Department (DAWE 2020a). Furthermore, most the CSOF affected by bushfire is associated with coastal floodplains on the mid north coast and south coast regions of NSW and not within the Sydney Basin Bioregion. The areas of this community that were subject to the recent bushfires are considered likely to recover in time, further mitigating the fires impacts.

1.2.3 Specific impacts

The referred action might require the clearing of up to approximately 4.94 hectares of CSOF within the off-airport study area.

1.2.4 EPBC Act significance assessment

Field validated vegetation mapping prepared for the SA mapped PCT 1800 which is associated with CSOF within the study area (Biosis 2018). The referred action would impact on approximately 4.94 hectares of CSOF meeting the specific condition requirements of the listing under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

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An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- *reduce the extent of an ecological community*
- *fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines*

The referred action might impact 4.94 hectares of CSOF protected under the EPBC Act.

The potentially impacted area is restricted to the referred action's crossing of Cosgroves Creek. Following construction, riparian connectivity would be maintained, including opportunities to rehabilitate CSOF. The final extent and level of impact is likely to be reduced once a final design has been selected and potential impacts would be further reduced and managed through recommended mitigation measures. The referred action might fragment the existing patch, however even should this occur, this is considered unlikely to have a significant impact on CSOF.

- *adversely affect habitat critical to the survival of an ecological community*

The Approved Conservation Advice for CSOF states that the habitat most critical to the survival of the ecological community consists of those patches that are of a reasonable size and in the best condition. These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function (Department of the Environment and Energy, 2018).

The field validated PCT associated with COSF (PCT 1800) was recorded in 'Thinned' condition in the vegetation mapping prepared for the SA). Given this, the COSF that might be impacted is unlikely to be critical to the survival of COSF as the PCT 1800 recorded is not in best condition and is unlikely to be close to benchmark.

- *modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns*

Though the referred action might modify the soil profile in the areas that require clearing of vegetation, this impact is unlikely to significantly modify abiotic factors such as the soil profile, groundwater levels of surface water drainage patterns necessary to the survival of vegetation surrounding the study area.

- *cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting*

CSOF within the study area is located proximate to agricultural lands. As such, the CSOF is subject to associated existing edge effects. Whilst the referred action may introduce edge effects to the remaining CSOF within the study area, these would be reduced and managed through recommended mitigation measures.

The referred action does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting.

The referred action is considered unlikely to cause a substantial change in the species composition of CSOF.

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Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- *assisting invasive species, that are harmful to the listed ecological community, to become established*
- *causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community*

The referred action has potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing COSF occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species.

As such, the referred action is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence. The referred action does not involve other processes that are likely to reduce the quality or integrity of COSF other than those described above.

Interfere with the recovery of an ecological community

Currently there is no recovery plan for COSF. The Approved Conservation Advice outlined four priority conservation actions (Section 6.2, Department of the Environment and Energy, 2018). The referred action is likely to interfere with one priority conservation action being *conserve remaining patches*.

Conclusion

The referred action might require the removal of up to 4.94 ha of CSOF consistent with the EPBC Act listing. The ecological community is unlikely to be significantly impacted by referred action. The final impact is likely to be reduced once a final design has been selected and the design would avoid areas of high biodiversity value as far as possible.

A total of 4.94 hectares of unburnt CSOF will be potentially impacted by the Project. The impacts of the recent bushfires to CSOF within the Sydney basin is largely restricted to the Hawksbury river catchment, with generally no impacts to CSOF within the locality (10 kilometres) of the Project. Therefore, following consideration of the recent bushfire impacts to CSOF the Project is considered unlikely to significantly impact upon this threatened ecological community.

2 Threatened Flora

Threatened flora assessed in this section have been summarised in Table 2.1.

Table 2.1 Threatened flora impacts

Scientific Name	Common Name	EPBC Act Status	Associated Habitat	Impact (hectares)
Acacia bynoeana	Bynoe's Wattle	Vulnerable	PCT 724	1.25
Acacia pubescens	Downy Wattle	Vulnerable	PCTs 849, 724	2.23
Allocasuarina glareicola	-	Endangered	PCT 724	1.25

Scientific Name	Common Name	EPBC Act Status	Associated Habitat	Impact (hectares)
Cynanchum elegans	White-flowered Wax Plant	Endangered	PCT 849	0.57
Grevillea parviflora subsp. Parviflora	Small-flower Grevillea	Vulnerable	PCT 724	1.27
Micromyrtus minutiflora	-	Vulnerable	PCT 724	1.25
Pimelea curviflora var. curviflora	-	Vulnerable	PCT 849	0.57
Pimelea spicata	Spiked Rice-flower	Endangered	PCT 849	0.96
Pultenaea parviflora	-	Vulnerable	PCT 724	1.25

2.1 Acacia bynoeana (Bynoe's Wattle)

2.1.1 Status

Acacia bynoeana is listed as Vulnerable under the EPBC Act.

2.1.2 Description

Acacia bynoeana (Bynoe's wattle) family Mimosaceae has a prostrate habit, with stems lying on the ground but rising at the tip. Bynoe's wattle grows to 0.3 m high, with ribbed branchlets. It is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at each location being very small (generally 1-5 plants) with only a few sites with 30-50 individuals (Department of the Environment, 2013).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Acacia bynoeana* (Bynoe's wattle) was not included in that priority list (DAWE 2020b).

2.1.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). Within the study area associated habitat includes PCTs 724 and 725. There is a total of 1.25 ha of potential habitat for *Acacia bynoeana* mapped in the study area. These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas of Orchard Hills.

2.1.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

Within the study area, a total of 1.25 hectares of potential habitat for *Acacia bynoeana* has been mapped as intact and thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas between Lansdowne Road and M4 Western Motorway in Orchard Hills. It is unlikely that all of this potential habitat would be removed as a result of the referred action.

This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities, this is not preferred habitat. The 1.25 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

Within the study area there are no known historical records for this species and this species was not recorded within the study area during surveys for the SA. Any population of this species is likely to cover a small area and not disperse beyond the immediate area given the limited seed dispersal of the species. Given there are no historic records within the study area or any native vegetation with connectivity, it is considered unlikely that the referred action would disrupt the breeding cycle of this species.

It is unknown whether a viable population of this species exists within the study area, however the presence of a substantial population with potential for long-term viability is unlikely. If present, this species would likely exist as a small, isolated population.

Given the relatively small areas of potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

Critical habitat has not been identified for *Acacia bynoeana* under the EPBC Act.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, a total of 1.25 hectares of potential habitat for *Acacia bynoeana* would be removed. This occurs as intact and thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis, 2018). It is unlikely however that all potential habitat would be removed as a result of the referred action.

This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities, this is not preferred habitat.

The 1.25 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would decrease the availability of quality 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*

The referred action has potential to result in minor increases in the establishment, density or diversity of weed species. The part of the study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely to result in invasive species that are harmful to *Acacia bynoeana* becoming established in *Acacia bynoeana* potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Acacia bynoeana* to decline is outlined in the Approved Conservation Advice (Department of the Environment, 2013).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

There is no recovery plan for *Acacia bynoeana* under the EPBC Act. The referred action would not interfere with any Regional/Local priority actions outlined in the Approved Conservation Advice (Department of the Environment, 2013).

Conclusion

Given the relatively small areas of potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.2 Acacia pubescens (Downy Wattle)

2.2.1 Status

Acacia pubescens is listed as Vulnerable under the EPBC Act.

2.2.2 Description

The downy wattle is a spreading shrub, 1 - 5 m high with brilliant yellow flowers, bipinnate leaves (divided twice pinnately) and conspicuously hairy branchlets. The downy wattle flowers August-October and can be distinguished from the other bipinnate Acacia species in the region by its conspicuously hairy branchlets and spreading hairs (Threatened Specific Scientific Committee, 2016a).

The downy wattle is restricted to the Sydney region of NSW. Its distribution is concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. The downy wattle occurs in open woodland and forest, in a number of plant communities. Most sites are within Cooks River / Castlereagh Ironbark Forest, Shale Gravel Transition Forest or Shale Plains Woodland (Threatened Specific Scientific Committee, 2016).

