

21 December 2022

Darren Flynn
Project Director
Legacy Property
Level 45, 25 Martin Place
Sydney NSW 2000

Cumberland Ecology
PO Box 2474
Carlingford Court 2118
NSW Australia
Telephone (02) 9868 1933
ABN 14 106 144 647
Web: www.cumberlandecology.com.au

Orchard Hills North: Technical Study Addendum

Dear Darren,

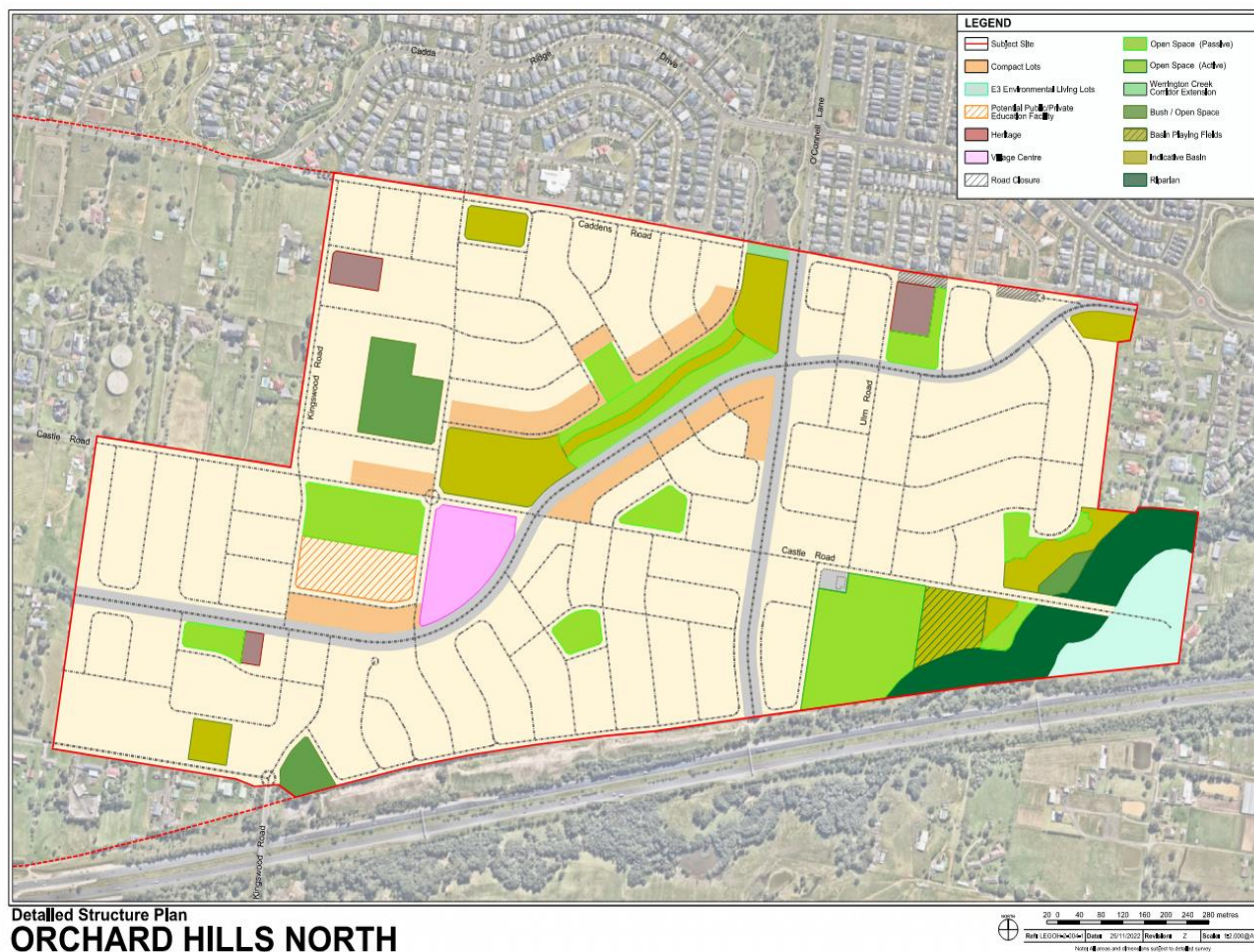
Cumberland Ecology Pty Ltd prepared the Flora and Fauna Assessment (Ref. 17224RP1, dated 17 March 2018) in support of the Planning Proposal seeking to rezone a 151.9 hectare parcel of land referred to as Orchard Hills North.

Since the original report was prepared, various amendments have occurred to the Planning Proposal leading up to and following the public exhibition period. These amendments generally include:

- Revision to the configuration of the potential new school site and adjoining open space OS8 in response to the requirements of Schools Infrastructure NSW;
- Incorporation of planning mechanisms relating to reservation of a proposed north-south road corridor, including incorporation of a Transport Investigation Area (TIA) overlay;
- Introduction of an additional stormwater detention basin B8, on the northern side of Frogmore Road;
- Altering or incorporating a range of planning mechanisms relating to:
 - Lot size controls;
 - Building height provisions for the potential new school site;
 - Precinct boundaries and yield controls; and
 - Provision of local infrastructure.

Importantly, there has been no overall change to the proposed yield of 1,729 lots or the fundamental intent of the Planning Proposal to facilitate urban development of the site

supported by provision of appropriate local infrastructure. The final structure plan is shown in the following plan:



The final Planning Proposal was endorsed by Penrith City Council on 12 December 2022.

The Planning Proposal is supported by a site specific Development Control Plan (DCP) and draft Section 7.11 Local Contributions Plan.

Technical Study Conclusions

The amendments incorporated into the final Planning Proposal are generally minor in nature and have no impact on the conclusions and recommendations of the original Flora and Fauna Assessment (Ref. 17224RP1, dated 17 March 2018).

The relevant recommendations of the report have been previously incorporated into the Planning Proposal and/or DCP as appropriate, and the final Planning Proposal remains consistent with the outcomes of our assessment.

Yours sincerely,

A handwritten signature in black ink that reads "David Robertson". The signature is written in a cursive, flowing style.

Dr David Robertson

Director

David.robertson@cumberlandecology.com.au

ORCHARD HILLS NORTH

Ecological Services

For:

Legacy Property

March 2018

Final



**PO Box 2474
Carlingford Court 2118**

Report No. 17224RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	14/02/2018	TM, KW, MD	Draft
2	16/03/2018	TM, KW, MD	Final
3	17/03/2018	MD	Final

Approved by: David Robertson

Position: Director

Signed:



Date:

17 March, 2018

Table of Contents

EXECUTIVE SUMMARY

1 INTRODUCTION

1.1	Purpose	1.1
1.2	Background	1.2
1.2.1	Site Description	1.2
1.3	The Proposal	1.4
1.3.1	Vision	1.4
1.3.2	Design Principles	1.4
1.3.3	Master Plan and Rezoning Description	1.5
1.4	Legislative Requirements	1.6
1.4.1	Environmental Planning and Assessment Act 1979	1.6
1.4.2	Environment Protection and Biodiversity Conservation Act 1999	1.6
1.4.3	Threatened Species Conservation Act 1995	1.6
1.4.4	Biodiversity Conservation Act 2016	1.7
1.4.5	Water Management Act 2000	1.7
1.4.6	Biosecurity Act 2015	1.7
1.5	State and Local Government Planning Instruments	1.8
1.5.1	Penrith Local Environmental Plan 2010	1.8

2 METHODOLOGY

2.1	Literature Review	2.1
2.2	Database Analysis	2.1
2.3	Flora Survey	2.2
2.3.1	Vegetation Mapping	2.2
2.3.2	BioBanking Plots and Transects	2.3
2.3.3	Random Meander Surveys, Grassland Surveys and Threatened Species Searches	2.4
2.3.4	Survey Effort	2.4
2.4	Fauna Survey	2.4

Table of Contents *(Cont'd)*

	2.4.1 General Habitat Assessment	2.5
	2.4.2 Microchiropteran Bat Surveys	2.5
	2.4.3 Diurnal Bird Surveys	2.5
	2.4.4 Amphibian Surveys	2.5
	2.4.5 Incidental Observations	2.6
	2.4.6 Survey Effort	2.6
2.5	Weather Conditions	2.6
2.6	Limitations	2.7
	2.6.1 Flora	2.8
	2.6.2 Fauna	2.8
3	RESULTS	
3.1	Vegetation Communities	3.1
	3.1.1 Cumberland Plain Woodland	3.2
	3.1.2 River-flat Eucalypt Forest	3.4
	3.1.3 Urban Native/Exotic	3.6
	3.1.4 Exotic Vegetation	3.6
	3.1.5 Exotic Dominated Grassland	3.7
	3.1.6 Dam Vegetation	3.7
	3.1.7 Cleared Land	3.9
	3.1.8 Other Vegetation Communities of the Study Area	3.9
3.2	Flora	3.9
	3.2.1 General Species	3.9
	3.2.2 Threatened Species	3.10
3.3	Fauna	3.11
	3.3.1 Fauna Habitat	3.11
	3.3.2 General Species	3.15
	3.3.3 Threatened Species	3.18

Table of Contents *(Cont'd)*

4 IMPACT ASSESSMENT

4.1	Introduction	4.1
4.2	Direct Impacts	4.1
4.2.1	Vegetation Removal	4.1
4.2.2	Loss of Specific Habitat Features	4.2
4.3	Indirect Impacts	4.4
4.4	Impacts to Threatened Ecological Communities	4.7
4.4.1	River-flat Eucalypt Forest	4.7
4.4.2	Cumberland Plain Woodland	4.8
4.5	Impacts to Threatened Flora Species	4.8
4.6	Impacts to Threatened Fauna Species	4.9
4.6.1	Powerful Owl	4.9
4.6.2	Grey-headed Flying Fox	4.9
4.6.3	Microchiropteran Bats (Microbats)	4.10
4.6.4	Cumberland Plain Land Snail	4.10

5 AVOIDANCE, MITIGATION AND COMPENSATORY MEASURES

5.1	Avoidance Measures	5.1
5.2	Mitigation Measures	5.2
5.2.1	Vegetation Clearance and Fauna Management Protocols	5.2
5.2.2	Weed Control Measures	5.4
5.2.3	Nest Box Installation	5.4
5.2.4	Other Relevant Measures	5.4
5.3	Compensatory Measures	5.5
5.4	Adequacy of Mitigation and Compensation Measures	5.6

6 CONCLUSION

REFERENCES

List of Appendices

A.	FLORA SPECIES LIST
B.	THREATENED FLORA LIKELIHOOD OF OCCURRENCE
C.	FAUNA SPECIES LIST
D.	THREATENED FAUNA LIKELIHOOD OF OCCURRENCE
E.	ASSESSMENTS OF SIGNIFICANCE

List of Tables

S.1.1	Vegetation communities within the subject site	1
S.1.2	Estimation of areas of vegetation to be removed in the subject site	3
2.1	Flora survey effort	2.4
2.2	Fauna survey effort	2.6
2.3	Weather conditions during the survey period	2.7
3.1	Vegetation communities within the subject site	3.1
3.2	Priority Weeds	3.10
3.3	Habitat features within the subject site	3.14
4.1	Estimation of areas of vegetation to be removed in the subject site	4.2
A.1	Flora Species List	A.1
6.2	Threatened flora likelihood of occurrence	B.1
6.3	Fauna Species List	C.1
6.4	Threatened Fauna Likelihood of Occurrence	D.1

List of Figures

1.1	Location of the subject site	1.10
1.2	Orchard Hills North indicative layout master plan	1.11
2.1	Flora survey locations within the subject site	2.10
2.2	Fauna survey locations within the subject site	2.11
3.1	Vegetation communities within the subject site	3.23

List of Figures

3.2	Habitat features within the subject site	3.24
3.3	Threatened fauna species recorded within the subject site	3.25
3.4	Vegetation Communities of the study area	3.26
4.1	Impacts to TECs within the subject site	4.11

List of Photographs

3.1	Degraded CPW within the subject site	3.4
3.2	Degraded RFEF within the subject site	3.6
3.3	Low diversity <i>Casuarina glauca</i> dominated RFEF within the subject site	3.6
3.4	Exotic dominated grassland typical of the subject site	3.8
3.5	Farm dam lacking fringing vegetation	3.9
3.6	Farm dam with abundant fringing vegetation	3.9

Glossary of Terms

BBAM	BioBanking Assessment Methodology
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CPW	Cumberland Plain Woodland
DA	Development Application
DoEE	Commonwealth Department of the Environment and Energy
EEC	Endangered Ecological Community
EP&A Act	NSW <i>Environment Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
GIS	Geographical Information System
GPS	Global Positioning System
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service
OEH	NSW Office of the Environment and Heritage
PLEP	Penrith Local Environmental Plan 2010
RFEF	River-flat Eucalypt Forest
SEPP	State Environmental Planning Policy
SOFF	Swamp Oak Floodplain Forest
Subject Site	The area subject to direct impacts relevant to the rezoning proposal, as shown in Figure 1.1
TEC	Threatened Ecological Community
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

Executive Summary

S1 Introduction

Cumberland Ecology Pty Ltd (Cumberland Ecology) has been commissioned by Legacy Property to conduct a flora and fauna assessment of Orchard Hills North to support a rezoning application. The purpose of this report is to describe the ecological values of the subject site and to assess the impacts of the proposed rezoning and development on flora and fauna, particularly threatened species, populations and communities listed under the *Biodiversity Conservation Act 2016* (BC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

S2 Methods

Database analysis, vegetation/flora surveys, fauna habitat surveys, targeted fauna surveys and incidental fauna observations were undertaken in December 2017. Flora surveys involved recording the presence and abundance of flora species within 20m x 20m quadrats, recording the presence of species in random meanders and targeted threatened flora surveys. All vascular plants were recorded or collected and were identified to species level where possible. Fauna surveys included a habitat assessment and targeted surveys using ultrasonic call detection, and any incidental observations of birds and other vertebrates. Targeted surveys for the Green and Golden Bell Frog (GGBF) were performed over four nights for each suitable water body throughout the survey period.

S3 Results

Orchard Hills North is currently comprised of disused orchards, agricultural land and scattered residential dwellings. As a result of historical and recent land uses, the subject site comprises a highly modified, landscape with small and scattered remnants of native vegetation. **Table S.1** lists the vegetation communities occurring within the subject site, their extent, and their conservation status.

Table S.1.1 **Vegetation communities within the subject site**

Vegetation Community	BC Act Status	EPBC Act Status	Total Area (ha)
Native Vegetation			
Cumberland Plain Woodland	CEEC	CEEC	2.05
River-flat Eucalypt Forest	EEC		5.09
Dam Vegetation			0.84

Table S.1.1 Vegetation communities within the subject site

Vegetation Community	BC Act Status	EPBC Act Status	Total Area (ha)
Exotic Vegetation			
Urban Native/Exotic			5.46
Exotic Vegetation			3.76
Exotic Dominated Grassland			114.29
Other			
Cleared Land (i.e. roads, buildings, dams)			13.17

River-flat Eucalypt Forest (RFEF) is listed as Endangered under the BC Act and occurs as a linear corridor along Claremont Creek in addition to fragmented and isolated patches throughout the subject site. Cumberland Plain Woodland (CPW) is listed as Critically Endangered under both the BC Act and the EPBC Act. These native vegetation communities occur in a highly modified form with an understorey dominated by exotic groundcover and shrub species with limited scope for natural regeneration.

A total of 150 plant species were recorded during surveys. The majority were either exotic (92) or planted native species (9) not naturally occurring in the area. The remaining species are species native to the region (49). Threatened flora species were not detected within the subject site, however *Grevillea juniperina* subsp. *juniperina* (Juniper Leaved Grevillea), listed as Vulnerable under the BC Act is considered to have the potential to occur.

A total of 65 fauna species were recorded within the subject site. The fauna group with the highest number of individual species observed was birds (36), followed by mammals (18), amphibians (5), reptiles (4) and fish (2). Five threatened fauna species were observed within the subject site. The Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as vulnerable under the BC Act and the EPBC Act whilst the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Southern Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) and the Eastern Freetail-bat (*Mormopterus norfolkensis*) are listed as vulnerable under the BC Act. From the desktop assessment and site inspections, an additional three threatened fauna species are considered to have the potential to occur within the subject site. The wooded habitats relevant to threatened species are highly fragmented, isolated and small in area within the subject site, lacking connectivity to higher quality habitat, reducing the potential for sessile species to occur. The threatened fauna species known to occur within the subject site and those potentially occurring are highly mobile and are expected to move between areas of remaining habitat within the immediate vicinity of the subject land and wider area.

S4 Impact Assessment

The proposed project will involve the clearing of the following vegetation communities within the subject site:

Table S.1.2 Estimation of areas of vegetation to be removed in the subject site

Vegetation Community	BC Act Status	EPBC Act Status	Total Area (ha)
Native Vegetation			
Cumberland Plain Woodland	CEEC	CEEC	0.53*
River-flat Eucalypt Forest	EEC		1.21
Dam Vegetation			0.84
Exotic Vegetation			
Urban Native/Exotic			5.46
Exotic Vegetation			3.76
Exotic Dominated Grassland			114.29
Other			
Cleared Land (i.e. roads, buildings, dams)			14.60

* Approximately 0.29 ha of this area is anticipated to be partially cleared with scope for the retention of canopy and pockets of understorey throughout an open space park.

Small, isolated patches of RFEF and CPW are anticipated to be cleared as a result of the proposed project, as shown in **Table S.1.2**. The areas of CPW and RFEF to be impacted are highly modified and degraded in nature, characterised by a native canopy over an understorey dominated by exotic grasses shrubs, grasses and herbs with native species scattered throughout. Assessments of Significance have determined that the proposed development is unlikely to have a significant impact on these communities.

No naturally occurring threatened flora species were detected within the subject site and few threatened flora species were concluded to have the potential to occur. The subject site is considered to contain potential, unoccupied habitat for *Grevillia juniperina* subsp. *juniperina* (Juniper-leaved Grevillea) and *Pimelea spicata* (Spiked Rice-flower). Assessments of Significance has determined that the proposed development is unlikely to have a significant impact on these threatened flora species.

Habitat for threatened fauna species will be removed for the proposed development; however none of the known and potentially occurring threatened fauna species are likely to be dependent on habitat within the subject site for their survival. A majority of the species in question are highly mobile species that access resources from a wide area. Assessments of Significance have determined that the proposed development is unlikely to have a significant impact these threatened fauna species.

S5 Avoidance and Mitigation Measures

A number of avoidance and mitigation measures are recommended for the proposed project including:

- Consideration of Threatened Ecological Communities during the design phase resulting in retention of a large majority of CPW and limited clearing of RFEF within the subject site.
- Implementation of vegetation clearance and fauna management protocols;
- Implementation of weed control measures;
- Nest box installation;
- Plantings along Werrington Creek;
- Preparation of a Vegetation Management Plan addressing revegetation along Werrington Creek and throughout bushland parks; and
- Preparation of a Landscape Management Plan.

Clearing of native vegetation within the subject site is likely to require offsetting. The quantum of offsets is required to be calculated using an approved metric system which will be determined once the development approval pathway is known (e.g. Biodiversity Certification, Part 4 Development Application).

S6 Conclusion

The rezoning and eventual development of Orchard Hills North will involve the removal of a 123.51 ha area of non-native vegetation, comprised of exotic grasslands, stands of exotic weeds and exotic plantings adjacent to dwellings. Approximately 1.21 ha of RFEF and 0.53 ha of CPW vegetation will be directly impacted within the site. When avoidance and mitigation measures are taken into account, it is considered that there may be residual impacts to RFEF and CPW vegetation communities as a result of clearing.

Anticipated impacts associated with the rezoning and eventual development can be managed through the provision of mitigation and compensatory measures. It is recommended that the clearing of native vegetation communities and associated habitat be addressed through the provision of an onsite offset site along the Werrington Creek corridor in addition to the retirement of a suitable number of biodiversity credits. The strategic approach to offsets is anticipated to be developed post gateway. The proposed avoidance, mitigation and compensatory measures are likely to sufficiently ameliorate the impacts of the project to the extent that no TECs or threatened species are likely to become extinct as a result of the project.

All future development applications (DA) within the rezoning area will require the application of the relevant Biodiversity legislation. Part 4 DAs submitted prior to November 24 2018 are able to be assessed under the former planning provisions as the Penrith LGA has been

nominated as an interim designated area. Should DAs be lodged after this time, they will be subject to the provisions of the BC Act.

Introduction

Cumberland Ecology Pty Ltd (Cumberland Ecology) has been commissioned by Legacy Property to conduct a flora and fauna assessment of Orchard Hills North (hereafter referred to as the 'subject site') (**Figure 1.1**).

1.1 Purpose

The purpose of this report is to describe the ecological values of the subject site and to assess the impacts of the proposed rezoning and development on flora and fauna, particularly threatened species, populations and communities listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) / *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Specifically, the objectives of this ecological assessment are to:

- Describe the existing flora and fauna of the subject site to provide a baseline for impact assessment;
- Describe and map vegetation communities of the subject site, identifying threatened communities listed under the BC Act and/or the EPBC Act;
- Identify and map the location of threatened flora and fauna species or their habitats (if present);
- Assess the likelihood that threatened flora and fauna species could occur in the subject site;
- Describe the types and extent of potential ecological impacts that could arise from the proposed project; and
- Prescribe appropriate avoidance, mitigation or compensatory measures to manage impacts on threatened species and areas of high conservation value.

1.2 Background

1.2.1 Site Description

Legacy Property is proposing to rezone a site in Orchard Hills North, located within the Penrith Local Government Area (LGA). The proposed rezoning area is approximately 146.1 hectares (ha) with frontages to Caddens Road to the north, Kingswood Road to the west, the Western Motorway to the south and Claremont Meadows residential lots to the east.

Orchard Hills North, is well located being north of the Western Sydney Motorway, in close proximity to the University of Western Sydney (to the north), Nepean Hospital (to the north) and to the Penrith City Centre. South of the Motorway land is mostly Orchard Hills rural lands, Defence Lands and to the south west is Glenmore Park.

The rezoning site comprises 54 existing lots (including the school and Uniting Church) within the proposed rezoning area, located at the following addresses:

- 80-154 Caddens Road, Orchard Hills
- 26-48 Kingswood Road, Orchard Hills
- 79-101 Kingswood Road, Orchard Hills (school)
- 117-149 Castle Road, Orchard Hills
- 53-105 Castle Road, Orchard Hills
- 182-226 Caddens Road, Orchard Hills
- 2-164 Castle Road, Orchard Hills
- 1-5 Castle Road, Claremont Meadows
- 7 Castle Road, Claremont Meadows
- 5, 9, 13, 19, 23, 29, 33 and 35 Frogmore Road, Orchard Hills

The proposed rezoning area is identified in **Figure 1.1.** below.

Legacy Property nominated the Orchard Hills North site under Penrith City Council's Accelerated Housing Delivery Program (AHDP) in October 2017. In November 2017 the site was endorsed by Penrith City Council as a short-term rezoning opportunity to provide for housing delivery over the next 3-5 years.

i. Historical and Present Land Use

The cultural landscape of the Orchard Hills North site has developed as a rural landscape over the past 100 years with constantly evolving pastoral practices and declining Cumberland Plain Woodland. Within the last 50 years Orchard Hills North has typically been associated with orchard food production, grazing farming practices with some specialisation in agricultural farming and rural residential communities.

Although food production has steadily declined over recent years, and only two lots within the site are currently used for any form of agricultural production, the site remains zoned as RU4 Primary Production Small lots. Presently, the majority of the site is utilised for residential purposes and has been substantially cleared.

ii. Topography, Geology and Soils

The topography of the rezoning area is undulating, extending across two ridges which trend in a north-easterly direction. The elevation of the rezoning area ranges between 35m at its lowest point along Claremont Creek to 85m near the western boundary (Douglas Partners, 2018).

Mapping shown on the Soil Landscapes of the Penrith 1:100 000 Sheet Map (Bannerman and Hazelton, 1990) indicates that the subject site is underlain by Luddenham, South Creek and Blacktown Soil landscapes.

The Luddenham soil landscape unit comprises the majority of the soils within the subject site, with all land west of Claremont Creek falling within the distribution of this unit. The Luddenham unit is described as an erosional soil landscape with dark podzolic soils or massive earthy clays on crests, with moderately deep red podzolic soils on upper slopes and moderately deep yellow podzolic soils and prairie soils distributed throughout the lower slopes and drainage lines (Bannerman and Hazelton, 1990). The Luddenham unit is underlain by Wianamatta Group Ashfield Shale and Bringelly Shale geological formations (Bannerman and Hazelton, 1990).

Land surrounding Claremont Creek falls within the distribution of the South Creek soil landscape unit. This unit comprises the present active floodplain of drainage networks within the Cumberland Plain (Bannerman and Hazelton, 1990). The South Creek unit is described as an alluvial soil landscape comprised of deep layered sediments over bedrock or relict soils with structured plastic clays or structured loams occurring along drainage lines with red and yellow podzolic soils commonly forming terraces (Bannerman and Hazelton, 1990). The South Creek unit is underlain by Quarternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone geological units (Bannerman and Hazelton, 1990).

A small area of the subject site in the south eastern corner falls within the distribution of the Blacktown Soil Landscape unit. The Blacktown unit is described as a residual soil landscape comprised of shallow to moderately deep hardsetting mottled texture contrast soils with red and brown podzolic soils on crests and yellow podzolic soils throughout lower slopes and drainage lines (Bannerman and Hazelton, 1990). The Blacktown unit is underlain by the

Ashfield shale, Bringelly Shale and Minchinbury Sandstone derived from the Wiannamatta group geological unit (Bannerman and Hazelton, 1990).

iii. Hydrology

The watercourses within the subject site form part of the Hawkesbury-Nepean Catchment. The two primary watercourses occurring within the subject site include Werrington Creek and Claremont Creek, occurring alongside a number of associated minor drainage lines. The headwaters of Werrington Creek are located within the south-west area of the subject site. Werrington Creek flows through the subject site for approximately 950m in a northerly direction. Werrington Creek is a tributary of Claremont Creek, with which it joins north of the subject site. The headwaters of Claremont Creek are located south of the subject site with the main body of the creek occurring as a 650m stretch through the subject site. Claremont Creek is a tributary of South Creek. Claremont Creek continues north for approximately 3km before flowing into South Creek. Twenty-four (24) farm dams are scattered throughout the subject site, with ten occurring along watercourses or drainage lines.

1.3 The Proposal

1.3.1 Vision

Orchard Hills North will be a residential community set amongst rolling hills in the rich natural landscape of Western Sydney, offering panoramic views to the Blue Mountains and surrounding areas. The development will incorporate a diverse mix of housing types across 1,800 – 2,000 residential lots, focused around a new neighbourhood centre that forms the focal point of the future community and offers a high level of convenience for residents.

The overarching vision of Orchard Hills North is to support a safe and connected community. This will be achieved through the provision of a wide variety of green spaces and links, connecting each of the future neighbourhood precincts with one another as well as the wider regional community, thereby placing a focus on active transport such as walking and cycling.

1.3.2 Design Principles

A site analysis, supported by extensive technical studies, has informed the following design principles for the Structure Plan and rezoning area:

- Retain key creek lines and capitalise on the opportunity to create a central green link;
- Retain existing significant vegetation as natural bushland;
- Manage and retain views into and out of the site;
- Provide opportunities for a diverse mix of housing types, with medium density housing located around the neighbourhood centre and major open space;

- Create a new neighbourhood centre combined with a relocated primary school to establish a community focal point;
- Respect heritage buildings and the character of the area;
- Integrate with the community to the north, west and east;
- Link O'Connell Lane, Caddens Road, Frogmore Road and The Northern Road into a meaningful urban road network;
- Improve water quality and water flow;
- Utilise landscaping and topography on the southern boundary to manage noise;
- Promote pedestrian and cycle linkages;and
- Generate employment opportunities along the Northern Road.

1.3.3 Master Plan and Rezoning Description

It is proposed to rezone the site from RU4 Primary Production Small Lots, under Penrith Local Environmental Plan (PLEP) 2010, to part R1 General Residential, B2 Local Centre, RE1 Public Recreation, E2 Environmental conservation and E4 Environmental living in the south eastern corner of the site, as well as provide for appropriate controls relating to minimum lot size, height, heritage items, and visual landscape.

The rezoning of Orchard Hills North will provide between 1,800-2,000 residential lots. It is expected that the site will ultimately provide a broad mix of housing types ranging from larger environmental living lots (2,000m²) to traditional detached residential lots (primarily 300-600m²) and smaller compact and attached housing lots (125-300m²). The proposed neighbourhood centre will provide around 6,000-8,000m² of retail space supported by cycle and pedestrian links with approximately 17.5ha of open space, bushland and riparian corridors.

A new/relocated primary school is proposed adjacent to the neighbourhood centre, supported by open space to facilitate share usage. The location of parks and open space areas have been carefully selected to enhance the existing value of the natural landscape, such as hill tops and creek lines, and to retain the significant bushland areas, in order to provide the highest level of amenity for future residents.

The site is physically and strategically suited for urban development, noting that:

- It is a discrete area formed by the boundary of an existing urban area and major road infrastructure;
- it adjoins an existing residential subdivision, and in close proximity to the hospital, Western Sydney University and the Penrith CBD;

- there are limited environmental or physical constraints that would prevent redevelopment;
- it is outside the Western Sydney Priority Growth Area and is therefore better placed to be rezoned through a developer led PP;
- upgrades are currently being undertaken to the Northern Road, which the Orchard Hills site is located east thereof, and gains access thereto. Thus, the rezoning of the land will support the Government's cost of infrastructure and will result better utilisation of the land;
- it is able to capitalise on the availability of new and existing infrastructure, such as the recently completed Werrington Arterial Road and new M4 on and off-ramps, the signalisation of the Frogmore Road/Northern Road intersection as part of The Northern Road upgrade, and four train stations within 4.5km of the site (Penrith, Kingswood, Werrington, St Marys); and

The indicative Concept Master Plan for the site is identified in **Figure 1.2.** below.

1.4 Legislative Requirements

1.4.1 *Environmental Planning and Assessment Act 1979*

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the overarching planning legislation in NSW. This act provides for the creation of planning instruments that guide land use. The EP&A Act also provides for the consideration of the environmental and biodiversity values, which is addressed in Section 5A (Significant effect on species, populations or ecological communities or their habitats) should a land use change be proposed. This includes threatened species, communities, habitat and processes as listed under the BC Act and *Fisheries Management Act 1994* (FM Act).

1.4.2 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act is the Commonwealth Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the EPBC Act as Matters of National Environmental Significance (MNES). Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES (including nationally listed threatened ecological communities and species, and listed migratory species) must be referred to the Australian Government Minister for the Environment (the Minister). The purpose of the referral is to allow a decision to be made about whether an action requires approval on a Commonwealth level. If an action is declared a "controlled action", then Commonwealth approval is required.

1.4.3 *Threatened Species Conservation Act 1995*

The TSC Act was the key piece of legislation in NSW relating to the protection and management of biodiversity and threatened species. The TSC Act aimed to protect and

encourage the recovery of threatened species, populations and communities that are listed under the Act through threat abatement and species recovery programs.

The TSC Act required consideration of whether a development (Part 4) or an activity (Part 5) is likely to significantly impact threatened species, populations, communities or their habitat. The potential impacts of any development, land use changes or activities were required to undergo an "Assessment of Significance" under Section 5A of the EP&A Act.

If the results of an Assessment of Significance indicated that a development or activity is likely to significantly affect threatened species, populations or ecological communities, the DA would have to be accompanied by a Species Impact Statement (SIS), a detailed ecological study carried out in accordance with a set of assessment requirements issued by the Chief Executive of the NSW Office of Environment and Heritage (OEH).

1.4.4 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* is the current legislation relating to biodiversity and threatened species in NSW, replacing the repealed TSC Act. Under transitional arrangements, some areas including Penrith City Council can be assessed under TSC Act methodology until 25 August 2018. However, because threatened species and communities listings under the TSC Act carry over to the BC Act, this report makes reference to BC Act throughout this document when referring to these entities.

1.4.5 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is, together with the *Water Act 2007*, the key piece of legislation for the management of water in NSW. The objectives of the WM Act are to provide for the sustainable and integrated management of the water sources of the State, and the Act itself is based on the concept of ecologically sustainable development.

Controlled activities on waterfront land in NSW are regulated by the WM Act, and require a controlled activity approval. Waterfront land is defined as the bed of any river, lake or estuary and includes any land within 40 m of the river banks, lake shore or estuary.

1.4.6 Biosecurity Act 2015

The *Biosecurity Act 2015* provides a framework for the roles of government, industries and communities regarding the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter that may have an impact on the economy, community or environment. The aim of this legislation is to promote the shared responsibility of government, industry and communities in the effective and timely management of biosecurity. This includes the management of the following:

- Economically significant pests, diseases, contaminants and other biosecurity matter for primary production industries;
- Threats to terrestrial and aquatic environments due to pests, diseases, contaminants and other biosecurity matter;

- Risks to public health and safety arising from contaminants, exotic flora and fauna and other biosecurity matters known to contribute to human health problems;
- Pests, diseases and contaminants which may have an adverse effect on community activities and infrastructure.

A key component of the legislation relevant to biodiversity is the management of negative impacts of priority weeds. This is performed by preventing, eliminating or restricting significant weeds from spreading or establishing, and implementing effective management and monitoring of widespread priority weeds.

1.5 State and Local Government Planning Instruments

1.5.1 *Penrith Local Environmental Plan 2010*

The Orchard Hills North site is located within the Penrith LGA and falls under the Penrith Local Environmental Plan 2010 (PLEP 2010). The PLEP 2010 was prepared by Council and was vetted by the State Government to ensure consistency with the EP&A Act and State Environmental Planning Policies (SEPPs) before being gazetted by the Minister for Planning and Environment.

The particular aims of the PLEP 2010 are:

- to provide the mechanism and planning framework for the management, orderly and economic development, and conservation of land in Penrith;
- to promote development that is consistent with the Council's vision for Penrith, namely, one of a sustainable and prosperous region with harmony of urban and rural qualities and with a strong commitment to healthy and safe communities and environmental protection and enhancement;
- to accommodate and support Penrith's future population growth by providing a diversity of housing types, in areas well located with regard to services, facilities and transport, that meet the current and emerging needs of Penrith's communities and safeguard residential amenity;
- to foster viable employment, transport, education, agricultural production and future investment opportunities and recreational activities that are suitable for the needs and skills of residents, the workforce and visitors, allowing Penrith to fulfil its role as a regional city in the Sydney Metropolitan Region;
- to reinforce Penrith's urban growth limits by allowing rural living opportunities where they will promote the intrinsic rural values and functions of Penrith's rural lands and the social well-being of its rural communities;
- to protect and enhance the environmental values and heritage of Penrith, including places of historical, aesthetic, architectural, natural, cultural, visual and Aboriginal significance;

- to minimise the risk to the community in areas subject to environmental hazards, particularly flooding and bushfire, by managing development in sensitive areas; and
- to ensure that development incorporates the principles of sustainable development through the delivery of balanced social, economic and environmental outcomes, and that development is designed in a way that assists in reducing and adapting to the likely impacts of climate change.



Legend





-  Subject Site
-  Study Area
-  Rezoning Area
-  Watercourse

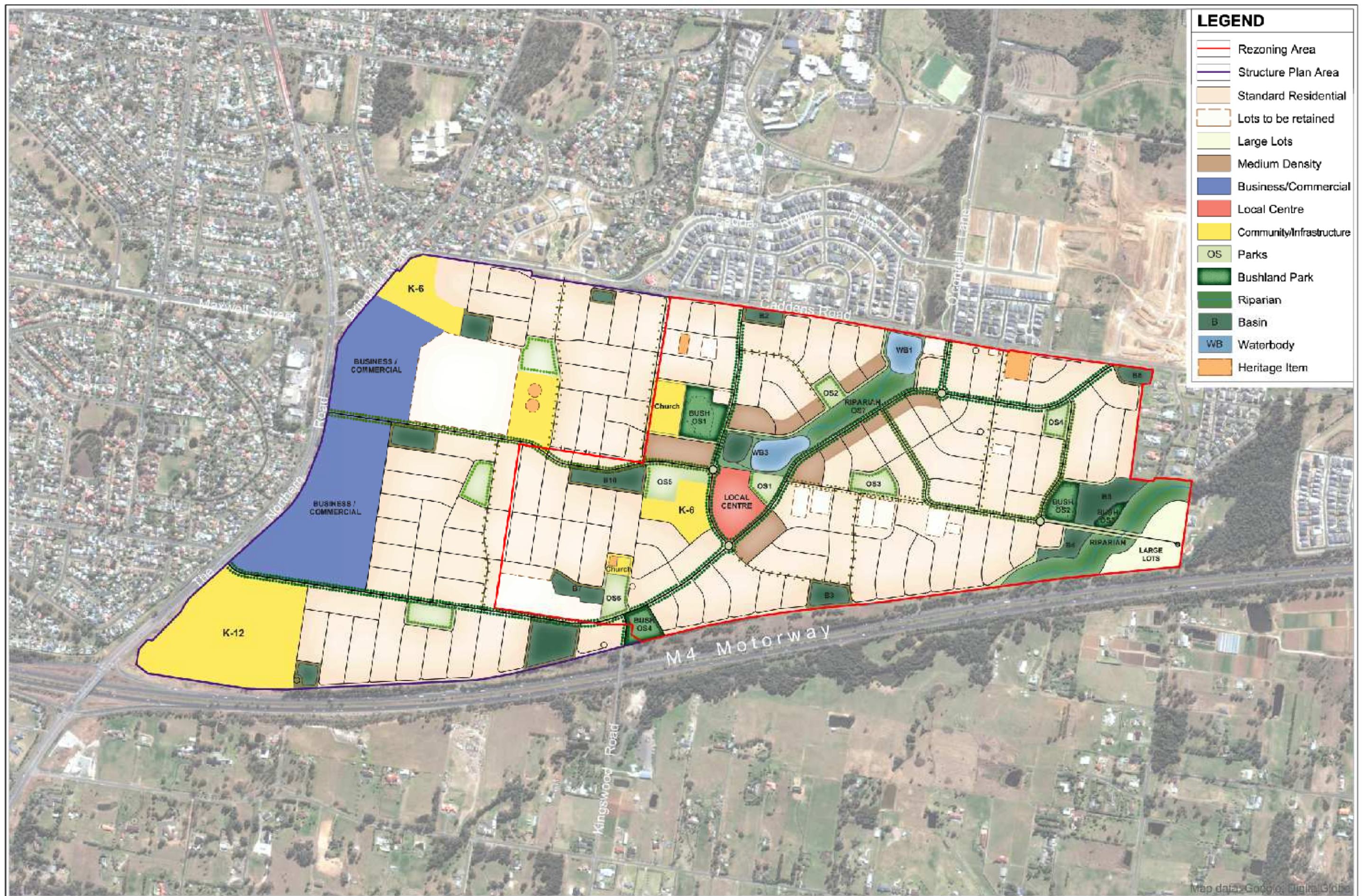
Image Source:
Image © Nearmap
(09/09/2017)

Coordinate System: MGA Zone 56 (GDA 94)



0 250 500 750 1,000 m

Figure 1.1. Location of the subject site



Indicative Layout Master Plan
ORCHARD HILLS NORTH



Scale: 1:50,000
 50 0 100 200 300 400 500 metres
 Roll: LEGON 1 013 1 Date: 07/03/2018 Revision: B
 Note: All areas and dimensions are subject to detailed survey

design PLANNING
 PO Box 1978 SYDNEY NSW 2001
 Tel: 02 9550 1978 Fax: 02 9550 1979
 Email: info@designplanning.com.au Website: www.designplanning.com.au

Figure 1.2. Orchard Hills North indicative layout master plan

Image Source: Design + Planning (2018)

Methodology

2.1 Literature Review

A review of relevant ecological literature was undertaken as part of this ecological assessment to evaluate the flora and fauna values associated with the study area. The key document reviewed for this assessment included:

- Vegetation mapping and description for the Cumberland Plain (NSW NPWS, 2002).

The information collected during the literature review guided the field surveys undertaken for this ecological assessment. Information within the literature reviewed was also utilised in determining the likelihood of threatened species occurring within the subject site and assessing the potential impacts of the proposed project.

2.2 Database Analysis

Database analysis was conducted for the locality using the Office of Environment and Heritage (OEH) BioNet Atlas search facility (OEH, 2018) and the Commonwealth Department of the Environment and Energy (DoEE) EPBC Protected Matters Search Tool (DoEE, 2018). The BioNet Atlas search facility was used to generate records of threatened flora and fauna species and populations listed under the BC Act within the locality (10 km search area) of the study area.

The Protected Matters Search Tool generated a list of potentially occurring MNES listed under the EPBC Act within the locality (10 km search area) of the study area. The lists generated from these databases were used to assist in designing surveys for threatened species considered to have potential to occur within the subject site. The abundance, distribution and age of records generated within the search area also provided supplementary information for the assessment of the likelihood of occurrence of threatened species within the subject site.

2.3 Flora Survey

Cumberland Ecology conducted flora surveys across the subject site in December 2017. The flora survey methods are described in detail in subsequent sections and included the following components:

- Vegetation mapping, to verify condition and extent of vegetation communities;
- BioBanking plots and transects, to obtain information on species composition and community structure;
- Random meander surveys and random grassland surveys to detect additional flora species not recorded during plot sampling; and
- Threatened species searches for threatened flora previously recorded from the locality.

Flora surveys were conducted in the subject site generally in accordance with standards provided in the OEH (then Department of Environment and Conservation (DEC)) Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW), 2004b), the BioBanking Assessment Methodology (BBAM) (OEH, 2014a) and the Biodiversity Assessment Method (BAM) (OEH, 2017).

2.3.1 *Vegetation Mapping*

Prior to this ecological assessment, the most recent detailed vegetation mapping project to encompass the subject site, was undertaken by the NSW National Parks and Wildlife Service (NPWS) and published as a report in 2002 (NSW NPWS, 2002), with updates to the vegetation mapping released in 2007, 2008, 2010 and 2013. This was aimed at providing a consistent, fine scale map of all vegetation communities present within the Cumberland Plain and sections of the Hornsby Plateau.

The mapping by NPWS was still at a subregional level and was not based upon site-specific flora survey data collected from the subject site. For this reason, although it provided a useful assessment, it was not at a site scale. For this reason Cumberland Ecology conducted vegetation surveys within the subject site in February 2017 and March 2018 to provide more detailed, site-specific vegetation mapping that could be used for impact assessment purposes.

Initially, the more recent NPWS vegetation mapping was utilised, to create a preliminary vegetation map and to determine potential vegetation communities likely to occur within the subject site. Subsequently, the vegetation within the subject site was ground-truthed to examine and verify the condition and extent of the different vegetation communities. Where vegetation community boundaries were found to differ from the NPWS mapping, records were made of proposed new boundaries using a hand-held Global Positioning System (GPS) and mark-up of aerial photographs.

The resultant information was synthesised using Geographical Information Systems (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the subject site. Mapping was completed using ArgGIS Arcmap Version 10.4.1 (ESRI, 2016). For areas that were not able to be directly surveyed due to the limitations of the project, an informed conclusion was made considering regional vegetation mapping and visual assessments from a distance.

2.3.2 BioBanking Plots and Transects

Six BioBanking and Biodiversity Assessment Method (BAM) plots and transects were surveyed during the flora survey period, using the field survey methodologies prescribed by the BBAM (OEH, 2014a). The locations of BioBanking/BAM plots and transects were recorded using a GPS and are shown in **Figure 2.1**. Plot locations were selected so that sampling was conducted in areas most representative of the varying condition and composition of the vegetation within the subject site.

The following data was collected at each BioBanking/BAM plot:

- Native species richness recorded within each stratum of a 20 m x 20 m plot;
- Native over-storey projected foliage cover recorded at 10 points along a 50 m transect;
- Native mid-storey projected foliage cover recorded at 10 points along a 50 m transect;
- Native groundcover projected foliage cover recorded at 10 points along a 50 m transect for three life forms (shrubs, grasses and other);
- Weed species projective foliage cover expressed as a percentage of over-storey, mid-storey and ground cover along a 50 m transect;
- The size class and number of trees with hollows where entrance width is over 5 cm and hollow is at least 1 m above ground within the 20 m x 50 m plot;
- Litter cover expressed as a percentage throughout five 1m x 1m plots spaced 10 m apart, alternating between 5 m left and right of the 50 m transect;
- The percentage of regenerating canopy species within the vegetation community; and
- The total length in metres of fallen logs over 10 cm in diameter within the 20 m x 50 m plot.

The floristic data is presented in a combined flora list in **Appendix A**.

2.3.3 Random Meander Surveys, Grassland Surveys and Threatened Species Searches

To provide extra flora data between the BioBanking survey plots, 'random meander' surveys and grassland surveys were undertaken throughout the subject site in conjunction with vegetation mapping surveys in order to maximise the number of vascular plant species recorded. Additional species not recorded during BioBanking/BAM plot sampling were noted during the random meander surveys and included in the total species list for the subject site. Grassland meander surveys were performed with particular emphasis on the detection of native derived grasslands which may meet the classification requirements of CPW under the BC/EPBC Act.

The locations of the random meander surveys are shown in **Figure 2.1**.

Targeted threatened flora surveys were undertaken across the subject site for threatened species considered to have potential to occur based on database records. These surveys were undertaken as part of the vegetation mapping ground-truthing, random meander surveys, grassland surveys and BioBanking/BAM plot surveys, and included targeted searches within suitable habitat.

2.3.4 Survey Effort

Flora survey methods and survey effort for the subject site are summarised in **Table 2.1**.

Table 2.1 Flora survey effort

Survey Method	Dates	Effort
Vegetation community mapping	11/12/2017, 12/12/2017, 22/12/2017, 7/03/2018	9 hours, two people
BioBanking plot and transect sampling	11/12/2017, 12/12/2017, 7/03/2018	7 BioBanking plots and transects
Random meander surveys	11/12/2017, 12/12/2017, 22/12/2017, 7/03/2018	9 hours, two people
Threatened species searches	11/12/2017, 12/12/2017, 22/12/2017, 7/03/2018	10 hours, two people

2.4 Fauna Survey

Cumberland Ecology conducted fauna surveys for selected species in the subject site during December 2017 and March 2018. These fauna surveys were conducted, where appropriate, in accordance with the survey guidelines provided in the OEH (then DEC) Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW), 2004a). The fauna surveys included a general fauna habitat assessment, Anabat detection, call playback, bird surveys and targeted amphibian surveys.

The fauna survey methods are described in detail in the following sections. The locations of all fauna survey sites are shown in **Figure 2.2**.

2.4.1 General Habitat Assessment

A general fauna habitat assessment of the subject site was undertaken on 6 and 7 December 2017 and 7 March 2018. The habitat assessment included consideration of important indicators of fauna habitat condition and complexity including the presence of suitable nesting, roosting and foraging habitat features suitable for threatened species and the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. Structural features considered included the nature and extent of the understorey and ground stratum and extent of canopy. The survey also included an assessment of the presence of habitat features suitable for use by threatened fauna species known from the locality. The general habitat assessment was used to guide the positioning of targeted fauna survey locations in areas of generally higher habitat value.

2.4.2 Microchiropteran Bat Surveys

Surveys for microchiropteran bats were undertaken over a period of four consecutive nights from 8-11 December 2017 using “Anabat” units to record ultrasonic bat calls. A total of six locations were surveyed at locations identified in the habitat assessment as potential fly-ways and/or roost sites for microchiropteran bat species. Locations included existing structures, habitat trees and vegetated areas near water bodies (see **Figure 2.2**). Anabat units were set to activate before dusk each evening and switch off after dawn. Ultrasonic calls collected from the Anabat units were sent to Greg Ford of ‘Balance Environmental’ for identification. Scientific naming of microchiropteran bats within this assessment follows Churchill (2009).

2.4.3 Diurnal Bird Surveys

Visual observation and call identification of diurnal birds was carried out throughout the subject site during the general habitat assessment in December 2017. Diurnal birds were identified and recorded as they were encountered throughout the subject site during the survey period.

2.4.4 Amphibian Surveys

Visual observation and call identification of amphibians was carried out throughout the subject site during the general habitat assessment and spotlighting survey in December 2017.

Targeted fauna surveys for the Green and Golden Bell Frog (*Litoria aurea*) were undertaken in December 2017 and included basking surveys and call playback/spotlighting surveys.

i. Basking Surveys

A diurnal survey for basking Green and Golden Bell Frogs was undertaken from 13-18 December 2017. Areas targeted included water bodies and areas of grassland between

water bodies which may be utilised for the Green and Golden Bell Frog as foraging habitat (**Figure 2.2**).

ii. *Call Playback/Spotlighting*

Call playback/spotlighting surveys were undertaken for the Green and Golden Bell Frog concurrently from 13-18 December 2017. Surveys were conducted after dusk, targeting water bodies and areas of grassland between water bodies which may be utilised for the Green and Golden Bell Frog for foraging. Spotlighting was performed using a hand-held spotlight to search for individuals and call playback was undertaken by playing a recorded Green and Golden Bell Frog call through a megaphone for several minutes then waiting for any individuals to call. This process was repeated several times at each call playback location identified in **Figure 2.2**.

2.4.5 Incidental Observations

Any incidental vertebrate fauna species that were observed heard calling or otherwise detected on the basis of tracks or signs were recorded and listed in the total species list for the subject site.

2.4.6 Survey Effort

Fauna survey methods and survey effort for the subject site are summarised in **Table 2.2**.

Table 2.2 Fauna survey effort

Survey Method	Dates	Effort
Habitat assessment	06/12/2017, 07/12/2017, 07/03/2018	11 hours, two people
Threatened species searches	06/12/2017, 07/12/2017, 07/03/2018	7 hours, two people
Anabat setup	08/12/2017	4 hours, two people
Green and Golden Bell Frog Basking Surveys and call playback	13/12/2017, 14/12/2017, 15/12/2017, 18/12/2017, 20/12/2017, 21/12/2017	44 hours, two people

2.5 Weather Conditions

Weather conditions throughout the 2017 and 2018 survey periods were generally very favourable for surveys. Most days were sunny and warm with some brief periods of light rain and one heavy rain/hail event on 7 December 2017. Weather conditions were favourable for plant growth and production of features required for identification of most flora species. The warm and clear conditions provided suitable conditions for fauna surveys with most species exhibiting high activity during the survey period. Conditions were particularly favourable for

targeted Green and Golden Bell Frog surveys with periods of rainfall, warm nights and low wind.

Table 2.3 Weather conditions during the survey period

Date	Survey Group	Temperature Minimum (°C)	Temperature Maximum (°C)	Rainfall (mm)
06/12/2017	Fauna	16.4	27.7	2.8
07/12/2017	Fauna	14.6	34.4	2.8
08/12/2017	Fauna	17.0	33.0	0.2
11/12/2017	Flora	15.8	34.2	0
12/12/2017	Flora	19.2	34.5	0
13/12/2017	Fauna	18.1	39.8	0
14/12/2017	Fauna	19.3	43.5	0
15/12/2017	Fauna	21.8	28.9	0
18/12/2017	Fauna	20.3	35.9	0
20/12/2017	Fauna	25.3	43.6	5.4
21/12/2017	Fauna	20.6	23.7	6.0
22/12/2017	Flora	19.3	29.4	4.6
07/03/2018	Flora/Fauna	16.3	26.5	2.0

2.6 Limitations

Vertebrate fauna and vascular flora of the locality is well known based upon a sizeable database of past records. The surveys by Cumberland Ecology in 2017 and 2018, during appropriate seasonal conditions, added to the existing database and helped to provide a clear indication of the likelihood that various species occur, or are likely to occur within the subject site. Generally, the data obtained from literature review, database assessment and current surveys of the subject site furnished an appropriate level of information to support the project assessment.

A primary limitation to the study was the short survey period of two weeks due to limited access agreements with landowners. Additionally, site access was denied throughout the survey period for the following properties:

- Lots 41 and 42 DP879632
- Lots 101 and 105 DP 825993
- Lots 40 and 35 DP811320

- Lot 43 DP881960
- Lot 5 DP239091
- Lot 1 DP583439
- Lot 8 DP857982 (partial access granted to north eastern paddocks and around the dwelling)
- Lot 1 DP118729
- Lots 1, 2, 3, 4 , 5, 6 and 7 DP 857982

Flora and fauna habitat was assessed visually from a distance with no targeted threatened species searches undertaken within these properties.

2.6.1 Flora

The weather conditions at the time of the 2017 and 2018 flora surveys were generally very favourable for plant growth and production of features required for identification of most species. Shrubs, grasses, herbs and creepers were readily identifiable in most instances. However, the species assemblage at any given time is likely to be influenced by seasonality and the current condition of the vegetation.

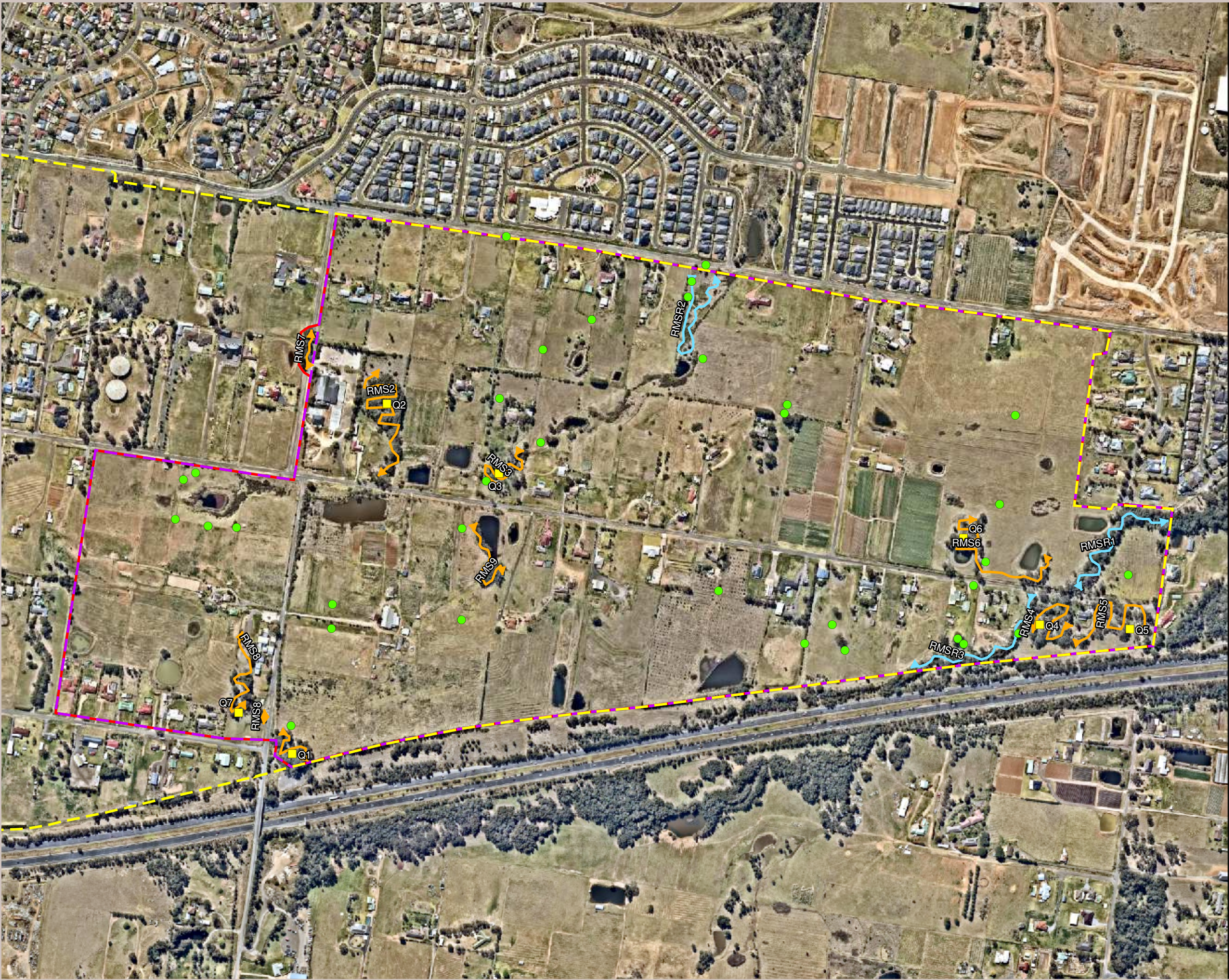
The flora surveys were intended to capture a “snapshot” of the flora species that are present at the time of survey, and it is not expected that an absolute census of the flora species would have been recorded during surveys. Despite this, given the modified nature of the subject land, it is considered that sufficient information has been collected to assess issues including conservation significance of the flora, condition and viability of bushland and likely impact on native vegetation.

2.6.2 Fauna

Limited targeted fauna surveys were undertaken for this assessment, which relied on database analysis and fauna habitat assessment. In general, opportunistic observations of fauna provide a “snapshot” of some of the fauna present on a site that were active during time of the surveys. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all vertebrate fauna species occurring within the subject site. Therefore not all fauna utilising the subject site are likely to have been recorded during surveys. An assessment of the likelihood of occurrence of threatened and migratory fauna species listed for the locality in the database searches was undertaken to supplement the fauna surveys. The combination of these techniques is considered appropriate for assessing the habitat values of the site for threatened fauna within the subject site.

In general, the opportunistic observations and targeted fauna surveys undertaken for fauna provides a good indication of the fauna likely to utilise the subject site. However, it is acknowledged that not all fauna utilising the subject site are likely to have been recorded, therefore, the data produced by the surveys is not an absolute census of all vertebrate fauna

species occurring within the subject site. An assessment of the likelihood of occurrence of threatened and migratory fauna species listed for the locality in the database searches was undertaken to supplement the fauna surveys. The combination of these techniques is considered appropriate for assessing the habitat values of the site for threatened fauna within the subject site.



Legend

Subject Site

Study Area

Rezoning Area

Survey Locations

20x20m Flora Plot

Grassland Survey Locations

Random Meander

Riparian Random Meander

Image Source:
Image © Nearmap
(09/09/2017)

Coordinate System: MGA Zone 56 (GDA 94)

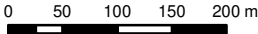
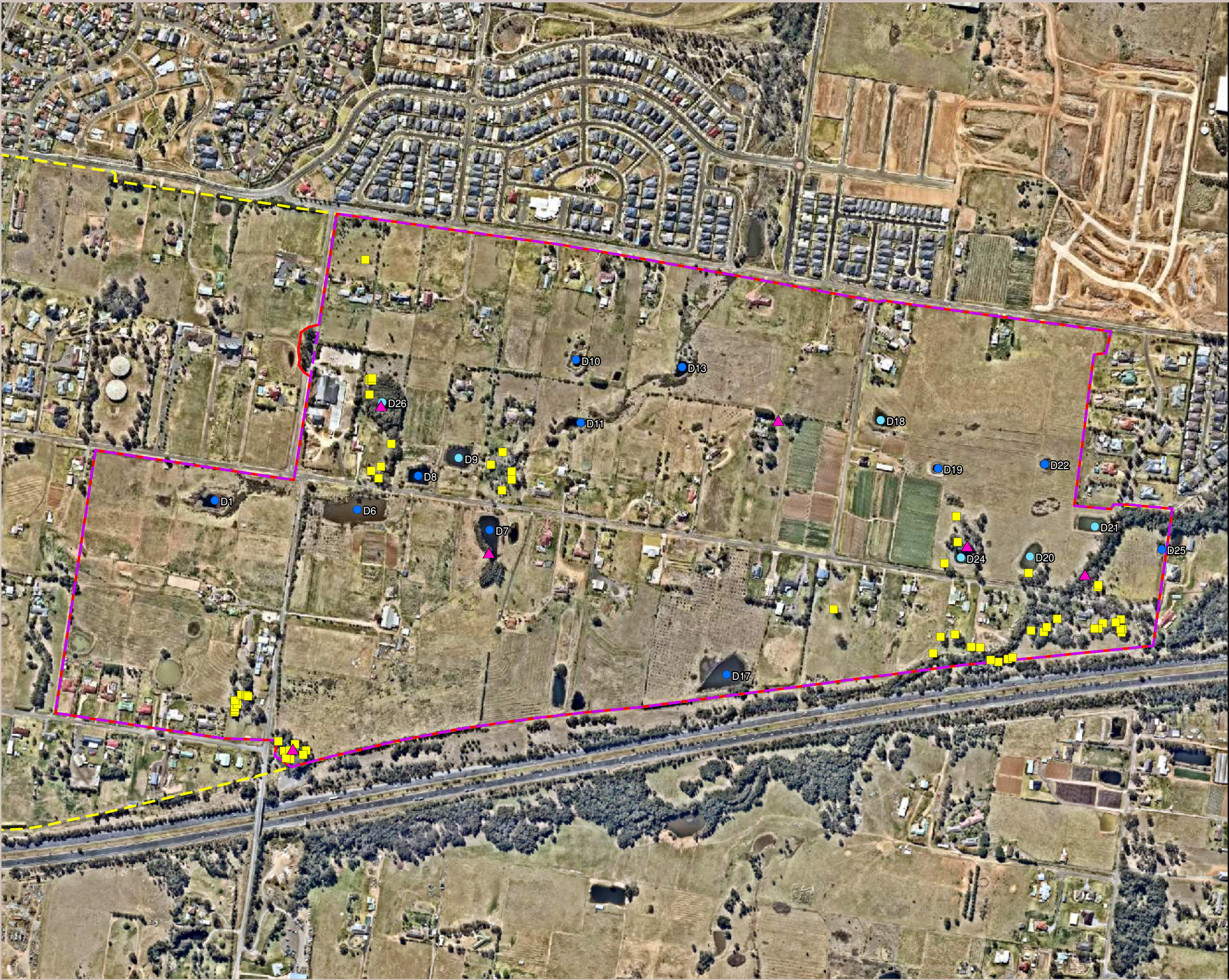


Figure 2.1. Flora survey locations within the subject site



Legend

Subject Site

Study Area

Rezoning Area

Fauna Survey Locations

▲ Anabat

■ Cumberland Plain Land Snail Search

● Dam

● Dam (GGBF Survey Performed)

Image Source:
Image © Nearmap
(09/09/2017)

Coordinate System: MGA Zone 56 (GDA 94)

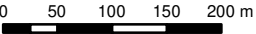


Figure 2.2. Fauna survey locations within the subject site

Results

This chapter presents the results of the flora and fauna surveys undertaken across the subject site. A number of vegetation communities have been mapped within the subject site, and descriptions of these communities are provided below, including floristic data, conservation status and extent. Additionally, a variety of flora and fauna are known to occur in the locality and a diversity of species, including some threatened species, have been identified as occurring or likely to occur within the subject site and are discussed in this chapter.

3.1 Vegetation Communities

The subject site has been highly modified, landscaped, and utilised for agriculture, and little original vegetation remains. Vegetation mapping conducted by the OEH has identified all the vegetation currently occurring in the subject site as a combination of Shale Hills Woodland, Shale Plains Woodland and Alluvial Woodland.

Table 3.1 lists the vegetation communities occurring within the subject site, their extent, and their conservation status. A total of six vegetation communities are recognised and mapped in the subject site by Cumberland Ecology (**Figure 3.1**). Two native vegetation communities occur within the subject site, including Cumberland Plain Woodland (BC/EPBC Act listed CEEC) and River-flat Eucalypt Forest (BC Act listed EEC).

Descriptions are provided below. Vegetation communities are named according to the dominant life form of plants in each community.