There are many threats to the species, including loss of habitat, degradation of habitat (through weed invasion, mechanical damage, rubbish dumping, track creation, inappropriate fire regimes), disease and hybridisation. This species is listed as vulnerable as its distribution is highly fragmented and it largely occurs on land where the future use is likely to change and threaten its continued survival (NSW National Parks and Wildlife Service, 2003).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Acacia pubescens* (Downy Wattle) was not included in that priority list (DAWE 2020b).

2.2.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 2.23 hectares of potential habitat in PCTs 724 and 849 for *Acacia pubescens* mapped in the study area. It is unlikely that all of this potential habitat would be removed as a result of the referred action.

2.2.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

There is a total of 2.23 hectares of potential habitat for *Acacia pubescens* mapped in the study area; it is unlikely that all this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

If present, the potential loss of a small number of individuals would be unlikely to lead to a long-term decrease in population size.

Given the, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

The Recovery Plan for *Acacia pubescens* outlines that habitat critical to the survival of *A. pubescens* cannot be identified given the clonal nature of the species and a lack of genetic information about this clonality (NSW National Parks and Wildlife Service, 2003).

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, there is a total of 2.23 hectares of potential habitat for *Acacia pubescens*, however it is unlikely that all of this habitat would be removed.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, the referred action is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that *Acacia pubescens* is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely to result in invasive species that are harmful to *Acacia pubescens* becoming established in the *Acacia pubescens* potential habitat.

- *introduce disease that may cause the species to decline*

An unknown disease known to affect *Acacia pubescens* is outlined in the Recovery Plan. Recovery actions focus on investigating the nature and extent of impact (NSW National Parks and Wildlife Service, 2003). Mitigation measures recommended as part of the referred action would reduce and manage disease and pathogens.

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- *interfere substantially with the recovery of the species*

The Recovery Plan outlines 13 recovery actions for *Acacia pubescens* (NSW National Parks and Wildlife Service, 2003). The referred action would not interfere with any of these recovery actions.

Conclusion

Given the, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

Further targeted (seasonal) surveys for *Acacia pubescens* are proposed to confirm whether individuals of this species are present within the study area.

2.3 Allocasuarina glareicola

2.3.1 Status

Allocasuarina glareicola is listed as Endangered under the EPBC Act.

2.3.2 Description

Allocasuarina glareicola (Family Casuarinaceae) is a smooth-barked, slender, erect to stunted she-oak shrub growing to 2 m high. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. It grows in Castlereagh woodland on lateritic soil and is found in open woodland with *Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla* and *Melaleuca decora*. Commonly associated understorey species include *Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, Acacia brownei, Themeda australis* and *Xanthorrhoea minor* (Office of Environment and Heritage, 2019a).

The main identified threats to A. glareicola are habitat loss due to clearing for development or mining, and habitat degradation through rubbish dumping and unrestricted public access (Department of the Environment, Water, Heritage and the Arts, 2008a).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Allocasuarina glareicola* was not included in that priority list (DAWE 2020b).

2.3.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 1.25 ha of potential habitat for *Allocasuarina glareicola* mapped in the study area; it is unlikely however that all of the potential habitat would be removed as a result of the referred action.

2.3.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

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Is there an important population?

There is a total of 1.25 hectares of potential habitat for *Allocasuarina glareicola* mapped in the study area in the form of Intact and Thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas between Lansdowne Road and M4 Western Motorway in Orchard Hills. It is unlikely however that all of this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities, this is not preferred habitat.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

Given the relatively small areas of potential sub-optimal habitat, the general condition of PCTs to be impacted, and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat is listed for *Allocasuarina glareicola* under the EPBC Act.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

There is a total of 1.25 hectares of potential habitat for *Allocasuarina glareicola* mapped in the study area in the form of Intact and Thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis 2018). It is unlikely however that all of this potential habitat would be removed as a result of the referred action.

The 1.25 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would decrease the availability or quality of habitat to the extent that the species is likely to decline.

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- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely to result in invasive species that are harmful to *Allocasuarina glareicola* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Allocasuarina glareicola* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008a).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

There is currently no recovery plan for *Allocasuarina glareicola*.

Conclusion

Given the relatively small areas of potential sub-optimal habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.4 Cynanchum elegans

2.4.1 Status

Cyanchum elegans (White-flowered Wax Plant) is listed as an Endangered species under the EPBC Act.

2.4.2 Description

A climber or twiner with a highly variable form. Mature stems have a fissured corky bark and can grow to 10 metres long and 3.5 cm thick. The leaves are paired (or rarely in threes), ovate to broadly ovate in shape, 1.5 to 10.5 cm long, and 1.5 to 7.5 cm wide. The flowers are white, tubular, and up to 4 mm long and 12 mm wide. The fruit is a dry pointed pod to 8 cm long, which contains up to 45 seeds with long silky hairs attached to one end.

Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. Occurs on the edge of dry rainforest vegetation. 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 (Office of Environment and Heritage, 2019b).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Cynanchum elegans* was not included in that priority list (DAWE 2020b).

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2.4.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 0.57 hectares of potential habitat for *Cynanchum elegans* mapped in the study area; it is unlikely however that all of this potential habitat would be removed as a result of the referred action.

2.4.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

Within the study area, a total of 0.57 hectares of potential habitat for *Cynanchum elegans* was recorded as areas of Intact and Thinned condition classes for PCT 849, as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants between Elizabeth Drive in Luddenham and the M4 Western Motorway, Claremont Meadows. It is unlikely however that all of this potential habitat would be removed as a result of the referred action.

This species is more typically associated with dry rainforest vegetation communities and sheltered gullies not present within the study area. Although the species is associated with some shale based ecological communities, this is not preferred habitat.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

Given the relatively small areas of sub-optimal potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

There is currently no critical habitat for *Cynanchum elegans* listed under the EPBC Act or mentioned in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008b).

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- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, there is a total of 0.57 hectares of potential habitat for *Cynanchum elegans* however it is unlikely that all of this habitat would be removed. This occurs as intact and thinned condition classes for PCT 849 as mapped for the Western Sydney SA (Biosis 2018). It is unlikely however that all potential habitat would be removed as a result of the referred action.

The 0.57 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage any invasive species.

As such, the referred action is unlikely to result in invasive species that are harmful to *Cynanchum elegans* becoming established in the *Cynanchum elegans* potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Cynanchum elegans* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008b).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

There is currently no recovery plan for *Cynanchum elegans*.

Conclusion

Given the relatively small areas of sub-optimal potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.5 Grevillea parviflora subsp. Parviflora (Small-flower Grevillea)

2.5.1 Status

Grevillea parviflora subsp. Parviflora is listed as Vulnerable under the EPBC Act.

2.5.2 Description

Grevillea parviflora subsp. parviflora is a low spreading shrub usually less than 1 m tall that grows sporadically throughout the Sydney Basin with sizeable populations around Picton, Appin and Bargo (and possibly further south to the Moss Vale area) and in the Hunter in the Cessnock - Kurri Kurri area (particularly Werakata NP). Separate populations are also known from Putty to Wyong and Lake Macquarie on the Central Coast. *Grevillea parviflora subsp. parviflora* usually grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney Region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park. It occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests, Hunter occurrences are usually 30-70m ASL, while the southern Sydney occurrences are typically at 200-300m ASL. It also occurs occasionally in open, slightly disturbed sites such as along tracks (Office of Environment and Heritage, 2019c).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Grevillea parviflora subsp. parviflora* was not included in that priority list (DAWE 2020b).

2.5.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 1.27 ha of potential habitat for *Grevillea parviflora subsp. parviflora* mapped in the study area; it is unlikely however that all of this potential habitat would be removed as a result of the referred action.

2.5.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

There is a total of 1.27 hectares of potential habitat for *Grevillea parviflora subsp. parviflora* mapped in the study area recorded as Intact and Thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas between Lansdowne Road and M4 Western Motorway in Orchard Hills. It is unlikely however that all of this potential habitat would be removed as a result of the referred action.