Table 3.1 Vegetation communities within the subject site

Vegetation Community	BC Act Status	EPBC Act Status	Total Area (ha)
Native Vegetation			
Cumberland Plain Woodland	CEEC	CEEC	2.05
River-flat Eucalypt Forest	EEC		5.09
Dam Vegetation			0.84
Exotic Vegetation			

Table 3.1 Vegetation communities within the subject site

Vegetation Community	BC Act Status	EPBC Act Status	Total Area (ha)
Urban Native/Exotic			5.46
Exotic Vegetation			3.76
Exotic Dominated Grassland			114.29
Other			
Cleared Land			14.60

BC Act / EPBC Act Status: EEC = Endangered Ecological Community, CEEC = Critically Endangered Ecological Community

3.1.1 Cumberland Plain Woodland

BC Act Status: Critically Endangered Ecological Community (EEC)

EPBC Act Status: Critically Endangered Ecological Community (CEEC)

The Cumberland Plain Woodland CPW within the subject site was compared to the EPBC listing for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (DEWHA, 2010) to determine whether it constitutes the EPBC Act threatened ecological community. The patches of vegetation within the subject site do not meet EPBC listing criteria as they do not meet minimum patch size requirements, nor do they meet native perennial understorey vegetation cover requirements. Subsequently, assessment under the EPBC Act is not required and is not referred to within this document.

i. Overall Site Description

CPW is present throughout a total of 2.05 ha of the subject site. The community presents as highly degraded and fragmented patches of vegetation and is considered to be in relatively poor condition with low potential for regeneration. The canopy species within the subject site include *Eucalyptus moluccana* (Grey Box), *Eucalyptus tereticornis* (Forest Red Gum). To a lesser extent, *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus amplifolia* (Cabbage Gum) are also present in some areas. No areas of native derived grassland were observed throughout the subject site.

The CPW throughout the subject site lacks a prominent shrub layer. All of the patches of CPW are located within or are adjacent to livestock grazing paddocks, retired orchards and exotic dominated grasslands. The CPW has evidently been highly degraded from past clearing and mowing of the groundcover and understorey. The soils in these areas have undoubtedly been modified and the native seed bank is likely to have been exhausted. As it exists, the low condition CPW has limited ecological quality and limited scope for natural regeneration. Numerous exotic shrubs are present throughout the subject site including *Olea europaea* subsp. *cuspidata* (African Olive) and *Lycium ferocissimum* (African Boxthorn), with

both species dominating the understorey of the patches of CPW associated with quadrats Q1, Q6 and Q7. The most abundant native shrub species typical of CPW occurring within the subject site is *Bursaria spinosa* (Blackthorn).

Generally, a fairly low abundance of native herbaceous species characteristic of this community was recorded within the subject site. However this varied in different areas. Ten native, sedges, rushes, forbs and grass species typical of CPW are present within the subject site, these being *Einadia hastata* (Berry Saltbush), *Dichondra repens* (Kidney Weed), *Desmodium varians* (Slender Tick-trefoil), *Glycine clandestina* (Small-leaf glycine), *Commelina cyanea*, *Cyperus gracilis* (Slender Flat-sedge), *Juncus usitatus*, *Microlaena stipoides* (Weeping Grass), *Sporobolus creber* (Slender Rat's Tail Grass) and *Themeda triandra* (Kangaroo Grass). These occur in varying compositions throughout CPW, where native species are more common in some areas and absent/low abundance in other areas. Other native species are also present within the subject site but are not listed under the CPW assemblage within the Final Determination (OEH, 2011).

Exotic species are extremely dominant in the ground layer within CPW on the subject site including species such as *Nassella neesiana* (Chilean Needle Grass), *Sida rhombifolia* (Paddy's Lucerne), *Bidens pilosa* (Cobblers Pegs), *Senecio madagascariensis* (Fireweed), *Sonchus oleraceus* (Common Sowthistle), *Plantago lanceolata* (Lamb's Tongues), *Araujia sericifera* (Moth Vine), *Rubus fruticosus* spp. agg. (Blackberry), *Asparagus asparagoides* (Bridal Creeper), *Ehrharta erecta* (Panic Veldtgrass) and *Pennisetum clandestinum* (Kikuyu Grass).

A full flora list is provided in **Appendix A**.

The vegetation within the subject site comprises species that are characteristic of CPW (listed as a critically endangered ecological community under both the BC Act and EPBC Act). All of the canopy species within the subject site are characteristic of the community and the vegetation occurs upon shale derived soils typical of the community.



Photograph 3.1 Degraded CPW within the subject site

3.1.2 River-flat Eucalypt Forest

BC Act Status: EEC

EPBC Act Status: Not listed

River-flat Eucalypt Forest (RFEF) is present throughout 5.09 ha of the subject site. The community presents as highly degraded and fragmented patches of vegetation and is considered to be in relatively poor condition. A majority of the RFEF within the subject site occurs within the riparian zone of Claremont Creek as a continuous stand of vegetation with connectivity to vegetation extending beyond the subject site. River-flat Eucalypt Forest occurs in smaller, isolated patches along Werrington Creek and throughout smaller drainage lines within the broader floodplain area, separated by areas of exotic vegetation, exotic dominated grassland and cleared areas. Within the subject site, this community is considered to be in relatively poor condition. Canopy species within the subject site include *Casuarina glauca* (Swamp Oak), *Eucalyptus amplifolia* (Cabbage Gum), *Eucalyptus moluccana* (Grey Box), *Eucalyptus tereticornis* (Forest Red Gum) and in lower abundance, *Angophora floribunda* (Rough-barked Apple).

Patches of RFEF within the subject site were either dominated by *Eucalyptus* sp. or by *Casuarina glauca*, potentially indicating the presence of two distinct vegetation types, both of which comprise the River-flat Eucalyptus Forest Endangered Ecological Community under the BC Act. Patches of vegetation dominated by *Casuarina glauca* occurred as isolated stands and throughout areas of contiguous vegetation along Werrington Creek, Claremont Creek, and small drainage lines and along the banks of dams in relatively close proximity to watercourses. *Casuarina glauca* dominated River-flat Eucalyptus forest is known to be a pioneering community, often re-establishing following clearing (OEH, 2016). Additionally,

increased abundance of the salt-tolerant *Casuarina glauca* may be a result of increased salinity due to rising water tables or drought periods (OEH, 2016). *Casuarina glauca* dominated patches of RFEF within the subject site are not considered to constitute the Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions endangered ecological community under the BC Act. Swamp Oak Floodplain Forest (SOFF) typically occurs below 20m elevation within floodplains (OEH, 2011). As the vegetation in question occurs above 20m elevation and outside of the 1:100 year flood line, the vegetation has been classified as a *Casuarina glauca* (Swamp Oak) dominated component of RFEF. Patches of vegetation dominated by *Eucalyptus* sp. occurred predominantly throughout the riparian zone of Claremont Creek and adjacent to small drainage lines throughout the subject site.

A large majority of the RFEF throughout the subject site lacks a prominent shrub layer with exception to the riparian zone of Claremont Creek, north of Castle Road where *Bursaria spinosa* (Blackthorn) is present in addition to scattered native herbaceous species. All of the patches of RFEF are located within or are adjacent to livestock grazing paddocks, retired orchards and exotic dominated grasslands. The RFEF has evidently been highly degraded from past clearing and mowing of the groundcover and understorey. The soils in these areas have undoubtedly been modified and the native seed bank is likely to have been exhausted. As it exists, the degraded RFEF has limited ecological quality and limited scope for natural regeneration. Native shrubs present throughout RFEF within the subject site include *Melaleuca styphelioides* (Prickly Paperbark), *Melaleuca decora* (White Feather Honeymyrtle), *Acacia implexa* (Hickory Wattle), and *Melia azedarach* (White Cedar). A large majority of the RFEF throughout the subject site is directly adjacent to livestock grazing paddocks, and disused orchards.. Numerous exotic shrubs are present throughout the subject site including *Olea europaea* subsp. *cuspidata* (African Olive), *Lycium ferocissimum* (African Boxthorn), *Ligustrum lucidum* (Broad-leaved Privet), *Ligustrum sinense* (Small-leaved Privet), *Opuntia stricta* (Prickly Pear), *Senna pendula* var. *glabrata* (Cassia) and *Morus nigra* (Mulberry).

Generally, a fairly low abundance of native herbaceous species characteristic of this community were recorded as present within the subject site. Four native forb and grass species typical of RFEF are present within the subject site, being *Einadia hastata* (Berry Saltbush), *Dichondra repens* (Kidney Weed), *Glycine clandestina* (Small-leaf glycine), and *Microlaena stipoides* (Weeping Grass). Other native species are also present within the subject site but are not listed under the RFEF assemblage within the Final Determination (NSW Scientific Committee, 2011).

Exotic groundcover is generally dominant within RFEF on the subject site and includes species such as *Sida rhombifolia* (Paddy's Lucerne), *Paronychia brasiliiana* (Chilean Whitlow Wort), *Pavonia hastata* (Pink Pavonia), *Hypochaeris radicata* (Catsear), *Bidens pilosa* (Cobblers Pegs), *Senecio madagascariensis* (Fireweed), *Sonchus oleraceus* (Common Sowthistle), *Plantago lanceolata* (Lamb's Tongues), *Araujia sericifera* (Moth Vine), *Rubus fruticosus* spp. agg. (Blackberry), *Asparagus asparagoides* (Bridal Creeper), *Ehrharta erecta* (Panic Veldtgrass) and *Pennisetum clandestinum* (Kikuyu Grass).

A full flora list is provided in **Appendix A**.



Photograph 3.2 Degraded RFEF within the subject site



Photograph 3.3 Low diversity *Casuarina glauca* dominated RFEF within the subject site

3.1.3 Urban Native/Exotic

BC Act Status: Not listed

EPBC Act Status: Not listed

Urban Native/Exotic Cover is present surrounding existing residential dwellings, and comprises an area of 5.46 ha throughout the subject site. Canopy and sub-canopy species within this vegetation community are predominantly planted exotic and non-endemic native

species. Exotic canopy species include *Jacaranda mimosifolia* (Jacaranda), *Ulmus parvifolia* (Chinese Elm), *Fraxinus angustifolia* (Narrow Leaved Ash) and *Acer japonicum* (Japanese Maple). Planted non-endemic natives include *Eucalyptus microcorys* (Tallowwood), *Casuarina cunninghamiana* (River Oak), *Melaleuca armillaris* (Bracelet Honey-myrtle) and *Araucaria cunninghamii* (Hoop Pine). Exotic fruiting trees are abundant throughout the subject site including *Prunus persica* (Peach), *Prunus* sp. (Plum), *Vitis vinifera* (Grape), *Ficus carica* (Common Fig) and *Olea europaea* (Common Olive).

3.1.4 Exotic Vegetation

BC Act Status: Not listed

EPBC Act Status: Not listed

Exotic vegetation is defined as non-planted, exotic vegetation present along cleared creeks and drainage lines and along property borders occurring throughout 3.76 ha of the subject site. Exotic canopy and sub-canopy species include *Olea europaea* subsp. *cuspidata* (African Olive), *Salix* sp. (Willow), *Erythrina x sykesii* (Common Coral Tree) and *Erythrina crista-galli* (Cockspur Coral Tree).

3.1.5 Exotic Dominated Grassland

BC Act Status: Not listed

EPBC Act Status: Not listed

Exotic Grassland is the most dominant vegetation type, occurring throughout 111.97 ha of the subject site. Groundcover within this community is predominantly exotic grass and consists of species including *Pennisetum clandestinum* (Kikuyu), *Paspalum dilatatum* (Paspalum), *Eragrostis curvula* (African Lovegrass) and *Nassella neesiana* (Chilean Needle Grass). Some native grasses are also present in some areas including *Eragrostis brownii* (Brown's Lovegrass), *Microlaena stipoides* (Weeping Grass), *Rytidosperma caespitosum* (Wallaby Grass), *Sporobolus creber* (Slender Rat's Tail Grass) and *Themeda triandra* (Kangaroo Grass).

Herbaceous exotic species include *Bidens pilosa* (Cobbler's Pegs), *Cirsium vulgare* (Spear Thistle), *Hypochaeris radicata* (Catsear), *Oxalis corniculata* (Creeping Oxalis) *Senecio madagascariensis* (Fireweed) and *Sida rhombifolia*. See **Appendix A** for full species list.



Photograph 3.4 Exotic dominated grassland typical of the subject site

3.1.6 Dam Vegetation

BC Act Status: Not listed

EPBC Act Status: Not listed

Dam vegetation is present surround the dams situated throughout the subject site, comprising 0.84 ha. The dominant native species include *Typha orientalis* (Cumbungi), *Juncus usitatus* (Common Rush) and *Ludwigia peploides* (Water Primrose). Prominent exotic vegetation throughout this community includes *Juncus acutus* (Spiny Rush) and *Rubus fruticosus* spp. agg. (Blackberry). A number of native aquatic species were observed within dams including *Azolla pinnata* (Mosquito fern), *Lemna disperma* (Duckweed) and *Ottelia ovalifolia* (Swamp Lily). The dam vegetation throughout the subject site does not conform to BC Act or EPBC Act listed Freshwater Wetlands community listings as the majority of dams are located below the 1:100 year flood level or are located on previously dry land.



Photograph 3.5 Farm dam lacking fringing vegetation



Photograph 3.6 Farm dam with abundant fringing vegetation

3.1.7 Cleared Land

BC Act Status: Not listed

EPBC Act Status: Not listed

The subject site includes 13.17 ha of cleared land comprised of residential dwellings, roads and all other areas absent of vegetation.

3.1.8 Other Vegetation Communities of the Study Area

Regional mapping indicates that the study area contains an additional 5.73 ha of CPW and an additional 1.16 ha of RFEF throughout scattered and isolated patches as shown in **Figure 3.4**. Whilst this gives an indication of the likely vegetation communities within this region, floristic surveys would be required to confirm the presence, extent and condition of these communities. These patches of vegetation have not been included in the impact assessment associated with this report and must be subject to further study prior to the rezoning and eventual development of this region.

3.2 Flora

3.2.1 General Species

One hundred and fifty (150) vascular plant species have been recorded within the subject site. Of these the majority were either exotic species (92) or planted native species (9) not naturally occurring in the area. The remaining species are species native to the region (49).

Twenty Nine (29) of these species are listed as priority weeds under the NSW *Biosecurity Act 2015*, and seven are also listed as a Weed of National Significance (WONS) (see **Table 3.2**). A list of plant species that were detected on subject site is provided in **Appendix A**.

Table 3.2 Priority Weeds

Scientific Name	Common Name	Status
<i>Ageratina adenophora</i>	Crofton Weed	RC
<i>Araujia sericifera</i>	Moth Vine	RC
<i>Asparagus asparagoides</i>	Bridal Creeper	SP, WONS
<i>Asparagus officinalis</i>	Asparagus	SP
<i>Asparagus virgatus</i>	Asparagus Fern	SP
<i>Cardiospermum grandiflorum</i>	Balloon Vine	RC
<i>Chrysanthemoides monilifera</i>	Bitou Bush	SP, WONS
<i>Eragrostis curvula</i>	African Lovegrass	RC
<i>Erythrina x sykesii</i>	Common Coral Tree	RC
<i>Juncus acutus</i>	Spiny Rush	RC
<i>Lactuca saligna</i>	Willow-leaved Lettuce	
<i>Ligustrum lucidum</i>	Large-leaved Privet	RC
<i>Ligustrum sinense</i>	Small-leaved Privet	RC
<i>Lycium ferocissimum</i>	African Boxthorn	SP, WONS

Table 3.2 Priority Weeds

Scientific Name	Common Name	Status
<i>Nassella neesiana</i>	Chilean Needle Grass	SP, WONS
<i>Ochna serrulata</i>	Mickey Mouse Plant	RC
<i>Olea europaea</i>	Common Olive	RC
<i>Olea europaea subsp. Cuspidata</i>	African Olive	RP
<i>Opuntia stricta</i>	Common Prickly Pear, Smooth Pest Pear	SP, WONS
<i>Phoenix canariensis</i>	Canary Island Date Palm	RC
<i>Pyracantha angustifolia</i>	Pyracantha	RC
<i>Rubus fruticosus sp. agg.</i>	Blackberry complex	SP, WONS
<i>Salix sp.</i>	Willow	SP
<i>Senecio madagascariensis</i>	Fireweed	SP, WONS
<i>Senna pendula var. glabrata</i>	Cassia	RC
<i>Solanum mauritianum</i>	Wild Tobacco	RC
<i>Syagrus romanzoffiana</i>	Cocos Palm	RC
<i>Tradescantia fluminensis</i>	Wandering Jew	RC
<i>Ulmus parvifolia</i>	Chinese Elm	RC

3.2.2 Threatened Species

i. Flora

No threatened flora species were recorded during surveys. Database analysis indicates that several threatened flora species have been recorded from the locality, however, few species are considered to have potential to occur in the subject site due to the degraded nature of suitable habitat. The following species are considered to have the greatest likelihood of occurring within the subject site:

- *Grevillea juniperina subsp. juniperina* (Juniper Leaved Grevillea); and
- *Pimelea spicata* (Spiked Rice-flower).

A discussion of this species and its likely occurrence within the subject site is provided below.

Appendix B analyses the likelihood of occurrence within the subject site for each threatened flora species recorded within the locality.

a. *Grevillea juniperina* subsp. *juniperina* (Juniper Leaved Grevillea)

Grevillea juniperina subsp. *juniperina* (Juniper Leaved Grevillea) is endemic to Western Sydney and centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outer populations at Kemps Creek and Pitt Town. It is a broadly spreading to erect shrub to 2.5 m high and grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence) which typically contain lateritic gravels (OEH, 2012). Physical disturbance of the soil appears to result in an increase in seedling recruitment.

Grevillea juniperina ssp. *juniperina* is listed as Vulnerable under the BC Act. *Grevillea juniperina* ssp. *juniperina* is well-represented across the Penrith LGA. In excess of 1000 BioNet records exist within a 10km locality of the subject site. The species was not observed during 2017 or 2018 surveys however, patches of woodland throughout the subject site may contain potential, unoccupied habitat for the species.

b. *Pimelea spicata* (Spiked Rice-flower)

Pimelea spicata (Spiked Rice-flower) is endemic to the Cumberland Plain and the Illawarra regions. It is an erect or spreading shrub, growing to approximately 50cm tall. The species is most commonly seen during summer but may be detected at any time of year, potentially linked to rainfall. The species is typically found on clay soils, associated with Grey Box communities and ironbark communities. The species is typically cryptic and difficult to detect during survey.

Pimelea spicata is listed as endangered under the BC Act and the EPBC Act. There are 19 BioNet records within a 10km locality of the subject site. The species was not observed during the 2017 or 2018 surveys, however, patches of CPW may provide potential habitat for the species and RFEF may contain potential marginal habitat for the species.

3.3 Fauna

3.3.1 Fauna Habitat

Fauna habitats of the subject site include:

- Planted areas of trees and shrubs;
- Exotic grasslands;
- Patches of native woodland vegetation;
- Dams;
- Hollow-bearing trees;
- Dwellings and other structures;

- Drainage headwalls and culverts; and
- Werrington Creek and Claremont Creek and associated riparian vegetation.

Of these habitats, exotic grasslands dominate comprising approximately 80% of the vegetation within the subject site (see **Figure 3.2**). The habitat value of the majority of the subject site is therefore quite limited for native fauna, as the exotic grasslands appear to be frequently slashed and mown.

Despite the dominance of exotic grasslands, some vegetation and the artificial wetlands of the subject site provide habitat for fauna including a limited number of threatened species. Microhabitats present within the subject site include tree hollows, water bodies, decorticated bark and ground litter (see **Table 3.3** below for details and **Figure 3.3** for locations of habitat features).

Flowering and fruiting trees and shrubs that support insects for microchiropteran bats and blossoms, fruit and nectar for flying foxes occur within the native vegetation and exotic plantings of the subject site. Amongst such trees, *Eucalyptus* sp., *Melaleuca* sp. and exotic fruiting trees provide foraging resources for flying foxes when in flower or fruit.

A limited number of mature hollow-bearing trees were observed. These trees may provide refuge and nesting opportunities for birds, bats, arboreal mammals and reptiles. Twelve trees containing hollows were identified during surveys. The majority of the hollows were small (0-10cm in diameter) or medium in size (10-15cm in diameter) and were located within *Eucalyptus* sp. trees scattered throughout the subject site. The smaller hollows may provide suitable refuge or nesting habitat for Microchiropteran bats, and smaller birds including the Red-rumped Parrot (*Psephotus haematonotus*). The medium sized hollows may provide suitable refuge or nesting habitat for arboreal mammals such as the Common Brushtail Possum (*Trichosurus vulpecular*) and medium sized birds, such as the Galah (*Eolophus roseicapillus*).

Decorticated bark and ground litter occurs throughout the patches of native and exotic planted vegetation throughout the subject site. The majority of areas containing such debris are located within the riparian zone of Claremont Creek, the isolated patches of Cumberland Plain Woodland and River-flat Eucalypt Forest vegetation and throughout the urban native/exotic vegetation surrounding dwellings. As such, this type of habitat occurs in isolated patches bound by mown grass, offering little connectivity to adjacent areas of similar habitat, other than those located along Claremont Creek.

Aquatic habitat in the subject site is present in the form of creeks, drainage lines and farm dams. The aquatic habitats present afford potential habitat for fish, reptiles, amphibians and birds. The numerous farm dams scattered throughout the subject site may offer the most suitable habitat for native fauna are located within the central to southern sections of the subject site. Claremont Creek and Werrington Creek appear to be ephemeral and did not contain flowing water or substantial pools at the time of survey and would be expected to be only utilised after times of heavy rain. Microchiropteran bats were observed foraging for food along the surface of two larger dams located along or adjacent to Werrington Creek.

The exotic dominated grasslands are relatively sterile habitats, particularly by day. However, patches of longer grass adjacent to creeks, drainage channels and farm dams provide habitat for foraging by frogs and birds.

Table 3.3 Habitat features within the subject site

Habitat ID	Habitat Type	Description of Habitat Feature
H1	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H2	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H3	Nest	<i>Citrus</i> sp. containing a finch nest.
H4	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H5	Rock Pile	Rock pile
H6	Nest	Welcome Swallow nests on side of dwelling. Adults present.
H7	Hollow-bearing Tree	<i>Salix</i> sp. bearing a single hollow.
H8	Stag	Stag with decorticated bark and potential small hollows.
H9	Nest	Fairy Martin nests on side of dwelling.
H10	Nest	<i>Eucalyptus</i> sp. with two Magpie-lark nests.
H11	Hollow-bearing Tree	<i>Eucalyptus tereticornis</i> with multiple hollows of varying sizes. Red-rumped Parrots present.
H12	Hollow-bearing Tree	<i>Casuarina</i> sp. bearing three small hollow.
H13	Nest	Fairy Martin nests on side of dwelling.
H14	Nest	<i>Eucalyptus tereticornis</i> with a small raptor or Currawong nest.
H15	Hollow-bearing Tree	Stag bearing three hollows. Red-rumped Parrots present.
H16	Hollow-bearing Tree	Stag bearing four hollows.
H17	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H18	Potential Nesting/Roosting Habitat	<i>Syagrus romanzoffiana</i> containing potential nesting habitat. Indian Mynas observed.

Table 3.3 Habitat features within the subject site

Habitat ID	Habitat Type	Description of Habitat Feature
H19	Potential Nesting/Roosting Habitat	<i>Syagrus romanzoffiana</i> containing potential nesting habitat.
H20	Potential Nesting/Roosting Habitat	<i>Syagrus romanzoffiana</i> containing potential nesting habitat.
H21	Potential Nesting/Roosting Habitat	<i>Syagrus romanzoffiana</i> containing potential nesting habitat.
H22	Potential Nesting/Roosting Habitat	<i>Syagrus romanzoffiana</i> containing potential nesting habitat.
H23	Nest	Fairy Martin nests on side of dwelling.
H24	Hollow-bearing Tree	Stag bearing a hollow and fissures/splits.
H25	Hollow-bearing Tree	<i>Eucalyptus moluccana</i> bearing a single hollow and a Magpie-lark nest.
H26	Nest	<i>Prunus</i> sp. bearing a single Finch nest.
H27	Hollow-bearing Tree	<i>Eucalyptus tereticornis</i> bearing three hollows and an Australian Magpie nest.
H28	Hollow-bearing Tree	<i>Eucalyptus tereticornis</i> bearing a single hollow and a Magpie-lark nest.
H29	Nest	<i>Eucalyptus tereticornis</i> bearing a Magpie-lark nest.
H30	Culvert	Culvert and pond.
H31	Stag	Stag with prominent decorticating bark.
H32	Hollow-bearing Tree	<i>Eucalyptus tereticornis</i> bearing a single hollow.
H33	Nest	<i>Eucalyptus moluccana</i> bearing a Noisy Miner nest.
H34	Nest	<i>Eucalyptus moluccana</i> bearing an Australian Magpie nest.
H35	Culvert	Culvert.
H36	Nest	<i>Melaleuca styphelioides</i> bearing an open cup stick nest.
H37	Stag	Stag bearing a single hollow.
H38	Hollow-bearing Tree	<i>Eucalyptus microcorys</i> bearing a single hollow.

Table 3.3 **Habitat features within the subject site**

Habitat ID	Habitat Type	Description of Habitat Feature
H39	Nest	<i>Eucalyptus moluccana</i> bearing a single stick nest.
H40	Culvert	Culvert
H41	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H42	Potential Nesting/Roosting Habitat	<i>Phoenix canariensis</i> containing potential nesting habitat.
H43	Nest	Welcome Swallow/Fairy Martin nests on side of dwelling.
H44	Nest	Welcome Swallow/Fairy Martin nests on side of dwelling.
H45	Potential Nesting/Roosting Habitat	Old shed with potential nesting habitat for Microchiropteran bats, Welcome Swallows and Fairy Martins. Indian Mynas observed
H46	Hollow-bearing Tree	<i>Casuarina glauca</i> bearing three small hollows.
H47	Hollow-bearing Tree	<i>Eucalyptus tereticornis</i> bearing a single hollow.

3.3.2 General Species

Sixty-five (65) fauna species were recorded within the subject site through incidental observations and targeted surveys, during the 2017 surveys by Cumberland Ecology. The fauna group with the highest number of individual species observed was birds (36), followed by mammals (18), amphibians (5), reptiles (4) and fish (2). **Appendix C** contains a list of all fauna species recorded within the subject site.

i. Birds

Despite the highly disturbed nature of the subject site, it supports a moderate diversity of birds. Thirty-six bird species were recorded within the subject site during surveys. The dams and creek lines within the subject site are utilised by a number of waterbirds including ducks (*Chenonetta jubata* and *Anas superciliosa*), grebes (*Tachybaptus novaehollandiae*), swamphens (*Fulica atra*, *Porphyrio porphyrio* and *Gallinula tenebrosa*) herons (*Egretta novaehollandiae*) and cormorants (*Phalacrocorax sulcirostris* and *Microcarbo melanoleucos*). Areas of open grassland adjacent to water bodies are also utilised by many of the waterbirds for foraging. Minimal nesting habitat in the form of hollow bearing-trees is present within the

subject site, therefore the majority of hollow-dependant birds recorded, such as the Red Rumped Parrot, were likely utilising the subject site for foraging purposes only. Areas containing shrubby and treed vegetation provide suitable nesting and foraging habitat for a variety of small to medium sized birds including fairy-wrens, honeyeaters and lorikeets. No threatened bird species were recorded within the subject site.

ii. Mammals

The subject site supports a low diversity of mammals, likely due to the highly modified nature of the subject site and its exposure to edge effects. The mammals recorded were mostly arboreal bats, and exotic terrestrial mammals. The feral European hare (*Lepus europaeus*) and European Rabbit (*Oryctolagus cuniculus*) were observed throughout exotic grasslands and patches of native vegetation. Kangaroos/Wallabies (*Macropus* sp.) were observed from a distance in areas of open exotic grassland adjacent to dam D7.

Twelve (12) microchiropteran bat species including the Large-eared Pied Bat (*Chalinolobus dwyeri*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Southern Myotis (*Myotis macropus*), Eastern Broad-Nosed Bat (*Scotorepens orion*), Eastern Forest Bat (*Vespadelus pumilus*), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), White-striped Free-tailed Bat (*Austronomus australis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), South-Eastern Free-tailed Bat (*Mormopterus planiceps*) and Ride's Free-tailed Bat (*Mormopterus ridei*) were recorded within the subject site. Of these, the Large-eared Pied Bat is listed as vulnerable under the BC Act and the EPBC Act whilst the Eastern False Pipistrelle, Southern Myotis, Eastern Bentwing-bat and the Eastern Freetail-bat are listed as vulnerable under the BC Act.

The habitat present in the subject site provides potential foraging habitat for microchiropteran species throughout the native canopy and over dams. Roosting habitat for microchiropteran bat species may be present as 13 trees containing suitable hollows were recorded. A majority of existing buildings that could be utilised for roosting are well maintained, lack entry points, and are therefore unlikely to be utilised. Two large sheds/barns within the subject site may be utilised by microchiropteran species as a refuge or roosting site. Small culverts and bridges are present in low numbers throughout the subject site, however, the observed culverts may periodically fill with water entirely during periods of heavy rain and may be less likely to be utilised for roosting. No Grey-headed Flying-fox (*Pteropus poliocephalus*) camp is located within the subject site and therefore this species is considered not to roost there. Due to the lack of preferred roosting habitat present for bat species recorded within the subject site, the habitat present is more likely utilised by bats for foraging purposes only as part of a broader foraging range.

Habitat within the subject site is well suited for the Red Fox (*Vulpes vulpes*) and Black Rat (*Rattus rattus*). Dense areas of weeds located along drainage lines and creeks are likely utilised by the Red Fox for refuge during the day, and open areas within the exotic grasslands provide ample foraging habitat. The Black Rat was not recorded during surveys but is likely to be widespread throughout the subject site.

iii. *Amphibians*

The subject site supports a low diversity of amphibian species, with only five species being detected through targeted surveys. The permanent water bodies comprising farm dams and creeklines within the subject site constitute suitable habitat for a number of amphibian species. Areas of open grassland adjacent to water bodies offer suitable foraging habitat for amphibians. Although a relatively large area of suitable amphibian habitat is present within the subject site, a low number of species was recorded. This is likely due to the presence of Mosquito Fish (*Gambusia holbrooki*) in all of the waterways, which is a known predator to native amphibians. The most abundant frog species recorded were the Eastern Dwarf Tree Frog (*Litoria fallax*) and Peron's Tree Frog (*Litoria peronii*) which were heard calling throughout the dams and creek lines of the subject site. No threatened amphibian species were recorded within the subject site during the field surveys.

iv. *Fish*

The subject site contains several water bodies that may provide habitat for fish species including farm dams and pools along the ephemeral creeklines. Mosquito Fish and the Long-finned Eel (*Anguilla reinhardtii*) or Short-finned Eel (*A. australis*) were the only species recorded through incidental observation. Mosquito Fish and the Long or Short-Finned Eel were found within a number of dams throughout the subject site. Mosquito Fish were observed within pools along Werrington Creek and Claremont Creek within the subject site. The Long and Short-finned Eel are commonly occurring native fish, while the Mosquito Fish is listed as a Class 3 noxious fish species in the greater Sydney region under the *Fisheries Management Act 1994*. No threatened aquatic species were recorded within the subject site and none are considered likely to occur.

v. *Reptiles*

The subject site offers moderate habitat for reptiles. Only four species of reptiles were recorded through incidental observations. These included the Tree Skink (*Egernia striolata*) and Garden Skink (*Lampropholis guichenoti*) throughout woodland areas, the Red-bellied Black Snake (*Pseudechis porphyriacus*) observed along Claremont Creek and the Eastern Long-necked Turtle (*Chelodina longicollis*) throughout farm dams.

The majority of the subject site consists of landscaped areas that lack preferred habitat features for reptiles such as fallen logs and bush rock. Nevertheless, commonly occurring reptiles including snakes, skinks and geckos are likely to persist within the subject site. No threatened reptile species were recorded within the subject site.