This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities, this is not preferred habitat.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

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Given the relatively small areas of potential sub-optimal habitat, the general condition of PCTs to be impacted and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

Critical habitat for this species has not been listed under the EPBC Act.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area a total of 1.27 hectares of potential habitat for *Grevillea parviflora subsp. parviflora* was recorded as Intact and Thinned condition classes for PCTs 724 and 725 between Lansdowne Road and Western Motorway in Orchard Hills as mapped for the SA (Biosis 2018). It is unlikely that all of this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely to result in invasive species that are harmful to *Grevillea parviflora subsp. parviflora* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Grevillea parviflora subsp. parviflora* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008c).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

Currently there is no recovery plan for *Grevillea parviflora subsp. parviflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the referred action (Department of the Environment, Water, Heritage and the Arts, 2008c).

Conclusion

Given the relatively small areas of potential sub-optimal habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.6 Micromyrtus minutiflora

2.6.1 Status

Micromyrtus minutiflora is listed as Vulnerable under the EPBC Act.

2.6.2 Description

Micromyrtus minutiflora is a slender spreading shrub to 2 m high. Restricted to the general area between Richmond and Penrith in western Sydney. There are 11 sites with a total of 1800 individuals across the Blacktown, Hawkesbury and Penrith local government areas. Only one population of fewer than 50 plants is conserved within the Castlereagh Nature Reserve. This species is known to grow in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, Open Forest on tertiary alluvium and consolidated river sediments (Office of Environment and Heritage, 2019d).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Micromyrtus minutiflora* was not included in that priority list (DAWE 2020b).

2.6.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 1.25 hectares of potential habitat for *Micromyrtus minutiflora* mapped in the study area; it is unlikely however that all of this potential habitat would be removed as a result of the referred action.

2.6.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, 2013).

Is there an important population?

There is a total of 1.25 hectares of potential habitat for *Micromyrtus minutiflora* mapped in the study area recorded as Intact and Thinned condition classes for PCTs 724 and 725 as mapped

for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas between Lansdowne Road and M4 Western Motorway in Orchard Hills.

This species is more typically associated with sandy soils, either containing tertiary alluvium or derived from underlying Hawkesbury sandstone. Although the species is associated with some shale based ecological communities, this is not preferred habitat.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

Given the relatively small areas of potential sub-optimal habitat, the general condition of PCTs to be impacted and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

Critical habitat for this species has not been listed under the EPBC Act.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area a total of 1.25 hectares of potential habitat for *Micromyrtus minutiflora* was recorded as Intact and Thinned condition classes for PCTs 724 and 725 between Lansdowne Road and Western Motorway in Orchard Hills as mapped for the SA (Biosis 2018). It is unlikely that all of this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a

broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely result in invasive species that are harmful to *Micromyrtus minutiflora* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Micromyrtus minutiflora* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008d).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

Currently there is no recovery plan for *Micromyrtus minutiflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the referred action (Department of the Environment, Water, Heritage and the Arts, 2008d).

Conclusion

Given the relatively small areas of potential sub-optimal habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.7 Pimelea curviflora var. curviflora

2.7.1 Status

Pimelea curviflora var. *curviflora* is listed as Vulnerable under the EPBC Act.

2.7.2 Description

A much-branched sub-shrub or shrub 20 to 120 cm high with hairy stems. Flowers are red to yellow, hairy and occur in terminal heads of 4 - 12 flowers. Leaves are 5 - 10 mm long, 2 - 4 mm wide, with a sparsely hairy lower surface. The curved fruit is 2 - 4 mm long.

Confined to the coastal area of the Sydney and Illawarra regions. Populations are known between northern Sydney and Maroota in the north-west. New population discovered at Croom Reserve near Albion Park in Shellharbour LGA in August 2011. Formerly recorded around 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. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain (Office of Environment and Heritage, 2019e).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Pimelea curviflora* was not included in that priority list (DAWE 2020a).

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2.7.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 0.57 hectares of potential habitat for *Pimelea curviflora var. curviflora* mapped in the study area; it is unlikely that all of this potential habitat would be removed as a result of the referred action.

2.7.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

There is a total of 0.57 hectares of potential habitat for *Pimelea curviflora var. curviflora* mapped in the study area as areas of intact and thinned condition classes for PCT 849 as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants between Elizabeth Drive in Luddenham and the M4 Great Western Motorway, Claremont Meadows. It is unlikely that all of this potential habitat would be removed as a result of the referred action.

Although the species is associated with some shale based ecological communities, this is not preferred habitat.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

Given the relatively small areas of sub-optimal potential habitat, the general condition of PCTs to be impacted and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat has been listed for *Pimelea curviflora var. curviflora* under the EPBC Act.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, a total of 0.57 hectares of potential habitat for *Pimelea curviflora var. curviflora* would be removed. This occurs as Intact and Thinned condition classes for PCT 849 as mapped for the SA (Biosis 2018). It is unlikely however that all potential habitat would be removed as a result of the referred action.

The 0.57 ha of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely result in invasive species that are harmful to *Pimelea curviflora var. curviflora* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Pimelea curviflora var. curviflora* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008e).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

There is currently no recovery plan for *Pimelea curviflora var. curviflora* under the EPBC Act. The Approved Conservation Advice outlines Regional and Local Priority Actions, none of which would be interfered with by the referred action (Department of the Environment, Water, Heritage and the Arts, 2008e).

Conclusion

Given the relatively small areas of sub-optimal potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore it is unlikely that the referred action would result in a significant impact to the species.

2.8 Pimelea spicata

2.8.1 Status

Pimelea spicata is listed as Endangered under the EPBC Act.

2.8.2 Description

The Spiked Rice-flower is a shrub to 50 cm tall that may be erect or somewhat spreading in habit. The leaves are opposite and elliptical, to 20 mm long by 8 mm wide, and usually held outwards from the stem. The white, pink-tinged flowers are tubular, to 10 mm long, with four spreading petals. They may appear at any time of the year but are mostly seen in summer as they are probably related to rainfall. Inflorescences start as dense clusters (like most rice flowers) and then extend along an elongating stem as the inflorescences age.

Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). On the Cumberland Plain sites, it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of Ironbark (Office of Environment and Heritage, 2019f).

Mature plants spread over short distances through underground rhizomes and this can assist them to recover from disturbances like fire and irregular grazing. However, the age plants must be, and what proportion recover, is largely unknown.

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Pimelea spicata* was not included in that priority list (DAWE 2020b).

2.8.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 0.96 hectares of potential habitat for *Pimelea spicata* mapped in the study area; it is unlikely that all of this potential habitat would be removed as a result of the referred action.

2.8.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

There is a total of 0.96 hectares of potential habitat for *Pimelea spicata* mapped in areas of Intact and Thinned condition classes for PCT 849 as mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants between Elizabeth Drive in Luddenham and the M4 Western Motorway, Claremont Meadows. It is unlikely that all of this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

There are no known historical records for this species within the study area and this species was not recorded within the study area during surveys for the SA.

Though not historically recorded, it is possible that individuals may be present in the study area and/or be present in a soil-stored seedbank. If present, these individuals likely form part

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of the Cumberland Plain meta population which extends between Camden in the south to Maraylya in the north and from Horsley Park east to Bankstown. The total number of mature individuals is approximately 4,300 across 30 known smaller populations (Department of the Environment, 2019). None of these populations are located within, or have connectivity to, the study area or study area. The potential loss of a small number of individuals would be unlikely to lead to a long-term decrease in population size.

Given the relatively small areas of sub-optimal potential habitat, the general condition of PCTs to be impacted and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat is listed for *Pimelea spicata* under the EPBC Act (Department of Environment and Conservation, 2005a). The Conservation Advice for *Pimelea spicata* outlines that any habitat where populations are known to occur is considered critical habitat (Threatened Species Scientific Committee, 2016b). *Pimelea spicata* has not been recorded within the study area.

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, a total of 0.96 hectares of potential habitat for *Pimelea spicata* would be removed. This occurs as Intact and Thinned condition classes for PCT 849 as mapped for the SA (Biosis 2018). It is unlikely however, that all potential habitat would be removed as a result of the referred action.

The 0.96 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge

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effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely result in invasive species that are harmful to *Pimelea spicata* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Pimelea spicata* to decline is outlined in the Conservation Advice or Recovery Plan (Department of Environment and Conservation, 2005a; Threatened Species Scientific Committee, 2016b).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

The Recovery Plan for *Pimelea spicata* outlines six specific recovery objectives which focus on conserving known populations of *Pimelea spicata* (s 9) (Threatened Species Scientific Committee, 2016b). Given this species has not been recoded within the study area, the referred action is not likely to interfere with any recovery objectives for *Pimelea spicata.*

Conclusion

Given the relatively small areas of sub-optimal potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

2.9 Pultenaea parviflora

2.9.1 Status

Pultenaea parviflora is listed as Vulnerable under the EPBC Act.

2.9.2 Description

Pultenaea parviflora is usually a small erect branching shrub up to 1.8 m tall. Leaves are alternate, narrow- to broad-obovate to cuneate, 2-6 mm long, 1-1.5 mm wide, apex obtuse to slightly notched, strongly recurved. Grows in dry sclerophyll forest on Wianamatta Shale, laterite or alluvium, Cumberland Plain. 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. It can also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.

The dominant canopy is usually *Eucalyptus fibrosa* however *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 triandra* (Department of the Environment, Water, Heritage and the Arts, 2008f).

On 23 April 2020, the Wildlife and Threatened Species Bushfire Recovery Expert Panel released a list of 471 plant species identified as the highest priorities for urgent management intervention to support recovery from the 2019-20 bushfires. *Pultenaea parviflora* was not included in that priority list (DAWE 2020b).

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2.9.3 Specific impacts

This species was not recorded within the study area despite targeted surveys as part of the SA (Biosis 2018). There is a total of 1.25 hectares of potential habitat for *Pultenaea parviflora* mapped in the study area; it is unlikely that all of this potential habitat would be removed as a result of the referred action

2.9.4 EPBC significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, Water, Heritage and the Arts, 2013).

Is there an important population?

There is a total of 1.25 hectares of potential habitat for *Pultenaea parviflora* mapped in areas of Intact and Thinned condition classes for PCTs 724 and 725 was mapped for the SA (Biosis 2018). These areas of potential habitat are restricted to small and relatively isolated remnants within the rural residential areas between Lansdowne Road and M4 Western Motorway in Orchard Hills. It is unlikely that all of this potential habitat would be removed as a result of the referred action.

The majority of the potential habitat for this species is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses

The potential loss of a small number of individuals would be unlikely to lead to a long term decrease in population size.

Given the relatively small areas of sub-optimal potential habitat, the general condition of PCTs to be impacted and the lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore it is unlikely that the referred action would result in a significant impact to the species.

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*

It is considered unlikely that an important population would occur within the study area.

- *reduce the area of occupancy of an important population*

It is considered unlikely that an important population would occur within the study area.

- *fragment an existing important population into two or more populations*

It is considered unlikely that an important population would occur within the study area.

- *adversely affect habitat critical to the survival of a species*

There is currently no critical habitat listed for *Pultenaea parviflora* under the EPBC Act or outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008f).

- *disrupt the breeding cycle of an important population*

It is considered unlikely that an important population would occur within the study area.

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

Within the study area, a total of 1.25 hectares of potential habitat for *Pultenaea parviflora* would be removed. This occurs as Intact and Thinned condition classes for PCTs 724 and 725 as mapped for the SA (Biosis 2018). It is unlikely however that all of this potential habitat would be removed as a result of the referred action.

The 1.25 hectares of potential habitat within the study area is subject to existing disturbances associated with edge effects and fragmentation from the adjoining roads, residential and agricultural land uses.

As such, it is considered unlikely that the referred action would 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*

The referred action has the potential to result in minor increases in the establishment, density or diversity of weed species. The study area containing potential habitat occurs within a broader study area which is surrounded by urban development and roads and subject to edge effects resulting in invasive species. Mitigation measures recommended as part of the referred action would reduce and manage invasive species.

As such, the referred action is unlikely result in invasive species that are harmful to *Pultenaea parviflora* becoming established in areas of its potential habitat.

- *introduce disease that may cause the species to decline*

No disease known to cause *Pultenaea parviflora* to decline is outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008f).

Mitigation measures recommended as part of the referred action would reduce and manage disease that may cause the species to decline.

- *interfere substantially with the recovery of the species*

There is no recovery plan for *Pultenaea parviflora* under the EPBC Act. The referred action would not interfere with any Regional/Local priority actions outlined in the Approved Conservation Advice (Department of the Environment, Water, Heritage and the Arts, 2008f).

Conclusion

Given the relatively small areas of sub-optimal potential habitat, general condition of PCTs to be impacted and lack of historical records, it is considered unlikely that an important population would occur within the study area. Therefore, it is unlikely that the referred action would result in a significant impact to the species.

3 Threatened Fauna

3.1 Large-eared pied bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat is listed as Vulnerable under the EPBC Act.

It is an insectivorous bat with a distribution from Shoalwater Bay in Queensland through to around Ulladulla in NSW (DoEE 2016). The species is largely restricted to the interface of sandstone escarpment for roosting habitat, and relatively fertile areas supporting woodlands and forests for foraging habitat. The species forages for insects in and around forest canopies. The Large-eared Pied Bat is dependent on the presence of diurnal roosts for shelter; the

species is known to roost in disused mine shafts, caves, overhangs and abandoned fairy martin nests (Churchill 2009). Breeding habitat is not present in the study area.

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

On 24 March, 2020, a revised list of 119 animal species considered a high priority for urgent management intervention, was released by the Wildlife and Threatened Species Bushfire Recovery Expert Panel (DAWE 2020a). The Large-eared Pied Bat was not included in this list.

3.1.1 Specific impacts

The referred action would remove approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging habitat, in the form of intact and thinned canopy species associated with Cumberland Plain Woodland, Shale Gravel Transition Forest and River Flat Eucalyptus Forest. The referred action area is unlikely to contain habitat critical to the survival of the species due to the absence of suitable roosting/breeding habitat.

3.1.2 EPBC Act significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, 2013).

Is there an important population?

Important populations for this species occur in the sandstone escarpments of the Hunter Valley, Sydney Basin and Southern Tablelands of NSW (DERM 2011). If Large-eared Pied Bats are using the study area, they are unlikely to be part of an important population for the following reasons:

The project corridor does not contain any sandstone escarpments such as those identified in the national recovery plan (DERM 2011).

It is unlikely that any Large-eared Pied Bat foraging in the study area would be part of a key source population for breeding or dispersal due to the limited roosting and breeding habitat in the locality.

The project corridor does not occur at the limit of the species' range. Woodland in the project corridor is already heavily fragmented, and the landscape has been extensively modified for agricultural purposes.

Potential occurrences of this species within the study area are not at the limits of the species' distribution and as such the study area can only be considered to represent a part of the foraging range of widely occurring individuals. For these reasons, if present within the study area, individuals of this species would not be considered to be part of an important population.

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An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

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

Not applicable. Large-eared Pied Bat in the study area is not part of an important population (refer to above).

- *reduce the area of occupancy of an important population*

Not applicable. Large-eared Pied Bat in the study area is not part of an important population (refer to above).

- *fragment an existing important population into two or more populations*

Not applicable. Large-eared Pied Bat in the study area is not part of an important population (refer to above).

- *adversely affect habitat critical to the survival of a species*

No critical habitat is listed for this species under the EPBC Act.

The study area contains native vegetation communities that occur as discrete patches of vegetation surrounded by agricultural development, urban development in the northern section, and roads. Approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of vegetation to be impacted could provide potential foraging habitat for the Large-eared Pied Bat.

Whilst 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of foraging habitat may be removed as part of the referred action, an abundance of similar or high quality foraging habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging habitat in the form of native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) would represent <1% of available foraging habitat for this species.

It is unlikely that the removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging habitat would be classified as critical habitat for the species.

- *disrupt the breeding cycle of an important population*

Not applicable. Large-eared Pied Bat in the study area is not part of an important population (refer to above).

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

Habitat modelling based on surveys in the Southern Sydney region suggest that the Large-eared Pied Bat is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat) (DoEE 2011).

There are no sandstone escarpments or cliff lines within the study area, therefore the action is unlikely to reduce the area of potential breeding habitat of the Large-eared Pied Bat.

The study area occurs on a floodplain which has been extensively cleared for agricultural purposes.

While native vegetation to be removed represents potential foraging opportunities for the Large-eared Pied bat, it is considered unlikely that the removal of this vegetation would

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significantly affect this species (if it occurs), due to the disturbed nature of the vegetation and the retention of similar, and higher quality, habitat in the wider locality.