3.3.3 *Threatened Species*

i. *Fauna*

The following threatened species have been recorded within the subject site by Cumberland Ecology during 2017 surveys:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Southern Myotis (*Myotis macropus*);
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*); and
- Eastern Freetail-bat (*Mormopterus norfolkensis*).

Although not recorded from the subject site, the following species have been recorded from the locality and may have potential to occur in the subject site due to the presence of suitable foraging habitat:

- Powerful Owl (*Ninox strenua*);
- Cumberland Plain Land Snail (*Meridolum corneovirens*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*); and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

A discussion of these species and their likely occurrence within the subject site is provided below.

Appendix D analyses the likelihood of occurrence within the subject site for each threatened fauna species recorded within the locality.

a. Green and Golden Bell Frog

The Green and Golden Bell Frog (*Litoria aurea*) is a large frog species that is listed as Endangered under the BC Act and Vulnerable under the EPBC Act. The species is found in freshwater marshes, dams or streams with *Typha* (bullrushes) or *Eleocharis* (spike rushes), often at disturbed habitats. Favourable breeding habitat includes water bodies that are shallow, still or slow flowing, ephemeral and/or widely fluctuating, unpolluted, unshaded, with aquatic plants. Favourable breeding habitat are also free of introduced Mosquito Fish (*Gambusia holbrooki*) and other predatory fish, with adjacent terrestrial habitats that consist of grassy areas and vegetation no higher than woodlands, and a range of diurnal shelter sites (OEH, 2017f).

The Green and Golden Bell Frog was originally a common frog species of the eastern seaboard of much of NSW (Pyke and White, 2001) (DEC (NSW), 2005). However, habitat clearing and modification, introduced disease (the Chytrid fungus) and introduced fish (Mosquito Fish) have severely depleted this species. In the Sydney Basin Bioregion, it now remains as a series of highly fragmented, disparate subpopulations (DEC (NSW), 2005). The species was not detected within the subject site and the nearest BioNet records were located approximately 5km from the subject site. The subject site may contain suitable habitat for the species throughout the numerous farm dams with emergent/fringing vegetation.

b. Large-eared Pied Bat

The Large-eared pied bat is distributed Queensland to the NSW Southern Highlands region and typically occurs in areas with abundant cliffs and caves. The Large-eared Pied Bat is listed as Vulnerable under the BC Act and the EPBC Act (OEH, 2017). The species typically roosts in caves, cliffs, and mud nests of the Fairy Martin. The species inhabits dry open forest and woodlands where they forage for insects below the canopy (OEH, 2017). The species was positively identified as occurring within the subject site during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the species. Fairy Martin nests were observed along dwellings within the subject site, potentially providing roosting habitat.

c. Eastern False Pipistrelle

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is distributed along south-east coast and ranges of Australia. It inhabits moist habitats with trees taller than 20m. The species generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It preys on insects above or just below tree canopy and forages up to 12km from roost sites. The Eastern False Pipistrelle is listed as Vulnerable under the BC Act (OEH, 2014b; OEH, 2017c). The species was positively identified as occurring within the subject site during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the species. A number of Eucalypts containing small hollows and decorticating bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings throughout the subject site.

d. Southern Myotis

The Southern Myotis (*Myotis macropus*) is found from the north-west through to western Victoria along the coast. It forages over pools and streams. The Southern Myotis roosts in groups of 10-15 close to water in caves, but can also roost in mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. The species is listed as Vulnerable under the BC Act (OEH, 2017j). The species was positively identified as occurring within the subject site during 2017 surveys. The numerous farm dams within the subject site may provide foraging habitat for the species. A number of Eucalypts containing small hollows and decorticating bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings, culverts and bridges throughout the subject site.

e. Eastern Bentwing-bat

The Eastern Bentwing-bat has a large distribution throughout the east and north-west coasts of Australia. The Eastern Bentwing-bat is listed as Vulnerable under the BC Act (OEH, 2017). The species is known to roost primarily in caves but may also utilise storm-water tunnels, buildings and other urban habitats. Populations are typically centred on maternity caves during the breeding season (spring to summer) with dispersal of up to 300km at other times of the year. The species forages for insects above the canopy in wooded areas. (OEH, 2017b) The species was positively identified as occurring within the subject site during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the

species. A number of Eucalypts containing small hollows and decortivating bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings, culverts and bridges throughout the subject site.

f. Eastern Freetail-bat

The Eastern Freetail-bat (*Mormopterus norfolkensis*) is distributed along the east coast from southern QLD to southern NSW. The species inhabits dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts singly and communally, mainly in tree hollows but will also roost under decortivating bark or in man-made structures. The Eastern Freetail-bat is listed as Vulnerable under the BC Act (OEH, 2017d). The species was positively identified as occurring within the subject site during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the species. A number of Eucalypts containing small hollows and decortivating bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings throughout the subject site.

g. Greater Broad-nosed Bat

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) occurs from the Atherton Tableland to north-eastern Victoria. It is found in various habitats being most commonly found in tall wet forest. Predominantly roosts in tree hollows but also roosts in buildings. The Greater Broad-nosed Bat flies approximately 3 to 6m above creek and river corridors. The species is listed as Vulnerable under the BC Act (OEH, 2017e). The species may occur within the subject site as calls similar to the species were recorded but were not reliably identified during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the species. A number of Eucalypts containing small hollows and decortivating bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings throughout the subject site.

h. Grey-headed Flying Fox

The Grey-headed Flying-fox is distributed along the east coast from Bundaberg in Queensland to Melbourne, Victoria. It occurs as far west as the western slopes of the Great Dividing Range in northern NSW. It occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Grey-headed Flying-foxes migrate according to the availability of native fruits, nectar and pollen. They roost in large “camps” which are generally within 20km of a food source. The Grey-headed Flying-fox is listed as Vulnerable under the BC Act and the EPBC Act (OEH, 2017g). The subject site does not contain a camp ruling out suitability of the subject site for roosting habitat. The blooms of native species within CPW and RFEF and the sparsely scattered fruiting trees within the exotic vegetation of the subject would be expected to provide foraging habitat for the species. The nearest camp is located approximately 5.5km from the subject site in Emu Plains, well within the foraging range of the species.

i. Cumberland Plain Land Snail

The Cumberland Plain Land Snail is known to inhabit small areas of the Cumberland Plain, west of Sydney. The species is known to occur within approximately 100 isolated locations.

The Cumberland Plain Land Snail primarily inhabits Cumberland Plain Woodland but is also known to occur within Shale Gravel Transition Forests, Castlereagh Swamp woodlands and the margins of River-Flat Eucalypt Forest. The species typically makes refuge under plant litter, in loose soil, around grass clumps and occasional under rubbish piles. The Cumberland Plain Land Snail specialises in eating fungus unlike other common snail species (OEH, 2017a).

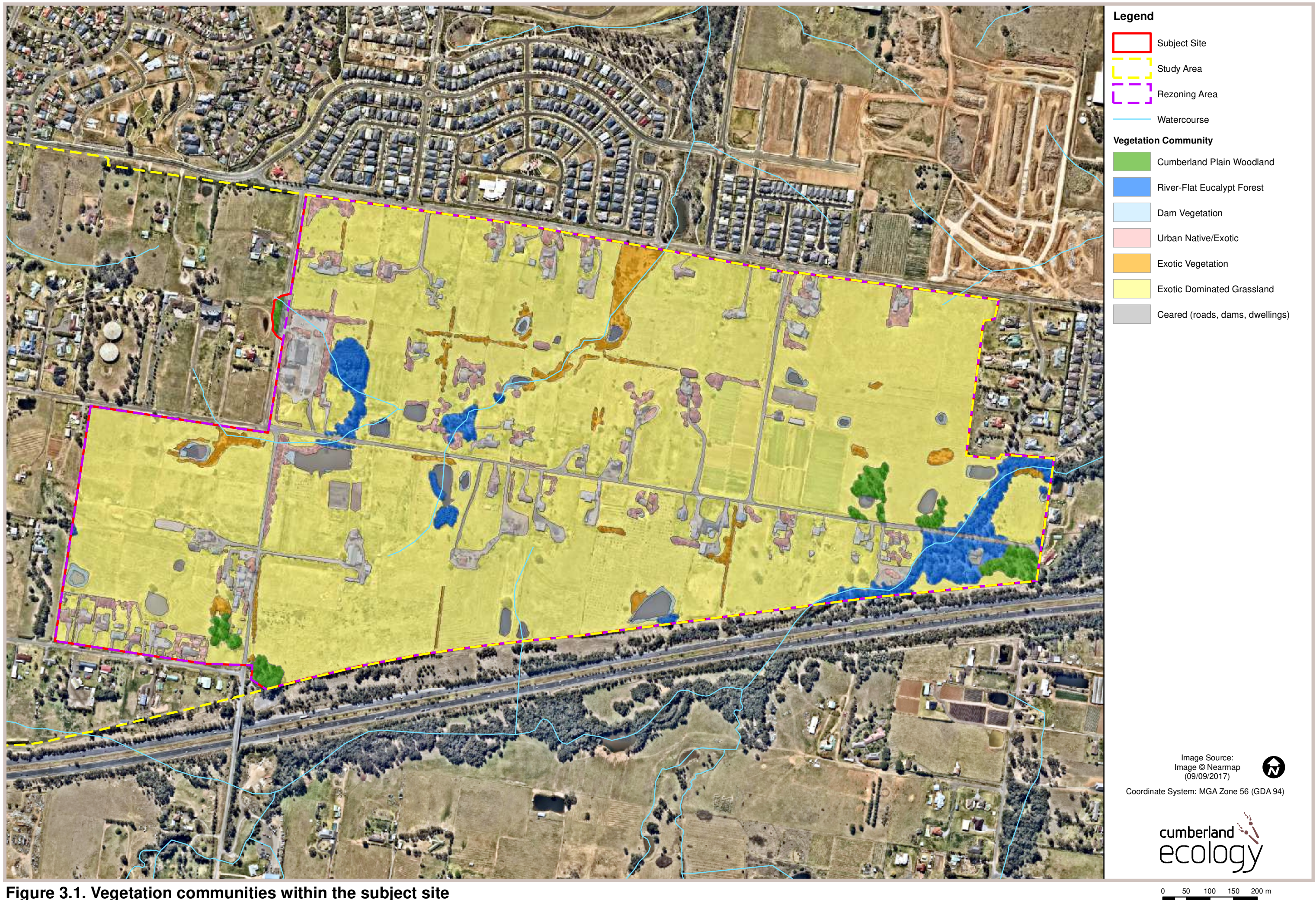


Figure 3.1. Vegetation communities within the subject site

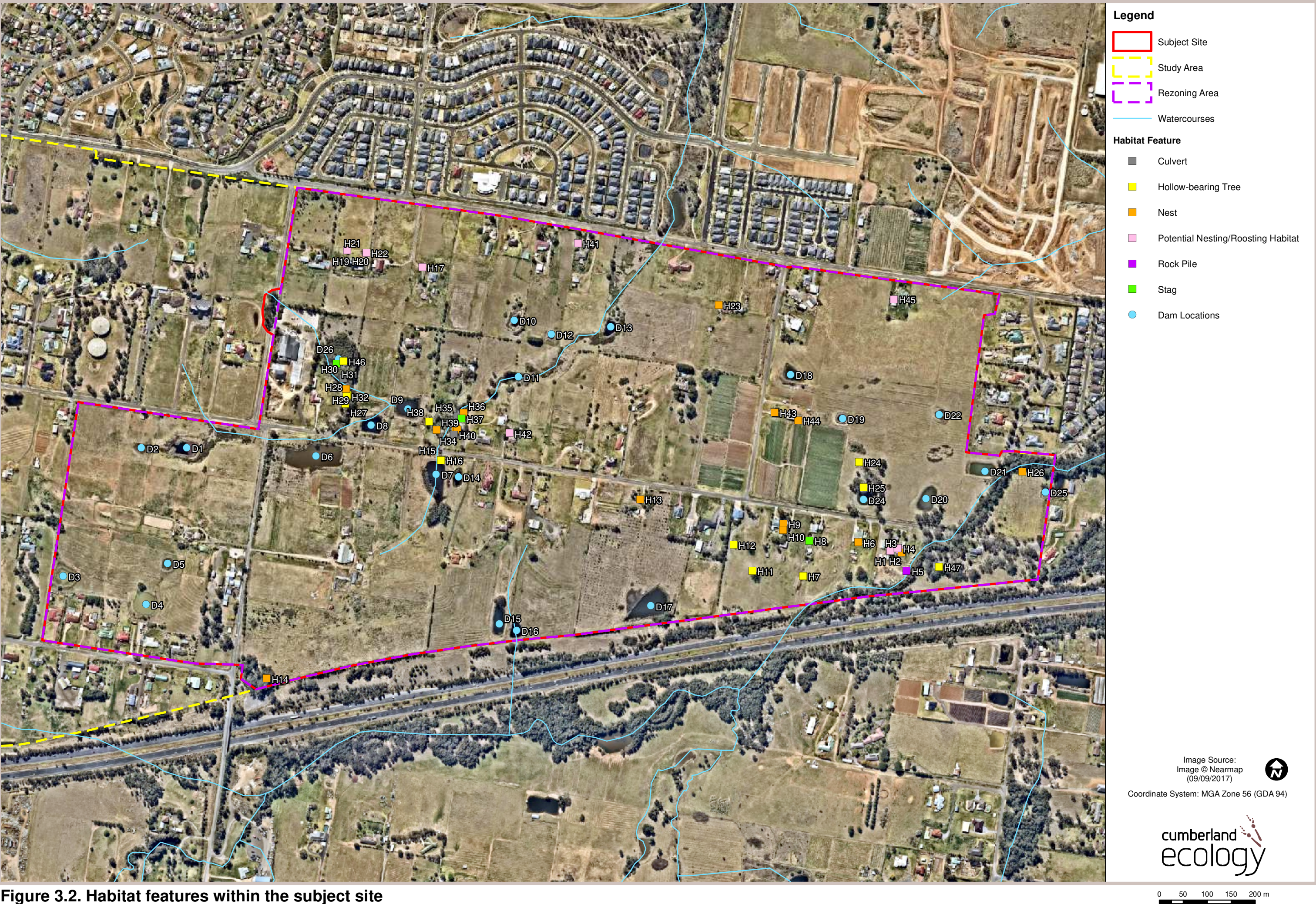


Figure 3.2. Habitat features within the subject site

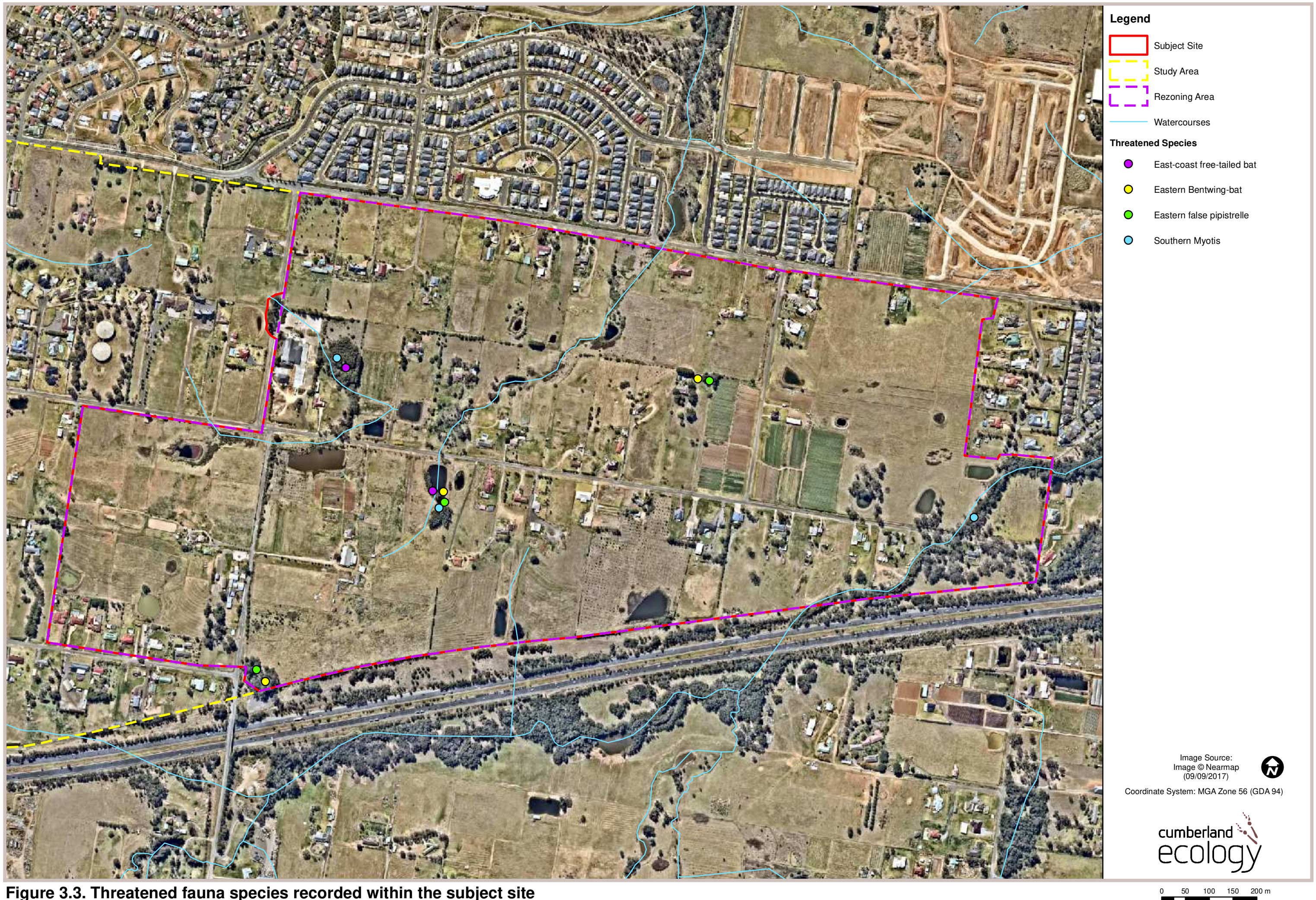


Figure 3.3. Threatened fauna species recorded within the subject site

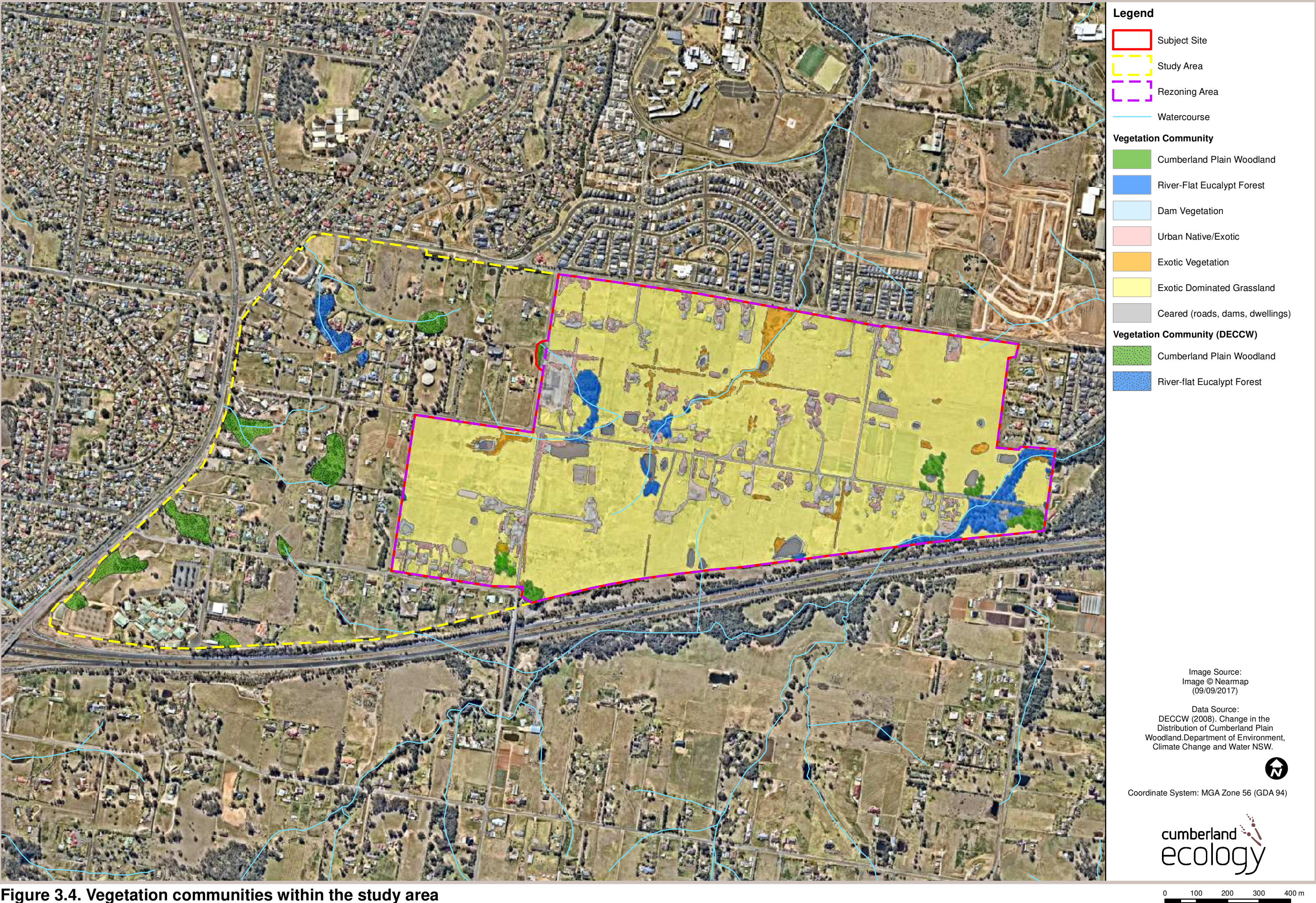


Figure 3.4. Vegetation communities within the study area

Impact Assessment

This chapter discusses the potential impacts of the proposed project on the biodiversity values of the subject site. Both direct and indirect impacts have been considered in the impact assessment, with direct impacts being primarily related to vegetation and habitat removal and indirect impacts relating to alteration to hydrological regimes and increase edge effects, resulting from such impacts. Impacts to endangered ecological communities, threatened flora and threatened fauna are also discussed within this chapter. A number of avoidance, mitigation and compensatory measures have been proposed to address the impacts of the proposed project, and are provided in **Chapter 5**.

4.1 Introduction

The total subject site is approximately 141.2 ha in area. For the purposes of this impact assessment and for the remainder of this report the term 'development footprint' includes all areas that would require clearing of vegetation and associated habitat within the subject site. The indicative development footprint, as described above, is approximately 140.69 ha and is shown in **Figure 4.1**.

4.2 Direct Impacts

4.2.1 *Vegetation Removal*

The primary direct impact of the proposed project is the removal of vegetation and associated habitats within the proposed development footprint. Although there are different types of flora and fauna habitat within the subject site such as water bodies and ground litter, the most extensive habitat to be impacted is represented by vegetation.

The total development footprint is approximately 140.69 ha in area. The majority of the vegetation within the development footprint is comprised of non-native vegetation communities including exotic grasslands (114.29 ha), exotic/native plantings (5.46 ha) and exotic vegetation (3.76 ha). Additionally, native vegetation occurring along the fringes of dams is anticipated to be cleared (0.84 ha). The proposed project will involve the clearance of approximately 1.21 ha of the BC Act listed River-flat Eucalypt Forest endangered ecological community (EEC) and approximately 0.53 ha of the BC/EPBC Act listed Cumberland Plain Woodland CEEC. It should be noted that a proportion of the area of CPW

indicated for removal may have scope for the retention of canopy and pockets of understorey within Open Space Parks.

Impacts to these TECs are discussed further within **Section 4.4**. An estimation of the areas of each vegetation community to be cleared within the development footprint is provided in **Table 4.1**. **Figure 4.1** shows the native vegetation communities within the development footprint.

The proposed project will remove approximately 5.46 ha of planted trees and shrubs within the subject site, comprised of the Urban Native/ Exotic community. Additionally, 3.76 ha of exotic vegetation, 114.29 ha of exotic grasslands and 0.84 ha of dam fringing vegetation is anticipated to be removed.

As discussed in **Section 3.1**, these communities are not considered to conform to any listed TECs under the BC Act or the EPBC Act. As a result, an assessment of significance of the impacts to this community is not required. However, the potential impacts on threatened fauna species that may occur as a result of the removal of this community in relation to its habitat value, is discussed in subsequent sections and have been considered within the assessments of significance in **Appendix E**.

Mitigation measures to address the loss of vegetation and associated habitat are addressed in **Chapter 5**.

Table 4.1 Estimation of areas of vegetation to be removed in the subject site

Vegetation Community	Current Extent (ha)	Removed Extent (ha)
Native Vegetation		
Cumberland Plain Woodland	2.05	0.53*
River-flat Eucalypt Forest	5.09	1.21
Dam Vegetation	0.84	0.84
Exotic Vegetation		
Urban Native/Exotic	5.46	5.46
Exotic Vegetation	3.76	3.76
Exotic Dominated Grassland	114.29	114.29

* Approximately 0.29 ha of this area is anticipated to be partially cleared with scope for the retention of canopy and pockets of understorey throughout an open space park.

4.2.2 Loss of Specific Habitat Features

In addition to the clearance of broad habitats, the project will include the removal of specific habitat features within the subject site. Specific fauna habitat features that will be removed by the project include:

- Blossom and fruit producing trees and shrubs suitable as forage for a range of frugivores, nectarivores and insectivores;
- Artificial water bodies that offer suitable aquatic habitat for fish, reptiles, amphibians and birds; and
- Six hollow-bearing trees suitable as shelter and breeding habitat for a range of fauna that may utilise small to medium size hollows;

The removal of these habitat features also has the potential to directly impact the fauna species utilising the habitats during the clearing process. Although some species, including diurnal species and highly mobile species may relocate during this period, there is potential for fauna to remain within the habitat features, such as hollows and water bodies. Species with a higher potential to be impacted during the clearing process include nocturnal species, less mobile species and species that are hibernating or in torpor during the clearing period. Additionally species that have smaller home ranges may not be able to relocate into non-clearing areas. There is potential for injury and mortality during the clearing process to individuals that remain within the clearing areas. If the mitigation measures outlined in **Chapter 5** are implemented, these impacts can be avoided or minimised.

Despite the project resulting in the removal of habitat and specific habitat features, areas of land containing similar habitat occurs within the study area and the broader locality. It is important to recognise that the riparian zone of Werrington Creek is proposed to be substantially replanted with species conforming to RFEF, adding to the habitat values within the locality and resulting in a net increase to the total area of woody vegetation within the subject site in the long term. Additionally, Claremont Creek is anticipated to be suitably maintained after being handed over to Penrith City Council as proposed.

It is anticipated that the types of flora and fauna species utilising the habitat within the development footprint will continue to persist within other areas of the study area and beyond where suitable habitat is present. The habitats within the south eastern portion of the subject site area are connected with similar contiguous habitats within the locality, through the M4 roadside corridor and contiguous woodland to the east of the site. The habitats within Werrington Creek and Claremont Creek are connected to similar habitats both downstream and upstream.

i. Hollow-bearing Trees

Trees containing hollows are largely absent from the subject site, and only twelve individual hollow-bearing trees were identified during surveys (see **Section 3.3.1**). The retained habitat trees include those two occurring throughout CPW and four of those occurring throughout RFEF within the subject site.

The proposed project will remove six hollow-bearing trees in total within the subject site. Mitigation measures are provided within **Chapter 5**, and include the installation of nest boxes within the study area to address the loss of potential roosting habitat.

ii. *Blossom-producing and Fruiting Trees*

A suite of native fruiting and blossom-producing trees that provide foraging opportunities for wildlife occur within the development footprint and may be cleared by the proposed project. These include *Eucalyptus* sp., *Melaleuca* sp., *Angophora* sp. and *Casuarina* sp. These trees occur mostly within the CPW and RFEF communities, of which the majority will be retained.

A suite of exotic fruiting and blossom-producing trees that provide foraging opportunities for wildlife occur within the development footprint that will be cleared by the proposed project. These include *Prunus* sp., *Ficus carica*, *Olea* sp., *Phoenix canariensis*, *Syagrus romanzoffiana* and *Morus nigra*. These trees occur mostly within the Exotic Vegetation and Urban Native/Exotic communities, which are anticipated to be completely cleared. Additional scattered exotic fruiting trees occur throughout retired orchards in areas of exotic grassland, which are anticipated to be completely cleared.

The suite of native blossom-producing trees occurring within the development footprint is also known to occur within other areas of the immediate surrounds of the study area. It is anticipated that these features will continue to provide habitat for the species utilising this habitat within the subject site. Nonetheless, the potential impact associated with the loss of these blossom-producing trees on threatened species is discussed in subsequent sections and within the Assessment of Significance section in **Appendix E**.

Mitigation measures relevant to the loss of blossom-producing trees are provided within **Chapter 5**.

iii. *Water Bodies*

Several water bodies are present within the development footprint in the form of farm dams, drainage lines and creeks. These water bodies offer suitable habitat for fish, reptiles, amphibians and birds.

The removal of these aquatic habitats will reduce potential foraging and breeding habitat for fauna species which utilise water bodies. However, numerous water bodies, wetlands and creek lines occur outside the study area and it is anticipated that these features will continue to provide habitat for the suite of species that utilise the aquatic habitats within the subject site. Additionally, the proposed project will restore riparian habitats within the subject site along Werrington Creek. Nonetheless, the potential impacts on threatened species in relation to the removal of water bodies within the subject site have been addressed within the Assessment of Significance section in **Appendix E**.

Mitigation measures relevant to the removal of water bodies are provided within **Chapter 5**.

4.3 Indirect Impacts

The proposed project may have indirect impacts on the ecological values of remaining vegetation and habitat within the study area, including edge effects, alteration to wildlife corridors, alteration to hydrological regimes and changes to weed occurrence.

Additionally, a number of construction and operational impacts, such as those relating to dust, noise, light and erosion, will also impact the remaining vegetation and habitat within the subject site. Indirect impacts relevant to the project are considered in more detail below. Whilst it is acknowledged that indirect impacts can potentially be significant for a variety of threatened species, such impacts cannot be mapped or accurately calculated in advance.

Indirect impacts may also be felt outside the study area. For mobile species with large territories, such as the Grey-headed Flying-fox, the clearance of habitat within the development footprint may potentially impact the territories further afield. Whilst not quantifiable, these impacts have been considered within the Assessments of Significance within **Appendix E**.

A range of mitigation measures will be implemented to minimise any adverse effects of the proposed project on biodiversity. These measures are considered in **Chapter 5**.

i. Weeds

Alterations to habitat conditions often favour introduced and/or hardy native plant species that can proliferate in disturbed conditions. Such species have potential to impact upon the original local native plant species. Weeds such as exotic grasses and other introduced plants have potential to outcompete regenerating native plant species.

There are 29 species of weeds listed as priority weeds, under the *NSW Biosecurity Act 2015*, currently occurring within the subject site and seven of these are also listed as a Weed of National Significance (WONS). There is a risk that seeds or other propagules from these weeds could be dispersed while the works of the proposed project is being undertaken, on vehicles or clothing of the workers involved. This could potentially be a serious threat to remaining vegetation within the study area and immediate surrounds.