The referred action is not likely to affect the availability of quality habitat for this species to the extent that it is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The referred action is not likely to increase the likelihood of an invasive species becoming established in the habitat of the Large-eared Pied Bat.

- *introduce disease that may cause the species to decline*

The referred action is not likely to increase the likelihood of a disease becoming established or proliferating in a local population that would result in a decline of the Large-eared Pied Bat. White-nosed syndrome, a fungal disease causing widespread concern due to its impact upon bat populations in North America, has been identified in microbats but it has not been identified in Australia.

- *interfere substantially with the recovery of the species*

Due to the small amount of foraging habitat likely to be affect by the referred action (27.40 hectares) and no impact to roosting/breeding habitat, the referred action is not likely to interfere with the recovery of this species.

Conclusion

The project is unlikely to significantly impact upon the Large-eared Pied Bat as:

- The study area does not contain any sandstone escarpments such as those identified in the recovery plan.
- It is unlikely that any Large-eared Pied Bat foraging in the study area would be part of an important population.
- The study area does not occur at the limit of the species' range.
- Woodland in the study area is already heavily fragmented and the landscape has been extensively modified for agriculture.

3.2 Swift Parrot (Lathamus discolor)

The Swift Parrot is listed as Critically Endangered under the EPBC Act.

The Swift Parrot breeds mostly on the east and south-east coast of Tasmania during summer and migrates to mainland Australia for winter, where it forages across a broad range of forest types (Commonwealth of Australia, 2019).

In NSW, Swift Parrots forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions in New South Wales tend to support larger numbers of birds when inland habitats are subjected to drought, as occurred in 2002 and 2009 (Tzaros et al. 2009).

In May 2019, a flock of over 100 Swift Parrots was recorded in stands of flowering Swamp Mahogany at Chain Valley Bay along the NSW Central Coast. Several birds were also sighted in Mt Annan Botanic Gardens and Yengo National Park.

Although the species is known to forage in Western Sydney on occasion, no Swift Parrots were reported in the study area during this time (www.ebird.org).

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While there are several historic records for the Swift Parrot within 10 kilometres of the study area, there are no records within the study area (BioNet 2019).

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

On 24 March, 2020, a revised list of 119 animal species considered a high priority for urgent management intervention, was released by the Wildlife and Threatened Species Bushfire Recovery Expert Panel (DAWE 2020a). The Swift Parrot was not included in this list.

3.2.1 Specific impacts

The referred action would remove approximately about 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of marginal foraging habitat (myrtaceous winter flowering canopy species in Cumberland Plain Woodland, Shale Gravel Transition Forest, and River-flat Eucalyptus Forest). The referred action would not remove any nesting sites or important foraging areas as outlined in the National Recovery Plan for the Swift Parrot (Commonwealth of Australia, 2019).

3.2.2 EPBC Act significance assessment

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of Environment 2013).

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 result in one or more of the following:

- *lead to a long-term decrease in the size of a population of a species*

Approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of marginal foraging habitat for the Swift Parrot would be affected by the referred action. While limited habitat in the study area has the potential to be used by this species, it is not likely to be of high importance due to its relatively small area and the availability of equal or greater quality habitat within the locality and wider region. Any identified population of Swift Parrot in the area would not be restricted to habitat within the study area. Due to the species' large home range and nomadic nature, similar foraging habitat can be accessed in the locality. Therefore, the referred action is not considered likely to significantly contribute to a long-term decline in the size of a population of this species.

- *reduce the area of occupancy of the species*

The referred action is likely to affect approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of marginal foraging habitat for this species. Although the referred action would result in the loss of potential foraging habitat, the incremental loss of a small, linear area of potential habitat, only represents a small component of similar, locally occurring resources accessible to this species (<1% in 10 km area). Nevertheless, the removal of approximately 19.08 hectares of potential habitat is considered to be a small incremental loss of suitable habitat locally and as such has the potential to incrementally reduce the area of occupancy for the Swift Parrot during seasons when individuals of this species may be reliant on local resources.

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- *fragment an existing population into two or more populations*

Habitat connectivity is not likely to be affected by the referred action. Much of the study area occurs within or adjacent to land previously disturbed for agriculture or urban development. Approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of marginal foraging habitat is likely to be affected by the referred action which occurs as discrete patches of native vegetation. As the study area is relatively small in nature, the referred action would not further fragment or isolate any previously undisturbed patches of habitat than what already exists. Furthermore, given that the species is highly mobile and nomadic, the referred action would not present a significant barrier. It is not considered likely that habitat would become further isolated or fragmented significantly beyond that currently existing in the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat has been listed for the Swift Parrot to date. The study area does not contain any breeding areas nor is the study area the only limiting foraging area for this species. As such, it is unlikely that this referred action would adversely affect habitat critical to the survival of this species.

- *disrupt the breeding cycle of a population*

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Commonwealth of Australia, 2019). While Swift Parrots are dependent on flowering resources across a wide range of habitats (woodlands and forests) within their NSW wintering grounds, the removal of approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging habitat is unlikely to disrupt their movements to Tasmanian breeding grounds. As such the referred action is unlikely to affect their breeding cycle.

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

Whilst 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land)of marginal foraging habitat may be removed as part of the referred action, an abundance of similar or higher quality foraging habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging habitat in the form of native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) would represent <1% of available foraging habitat for this species.

The referred action is not likely to affect the availability of quality habitat for this species to the extent that it 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*

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Swift Parrot would become further established as a result of the referred action.

- *introduce disease that may cause the species to decline*

It is unlikely that disease would be increased by the referred action.

- *interfere with the recovery of the species*

The *Action Plan for Australian Birds* (Garnett and Crowley 2000) notes pressure on Swift Parrot breeding areas from forestry and firewood collection in Tasmania. On the mainland

though, pressures relate to the loss of foraging habitats due to clearing for agriculture and residential development (Garnett and Crowley 2000).

A National Recovery Plan for the Swift Parrot *Lathamus discolor* was prepared in 2011 (Saunders 2011). Recovery actions outlined in this plan include:

- 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.

Based on the potential ecological impacts of the referred action on the Swift Parrot, as discussed above, it is likely the referred action would conflict with the second recovery action above, to manage and protect swift parrot habitat at the landscape scale.

Conclusion

The extent of native vegetation clearing and foraging habitat removal associated with the referred action is considered to be small in terms of available habitat for the species within the Region (<1% in 10 km^2). The irregular distribution of blossom resources, which is a key driver of nomadism of this species, may cause this species to occasionally forage within the study area. The referred action would remove potential foraging habitat that may be utilised by this species under some intermittent seasonal contexts. The referred action is not considered to fragment any locally occurring populations, affect habitat critical to their survival, disrupt their breeding cycles, or interfere with the recovery of the species. The referred action is therefore considered unlikely to have a significant impact on the Swift Parrot.

3.3 Grey-headed flying-fox (*pteropus poliocephalus*)

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act.

The Grey-headed Flying-fox has historically occupied forests and woodlands in the coastal lowlands, tablelands and slopes of south-eastern Australia, from Bundaberg in Queensland to Geelong in Victoria, with rare sightings outside its range. More recently, camps have established in Adelaide, the Australian Capital Territory and inland areas of central and southern New South Wales and Victoria (Commonwealth of Australia 2017). Roosting camps are commonly found in creek lines, forested gullies, close to water, and in vegetation with a dense canopy. Camps are typically located within 20 km of a regular food source, but satellite camps would form closer to food sources in critical food shortages or when historically occupied camps are disturbed by vegetation maintenance (Peggy Eby, *pers.comm* April 2018).

Foraging habitat comprises nectar and pollen of native trees and fruits of rainforest trees and vines. This species also forages in cultivated gardens and fruit crops. The majority of myrtaceous plants in the diet of Grey-headed Flying-foxes flower within a defined season but are not annually reliable, and the location of productive foraging habitat from these plants varies (Commonwealth of Australia 2019). The NSW Draft Recovery Plan (DECCW 2009) outlines criteria for foraging habitat that can be considered critical to survival of the Grey-headed Flying-fox, being:

- productive during winter and spring
- known to support populations of > 30,000 individuals within an area of 50 km radius

Grey-headed Flying-foxes are seasonal breeders, with a single breeding event per year. Females give birth to a single pup and the majority of births occur from October to December,

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although births have been recorded before September (John Martin, *pers.comm* August 2019).

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

The Grey-headed Flying-fox has a range that extends from south east Queensland along the east coast of NSW and Victoria. Approximately 10-30% of the Grey-headed Flying-fox range has been impacted by bushfires, which has coincided with a prolonged food shortage and significant heat stress event over summer 2019-2020. The combination of these events is behind the provisional inclusion on the high priority list (DAWE 2020b)

In the project's locality, the extent of Grey-headed Flying-fox habitat impacted by the bushfire has been limited to relatively small proportion of the available foraging habitat. The nearest fire effected habitat occurred approximately 10 km to the west of the project in the lower Blue Mountains. The Project would result in the removal of up to 32.78 hectares (on-airport and off-airport) of potential Grey-headed Flying-fox foraging habitat in the form of Myrtaceous canopy species including Cumberland Plain Woodland. None of these Myrtaceous canopy species (e.g. CPW) provide winter foraging habitat.

This significant impact assessment has been updated to include reference to the intent of the provisional lists.

A cumulative impact assessment has been undertaken for the Project and other proposed developments in Western Sydney. The projects that have the potential to have a cumulative impact with the Project were considered Chapter 26 (Cumulative Impacts) of the Environmental Impact Statement. The projects considered to be relevant for the cumulative biodiversity impact assessment include:

- Western Sydney International
- future M12 Motorway project
- The Northern Road
- St Marys Intermodal Facility

A summary of the projects considered to be relevant to this biodiversity assessment and each projects impact on NSW threatened ecological communities and native vegetation is provided in below in Table 3-1. A brief description of these projects, future developments and associated potential cumulative impacts is provided below.

Table 3-1 Summary of cumulative impact on threatened ecological communities and native vegetation

Projects	Western Sydney International*	Future M12 Motorway project	The Northern Road	St Marys Intermodal Facility	SM- Western Sydney Airport	Total
Vegetation type	Area (Hectares)[1]					
Cumberland Plain Woodland (CEEC)	272.80	66.86	30.87	0	39.80	410.33
River-flat Eucalypt Forest (EEC)	47.6	3.18	3.86	0.72	18.06	73.42
Shale-Gravel Transition Forest (EEC)	5.90	6.91	0.00	0.00	10.42	23.23
Swamp oak floodplain forest (EEC)	0.00	2.82	0.00	0.00	5.38	8.20
Moist Shale Woodland (EEC)	0.00	0.44	0.00	0.00	0.00	0.44
Other non-threatened native vegetation	37.20	0.57	6.06	1.51	0.01	45.35
Total	363.50	80.78	40.79	2.23	73.67	560.97

3.4 Specific impacts

Myrtaceous woodland, forest and scattered eucalypts in the study area provide foraging habitat for the Grey-headed Flying-fox. The project would result in the removal of up to 32.78 hectares (which includes up to 7.99 hectares on-airport) of unburnt and potential foraging habitat in canopy species of Cumberland Plain Woodland and River Flat Eucalyptus Forest for this species. With regard to the cumulative impact assessment, the on-airport and off-airport components of this project account for approximately 5 per cent of Myrtaceous feed tree species being removed by all of the projects in the general area. The project is not removing large stands of winter-flowering resources (such as Spotted Gums). Removal of Spotted Gums is limited to a few planted street trees.

3.4.1 EPBC Act significance assessment

The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment 2013). Under the EPBC Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity

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- at or near the limit of the species' range.

Is this part of an important population?

Grey-headed Flying-foxes occur across a range of wooded habitats where their favoured food, eucalypt blossom, occurs. They set up roosting camps in association with blossom availability which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

With reference to DAWE's National Flying-fox monitoring viewer, there are no recorded Flying-fox camps within the study area (DoEE 2019). The closest existing camp to the study area is located at Ropes Creek, approximately 5 km to the northeast of the study area, with anywhere from 500 to 10,000 individuals counted during surveys between 2013 and 2019. Based on a review of the National Flying-fox monitoring viewer, there are likely to be >30,000 individuals of the species within a 50 km radius of the study area. Flying-fox camps within 50km are listed in Table 3.2 and presented in Figure 3-1 below.

Table 3-2 Flying-fox camps within approximately 50km of the study area

Flying-fox camp	**No of individuals (May 2019)**	**Distance to study area**	**Nationally important Flying-fox camp?**
Emu Plains (ID: 237)	500 - 2, 499	21km	No
Ropes Creek (ID: 626)	500 - 2, 499	5km	No
Wetherill Park (ID: 490)	500 - 2, 499	16km	No
Parramatta Park (ID: 134)	10, 000 - 15, 000	35km	Yes
Clyde (ID: 234)	2, 500 – 9, 999	38km	No
Cabramatta (ID:25)	2, 500 – 9, 999	15km	No
Macquarie Fields (ID: 482)	500 - 2, 499	20km	Yes
Campbelltown (ID: 489)	2, 500 – 9, 999	50km	No
Camden (ID: 22)	2, 500 – 9, 999	50km	No
Kareela (ID: 364)	10, 000 – 15, 999	>50km	Yes
Centennial Park (ID:487)	16, 000 – 49, 999	>50km	Yes
Gladesville (ID: 481)	2, 500 – 9, 999	>50km	Yes
Gordon (ID: 45)	10, 000 – 15, 999	>50km	Yes
Yarramundi (ID: 97)	500 - 2, 499	25km	No

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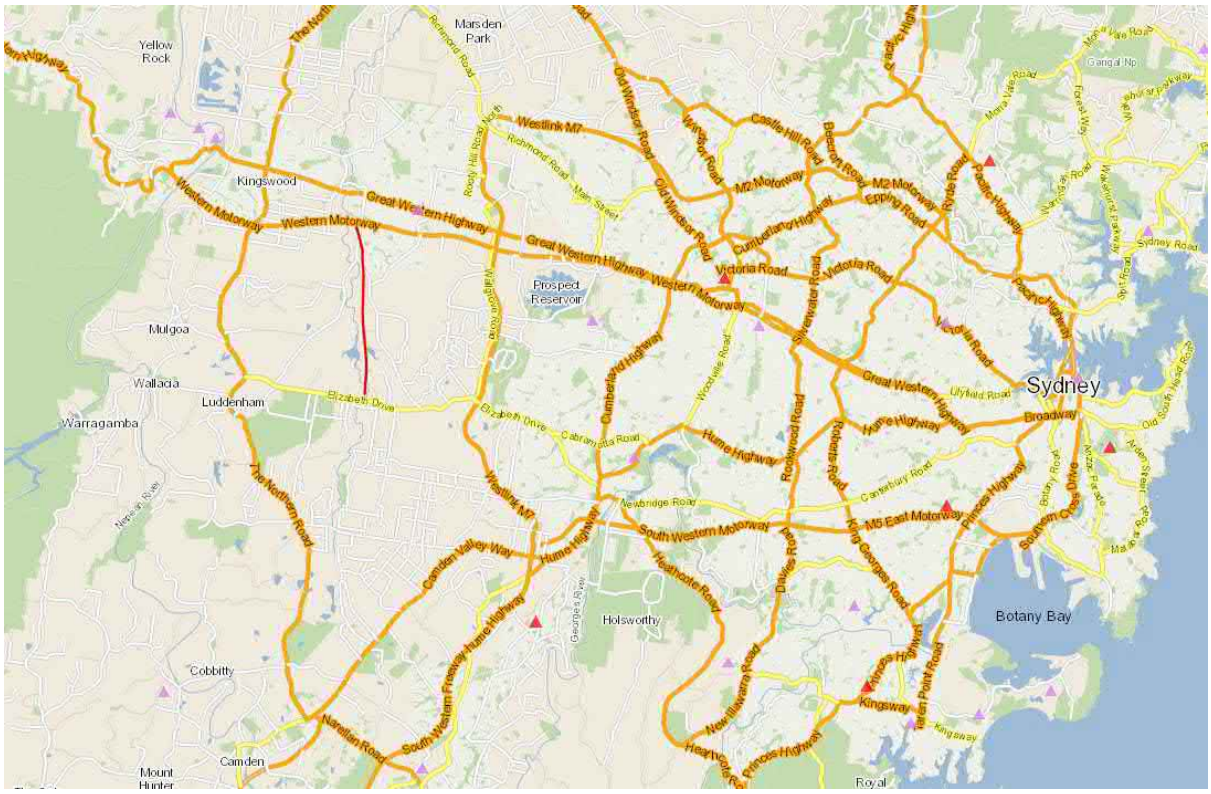

Figure 3-1 Location of Grey-headed Flying-fox camps in relation to the study area

Occurrences of this species within the study area are not at the limits of the species' distribution, nor are any maternity camps present. As such, the study area can only be considered to represent a part of the foraging range of widely occurring individuals.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

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

Not applicable. Grey-headed Flying-fox foraging in the study area are not part of an important population.