If the mitigation measures outlined in **Chapter 5** are undertaken, then this impact can be minimised.

ii. Alteration to Hydrological Regimes and Flows

The general reshaping of the landform of the subject site for the proposed project have the potential to alter the hydrological flows within the site. Also, the modification of hydrology necessary for vegetation and habitat survival, such as surface water drainage patterns, through the construction of hard surfaces, can impact the retained vegetation communities and their associated habitats. In addition, some fauna habitats within the retained portions of the subject site could potentially be reliant on drainage patterns. Changes to drainage lines have the potential to affect the integrity, structure and composition of water reliant habitat and thus, have secondary impacts on the species that rely on them. The proposed project may also impact water quality which can create unfavourable conditions for native species.

iii. Fragmentation and Isolation

Fragmentation is the process where habitats that were once continuous become divided into separate fragments isolated from each other by non-forest land (Primack, 1993; Fahrig,

2003; Lindenmayer and Fischer, 2006). This process, together with habitat loss, is a major cause of biodiversity loss and a threat to native species (Rand *et al.*, 2006; Laurance *et al.*, 2007). Habitat fragmentation affects biodiversity by reducing the amount of available habitat for some species to occupy due to increased distances between habitat patches. Plants and other sessile organisms are usually directly removed, while mobile animals (especially birds and mammals) retreat into other remnant patches of habitat (Lindenmayer and Fischer, 2006). The displacement of mobile fauna can reduce the survivorship of species in the case where there are limited areas of sufficiently large habitat within dispersal distance to retreat to.

Whilst the habitats that currently exist within the subject site are highly fragmented and isolated, the project has the potential to temporarily marginally increase fragmentation within the study area throughout the removal of partial and entire patches of vegetation. However, fragmentation is likely to be a temporary impact as there is intention to establish a planted corridor consistent with RFEF along Werrington Creek, subsequently restoring connectivity to isolated patches of vegetation within the subject site, resulting in a net increase of wooded vegetation in the long term.

iv. *Edge Effects*

Edge effects are impacts that occur at the interface between natural habitats, especially forests and disturbed or developed land (Yahner, 1988). When an edge is created between woodland and a cleared area, changes to ecological processes within the vegetation can extend between 10 m and 100 m from the edge (Yahner, 1988). These include microclimatic changes in light, temperature, humidity and wind, which can favour a suite of different species and therefore cause significant changes to the ecology of the patch (Lindenmayer and Fischer, 2006). These changes include; invasion by weeds, increase in feral animals, reduction in tree health, and barriers to dispersal or distribution (Yahner, 1988). Edge effects are typically more pronounced in small habitat fragments and they may extend throughout small patches, rendering them unsuitable for some species. In particular, small patches of woodland habitat may be unfavourable for species which require interior habitat. As habitat loss progresses, the understanding of edge effects on ecological processes becomes increasingly important (Rand *et al.*, 2006).

The project will result in minor edge effects where areas of woody vegetation are cleared adjacent to retained vegetation. Due to edge effects, the impacts of the project could potentially extend beyond the clearing limits into areas of retained RFEF vegetation. Due to the highly fragmented and degraded nature of the native vegetation within the subject site, this impact is anticipated to be minor.

If the mitigation measures outlined in **Chapter 5** are undertaken, which includes the implementation of specific management plans relevant to the retained vegetation, then this impact can be minimised.

v. *Sedimentation, Erosion and Runoff*

During the construction of the proposed project the retained vegetation can be impacted by sedimentation, erosion and runoff. Filling of the development footprint to alter the height of

the development could potentially increase erosion. Sediments can smother retained vegetation if appropriate control measures are not implemented. Smothering can cause dieback of herbs and shrubs and reduce regeneration of groundcover species. Sediment and eroded material can also contain weed matter and nutrients, and movement of this material into the retained vegetation or the Claremont Creek or Werrington Creek can facilitate the spread of weeds. Increased weed invasion can result in changes to community composition and spread of weed to surrounding areas within the locality.

vi. *Construction and Operational Impacts*

A number of indirect impacts relevant to the construction and operational phases of the project have the potential to impact the ecological values of the study area, such as those relating to dust, noise, light and erosion.

A suite of mitigation measures are proposed to minimise the indirect impacts described below. These measures are discussed in **Chapter 5**.

4.4 Impacts to Threatened Ecological Communities

Two TECs occur within the subject site:

- BC Act listed 'Cumberland Plain Woodland in the Sydney Basin Bioregion' critically endangered ecological community and;
- BC Act listed 'River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions' endangered ecological community.

The patches of RFEF and CPW that are anticipated to be retained are expected to be subjected to indirect impacts associated with vegetation clearing, development activities and future use of the site as described in **Section 4.3** and shown in **Figure 4.1**.

4.4.1 *River-flat Eucalypt Forest*

The proposed project will involve the clearance of approximately 1.21 ha of the BC Act listed River-flat Eucalypt Forest endangered ecological community (EEC). This includes approximately 0.44 ha of a form of the community that is relatively low in diversity, consisting of monospecific stands of *Casuarina glauca* (Swamp Oak) with a cleared or degraded understorey. A further 0.79 ha of relatively higher quality, yet still degraded Eucalypt dominated vegetation is anticipated to be cleared. There may be some scope for the retention of individual trees within a 0.39 ha patch of RFEF vegetation throughout a patch of vegetation anticipated to be cleared along Werrington Creek, surrounding a proposed basin and water body.

The RFEF to be cleared within the subject site comprises a number of patches that are small in area, highly isolated, fragmented, degraded in nature with low species diversity. These

patches are not considered to be important for the long-term survival of the local occurrence of this community in the locality. Subsequently, the clearing of these areas is not considered to result in significant impacts to the community. Nevertheless, mitigation measures to address the loss of RFEF and associated habitat are provided in **Chapter 5**.

4.4.2 Cumberland Plain Woodland

The proposed project will is anticipated to involve small scale clearance of the BC Act listed Cumberland Plain Woodland CEEC. The total area of CPW to be directly impacted is 0.54 ha, contained within three isolated patches. Approximately 0.24 ha of CPW vegetation is anticipated to be completely cleared. This includes two small degraded patches of vegetation adjacent to Castle Road, consisting of five *Eucalyptus mollucana* with an understorey dominated by exotic grasses with scattered native grasses and herbs. These two patches comprise an area of approximately 0.11 ha. Additionally, a small patch of roadside CPW with a degraded understorey of scattered native and exotic shrubs is anticipated to be cleared, comprising an area of approximately 0.13 ha.

A 0.30 ha area of CPW to the south of Orchard Hills Public School and the adjacent Church property has been designated as an open space park, provided that the school is to be relocated elsewhere within the subject site. Vegetation within this area is anticipated to be cleared to some degree with scope for the retention of the canopy and some percentage of the sparse, shrubby understorey. At the time of writing this report, the Department of Education had not clarified their position as to whether the school is anticipated to be moved to an alternative location adjacent to the local centre. Post-gateway, when the Department of Education's position is known, further clarification regarding the impacts to this patch of vegetation may be available. If the school is to remain at its current location, it is likely that the patch of vegetation would remain in its current state.

The CPW to be cleared within the subject comprises a number of patches that are small in area, highly isolated, fragmented and degraded in nature. These patches are not considered to be important for the long-term survival of the local occurrence of this community in the locality. Subsequently, the clearing of these areas is not considered to result in significant impacts to the community. Nonetheless, mitigation measures to address the loss of CPW and associated habitat are provided in **Chapter 5**.

4.5 Impacts to Threatened Flora Species

No threatened flora species were recorded within the subject site during the time of the field survey. Additionally, few threatened flora species are considered to have the potential to occur within the development footprint due its highly modified nature. However, the proposal may result in a minor decrease in potential unoccupied habitat for *Grevillea juniperina subsp juniperina* (Juniper-leaved Grevillea) and *Pimelea spicata* (Spiked Rice-flower)

Assessments of Significance for the mentioned species is provided in **Appendix E**. Avoidance, mitigation and compensatory measures to address impacts to threatened flora are provided in **Chapter 5**, including provisions for ongoing management. *Pimelea spicata* (Spiked Rice-flower) and *Grevillea juniperina subsp juniperina* (Juniper-leaved Grevillea) are

considered unlikely to be significantly impacted by the proposed development and therefore no Species Impact Statement is required.

4.6 Impacts to Threatened Fauna Species

Five threatened fauna species have been recorded within the subject site with a further nine threatened fauna species considered to have the potential to occur. The following sections outline impacts to the threatened fauna species known within the subject site, or having high potential to occur, and the significance of these impacts.

Threatened fauna species listed under the BC Act considered to have the potential to occur within the development footprint includes one bird species, seven bat species and the Cumberland Plain Land Snail. However, of these species, only the bird and bat species are considered to have habitat within the area of the proposed development. A total of approximately 1.74 ha of potential foraging habitat for these species will be removed as a result of the proposed development. Approximately 114.29 ha of sub-optimal, modified and exotic dominated habitat will be removed. Approximately six trees bearing small hollows will be removed, resulting in a minor reduction in roosting/breeding habitat for threatened species that utilise hollows.

Assessments of Significance for the mentioned species are provided in **Appendix E**. Avoidance, mitigation and compensatory measures to address impacts to threatened fauna are provided in **Chapter 5**, including provisions for ongoing management. Groups of species that share similar habitat requirements were assessed collectively and are summarised below. All of the assessed species are considered unlikely to be significantly impacted by the proposed development and therefore no Species Impact Statement is required.

4.6.1 *Powerful Owl*

The Powerful Owl (*Ninox strenua*) is considered to have the potential to occur within the subject site as potential foraging habitat is present. The highest quality foraging habitat for the species occurs within areas of wooded vegetation, of which, 1.74 ha is anticipated to be cleared. This represents an extremely small area of habitat in the context of the available habitat of the broader locality. Although the species is known to forage in open areas, the areas of exotic grassland and non-native vegetation communities are considered as sub-optimal foraging habitat and is unlikely to contain a high number known prey of the species. Additionally, the species is highly mobile and would likely only utilise the habitat present on occasion as part of a much broader foraging range. No suitable roosting habitat is present as no large tree hollows are present. Therefore, the proposed development is unlikely to have a significant impact on this species.

4.6.2 *Grey-headed Flying Fox*

The Grey-headed Flying-fox (*Pteropus policephaus*) is considered to have the potential to utilise the development footprint for foraging purposes as part of a much broader foraging

range. As a camp is not present and only a small amount of foraging habitat is available, this species is unlikely to be reliant on the habitat present for survival and the proposed removal of vegetation as a result of the proposed development is unlikely to adversely impact this species.

4.6.3 Microchiropteran Bats (Microbats)

- Greater Broad-nosed Bat (*Scoteanax rueppellii*).
- Eastern Freetail-bat (*Mormopterus norfolkensis*).
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*);
- Southern Myotis (*Myotis macropus*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*); and
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

The Eastern Freetail-bat, Eastern Bentwing-bat, Southern Myotis, Large-eared Pied Bat and the Eastern False Pipistrelle were confirmed to occur within the subject site during 2017 surveys. The Greater Broad-nosed Bat was not detected within the subject site but is considered to have the potential to occur. Foraging habitat for each of these species is generally restricted to the CPW and RFEF canopy occurring in patches throughout the subject site, the majority of which is to be retained (1.74 ha of native woody vegetation to be cleared or partially cleared). Potential roosting habitat for the species is anticipated to be reduced as a number of hollow-bearing trees (6) and urban habitat features are anticipated to be removed during development. These species are highly mobile and the habitat within the subject site is likely a small component of a much broader range of habitat. Therefore, it is unlikely that the proposed development will have a significant impact on any of these species.

4.6.4 Cumberland Plain Land Snail

Although no individuals were recorded during targeted surveys, the Cumberland Plain Land Snail (*Meridolum corneovirens*) is considered to have the potential to occur within areas of Cumberland Plain Woodland throughout the subject site, particularly throughout the woodland in the southeast of the development footprint with connectivity to contiguous habitat outside of the subject site. The proposal is anticipated to result in the removal or modification of 1.74 ha of marginal potential habitat. The habitat in question is considered marginal due to the high degree of weed infestation and the isolated nature of the vegetation. Therefore, the proposed development is unlikely to have a significant impact on this species.

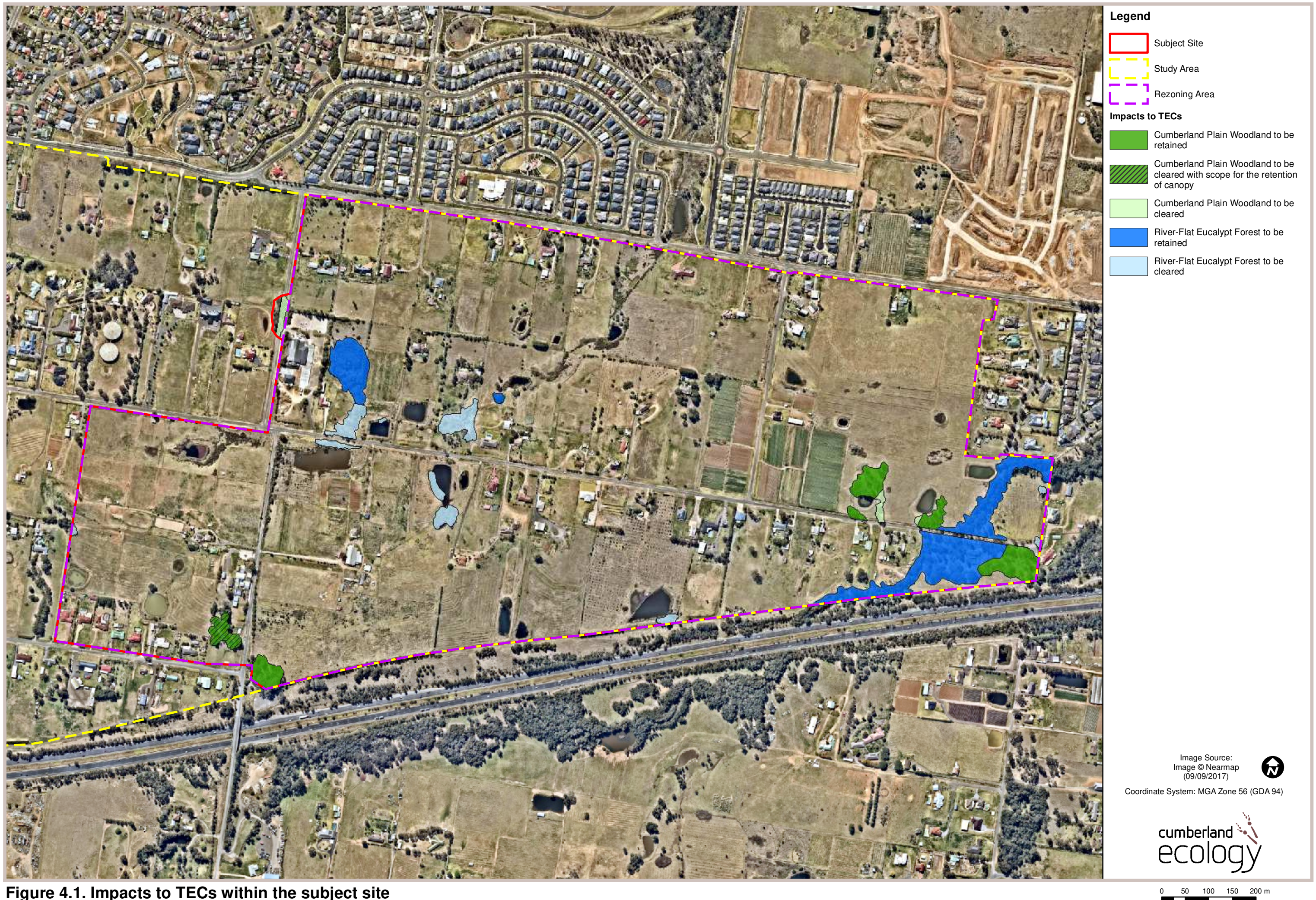


Figure 4.1. Impacts to TECs within the subject site

Avoidance, Mitigation and Compensatory Measures

This chapter presents the avoidance, mitigation and compensation measures proposed to ameliorate the impacts of the project on flora and fauna. Although the subject site is highly degraded, several threatened species are known to occur and suitable habitat is present for additional threatened species.

Mitigation measures for the project have been developed in accordance with the following principles:

- Avoid: to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- Mitigate: where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and
- Compensate: the residual impacts of the project, following the implementation of mitigation measures, should be compensated for in some way to offset what would otherwise be a net loss of habitat.

This chapter provides an assessment of how the hierarchy has been considered for the proposed project.

5.1 Avoidance Measures

Native vegetation within the subject site is composed of CPW and RFEF restricted to small isolated and degraded patches and linear corridors along creek lines. These patches and linear strips of vegetation are considered to provide the greatest habitat value for threatened species out of the available habitat within the subject site. The most ecologically significant area within the subject site exists within the south-eastern corner, along the vegetated corridor of Claremont Creek. Vegetation along the riparian corridor and east of Claremont Creek adjoins to a large patch of vegetation outside of the subject site, providing the greatest connectivity to contiguous habitat. In order to conserve the areas of greatest ecological value, the proposed project has been designed to avoid impacts to this area. Additionally, a majority of the area of CPW and RFEF throughout the subject site will be retained within parks, bushland parks and riparian corridors. Whilst a small area of RFEF and CPW is

proposed to be removed (1.21 ha and 0.53 ha respectively), this area is comprised of small, isolated patches of a degraded nature, with low management viability.

5.2 Mitigation Measures

A range of mitigation measures will be implemented for the proposed project. These measures will be implemented to minimise impacts to biodiversity values, and to provide ongoing management of native fauna species and retained and replanted vegetation, and to guide the overall management of the open space corridors and other landscape elements.

The following mitigation measures are suggested to be implemented post gateway, during the DA to minimise any adverse effects of the proposed project on biodiversity:

- Vegetation Clearance and Fauna Management Protocols;
- Weed Control Measures;
- Nest Box Installation;
- Plantings along Werrington Creek;
- Preparation of a Vegetation Management Plan addressing replanting along the Werrington Creek corridor and throughout bushland parks; and
- Preparation of a Landscape Management Plan.

In addition to these measures, inductions for contractors and visitors are recommended to address the locations of sensitive flora and fauna and outline their roles and responsibilities for the protection and/or minimisation of impacts to biodiversity values. The proposed mitigation measures are discussed in more detail below.

5.2.1 ***Vegetation Clearance and Fauna Management Protocols***

i. Delineation of Clearing Areas

To avoid unnecessary removal or damage to vegetation to be retained adjacent to proposed development areas, the clearing area should be clearly demarcated and signed where appropriate, to ensure no vegetation beyond these boundaries is removed.

Areas that require clearance should be flagged and clearly delineated by temporary fencing to ensure that no areas intended for conservation will be inadvertently cleared during the construction process. No machinery should be parked on areas beyond the temporary fencing and no access will be allowed during construction. Ancillary facilities such as stockpile sites, site compounds and construction zones should not be located beyond the limits of clearing.

ii. *Pre-clearance and Clearance Surveys – General Procedures*

Pre-clearing surveys are to be undertaken by a suitably qualified ecologist. Pre-clearing surveys should include:

- Demarcation of key habitat features as hollow-bearing trees, fallen logs and bush rock;
- Checking trees for the presence of bird nests and arboreal mammals, such as possums, gliders and bats, prior to felling;
- Animals found to be occupying trees and habitat will be safely removed before the clearing of trees and relocated into nearby woodlands; and
- Provision of a report following the completion of a pre-clearing survey, detailing the location and type of each habitat feature.

To minimise impacts to native fauna species, clearing should be undertaken in the following two-stage process under the supervision of a suitably qualified ecologist:

- The initial phase of clearing will involve clearing around identified habitat features and leaving the features overnight; and
- The second stage will involve clearing of the habitat features left overnight followed by an inspection.

An ecologist should investigate all fallen trees for the presence of hollows not detected prior to clearing. Inspections should be undertaken of these hollows for native fauna.

An ecologist should be present while clearing to rescue animals injured during the clearance operation. Provisions will be made to protect any native fauna during clearing activities by the following means:

- All persons working on the vegetation clearing will be briefed about the possible fauna present and should avoid injuring any present;
- Animals disturbed or dislodged during the clearance but not injured should be assisted to move to the adjacent bushland or other specified locations; and
- If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal (either taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanized).

iii. *Decommissioning Procedure for Dams*

The subject site contains twenty four (24) discrete farm dams. The presence of native eels and turtles has been confirmed and there is the potential for native fish to be present within the dams. It is recommended that a decommissioning procedure for these dams will be prepared during the detailed design phase of the proposed project.

The timing and method of de-watering the dams will be managed by engineers, while a qualified ecologist should be present during the process. Any displaced native aquatic fauna species will be captured and relocated to a predetermined location containing suitable alternative habitat. Any alien fauna species will be destroyed according to current standards and guidelines.

5.2.2 Weed Control Measures

In order to minimise the spread of weeds throughout the site, and spread of weeds present in the site to areas outside of the site, appropriate weed control activities will be undertaken. Prior to construction, weeds present in the construction area will be identified and controlled if necessary to prevent spread.

A wash-down station will be established and all construction vehicles entering and leaving the site will be required to be washed down to prevent weed seeds entering or leaving the site. These procedures will also assist in preventing the introduction of *Phytophthora cinnamomi*, which is a pathogen of native vegetation that is carried in contaminated soil.

5.2.3 Nest Box Installation

As discussed within the Avoidance Measures in **Section 5.1**, trees containing hollows are not abundant within the subject site. Although allowance has been made in the design for the proposed project to retain and incorporate existing hollow-bearing trees within bushland parks to reduce the impacts on habitat features, the proposed project will still involve removal of six hollow-bearing trees.

To minimise the impact on native fauna that would potentially utilise these hollows for roosting or nesting, nest boxes will be installed in areas of retained tall vegetation contained within bushland parks and riparian corridors to provide roosting or nesting habitat for birds, micro-bats and arboreal mammals. A Nest Box Management Plan will be prepared in the detailed design stage of the project, and will identify suitable locations for nest boxes and will include relevant management and monitoring objectives.

5.2.4 Other Relevant Measures

The following mitigation measures have been and/or are proposed to be undertaken within the planning process and during the construction/operational phase.

Planning-related mitigation measures include:

- Staged development which will allow fauna to relocate into adjacent vegetation without assistance by using surrounding habitat connectivity to facilitate dispersal; and
- Timing of construction works, to coincide with time of year when impacts to threatened fauna can be minimised.

General construction mitigation measures include:

- Dust management - to minimise the impacts to vegetation and habitat quality;
- Noise management - to minimise impacts to fauna species;
- Erosion and sedimentation controls - to minimise the impact to adjacent vegetation and downstream environments;
- Stormwater management, through the implementation of a stormwater management plan - to minimise impacts to adjacent vegetation and habitat, and to provide stormwater control devices that could serve as potential habitat for fauna;

General operational mitigation measures include:

- Ongoing erosion and sediment control;
- Ongoing stormwater management;
- Promotion of community awareness of biodiversity values of the retained vegetation and associated habitats; and
- Inspections to monitor effectiveness of mitigation measures and provisions for adaption as required.

Details of these construction and operational mitigation measures are to be included with any construction management plan, as well as in relevant management plans such as the storm water management plan, soil and water management plan, and sediment management plan.

5.3 Compensatory Measures

The strategic approach to offsets is anticipated to be developed post gateway. Approximately 1.74 ha of native woody vegetation communities is anticipated to be directly impacted as a result of the proposed project. This includes approximately 1.21 ha of RFEF and 0.53 ha of CPW. Clearing of native vegetation within the subject site will require offsetting. The quantum of offsets is required to be calculated using an approved metric system, such as the BioBanking Assessment Methodology (BBAM) or Biodiversity Assessment Method (BAM). It is recommended that the clearing of native vegetation communities and associated habitat be addressed through the provision of an onsite offset site along the Werrington Creek corridor in addition to the retirement of a suitable number of biodiversity credits.

It is recommended that replanting works along Werrington Creek include local indigenous species, with a composition consistent with that of RFEF. Replanting works outside of the creek corridors and other isolated patches of RFEF should be comprised of local indigenous species of a composition consistent with that of CPW. In particular, it is recommended that blossom and fruit producing species that will compensate for any loss of foraging habitat for bat species be included in planting lists. This will be detailed in a landscape management plan post gateway.

5.4 Adequacy of Mitigation and Compensation Measures

Anticipated impacts associated with the rezoning and eventual development can be managed through the provision of mitigation and compensatory measures. The proposed avoidance, mitigation and compensatory measures are likely to sufficiently ameliorate the impacts of the project to the extent that no TECs or threatened species are likely to be significantly impacted or become extinct as a result of the project.

Conclusion

Orchard Hills North is currently comprised of retired orchards, agricultural land and scattered residential dwellings. As a result of historical and recent land uses, the subject site comprises a highly modified, landscape with small and scattered remnants of native vegetation. Despite the impacts of previous disturbance and location within a fragmented landscape, the subject site does provide suitable habitat for a diversity of flora and fauna species, including threatened species and threatened ecological communities.

The rezoning and eventual development of Orchard Hills North will involve the removal of a large area (120.24 ha) of non-native vegetation communities, dominated by exotic grasslands, stands of exotic weeds and exotic plantings adjacent to dwellings.

Threatened ecological communities occurring within the subject site include the BC Act listed River-flat Eucalypt Forest (RFEF) Endangered Ecological Community and the BC Act listed Cumberland Plain Woodland (CPW) Critically Endangered Ecological Community. The occurrence of CPW within the subject site exists as a number of small, isolated and degraded patches of vegetation with limited connectivity to contiguous habitat.

A majority of the current distribution of CPW within the subject site will be retained within parks and bushland reserves with 0.53 ha anticipated to be cleared or modified. The occurrence of RFEF within the subject exists as a linear corridor along Claremont Creek in addition to small, isolated and degraded patches. Approximately 1.21 ha of RFEF is proposed to be cleared, comprising small and isolated patches of lower quality vegetation. The highest quality RFEF vegetation within the subject site will be retained along the Claremont Creek riparian corridor. Although there will direct impacts to RFEF and CPW within the subject site, the overall impact on the communities is considered to be of minor ecological significance in the context of the study area and the broader locality. The proposed revegetation of Werrington Creek is anticipated to encompass a net increase in the total area of RFEF and subsequently, wooded habitat within the subject site.

Threatened flora species were not recorded within the subject site during 2017 and 2018 surveys, with the Juniper-leaved Grevillea being the only threatened flora species considered to have potential to occur within woodland throughout the subject site. A total of five listed fauna species were detected within the subject site with a further four considered likely to occur. None of these threatened fauna species are considered to be significantly impacted by the project. A majority of the wooded vegetation providing the greatest habitat values for threatened fauna will be retained.

In recognition of the potential ecological impacts of the project, avoidance, mitigation and compensatory measures have been proposed. Avoidance measures include avoiding direct impacts to CPW vegetation and the largest and highest quality patches of RFEF. Mitigation measures proposed for the project implementation of vegetation clearance and fauna management protocols, weed control measures, nest box installation, plantings, and implementation of a landscape management plan. A suite of other mitigation measures are proposed as part of the planning, construction and operational phases of the project.

When avoidance and mitigation measures are taken into account, it is considered that there may be small scale residual impacts to the RFEF Endangered Ecological Community and the CPW Critically Endangered Ecological Community as a result of vegetation clearing. The clearing of native vegetation will be addressed through the provision of an onsite offset site along the Werrington Creek corridor in addition to the calculation and retirement of a suitable number of offset credits for the community being impacted.

Anticipated impacts associated with the rezoning and eventual development can be managed through the provision of mitigation and compensatory measures. It is recommended that the clearing of native vegetation communities and associated habitat be addressed through the provision of an onsite offset site along the Werrington Creek corridor in addition to the retirement of a suitable number of biodiversity credits. The strategic approach to offsets is anticipated to be developed post gateway. The proposed avoidance, mitigation and compensatory measures are likely to sufficiently ameliorate the impacts of the project to the extent that no TECs or threatened species are likely to become extinct as a result of the project. The strategic approach to offsets is anticipated to be developed post gateway.

All future development applications (DA) within the rezoning area will require the application of the relevant Biodiversity legislation. Part 4 DAs submitted prior to November 24 2018 are able to be assessed under the former planning provisions, as the Penrith LGA has been nominated as an interim designated area. Should DAs be lodged after this time, they will be subject to the planning and assessment provisions of the BC Act.

References

- Bannerman, S. M. and Hazelton, P. A. (1990). *Soil Landscapes of the Penrith 1:100,000 Sheet*. Soil Conservation Service of New South Wales, Sydney, NSW.
- Churchill, S. (2009). *Australian Bats*. Allen & Unwin, Crows Nest, NSW.
- DEC (NSW) (2004a). *Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities. Working Draft*. Department of Environment and Conservation (NSW), Sydney.
- DEC (NSW) (2004b). *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)*. New South Wales Department of Environment and Conservation, Hurstville, NSW.
- DEC (NSW) (2005). *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea)*. Department of Environment and Conservation (NSW), Hurstville, NSW.
- DEC (NSW) (2006). *Recovery Plan for the Large Forest Owls: Powerful Owl *Ninox strenua*; Sooty Owl *Tyto tenebricosa*; Masked Owl *Tyto novaehollandiae**. Department of Environment and Conservation (NSW), Hurstville.
- DECC (NSW) (2007). *Threatened Species Assessment Guidelines: The Assessment of Significance*. Department of Environment and Climate Change (NSW), Sydney South, NSW.
- DECCW (2011). *Approved Cumberland Plain Recovery Plan*. DECCW, Hurstville.
- DECCW (NSW) (2011). *Cumberland Plain Recovery Plan*. Department of Environment, Climate Change and Water,, Sydney.
- DEWHA (2010). *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest*. W. Department for Environment, Heritage and the Arts,, Canberra.
- Douglas Partners (2018) Report on Geotechnical Assessment, Orchard Hills, Orchard Hills North
- Fahrig, L. (2003). "Effects of habitat fragmentation on biodiversity." *Annual Review of Ecology Evolution and Systematics* **34**: 487–515.
- Laurance, W., Nascimento, H., Laurance, S., Andrade, A., Ewering, R., Harms, K., Luizao, R. and Riberio, J. (2007). "Habitat Fragmentation, Variable Edge Effects, and the Landscape Divergence Hypothesis." *PLoS ONE* **2**(10): e1017.
- Lindenmayer, D. B. and Fischer, J. (2006). *Habitat fragmentation and landscape change: An Ecological and Conservation Synthesis*. Island Press, Washington D.C.
- NSW NPWS (2002). *Native Vegetation Maps of the Cumberland Plain Western Sydney. Final Edition - DECCW 2007 Update: DECCW (2008) Change in the Distribution of Cumberland Plain Woodland*. NSW National Parks and Wildlife Service, Sydney.
- NSW Scientific Committee (2011). "River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing." from <http://www.environment.nsw.gov.au/determinations/RiverflatEucalyptForestEndSpListing.htm>.
- OEH (2011). *Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing: NSW Scientific Committee - final determination*
- OEH (2012). *Threatened Species Profile - Grevillea juniperina subsp. juniperina*. OEH.
- OEH (2014a). *BioBanking Assessment Methodology 2014*. Office of Environment and Heritage, Sydney.
- OEH (2014b). "Eastern False Pipistrelle - profile." from <http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10331>.
- OEH (2016). "Juniper-leaved Grevillea - profile ".

- OEH (2017a). *Cumberland Plain Land Snail - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017b). *Eastern Bentwing-bat - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017c). *Eastern False Pipistrelle – Profile*. NSW Office of Environment and Heritage, Hurstville.
- OEH (2017d). *Eastern Freetail-bat - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017e). *Greater Broad-nosed Bat – Profile*. NSW Office of Environment and Heritage, Hurstville.
- OEH (2017f). *Green and Golden Bell Frog - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017g). *Grey-headed Flying-fox - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017h). *Powerful Owl - profile*. Office of Environment and Heritage, Hurstville.
- OEH (2017i). *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions - Profile*. NSW Office of the Environment and Heritage, Hurstville.
- OEH (2017j). *Southern Myotis - Profile*. NSW Office of the Environment and Heritage, Hurstville.
- Primack, R. B. (1993). *Essentials of Conservation Biology*. Sinauer Associates Inc, Sunderland.
- Pyke, G. H. and White, A. W. (2001). "A review of the biology of the Green and Golden Bell Frog *Litoria aurea*." *Australian Zoologist* **31**(4): 563-598.
- Rand, T. A., Tylianakis, J. M. and Tscarntke, T. (2006). "Spillover edge effects: the dispersal of agriculturally subsidized natural enemies into adjacent natural habitats." *Ecology Letters* **9**: 603-614.
- TSSC (2014). "Approved Conservation Advice for *Litoria aurea* (green and golden bell frog)." s266B of the *Environment Protection and Biodiversity Conservation Act 1999*, from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1870.
- Yahner, R. H. (1988). "Changes in wildlife communities near edges." *Conservation Biology* **2**: 333-339.