- *reduce the area of occupancy of an important population of the species*

Not applicable. Grey-headed Flying-fox foraging in the study area *are* not part of an important population.

- *fragment an existing important population into two or more populations*

Not applicable. Grey-headed Flying-fox foraging in the study area are not part of an important population.

- *adversely affect habitat critical to the survival of a species*

The foraging habitat within the study area meets the DECCW (2009) criteria for habitat critical for the survival of Grey-headed Flying-fox due to its proximity to existing camps (within 50 km) but removal of up to 32.78 hectares of scattered foraging habitat (on-airport and off-airport) is unlikely to significantly impact on this species, given the abundance of higher quality myrtaceous foraging habitat within the locality.

- *disrupt the breeding cycle of an important population*

Not applicable. Grey-headed Flying-fox occurring in the study area are not part of an important population.

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

The remnant vegetation which could provide potential foraging habitat for the Grey-headed Flying-fox includes Cumberland Plain Woodland and River Flat Eucalypt Forest.

Whilst 32.78 hectares of scattered foraging habitat may be removed as part of the referred action, an abundance of similar or high quality foraging habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging habitat in the form of native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of up to 32.78 hectares (on-airport and off-airport) would represent 1.9% of available foraging habitat for this species in the locality.

Further, the referred action is not removing any large stands of winter foraging resources as these resources are limited in distribution to a narrow coastal strip in northern NSW and Queensland (Commonwealth of Australia, 2001). The study area for the referred action is over 100km outside the distribution of these annually reliable winter resources.

The referred action is therefore not likely to affect the availability of quality habitat for this species to the extent that it is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat*

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the referred action.

- *introduce disease that may cause the species to decline*

No. There are no known diseases that are likely to increase in the area as a result of the referred action.

Australian flying-foxes, including the Grey-headed Flying-fox, are natural reservoirs for at least three diseases, being Australian Bat Lyssavirus (ABL), Hendra virus and Menangle virus. While injured and orphaned Grey-headed Flying-foxes have a higher chance of testing positive for ABL, it is unlikely the referred action would introduce this disease.

White-nose syndrome (WNS), a fungal disease causing widespread concern due to its impact upon bat populations in North America, has only been identified in microbats. The disease has not been identified in Australia.

- *interfere with the recovery of the species*

Due to the relatively small foraging habitat likely to be affect by the referred action (about 32.78 hectares), and as no roost camps are located in the study area, the referred action is not likely to interfere with the recovery of this species.

Conclusion

The Grey-headed Flying-fox frequents habitats that contain eucalypt blossom and native fruits such as figs, which are their favoured foods. The study area contains eucalypt dominated communities, including those that are favoured by this species. A relatively small amount of foraging habitat (up to 32.78 hectares) (on-airport and off-airport) would be affected by the referred action, although this is unlikely to be significant to local populations, due to the

abundance of similar and greater quality foraging habitat elsewhere within the study area and in the wider locality (>1700 hectares). There are no Grey-headed Flying-fox camps within the study area, but there is one camp at Rope's Creek about 5 km away.

Approximately 1,700 hectares of potential foraging habitat in the form of unburnt native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of up to 32.78 hectares (on-airport and off-airport) would represent 1.9% of available foraging habitat for this species in the locality. This is unlikely to significantly impact on this species, given the abundance of higher quality myrtaceous foraging habitat within the locality.

The referred action is not considered to fragment any locally occurring populations, disrupt their breeding cycles, introduce disease that may cause the species to decline or interfere with the recovery of the species. The referred action is therefore considered unlikely to have a significant impact on the Grey-headed Flying-Fox.

3.5 White-throated Needletail (*Hirundapus caudacutus*)

The White-throated Needletail is listed as Vulnerable, Migratory and Marine under the EPBC Act.

This is a trans-equatorial migratory species, breeding in the Northern Hemisphere and flying south for the boreal winter. They arrive in Australia for the non-breeding season as early as September and may remain until as late as April. In Australia, they are widespread and occur throughout eastern and south-eastern Australia. They are almost exclusively aerial and are most commonly recorded above wooded areas including open forest and rainforest, as well as heathlands, and are less commonly recorded above treeless areas such as grassland and swamps. They are insectivorous and often forage in areas of updraught such as ridges, cliffs or sand dunes, in the smoke of bushfires, or occasionally in whirlwinds (Department of Environment and Energy 2019).

The White-throated Needletail has been recorded roosting in trees in forests and woodlands, in both dense canopy foliage and in hollows. They breed outside of Australia in wooded lowlands, sparsely vegetated hills, and mountains covered with coniferous forests.

On 11 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released a provisional list of 113 animal species that have been identified by experts as the highest priorities for urgent management intervention over the weeks and months following the 2019-20 bushfires in southern and eastern Australia. Most of these animals have potentially had at least 30% of their range burnt, and many have had substantially more. DAWE further released an initial list of threatened ecological communities which have more than 10% of their estimated distribution in areas affected by those same bushfires.

On 24 March, 2020, a revised list of 119 animal species considered a high priority for urgent management intervention, was released by the Wildlife and Threatened Species Bushfire Recovery Expert Panel (DAWE 2020a). The White-throated Needletail was not included in this list.

This significant impact assessment has been updated to include reference to the intent of the provisional lists.

3.5.1 Specific impacts

The referred action would remove approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging and roosting habitat, in the form of canopy species associated with Cumberland Plain Woodland, Shale Gravel Transition

Forest and River Flat Eucalyptus Forest. The referred action area is unlikely to contain habitat critical to the survival of the species due to the absence of suitable hollows for the species to roost.

3.5.2 EPBC Act significance assessment

In accordance with the Matters of National Environmental Significance, Significant Impact Guidelines 1.1, the presence of an important population must be identified prior to addressing the significance impact criteria. An important population is defined in the guidelines as a population that is necessary for a species' long-term survival and recovery (Department of the Environment, 2013).

Is there an important population?

There are no important populations listed under the conservation advice (Department of Environment and Energy 2019).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:

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

Not applicable. White-throated Needletail in the study area are not part of an important population (refer to above).

- *reduce the area of occupancy of an important population*

Not applicable. White-throated Needletail in the study area are not part of an important population (refer to above).

- *fragment an existing important population into two or more populations*

Not applicable. White-throated Needletail in the study area are not part of an important population (refer to above).

- *adversely affect habitat critical to the survival of a species*

No critical habitat is listed for the White-throated Needletail under the EPBC Act.

The study area contains native vegetation communities that occur as discrete patches of vegetation surrounded by agricultural development, urban development in the northern section, and roads. Approximately 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of vegetation to be impacted could provide potential foraging and roosting habitat for the White-throated Needletail.

Whilst 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of foraging and roosting habitat may be removed as part of the referred action, an abundance of similar or higher quality foraging and roosting habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging and roosting habitat in the form of native vegetation has been mapped within 10 km of the study which is accessible to this species. The removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land)would represent <1% of available foraging habitat for this species.

It is unlikely that the removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging and roosting habitat would be classified as critical habitat for the species.

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- *disrupt the breeding cycle of an important population*

Not applicable. White-throated Needletail in the study area are not part of an important population (refer to above).

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

The study area occurs on a floodplain which has been extensively cleared for agricultural purposes.

While native vegetation to be removed represents potential foraging and roosting opportunities for the White-throated Needletail, it is considered unlikely that the removal of this vegetation would significantly affect this species (if it occurs), due to the disturbed nature of the vegetation and the retention of similar, higher quality habitat in the wider locality.