Appendix A

Flora Species List

Table A.1 Flora Species List

Species Name	Common Name	Exotic	Q1	Q2	Q3	Q4	Q5	Q6	Q7	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8	RMS9	RMSR1
Canopy																			
<i>Acer buergerianum</i>	Trident Maple	*																	
<i>Angophora floribunda</i>	Rough-barked Apple															X			
<i>Araucaria cunninghamii</i>	Hoop Pine	P																	
<i>Casuarina cunninghamiana</i>	River She-oak	P																	
<i>Casuarina glauca</i>	Swamp Oak		X	X							X							X	X
<i>Corymbia maculata</i>	Spotted Gum																		
<i>Erythrina x sykesii</i>	Common Coral Tree	*																	
<i>Eucalyptus amplifolia</i>	Cabbage Gum		X	X	X	X			X		X	X	X					X	X
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark						X			X									
<i>Eucalyptus microcorys</i>	Tallowood	P																	
<i>Eucalyptus moluccana</i>	Grey Box		X		X			X	X	X		X			X	X	X		X
<i>Eucalyptus tereticornis</i>	Forest Red Gum		X			X	X		X	X			X	X		X	X		X
<i>Jacaranda mimosifolia</i>	Jacaranda	*																	
<i>Populus</i> sp.	Poplar	*																	
Sub-canopy																			
<i>Angophora floribunda</i>	Rough-barked Apple			X							X								
<i>Casuarina glauca</i>	Swamp Oak		X								X	X						X	X
<i>Erythrina crista-galli</i>	Cockspur Coral Tree																		
<i>Eucalyptus amplifolia</i>	Cabbage Gum		X		X	X			X				X						X
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark									X					X				
<i>Eucalyptus moluccana</i>	Grey Box				X			X							X				

Table A.1 Flora Species List

Species Name	Common Name	Exotic	Q1	Q2	Q3	Q4	Q5	Q6	Q7	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8	RMS9	RMSR1
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree				X														
<i>Melia azedarach</i>	White Cedar		X																X
<i>Morus alba</i>	White Mulberry	*																X	
<i>Morus nigra</i>	Black Mulberry	*																	
<i>Olea europaea</i>	Common Olive	*							X									X	
<i>Olea europaea</i> subsp. <i>Cuspidata</i>	African Olive	*	X	X	X					X	X	X				X	X		X
<i>Opuntia stricta</i>	Common Prickly Pear, Smooth Pest Pear	*																	
<i>Phoenix canariensis</i>	Canary Island Date Palm	*								X									
<i>Prunus persica</i>	Peach	*								X									
<i>Pyracantha</i> sp.	Pyracantha	*																X	
<i>Senna pendula</i> var. <i>glabrata</i>	Cassia	*								X									
<i>Solanum mauritianum</i>	Wild Tobacco	*																X	
<i>Syagrus romanzoffiana</i>	Cocos Palm	*				X							X						
<i>Toxicodendron succedaneum</i>	Rhus Tree								X										
<i>Triadica sebifera</i>	Chinese Tallowood	*																X	
Dicots																			
<i>Ageratina adenophora</i>	Crofton Weed	*	X									X							X
<i>Amyema pendula</i>					X				X										
<i>Amyema</i> sp.	Mistletoe		X																X
<i>Asparagus officinalis</i>	Asparagus								X								X		
<i>Asphodelus fistulosus</i>	Onion Weed	*											X						
<i>Atriplex canescens</i>		*	X									X							X

Table A.1 Flora Species List

Species Name	Common Name	Exotic	Q1	Q2	Q3	Q4	Q5	Q6	Q7	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8	RMS9	RMSR1
<i>Commelina cyanea</i>	Native Wandering Jew								X										
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	*				X			X				X				X	X	
<i>Conyza sumatrensis</i>	Tall fleabane	*	X									X				X		X	X
<i>Cyclospermum leptophyllum</i>	Slender Celery	*	X													X			X
<i>Dianella caerulea</i>	Blue Flax-lily	P	X																X
<i>Dichondra repens</i>	Kidney Weed		X			X	X		X	X			X	X		X	X		X
<i>Einadia hastata</i>	Berry Saltbush		X			X	X	X					X	X	X				X
<i>Einadia nutans</i>	Climbing Saltbush								X									X	
<i>Einadia trigonos</i>	Fishweed																	X	
<i>Foeniculum vulgare</i>	Fennel	*	X												X	X	X	X	X
<i>Galium leptogonium</i>							X												
<i>Gamochaeta purpurea</i>	Purple Cudweed	*										X							
<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	*	X		X													X	X
<i>Hypericum gramineum</i>	Small St. Johns Wort																		
<i>Hypochaeris microcephala</i>	White Flatweed	*														X			
<i>Hypochaeris radicata</i>	Catsear	*	X		X				X			X					X		X
<i>Lactuca saligna</i>	Willow-leaved Lettuce	*																X	
<i>Ligustrum lucidum</i>	Large-leaved Privet	*	X																X
<i>Ligustrum sinense</i>	Small-leaved Privet	*	X																X
<i>Linum trigynum</i>	French Flax	*																	
<i>Ludwigia peploides</i>	Water Primrose																		
<i>Lycium ferocissimum</i>	African Boxthorn	*																X	
<i>Lysimachia arvensis</i>	Scarlet Pimpernel	*				X	X												
<i>Modiola caroliniana</i>	Red-flowered Mallow	*				X	X					X	X	X				X	

Table A.1 Flora Species List

[illegible]

Table A.1 Flora Species List

Species Name	Common Name	Exotic	Q1	Q2	Q3	Q4	Q5	Q6	Q7	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8	RMS9	RMSR1
<i>Dichelachne micrantha</i>	Shorthair Plumegrass								X										
<i>Ehrharta erecta</i>	Panic Veldtgrass	*	X	X		X					X		X						X
<i>Eragrostis brownii</i>	Brown's Lovegrass							X											
<i>Eragrostis curvula</i>	African Lovegrass	*						X	X						X	X	X		
<i>Lolium perenne</i>	Perennial Ryegrass	*	X												X				X
<i>Microlaena stipoides</i>	Weeping Grass					X	X		X	X			X	X			X		
<i>Nassella neesiana</i>	Chilean Needle Grass	*	X	X		X	X	X			X	X	X	X	X				X
<i>Paspalum dilatatum</i>	Paspalum	*				X	X	X	X					X	X		X	X	
<i>Paspalum distichum</i>	Water Couch																		
<i>Rytidosperma caespitosum</i>	Wallaby Grass						X							X					
<i>Sporobolus africanus</i>	Parramatta Grass	*				X	X							X					
<i>Sporobolus creber</i>	Slender Rat's Tail Grass		X				X	X						X	X				X
<i>Stenotaphrum secundatum</i>	Buffalo Grass	*																	
<i>Themeda triandra</i>	Kangaroo Grass						X						X	X		X			
Monocots (others)																			
<i>Asparagus asparagoides</i>	Bridal Creeper	*	X		X														X
<i>Asparagus officinais</i>	Asparagus	*																	
<i>Asparagus virgatus</i>	Asparagus Fern	*																	
<i>Commelina cyanea</i>																			
<i>Cyperus brevifolius</i>		*																X	
<i>Cyperus eragrostis</i>	Umbrella sedge	*																	
<i>Cyperus gracilis</i>	Slender Flat-sedge					X	X		X			X	X	X			X		
<i>Dianella caerulea</i>	Blue Flax-lily											X							



RMS (riparian) columns are RMSR1, RMSR2 and RMSR3.

Grassland surveys are "Grass" and incidental is "Inc."

Appendix B

Threatened Flora Likelihood of Occurrence

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	<i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E		431	Found in open shale woodland in vine thickets.	Low likelihood of occurrence. Suitable habitat occurs within the subject site in the form of open shale woodland, however vine thickets were not observed. Species recorded in locality.
<i>Allocasuarina glareicola</i>		E	E	4	Grows in Castlereagh woodland on lateritic soil with <i>Eucalyptus parramattensis</i> , <i>Eucalyptus fibrosa</i> , <i>Angophora bakeri</i> , <i>Eucalyptus sclerophylla</i> and <i>Melaleuca decora</i> . Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Unlikely to occur. No suitable habitat as the subject site does not occur within the NW Cumberland Plain and does not contain Castlereagh Woodland or lateritic soils.
<i>Tetratheca glandulosa</i>		V		1	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone. Occupies ridgetops, upper-slopes and to a lesser extent mid-slope	Unlikely to occur. Shale-sandstone transition habitat not present within the subject site.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					sandstone benches. Occurs in open woodland, woodland and open forest.	
<i>Dillwynia tenuifolia</i>		V		432	Locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Unlikely to occur. No suitable habitat present as the subject site does not contain Castlereagh Ironbark Forest, Shale Gravel Transition Forest or Castlereagh Scribbly Gum Woodland communities or scrubby/dry heath vegetation types.
<i>Pultenaea glabra</i>	Smooth Bush-pea	V	V	0	The species occurs in discrete populations within swamp margins, hillslopes, gullies and along creeks within dry sclerophyll forest and tall damp heath in sandstone areas. Within NSW the species is only known to occur in the higher areas of the Blue Mountains.	Unlikely to occur. No suitable habitat present as the subject site is not situated in the higher areas of the Blue Mountains. Additionally, no swamps, hill slopes, gullies or creeks within dry sclerophyll forest occur within the subject site. Species not recorded in locality.
<i>Pultenaea parviflora</i>		E	V	559	Endemic to the Cumberland Plain. Core distribution is from Windsor	Unlikely to occur. No suitable habitat as the subject site does not contain

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					to Penrith and east to Dean Park. Found in scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays and in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	scrubby/dry heath areas, Castlereagh Ironbark Forest or Shale Gravel Transition Forest, or areas adjoining Castlereagh Scribbly Gum Woodland. Species recorded in locality.
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	12	Found in heath and woodland on sandy soils. Prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include <i>Corymbia maculata</i> (Red Bloodwood), <i>Eucalyptus haemastoma</i> (Scribbly Gum), <i>Eucalyptus parramattensis</i> (Parramatta Red Gum), <i>Banksia serrata</i> (Saw Banksia) and	Unlikely to occur. No suitable habitat present as the subject site does not contain sandy soils or associated overstorey species.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					<i>Angophora bakeri</i> (Narrow-leaved Apple).	
<i>Acacia pubescens</i>	Downy Wattle	V	V	7	Occurs on alluviums, shales and at the intergrade between shales and sandstones. Occur in open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	Unlikely to occur. Suitable habitat occurs within the subject site in the form of alluvium and shale soils and Cumberland Plain Woodland and River-flat Eucalypt Forest vegetation communities. Species recorded in locality in low numbers.
<i>Pelargonium</i> sp. <i>Striatellum</i>	Omeo Stork's-bill	E	E	0	Has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Unlikely to occur. No suitable habitat present as the subject site does not contain irregularly inundated or ephemeral lakes. Species not recorded in locality.
<i>Haloragis exalata</i> subsp. <i>exalata</i>	Wingless Raspwort	V	V	0	Species requires protected and shaded damp situations in riparian habitats.	Unlikely to occur. No suitable habitat as the subject site is not located within any of the four known scattered localities in which the species occurs. Species not recorded in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
<i>Eucalyptus aggregata</i>	Black Gum	V	V	0	Found in grassy woodland on alluvial soils, along creeks on broad, cold flats; south from Bathurst	Unlikely to occur. No suitable habitat as the subject site is not located within the NSW Central or Southern Tablelands and does not occur within a wetter, cooler and higher area. Species not recorded in locality.
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	1	Found in wet forest on sandy alluvial soils along valley floors. It is confined to the lower Nepean River area.	Unlikely to occur. No suitable habitat as the subject site is outside of the known range of the species and does not include alluvial flats of the Nepean River or its tributaries.
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	1	Found in marshy heath on coastal sandstone plateaus. Restricted to sandstones of Sydney and south coast.	Unlikely to occur. No suitable habitat as the subject site does not contain marshy heath on coastal sandstone plateaus and does not contain sandstone geological formations. Only one record of the species in the locality.
<i>Micromyrtus minutiflora</i>		E	V	81	Found in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest,	Unlikely to occur. Suitable habitat occurs within the subject site in the form of open forest on alluvium soils,

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					open forest on tertiary alluvium and consolidated river sediments.	however the typical vegetation communities that the species inhabits are not present. Species recorded in locality.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	0	On south coast of NSW occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Unlikely to occur. No suitable habitat as the subject site does not contain littoral rainforest with grey soils over sandstone. Species not recorded in locality.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	C	0	Occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, <i>Xanthorrhoea</i> spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and	Unlikely to occur. Potential habitat occurs within the subject site in the form of woodland, however none of the commonly associated species occur. Species not recorded in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					wet sclerophyll forests. Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils. Is associated with the community Bloodwood / Scribbly Gum / Silver-top Ash Forest on the South Coast. Species is known to have occurrence associated with other <i>Cryptostylis</i> species. Flowering occurs generally from November to February.	
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	E	E	0	Grows in dry sclerophyll forest and moss gardens over sandstone.	Unlikely to occur. No suitable habitat as the subject site does not contain sandstone geology. Species not recorded in locality.
<i>Pterostylis chaetophora</i>		V		1	Found in sclerophyll forest among grasses and shrubs. Chiefly found in Taree district.	Unlikely to occur. No suitable habitat as the subject site does not contain seasonably moist, dry schlerophyll forest and is outside of the species known range. Species only recorded once in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
<i>Pterostylis gibbosa</i>	Illawarra Greenhood		E	0	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. longifolia</i> (Woollybutt), and <i>Melaleuca decora</i> (White Feather Honey-myrtle). Near Nowra, the species grows in open forest of <i>Corymbia maculata</i> (Spotted Gum), <i>E. tereticornis</i> , and <i>E. paniculata</i> (Grey Ironbark). It is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The species is currently only known to occur at five sites three in the Illawarra, one near Nowra, and one at Milbrodale in the Hunter Valley.	Unlikely to occur. No suitable habitat as the subject site is not located within the Hunter region, the Illawarra region or the Shoalhaven region. The species is thought to be extinct throughout its past distribution within Western Sydney. Species not recorded in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood		E	0	The species occurs in small pockets of shallow soil in flat areas on top of sandstone rock shelves above cliff lines, or on mossy rocks in gullies. Sclerophyll forest/woodland often occurs growing above where the species occurs, on shale or shale/sandstone transition soils. Flowering time is from October to December. It is currently only known to occur at five locations within western Sydney: Georges River National Park, close to Yeramba Lagoon, Peter Meadows Creek, and St Marys Towers.	Unlikely to occur. Whilst the subject site does contain Cumberland Plain Woodland, it does not contain suitable in the form of sandstone rock shelves, cliff lines or rocky gullies. Species not recorded in locality.
<i>Rhizanthella slateri</i>	Eastern Underground Orchid	V	E	0	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. The species is	Unlikely to occur. The subject site does not overlap with the distribution of the species and is not within an area containing a known population. Suitable habitat may occur in the form of woodland. Species not recorded in

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Flowers September to November.	locality, however the species is highly cryptic and difficult to detect.
<i>Thelymitra kangaloonica</i>	Kangaloon Sun Orchid	CE	CE	0	Occurs in the Fitzroy Falls/Robertson/Kangaloon area and grows in seasonally swampy sedgeland on grey silty clay loam.	Unlikely to occur. No suitable habitat as the subject site is not located within the Southern Highlands region comprising the known range of the species. Species not recorded in locality.
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	V		1236	Found in Cumberland Plain Woodland and Castlereagh Woodland often in small populations on road verges. Grows on reddish clay to sandy soils typically containing lateritic gravels.	Potential to occur. The subject site contains Cumberland Plain Woodland vegetation on clay soils derived from Wianamatta Shale and Tertiary alluvium. Species recorded extensively in locality. No individuals were observed during surveys.
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	0	Grows in light sandy or clay soils over thin shales, often with lateritic ironstone gravels and nodules. Is	Unlikely to occur. No suitable habitat as the subject site does not contain Shale-sandstone transition forest and

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					known to occur in Shale/Sandstone Transition Forest.	is not situated upon Lucas Heights or Berkshire Park soil landscapes. Species not recorded in locality.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	2	Occurs in dry sclerophyll forest and woodland with a shrubby understorey.	Unlikely to occur. Marginal habitat present within the subject site in the form of woodland, however the vegetation within the subject site lacks a shrubby understorey and is predominantly cleared. Species recorded in locality.
<i>Persoonia nutans</i>	Nodding Geebung	E	E	70	Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Southern populations also occupy tertiary alluvium, but extend onto shale	Unlikely to occur. The preferred vegetation communities and habitat are absent from the subject site. Species recorded in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest.	
<i>Pomaderris brunnea</i>	Rufous Pomaderris		V	0	In the region, the species is only found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Unlikely to occur. The subject site contains suitable habitat in the form of woodland on clay and alluvial soils. The subject site is not located within the known distribution of the species. Species not recorded in locality.
<i>Asterolasia elegans</i>		E	E	0	Occurs on Hawkesbury sandstone growing between sandstone boulders and rocky outcrops found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest. It is currently only known from 7 populations occurring in the hills north of Maroota within a 22 km ² extent of occurrence.	Unlikely to occur. No suitable habitat as the subject site does not contain Hawkesbury sandstone geology, sandstone boulders, rocky outcrops or sheltered forests. Species not recorded in locality.

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
<i>Thesium australe</i>	Austral Toadflax	V	V	0	Found in very small populations scattered across eastern NSW. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	Unlikely to occur. The subject site contains marginally suitable habitat in the form of woodland containing <i>Themeda triandra</i> in low abundance. Species not recorded in locality.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	0	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Unlikely to occur. No suitable habitat as the subject site does not contain ridgetops and slopes on sandy soil derived from sandstone, lateritic soils or shale/sandstone transition soils. Species not recorded in locality.
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	19	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	Potential to occur. The subject site contains suitable habitat in the form of Cumberland Plain Woodland vegetation on clay soils with undulating topography. Moderate recordings within the locality. An

Table 6.2 Threatened flora likelihood of occurrence

Scientific Name	Common Name	BC Act Status	EPBC Act Status	No. Of Records	Habitat Requirements	Likelihood of Occurrence
					ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey. Coastal headlands and hilltops are the favoured sites.	assessment of significance has been performed.

Notes: V = Vulnerable, E = Endangered, CE = Critically Endangered

Appendix C

Fauna Species List

Table 6.3 Fauna Species List

Common Name	Scientific Name	Exotic	BC Act Status	EPBC Act Status	S/H/B
Actinopterygii					
Short/Long Finned Eel	<i>Anguilla</i> sp.				S
Mosquito Fish	<i>Gambusia holbrooki</i>	*			S
Amphibia					
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>				S/H
Peron's Tree Frog	<i>Litoria peronii</i>				H
Striped Marsh Frog	<i>Limnodynastes peronii</i>				S/H
Whisting Tree Frog	<i>Litoria verreauxii</i>				H
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>				H
Aves					
Crested Pigeon	<i>Ocyphaps lophotes</i>				S
Masked Lapwing	<i>Vanellus miles</i>				S
Australian Magpie	<i>Gymnorhina tibicen</i>				S
Noisy Miner	<i>Manorina melanocephala</i>				S
Willie Wagtail	<i>Rhipidura leucophrys</i>				S/H
Galah	<i>Eolophus roseicapilla</i>				S
Common Starling	<i>Sturnus vulgaris</i>	*			S/H
Superb Fairy-wren	<i>Malurus cyaneus</i>				S/H
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>				H
Indian Myna	<i>Acridotheres tristis</i>	*			S/H
Magpie-lark	<i>Grallina cyanoleuca</i>				H
Australian Raven	<i>Corvus coronoides</i>				S/H
Silvereye	<i>Zosterops lateralis</i>				H
Black-shouldered Kite	<i>Elanus axillaris</i>				S
Spotted Dove	<i>Spilopelia chinensis</i>	*			S/H
Fairy Martin	<i>Petrochelidon ariel</i>				S
Red Wattlebird	<i>Anthochaera carunculata</i>				S

Table 6.3 Fauna Species List

Common Name	Scientific Name	Exotic	BC Act Status	EPBC Act Status	S/H/B
Red-rumped Parrot	<i>Psephotus haematonotus</i>				S/H
Golden-headed Cisticola	<i>Cisticola exilis</i>				H
Eurasian Coot	<i>Fulica atra</i>				S
Pacific Black Duck	<i>Anas superciliosa</i>				S
Eastern Koel	<i>Eudynamys orientalis</i>				H
Australian Reed Warbler	<i>Acrocephalus australis</i>				H
Purple Swampphen	<i>Porphyrio porphyrio</i>				S
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>				S
Mistletoebird	<i>Dicaeum hirundinaceum</i>				H
House Sparrow	<i>Passer domesticus</i>	*			S/H
Dusky Moorhen	<i>Gallinula tenebrosa</i>				S
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>				S
European Blackbird	<i>Turdus merula</i>				S
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>				S
Australian Wood Duck	<i>Chenonetta jubata</i>				S
Grey Butcherbird	<i>Cracticus torquatus</i>				S/H
White-faced Heron	<i>Egretta novaehollandiae</i>				S
African Grey	<i>Psittacus erithacus</i>	*			S/H
Domestic Chicken	<i>Gallus gallus domesticus</i>	*			S
Gastropoda					
Garden Snail	<i>Helix aspera</i>	*			S
Mammalia					
Dog	<i>Canis familiaris</i>	*			S/H
Sheep	<i>Ovis aries</i>	*			S/H
European Hare	<i>Lepus europaeus</i>	*			S
European Rabbit	<i>Oryctolagus cuniculus</i>	*			S
Horse	<i>Equus ferus caballus</i>	*			S/H
Kangaroo/Wallaby	<i>Macropus sp.</i>				S
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>		V	V	B

Table 6.3 Fauna Species List

Common Name	Scientific Name	Exotic	BC Act Status	EPBC Act Status	S/H/B
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>				B
Chocolate Wattled Bat	<i>Chalinolobus morio</i>				B
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>		V		B
Southern Myotis	<i>Myotis macropus</i>		V		B
Eastern Broad-Nosed Bat	<i>Scotorepens orion</i>				B
Eastern Forest Bat	<i>Vespadelus pumilus</i>				B
Eastern Bentwing-bat	<i>Miniopterus orianae oceanensis</i>		V		B
White-striped Free-tailed Bat	<i>Austronomus australis</i>				B
Eastern Freetail-bat	<i>Micronomus norfolkensis</i>		V		B
South-Eastern Free-tailed Bat	<i>Ozimops planiceps</i>				B
Ride's Free-tailed Bat	<i>Ozimops ridei</i>				B
Reptilia					
Tree Skink	<i>Egernia striolata</i>				S
Garden Skink	<i>Lampropholis guichenoti</i>				S
Red-bellied Back Snake	<i>Pseudechis porphyriacus</i>				S
Eastern Long-necked Turtle	<i>Chelodina longicollis</i>				S

Notes:

V = Vulnerable, S = Seen, H = Heard, B = Bat Detector

Appendix D

Threatened Fauna Likelihood of Occurrence

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Amphibia							
Hylidae	<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	10	The species is found in a wide range of water bodies except fast moving streams. It commonly inhabits disturbed sites such as abandoned quarries and mines, though generally breeds in habitats that include still, shallow, unpolluted water bodies, that are unshaded, contain aquatic plants and are free of Mosquito fish and other predators, with a range of diurnal shelter sites (emergent aquatic vegetation).	Low likelihood of occurrence. Suitable habitat exists within the subject site in the form of riparian zones and numerous unshaded farm dams fringed by thick stands of <i>Typha orientalis</i> . Limitations to the presence of the species within the subject site include the presence of Mosquito Fish within many of the dams and the creeks and pollution as a result of agricultural runoff. Species records exist approximately 5km from the subject site, within the dispersal range of the species. The most recent records are from 2012 with a majority of sightings occurring between 1993 and 1999. Green and Golden Bell Frog individuals were not observed during targeted surveys and searches. Assessment of significance undertaken as a precaution.
Hylidae	<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	0	Inhabits forest, coastal woodland and heath, from 100 to 950 m above sea level. It breeds in rocky streams, still water in	Unlikely to occur. No suitable habitat as the subject site does not contain permanent streams or perched swamps

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						dams, ditches, isolated pools, and temporary pools where sufficient run-off water is available.	which are considered to be their preferred breeding habitat. Additionally, the elevation of the subject site is approximately 50m which is below the elevation range of the species. Species not recorded in locality.
Myobatrachidae	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	1	Occurs in heath, woodland and open dry sclerophyll forest on a variety of soil types, except for clay soils. Breeding habitat for this species usually contains soaks or pools within first of second order streams.	Unlikely to occur. No suitable habitat as the subject site contains clay soils. There has only been a single recording throughout the 10km locality.
Myobatrachidae	<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		29	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.	Unlikely to occur. No suitable habitat as the subject site does not occur on Hawkesbury or Narrabeen Sandstone geology and does not contain drainage lines below sandstone ridges.
Aves							

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Acanthizidae	<i>Chthonicola sagittata</i>	Speckled Warbler	V		19	Occurs in communities dominated by Eucalyptus, with a grassy understorey, most commonly occurring on rocky ridges and gullies.	Unlikely to occur. Suitable habitat occurs within the subject site in the site of small, fragmented patches of woodland with a grassy understorey, however no rocky ridges or gullies occur within the subject site. Records of the species have been made approximately 2km from the subject site.
Accipitridae	<i>Circus assimilis</i>	Spotted Harrier	V		1	Occurs throughout mainland Australia except in densely forested or wooded habitats of the coast, escarpment, and ranges. It inhabits open grassy woodland, shrubland, and grassland. It nests in trees and preys on terrestrial mammals, birds, and reptiles, and will occasionally consume carrion.	Unlikely to occur. The subject site contains suitable habitat in the form of fragmented patches of open grassy woodlands, riparian woodland and agricultural land. However, only a single recording has been made of the species within 10km. The species tends to occur in drier habitats further inland.
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M	7	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of	Unlikely to occur. Large area of water not present on subject site. As this species is a migratory species with a wide range, this species may pass near the subject site on occasion as part of a wider foraging range, particularly to access the Nepean River to the west. The species is unlikely to utilise

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						large areas of open water.	the subject site itself. No nests were recorded on the subject site during recent surveys.
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	V		5	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland, or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Unlikely to occur. The subject site contains suitable habitat in the form of fragmented patches of open grassy woodlands and riparian woodland. A large majority of the potential habitat within the subject site is highly marginal and disturbed. Few species records in the locality.
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	V		7	Found in a variety of timbered habitats including dry woodlands and open forests. It is a specialist hunter preying on passerine birds, especially honeyeaters and targets predominately nestlings and insects occurring in the tree canopy. It nests in tree forks or on large horizontal tree limbs located mostly along or near watercourses.	Unlikely to occur. The subject site contains suitable habitat in the form of fragmented patches of open grassy woodlands and riparian woodland. A large majority of the potential habitat within the subject site is highly marginal and disturbed.
Accipitridae	<i>Pandion cristatus</i>	Eastern Osprey		M	0	Found in littoral and coastal habitats and terrestrial wetlands. They generally are found in coastal areas though will travel inland along major water courses. They visit a wide range of wetland habitats	Unlikely to occur. The subject site does not contain suitable habitat such as large open water bodies or the mouth of a large river, and is not within 1km of the ocean. Species not recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						including inshore waters, reefs, bays, coastal cliffs, estuaries, mangrove swamps, broad rivers, reservoirs, large lakes, and water holes. They feed on fish over clear, open water, and nest in trees or dead trees, generally within one kilometre of the ocean.	
Anatidae	<i>Stictonetta naevosa</i>	Freckled Duck	V		2	<p>This species occurs primarily in south-eastern and south-western Australia and occurs as a vagrant elsewhere. It breeds in large, temporary swamps created during flood events in the Bulloo and Lake Eyre basins and along the Murray-Darling river system. During inland droughts the species disperses to wetlands in the Murray River basin, and occasionally to coastal areas.</p> <p>The species prefers permanent freshwater swamps and creeks heavy with shrub, sedge, and rush growth. It rests in dense cover during the day, usually in deep water and feeds at dusk and dawn on algae, seeds, and vegetative parts of aquatic sedges and grasses. It nests generally</p>	<p>Unlikely to occur. No suitable habitat as the subject site does not contain large, temporary swamps, large wetlands or thickly vegetated creeks with deep water. Riparian areas are limited and do not represent major watercourses. Species may occasionally visit watercourses as part of seasonal movements.</p>

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						during October to December in dense vegetation near to the water level.	
Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift		M	4	Species has been recorded throughout NSW, but mostly east of the Great Divide. The species is almost exclusively aerial in Australia and breeds overseas. It forages from a metre above the ground, up to hundreds of metres in altitude, and mostly occur over inland plains, though sometimes over foothills, and coastal areas.	Unlikely to occur. Highly mobile, aerial species that may pass over the subject site but unlikely to utilise it directly. Few records in the locality.
Apodidae	<i>Hirundapus caudacutus</i>	White-throated Needletail		M	3	Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Occur over most types of habitat, particularly above wooded areas including open forest and rainforest, between trees or in clearings and below the canopy.	Unlikely to occur. Highly mobile, aerial species that may pass over the subject site but unlikely to utilise it directly. Few records in the locality.
Ardeidae	<i>Ardea alba</i>	Great Egret		M	0	Usually inhabit open, freshwater wetlands with low, dense vegetation. Will utilise artificial habitats including pasture and ploughed paddocks.	Unlikely to occur. The subject site does not contain suitable breeding habitat as no large reedlands or wetlands occur. The subject site may contain marginal foraging habitat in the form of numerous scattered dams. Species not recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Ardeidae	<i>Ardea ibis</i>	Cattle Egret		M	50	Found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock.	Potential to occur. The subject site contains suitable habitat in the form of fragmented woodland. The species is known to forage on low lying grasslands, improved pastures and croplands which occur within the subject site. Species recorded in locality.
Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	1	Occurs in freshwater wetlands, and more rarely, estuarine wetlands. It favours wetlands with tall, dense vegetation, and forages in shallow water up to a depth of 0.3m. It nests in deep vegetative cover over shallow pools.	Unlikely to occur. The subject site contains no suitable habitat in the form of large, shallow wetlands. Only one record exists for the species within the 10km locality.
Ardeidae	<i>Ixobrychus flavicollis</i>	Black Bittern	V		2	Inhabits terrestrial and estuarine wetlands, generally in areas containing permanent water and dense vegetation. The species can occur in flooded grassland, woodland, rainforest, and mangroves. It feeds on frogs, reptiles, fish, and invertebrates such as snails, dragonflies, shrimp and crayfish. It roosts during the day on the ground amongst dense reeds or within trees. It nests in branches overhanging water.	Unlikely to occur. The subject site contains minimal suitable habitat as it does not feature permanent wetlands surrounded by dense vegetation. The fragmented patches of woodland and riparian woodland are considered to be disturbed and marginal habitat. Only one record occurs for the species in the subject locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Artamidae	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V		27	In New South Wales the species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. The Dusky Woodswallow is found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. The species primarily eats invertebrates, mainly insects, which are captured whilst hovering and sallying above the canopy or over water.	Low likelihood of occurrence. Suitable habitat occurs within the subject site in the form of fragmented patches of woodland over dams. Species recorded in locality.
Burhinidae	<i>Burhinus grallarius</i>	Bush-stone Curlew	E		2	Lives in open forest and woodlands with a sparse, grassy ground layer, and fallen timber. It feeds on insects and small insects and vertebrates including frogs, lizards, and snakes. Nesting is undertaken in a scrape or small bare patch.	Unlikely to occur. Marginal habitat occurs within the subject site in the form of fragmented patches of woodland with little woody debris. Few recordings have been made of the species within the locality.
Cacatuidae	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		13	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in	Unlikely to occur. The subject site contains suitable habitat in the form of woodland patches and is known to occur in urban areas. Few species records in the locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						urban areas. In NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes.	
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		24	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur.	Low likelihood of occurrence. The subject site contains suitable habitat in the form of woodland patches. Species recorded in locality in low numbers.
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E		1	Occurs in floodplain wetlands of major coastal rivers along with minor floodplains, coastal sandplain wetlands and estuaries. Species builds nest in high in trees close to water.	Unlikely to occur. No suitable habitat occurs in the subject site in the form of floodplain wetlands or estuaries. Species only recorded in subject site once.
Cuculidae	<i>Cuculus optatus</i>	Oriental Cuckoo		M	0	Non-breeding visitor to Australia who is a brood parasite. Usually inhabits forested areas and can be found at all levels of the canopy and at a range of elevations.	Unlikely to occur. No suitable habitat occurs in the subject site as forested habitats are preferred by the species.
Estrildidae	<i>Stagonopleura</i>	Diamond Firetail	V		3	Occurs in grassy eucalypt woodland, open	Unlikely to occur. Suitable habitat occurs

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
	<i>guttata</i>					forest and riparian areas.	within the subject site in the form of riparian areas and lightly wooded farmland. Few individuals recorded in locality.
Meliphagidae	<i>Anthochaera phrygia</i>	Regent Honeyeater	E	CE	2	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes.	Unlikely to occur. Marginal habitat may occur within the subject site in the form of fragmented patches of woodland and riparian forest. The species favoured vegetation communities do not occur within the subject site. Few species records from the locality.
Meliphagidae	<i>Grantiella picta</i>	Painted Honeyeater	V	V	0	Occurs in Boree, Brigalow and Box-Gum Woodlands and Box-Ironbarks. Feeds primarily on mistletoe fruit and insects.	Unlikely to occur. No suitable habitat within the subject site as it does not contain Boree/Weeping Myal, Brigalow, Box-Gum Woodlands or Box-ironbark Forests.
Meliphagidae	<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		2	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>)	Unlikely to occur. The subject site may contain suitable habitat in the form of <i>Eucalyptus tereticornis</i> dominated woodlands. The subject site is not located within the typical distribution of the species. Few records in the locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						and Forest Red Gum (<i>E. tereticornis</i>). 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.	
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater		M	8	In Australia it is widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to breed. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	Unlikely to occur. The subject site contains suitable habitat in the form of woodland patches, cleared areas near water, in orchards, vineyards and farmland with remnant vegetation. Few species records in the locality.
Monarchidae	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		M	0	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.	Unlikely to occur. The subject site does not contain suitable habitat in the form of moist, tall eucalyptus forests. Species not recorded in locality.
Muscicapidae	<i>Monarcha melanopsis</i>	Black-faced Monarch		M	0	Found along the coast of eastern Australia, becoming less common further south. The	Unlikely to occur. No suitable habitat as the subject site does not contain rainforest

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	vegetation. Species not recorded in locality.
Muscicapidae	<i>Monarcha trivirgatus</i>	Spectacled Monarch		M	0	Found along the entire eastern seaboard of Australia. More often found where there is thick understorey in rainforests, wet gullies, waterside vegetation and also in mangroves.	Unlikely to occur. No suitable habitat as the subject site does not contain rainforest, moist eucalypt forests or other densely vegetated habitats. Species not recorded in locality.
Muscicapidae	<i>Rhipidura rufifrons</i>	Rufous Fantail		M	0	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground.	Unlikely to occur. No suitable habitat as the subject site does not contain wet sclerophyll forests, moist wooded gullies, subtropical rainforests or temperate rainforests. They may rarely visit the site as a vagrant whilst migrating. Species not recorded in locality.
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		42	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Inhabits most of mainland Australia except the treeless deserts and open grasslands.	Low likelihood of occurrence Suitable eucalypt and woodland habitat occurs, however it is fragmented and occurs in small patches. Species recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Petroicidae	<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V		1	Hooded Robins are found in lightly timbered woodland, mainly dominated by acacia and/or eucalypts.	Unlikely to occur. No suitable habitat as the subject site does not contain structurally diverse habitats as the fragmented patches of native vegetation are heavily degraded.
Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V		5	Occurs in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. 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. Habitat usually contains abundant logs and fallen timber: these are important components of its habitat. Nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	Low likelihood of occurrence. The subject site contains suitable woodland habitat with an open understorey occurs, however it is fragmented and occurs in small patches. Few records of the species in the locality.
Petroicidae	<i>Petroica phoenicea</i>	Flame Robin	V		3	Breeds in upland tall, moist, eucalypt forests and woodlands, often on ridges and slopes. Groundlayer of breeding habitat is dominated by native grasses. It occasionally occurs in herbfields, heathlands, shrublands, and sedgeland at	Low likelihood of occurrence. Suitable winter foraging habitat occurs, however it is fragmented and occurs in small patches. Few records of the species from the locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						high altitudes. In winter the species migrates to drier, more open habitats in the lowlands. The species forages from low perches, pouncing on small invertebrates on the ground or off logs, and other coarse woody material.	
Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	V		2	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Also utilises isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts.	Low likelihood of occurrence. The subject site contains suitable foraging habitat in the form of isolated flowering trees, the woodland canopy and riparian zones. The subject site contains limited breeding habitat as few hollow bearing trees were observed. Few species records from the locality recorded in locality.
Psittacidae	<i>Lathamus discolor</i>	Swift Parrot	E	M	15	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	Low likelihood of occurrence. The subject site may contain suitable foraging habitat, as the species favours flowered eucalypts and trees prone to lerp infestation including

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> , <i>C. gummifera</i> , <i>E. sideroxylon</i> , and <i>E. albens</i> . Breeds in Tasmania in spring and summer.	<i>Eucalyptus mollucana</i> . Species may use subject site for foraging as part of their migratory route. Low number of records in the locality.
Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	V		1	Found at the edges of eucalypt woodland adjacent to clearings, timbered ridges and creeks in farmland. Associated with coastal scrubland, open forest and timbered grassland. Nests in hollow-bearing trees, logs or posts.	Low likelihood of occurrence. The subject site contains suitable habitat in the form of eucalypt woodland adjoining clearings and creeks in farmland. The subject site contains limited breeding habitat as few hollow bearing trees were observed. Only a single record of the species exists within the locality.
Rostratulidae	<i>Rostratula australis</i>	Australian Painted Snipe	E	E	1	Inhabits fringes of shallow inland wetlands, swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Unlikely to occur. Extremely marginal habitat exists within the subject site in the form of degraded farm dams. No high quality habitat exists within the subject site as it does not contain large shallow inland wetlands, swamps or marshy areas. Species only recorded in locality once.
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper		M	1	Species occurs near coastlines utilising coastal and inland wetlands, streams,	Unlikely to occur. No suitable habitat present within the subject site.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						mudflats, lakes, claypans and reservoirs. Forages in shallow water and roosts on rocks or in roots or branches of vegetation.	
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		M	0	Species prefers muddy edges of shallow fresh or brackish wetlands with inundated or low vegetation. Known to occur lagoons, swamps, lakes, dams, and other waterbodies. Roosts at the edges of wetlands.	Unlikely to occur. Minimal habitat exists within the subject site as it does not contain large fresh or brackish wetlands. The degraded farm dams may provide extremely marginal foraging and roosting habitat. Species not recorded in locality.
Scolopacidae	<i>Calidris ferruginea</i>	Curlew Sandpiper	E	M	0	The Curlew Sandpiper is found in coastal areas with intertidal mudflats, including estuaries, inlets and lagoons, and ponds in saltworks. The species have also occasionally been recorded inland around lakes , dams and waterholes with mud or sand present. Main requirements for feeding habitats are the presence of mudflats or shallow water up to 60mm. The Curlew Sandpiper may also forage in saltmarsh environments and flooded paddocks.	Unlikely to occur. No suitable habitat present within the subject site.
Scolopacidae	<i>Calidris melanotos</i>	Pectoral Sandpiper		M	0	Species prefers shallow fresh to saline wetlands and is known to utilise lagoons,	Unlikely to occur. No suitable habitat present within the subject site.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						estuaries, bays, swamps, lakes, inundated grasslands and other waterbodies. Species does not breed in Australia.	
Scolopacidae	<i>Gallinago hardwickii</i>	Latham's Snipe		M	6	Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Potential to occur. The subject site contains suitable foraging habitat in the form of farm dams and pasture. Species may use subject site for foraging as part of their migratory route. Species recorded in locality.
Scolopacidae	<i>Limosa limosa</i>	Black-tailed Godwit	V	M	1	Found in coastal habitats such as mudflats, estuaries, bays and intertidal sandflats.	Unlikely to occur. No suitable habitat present within the subject site.
Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew		M	0	Prefers sheltered coasts, especially estuaries, bays, harbours, inlets and lagoons. Also known to occur in sewage farms, wetlands and mangroves. Species roosts on sandy spits and in low Saltmarsh or mangroves.	Unlikely to occur. No suitable habitat present within the subject site.
Scolopacidae	<i>Tringa glareola</i>	Wood Sandpiper		M	2	Occurs in well-vegetated, shallow, freshwater wetlands that are contain emergent, aquatic plants or grass, and are	Unlikely to occur. Minimal suitable habitat as the subject site does not contain large freshwater wetlands. The subject site may

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums (Eucalyptus camaldulensis) and often with fallen timber. Also recorded in grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops.	contain extremely marginal foraging habitat in the form of small farm dams. Few records from within the locality.
Scolopacidae	<i>Tringa nebularia</i>	Common Greenshank		M	1	Occurs in a wide variety of inland wetlands and sheltered coastal areas. Species does not breed in Australia.	Unlikely to occur. Minimal suitable habitat as the subject site does not contain large wetlands. The degraded farm dams and creek lines may provide marginal foraging or roosting habitat. Species not recorded in locality.
Strigidae	<i>Ninox connivens</i>	Barking Owl	V		1	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. Nests in hollows of large, old eucalypts. Hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows	Low likelihood of occurrence. The subject site contains suitable habitat in the form of fragmented woodland remnants throughout cleared farmland. The subject site may comprise a small portion of a 2000ha territory of a breeding pair. The subject site contains minimal breeding habitat as it does not contain trees bearing

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						decreases these prey populations it becomes more reliant on birds, invertebrates and terrestrial mammals. Requires very large permanent territories in most habitats due to sparse prey densities.	large hollows. Single species record within the locality.
Strigidae	<i>Ninox strenua</i>	Powerful Owl	V		33	In NSW the Powerful Owl lives in forests and woodlands occurring in the coastal, escarpment, tablelands and western slopes environments. Specific habitat requirements include eucalypt forests and woodlands on productive sites on gentle terrain; a mosaic of moist and dry types, with mesic gullies and permanent streams; presence of leafy sub canopy trees or tall shrubs for roosting; presence of large old trees to provide nest hollows. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials.	Potential to occur. The subject site contains suitable foraging habitat in the form of fragmented woodland. The subject site does not contain suitable thick vegetation for roosting or large tree hollows for breeding. The subject site would be expected to form part of a broader 400-4000 ha territory of a breeding pair. Species recorded throughout the locality. Assessment of significance required.
Threskiornithidae	<i>Plegadis falcinellus</i>	Glossy Ibis		M	1	Preferred foraging and breeding habitat are fresh water marshes at the edges of waterbodies. This species has low breeding site fidelity and nests in primarily	Unlikely to occur. No suitable habitat exists within the subject site as it does not contain large fresh water marshes at the edges of water bodies. Only a single

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						in swamps.	record exists within the subject site.
Tytonidae	<i>Tyto novaehollandiae</i>	Masked Owl	V		12	Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats.	Low likelihood of occurrence. Suitable habitat exists within the subject site as it contains fragmented woodlands. The species may hunt along the edges of woodland patches or along roadsides within the subject site. No suitable breeding habitat exists within the subject site as it does not contain trees bearing large hollows.
Tytonidae	<i>Tyto tenebricosa</i>	Sooty Owl	V		4	Occurs in coastal rainforest, including dry, subtropical, and temperate rainforests, and moist eucalypt forests. Utilises tall trees in heavily vegetated areas for day time resting. It hunts during the night for small ground or tree dwelling mammals such as the Common Ringtail Possum or Sugar Glider. The species requires very large tree hollows for nesting.	Unlikely to occur. No suitable habitat exists within the subject site as it does not contain coastal rainforests, dry subtropical or temperate rainforests or moist eucalypt forests. No suitable breeding habitat exists within the subject site as it does not contain trees bearing large hollows. Species recorded in locality.
	<i>Motacilla flava</i>	Yellow Wagtail		M	0	Species is believed to be a regular summer visitor to NSW, preferring open grassy flats near water.	Unlikely to occur. Suitable habitat limited on subject site. Species not recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
Fish							
Percichthyidae	<i>Macquaria australasica</i>	Macquarie Perch	E	E	0	The species is a riverine, schooling species that prefers clear water, and deep rocky holes with lots of cover. It naturally occurs in the murray-darling basin and associated water courses, Shoalhaven River, and the Hawkesbury Nepean System	Unlikely to occur. No suitable habitat present within the subject site.
Retropinnidae	<i>Prototroctes maraena</i>	Australian Grayling		V	0	Species spends part of its lifecycle in freshwater and part of the larval and/or juvenile stages in coastal seas. Adults inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones	Unlikely to occur. No suitable habitat present within the subject site.
Gastropoda							
Camaenidae	<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E		315	Primarily inhabits Cumberland Plain Woodland. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Lives in a very small area on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue	Potential to occur. Suitable habitat exists within the subject site as the species primarily inhabits Cumberland Plain Woodland and occasionally the margins of River-fat Eucalypt Forest. The species is typically found within plant litter, logs, loose soil and grass clumps. The subject site was extensively searched, however

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						Mountains.	the species was not detected. This may be due to the fragmented distribution of woodland throughout the subject site. Species recorded in locality. Assessment of significance undertaken.
Camaenidae	<i>Pommerhelix duralensis</i>	Dural Woodland Snail	E	E	1	Species occurs under rocks or inside curled-up bark within communities in the interface region between sandstone-derived and shale-derived soils.	Unlikely to occur. No suitable habitat exists within the subject site as it does not contain shale-sandstone transitional communities. Only a single record exists within the locality.
Mammalia							
Burramyidae	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		1	Species is found in a broad range of habitats from rainforest to wet and dry sclerophyll forests through to woodland and heath. Woodland and heath habitats are preferred. The species feeds on pollen and nectar from banksias, eucalypts, and bottlebrushes, though will eat soft fruits when flowers are unavailable, and will also eat insects throughout the year. They shelter in tree hollows, rotten stumps, holes in the ground, abandoned birds nests and Ringtail Possum dreys, and thickets of	Unlikely to occur. The subject site may contain extremely marginal habitat as it contains fragmented patches of woodland. The subject site does not contain significant foraging resources such as flowering banksias or callistemons. Species recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						vegetation. Tree hollows are preferred for nesting but the species will also nest under tree bark and shredded bark in tree forks.	
Dasyuridae	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	14	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.	Unlikely to occur. Rocky habitats are limited and the woodland vegetation at the subject site is highly fragmented and occurs in small patches.
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		2	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Unlikely to occur. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. The species may occasionally and opportunistically forage within the woodland canopy and in treeless areas. May potentially roost in the subject site in small hollows and buildings. Minimal sightings in the locality.
Macropodidae	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	0	Prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges, and isolated rock stacks. Vegetation types associated with	Unlikely to occur. Suitable rocky habitat does not occur within the subject site. Species not recorded in locality.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						the species include dense forest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest.	
Molossidae	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		32	Found in dry sclerophyll forest, woodland, swamp forest and mangrove forests east of the Great dividing Range. Primarily roosts in tree hollows but will also utilise man-made structures.	Likely to occur. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. The subject site contains suitable foraging habitat as it contains patches of woodland. The subject site contains suitable roosting habitat as it contains decorticated bark and trees bearing small hollows. Species recorded in locality. Assessment of significance undertaken.
Muridae	<i>Pseudomys novaehollandiae</i>	New Holland Mouse			0	Occurs in open habitats (heathland, woodland and forest) with a heath understorey and vegetated sand dunes. The species prefers deep soft top soils in order to burrow.	Unlikely to occur. No suitable habitat as the subject site does not contain vegetation with a heath understorey. Suitable habitat does not occur within the subject site. Species not recorded in locality.
Petauridae	<i>Petaurus australis</i>	Yellow-bellied Glider	V		6	Occurs in tall, mature, eucalypt forest generally in areas with high rainfall and nutrient rich soils. It feeds primarily on plant and insect exudate, with insects providing	Unlikely to occur. Subject site is located in a lower rainfall, low nutrient soil area, so the and subsequently is unlikely to support a significant population. The patches of

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						protein. It extracts sap from trees by biting into the trunk and branches leaving distinctive 'V' shaped scars. It dens in large hollows within trees, in groups of two to six individuals.	woodland throughout the subject site are highly fragmented providing a barrier to movement of the species.
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	V		2	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. Widely, though sparsely, distributed in eastern Australia, from northern Queensland to western Victoria.	Unlikely to occur. No suitable habitat as the subject does not contain old growth Box woodland, Box-Ironbark woodland, River Red Gum forest or Blackbutt-Bloodwood forest with a heath understorey. Few records exist within the locality.
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V	V	22	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred feed species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Unlikely to occur. The patches of wooded vegetation throughout the subject site are small and lacking connectivity to contiguous habitat. The species has been recorded in the locality in low numbers.
Pseudocheiridae	<i>Petauroides volans</i>	Greater Glider		V	6	Occurs in eucalypt forests and woodlands from north-eastern Queensland to the	Unlikely to occur. Marginal habitat may exist within the subject site as it contains

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						Central Highlands of Victoria. The species has a relatively small home range which consists of numerous tree hollows.	small patches of woodland. Species may utilise the locality as part of a larger foraging range. The subject site does not contain suitable refuge habitat as large hollows were not observed.
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	57	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Likely to occur. Species may utilise the locality as part of a larger foraging range, however no roosting camps occur within the subject site. The nearest roosting camp is located within 20km from the subject site at Emu Plains. This indicates that the species may occasionally or opportunistically utilise the native woodland and exotic plantings within the subject site for foraging resources. Species recorded in locality. Assessment of significance undertaken.
Vespertilionidae	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	4	The species is associated with areas dominated by sandstone escarpments; sandstone cliffs and fertile woodland valley habitat occurring in close proximity to each other is important for the species. It roosts in cliff/escarpment areas and forages in	Likely to occur. The subject site may contain roosting habitat as the species is known to roost within Fairy Martin nests which were observed along buildings. The subject site contains foraging resources throughout the woodland canopy.

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						fertile forest. Roosting is predominately in arch caves with dome roofs, but has been observed in disused mines shafts, overhangs, and disused Fairy Martin nests.	Recorded in locality. The species was confirmed as occurring within the subject site during 2017 surveys. Assessment of significance undertaken
Vespertilionidae	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		9	Favours hollow trunks of Eucalypt trees over 20m high in wet sclerophyll forest and coastal mallee. Occasionally found in old wooden buildings.	Likely to occur. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. Limited roosting habitat occurs within the subject site as few hollow bearing trees were observed and a majority of the buildings did not appear to be suitable. The subject site contains foraging resources throughout the woodland canopy. Species recorded in locality. The species was confirmed as occurring within the subject site during 2017 surveys. Assessment of significance undertaken.
Vespertilionidae	<i>Miniopterus australis</i>	Little Bentwing-bat	V		2	Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Low likelihood of occurrence. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. The vegetation of the subject does not conform to the preferences of the species as moist eucalypt forest,

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
							rainforest, vine thicket, wet or dry sclerophyll forest, Melaleuca swamps, dense coastal forests or Banksia Scrub do not occur within the subject site. The subject site may contain suitable roosting habitat as it contains stormwater drains, culverts, bridges, buildings and occasional hollow bearing trees. Species recorded in locality in low numbers.
Vespertilionidae	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		48	Forages above the canopy and eats mostly moths. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Likely to occur. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. Whilst caves are the primary roosting habitat, the species may utilise buildings and other man-made structures within the subject site. The subject site contains foraging resources throughout the woodland canopy. Species recorded in locality. The species was confirmed as occurring within the subject site during 2017 surveys. Assessment of significance undertaken.
Vespertilionidae	<i>Myotis macropus</i>	Southern Myotis	V		39	Generally roost in groups of 10 - 15 close	Likely to occur. Highly mobile, aerial

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						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 their feet across the water surface.	species that may pass over the subject site as part of a larger foraging range. The subject site contains suitable roosting habitat including hollow-bearing trees, storm water channels, buildings, bridges and woodland foliage. The subject site contains suitable foraging habitat including numerous farm dams and two creek lines. The subject site contains foraging resources throughout the woodland canopy. Species recorded in locality. The species was confirmed as occurring within the subject site during 2017 surveys. Assessment of significance undertaken.
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		19	Found mainly in the gullies and river systems that drain the Great Dividing Range. Usually roosts in tree hollows and buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-	Potential to occur. Highly mobile, aerial species that may pass over the subject site as part of a larger foraging range. The subject site may contain suitable habitat in the form of buildings and a small number of hollow-bearing trees. The subject site contains foraging resources throughout the woodland canopy. Species recorded in locality. The species was confirmed as

Table 6.4 Threatened Fauna Likelihood of Occurrence

Family	Scientific Name	Common Name	TSC Act	EPBC Act	No. Of Records	Habitat Requirements	Likelihood of Occurrence
						flying insects.	occurring within the subject site during 2017 surveys. Assessment of significance undertaken
Reptilia							
Elapidae	<i>Hoplocephalus bungaroides</i>	Broad-headed snake	E	V	0	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 crevices or hollows in large trees within 500m of escarpments in summer.	Unlikely to occur. No suitable habitat as the species is typically confined to areas with underlying sandstone geology. No suitable habitat cliff or escarpment habitat present.

Notes: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory

Appendix E

Assessments of Significance

E.1 Introduction

This appendix contains formal Assessments of Significance required under Section 5A of the EP&A Act that have been prepared in accordance of the *Threatened Species Assessment Guidelines* (DECC (NSW), 2007). The Assessments of Significance provide a means by which to gauge the significance of predicted impacts to threatened species, populations and ecological communities listed under the BC Act. They have been prepared to help examine the magnitude of impacts to local occurrences of threatened biota.

Both direct and indirect impacts are taken into account within these assessments. Direct impacts have been quantified within the assessments and are represented by the development footprint. Whilst it is acknowledged that indirect impacts can potentially be significant for a variety of species, such impacts cannot be mapped or accurately calculated in advance. An important consideration in these assessments is that the direct and indirect impacts are not proposed to take place at one time; rather they will take place progressively.

Assessments of Significance have been provided for communities and species listed as vulnerable, endangered or critically endangered under the BC Act. Each Assessment of Significance is a series of questions (shown as italicised text below) for which a response has been supplied beneath in plain text.

E.1.1 Terminology

The *Threatened Species Assessment Guidelines* (DECC (NSW), 2007) utilise and define a number of key terms that are used within an Assessment of Significance, including subject site, study area, direct impacts, indirect impacts, life cycle, viable, local population, risk of extinction, local occurrence, composition, habitat, extent, importance and locality. The Assessments of Significance present below have been prepared in consideration of these terms and the definitions provided in the guidelines.

E.2 Ecological Communities

E.2.1 Cumberland Plain Woodland

Cumberland Plain Woodland (CPW) typically comprises an open tree canopy layer, sometimes with a shrub layer and groundcover dominated by grasses and herbs. Dominant canopy species are *Eucalyptus moluccana* (Grey Box) and *E. tereticornis* (Forest Red Gum), often with *E. crebra* (Narrow-leaved 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) (OEH, 2011). Soils within this community are derived from Wianamatta Group geology. Cumberland Plain Woodland is listed as a Critically Endangered Ecological Community under the BC and EPBC Act.

CPW exists throughout the subject site in the form of scattered and isolated patches, some of which adjoin to RFEF vegetation and contiguous vegetation outside of the subject site.

The dominant canopy species within the subject site include *Eucalyptus mollucana* (Grey box), *E. crebra* (Narrow-leaved Ironbark) and *E. tereticornis* (Forest Red Gum). It is evident that the vegetation on the subject site has been cleared extensively from historic and on-going land uses from agricultural development and therefore the groundcover generally contains predominantly exotic species and the understorey is very sparse to absent in the majority of the community on the subject site.

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

Not applicable.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

The total area of CPW within the subject site is 2.05 ha. The proposed action is anticipated to result in the removal or modification of approximately 0.54 ha of CPW vegetation. It is suspected that CPW has previously been substantially cleared and or modified within the subject site. The extent of the community remaining within the subject site is not considered to be critical to the survival of the community in the immediate locality, given the modified nature of the habitat and the degraded nature of the existing vegetation. CPW is represented throughout the subject site as native canopy trees over an understorey dominated by exotic grasses with scattered native shrubs and herbs. The removal of small patches of the community within the subject site is not considered to modify the remaining extent of this community such that its local occurrence is likely to be placed at risk of extinction.

Patches of CPW to be retained within the subject site may be subject to indirect impacts associated with the construction and operational phases of the development. Disturbance to land adjacent to patches of CPW during the construction phase may result in favourable habitat conditions for introduced and/or hardy native plant species that can proliferate in disturbed conditions. Such species have potential to impact upon the original local native plant species that inhabit patches of CPW. Weeds such as exotic grasses and other introduced plants have potential to outcompete regenerating native plant species. There is a risk that seeds or other propagules from these weeds could be dispersed while works associated with the proposed project is being undertaken, on vehicles or clothing of the workers involved. Whilst the patches of CPW exhibit a cleared understorey dominated by grassy, herbaceous and woody weeds, construction related disturbance may result in minor further weed invasion within the subject site. Due to the current degraded state of the community within the subject site, these impacts are considered to be minor and are not anticipated to modify the community further than current conditions.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The proposed activity is anticipated to result in the clearance of 0.24 ha of CPW vegetation from three distinct isolated patches. Additionally, a 0.30 ha patch of CPW is anticipated to be partially cleared, with scope for the retention of the native canopy and small pockets of understorey. The vegetation to be removed or modified is currently highly degraded, existing as native canopy species over an understorey dominated by exotic grasses with scattered native shrubs and herbs.

The community within the study area has already been impacted by previous and current land uses, including grazing and mowing, as well as the development of land immediately adjacent. Within the subject site, this community is highly modified, with exotic species dominating the ground layer, including the presence of priority weeds. Due to the community's generally degraded nature, the area of CPW to be indirectly impacted is not important for the long-term survival of the community.

The proposed activity is not anticipated to result in greater fragmentation or isolation further than current conditions. Additionally, patches of vegetation to be retained within the subject site may be subject to indirect impacts associated with adjacent development.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following key threatening processes are relevant to CPW occurring within the subject site:

- 'Invasion and establishment of exotic vines and scramblers';
- 'Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat)';
- 'Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*';
- 'Invasion of native plant communities by exotic perennial grasses'; and

- 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants'.

The project is not anticipated to increase in the impact of the aforementioned key threatening processes, provided that appropriate measures are undertaken by contractors and site workers to prevent the spread of exotic flora. The CPW within the subject site is currently heavily invaded by many of the species referred to within the relevant key threatening processes. The proposed development is not considered to exacerbate relevant key threatening process further than current conditions.

Conclusion

The proposed development will result in the clearing or modification of 0.53 ha of CPW. The patches of vegetation to be cleared are small in area, highly isolated and disturbed. The CPW to be removed is characterised by a native canopy over an understorey dominated by exotic grasses, shrubs and herbs with native species scattered throughout. Thus, the patches of vegetation in question are considered to have low potential for natural regeneration.. The community is set within an environment that is becoming highly urbanised and it has very little scope for regenerating naturally and surviving in the long-term without assistance. Subsequently, the vegetation in question is not considered to be significant to the persistence of the community in the locality. Nonetheless, larger patches of CPW including patches with some degree of native understorey will be conserved within the subject site throughout open space including parks and bushland reserves.

The proposed development is anticipated to result in minor increased isolation of the CPW patches to be retained. Retained patches may be subject to indirect impacts associated with adjacent development including the potential spread of exotic flora, sedimentation, erosion and runoff. These impacts are anticipated to be temporary in nature, primarily occurring during the construction phase of the development. Isolation of CPW patches is anticipated to be a temporary impact as the Werrington Creek corridor is to be replanted with a species composition resembling RFEF, resulting in a net increase of wooded vegetation throughout the subject site. Impacts associated with the development are not anticipated to result in deterioration of the community further than current conditions.

The proposed development is not anticipated to result in significant impacts to CPW and subsequently, a Species Impact Statement is not required for this community.

E.2.2 River-flat Eucalypt Forest

River-flat Eucalypt Forest (RFEF) is a tall open forest or woodland characterised by a scattered shrub layer, small trees and a groundcover of scramblers, grasses and forbs. Dominant canopy species of RFEF include *Eucalyptus amplifolia* (Cabbage Gum), *E. tereticornis* (Forest Red Gum), *Angophora floribunda* (Rough-barked Apple) and *A. subvelutina* (Broad-leaved Apple) (OEH, 2017i). The community occurs on silt soils, clay-loam and sandy loams usually below 50m elevation. River-flat Eucalypt Forest is listed as an Endangered Ecological Community under the BC Act (OEH, 2017i).

This community occurs in the northern portion of the study area. The canopy trees present within the study area include *Casuarina glauca* (Swamp She-oak), *Eucalyptus moluccana* (Grey Box), *E. tereticornis* (Forest Red Gum), *E. amplifolia* (Cabbage Gum), and *Angophora floribunda* (Rough-barked Apple). It is evident that the vegetation has been cleared extensively from grazing as the groundcover contains predominantly exotic species, mainly *Pennisetum clandestinum* (Kikuyu), and the understorey is very sparse. Characteristic native shrub and groundcover species are also present throughout the community; however they are generally in low abundances.

Assessment of Significance

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

Not applicable.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

The total area of RFEF within the study area is 5.09 ha. The proposed action will result in the removal of 1.21 ha of RFEF vegetation within the subject site. River-flat Eucalypt Forest has previously been substantially cleared and or modified within the study area. The habitat remaining within the study area is not considered to be critical to the survival of the community in immediate locality, given the modified nature of the habitat and the remaining vegetation. RFEF is represented throughout the subject site as native canopy trees over an understorey dominated by exotic grasses and shrubs with scattered native shrubs and herbs. The RFEF on the subject site is considered to be in relatively poor condition with a low abundance of native species throughout. The removal of the community within the subject site is not considered to modify the remaining extent of this community such that its local occurrence is likely to be placed at risk of extinction. The community already exists in a modified and degraded form within a fragmented landscape.

Patches of RFEF within the subject site may be subject to indirect impacts associated with the construction and operational phases of the development. Disturbance to land adjacent to patches of RFEF during the construction phase may result in favourable habitat conditions for introduced and/or non-local native plant species that can proliferate in disturbed conditions. Such species have potential to impact upon the original local native plant species that inhabit patches of RFEF. Weeds such as exotic grasses and other introduced plants have potential to outcompete regenerating native plant species. There is a risk that seeds or other propagules from these weeds could be dispersed while the works associated with the proposed project is being undertaken, on vehicles or clothing of the workers involved. Whilst

the patches of RFEF exhibit a cleared understorey dominated by grassy, herbaceous and woody weeds, construction related disturbance may result in further weed invasion within the subject site.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The RFEF occurring within the study area and immediate surrounds has previously been fragmented by various developments throughout past decades. This community exists as a linear corridor along Claremont Creek and isolated patches in varying conditions along drainage lines and adjacent to dams.