The referred action is not likely to affect the availability of quality habitat for this species to the extent that it is likely to decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The referred action is not likely to increase the likelihood of an invasive species becoming established in the habitat of the White-throated Needletail.

- *introduce disease that may cause the species to decline*

The referred action is not likely to introduce disease that may cause the White-throated Needletail to decline.

- *interfere substantially with the recovery of the species*

The referred action is unlikely to substantially interfere with the recovery of the White-throated Needletail due to the lack of hollow bearing trees that the species may roost in, and it would not exacerbate other threats to the species (collision with wind farm turbines, secondary poisoning).

Conclusion

Whilst 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) of potential foraging and roosting habitat may be removed as part of the referred action, an abundance of similar or higher quality foraging and roosting habitat occurs in the wider locality (>1700 hectares of mapped native vegetation (Tozer, Turner et al. 2010)). Approximately 1700 hectares of potential foraging and roosting habitat in the form of native vegetation has been mapped within 10 km of the study area which is accessible to this species. The removal of 27.40 hectares (19.41 hectares off-airport land and 7.99 hectares on-airport land) would represent <1% of available foraging habitat for this species.

The study area is not located at the limit of the species' range. Woodland in the study area is already heavily fragmented and the landscape has been extensively modified.

The referred action is unlikely to substantially interfere with the recovery of the White-throated Needletail and it would not exacerbate other threats to the species (collision with wind farm turbines, secondary poisoning).

On the basis of these considerations, it is considered unlikely that the referred action would have a significant impact on the White-throated Needletail.

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4 References

Biosis (2018) Western Sydney Strategic Assessment

Churchill, S. (2009). Australian Bats. New Holland Press, Sydney, Australia.

Commonwealth of Australia (2017). Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*).

Commonwealth of Australia (2001). Conservation advice for *Pteropus poliocephalus* (Grey-headed Flying-fox) for listing as vulnerable under section 178 of the EPBC Act.

Commonwealth of Australia (2019). National Recovery Plan for the Swift Parrot (*Lathamus discolor*).

Department of Agriculture, Water and the Environment (2020a). Rapid analysis of impacts of the 2019-20 fires on animal species, and prioritisation of species for management response – preliminary report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel. Canberra.

Department of Agriculture, Water and the Environment (2020b). Provisional list of plants requiring urgent management intervention– preliminary report prepared for the Wildlife and Threatened Species Bushfire Recovery Expert Panel. Canberra.

Department of Environment and Conservation (2005a). *Pimelea spicata*. Recovery Plan. Department of Environment and Conservation (NSW), Hurstville NSW. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-pimelea-spicata. In effect under the EPBC Act from 10-Nov-2006.

Department of Environment and Conservation (2005b). Recovering bushland on the Cumberland Plain - Best practice guidelines for the management and restoration of bushland. Hurstville, Department of Environment and Conservation,.

Department of Environment and Water Resources (2007). Cumberland Plain Woodlands. Advice to the Minister for the Environment and Water Resources from the Endangered Species Scientific Subcommittee (ESSS) on a project to add an ecological community to Schedule 2 of the Endangered Species Protection Act 1992 (ESP Act). Department of Environment and Water Resources.

Department of Environment Climate Change and Water (2010). Cumberland Plain Recovery Plan. C. C. a. W. Department of Environment. Sydney, Department of Environment, Climate Change and Water.

Department of the Environment (2013). Approved Conservation Advice for *Acacia bynoeana* (Bynoe's wattle). Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/8575-conservation-advice.pdf. In effect under the EPBC Act from 17-Dec-2013.

Department of the Environment (2015). Approved Conservation Advice (including listing advice) for Shale Gravel Transition Forest of the Sydney Basin Bioregion. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/129-conservation-advice.pdf. In effect under the EPBC Act from 17-Mar-2015.

Department of the Environment (2019). *Pimelea spicata* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat

Department of the Environment (2019). *Hirundapus caudacutus* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=682

Department of the Environment and Energy (2016). *Chalinolobus dwyeri* — Large-eared Pied Bat SPRAT Profile

Department of the Environment and Energy (2018). Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf. In effect under the EPBC Act from 20-Mar-2018.

Department of the Environment, Water, Heritage and the Arts (2013). Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. D. o. Environment. Canberra, ACT, Commonwealth of Australia.

Department of the Environment, Water, Heritage and the Arts (2008a). Approved Conservation Advice for *Allocasuarina glareicola*. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/21932-conservation-advice.pdf. In effect under the EPBC Act from 26-Mar-2008.

Department of the Environment, Water, Heritage and the Arts (2008b). Approved Conservation Advice for *Cynanchum elegans* (White-flowered Wax Plant). Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/12533-conservation-advice.pdf. In effect under the EPBC Act from 26-Mar-2008.

Department of the Environment, Water, Heritage and the Arts (2008c). Approved Conservation Advice for *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea). Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/64910-conservation-advice.pdf. In effect under the EPBC Act from 26-Mar-2008.

Department of the Environment, Water, Heritage and the Arts (2008d). Approved Conservation Advice for *Micromyrtus minutiflora*. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/11485-conservation-advice.pdf. In effect under the EPBC Act from 03-Jul-2008.

Department of the Environment, Water, Heritage and the Arts (2008e). Approved Conservation Advice for *Pimelea curviflora var. curviflora.* Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/4182-conservation-advice.pdf. In effect under the EPBC Act from 03-Jul-2008.

Department of the Environment, Water, Heritage and the Arts (2008f). Approved Conservation Advice for *Pultenaea parviflora.* Canberra: Department of the Environment, Water, Heritage and the Arts.

Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/19380-conservation-advice.pdf. In effect under the EPBC Act from 26-Mar-2008.

Department of Environment, Climate Change and Water NSW (2009). Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment and Resource Management (2011). National recovery plan for the large-eared pied bat *Chalinolobus dwyeri.*

NSW National Parks and Wildlife Service (2003). Downy Wattle (*Acacia pubescens*) Recovery Plan. NSW NPWS, Hurstville, NSW. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-downy-wattle-acacia-pubescens. In effect under the EPBC Act from 13-Oct-2003 as Acacia pubescens.

NSW Scientific Committee (1997). Final determination to list Cumberland Plain Woodland as an endangered ecological community. Hurstville, NSW National Parks and Wildlife Service.

NSW Scientific Committee (2008). "Preliminary determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from http://www.environment.nsw.gov.au/determinations/cumberlandplainpd.htm.

NSW Scientific Committee (2011). "Final determination to list Cumberland Plain Woodland in the Sydney Basin Bioregion as a Critically Endangered Ecological Community." from http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm.

Office of Environment and Heritage (2017). "Cumberland Plain Woodland in the Sydney Basin Bioregion - Profile."

Office of Environment and Heritage (2019a) "*Allocasuarina glareicola* - profile". Available from: https://www.environment.nsw.gov.au/ThreatenedSpeciesApp/profile.aspx?id=10038

Office of Environment and Heritage (2019b) "*Cynanchum elegans* - profile". Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10196

Office of Environment and Heritage (2019c) "*Grevillea parviflora subsp. parviflora* – profile". Available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10373

Office of Environment and Heritage (2019d) "*Micromyrtus minutifolia* - profile". Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10529

Office of Environment and Heritage (2019e) "*Pimelea curviflora var curviflora* - profile". Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10629

Office of Environment and Heritage (2019fe) "*Pimelea spicata* - profile". Available from: https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10632

Threatened Species Scientific Committee (2016a). Conservation Advice *Acacia pubescens* downy wattle. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/18800-conservation-advice-15072016.pdf. In effect under the EPBC Act from 15-Jul-2016.

Threatened Species Scientific Committee (2016b). Conservation Advice *Pimelea spicata* spiked rice-flower. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/20834-conservation-advice-15072016.pdf. In effect under the EPBC Act from 15-Jul-2016.

Tozer, M., et al. (2010). "Native Vegetation of southeast NSW: a revised classification and map for the coast and tablelands." Cunninghami 11(3).

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Tzaros C, Saunders D, Webb M & Ingwersen D. (2009). Swift Parrots – dynamic migrants within a drought prone environment. Wingspan 19 (3), 14-15.

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