The development is anticipated to result in marginally increased fragmentation and isolation of patches of habitat. The largest isolated patch of RFEF vegetation within the subject site will be subject to clearing at the edge of treed habitat and will therefore encroach further into remaining habitat rather than creating fragmented habitat patches. The stretch of RFEF along Claremont Creek which adjoins to contiguous habitat outside of the study area will be retained in its entirety. Fragmentation is likely to be a temporary impact as there is intention to establish a planted corridor consistent with RFEF along Werrington Creek, subsequently restoring some degree of connectivity to isolated patches of vegetation within the subject site.

The community within the study area has already been impacted by previous and current land uses, including grazing and mowing, as well as the development of land immediately adjacent. Within the subject site, this community is highly modified, with exotic species dominating the ground layer, including the presence of priority weeds. Given the occurrence within a fragmented corridor and the condition of the vegetation, the area of habitat to be removed within the subject site is not considered to be important for the long-term survival of this community.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following key threatening processes are relevant to RFEF occurring within the study area:

- 'Clearing of native vegetation';
- 'Invasion and establishment of exotic vines and scramblers';
- 'Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat)';
- 'Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*';
- 'Invasion of native plant communities by exotic perennial grasses'; and
- 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants'.

The project is not anticipated to increase in the impact of the aforementioned key threatening processes relating to invasive flora, provided that appropriate measures are undertaken by contractors and site workers to prevent the spread of exotic flora. The RFEF within the subject site is currently heavily invaded by many of the species referred to within the relevant key threatening processes. Whilst the proposed development is anticipated to result in the clearing of 1.21 ha of RFEF, within the subject site, the community is not considered to be significant. It has been highly degraded from past clearing and fragmentation. The largest patches of the community and those connecting to contiguous vegetation are to be retained. The proposed development is not considered to exacerbate relevant key threatening process further than current conditions.

Conclusion

The proposed development is expected to result in the removal of approximately 1.21 ha of RFEF within the subject site. The current state of the community on the subject site is poor as the groundcover is dominated by exotic species, including priority weeds. The community is set within an environment that is becoming highly urbanised and it has very little scope for regenerating naturally and surviving in the long-term without assistance. Nonetheless, relatively greater quality RFEF will be conserved within the subject site along Claremont Creek and in larger patches west of Werrington Creek. Additionally, the Werrington Creek corridor is to be replanted with a species composition resembling RFEF, resulting in a net increase in the extent of the community within the subject site. The proposed development is not considered likely to significantly impact RFEF on the subject site, and subsequently a Species Impact Statement is not required for this community.

E.3 Flora

E.3.1 *Grevillea juniperina* spp. *juniperina* (Juniper Leaved Grevillea)

Juniper-leaved Grevillea (*Grevillea juniperina* ssp. *juniperina*) is endemic to Western Sydney and centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outer populations at Kemps Creek and Pitt Town. It is a broadly spreading to erect shrub to 2.5 m high and grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence) which typically contain lateritic gravels (OEH, 2016). Physical disturbance of the soil appears to result in an increase in seedling recruitment.

Juniper-leaved Grevillea is listed as Vulnerable under the BC Act. Juniper-leaved Grevillea is well-represented across the Penrith LGA. In excess of 1000 BioNet records exist within a 10km locality of the subject site. The species was not observed during 2017 or 2018 surveys.

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

No individuals were observed within the subject site during 2017 or 2018 surveys and as such, no direct impacts are expected.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following areas are anticipated to be cleared or modified as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha; and
- Cumberland Plain Woodland: 0.54 ha.

A total of 1.75 ha of potential habitat relevant to the species is anticipated to be removed, representing a relatively small area of habitat within the broader locality for the species.

The habitat occurring within the study area and immediate surrounds has previously been fragmented by various developments. Within this area, available habitat for these species exists as fragmented linear corridors along creek lines and isolated patches of vegetation in a highly degraded condition. The proposed development will further isolate some areas of existing habitat through the removal of small patches of RFEF and CPW.

The habitat to be removed or modified as a result of the proposed development is not considered important to the long-term survival of the species within the locality. Areas of high quality habitat and large numbers of the species occur outside of the subject site.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the BC Act. A relatively small area of habitat for the species is anticipated to be cleared for the proposed development. However, potential habitat for the species and large numbers of the species will be contained within the broader locality. Additionally management is recommended to be implemented during and after construction allowing natural regeneration of native communities to take place.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

Approximately 1.74 ha of potential habitat is anticipated to be cleared as a result of the proposed development. These areas lack connectivity to areas of greater quality habitat and the species is unlikely to occur within the clearance footprint. The greatest quality habitat within the south-eastern corner of the subject site is to be retained. This habitat adjoins to contiguous habitat outside of the subject site. Therefore, the proposed development is unlikely to have a significant impact on the Juniper-leaved Grevillea and a Species Impact Statement is not required for this species.

E.3.2 Pimelea spicata (Spiked Rice-Flower)

Pimelea spicata (Spiked Rice-flower) is endemic to the Cumberland Plain and the Illawarra regions. It is an erect or spreading shrub, growing to approximately 50cm tall. The species is most commonly seen during summer but may be detected at any time of year, potentially linked to rainfall. The species is typically found on clay soils, associated with Grey Box communities and ironbark communities. The species is typically cryptic and difficult to detect during survey.

Pimelea spicata is listed as endangered under the BC Act and the EPBC Act. There are 19 BioNet records within a 10km locality of the subject site. The species was not observed during the 2017 or 2018 surveys.

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

No individuals were observed within the subject site during 2017 and 2018 surveys and as such, no direct impacts are expected.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following areas are anticipated to be cleared or modified as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha; and
- Cumberland Plain Woodland: 0.54 ha.

A total of 0.53 ha of CPW comprising potential habitat relevant to the species is anticipated to be removed, representing a relatively small area of habitat within the broader locality for the species. A total of 1.21 ha of RFEF comprising marginal potential habitat relevant to the species is anticipated to be removed, representing a relatively small area of habitat within the broader locality for the species.

The habitat occurring within the study area and immediate surrounds has previously been fragmented by various developments. Within this area, available habitat for these species exists as fragmented linear corridors along creek lines and isolated patches of vegetation in a highly degraded condition. The proposed development will further isolate some areas of existing habitat through the removal of small patches of CPW.

The habitat to be removed or modified as a result of the proposed development is not considered important to the long-term survival of the species within the locality. Areas of high quality habitat and large numbers of the species occur outside of the subject site.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Clearing of native vegetation resulting in the loss of habitat is a listed threatening process under the BC Act. A relatively small area of habitat for the species is anticipated to be cleared for the proposed development. However, potential habitat for the species and large numbers of the species will be contained within the broader locality. Additionally management is recommended to be implemented during and after construction allowing natural regeneration of native communities to take place.

No other key threatening process that may be exacerbated by the proposed action will affect this species.

Conclusion

Approximately 0.53 ha of potential habitat and 1.21 ha of marginal potential habitat is anticipated to be cleared as a result of the proposed development. These areas lack connectivity to areas of greater quality habitat and the species is unlikely to occur within the clearance footprint. The greatest quality habitat within the south-eastern corner of the subject site is to be retained. This habitat adjoins to contiguous habitat outside of the subject site. Therefore, the proposed development is unlikely to have a significant impact on *Pimelea spicata* (Spiked Rice-flower) and a Species Impact Statement is not required for this species.

E.4 Fauna

E.4.1 Powerful Owl (*Ninox strenua*)

The Powerful Owl (*Ninox strenua*) is distributed from Mackay to south western Victoria, mainly on the coastal side of the Great Dividing Range. This species occurs in many vegetation types from woodland and open sclerophyll to tall open wet forest and rainforest. It requires large tracts of native vegetation but can survive in fragmented landscapes. It roosts in dense vegetation and nests in large tree hollows. The Powerful Owl is listed as Vulnerable under the BC Act (OEH, 2017h).

There are 33 records of Powerful Owl within the locality. Potential foraging habitat for this species occurs throughout the subject site throughout the patches of Cumberland Plain Woodland, River-flat Eucalypt Forest and within areas of planted trees and shrubs. It is unlikely that suitable nesting habitat could occur within the subject site, as trees bearing large hollows were not observed. The Powerful Owl is considered to have the potential to occur within the subject site given the species is known to utilise fragmented habitat within urban areas, however the subject site is considered to only provide marginal habitat for this species.

Assessment of Significance

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

The Powerful Owl has the potential to utilise the subject site as foraging habitat as part of a much larger foraging range. It is a mobile species that accesses resources from across a wide area and would not depend upon resources contained on the subject site for its long-term survival.

It is unlikely that breeding habitat occurs within the subject site as no large hollows were observed within wooded habitat. Therefore the proposed development is unlikely to place a viable local population of the species at risk of extinction due to the limited area of potential foraging and breeding habitat present within the subject site.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following areas are anticipated to be cleared as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha; and
- Cumberland Plain Woodland: 0.53 ha;

The Powerful Owl is known to occasionally forage in open areas (OEH, 2017). Whilst a relatively large area of Exotic Dominated Grassland, Urban Native/Exotic and Exotic Vegetation is anticipated to be removed as a result of the proposed development, these communities are considered to contain marginal foraging habitat for the species, as it prefers to forage in more vegetated habitats such as forests and woodlands.

The total area of wooded vegetation to be removed (1.75 ha) represents a relatively small area of potential foraging habitat within the subject site and the broader locality. The foraging habitat within the subject site is currently bound by developed and cleared areas and has little connectivity to offsite habitat. The proposed development may marginally increase isolation between small patches of habitat. However, the Powerful Owl is a highly mobile species that is capable of flying over disturbed land and accessing fragmented habitats.

The small area of foraging habitat available is likely only utilised periodically as part of a much broader foraging range. Therefore, the habitat to be removed is unlikely to be important for the long-term survival of this species in the locality. Much larger areas of potential habitat occur throughout the wider locality.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently such areas will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following Key Threatening processes listed under the BC Act are likely to affect the Powerful Owl:

- 'Clearing of native vegetation'; and
- 'Loss of hollow-bearing trees'

The project is not anticipated to increase in the impact of the aforementioned key threatening processes. Hollow-bearing trees will be cleared as part of the proposed development. The observed hollows are not suitable in size for the Powerful Owl to utilise as roosting or breeding habitat. Therefore the removal of hollow-bearing trees is unlikely to cause a significant impact to the species. 1.74 ha of native wooded vegetation is anticipated to be cleared, however such clearing is unlikely to have a significant detrimental impact on the biodiversity values of the subject site. The proposed revegetation of Werrington Creek is anticipated to result in a net increase of wooded foraging habitat throughout the subject site in the long term.

Conclusion

The proposed development will remove a relatively small area of foraging habitat for this species within the subject site that is likely only utilised periodically as part of a much broader foraging range. Due to this and that no known suitable nesting habitat will be removed within the subject site; the habitat to be removed is unlikely to be important for the long-term survival of a local population of the Powerful Owl in the locality.

The proposed development involves the removal of approximately 1.74 ha of wooded vegetation which is expected to comprise an extremely small portion of foraging habitat within the locality. Replanting of RFEF along the riparian zone of Werrington Creek is anticipated to result in a net increase of foraging habitat in the long term. The species is also known to utilise isolated street trees and garden areas, which would be increased as a result of the proposed development. Therefore, the proposed development is unlikely to have a significant impact on the Powerful Owl and no Species Impact Statement is required.

E.4.2 Green and Golden Bell Frog (*Litoria aurea*)

The Green and Golden Bell Frog (*Litoria aurea*) is listed as Endangered under the BC Act and Vulnerable under the EPBC Act. The species is known to inhabit a variety of natural, artificial and disturbed habitats including coastal swamps, marshes, dune swales, lagoons, lakes and other estuarine wetlands, as well as riverine floodplain wetlands, billabongs and constructed wetlands such as detention basins, farm dams, bunded areas, drains and ditches (Pyke and White, 2001; DEC (NSW), 2005). The Green and Golden Bell Frog breeds during summer when conditions are at their warmest, preferring times after heavy rain in January and February (DEC (NSW), 2005; TSSC, 2014).

The species is highly mobile and has been known to travel between breeding sites covering large distances of to 1-1.5km in a single day/night (Pyke and White, 2001). Within the locality, 10 occurrences of the Green and Golden Bell Frog have been recorded with the closest record occurring approximately 5km from the subject site (OEH, 2017f). The species was not observed within the subject site despite extensive surveys.

Assessment of Significance

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

The proposed project will result in the loss of potential foraging and breeding habitat for the Green and Golden Bell Frog with the removal of twenty-four (24) farm dams in addition to 0.84 ha of fringing vegetation. The farm dams vary significantly in terms of habitat quality with eleven (11) dams exhibiting some degree of fringing or emergent vegetation (*Typha* sp.) with the remainder being absent of vegetation. Mosquito Fish (*Gambusia holbrooki*) were observed in a large majority of the water bodies, greatly reducing the probability that the habitat is used for breeding. As such due to the lack of observations of the species during 2017 surveys and the low quality of a majority of the habitats observed, it is unlikely that breeding is occurring within the subject site. Subsequently, it is unlikely that the proposed project will have an adverse effect on the life cycle of the species that a viable population is likely to be placed at risk of extinction.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following habitats relevant to the species are anticipated to be cleared as a result of the proposed development:

- Farm dams: 24; and
- Dam Vegetation: 0.84ha.

24 farm dams and approximately 0.84 ha of dam vegetation will be removed as a result of the proposed development. As the species is not known to occur within the subject site, these habitat features may be considered as marginal potential foraging or breeding habitat for the species, however at this point in time it appears to be unoccupied. Additionally,

114.29 ha of exotic dominated grassland will be removed. Grasslands directly surrounding farm dams may comprise marginal potential foraging and dispersal habitat for the species, through which some degree of connectivity between the water bodies is provided. The habitat to be removed is unlikely to be significant to the long-term survival of the species in the locality as it does not constitute preferred habitat.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Below are the key threatening processes listed under the BC Act that are likely to affect the Green and Golden Bell Frog along with a brief description of how the proposed development will impact them:

- 'Alteration to natural flow regimes of rivers and streams and their floodplains and wetlands';
- 'Clearing of native vegetation';
- 'Infection of frogs by amphibian chytrid causing the disease chytridiomycosis';
- 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants'; and
- 'Predation by *Gambusia holbrooki* (plague minnow or mosquito fish)'.

Wetlands exist within the subject site in the form of 24 farm dams; however these water bodies appear to have been man-made and a large majority do not occur within a floodplain. Subsequently, the proposed development will not result in impacts to natural wetlands. Additionally, the flow regimes of Claremont Creek and Werrington Creek are unlikely to be altered by the proposed development.

114.29 ha of exotic dominated grassland, 0.84 ha of dam vegetation and 1.21 ha of RFEF are anticipated to be removed as a result of the proposed development. The removal of these areas of marginal foraging and dispersal are unlikely to have a significant detrimental impact on the habitat values of the subject site in regards to the GGBF. Additionally, the RFEF riparian corridor along Claremont Creek will be retained and managed, whilst additional areas of vegetation are to be planted along Werrington Creek resulting in a net increase in habitat.

It is unlikely that the proposed development will result in the spread of chytridiomycosis, other pathogens or exotic aquatic plants throughout the subject site. A construction environmental management plan is anticipated to be developed prior to any construction

works, outlining protocols to avoid the spread of pathogens and weeds throughout the subject site.

The Mosquito Fish (*Gambusia holbrooki*) is already present throughout a large majority of water bodies within the subject site. It is anticipated that a qualified ecologist will be present during the dam decommissioning process. All native aquatic fauna will be captured and relocated whilst all alien fauna will be destroyed in accordance with current standards and guidelines. This will prevent the further spread of Mosquito Fish (*Gambusia holbrooki*) throughout the subject site.

Conclusion

The proposed development will result in the loss of 24 farm dams, 0.84 ha of associated dam fringe vegetation that comprises marginal potential and unoccupied foraging and breeding habitat to the species. Additionally, 114.29 ha of exotic dominated grassland are to be removed, which may contribute to foraging resources and provide dispersal routes for the species throughout the subject site. The species was not observed within the subject site during 2017 surveys and few sightings have been made of the species in the locality. Subsequently, the proposed development is unlikely to have a significant impact on the species and no Species Impact Statement is required.

E.4.3 Microchiropteran Bats

The following Microchiropteran bat species were either positively or possibly identified as occurring within the subject site during 2017 surveys:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Southern Myotis (*Myotis macropus*);
- Eastern Bentwing-bat (*Miniopterus orianae oceanensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*); and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

Due to similarities in habitat requirements and behaviour, these species are being assessed collectively in the following Assessment of Significance.

Large-eared Pied Bat

The Large-eared pied bat (*Chalinolobus dwyeri*) is distributed Queensland to the NSW Southern Highlands region and typically occurs in areas with abundant cliffs and caves. The species typically roosts in caves, cliffs, and mud nests of the Fairy Martin. The species inhabits dry open forest and woodlands where they forage for insects below the canopy (OEH, 2017). The species was confirmed as occurring within the subject site during 2017

surveys. The Large-eared Pied Bat is listed as Vulnerable under the BC Act and the EPBC Act (OEH, 2017).

Eastern False Pipistrelle

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is distributed along south-east coast and ranges of Australia. It inhabits moist habitats with trees taller than 20m. The species generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It preys on insects above or just below tree canopy and forages up to 12km from roost sites. The Eastern False Pipistrelle is listed as Vulnerable under the BC Act/BC Act (OEH, 2017c). The species was positively identified as occurring within the subject site during 2017 surveys.

Southern Myotis

The Southern Myotis (*Myotis macropus*) is found from the north-west through to western Victoria along the coast. It forages over pools and streams. The Southern Myotis roosts in groups of 10-15 close to water in caves, but can also roost in mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. The species is listed as Vulnerable under the BC Act (OEH, 2017j). The species was positively identified as occurring within the subject site during 2017 surveys.

Eastern Bentwing-bat

The Eastern Bentwing-bat has a large distribution throughout the east and north-west coasts of Australia. The Eastern Bentwing-bat is listed as Vulnerable under the BC Act (OEH, 2017). The species is known to roost primarily in caves but may also utilise storm-water tunnels, buildings and other urban habitats. Populations are typically centred on maternity caves during the breeding season (spring to summer) with dispersal of up to 300km at other times of the year. The species forages for insects above the canopy in wooded areas (OEH, 2017b). The species was positively identified as occurring within the subject site during 2017 surveys. The woodland canopy within the subject site may provide foraging habitat for the species. A number of Eucalypts containing small hollows and decorticated bark were observed, potentially providing roosting habitat for the species. The species may also roost within urban dwellings, culverts and bridges throughout the subject site.

Eastern Freetail-bat

The Eastern Freetail-bat (*Mormopterus norfolkensis*) is distributed along the east coast from southern QLD to southern NSW. The species inhabits dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts singly and communally, mainly in tree hollows but will also roost under decorticated bark or in man-made structures. The Eastern Freetail-bat is listed as Vulnerable under the BC Act (OEH, 2017d). The species was positively identified as occurring within the subject site during 2017 surveys.

Greater Broad-nosed Bat

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) occurs from the Atherton Tableland to north-eastern Victoria. It is found in various habitats being most commonly found in tall wet forest. Predominantly roosts in tree hollows but also roosts in buildings. The Greater Broad-nosed Bat flies approximately 3 to 6m above creek and river corridors. The species is listed as Vulnerable under the BC Act (OEH, 2017e). The species may occur within the subject site as calls similar to the species were recorded but were not reliably identified during 2017 surveys.

Assessment of Significance

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

The above listed species are likely to use the subject site as foraging habitat as part of a much larger foraging range. They are all highly mobile species that accesses resources from across a wide area and would not depend upon resources contained on the subject site for their survival. The proposal is not likely to place a viable local population of any of these species at risk of extinction due to the limited amount of foraging habitat present within the subject site.

The subject site contains suitable roosting habitat for species which utilise eucalypt hollows including the Eastern False Pipistrelle, Southern Myotis, Eastern Freetail-bat and the Greater Broad-nosed Bat. However, a substantial proportion of hollow-bearing trees will be retained as part of the proposed development. Therefore the proposed development is unlikely to place a viable local population of the species at risk of extinction due to the limited amount of foraging and breeding habitat present within the subject site.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following habitats relevant to the species are anticipated to be cleared as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha; and
- Cumberland Plain Woodland: 0.53 ha;

Whilst a relatively large area of Exotic Dominated Grassland, Urban Native/Exotic and Exotic Vegetation is anticipated to be removed as a result of the proposed development, these communities are considered to contain marginal foraging habitat for the group of species, as preferred foraging habitat occurs in the wooded vegetation of the subject site. The total area of wooded vegetation to be removed (1.75 ha) represents a relatively small area of potential foraging habitat within the broader locality for these species. A number of farm dams (24) are anticipated to be removed as a result of the proposed development. This is anticipated to result in a minor reduction of foraging habitat for the Southern Myotis which are known to forage over open water.

The habitat occurring within the study area and immediate surrounds has previously been fragmented by various developments. Within this area, available habitat for these species exists as fragmented linear corridors along creek lines and isolated patches of vegetation in varying conditions. The proposed development will further isolate some areas of existing habitat as a result of the removal of small patches of RFEF. The threatened fauna species known or potentially occurring are highly mobile and would be able to move across the remaining fragments. A patch of higher quality habitat occurs directly adjacent to the subject site in Claremont Meadows, connected to the subject site via contiguous wooded habitat that is proposed to be retained.

The proposed action will not remove, modify, fragment or isolate important habitat. Habitat on the subject site is not important for these species in the locality as it is predominantly composed of largely cleared and modified vegetation. The areas to be cleared within the subject site would only likely provide marginal foraging habitat. The wooded habitat within the subject site is to be largely retained. The proposed development will not result in a significant net loss of foraging habitat for the species in question. Much larger areas of potential habitat occur throughout the wider locality in more heavily vegetated areas, particularly along Claremont Creek to the east and south of the subject site. These tracts of vegetation would provide more favourable roosting and foraging habitat for these species. It is therefore considered that the habitat provided on the subject site is not important for the long-term survival of the species in the wider locality.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following key threatening processes are relevant to the proposed development:

- Clearing of native vegetation;
- Loss of hollow-bearing trees; and
- Removal of dead wood and dead trees.

The project is not anticipated to increase in the impact of the aforementioned key threatening processes. However, the vegetation within the clearance footprint within the subject site is not considered to constitute significant habitat for these species. As potential habitat will remain within the subject site and in adjoining vegetation, the clearing of exotic vegetation and small areas of native vegetation is not likely to significantly impact habitat for the group of threatened species.

Conclusion

Approximately 121.1 ha of low quality foraging habitat dominated by exotic flora is anticipated to be cleared as a result of the proposed development. The majority of wooded habitats will be retained aside from the removal of 1.74 ha of wooded vegetation which includes hollow-bearing trees. The removal of 24 farm dams may result in a net loss of foraging habitat for the Southern Myotis within the subject site.

The foraging habitat to be removed is likely to be utilised as part of a much broader foraging range. Furthermore, areas of suitable foraging habitat within the subject site will be retained within public spaces in perpetuity and the habitat to be removed is unlikely to be important for the long-term survival of a local population in the locality. Therefore, the proposed development is unlikely to have a significant impact on Microchiropteran bats and a Species Impact Assessment is not required..

E.4.4 Grey-headed Flying Fox

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is listed as vulnerable under the BC Act and the EPBC Act. The species is distributed along the east coast of Australia from Queensland to South Australia, and can be found in a variety of habitats including subtropical and temperate rainforests, tall sclerophyll forest and woodlands, heaths, swamps, gardens and orchards. The species roosts in camps that are often close to water and within 20 km of a regular food source. The species is known to travel upwards to 50 km to forage, but more commonly commutes less than 20 km (OEH, 2017g).

There are 364 records of the Grey-headed Flying-fox from the locality, and it is known to forage on the subject site and within trees in the wider study area. Individuals have frequently been observed feeding on blossoms and the fruit of trees within the golf course. However, the species is highly mobile and are likely to fly from an active camp approximately 5 km or more from the subject site.

Three known 'active' camps are located within the foraging range of the species from the subject site:

- Emu Plains: approximately 5 km to the west;
- Agnes Banks: approximately 17 km to the north-west; and
- Parramatta: approximately 23 km to the east.

Assessment of Significance

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

The Grey-headed Flying Fox was not opportunistically observed throughout the subject site during nocturnal surveys by Cumberland Ecology in 2017. No camps are present within the subject site and the vegetation present is likely utilised only for foraging as part of a much broader foraging range. The Grey-headed Flying-fox is a highly mobile species with a large foraging range and is known to forage throughout the Sydney region, including areas with sparse street trees.

Although some foraging habitat will be removed from the wider home range of the nearest flying fox camp as a result of the proposed action, the subject site is only part of a much broader foraging range and is unlikely to be important to the species long-term survival in the locality. Therefore, the proposed development is unlikely to have an adverse effect on the life cycle of the species such that the local population would likely be placed at risk of extinction.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following habitats relevant to the Grey-headed Flying-fox are anticipated to be cleared as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha;
- Cumberland Plain Woodland: 0.53;
- Urban Native/Exotic: 5.46 ha;
- Exotic Dominated Grassland: 114.29 ha; and
- Exotic Vegetation: 3.76 ha.

A relatively large area of Exotic Dominated Grassland, Urban Native/Exotic and Exotic Vegetation is anticipated to be removed as a result of the proposed development, totalling 120.26 ha. These areas contain potential foraging habitat in the form of fruit contained within scattered exotic and native plantings surrounding dwellings, exotic fruiting trees along creek lines and property boundaries and scattered remnant orchard trees. Additionally, 1.74 ha of wooded vegetation is anticipated to be removed as a result of the proposed development. The patches of CPW and RFEF to be removed contains potential foraging habitat throughout the canopy during flowering. The areas of RFEF to be removed that are dominated by Swamp She-oak (*Casuarina glauca*) do not provide substantial foraging resources for the species.

The Grey-headed Flying-fox is a highly mobile species that is capable of flying over disturbed land and accessing fragmented habitats, and therefore the fragmentation caused by the project is not likely to impact this species. No Grey-headed Flying-fox camps are located on the subject site and the foraging habitat available is likely only utilised as part of a much broader foraging range. Therefore, the habitat to be removed is unlikely to be important for the long-term survival of this species in the locality. Additionally, the riparian corridor of Werrington Creek is anticipated to be revegetated to a community consistent with RFEF, resulting in a net increase of native vegetation within the subject site.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The following key threatening processes are relevant to the proposed development:

- Clearing of native vegetation;

- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants; and
- Invasion and establishment of exotic vines and scramblers.

The project is not anticipated to increase in the impact of the aforementioned key threatening processes. The vegetation within the clearance footprint within the subject site is not considered to constitute significant habitat for the Grey-headed Flying-fox. Additional areas of native vegetation will persist within reserves in the locality, providing suitable habitat for the species in the long-term. Removal of exotic vegetation and the use of native species in landscaping as specified in management plans will reduce threatening processes associated with invasion of exotic flora.

Conclusion

Approximately 121.1 ha of foraging habitat dominated by exotic flora are anticipated to be cleared as a result of the proposed development. These areas contain sparsely scattered exotic and native fruiting trees. The majority of wooded habitats will be retained aside from the removal of 1.73 ha of wooded vegetation which contains potential foraging resources for the species.

Although the ongoing loss of foraging habitat is a threatening process to the species, the foraging habitat to be removed is utilised as part of a much broader foraging range. Furthermore, areas of suitable foraging habitat within the subject site will be retained within public spaces in perpetuity and the habitat to be removed is unlikely to be important for the long-term survival of a local population in the locality. Therefore, the proposed development is unlikely to have a significant impact on the Grey-headed Flying-fox and a Species Impact Assessment is not required.

E.4.5 Cumberland Plain Land Snail (*Meridolum corneovirens*)

The Cumberland Plain Land Snail (*Meridolum corneovirens*) inhabits a very small area on the Cumberland Plain west of Sydney from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains (OEH, 2017a). It primarily occurs in Cumberland Plain Woodland, which is grassy open woodland with occasional dense patches of shrubs. It lives under litter or bark, leaves and logs or shelters in loose soil around grass clumps. The Cumberland Plain Land Snail is listed as Endangered under the BC Act.

Surveys were conducted for the Cumberland Plain Land Snail and no individuals were recorded. As such, a population is likely absent from the development footprint and no individuals are likely to be impacted. Nevertheless, the following Assessment of Significance assesses the potential impacts of the project on this species as some suitable habitat is present.

Assessment of Significance

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

The development footprint represents a small area of habitat available to the species which is known to occur within the locality of the subject site. Trees that may provide suitable habitat for the species are not anticipated to be removed as they occur within patches of vegetation isolated from contiguous habitat where the species is more likely occur. The proposed development is unlikely to place a viable population at risk of extinction. Additionally, the species was not observed within the subject site, despite extensive searches, indicating that the subject site does not support a viable population.

b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

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

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

Not applicable.

c) in relation to the habitat of a threatened species or ecological community:

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

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

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

The following areas are anticipated to be cleared as a result of the proposed development:

- River-flat Eucalypt Forest: 1.21 ha; and
- Cumberland Plain Woodland: 0.53 ha.

The habitat occurring within the study area and immediate surrounds has previously been fragmented by various developments. Within this area, available habitat for these species exists as fragmented linear corridors along creek lines and isolated patches of vegetation in varying conditions. Limited habitat for this species exists within these areas, due to the modified understorey of wooded habitats as a result of past land use and weed invasion. CPW and RFEF representing potential habitat for this species will be removed as a result of the proposed development, totalling approximately 1.21 ha.

The proposed development will further isolate some areas of existing habitat through the removal of small patches of RFEF. The only larger patch of isolated RFEF requires clearing at the edge of treed habitat and will therefore encroach further into remaining habitat rather than creating fragmented habitat patches. The habitat within the subject site is not significant to the persistence of the species. The species was not detected within the subject site and is unlikely to inhabit the isolated patches of vegetation currently and in the future due to a lack of connectivity to contiguous habitat. Additionally, the majority of wooded habitats were observed to be highly infested with grassy and woody weeds, significantly reducing the probability of occurrence.

d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The subject site and the broader locality do not contain declared areas of outstanding biodiversity value and subsequently these will not be directly or indirectly impacted.

e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

- Clearing of native vegetation (as defined and described in the final determination of the Scientific Committee to list the key threatening process);
- Invasion and establishment of exotic vines and scramblers;
- Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat);
- Invasion of native plant communities by African Olive *Olea europaea subsp. cuspidata* (Wall. ex G. Don) Cif.;
- Invasion of native plant communities by exotic perennial grasses;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants; and
- Removal of dead wood and dead trees.

The project is not anticipated to increase in the impact of the aforementioned key threatening processes relating to invasive flora, provided that appropriate measures are undertaken by contractors and site workers to prevent the spread of exotic flora. The proposed development is not considered to exacerbate key threatening process further than current conditions as the subject site is currently highly invaded by exotic flora.

Whilst the proposed development is anticipated to result in the clearing of 1.21 ha of RFEF and 0.53 ha of CPW, within the subject site, the habitat is not considered to be significant due to its isolation and degraded understorey. The largest patches of the community and those connecting to contiguous vegetation are to be retained.

Conclusion

Approximately 1.74 ha of marginal potential habitat is anticipated to be cleared as a result of the proposed development. These areas lack connectivity to areas of greater quality habitat and the species is unlikely to occur within the clearance footprint. The greatest quality habitat within the south-eastern corner of the subject site is to be retained. This habitat adjoins to contiguous habitat outside of the subject site. Therefore, the proposed development is unlikely to have a significant impact on the Cumberland Plain Land Snail and a Species Impact Statement is not required.